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CBSE 36 SAMPLE QUESTION PAPERS

CLASS XII : TERM-II

SCIENCE STREAM (PCB)

**English Core, Physical Education, Physics,
Chemistry, Biology**

**New Sample Question Paper Released by CBSE
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BY
PANEL OF AUTHORS

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EDITION : 2022

ISBN : 978-93-92563-61-4

PRINTED AT : Upkar Printing Unit, Agra

PUBLISHED BY

 OSWAL PUBLISHERS

Head Office : 1/12, Sahitya Kunj, M.G. Road, Agra - 282 002

Phone : (0562) 2527771-4

Whatsapp : +91 74550 77222

E-mail : info@oswalpublishers.in

Website : www.oswalpublishers.com

The cover of this book has been designed using resources from Freepik.com



PREFACE

In accordance with the latest syllabus prescribed by the
Central Board of Secondary Education, New Delhi.

**Based on the [CBSE/DIR (ACAD)/2022]
Circular No. Acad-07/2022, issued by the Board.**

We at Oswal-Gurukul believe that preparation in the right direction is the key to avoid stress, and perform well in one's board exams. Therefore, in order to excel in exams we have compiled CBSE 36 Sample Question Papers for TERM II Examination for class XII. To provide best matter to students, Subject-matter experts and the best teachers from across the country have collaborated to bring together this book.

This book comprises detailed solved Sample Question Paper by CBSE of each subject and sample papers of English Core, Physical Education, Physics, Chemistry and Biology according to the new SQP, explained in detail for better understanding of the concepts. We have made every attempt to cover as much ground as possible from the entire syllabus and to keep the language of the book lucid and crisp for easy grasping.

We sincerely hope that this book will prove to be a tool for effective time-management, as well as enable smart-study practices.

—The Publisher

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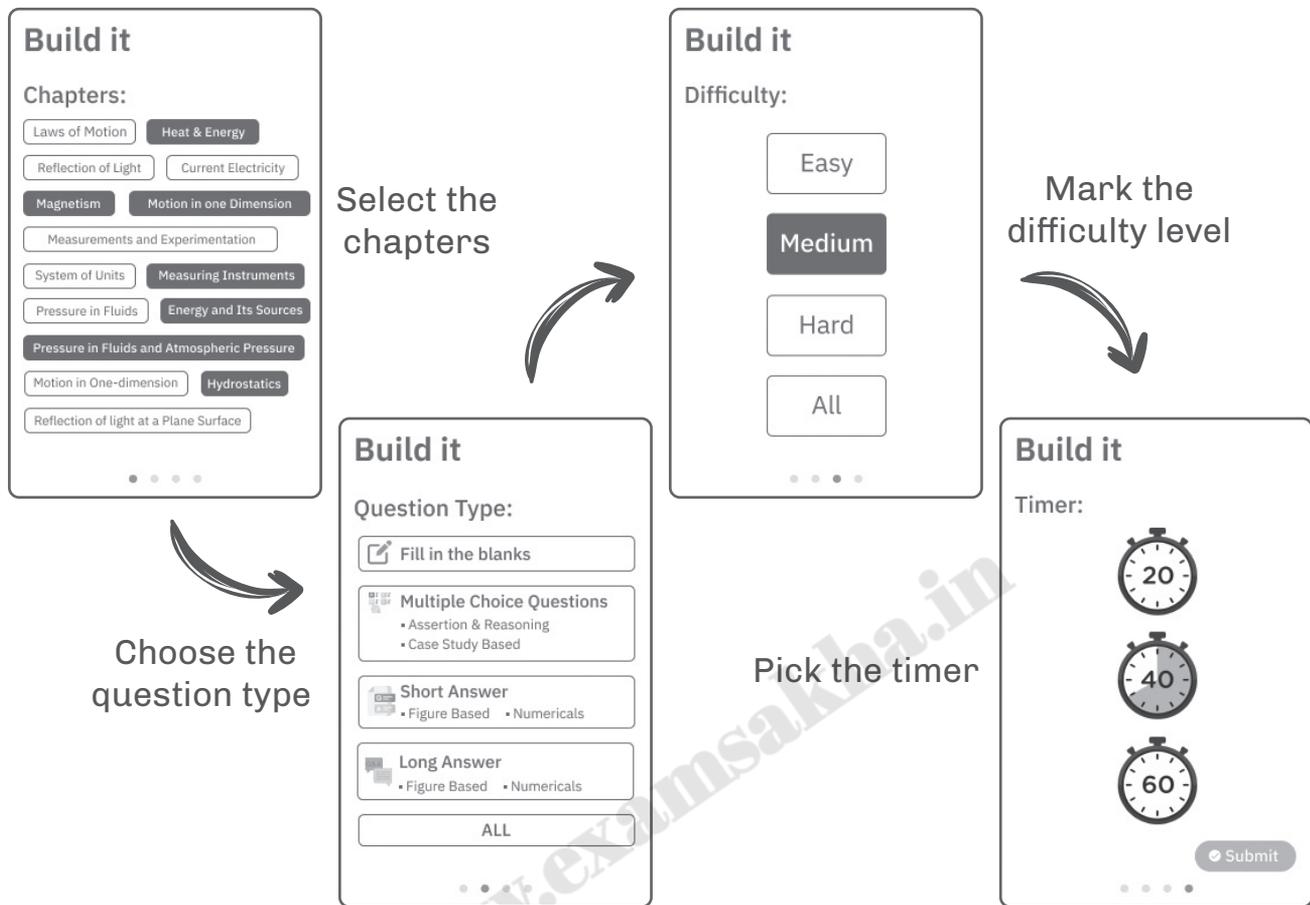
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Step 5 - Skip any question if not sure, proceed to next & submit

Step 6 - You will get your result emailed right away



CONTENTS

English Core

9–54

◆ Sample Question Paper	11	Answers	
◆ Paper 1	19	◆ Paper 1	38
◆ Paper 2	23	◆ Paper 2	41
◆ Paper 3	27	◆ Paper 3	44
◆ Paper 4	30	◆ Paper 4	48
◆ Paper 5	34	◆ Paper 5	51

Physical Education

55–80

◆ Sample Question Paper	57	Answers	
◆ Paper 1	66	◆ Paper 1	69
◆ Paper 2	67	◆ Paper 2	72
◆ Paper 3	68	◆ Paper 3	75

Physics

81–140

◆ Sample Question Paper	83	Answers	
◆ Paper 1	92	◆ Paper 1	106
◆ Paper 2	94	◆ Paper 2	110
◆ Paper 3	96	◆ Paper 3	115
◆ Paper 4	98	◆ Paper 4	119
◆ Paper 5	100	◆ Paper 5	124
◆ Paper 6	102	◆ Paper 6	129
◆ Paper 7	104	◆ Paper 7	134

Chemistry

141–198

◆ Sample Question Paper	143	Answers	
◆ Paper 1	150	◆ Paper 1	168
◆ Paper 2	152	◆ Paper 2	172
◆ Paper 3	155	◆ Paper 3	176
◆ Paper 4	157	◆ Paper 4	181
◆ Paper 5	160	◆ Paper 5	187
◆ Paper 6	163	◆ Paper 6	190
◆ Paper 7	165	◆ Paper 7	194

Biology

199–246

◆ Sample Question Paper	201	◆ Answers	
◆ Paper 1	208	◆ Paper 1	229
◆ Paper 2	211	◆ Paper 2	231
◆ Paper 3	214	◆ Paper 3	233
◆ Paper 4	217	◆ Paper 4	235
◆ Paper 5	220	◆ Paper 5	238
◆ Paper 6	223	◆ Paper 6	241
◆ Paper 7	226	◆ Paper 7	244

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CBSE/DIR (ACAD)/2022

Date: 14-01-2022

Circular No. Acad-07/2022

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Subject: Sample Question Papers for Term II Examination of Classes X and XII for the session 2021-22

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The Sample Question Papers for Term II Examination of Classes X and XII for the session 2021-22 are now available at CBSE website www.cbseacademic.nic.in at the links given below:

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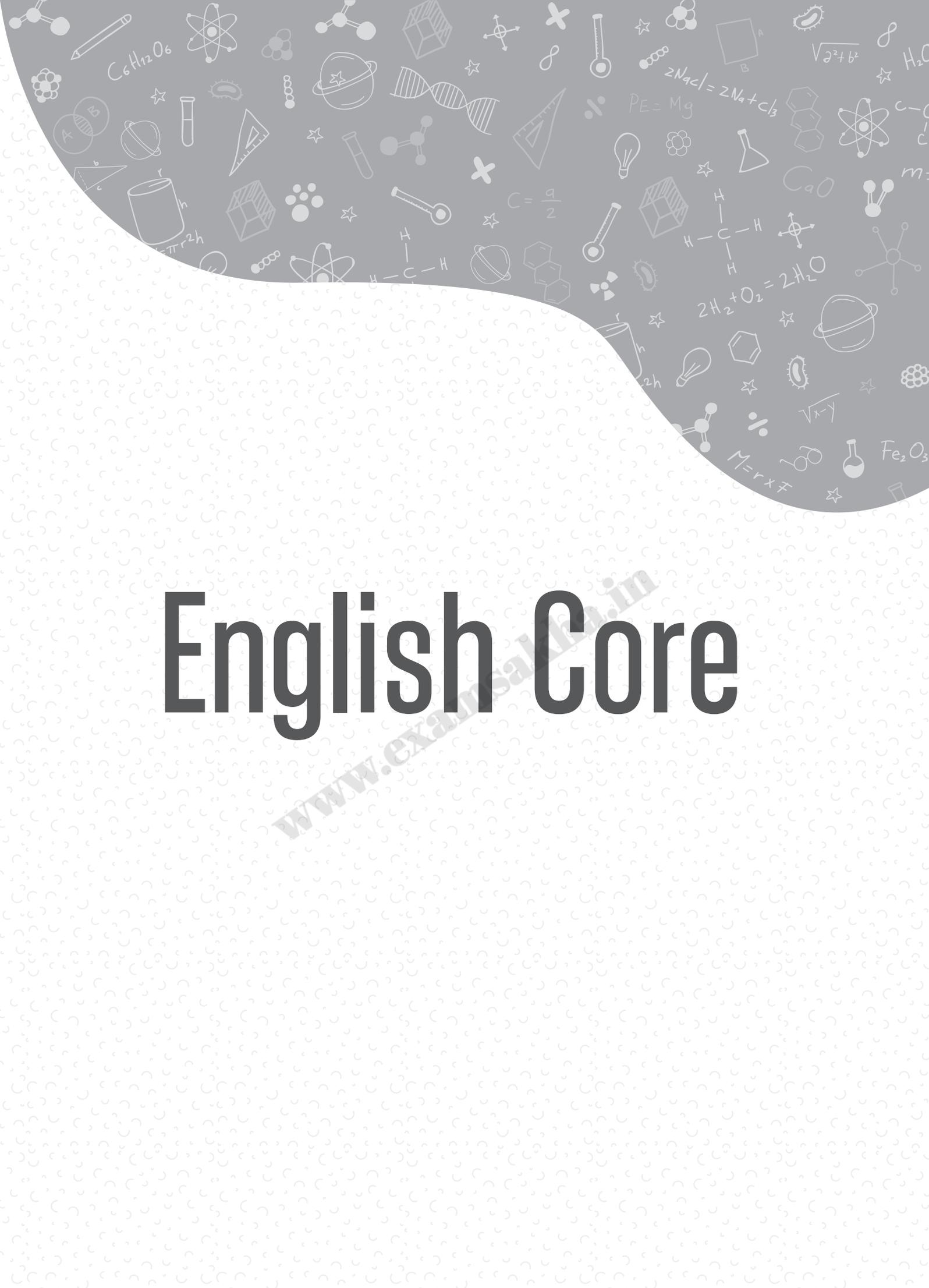
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Dr. Joseph Emmanuel
Director (Academics)



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The background features a dark grey curved banner at the top containing various white icons related to science and mathematics, such as chemical formulas, atomic models, DNA helix, and geometric shapes. Below the banner, the entire page is covered with a repeating pattern of small, light grey crescent shapes. The title 'English Core' is centered in a large, bold, black font. A faint watermark 'www.examsaladdin.in' is visible diagonally across the page.

English Core

Blueprint of the Sample Question Paper

S. No.	Chapter Name	Marks					
		2	3	4	5	6	8
1	Discursive Passage						✓
2	Case Based (Factual) Passage					✓	
3	Reply of Invitation		✓				
4 (A)	Letter of application for a job				✓		
4 (B)	Report Writing				✓		
5 (i)	The Rattrap	✓					
5 (ii)	Indigo	✓					
5 (iii)	Aunt Jennifer's Tiger	✓					
5 (iv)	A Thing of Beauty	✓					
5 (v)	On The Face Of It	✓					
5 (vi)	Should Wizard Hit Mommy?	✓					
6 (i)	A Thing of Beauty			✓			
6 (ii)	Evans Tries an O-level			✓			
6 (iii)	Indigo			✓			



Sample Question Paper

English Core [Code (301)]

Term - II

Time : 2 Hours

Max. Marks : 40

General Instructions :

1. The Question Paper contains THREE sections-READING, WRITING and LITERATURE.
2. Attempt questions based on specific instructions for each part.

Section-A

Reading (14 marks)

1. Read the passage given below.

[8]

I saw 'Jaws', the popular shark movie, the summer it came out, in 1975 and became paranoid about sharks. Though I kept swimming after *Jaws*, it was always with the vague fear that a shark's teeth could tug on my leg at any moment. Never mind that there'd been only two shark bites since 1900 on the Connecticut coast, where I lived.

5

So, when I got this assignment for the *National Geographic* magazine, I decided to accept and do what I'd never wanted to do: swim with the sharks. I had to go to a place in the Bahamas known as Tiger Beach and dive with tiger sharks, the species responsible for more recorded attacks on humans than any shark except the great white. It was to be my first dive after getting certified—which meant it would be my first dive anywhere other than a swimming pool or a quarry—and without a diver's cage. Most people who got wind of this plan thought I was either very brave or very stupid.

10

But I just wanted to puncture an illusion. The people who know sharks intimately tend to be the least afraid of them, and no one gets closer to sharks than divers. The divers who run operations at Tiger Beach speak lovingly of the tiger sharks, the way people talk about their children or their pets. In their eyes, these sharks aren't man-eaters any more than dogs are.

15

The business of puncturing illusions is never just black and white. My fellow divers had hundreds of dives under their belt and on the two-hour boat ride to the site in the morning of our first dive, they kept saying things like, "Seriously, I really can't believe this is your first dive." All this was okay with me until I reached the bottom and immediately had to fend off the first tiger shark, I had ever laid eyes on. However, when I watched the other divers feeding them fish and steering them gently, it became easy to see the sharks in a very benign light.

20

I think it would be unfair not to mention that though tiger sharks are apex predators, they act as a crucial balancing force in ocean

25

ecosystems, constraining the numbers of animals like sea turtles and limiting their behaviour by preventing them from overgrazing the sea grass beds. Furthermore, tiger sharks love warm water, they eat almost anything, have a huge litter and are the hardiest shark species. If the planet and its oceans continue to warm, some species will be winners and others will be losers, and tiger sharks are likely to be winners.

Based on your understanding of the passage, answer **ANY EIGHT** questions from the nine given below.

[1 × 8]

- i. Cite a point in evidence, from the text, to suggest that the writer's post-*Jaws* fear was not justified. (1)
- Ans.** The writer's fear of sharks, after watching the movie, was irrational. It has been stated in the passage that there were only 2 shark attacks reported in 75 years *i.e.*, from 1900-1975, so it was highly unlikely that he had anything to fear.
- ii. State any one trait of the writer that is evident from lines 5-10 and provide a reason for your choice. (1)
- Ans.** The writer was adventurous, courageous, bold and experimental because he feared the tiger sharks and was well aware of the fact that they were dangerous, yet he accepted his first assignment that required him to face them.
- iii. People thought the writer was 'either brave or very stupid'. Why did some people think that he was 'very stupid'? (1)
- Ans.** Some people thought the writer 'to be stupid' because he side lined the popular notion that tiger sharks were dangerous and did not pay any attention to the fact. He was walking into obvious danger without the required expertise.
- iv. Why does the writer say that people who know sharks intimately tend to be least afraid of them? (1)
- Ans.** The writer said that people who know sharks intimately tend to be least afraid of them because they find sharks harmless. These sharks feed on the food offered by them and seem as docile as pets.
- v. Rewrite the given sentence by replacing the underlined phrase with another one, from lines 10-20. (1)
- Some academicians think that reward, as a form of discipline, is a simple right or wrong issue.*
- Ans.** Some academicians think that reward, as a form of discipline, is a simple black and white issue.
- vi. What does the use of the phrase 'benign light' suggest in the context of the writer's viewpoint about the tiger sharks? (1)
- Ans.** The phrase, 'Benign light' is viewed as benevolent/ gentle/ friendly. Tiger sharks did not seem to be that harmful or dangerous. They seemed fairly docile and less dangerous than the other sharks.
- vii. Select a suitable phrase from lines 15-25 to complete the following sentence appropriately. (1)
- I agree the team will find this experience tough, but competing will be easier next time after they get this tournament _____.*
- Ans.** I agree the team will find this experience tough, but competing will be easier next time after they get this tournament under their belt.
- viii. Apex predators serve to keep prey numbers in check. How can we say that tiger sharks are apex predators? (1)
- Ans.** Tiger sharks are apex predators because they restrict the number of sea turtles by feeding on them, and act as a balancing force in the ocean ecosystem. If the numbers weren't constrained, it would result in the depletion of sea-grass which supports other marine life forms.
- ix. Analyse why having a large litter is one of the features that empowers tiger sharks to emerge winners if global warming persists. (1)
- Ans.** A large litter is one of the features that empowers tiger sharks to emerge winners if global warming persists. It reduces possibility of extinction or destruction due to harsh conditions, as large numbers would ensure that some definitely survive.

2. Read the passage given below.

[6]

Changing food preferences have brought about rapid changes in the structure of the Indian diet. The rapid proliferation of multinational fast-food companies and the influence of Western culture have replaced traditional home-cooked meals with ready-to-eat, processed foods thus increasing the risk of chronic diseases in urban Indians. Therefore, nurturing healthy eating habits among Indians from an early age would help to reduce health risks.

5

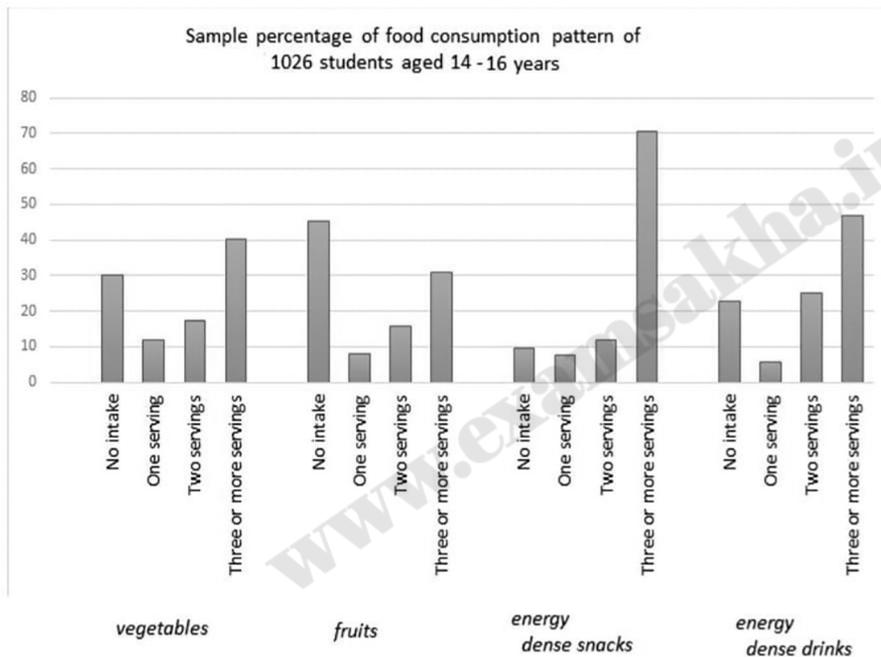
To date, little is known about the quality and quantity of foods and beverages consumed by urban Indian adolescents. This lack of evidence is a significant barrier to the development of effective nutrition promotion and disease prevention measures.

10

Therefore, a self-administered, semi-quantitative, 59-item meal-based food frequency questionnaire (FFQ) was developed to assess the dietary intake of adolescents. A total of 1026 students (aged 14–16 years) attending private, English-speaking schools in Kolkata completed the survey.

15

A sample percentage of the food consumption pattern is displayed (Fig. 1)



The survey results report poor food consumption patterns and highlights the need to design healthy eating initiatives. Interestingly, while there were no gender differences in the consumption of legumes and fried snacks, the survey found more females consumed cereals, vegetables and fruits than their male counterparts.

20

In conclusion, the report suggested that schools ought to incorporate food literacy concepts into their curriculum as they have the potential of increasing the fruit and vegetable intake in teenagers. Additionally, healthy school canteen policies with improved availability, accessibility, variety and affordability of healthy food choices would support the consumption of nutritious food in students.

25

Adapted from: <https://nutritionj.biomedcentral.com/articles/10.1186/s12937-017-0272-3>

Based on your understanding of the passage, answer ANY SIX out of the seven questions given below.

[1 × 6]

i. What does the researcher mean by 'changing food preferences'? (1)

Ans. 'Changing food preferences' means the transition of the urban population from healthy home-cooked meals to ready-to-eat-processed foods.

ii. Why was this survey on the food consumption of adolescents undertaken? (1)

Ans. This survey on the food consumption of adolescents is undertaken to understand the food consumption pattern of urban adolescents and to make recommendations based on the data.

iii. With reference to fig.1, write one conclusion about students' consumption of energy-dense drinks. (1)

Ans. It shows that close to 47% students drink three or more servings of energy dense beverages while a mere 5% students said 'no' to more than one serving of the beverage. It highlights the fact that energy dense beverages are greatly consumed by the adolescents.

iv. What can be concluded by the 'no intake' data of fruit consumption versus energy dense snacks, with reference to fig.1? (1)

Ans. The conclusion drawn by the 'no intake' data of fruit consumption versus energy dense snacks is that half the respondents (45%) did not consume any servings of fruit in contrast to 95% that had some form of energy dense snack.

v. There were no gender differences observed in the consumption of healthy foods, according to the survey. Substantiate. (1)

Ans. According to the survey, there were gender differences observed in the consumption of healthy foods wherein females had more nutritious dietary intake as they consumed more cereals, vegetables and fruits compared to their male counterparts.

vi. Why is 'affordability' recommended as a significant feature of a school canteen policy? (1)

Ans. 'Affordability' is recommended as a significant feature of a school canteen policy because the consumers are school children and therefore food should be affordable.

vii. Identify a word from lines 9-18 indicating that the questionnaire was specifically designed to be completed by a respondent without the intervention of the researcher collecting the data. (1)

Ans. Self-administered

Section-B

Writing (8 marks)

3. You are Natasha, residing in Pune. Your cousin, from the same city is hosting your grandmother's eightieth birth anniversary and has extended an invite to you. He has also requested your assistance for arrangements needed. Draft a reply of acceptance, in not more than 50 words. [3]

Ans. 217 MIG Flats

Surya Vihar, Pune,

15 March, 20XX

Dear Aman,

I acknowledge with thanks your kind invitation to grandma's eightieth birth anniversary on 25th March at 5pm at your place. I am extremely delighted to join this occasion and would like to confirm my participation. I would love to assist you for the arrangements, just let me know how I can help you. I assure you best of my services.

Looking forward to the momentous occasion.

Yours lovingly,

Natasha

4. Attempt **ANY ONE** from A and B given below.

[5]

- (A) You are Shantanu, residing at Ghar B-94, Balimela Road, Malkangiri. You come across the following classified advertisement in a local daily. Write a letter, in about 120-150 words, applying for the position of a volunteer for the *Each One Teach One* campaign.

SITUATION VACANT

WANTED committed volunteers, aged 18 years and above, to teach underprivileged children, for one hour a week, in the district of Malkangiri. Ability to speak, read and write Odiya fluently, important. Experience not necessary. All volunteers to receive training. Contact Nethra N, Coordinator (*Each One Teach One*), 4 Literacy, Ambaguda, Malkangiri, Odisha -764045

Ans. Ghar B-94, Balimela Road,
Malkangiri

19th September, 20XX

Nethra N, Coordinator (*Each One Teach One*),
4 Literacy, Ambaguda,
Malkangiri, Odisha -764045

Subject: Application for volunteer for *Each One Teach One* campaign

Madam,

In response to your advertisement in The Hindustan Times, dated 17 September 20XX, requiring young and committed volunteers for *Each One Teach One* campaign, I want to render my services for this noble cause.

I am quite enthusiastic about bringing a change in our society through education and teaching underprivileged children can be a good start. I have reasonably good command over Odiya as it is my mother tongue.

Although I am just 18 and have finished my schooling this year, I have participated in such projects under SUPW. I have heard a lot about your prestigious campaign. I think it will be an honour for me to get associated with your esteemed organisation and contribute my bit for this noble cause. I do assure you of my dedicated service and wholehearted cooperation.

I am enclosing herewith my detailed resume for your kind reference.

Yours faithfully,
Shantanu

RESUME

Name	: Shantanu Kaira
Father's Name	: Amit Kaira
Date of Birth	: 4th October, 2003
Address	: Ghar B-94, Balimela Road, Malkangiri
Marital Status	: Unmarried
Educational Qualifications	: (i) High School, CBSE, Year-2018, 75% : (ii) Senior Secondary, CBSE, Year-2020, 70%
Work Experience	: No experience
Languages Known	: English, Hindi, Odiya
Strengths	: Good time management, hard working
References	: 1. Dr S Purohit, Principal, Summer Fields Public School. : 2. Mr. P.S. Dalmia, Director, Summer Fields Public School

OR

- (B) The efforts of 400 volunteers working with the NGO, *4 Literacy*, in the district of Malkangiri, Odisha, was lauded by the District Collector, Shri V. Singh (IAS). As a staff reporter of 'The Odisha Bhaskar', write a report about this in 120-150 words covering all the details, such as training, teaching and infrastructure involved in the 'Each One Teach One' campaign, initiated by the district administration in association with the NGO.

Ans.

IAS PRAISE EACH ONE TEACH ONE CAMPAIGN

(Staff correspondent 'The Odisha Bhaskar')

2nd December, 20XX

The efforts of 400 volunteers in the *Each One Teach One* campaign was lauded by the District Collector, Shri V. Singh (IAS) in a felicitation ceremony organised by the district administration on 1st December, 20XX at the Community Hall.

The district administration of Malkangiri, Odisha initiated a literacy campaign *Each One Teach One* in association with an NGO, *4 literacy* with the aim of teaching under privileged children. These children had come from the nearby localities. For educating these children, 400 volunteers were trained for one month.

The campaign started with the evening classes which were held in a local government school. Classrooms were used for conducting classes. These classes were taken by the volunteers to teach children reading and writing, numbers 1 to 100, addition and subtraction, and environmental studies related to health and hygiene. The method adopted to teach the above mentioned syllabus was through skits, T.V shows, lectures and storytelling in their mother tongue, Odiya.

These volunteers worked hard to make these poor children learn basic numeric and reading competencies. Their efforts were greatly recognized and appreciated by the district collector who honoured these volunteers with medals and certificates of appreciation.

Section-C

Literature (18 marks)

5. Attempt ANY FIVE of the six questions given below, within 40 words each. [2 × 5 = 10]

- i. A mistaken identity led to a discovery of a new one for the rattrap peddler. How did this impact him? (2)

Ans. A mistaken identity led to a discovery of a new one for the rattrap peddler because it gave him the power to clear his conscience. Having raised to the status of a Captain brought out his latent goodness which lent him conviction to become a better human being. He got a chance of elevating himself from being a thief and to behave in a dignified manner befitting that of a Captain.

- ii. As the host of a talk show, introduce Rajkumar Shukla to the audience by stating any two of his defining qualities. (2)

You may begin your answer like this:

Meet Rajkumar Shukla, the man who played a pivotal in the Champaran Movement. He

Ans. Meet Rajkumar Shukla, the man who played a pivotal role in the Champaran Movement. He was determined and resolute to meet Gandhiji and to complain about the injustice of the landlord system in Bihar. His perseverance convinced Gandhiji to look into the matter and resolve the issue of sharecroppers.

- iii. Adrienne Rich chose to express her silent revolt through her poem, *Aunt Jennifer's Tigers*, just as Aunt Jennifer did with her embroidery. Explain. (2)

Ans. Adrienne Rich, through her poem, criticizes the traditional institution of marriage, in her times, suggesting that it oppresses women. Similarly, Aunt Jennifer, a victim of an unhappy marriage, under a domineering husband, chooses embroidery to vent her angst. Both use their creative outlet as a form of protest against societal expectations.

iv. Rationalise why Keats uses the metaphor 'an endless fountain of immortal drink' in his poem, *A Thing of Beauty*? (2)

Ans. Keats uses the metaphor 'an endless fountain of immortal drink' because things of beauty are just like the immortal drink of the gods that flow continuously and never die. Just as the endless fountain of immortality is an elixir of life, similarly things of beauty are constant/perennial in providing everlasting joy/motivation/bliss to the humans.

v. How do you think Derry's mother contributes to his sense of alienation and isolation? (*On the Face of It*) (2)

Ans. Derry's mother is overprotective and doesn't understand her son's longing for companionship. She does not allow him to meet Mr. Lamb. She treats Derry with a sense of pity and robs him of his dignity by perpetually treating him like a helpless victim.

vi. Validate John Updike's open-ended title, *Should Wizard Hit Mommy*? (2)

Ans. The story's title 'Should Wizard hit Mommy?' is a question that agrees either with Jo, who believes in justice for the skunk, or the father, who believes that mothers cannot err. Both seem right. The author leaves it open-ended for the reader to allow flexibility and creative insight. So that the reader can accept any view point.

6. Answer **ANY TWO** of the following in about 120-150 words each. [4 × 2]

i. How does Keats' poem, *A Thing of Beauty* appeal richly to the senses, stimulating the reader's inner sight as well as the sense of touch and smell? Write your answer in about 120-150 words. (4)

Ans. Keats' descriptions allow for a deeper perception of the imaginary, converting it into a life-like experience. They stimulate the reader's inner sight as well as the sense of touch and smell. Keats establishes this with powerful imagery and word play. The poem, 'A thing of Beauty' talks about the cooling comfort of the bower, dancing daffodils in its green environs, the babbling stream and the mid-forest brake with the musk rose blooms. These descriptions evoke in our imagination, a sense of hearing, touch and smell. The stories of mighty and the doom that befalls them appeals to our intellect. The endless fountain may be an allusion of the fountain of youth, however, it has a sublimating effect on the reader. Therefore, Keats, poetic descriptions presents beauty that appeals to our senses and gives delight.

ii. Colin Dexter, the author of *Evans Tries an O-level* employs the red herring technique of intentionally misleading readers by placing false clues to keep the plot enigmatic. Substantiate with reference to text, in about 120-150 words. (4)

Ans. Yes, it is true that Colin Dexter, the author of *Evans Tries an O-level* employs the red herring technique of intentionally misleading readers by placing false clues to keep the plot enigmatic. There are several loop holes in the story that create doubts in the mind of the readers. Firstly, the story begins with a strange setting where the prison was shown to be equipped with maximum security and a kleptomaniac with a record of breaking out of prison. Then, this skeptical prisoner, Evans' grubby appearance, jovial manner and friendly banter distracts us from his sharp intelligence and extraordinary talent for deception. Apart from his appearance, his silly but filthy looking bobble hat (a knit beanie with a pom-pom on top) also distracts, giving readers the appearance of a comical character.

At one place the author wrote 'Number Two Handkerchief' neatly placed on the bed, there is no mention of the number one handkerchief.

Next, Reverend Stuart Mc Leery was first seen exiting his bachelor flat in Broad Street and later was found gagged in the same flat. Then there is mention of the nail file in his suitcase and then reference to Mc Leery's meticulously manicured fingers, so there is no purpose of carrying the nail file. It has been shown that Mc Leery had grown thinner and then 'Mc Leery' was found slumped in a chair. This is a complete confusion. Finally, with the help of clues in the question paper, a chase started all over the town which seems entirely meaningless.

These sudden jerks make us conclude that Colin Dexter's *Evans Tries an O-level* is a creative and highly complicated prison-break interspersed with twists in the plot.

- iii. Biographies include features of non-fiction texts – factual information and different text structures such as description, sequence, comparison, cause and effect, or problem and solution. Examine *Indigo* in the light of this statement, in about 120-150 words. (4)

Ans. The story is based on the interview taken by Louis Fischer of Mahatma Gandhi. In order to write on him he had visited him in 1942 at his ashram- Sevagram where he was told about the Indigo Movement started by Gandhiji. The story revolves around the struggle of Gandhi and other prominent leaders in order to safeguard sharecroppers from the atrocities of landlords.

Indigo, being an excerpt of a biography, has features of fiction as well as non-fiction texts. The chapter describes the facts and factual information. It also has text structure that is suitable for non-fiction.

The facts are taken from history- Pre Independence era. The incident of Champaran was an important part of freedom struggle. This factual information is beautifully described keeping in mind the sequence of the events. The problem of sharecroppers is truthfully depicted. Gandhi took up the case of the Champaran farmers after ascertaining that their cause was just. He then employed the principle of civil disobedience to politely defy British orders to restrain him. This episode moved in Gandhi and he decided that the British must quit India. The triumph of the Champaran case gave fillip to the Civil Disobedience Movement. So all that has been described in the chapter is non-fictional.

□□



Sample Paper

1

English Core

Section–A Reading

1. Read the passage given below.

1. The world may look to South Korea as a model for education — its students rank among the best on international education tests — but the system’s dark side casts a long shadow. South Korean education produces ranks of overachieving students who pay a stiff price in health and happiness.
2. Cram schools known as ‘hagwons’ in Korean — are a mainstay of the South Korean education system and a symbol of parental yearning to see their children succeed at all costs. Hagwons are soulless facilities, with room after room divided by thin walls, lit by long fluorescent bulbs, and stuffed with students memorising English vocabulary, Korean grammar rules and math formulas.
3. This “investment” in education is what has been used to explain South Koreans’ spectacular scores on the Program for International Student Assessment, increasingly the standard by which students from all over the world are compared to one another.
4. Granted, the South Korean system has its strengths. The idea that success is most important, no matter the cost, is a great motivator. But a system driven by overzealous parents and a leviathan private industry is unsustainable over the long run, especially given the physical and psychological costs that students are forced to bear.
5. Many young South Koreans suffer physical symptoms of academic stress. Students are also inclined to see academic performance as their only source of validation and self-worth. Not surprisingly, South Korea’s position in the international education hierarchy is flipped when it comes to youth happiness, with only 60 per cent of the country’s students confessing to being content in school, compared with an average of 80 per cent, in 2012, among the world’s wealthy nations.
6. Korean culture’s special focus on the family unit is also a major factor. Many parents believe that their right to decide their children’s future is sacrosanct. To be a South Korean child ultimately is not about freedom, personal choice or happiness; it is about production, performance and obedience.
7. Despite decades of outright abuse and the entrenchment of this disturbing system, signs are emerging that some people are beginning to take reform seriously. In the course of coming to terms with the legacy of dictatorial rule, South Koreans have embraced the notion of “healing,” with the understanding that past political repression and continuing social pressure have psychological ills that require redress. That trend has led to discussion of the detrimental effects the education system has on students and what should be done.
8. But to effect any meaningful change in education, a culture that treats its children as a commodity to be used in the service of the family or the national economy, must be radically altered. The government must cease viewing children as mere cogs in the country’s economy with no right to personal happiness.

Based on your understanding of the passage, answer ANY EIGHT questions from the nine given below.

- i. Why is South Korea considered a model for education?
- ii. Cite a point in evidence, from the text, to suggest that the South Korean obsession with grades is not justified.
- iii. What is South Korea’s position in the international education hierarchy with respect to its youth happiness?

- iv. State any one trait of the Korean society that is evident from paragraphs 6-8 and provide a reason for your choice.
- v. Rewrite the given sentence by replacing the underlined phrase with another one, from paragraphs 3-4.
The scientists had to find the vaccine to cure the pandemic, no matter what difficulty was involved.
- vi. What is the Program for International Student Assessment?
- vii. What are hagwons?
- viii. Select a suitable phrase from paragraphs 1-2 to complete the following sentence appropriately.
Celebrities have to be extra careful in the world of social media because often their maligned past _____ over their good deeds.
- ix. What does the use of the phrase 'sacrosanct' suggest in the context of the Korean parent's viewpoint about their children's career?

2. Read the passage given below.

- One can define economic growth as the increase in the inflation-adjusted market value of the goods and services produced by an economy over time. Statisticians conventionally measure such growth as the percent rate of increase in real gross domestic product or real GDP.
- Growth is usually calculated in real terms - *i.e.*, inflation-adjusted terms – to eliminate the distorting effect of inflation on the prices of goods produced. Measurement of economic growth uses national income accounting. Since economic growth is measured as the annual percent change of gross domestic product (GDP), it has all the advantages and drawbacks of that measure. The economic growth-rates of countries are commonly compared using the ratio of the GDP to population (per-capita income).
- The, rate of economic growth, refers to the geometric annual rate of growth in GDP between the first and the last year over a period of time. This growth rate represents the trend in the average level of GDP over the period and ignores any fluctuations in the GDP around this trend.
- Economists refer to an increase in economic growth caused by more efficient use of inputs (increased productivity of labour, of physical capital, of energy or of materials) as intensive growth. In contrast, GDP growth caused only by increases in the number of inputs available for use (increased population, for example, or new territory) counts as extensive growth.

Economic Growth by Country				
Country	Period	Real GDP per person at beginning of period	Real GDP per person at end of period	Annualised growth rate
Japan	1890-2008	\$1,504	\$35,220	2.71%
Brazil	1900-2008	\$779	\$10,070	2.40%
Mexico	1900-2008	\$1,159	\$14,270	2.35%
Germany	1870-2008	\$2,184	\$35,940	2.05%
Canada	1870-2008	\$2,375	\$36,220	1.99%
China	1900-2008	\$716	\$6,020	1.99%
United States	1870-2008	\$4,007	\$46,970	1.80%
Argentina	1900-2008	\$2,293	\$14,020	1.69%
United Kingdom	1870-2008	\$4,408	\$36,130	1.47%
India	1900-2008	\$675	\$2,960	1.38%
Indonesia	1900-2008	\$891	\$3,830	1.36%
Bangladesh	1900-2008	\$623	\$1,440	0.78%

- Development of new goods and services also generates economic growth. As it so happens, in the U.S. about 60% of consumer spending in 2013 went on goods and services that did not exist in 1869. The economic growth rate is calculated from data on GDP estimated by countries' statistical agencies. The rate of growth of GDP per capita is calculated from data on GDP and people for the initial and final periods included in the analysis of the analyst.

6. Living standards vary widely from country to country and furthermore the change in living standards over time varies widely from country to country. The table above shows GDP per person and annualised per person GDP growth for a selection of countries over a period of about 100 years. The GDP per person data are adjusted for inflation, hence they are real. GDP per person (more commonly called per capita GDP) is the GDP of the entire country divided by the number of people in the country; GDP per person is conceptually analogous to average income.
7. Seemingly small differences in yearly GDP growth led to large changes in GDP when compounded over time. For instance, in the above table, GDP per person in the United Kingdom in the year 1870 was \$4,808. At the same time in the United States, GDP per person was \$4,007, lower than the UK by about 20%. However, in 2008 the positions were reversed: GDP per person was \$36,130 in the United Kingdom and \$46,970 in the United States, *i.e.*, GDP per person in the US was 30% more than it was in the UK. As the above table shows, this means that GDP per person grew, on average, by 1.80% per year in the US and by 1.47% in the UK. Thus, a difference in GDP growth by only a few tenths of a percent per year results in large differences in outcomes when the growth is persistent over a generation.

Based on your understanding of the passage, answer ANY SIX questions out of the seven given below.

- i. How do Statisticians measure economic growth?
- ii. What can be concluded by an increased 'Real GDP per person at end of period', with reference to the given table?
- iii. How is the rate of growth of GDP per capita is calculated?
- iv. The given table shows the GDP per person and annualised per person GDP growth for a selection of countries over a period of how many years?
- v. What does the researcher mean by 'real' GDP per person data in paragraph 6?
- vi. Which country's annualised growth rate is 2.05% according to the table given in the passage?
- vii. Identify a term from paragraph 4 which explains the growth in the quantity of output produced based on the expansion of the quantity of inputs used.

Section-B Writing

3. You are Gaurav/Garvita. You have been invited to attend the wedding function of your friend's sister Amisha. Send a reply confirming your acceptance in about 50 words.
4. Attempt **ANY ONE** from A and B given below.
- A. You are Kushagra/Kushi, resident of 124, Rana Sanga Marg, New Delhi. You read an advertisement given by Milan University in 'THE NEWS' which requires a lecturer in Botany for their new campus at Chandigarh. Apply for the same in 120-150 words giving your bio-data separately.

Milan University
Wanted Lecturer in Botany

Application from eligible, qualified and experienced candidates are invited for the post of Botany Lecturer for Chandigarh Campus.

Application must be submitted in the prescribed format through e-mail at recruit.mil.ac.in or before 20th January, 20XX. Hard copy must reach by 25th January, 20XX.

OR

- B. A massive fire due to short circuit gutted 50 odd shops in the congested area of Sadar Bazar in Delhi leading to loss of life and property. As a reporter with The Tribune write the report for the newspaper in 120-150 words.
- The fire erupted on the first floor at 5:00 a.m.
 - Fire engines able to control the blaze by 7.30 a.m.
 - Huge loss of property worth 2 crores.
 - No one hurt.
 - Government announced a compensation of 1,00,000 rupees.

Section–C

Literature

5. Attempt **ANY FIVE** of the six questions given below, within 40 words each.

- i. Do you think Evan’s statement, ‘I may surprise everybody’, has some special significance?
- ii. According to the poem, *Aunt Jennifer’s Tigers*, she chose to embroider tigers on the panel. Why do you think so?
- iii. What was the content of the letter written by the peddler to Edla?
- iv. What makes human beings love life in spite of troubles and suffering? Answer with reference to the poem, *A Thing of Beauty*.
- v. “I’m not fond of curtains shutting things out” says Mr. Lamb. What does this reveal about his personality?
- vi. Why did Gandhiji say —: “The battle of Champaran is won”?

6. Answer **ANY TWO** of the following in about 120-150 words each.

- i. The lesson *Indigo* highlights the qualities of leadership shown by Mahatma Gandhi to secure justice for the oppressed people through argumentation and negotiation. Getting a clue from the way Mahatma Gandhi dealt with the Champaran episode, write an article on ‘What makes a Good Leader?’
- ii. What kind of person was Jack as a father?
- iii. In the poem- *Aunt Jennifer’s Tigers*, there is a contrast made between Aunt’s creation and herself. Summarise this according to the poet’s perspective.

□□



Sample Paper

2

English Core

Section–A Reading

1. Read the passage given below.

1. Apollo, the Greek God, apart from being a God having the power to give the boon of knowing the future, is also vulnerable to the physical attraction towards beauty. According to Herodotus' History, there is a mention of a lady, a princess named Cassandra who was a daughter of Priam the king and the queen Hecuba of Troy. She was the smartest and the most beautiful of the daughters of King Priam.
2. Apollo was constantly on prowl for attractive humans. He falls in love with Cassandra. Strangely, this never happens in Greek myths, Cassandra resists his advances. So, he tries to bribe her. But she was already a princess. What could he give her? She was rich and beautiful. She was happy. Still Apollo had something to offer. He promised her the gift of prophecy. This was irresistible. She agreed. Quid pro quo. Apollo did whatever Gods can do to create seers, oracles and prophets out of mere mortals.
3. Scandalously, after receiving the boon, Cassandra reneged. She refused the overtures of a god. Apollo was incensed. As it is, Gods keep their promises, so he could not withdraw the gift of prophecy. Instead, he cursed her to a cruel and ingenious fate that no one would believe her prophecies.
4. This story is taken largely from Aeschylus's play *Agamemnon*. Cassandra also appears in texts written by Homer, Virgil, Aeschylus and Euripides. Each author depicts her prophetic powers differently. In Homer's work too, Cassandra is mentioned a total of four times as 'a virgin daughter of Priam', as bewailing Hector's death, as chosen by Agamemnon to be his slave mistress after the sack of Troy, and as killed by Clytemnestra over Agamemnon's corpse after Clytemnestra murders him on his return home.
5. Cassandra prophesies to her own people the fall of Troy. Nobody pays attention. She predicts the death of the leading Greek invader, Agamemnon. Nobody pays attention. She even foresees her own early death, and still, no one pays attention. They didn't want to hear. She was made fun of. Both Greeks and Trojans called her "the lady of many sorrows". There is a nice moment when she cannot understand why these prophesies of impending catastrophe— some of which if believed, could be prevented – were being ignored.
6. Later, after the fall of Troy, even with the Greeks, also, her forebodings did not have any effect. She told the Greeks, "How is it that you don't understand me? Your tongue I know only too well". But her pronunciation wasn't the problem. This was the answer she got. "You see, it's like this. Even the Delphic Oracle sometimes makes mistakes. Sometimes its own prophecies are ambiguous. We can't be sure. And if we can't be sure of Delphi, we can't be sure of you!"
7. The story was same with the Trojans. Cassandra says "I prophesied to my countrymen," telling further, "all their disasters." Tragically, her clairvoyance was ignored and the Trojans were destroyed. Soon she was also killed.

Based on your understanding of the passage, answer ANY EIGHT questions from the nine given below.

- i. Who was Cassandra?
- ii. Cite a point in evidence, from the text, to suggest that the mistrust of the Greeks over Cassandra's prophecies was justified.
- iii. State any one trait of Cassandra that is evident from paragraphs 2-3 and provide a reason for your choice.
- iv. Cassandra strangely refuses Apollo's advances and 'this never happens in Greek myths.' Why did the writer think that this was 'strange'?

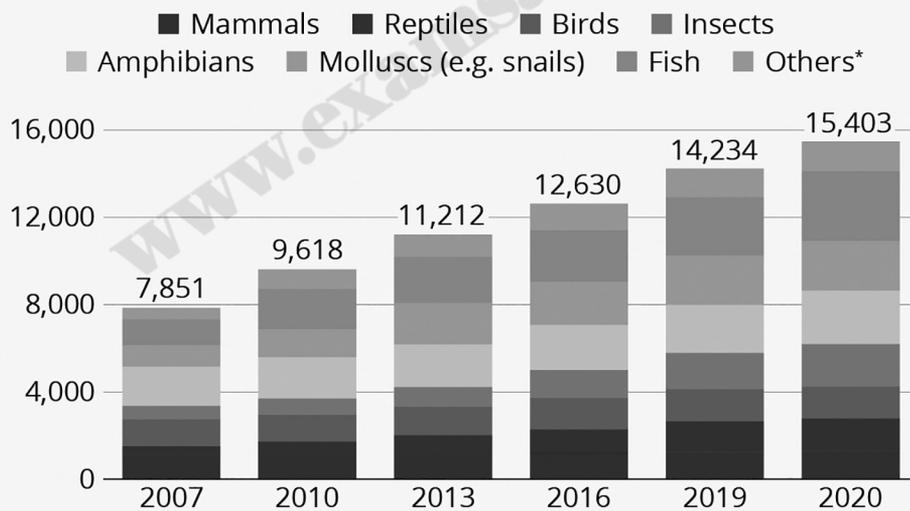
- v. Rewrite the given sentence by replacing the underlined phrase with another one, from paragraph 2.
His freedom was a barter for the valuable insider information he revealed about the cartel.
- vi. What does the use of the phrase 'the lady of many sorrows' suggest in the context of Trojans mocking Cassandra?
- vii. Select a suitable phrase from paragraph 2 to complete the following sentence appropriately.
I was more than willing to interact with my colleagues but they did not seem interested and _____.
- viii. The story of Cassandra is narrated by many Greek authors. Which authors narrate the story?
- ix. Analyse why Cassandra's boon was nothing more than a curse for her?

2. Read the passage given below.

- The widespread disappearance of snakes will be one impact of climate change that some people may find it hard to regret. But as vital predators in sensitive habitats such as rice fields, their decline will have wider ecological consequence, say scientists.
- Species assessed as Critically Endangered (CR), Endangered (EN), or Vulnerable (VU) are referred to as "threatened" species. Reporting the proportion of threatened species on The IUCN Red List is complicated because not all species groups have been fully evaluated, and some species have so little information available that they can only be assessed as Data Deficient (DD).
- Scientists in five countries across three continents report they found "alarming" declines in snake numbers after monitoring 17 populations in a variety of habitats – something they believe could be part of a global phenomenon.

The Number of Endangered Species is Rising

Number of animal species of the IUCN Red List, by class



* other invertebrate (spineless) animals, such as crustaceans, corals and arachnids (spiders, scorpions)

Source: IUCN Red List



statista

- "All the declines occurred during the same relatively short period of time and over a wide geographical area that included temperate, Mediterranean and tropical climates," write the authors. "We suggest that, for these reasons alone, there is likely to be a common cause at the root of the declines and that this indicates a more widespread phenomenon."

5. "The main importance of these findings is that snakes are top predators within the habitats they are found in and as such play a potentially important role in the functioning of many ecosystems," said Chris Reading of the UK's Centre for Ecology and Hydrology, who led the research. "For example, they play an important role in pest control – small rodents [like] rats and mice - in areas such as paddies and sugar cane plantations."
6. The IUCN said it had not done an analysis of snakes, but based on assessments of nearly one in five reptile species it estimates that 28% are threatened. This figure could reduce in future as vulnerable species are often assessed as a priority.
7. Researchers tracked the snake populations between 1987 and 2009 by carrying out regular surveys, a method not designed to measure absolute population sizes but relative abundance. The surveys varied in method between sites – from daily reports over several months of the year to monitoring roadkill – but were always the same in each location.
8. The authors note that six of the eight species which "crashed" had small home ranges, sedentary habits and relied on ambushing prey rather than actively seeking it out. "These patterns fit the prediction that 'sit-and-wait foragers may be vulnerable because they rely on sites with specific types of ground cover, and anthropogenic activities disrupt these habitat features, and ambush foraging is associated with a suite of life-history traits that involve low rates of feeding, growth and reproduction'," they add.

Based on your understanding of the passage, answer ANY SIX questions from the seven given below.

- i. What do the authors mean by 'sit-and-wait foragers'?
- ii. Why was this survey on the declining snake population undertaken?
- iii. Based on the information that can be gathered from the figure given in the passage, can we say that birds are more vulnerable than reptiles?
- iv. What can be concluded by the data of IUCN red list, with reference to the figure given in the passage?
- v. What are threatened species?
- vi. Why is it complicated to report threatened species to IUCN?
- vii. Identify a phrase from paragraph 8 suggesting that the sharp decline in snake population is a direct manifestation of human interference.

Section-B

Writing

3. Draft a formal invitation on behalf of Mrs. and Mr. Bhardwaj to be sent to all the relatives and friends on the occasion of their daughter's marriage. Prepare the invitation giving necessary details in not more than 50 words.
4. Attempt ANY ONE from A and B given below.

- (A) You are Nitin/Nitima living in Mysore. You have just completed Hotel Management Course and looking for a job. While browsing through The Times of India, you came across an advertisement for the requirement of an executive chef in Hotel Marriott. Write an application in about 120-150 words for the same giving your resume.

Hotel Marriott

Vacancy for the post of Executive Chef

Hotel Marriott, Bangalore, is looking for an executive chef for immediate placement. She/he should have in-depth knowledge of F&B Kitchen Management and controls, good communication skills, and specialise in culinary art.

Apply within seven working days of publication of this advertisement to the
HR Manager – Hotel Marriott, Bangalore.

OR

(B) You are Vijay/Vijaya, Assembly Secretary of Army Police Public School, Vasant Kunj. Write a report in 120-150 words on the felicitation ceremony held in your school. You may use the cues given below along with your own ideas.

- Felicitation ceremony for academic and co-curricular achievers
- Chief Guest of the programme
- Introductory dance
- Address by principal and chief guest
- Cash tokens to the toppers and all round topper

Section–C

Literature

5. Attempt **ANY FIVE** of the six questions given below, within 40 words each.

- i. How do 'denizens' and 'chivalric' add to our understanding of the tiger's attitudes?
- ii. 'The next day both men got up in good, season.' Who are the men who are mentioned in the line and what did they both do when they got up?
- iii. Why did Gandhiji agree to the settlement of 25% refund to the peasants?
- iv. According to the poet John Keats, what are the things that cause pain?
 - v. What did you feel about Evan's having the last laugh?
 - vi. What was the basic plot of each story told by Jack?

6. Answer **ANY TWO** of the following in about 120-150 words each.

- i. 'The blacksmiths glanced only casually and indifferently at the intruder' but 'The ironmaster did not follow the example of the blacksmiths who had hardly deigned to look at the stranger'. How was the attitude of both the persons different?
- ii. How do things of beauty enrich us?
- iii. What is the moral issue that the story 'Should Wizard Hit Mommy' raises?

□□



Sample Paper

3

English Core

Section–A Reading

1. Read the passage given below.

1. Christiaan Neethling Barnard (8 November 1922 – 2 September 2001) was a South African cardiac surgeon who performed world's first human-to-human heart transplant operation with his team, on 3 December 1967. It was a major historical event and a significant breakthrough for medical science.
2. Media coverage around the world of this event and subsequent transplants was front page and appeared daily for weeks and months on end, describing all aspects in detail and giving progress reports on the postoperative course of the patients. This degree of public acclaim had not been previously experienced by any other physician or surgeon and nor would it be experienced subsequently. This was in part because the dramatic nature of the operation had captured the public's imagination, but was equally a response to Chris Barnard's youthful good looks and charismatic personality. Barnard's name and that of the University of Cape Town and Groote Schuur Hospital are inextricably associated with the first heart transplant.
3. Today, when heart transplantation has become a relatively routine and commonplace procedure, one may be inclined to underestimate Christiaan Neethling Barnard. It was Barnard's immense courage in undertaking this first operation. Washkansky, a 53 year old man with severe coronary insufficiency, by far from an ideal recipient, being a diabetic and a smoker with peripheral vascular disease unfortunately succumbed from severe pneumonia and septicaemia on the 18th day post-operation.
4. Not daunted by this failure, Barnard immediately selected his second patient, a 59-year-old local dental surgeon named Philip Blaiberg. The operation was performed on 2 January 1968. On this occasion, the surgical technique was slightly modified from the approach developed in dogs by Shumway and the Stanford group. Blaiberg did well and was the first heart transplant patient to leave hospital. Media attention was enormous and his return to a relatively normal life was followed intensely over many months.
5. It was Blaiberg's success, perhaps more than any other single factor, that led to guarded optimism that heart transplantation would eventually prove a valuable treatment option. Blaiberg was the shining beacon, whereas the majority of other attempts at heart transplantation worldwide in the late 1960s and early 1970s seemed doomed to early failure. He eventually died 19 months after his transplant. His autopsy demonstrated severe and widespread coronary artery disease. This was the first example of transplant coronary artery disease that now dominates as the major cause of graft failure after the first post-transplant year.
6. Barnard was also a champion of the disadvantaged and the poor, and an opponent of racism and apartheid, who welcomed its demise. He did his best to not allow racial segregation of patients within his department, in defiance of Government policy to segregate patients in hospitals according to race, as elsewhere in South Africa.

Based on your understanding of the passage, answer ANY EIGHT questions from the nine given below.

- i. State any one trait of Dr. Barnard that is evident from paragraph 4 and provide a reason for your choice.
- ii. Rewrite the given sentence by replacing the underlined phrase with another one, from paragraph 5.
I have finally cleared my entrance exams and interviews, now I have a secure hope for a better future ahead.
- iii. Cite a point in evidence, from the text, to suggest that Dr. Barnard thought way ahead of his time in terms of values.

- iv. Can you guess at what age might have Dr. Christiaan Barnard conducted his first heart transplant?
- v. What does the use of the phrase 'shining beacon' suggest in the context of Blaiberg's heart transplant surgery?
- vi. The media couldn't stop raving about Dr Barnard's unique surgery. Why did some people think that it was revolutionary?
- vii. Why does the writer say that people may be inclined to underestimate Christiaan Neethling Barnard today?
- viii. Select a suitable phrase from paragraph 2 to complete the following sentence appropriately.
Most of the beauty pageant winners may be average in looks but they all have a _____ that makes them stand out.
- ix. Analyse why Washkansky couldn't make it past his heart transplant surgery?

2. Read the passage given below.

1. The idea that coffee is bad for heart pops up periodically. It was found that regularly drinking very strong coffee could sharply increase cholesterol levels. Researchers even isolated fatlike chemicals, cafestol and kahweol, responsible for the rise.
2. It turned out that the European brewing method—boiling water sits on the coffee grounds for several minutes before straining—produces high concentrations of cafestol and kahweol. By contrast, the filter and percolation methods remove all but a trace of these chemicals. Moreover, the studies involved large amounts of coffee, five to six cups a day.
3. Research has also shown that regular, moderate coffee drinking does not dangerously raise blood pressure. And studies have failed to substantiate fears that coffee might trigger abnormal heart rhythms (arrhythmias) in healthy people. "For heart disease, I think the issue is closed," says Meir Stampfer, an epidemiologist at Harvard who has studied many aspects of coffee and health. "Coffee drinking at reasonable levels is unrelated to heart risk."
4. The studies on coffee and cancer have focused on three organs and are reassuring. You may remember a brief coffee scare in the early 1980s when a single study linked coffee with pancreatic cancer. A false alarm: many studies since then have shown that the association is either extremely weak or non-existent. If there's a connection between coffee and bladder cancer, it possibly applies just to coffee junkies. A reanalysis of ten European studies found an increased risk only among people who drank ten or more cups a day. And studies show that coffee seems to have no adverse influence on the risk of colon cancer.
5. The question now arises: how much to drink? Those with heart burn and anxiety may want to see if cutting back coffee improves their condition. For most people, however, there's virtually no risk in consuming up to three normal cups a day. Harvard's Stampfer tries to keep his coffee drinking irregular enough to avoid habituation: "That way, I can get a buzz when I feel like it."
6. The FDA recommends that healthy adults limit their caffeine intake to a maximum of 400 milligrams (mg) a day, about 4 or 5 cups of coffee. This amount is not associated with negative effects. There is no set limit for children, but the American Academy of Pediatrics (AAP) discourages the consumption of caffeine and other stimulants by children and adolescents. The amount of caffeine included in some common foods and beverages are:

- One 8-ounce cup of coffee: 95 to 200 mg
- One 12-ounce can of cola: 35 to 45 mg
- One 8-ounce energy drink: 70 to 150 mg
- One 8-ounce cup of tea: 14 to 60 mg

7. Decaffeinated cola and soft drinks contain no caffeine, but decaffeinated coffee is not caffeine-free. "Energy drinks" contain varying amounts of caffeine. Additional products are now appearing on the market, from "psyched up" oatmeal to "wired" waffles. These have raised concerns, especially regarding the potential impact on children and adolescents. The FDA has questioned the safety of this practice.

Based on your understanding of the passage, answer ANY SIX questions from the seven given below.

- i. What does researcher Meir Stampfer mean by "For heart disease, I think the issue is closed"?
- ii. How much caffeine does 12 ounces of cola contain according to the table provided in the passage?

- iii. With reference to the table provided in the passage, write one conclusion about consumption of energy drinks.
- iv. Why has FDA recommended against the consumption of products with unregulated amounts of caffeine?
- v. Which method removes the chemicals cafestol and kahweol from coffee?
- vi. How much caffeine intake should the healthy adults must limit according to FDA recommendation?
- vii. Identify a word from paragraph 5 that states dependency on coffee for caffeine boost can make someone accustomed to it.

Section–B

Writing

3. You are Mr. Nilesh. Write a formal reply in about 50 words accepting the invitation of Mr. & Mrs. Verma’s daughter’s wedding.
4. Attempt **ANY ONE** from A and B given below.
 - A. You came across an advertisement in ‘The Times of India’ regarding the post of an animator in Mumbai. Draft an application in about 120-150 words for the post of the same in response to the advertisement giving your resume. You are Garvita/ Garvit of B-121, Street Park Lane, Kolkata.

Sitaara Edutech
Animator Required
 Needed a young and dynamic animator to create engaging and on-brand graphic and animations for various e-Learning courses and short films.
 Experienced candidates with specialisation in animations software and a creative flair preferred. Fluency in Adobe Creative Suit and English is a must.
 Apply within five days of the advertisement to the HR Manager.

OR

- B. You are Manoj/ Manju, an active member of the Animal Lovers Society which works for the welfare of animals by preventing cruelty to them. Recently you visited Animal Care Home. You were pleasantly surprised to see the good treatment given to the animals. Write a report in 120-150 words on your visit. You may use the cues along with your own ideas.
 - Campaign to raise awareness on the Animal Lovers Society
 - Services and facilities at the home
 - Medical treatment of animals
 - Care of animals at the home and strays
 - Your thoughts about what you witnessed at the home

Section–C

Literature

5. Attempt **ANY FIVE** of the six questions given below, within 40 words each.
 - i. What is the underlying idea behind the wizard’s taking the beating and tamely changing the rose smell?
 - ii. What was the conflict of Gandhiji?
 - iii. Why was the peddler surprised when he knocked on the door of the cottage?
 - iv. Why are the tigers of aunt Jennifer described as denizens of a world of green?
 - v. How did Mr. Lamb pass his leisure time?
 - vi. In the poem, *A Thing of Beauty*, Keats associated grandeur with the mighty dead. Comment.
6. Answer **ANY TWO** of the following in about 120-150 words each.
 - i. What do you understand by “unhealthy and o’er-darkened ways” as stated by Keats in his poem- *A Thing of Beauty*?
 - ii. The share cropping system was prevalent in Champaran on a wide scale. Comment.
 - iii. What clues did the Governor get from the answer sheet of Evans?



Sample Paper

4

English Core

Section–A Reading

1. Read the passage given below.

1. No student of a foreign language needs to be told that grammar is complex. By changing word sequences and by adding a range of auxiliary verbs and suffixes, we are able to communicate tiny variations in meaning. We can turn a statement into a question, state whether an action has taken place or is soon to take place, and perform many other word tricks to convey subtle differences in meaning. Nor is this complexity inherent to the English language.
2. All languages, even those of so-called ‘primitive’ tribes have clever grammatical components. The Cherokee pronoun system, for example, can distinguish between ‘you and I’, ‘several other people and I’ and ‘you, another person and I’. In English, all these meanings are summed up in the one, crude pronoun ‘We’. Grammar is universal and plays a part in every language, no matter how widespread it is. So, the question which has baffled many linguists is— who created grammar?
3. At first, it would appear that this question is impossible to answer. To find out how grammar is created, someone needs to be present at the time of a language’s creation, documenting its emergence. Many historical linguists are able to trace modern complex languages back to earlier languages, but in order to answer the question of how complex languages are actually formed, the researcher needs to observe how languages started from scratch. Amazingly, however, this is possible.
4. Some of the most recent languages evolved due to the Atlantic slave trade. At that time, slaves from a number of different ethnicities were forced to work together under colonial rule. Since, they had no opportunity to learn each other’s languages, they developed a make-shift language called Pidgin. Pidgins are strings of words copied from the language of the landowner. They have little in the way of grammar, and in many cases, it is difficult for a listener to deduce when an event happened, and who did what to whom. Speakers need to use circumlocution in order to make their meaning understood. Interestingly, however, all it takes for a pidgin to become a complex language is for a group of children to be exposed to it at the time when they learn their mother tongue. Slave children did not simply copy the strings of words uttered by their elders; they adapted their words to create a new, expressive language. Complex grammar systems which emerge from pidgins are termed creoles and they are invented by children.
5. Some linguists believe that many of the world’s most established languages were creoles at first. The English past tense –ed ending may have evolved from the verb ‘do’. ‘It ended’ may once have been ‘It end did’. Therefore, it would appear that even the most widespread languages were partly created by children. Children appear to have innate grammatical machinery in their brains, which springs to life when they are first trying to make sense of the world around them. Their minds can serve to create logical, complex structures, even when there is no grammar present for them to copy.

Based on your understanding of the passage, answer ANY EIGHT questions from the nine given below.

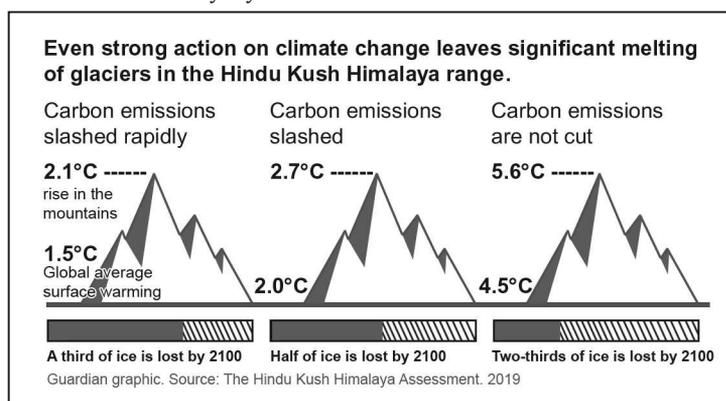
- i. Why does the writer say that complex grammar systems are partly invented by children?
- ii. What does the use of the term ‘circumlocution’ suggest in the context of the writer’s viewpoint about the evolution of grammatical systems?
- iii. The writer mentions looking at Atlantic slave trade for a better understanding of languages. Why do you think that is so?
- iv. Select a suitable phrase from paragraph 3 to complete the following sentence appropriately.

He had lost everything he earned in his business, however, he bounced back and _____ to build his business again.

- v. State any one trait of the Cherokee grammar system that is evident from paragraph 2 and provide a reason for your choice.
- vi. How do linguists understand the birth of modern language rules?
- vii. Rewrite the given sentence by replacing the underlined phrase with another one, from paragraph 4.
They were moving in their new apartment so all their sleeping arrangements were temporary by the time their furniture arrived.
- viii. Analyse why grammatical complexity is not inherent to the English language.
- ix. Cite a point in evidence, from the text, to suggest that the language we speak is constantly changing with generations.

2. Read the passage given below.

1. At least a third of the huge ice fields in Asia's towering mountain chain are doomed to melt due to climate change, according to a landmark report, with serious consequences for almost 2 billion people. Even if carbon emissions are dramatically and rapidly cut and succeed in limiting global warming to 1.5°C, 36% of the glaciers along in the Hindu Kush and Himalaya range will have gone by 2100. If emissions are not cut, the loss soars to two-thirds, the report found.
2. The glaciers are a critical water store for the 250 million people who live in the Hindu Kush-Himalaya (HKH) region, and 1.65 billion people rely on the great rivers that flow from the peaks into India, Pakistan, China and other nations. "This is the climate crisis you haven't heard of," said Philippus Wester of the International Centre for Integrated Mountain Development (ICIMOD), who led the report. "In the best of possible worlds, if we get really ambitious [in tackling climate change], even then we will lose one-third of the glaciers and be in trouble. That for us was the shocking finding."
3. Wester said that, despite being far more populous, the HKH region had received less attention than other places, such as low-lying island states and the Arctic, that are also highly vulnerable to global warming. Prof. Gemma Wadham, at the University of Bristol, said, "This is a landmark piece of work focused on a region that is a hotspot for climate change impacts."
4. The new report, requested by the eight nations the mountains span, is intended to change that. More than 200 scientists worked on the report over five years, with another 125 experts peer reviewing their work. Until recently the impact of climate change on the ice in the HKH region was uncertain, said Wester. "But we really do know enough now to take action, and action is urgently needed," he added. The HKH region runs from Afghanistan to Myanmar and is the planet's "third pole", harbouring more ice than anywhere outside Arctic and Antarctica. Limiting the global temperature rise to 1.5°C above pre-industrial levels require cutting emissions to zero by 2050. This is felt to be extremely optimistic by many but still sees a third of the ice lost, according to the report. If the global rise is 2°C, half of the glaciers are projected to melt away by 2100.



5. The melting glaciers will increase river flows through to 2050 to 2060, he said, pushing up the risk of high-altitude lakes bursting their banks and engulfing communities. But from the 2060s, river flows will go into decline. The Indus and central Asian rivers will be most affected. "Those areas will be hard hit,"

said Wester. Lower flows will cut the power from the hydrodams that generate much of the region's electricity.

6. But the most serious impact will be on farmers in the foothills and downstream. They rely on predictable water supplies to grow the crops that feed the nations in the mountains' shadows. But the changes to spring melting already appear to be causing the pre-monsoon river flow to fall just when farmers are planting their crops. Worse, said Wester, the monsoon is also becoming more erratic and prone to extreme downpours. "One-in-100-year floods are starting to happen every 50 years," he said.

Based on your understanding of the passage, answer ANY SIX questions from the seven given below.

- i. What does Philippus Wester mean by "This is the climate crisis you haven't heard of"?
- ii. With reference to the figure given in the passage, write one conclusion about what may happen to HKH region if Carbon emissions aren't cut.
- iii. Why is "third pole" remarked as a significant feature of Hindu Kush-Himalaya region?
- iv. For how many people who live in the Hindu Kush-Himalaya (HKH) region, the glaciers are a critical water store?
- v. What can be concluded by the data on ice coverage loss in HKH region, with reference to the figure provided in the passage?
- vi. How are the farmers downhill going to be affected by the changing climate and depleting ice in HKH region?
- vii. Identify a term from paragraph 4 indicating that the report, that more than 200 scientists worked on for over five years, was validated by the experts.

Section-B

Writing

3. The principal of your school is retiring this month. The students and the teachers want to give him a farewell party. Draft a formal invitation for the same in not more than 50 words.
4. Attempt **ANY ONE** from A and B given below.
 - A. You are Deepak/Deepika, of 12-A, Ramanujam Road, Chennai. You have come across an advertisement in The Times of India for recruitment of computer engineer trainees by Compro Software. Apply in response to this advertisement in 120-150 words, giving your detailed bio-data. Invent all necessary details.

**COMPRO SOFTWARE
REQUIRES
Computer Engineer Trainees**

Applicant must possess degree in computer applications and should be
B.Tech. in Computer Engineering.

WALK IN INTERVIEW on:
30th May, 20XX (Saturday)
10:00 a.m. to 12:00 p.m.

For further details, experience, remuneration, etc. please visit website :
<https://www.com.ac.in/facultyrecruitment>

OR

- B. You are Krishna/Kavita, a resident of Sunshine Helios. Recently the festival of Janmashtmi has been celebrated enthusiastically in your society. Write a report on the same in 120-150 words. You may use the cues given below along with your own ideas.
 - Devotion and enthusiasm seen everywhere
 - Nicely decorated Balgopal was kept inside the temple
 - Devotees offered prayers

- Cultural programs conducted
- Program ended with singing of bhajans

Section–C

Literature

5. Attempt **ANY FIVE** of the six questions given below, within 40 words each.

- Should criminals in the prison be given the opportunity of learning and education.
- What was the reaction of the peasants of Champaran when they came to know that a Mahatma had come to help them?
- 'It's all relative, beauty and beast.' Justify the statement given by Mr. Lamb
- What does the reference 'simple sheep' in the poem, *A Thing of Beauty*, symbolise?
- Explain: 'massive weight of Uncle's wedding band'.
- How does the metaphor of rattrap serve to highlight the human predicament?

6. Answer **ANY TWO** of the following in about 120-150 words each.

- Jo was not satisfied with the ending of the story. How did she want it to end and why?
- Write in brief the central idea of the poem, *Aunt Jennifer's Tigers*.
- What change did Mr. Lamb bring in Derry's attitude towards life?

□□



Sample Paper

5

English Core

Section–A Reading

1. Read the passage given below.

1. Few would know about Voltaire, the eminent French philosopher, writer, historian and fierce critic of The Roman Catholic Church. His real name was Francois-Marie Arouet. He decided to cross the English Channel and fell in love with England. He was extremely happy to find that there was a breath of fresh air. The works of Newton amazed him. His works represented the opposite of the arcane and ancient country that France was. A nation held to ransom by the aristocratic system. Newton's prediction of the trajectory impressed him, how the planets moved exactly the way his laws predicted.
2. When he returned to Paris, he pushed Newton's new vision. To be on the safe side, he had adopted a new pen name: Voltaire. To promote his views he needed a place, a patron who was not locked into the old guard's thinking. He founded it in a girl, a tomboy of sorts, Émilie du Châtelet. A patron quite apart from other girls of her age. A real investigator of the physical world. She almost came very close to come up with the law of conservation of mass, much before Lavoisier was born. Only it was her laboratory equipment that were not accurate.
3. Émilie was different. She came alongside the German mathematician, Gottfried Leibniz' analysis to believe that energy cannot be lost. The final conclusion of energy being proportional with mv^2 was due to her tireless efforts. Of course it was the decisive evidence that came from the recent experiments of a Dutch researcher, Willem Jacob's Gravesande. Willem wasn't a kind of theoretician like Leibniz to put it all together. Émilie's work on this topic bridged the gap. It was a huge discovery that went unnoticed. Even Lavoisier who shared fame for discovering the law of conservation of mass couldn't come to grasp this important concept.
4. Although Voltaire thought that she was wasting her time but she was unfazed. When it came to her own work, she took time and was very methodical. Along with her colleagues she published her finding without any delay. Émilie died whilst in labour in early September 1749 and Lavoisier was born on August 26, 1743. A century later even Michael Faraday and others used mv^2 . The commanding role of this wonderful lady was nearly forgotten.
5. "Judge a man by his questions rather than by his answers." This was a famous quote made by Voltaire that hinted at a break with old tradition and his attack on the Catholic Church and perhaps a close association with Émilie might have been a motivation to contribute towards the progress of science and scientific temper, although indirectly.

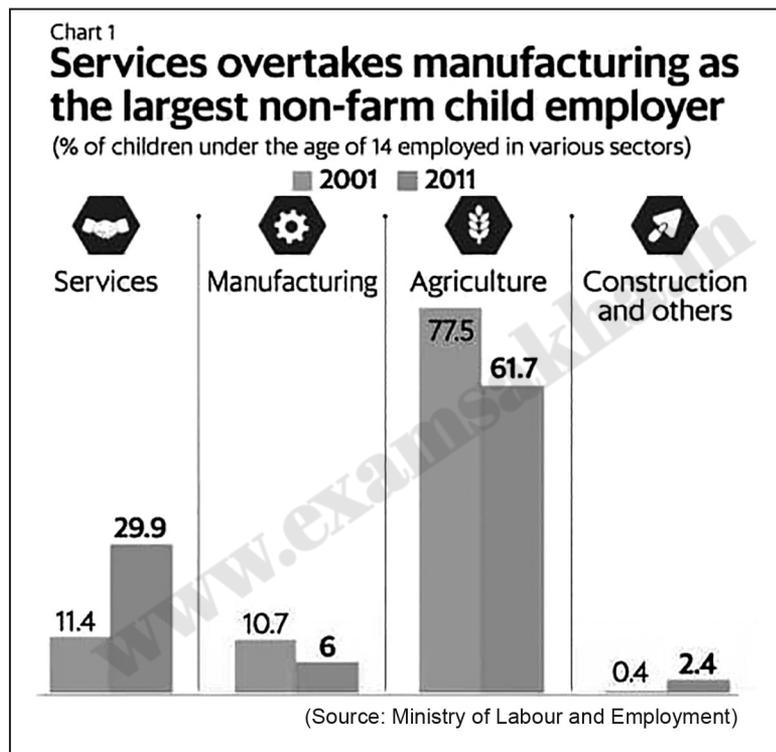
Based on your understanding of the passage, answer **ANY EIGHT** questions from the nine given below.

- i. State any one trait of Voltaire that is evident from paragraph 1 and provide a reason for your choice.
- ii. When looking for a patron, Voltaire founded it in a girl, a tomboy of sorts. Why did he think of her as a 'tomboy'?
- iii. Cite a point in evidence, from the text, to suggest that Voltaire was in awe of Newton's work.
- iv. Rewrite the given sentence by replacing the underlined phrase with another one, from paragraph 1.
Our school decided to host a themed farewell party which was a pleasantly different change.
- v. Why do you think Émilie's works were left largely overlooked regarding the law of conservation of mass?

- vi. Which other scientists reap the benefits from Émilie's works?
- vii. Analyse why Voltaire thought that Émilie was wasting her time?
- viii. Select a suitable phrase from paragraph 3 to complete the following sentence appropriately.
We successfully achieved communal harmony by finding an endearing common ground that _____ between the groups.
- ix. What does the use of the quote 'Judge a man by his questions rather than by his answers' suggest in the context of the Voltaire's viewpoint?

2. Read the passage given below.

1. 1 in every 10 workers in India is a child; a child who is guaranteed protections under the Indian Law, and guaranteed an education and mid-day meals, till the age of 14. The sight of a chotu running to fetch you a chai on the train platform or at your local tea stall, isn't much of a sight in India. In fact, one could almost say that the chotu has become so ubiquitous, that him not being there would be a bit confusing for some of the regulars. It has been normalised and has become an internalised personality trait of the larger Indian society, which tacitly continues to support the chotu culture at the tea stall and within the home.



2. In fact it's become so natural that, when engaging with some of our more conscientious friend, both chotu and we, know the routine to pull off. You casually ask chotu how old he is as he cleans your table, and he, with a pail the size of his torso, responds saying he's 18. His gangly limbs and prepubescent face are a dead giveaway, but now that he said he is 18, there's not much you can do... is there?
3. According to the UNICEF, there are about 10.1 million children employed in child labour in India today. That amounts to approximately 13% of our workforce. India has been trying to combat this blight since pre-republic times with the passing of the Employment of Children Act, 1938. While primitive, it was evident that even under an extractive colonial regime, it was understood that the use of children in the production process was anathema. Post-independence, the Factories Act, 1948 and the Mines Act, 1952, banned the practice of using children below the age of 14 and 18, in their respective production processes.
4. This set the tone for the Child Labour (Prohibition and Regulation) Act of 1986 which prevents the employment of children below the age of 14 years in life-threatening occupations identified in a list by the law and finally the Juvenile Justice (Care and Protection) of children Act of 2000 made the employment of children a punishable offence.

5. The JJ Act came into force shortly after India ratified the Convention on the Rights of the Child (CRC), in 1992 and made the offence punishable with imprisonment from three months to one year or with fine no less than INR 10,000–20,000 rupees or with both. The Right to Education Act, passed in 2009, was supposed to go beyond punishing people for child labour to creating a conducive environment for building the capabilities of all Indian children, so that they could have a complete education and enter the workforce out of choice and not compulsion. However, even after all this, child labour continues to be the norm in a lot of industries.

Based on your understanding of the passage, answer ANY SIX questions out of the seven given below.

- i. What is the data of UNICEF regarding child labour?
- ii. What does the writer mean by 'chotu culture'?
- iii. As per the chart given in the passage, which sector is the lowest child employer?
- iv. When did India ratify the Convention on the Rights of the Child (CRC)?
 - v. What can be concluded by the data of children employed within service sector from 2001-2011, with reference to the chart given?
- vi. What is the purpose of The Child Labour (Prohibition and Regulation) Act?
- vii. Identify a word from paragraph 2 which describes a child that hasn't gone through the biological phase of maturity.

Section-B

Writing

3. You are the secretary of Punjab Medical Doctors' Association, 12-A, Sodhi Colony, Chandigarh. You have planned a seminar on CANCER for the members of the association and invited a specialist guest speaker. Draft an invitation in not more than 50 words to be published in the local newspaper.
4. Attempt **ANY ONE** from A and B given below.
- A. You are Rajan/Rajni, resident of 33, Pratap Enclave, Udaipur. You read an advertisement in the newspaper for the job of an accountant in Freshers Pvt. Ltd. Chennai. Draft an application in about 120-150 words for the post of the same in response to the advertisement giving your bio-data separately.

Freshers Pvt. Ltd.
Needed Accountants

Looking for young, dynamic, experienced accountants. The candidates should have a graduate degree in commerce and worked on various accounts related computer software. Apply within ten working days of this advertisement. Fresh graduates may also apply.

OR

- B. TPS School, Kanpur, recently hosted its annual computer festival titled Ordin@trix13.0. You are Sanjay/Sanjana, editor of the school magazine. Write a report in 120-150 words on the event for your school magazine. You may use the cues given along with your own ideas.
- Computer Festival
 - Theme, events
 - Participants in the fest
 - Different activities and competitions judged by eminent personalities in the field
 - Sponsors of the event
 - Vote of thanks by the Principal

Section–C

Literature

5. Attempt **ANY FIVE** of the six questions given below, within 40 words each.

- i. List the things of beauty mentioned in the poem 'A Thing of Beauty'.
- ii. In the poem 'Aunt Jennifer's Tigers', what is the contrast between the reality of Aunt's life and her imagination?
- iii. Why was Edla happy to see the gift left by the peddler?
- iv. What were the terms of the indigo contract between the Indian peasants and the British landlords?
- v. How was the Skunk's story different from the other stories narrated by Jack?
- vi. What was the intention behind the call from the Examinations Board?

6. Answer **ANY TWO** of the following in about 120-150 words each.

- i. Give an account of the peddler's meeting with the old crofter. How does the peddler conduct himself? What light does this episode throw on human nature?
- ii. Who was Reverend Stuart Mc Leery and what was he carrying with him when he was heading towards the prison? Was he the actual person appointed by the prison authorities?
- iii. How did Derry's sneaking into Mr. Lamb's garden become a turning point in his life?

□□



Answers

Sample Paper 1

READING

1.
 - i. South Korea is considered a model for education because its students rank among the best on international education tests.
 - ii. Many young South Koreans suffer physical symptoms of academic stress. Students are also inclined to see academic performance as their only source of validation and self-worth.
 - iii. South Korea's position in the international education hierarchy with respect to the youth happiness is that only 60 per cent of the country's students are content in school.
 - iv. Korean society is heavily image driven, where parents curate the choices of their children's career. The Korean government also views children as mere cogs in the country's economy with no right to personal happiness.
 - v. The scientists had to find the vaccine to cure the pandemic, no matter the cost.
 - vi. The Program for International Student Assessment is the benchmark to measure the standard of students' education in a country.
 - vii. Cram schools are known as hagwons in Korean. They are soulless facilities, with room after room divided by thin walls, lit by long fluorescent bulbs, and stuffed with students memorising English vocabulary, Korean grammar rules and math formulas.
 - viii. Celebrities have to be extra careful in the world of social media because often their maligned past casts a long shadow over their good deeds.
 - ix. Korean culture's special focus is on the family status. Thus, parents deem it too important and special a decision to be left on their child to decide their future.
2.
 - i. Statisticians conventionally measure economic growth as the percent rate of increase in real gross domestic product or real GDP.
 - ii. An increased 'Real GDP per person at end of period' indicated an elevated annualised growth rate and the increased economic growth of that country.
 - iii. The rate of growth of GDP per capita is calculated from data on GDP and people for the initial and final periods included in the analysis of the analyst.
 - iv. The given table covers the data about the GDP per person and annualised per person GDP growth for over 100 years.
 - v. The GDP per person is conceptually analogous to average income, so GDP per person data is adjusted for inflation, hence they are real.
 - vi. Germany's annualised growth rate is 2.05% according to the table given in the passage.
 - vii. Extensive growth explains the growth caused only by increases in the number of inputs available for use.

WRITING

3. 1/27 Tank Road,

Pune

21st October, 20XX

Dear Anshuk,

I am so happy to hear the wonderful news of Amisha's wedding. Thank you for the cordial invitation on the occasion of your sister's wedding function. I will be delighted to attend the function as per the schedule.

Yours lovingly,
Gaurav/Garvita

4.A. 124, Rana Sanga Marg
New Delhi-000 001

10th January, 20XX

The Principal
Milan University
New Delhi- 000 001

Subject – Application for the post of lecturer in botany

Sir/Madam,

In response to your advertisement in 'The NEWS' dated 4th January, 20XX for the post of Botany Lecturer in your new campus based in Chandigarh, I wish to offer my candidature.

I would like to bring to notice that I possess all the aforementioned qualities required for the post. I am enclosing a copy of my bio-data for your perusal and kind consideration. I am available for the interview on any day of your convenience. If given a chance to serve you, I assure you that I shall work with utmost sincerity and dedication up to your satisfaction.

Thank you

Yours faithfully,
Kushagra/ Kushi

Encl: (i) Bio-data
(ii) Testimonials

BIO-DATA	
Name	: Kushagra/Kushi
Father's Name	: Om Agrawal
Date of Birth	: 17th May, 1987
Address	: 124, Rana Sanga Marg, New Delhi-000 001 Phone- 98XXXXXXXX
E-Mail Address	: kus123@gmail.com
Marital Status	: Married
Nationality	: Indian
Educational Qualifications	: (i) B.Sc. (Hons) Delhi University with 88% marks : (ii) M.Sc. (Botany) Delhi University with 86% marks
Experience	: 5 years as Botany Lecturer in Hansraj College
Languages	: Good command over spoken and written English.
Hobbies	: Reading and Travelling
References	: 1. Sanjay Singh, Principal, Apeejay School, Delhi. Ph-XXXXXXXXXX : 2. Rachna Sareen, HOD, Physics, Delhi University. Ph- XXXXXXXXXXXX

Looking forward to a favourable response.

Yours faithfully,
Kushagra/Kushi

OR

4.B. **Massive Fire Broke Out in Sadar Bazaar**

By XYZ, (The Tribune)

New Delhi, 20th May, 20XX: A huge fire broke out at a market place in old Delhi's Sadar Bazar area on Wednesday evening. The fire erupted on the first floor of a building at 5:00 a.m., according to the

sources of Delhi Fire Service. Twenty fire engines immediately rushed to the site and after a brave fight and struggle they were able to control the blaze by 7.30 a.m. A fireman also sustained some severe burns and got his leg injured. Police sources say that the fire was caused due to short circuit and spread quickly surrounding the huts. The furniture market is spread over 2,000 square yards and the fire had spread rapidly as a large amount of wood and plastic material was stored in the area. Nearly 50 shops were gutted in the fire in the congested area of Sadar Bazar in Delhi leading to huge loss of property. Although the people were not hurt as the fire broke out early morning and the shops were closed. A call was received around 5:15 a.m. regarding the fire and immediately the Fire Department was informed. However, Vinod Goyal, Director of the Delhi Fire Service, said: "We received the information at 5.25 a.m. and immediately, the fire tenders were rushed to the spot to douse the blaze". Total estimated loss is around 2 crores. Government has announced a compensation of 1,00,000 rupees for damages of business and 50,000 for those who have lost their homes.

LITERATURE

5. i. Evans seemed to be telling his teacher that he might surprise everybody by doing well in the examination but in reality, it was a warning that he was going to jolt everybody by escaping from the prison which he had planned.
 - ii. Aunt Jennifer chose to embroider tigers on the panel because of the nature of these 'bright topaz denizens'. Aunt Jennifer is an artist who makes what she yearns the most. Her marriage has made her meek and subservient over the years, but her tigers symbolise strength and freedom which she does not have.
 - iii. The peddler wrote to Edla that since she had treated him like a captain, he also wanted to be nice to her in return. He did not want her to be embarrassed at Christmas by a thief. He also requested her to return back the crofter's money that he had stolen.
 - iv. The poet says that the beautiful things on earth lift the pall off our spirits and make life worth living. Each beautiful thing is like a link that form a chain or wreath that bind us to the earth. The beautiful things in nature like the moon, the sun, the trees, the ferns and the daffodils bring happiness and reduce human's sufferings.
 - v. Mr. Lamb did not allow his physical disability to crush his openness and large-heartedness. He kept his house and heart open for people, he kept the gate of his garden open and anybody could enter it. He did not believe in shutting things out or disconnecting himself from the people. This reveals that Mr. Lamb was a man with positive attitude.
 - vi. The lawyers had decided to go home, if Gandhiji went to prison. But Gandhiji asked them what would become of the injustice to the sharecroppers. The lawyers thought over it and decided that they too would follow Gandhiji. This was the time that when Gandhiji said that the battle of Champaran was won.
6. i. Leadership is the process by which a leader directs, guides and influences the work of others in choosing and attaining specified goals by mediating between the individuals and the conflicting organisation in such a manner as will satisfy both. A leader may not be physically strong but he needs to be mentally strong and firm in decisions. For example, Mahatma Gandhi, the greatest of our leaders, had the power of organising, uniting and attracting people towards him with the power of his intelligence and alertness. A leader has to use his / her brain every time and has to remain alert with eyes and ears open, to avoid being carried away by any fraud or an enemy. Apart from being impartial, a leader needs to be action-oriented. A leader should be effective enough towards himself and encourage everyone through his word to do constructive work while walking on the right path so that everyone can become aware of his / her rights and duties. A leader has to be dedicated. He does whatever it takes to be a role model in every sense of the word.
 - ii. Jack had a four-year-old daughter named Jo whom he loved very much. He was a considerate and affectionate father who made sincere efforts to gratify his daughter's creative intellect. He used to narrate a story to her each day. He had been doing this as a customary for the past two years when she was only-two-years old. He himself had a very creative mind and nearly all the stories he told were creations of his own mind, each new story being a slight variation of a basic tale. Jack had mastered the

art of story-telling and could create new stories to suit the mood and occasion. He was able to create the preferred outcome to keep his daughter Jo's interest unharmed as he understood her very pulse. Jack was always full of creative zeal; many times, he even mimicked the voices of the characters in his stories too. Jack was a very loving and caring father.

- iii. In the poem 'Aunt Jennifer's Tigers', a woman expresses her suppressed feelings through her art. Aunt Jennifer is the victim of the male-dominated society. She has no one to talk about her mental and physical pain. She does an embroidery of graceful and powerful tigers to convey her deep feelings. They are set in motion and they are shown moving quickly in a chivalrous manner. In the green jungle, they look free, bright, brave, fearless and magnificent. There are men sitting under the tree, but the tigers do not care for them. They move on to their goal boldly and smoothly. Jennifer finds it difficult to make pictures by using the ivory needle. She is tired of doing the household work after she got married. She can't get herself involved in her artistic work. She has to do it in her leisure time. Even then, she has to be sure whether her husband is watching her or not. So, her hands are terrified. She will not be free from fear until she dies. She will be dominated by her husband. She will die, but her art will express her desire to move proudly and fearlessly like the tigers she has made. Unlike her fearless creation, Aunt Jennifer is a victim of fear and dominance.

Sample Paper 2

READING

1. i. Cassandra was a princess and the daughter of Priam the king and the queen Hecuba of Troy. She was the smartest and the most beautiful of the daughters of King Priam.
 - ii. The Greeks told Cassandra after the fall of Troy that even the Delphic Oracle sometimes makes mistakes. Sometimes its own prophecies are ambiguous. And if they couldn't be sure of them, they certainly couldn't be sure of her as well.
 - iii. Cassandra was a strong-willed and an unbending woman who did not accept Apollo's perverse advancements so easily. She couldn't resist the gift of prophecy but eventually refuses to be with Apollo.
 - iv. Usually when Gods in Greek myths convey their love to the mortals, they happily comply. But Cassandra straight up refused Apollo, the Greek God having the power to give the boon of knowing the future, and this comes off as strange.
 - v. His freedom was a quid pro quo for the valuable insider information he revealed about the cartel.
 - vi. Cassandra prophesies to her own people the fall of Troy, the death of the leading Greek invader Agamemnon. She even foresees her own early death, and still, no one pays attention. She's made fun of by both Greeks and Trojans alike for always foretelling doom and destruction
 - vii. I was more than willing to interact with my colleagues but they did not seem interested and refused the overtures.
 - viii. Cassandra appears in texts written by Homer, Virgil, Aeschylus and Euripides. Each author depicts her prophetic powers differently.
 - ix. Cassandra's gift of prophecy was wasted by the curse of people not believing in them. She spent her whole life in misery remaining unheard and overlooked. She was eventually taken by Agamemnon to be his slave mistress after the sack of Troy, and was later killed.
2. i. 'Sit-and-wait foragers' refers to snakes that are naturally ambush hunters. They have small home ranges, sedentary habits and rely on ambushing prey rather than actively seeking it out.
 - ii. Snakes are the top chain predators of their ecosystem, meaning that they keep the population of the pests like rats and mice under control. Their decline is going to push the food chain in an imbalance which makes it important to save the snake species. Therefore, a survey on the declining snake population was undertaken.
 - iii. The number of endangered bird species listed by IUCN has remain almost constant so far over the years but there is a visible increase in the number of endangered reptile species. Hence, it would be better to say that the rate with which reptiles are becoming endangered is more alarming.

- iv. The number of vulnerable and endangered species have been increasingly on the rise and the direct culprit for this can be labelled as climate change and human interference.
- v. Species assessed as Critically Endangered (CR), Endangered (EN), or Vulnerable (VU) are referred to as “threatened” species.
- vi. Reporting the proportion of threatened species on The IUCN Red List is complicated because not all species groups have been fully evaluated, and some species have so little information available that they can only be assessed as Data Deficient (DD).
- vii. Anthropogenic activities suggests that the sharp decline in snake population is a direct manifestation of human interference.

WRITING

3.

<p>Mrs and Mr BHARDWAJ request the pleasure of your benign presence on the occasion of the Marriage of their daughter SAKSHI with AKAASH (S/o. Mrs and Mr Ravikant Sharma) On 15th February, 20XX at 8:00 a.m. HOTEL LAKE PALACE Vinoba Vihar, Udaipur</p> <p>R.S.V.P Mrs. and Mr. Bhardwaj 12, Anita Colony, Udaipur Ph: XXXXXXXXXXX</p>
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- 4.A. 8/ 12, Sri Nagar,
 Mysore-XXXXXX
 10th June, 20XX
 The Manager
 Marriott Hotel
 Delhi

Subject: Application for the post of executive chef

Sir,

This is with reference to your job advertisement in ‘The Times of India’ regarding the post of an executive chef in your hotel. I would like to apply for the same. I am an efficient chef who excels in creating the menu and can very well oversee the kitchen staff competently. I am capable enough to prepare unique dishes that will make your business stand out from others. For further details, I am enclosing my bio-data herewith.

Encl.: Bio-data

BIO-DATA	
Name	: Nitin/Nitima
Father’s Name	: B.N. Kumar
Date of Birth	: 21st August, 1994
Address	: 8/12, Sri Nagar, Mysore-XXX XXX Phone- 98XXXXXXXX

E-Mail Address	: nit123@gmail.com
Marital Status	: Unmarried
Nationality	: Indian
Educational Qualifications	: (i) Bachelor in Hotel Management, XYZ Institute, Pune (ii) Certified Executive Chef (CEC) (iii) Associate degree in culinary art
Experience	: 2 years' experience as a cook in a Three Star Hotel
Strengths	: Ability to communicate in fast moving environment, organization skill, time management skill
Languages	: Good command over spoken and written English.
Hobbies	: Reading and Sketching
References	: 1. Rohin Khurana, Manager, Blue Lagoon Hotel, Pune Ph.-XXXXXXXXXX 2. Anil Sharma, Manager, Hyatt, Delhi. Ph- XXXXXXXXXXXX

Hoping for a favourable response.

Thanking you,

Your sincerely,

Nitin/ Nitima

OR

4.B. Felicitation Event at Army Police Public School

By Vijaya/Vijay

Army Police Public School, Vasant Kunj organised a ceremony to felicitate achievers in academics and co-curricular fields. The occasion was graced by Mr. Rohit Mallik, special CP, Deepa Mallik, Mahesh Vaidya, joint CP, Western range and Vishit Verma, additional DCP, South West district. A Bihu dance performed by the students was a feast for the eyes. In her address, Principal Shiny Datta stressed on recognising excellence not only in academic but also in co-curricular activities. She also focused on the need to develop basic life skills in children. The CBSE class 10th toppers bagging the first, second and third positions were awarded a cash prize of ₹3,000; ₹2,000 and ₹1,000 respectively. The stream toppers of class 12th received cash price of ₹5,000 each. Meritorious students from classes 6 to 9 and 11 were awarded. Student of the year, Gaurav Khandelwal was felicitated with a cash price of ₹10,000. The principal and the guests felicitated young achievers and other students were motivated to follow the footsteps of the merit holders.

LITERATURE

5. i. The word 'denizens' here means that the tigers are proud of their home, they feel safe and fearless there and have a feeling of belonging attached to it. The word 'chivalric' shows that they have a majestic and worthy position like knights. They are the masters of their area.
- ii. The two men who are mentioned in the line are the old crofter and the peddler. After getting up, the crofter was in a hurry to milk his cow. Peddler also did not want to stay in bed when the host had gotten up. They left the cottage at the same time. The crofter locked the door and put the key in his pocket. The peddler thanked him, bade him goodbye and then both went their own way.
- iii. Gandhiji had demanded 50 percent refund from the landlords. The landlords offered only 25 per cent. Gandhiji agreed to the settlement of 25 per cent because according to Gandhiji, money was not important. He had made the Britishers bow down before the Indian peasants, which was the primary aim of this struggle.
- iv. According to Keats, the things that cause pain and suffering are despondency, dearth of noble nature, gloomy days and unhealthy and darkened ways of human beings.
- v. The phrase 'Evans having the last laugh' refers to the clever plan devised by Evans to escape from the prison by fooling everyone till the end. He left some clues so that the officials would be misled in chasing him. Evans adopted the wrong way. He forged the van used by the governor of the prison. He finally managed to escape which is referred to here as Evans having the last laugh.

- vi. The basic plot of each story told by Jack was about a small creature, usually named Roger who had some problem and went with it to the wise old owl. The owl would tell him to go to the wizard and the wizard performed a magic spell that solved the problem and then demanded payment in pennies.
6. i. The attitude of both, the blacksmiths and the ironmaster was completely different. On one side where blacksmiths exhibited the typical attitude of physical labours for whom, work was the first priority and didn't bother about the onlookers, the ironmaster was a conscious man. The master blacksmith signalled an arrogant permission without honouring the intruder with a single word. It was clear from his gesture that the peddler didn't matter for him. His presence was insignificant for him. But the ironmaster, who was on one of his nightly rounds of inspection, saw the tall ragmuffin who had quietly made his way to the furnace for warmth. He walked closely up to him and looked him over carefully. Then he removed his slouch hat to get a better view of his face. In the uncertain light of the furnace he mistook the stranger for his old regimental comrade and requested him to go home with him. When the stranger declined the invitation, the ironmaster sent his daughter to persuade him to spend Christmas Eve with them. This highlights the different shades of human nature. It shows that even the person with best judgement may commit an error of judgement.
- ii. Our desire to live on this earth is to a great extent due to the presence of beautiful things that are a constant source of joy for us. Without beauty, the earth is full of gloom and sadness. There is cruelty, selfishness and mean behaviour all around with lack of good-natured people. It is this beauty, a creation of God, which removes the sadness and darkness from our minds and souls. As we get wrapped up in the beautiful flowery band or this strong connection with nature, we get a reason to live further. The sun, the moon, trees old and young are all sources of happiness for us. The trees sprout and spread their branches to provide shelter within their shade for the simple sheep. The Daffodils bloom within the green surroundings in which they grow. The clear and small streams of water make a cooling shelter for themselves against the hot season. The thick mass of ferns looks grand with their beautiful musk roses. All these things enrich our lives to an extent that it is not possible to live without them and in this way beauty enrich us.
- iii. The moral issue that the story raises is whether parents have the absolute right of judging what is good or bad for their child. There is a sharp contrast in the story about the child's viewpoint and an adult's perspective of life. In the story, Jo felt that the happiness of being able to make friends is more than anything else and so she wanted the story to end with Roger Skunk smelling like roses. On the other hand, her father Jack ended the story by saying that his mother was right in getting Roger's smell back to its original form, implying to his daughter that parents knew what is best for their children. He also advocates that children should respect their parent's opinions and obey them unquestioningly. Jack also narrated that all the other animals finally accepted Roger, as he was emphasising the importance of a person's originality and individuality.

Sample Paper 3

READING

1. i. Dr. Barnard was a strong headed and courageous man who went on to perform another heart transplant surgery with an improved technique despite his first failed attempt.
- ii. I have finally cleared my entrance exams and interviews, now I have a guarded optimism for a better future ahead.
- iii. Barnard was a champion of the disadvantaged and the poor, and an opponent of racism and apartheid. He did his best to not allow racial segregation of patients within his department, in defiance of Government policy prevalent in South Africa
- iv. Dr. Christiaan Barnard conducted his first heart transplant when he was 45 years.
- v. The word 'Shining beacon' suggests that the majority of other attempts at heart transplantation worldwide in the late 1960s and early 1970s seemed doomed to early failure, but it was Blaiberg's success, perhaps

more than any other single factor, that led to guarded optimism that heart transplantation would eventually prove a valuable treatment option.

- vi. Human-to-human heart transplant surgery was something that was unheard of at that time. Therefore, the dramatic nature of the operation had captured the public's imagination.
 - vii. Today heart transplantation has become a relatively routine and commonplace procedure, but it was Barnard's immense courage in undertaking this first operation. It was a major historical event and a significant breakthrough for medical science.
 - viii. Most of the beauty pageant winners may be average in looks but they all have a charismatic personality that makes them stand out.
 - ix. Washkansky was a 53-year-old man with severe coronary insufficiency, by far from an ideal recipient, being a diabetic and a smoker with peripheral vascular disease. He unfortunately succumbed from severe pneumonia and septicaemia on the 18th day post-operatively.
2. i. Research has shown that regular, moderate coffee drinking does not dangerously raise blood pressure. And studies have failed to substantiate fears that coffee might trigger abnormal heart rhythms in healthy people.
- ii. 12 ounces of cola contain 35 to 45 mg of caffeine.
 - iii. Energy drinks contain varying amounts of caffeine, one 8-ounce energy drink can have about 70 to 150 mg of caffeine in it.
 - iv. Additional products are now appearing on the market, from "psyched up" oatmeal to "wired" waffles. These have raised concerns, especially regarding the potential impact on children and adolescents. The FDA has questioned the safety of this practice.
 - v. The filter and percolation methods remove all but a trace of the chemicals cafestol and kahweol.
 - vi. The FDA recommends that healthy adults limit their caffeine intake to a maximum of 400 mg a day, about 4 or 5 cups of coffee
 - vii. Habituation states the dependency on coffee for caffeine boost can make someone accustomed to it.

WRITING

3. 44/1 Gulmarg Street
New Delhi

1st November, 20XX

The Manager
Xentrix Studios
Mumbai

Subject: Acceptance of the invitation of wedding

Dear Mr. and Mrs. Verma,

I have received your invitation of the marriage of your daughter, Karuna on 25th November, 20XX at 8:00 p.m. Thank you for inviting me. I confirm my presence at the venue at the scheduled time.

Yours truly,
Nilesh

4.A. B- 121, Street Park Lane
Kolkata

17th April, 20XX

The Manager
Xentrix Studios
Mumbai

Subject: Application for the post of animator

Dear Sir,

In response to the advertisement published in the newspaper, 'The Times of India' for the post of animator, I would like to apply for the same. After clearing All India Common Entrance Examination for Design (CEED), I did six months certificate program in domains like visual effects (VFX) specialisation, digital composting, and video editing.

I possess the foremost skills required in animation careers i.e. genuine interest in art and design which helps in bringing out the creative and artistic expression that will allow static images to develop visual graphics and movements. I believe that all these qualities will fulfill your requirement you need in a proficient animator.

If selected, I assure you that I would contribute my best to the work for your company. For reference, I am enclosing my resume as under.

Encl.: Resume

RESUME	
Name	: Garvit/Garvita
Father's Name	: D.K. Gandhi
Date of Birth	: 21st October, 1993
Address	: 121, Street Park Lane, Kolkata-XXXXXX : Phone- 98XXXXXXXX
E-Mail Address	: gar123@gmail.com
Marital Status	: Unmarried
Nationality	: Indian
Educational Qualifications	: (i) Senior Secondary from Tagore Public School, Kolkata (ii) Graduation in designing & Arts from Govt. run institute (iii) Diploma in Character Animation from Adam College
Experience	: 2 years at HOBNOB Enterprises, Mumbai
Strengths	: Sound IT skills and the ability to concentrate
Languages	: Good command over spoken and written Hindi & English.
Hobbies	: Drawing and Sketching
References	: 1. Ashok Singh, Manager, Accenture. Pune, Ph-XXXXXXXXXX 2. Minal Sathe, Crox, Delhi. Ph- XXXXXXXXXXX

Hoping for a favourable response.

Yours sincerely,
Garvit/Garvita

OR

4.B. Visit to The Animal Care Home

By Manoj/Manju

Recently, Animal Lovers Society was invited by the city Animal Care Home for a visit where an opportunity to have a look upon the working of the organisation was given.

It is a home to abandoned pets, rescued animals and the ones injured on the streets. There were many old animals as well. It was astonishing to see the wonderful care being taken of the helpless animals. They have a family-like environment for them. This helps them to heal faster and stay happy. The animal home has all the facilities ranging from well-equipped medical room to a veterinary surgeon. They provide 24 hours veterinary care, ambulance services, inpatient facilities and adoption of dogs and cats. They are now building a medical centre which will consist of an OPD, operation theatre, X-ray and scanning facilities for street animals. Regular check-ups of those unwell by a team of veterinary specialists are carried out. The surroundings are animal-friendly as well. They are not being ruthlessly kept in cages. They have green surroundings with enough space for them to play and nurture. Animal

Care Home is doing an amazing job by understanding and fulfilling the needs of those who can't speak for themselves. The experience was an overwhelming one.

LITERATURE

5. i. The author wishes to highlight the idea that mothers are always right and that we should accept what is natural. The wizard also sees the point and tamely changes the Skunk's rose smell into his natural Skunk smell.
 - ii. Gandhiji's conflict was of discharging his duties. On one hand, he did not want to set a bad example by breaking the law, on the other hand, he was to listen to the voice of his conscience and serve the human beings.
 - iii. It was the night time and the peddler couldn't imagine that he would be welcomed anywhere. But when he was provided food and shelter and treated like a guest at the crofter's house, he was surprised. The crofter was a lonely man and he needed company.
 - iv. Aunt Jennifer's tigers are brave, fearless and chivalric. They live in the green forests freely and gracefully and are known for their strength, boldness and power.
 - v. Mr. Lamb had a garden in which there were trees and plants of apples, pears, weeds and flowers. He used to sit in his garden and talk to those who came into his garden. He used to make toffees with honey.
 - vi. People celebrate the grand deeds and achievements of the mighty dead. Grandeur is associated with them because their achievements make their lives extraordinary. It becomes a source of an inspiration for the living to leave a legacy to be venerated after they are long gone.
6. i. In the poem, 'A Thing of Beauty', beautiful and pleasant things have been referred to as flowery bands. It is only those things which have beauty of some or the other kind that bind us to this Earth, or in a way, keep us going. The memory of our beautiful experiences helps us strengthen our bond with the Earth. The message that these lines convey is that the world is full of sorrow, sadness and depression. People have become selfish, and there is a scarcity of noble people.
- Despite this, life is possible because there are some beautiful things around, which help us to look towards the positive side of life. It is the beauty of these things which brings a smile on our face and gives us happiness in our lives. Today, there are few people who can rise above petty differences and be generous towards others. These days people are mostly selfish and do not think about others. The unhealthy and o'er-darkened ways refer to the trials and tribulations in our life, and the dishonest and unfair means people adopt to achieve their goals.
- ii. Most of the arable land in Champaran district was divided into large estates owned by Englishmen and worked by Indian tenants. The chief commercial crop was indigo. The landlords compelled all tenants to plant 15 percent of their holdings with indigo and surrender the entire indigo harvest as rent. This was done by long term contract. Meanwhile the landlords learned that Germany had developed synthetic indigo. Therefore, they obtained agreements from the share croppers to pay them compensation for being released from the 15 per cent arrangement. This system irked the peasants. When the information of synthetic indigo reached the ears of illiterate peasants who had signed the share cropping arrangement, they wanted their money back. A long battle under the leadership of Gandhiji was ensued and landlords agreed to return 25 percent of the compensation to the peasants. This way share cropping system came to an end.
 - iii. The answer-sheet had been cleverly attached to the last page of the question paper by Evans to outwit his adversaries and mislead the police. It was from his answer-sheet that the police got the clue that Evans had hit McLeery whom Evans was himself impersonating. McLeery showed a photocopied sheet to the Governor which had been cleverly superimposed on the last page of the German question paper. The six-figure reference landed him in the middle of Chipping Norton. The Governor decoded it for Newsbury and by putting together the six-figure reference, the index and centre number 313/271 and with the help of the 'Ordinance Survey Map of Oxfordshire' he was able to locate Evans in the middle of Chipping Norton. The correction slip provided him with the name of the hotel, 'The Golden Lion' where Evans was staying. So, Evans was trampled in his own game as he left evidences which helped in his arrest. He made things easier as he left the question paper behind in the cell. The clues the Governor got from it were sufficient to help him trace Evans.

Sample Paper 4

READING

1. i. Children appear to have innate grammatical machinery in their brains, which springs to life when they are first trying to make sense of the world around them. Their minds can serve to create logical, complex structures, even when there is no grammar present for them to copy.
- ii. Languages in their early stages, like Pidgin, have little in the way of grammar, and in many cases, it is difficult for a listener to deduce when an event happened, and who did what to whom. Speakers need to use circumlocution in order to make their meaning understood.
- iii. The writer mentions looking at Atlantic slave trade for a better understanding of languages because it is the most recent and well documented form of linguistic study in how grammar is created.
- iv. He had lost everything he earned in his business, however, he bounced back and started from scratch to build his business again.
 - v. The Cherokee pronoun system can distinguish between 'you and I', 'several other people and I' and 'you, another person and I'. In English, all these meanings are summed up in the one, crude pronoun 'We'.
 - vi. Many historical linguists are able to trace modern complex languages back to earlier languages, but in order to answer the question of how complex languages are actually formed, the researcher needs to observe how languages started from scratch.
 - vii. They were moving in their new apartment so all their sleeping arrangements were make-shift by the time their furniture arrived.
 - viii. All languages have clever grammatical components. By changing word sequences and by adding a range of auxiliary verbs and suffixes, we are able to communicate tiny variations in meaning. We can turn a statement into a question, state whether an action has taken place or is soon to take place, and perform many other word tricks to convey subtle differences in meaning.
 - ix. We use different terms to express ourselves today compared to how our grandparents spoke. Pidgin became a complex language when a group of children were exposed to it at the time when they were learning their mother tongue. Slave children did not simply copy the strings of words uttered by their elders; they adapted their words to create a new, expressive language. This suggests that the language we speak is constantly changing with generations.
2. i. Wester meant that, despite being far more populous, the HKH region had received less attention than other places, such as low-lying island states and the Arctic, that are also highly vulnerable to global warming.
 - ii. If the Carbon emissions aren't cut globally, then by 2100, the global average surface warming might rise to 4.5°C and in HKH region it might be up to 5.6°C, resulting in the loss of two-thirds of its ice coverage.
 - iii. The HKH region runs from Afghanistan to Myanmar and harbours more ice than anywhere outside Arctic and Antarctica, thus aptly being named as the 'third pole' of the planet.
 - iv. The glaciers are a critical water store for the 250 million people who live in the Hindu Kush-Himalaya region.
 - v. The impact of climate change is so severe that if all the carbon emissions are cut globally, we will lose one-third of the glaciers by 2100 and be in trouble due to rising global temperatures.
 - vi. The farmers rely on predictable water supplies to grow the crops that feed the nations in the mountains' shadows. But the changes to spring melting already appear to be causing the pre-monsoon river flow to fall just when farmers are planting their crops. One-in-100-year floods are starting to happen every 50 years.
 - vii. Peer reviewing indicates that the report, that more than 200 scientists worked on for over five years, was validated by a panel of 125 experts.

WRITING

3.

YOU ARE INVITED

The students and staff of APS school, Nagpur
feel proud in giving a farewell party
to our honourable principal after 38 years of service

Mr. Ajeet Kumar Singh

On
Wednesday

Venue: School auditorium
Time: 4:00 p.m.

With Best Compliment from:
The students and staff.

4.A. 12-A, Ramanujan Road

Chennai

13th May, 20XX

The HR Manager

Compro Software

Bangalore

Subject: Application for the post of computer engineer trainees

Dear Sir,

In response to your advertisement in The Times of India dated 11th May 20XX, I wish to be considered for the position mentioned above. I feel my qualifications and experience are good enough to enable me to discharge my duties. I attach herewith attested copies of my certificates and my bio-data. If given a chance, I assure you that I would contribute my best to the work for your company. For reference, I am enclosing my resume as under.

Thanking you,

Yours sincerely,

Deepak/Deepika

RESUME

Name	: Deepak/Deepika
Father's Name	: K.M. Mathur
Date of Birth	: 31st August, 1998
Address	: 12-A, Ramanujam Road, Chennai-XXXXXX Phone- 98XXXXXXXX
E-Mail Address	: dep123@gmail.com
Marital Status	: Unmarried
Nationality	: Indian
Educational Qualifications	: (i) B. Tech. Computer Engineering, Chennai (ii) Bachelor of Computer Application, Chennai
Experience	: Fresher
Strengths	: Proficiency in Mathematics, analytical and critical thinking
Languages	: Good command over spoken and written Hindi & English.
Hobbies	: Reading and Writing Poems
References	: 1. Rohan Kamath, Sales Head, Phoenix Ltd. Pune, Ph.-XXXXXXXXXX 2. Aniket Sharma, Professor, Delhi. Ph.- XXXXXXXXXXX

OR

4.B.

Janmashtami Celebration

By Krishna/Kavita

27th August, 20XX, Delhi: The great Hindu festival of Janmashtami celebrates the birth (Janm) of Lord Krishna on the eighth day of the dark fortnight of the month of Bhadrapada. The number eight has another significance in the Krishna legend in that he is the eighth child of his mother Devaki.

Like last year, Janmashtami was celebrated with great devotion and enthusiasm at Sunshine Helios on 24th August this year. On this occasion, the society temple was decorated with flowers and lights. Idol of Balgopal was kept in a cradle inside the temple and nicely decorated. Devotees, young and old, visited the temple and offered prayers. Needless to say, all of them did the ritual of swinging beloved Balgopal and sought his blessings. A stage was set up in front of the temple for cultural programs. The dance programs by children as well as adults were really outstanding with dancers dancing to the tune of songs depicting stories of Radha and Krishna. The program ended with singing of bhajans by senior citizens.

LITERATURE

5. i. No one should be denied the right to education. If the criminals in prison are provided with education and work-skills, their life can turn towards a bright and crime-free future. Education can help them become responsible citizens; therefore, efforts should be put in to provide opportunity of learning and education even to the criminals in prisons.
 - ii. When the peasants of Champaran came to know that a Mahatma had come to help them, they gathered in Motihari in large numbers. Thousands of peasants held a demonstration around the courthouse where Gandhiji was supposed to appear. The crowd was so uncontrollable that the officials felt powerless to regulate the crowd.
 - iii. Mr. Lamb told Derry that there are plenty of things to stare at and the people should not mind their disability because they will be soon tired of it. He further told Derry that beauty or ugliness depends upon an individual's perception. One might see beauty in a thing but to another it might be a beast.
 - iv. Lambs and sheep are envisioned as the embodiments of innocent and serene beauty. Jesus Christ, as an apostle of peace, was a shepherd and was seen surrounded by his flock of sheep, his followers. The poet has made specific reference to the sheep as symbols of 'divine beauty'.
 - v. The expression is symbolic of male authority and power. Matrimony bounds the woman physically as well as mentally. Likewise, Aunt Jennifer was trapped in gender oppression and felt herself burdened by the authority of her husband.
 - vi. The world is like a rattrap because we get attracted by the luxuries of the worst pleasures and once it happens, we are entrapped by them and forget the acts of kindness. We ought to help each other but we don't. We ignore the plight of the ones in need. The peddler makes a much deeper comment on the life and he himself realises it only when he appreciates the kindness shown to him by Edla.
6. i. Jo was not convinced with the ending of the story and wanted another end. She coaxed her father to retell the story the next day giving the story a predetermined path that she had set. Jo refused to accept the end where Roger Skunk's mother hits the wizard and that too without being hit back. On the other hand, Jack, her father, defended mother's decision on how their children should be like. Jo wanted the story to end on a note where the old Wizard takes revenge on the mother and hit Mommy Skunk hard on her head and refuse to get Roger back to his original smell. She wanted this to happen because she could not see Roger Skunk being left alone by his friends. According to her, Roger was perfect in smelling like roses and that his friends won't run away from him anymore. She didn't understand the purpose behind Mommy Skunk's eagerness to get her little roger back to smelling foul.
 - ii. In the poem "Aunt Jennifer's Tigers", the poet Adrienne Rich, narrates the tale of an old woman, Aunt Jennifer. She is a typical housewife who feels weighed down by her marriage. She is embroidering tigers on a frame. Aunt Jennifer has suffered all her life because of male-dominance. The tigers she is embroidering are in fact symbol of her husband. They can also be seen as a symbol of a woman's creative energy. The women give birth to men and the same men tyrannise women when they grow up. The poet

says that Aunt is crushed due to male chauvinism and it appears she won't be free from the bondage of her household chores, remaining subservient to her husband, even after her death

- iii. Mr. Lamb gave confidence and courage to Derry. He made Derry understand that the world is full of good and bad things and he should learn to accept both. He suggested Derry to get over his physical impairment instead of brooding over his burnt face. He told him that he still had two hands, two legs, eyes, a tongue and a brain. Thus, Mr. Lamb helped Derry to transform. Derry would change even after Mr. Lamb's death because by that time his attitude towards life had already changed. Before meeting Mr. Lamb, Derry used to remain dejected and had negative thoughts. He was always worried about his face and how people commented on the scar on his face. But after meeting Mr. Lamb, he developed positive thoughts and not cared about what people thought about him and his face. This is evident when he ran back to Mr. Lamb and didn't listen to the negative thoughts of his mother. He wanted to grab the opportunities that the world had to offer him and wanted to be in the company of Mr. Lamb. This is contradicting from the act that earlier, he used to seclude himself and never come close to a stranger.

Sample Paper 5

READING

1. i. Voltaire was a visionary who was very much willing to step into an advanced tomorrow, by shunning the archaic feudalism of French Aristocracy.
- ii. Émilie was a great mathematician, a real investigator of the physical world which was very unlikely for an 18th Century woman. Such traits were generally associated with men at that time. Thus, Voltaire thought of her as a tomboy.
- iii. Newton's prediction of the trajectory impressed Voltaire, how the planets moved exactly the way his laws predicted. When he returned to Paris, he pushed Newton's new vision into his philosophy as well.
- iv. Our school decided to host a themed farewell party which was a breath of fresh air.
- v. Émilie had the potential of being the greatest scientist of her time but was confined because of her gender. Her approach to law of conservation of mass was correct, only it was her laboratory equipment that were not accurate.
- vi. Willem Jacob's Gravesande, Lavoisier and Michael Faraday all applied Émilie's discoveries in their works.
- vii. Émilie took time and was very methodical in substantiating her calculations. A huge portion of her works was left unnoticed which made Voltaire feel like she was wasting her time.
- viii. We successfully achieved communal harmony by finding an endearing common ground that bridged the gap between the groups.
- ix. Voltaire's quote hinted at a break with old tradition and his attack on the Catholic Church by promoting the progress of science and scientific temper.
2. i. According to the UNICEF, there are about 10.1 million children employed in child labour in India today. That amounts to approximately 13% of Indian workforce.
- ii. The term 'chotu' has become so ubiquitous while referring to all forms of child labour, that it has been normalised and has become an internalised personality trait of the larger Indian society.
- iii. Construction sector is the lowest child employer as of 2011.
- iv. India ratified the Convention on the Rights of the Child (CRC), in 1992 and made the offence punishable with imprisonment from three months to one year or with fine no less than 10,000–20,000 rupees or with both.
- v. The percentage of children under 14 employed within service sector from 2001-2011 went from 11.4% to 29.9% which has only accelerated because of the exploitative practices and demand of cheap labour.
- vi. The Child Labour (Prohibition and Regulation) Act of 1986 prevents the employment of children below the age of 14 years in life-threatening occupations.
- vii. The word prepubescent describes a child who hasn't gone through the biological phase of maturity.

WRITING

3.

<p>MEDICAL SEMINAR</p> <p>We take immense pleasure in inviting all the members of</p> <p>PUNJAB MEDICAL DOCTOR'S ASSOCIATION</p> <p>to a talk on</p> <p>CANCER</p> <p>on 30th November, 20XX at 10:00 a.m.</p> <p>at</p> <p>Flex Convention Centre, Chandigarh</p> <p>Guest Speaker: Dr. Shekhar Chawla (HOD Medicine, PGI Chandigarh)</p> <p>Secretary 12-A, Sodhi Colony, Chandigarh Ph: XXXXXXXXXXX</p>

4.A. 33, Pratap Enclave
Udaipur

10th March, 20XX

The Manager
Freshers Pvt. Ltd.
Chennai

Subject: Application for the post of an accountant

Sir,

In response to your advertisement in The Times of India, dated February 28, 20XX for the post of an accountant, I wish to offer my candidature for the same.

I would like to bring to notice that I possess all the aforementioned qualities required for the job. I am enclosing a copy of my resume for your kind consideration.

I am available for the interview on any day of your convenience. If I am given a chance to serve you, I assure you that I shall work with utmost sincerity and dedication up to your satisfaction.

Thanking you,

Yours faithfully,
Rajan/Rajni

Encl.: (i) Bio-data (ii) Testimonials

BIO-DATA	
Name	: Rajan/Rajni
Father's Name	: Mr. Ramesh Kumar
Date of Birth	: 21st April, 1991
Address	: 33, Pratap Enclave, Udaipur -XXXXXX : Phone- 98XXXXXXXX
E-Mail Address	: raj123@gmail.com
Marital Status	: Unmarried

Age	: 28 years
Nationality	: Indian
Educational Qualifications	: (i) B. Com. Rajasthan University (ii) M. Com. Rajasthan University (iii) C.A. Institute of Chartered Accountants, Delhi
Experience	: 4 years as Senior Account Officer in Nayan, Udaipur
Strengths	: Good communication skills, computer literate
Languages	: Good command over spoken and written Hindi & English.
Hobbies	: Reading and Sketching
References	: 1. Mr. Sumit Sahn, AGM, Aerospace, Hyderabad Ph-XXXXXXXXXX : 2. Mr. Satish Singh Head of Department, Commerce, Jodhpur University Ph- XXXXXXXXXXX

OR

4.B. TPS School Showcases Skills at Computer Fest

By Sanjay/Sanjana

TPS School, Kanpur, hosted its 10th annual computer festival titled Ordin @ trix13.0. The computer department and the Pyrotech club of the school organised seven events on the theme 'Diversity' ranging from animation in scratch to video editing and movie making to website designing. About 35 schools from Kanpur and nearby places took part in the festival. The young techies were provided a platform to express, collaborate, showcase, learn and create in the field of movie making, photography, programming and quizzing. CADx Tools and Technologies Pvt. Ltd. collaborated for the event Innovative @ trix-Ideation. The event Adobe Spark was cloud-based and required collaboration. The Photography Club partnered with Ordin@trix to host a photography event. The judges were Mohit Malik and Shivendra. The judges for events in the different categories were Komal and Mrinal Roy, founders, CHINH India, Priyansh and Aryan from CADx Tools and Technologies Pvt. Ltd. and Innovation Hub respectively. The co-sponsors were CADx Tools and Technologies. Somayya School bagged the Overall Winner's trophy. It was a fantastic event which showcased the talents of future tech savvy generation and everyone's zeal was to be remembered. In the end, the Principal, Mrs. Kavita Krishna, congratulated the winner school and wished all the best to rest of the children.

LITERATURE

5. i. The things of beauty mentioned in Keats' poem are the sun, the moon, the trees, the innocence of the sheep, the blossoming of the daffodils in the meadows, the musk roses blooming, the mass of ferns and clear mountains.
- ii. The tigers that Aunt Jennifer creates are her ways of expressing pain through art and the way she wanted her life to be. The tigers represent fearlessness and power. They walk with elegance, grace and confidence. But in reality, she leads her life on her husband's terms without opposing to any restrictions laid on her.
- iii. Edla was happy to see the gift left by the peddler as he had valued her faith in him. Edla had retained him in her house even after knowing his actual identity and he, in turn displayed his hidden goodness of heart that had been stirred and he had been able to overcome the bait of the rattrap.
- iv. The chief commercial crop in the Champaran district was indigo. The arable land was divided into estates which were owned by Englishmen and their Indian tenants worked on them as farmers. The landlords compelled all tenants to plant 15 per cent of their holdings with indigo and surrender the entire indigo harvest as rent.
- v. The other stories narrated by Jack would end with the protagonist, who was some animal named Roger taking the help of the Wizard to solve his problem. However, the Skunk's story ended on a different note, where Roger's mother took him back to the Wizard and got his smell changed again. Thus, in this regard the Skunk's story was different from the other stories narrated by Jack.

vi. It was one of Evans' friends who made the call from the Examination Board. This call was primarily meant for confirming the time of the commencement of examination in order to calculate the end of the examination. The equally important reason behind this call was to misguide the Governor into Hotel Golden Lion to arrest Evans from there and thereby to make the escape safer altogether.

6. i. One dark evening the peddler reached a little gray cottage by the roadside. He knocked on the door to ask shelter for the night. The owner, an old man without wife or child, welcomed him. He was happy to get someone to talk to in his loneliness. He served him hot porridge for supper and gave him tobacco for his pipe. Then he played cards with him till bed time.

The host told the peddler that in his days of prosperity, he worked on land at Ramsjo Ironworks. Now his cow supported him. He sold her milk at the creamery every day. He showed the peddler the thirty kronor notes he got as payment that month. Then he hung the leather pouch on a nail in the window frame. Next morning the crofter went to milk the cow, and the peddler went away. However, he returned after half an hour, broke the window pane, took the money out of the leather pouch and hang it back on the nail. This episode shows that in loneliness, human beings crave for company, for social bonding. Secondly, temptations can overpower the greatest philosopher. The peddler who calls the world a rattrap is himself tempted by thirty kronor.

ii. Reverend Stuart McLeery was a person appointed by the prison authorities to invigilate the examination conducted for Evans. McLeery left his bachelor flat in Broad Street at 8:45 in the morning and stepped out briskly towards Carfax. As the weatherman reported temperatures below the normal for early June, he carried a long black overcoat and a shallow crowned clerical hat. In his right hand, he was carrying a small brown suitcase, which contained all that he would need for his morning duties including a sealed question paper envelope, a yellow invigilation form, a special authentication card from the Examinations Board, a paper knife, a Bible which he was to speak to the Women's Guild that afternoon on the Book of Ruth and a current copy of 'The Church Times'. He also carried a ring on which he was going to sit on the chair as he was suffering from piles.

No, the person who reached the prison was not real McLeery who was to invigilate. He was bound and gagged in his flat and a friend of Evans replaced him as the invigilator.

iii. Derry, a distraught lad of fourteen, was a victim of inferiority complex which was borne out of misconception of himself and the world. He suffered from a severe sense of self-hatred and dismissal due to his burnt face and this led him to total isolation. Mr. Lamb too had a disability. He had a tin leg but he never permitted his handicap to hinder his peace and pleasures of his life.

Mr. Lamb's meeting with Derry brought a turning point in the latter's life. He gave Derry confidence and influenced him to develop a positive attitude towards life. His message to Derry was very clear that alienation and withdrawal was not the solution. Derry believed in running away from people but Mr. Lamb lived among people. Derry's brief association with Mr. Lamb proved to be quite gratifying. Mr. Lamb taught him a new outlook of looking at life, people and things. Derry decided never to get back to his old habit of seclusion.





Physical Education

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Blueprint of the Sample Question Paper

S. No.	Chapter Name	Marks		
		2	3	4
1	Yoga & Lifestyle	✓		
2	Training in Sports	✓		
3	Psychology & Sports	✓		
4	Physical Education & Sports for CWSN (Children With Special Needs - Divyang)	✓		
5	Physiology & Injuries in Sports	✓		
6	Training in Sports	✓		
7	Physical Education & Sports for CWSN (Children With Special Needs - Divyang)	✓		
8	Physiology & Injuries in Sports	✓		
9	Physical Education & Sports for CWSN (Children With Special Needs - Divyang)	✓		
10	Psychology & Sports		✓	
11	Physical Education & Sports for CWSN (Children With Special Needs - Divyang)		✓	
12	Physiology & Injuries in Sports		✓	
13	Yoga & Lifestyle		✓	
14	Training in Sports		✓	
15	Psychology & Sports			✓
16	Training in Sports			✓
17	Training in Sports			✓
18	Yoga & Lifestyle			✓



Sample Question Paper

PHYSICAL EDUCATION [Code (048)]

Term - II

Time : 2 Hrs.

Max. Marks : 35

General Instructions :

1. There are three sections in the Question paper namely Section A, Section B and Section C.
2. Section A consists of 9 questions amongst which 7 questions have to be attempted. Each question carries 2 marks and should have 30-50 words.
3. Section B consists of 5 questions amongst which 3 questions have to be attempted. Each question carries 3 marks and should have 80-100 words.
4. Section C consists of 4 questions amongst which 3 questions have to be attempted. Each question carries 4 marks and should have 100-150 words.

SECTION A

1. Explain any two benefits of ardha matsyendrasana. [1 + 1]

Ans. Benefits of Ardha Matsyendrasana are:

- (i) It loses extra fat and makes the body beautiful and strong.
- (ii) It stimulates the liver, spleen and pancreas.
- (iii) It is beneficial for the respiratory system.
- (iv) It strengthens the spinal column and back muscles.
- (v) It glorifies the face and keeps the menstrual cycle in women in control.
- (vi) It rejuvenates the nerves around.
- (vii) It heals back pain, stress, and headache.
- (viii) It is helpful for people suffering from diabetes.

2. Define explosive strength with help of example. [1 + 1]

Ans. Explosive strength is the ability to overcome resistance with high speed. It is used in take-off jumping events like long jump, high jump, triple jump, jumping in volleyball for smashing or spiking, jumping for rebound in basketball.

3. Define personality and motivation. [1 + 1]

Ans. Personality :

- (i) According to Begge and Hunt, "Personality refers to the whole behavioral pattern of an individual to the totality of its characteristics."
- (ii) According to Velentine, "Personality is the sum-total of inherited and acquired abilities."
- (iii) According to Guild Ford, "Personality is an individual's unique pattern of traits."
- (iv) According to Sigmund Freud, "Personality is an individual's unique thought, feeling and behavior that persist over time and different situations."
- (v) According to Young, "Personality is the totality of behavior of an individual with a given tendency system interacting with a sequence of situations."
- (vi) According to R.B. Cattell, "Personality is that which permits a prediction of what a person will do in a given situation."
- (v) On the basis of these definitions, a brief definition would be that, "Personality is the sum total of inner and outer capabilities of an individual."

Motivation :

- (i) According to Sage, *“The drive to strive is called motivation.”*
- (ii) According to Crooks and Stein, *“Any condition that might energize and direct our actions is called motivation.”*
- (ii) According to Morgan and King, *“Motivation refers to a state within a person or animal that drives behavior towards some goal.”*
- (iii) According to P.T. Yong, *“Motivation is the process of arousing , action, sustaining the activities in progress, and regulating the patterns of activity.”*
- (iv) According to Johnson, *“Motivation is the influence of a general pattern of activities indicating and directing the behavior of the organism.”*

4. Write the full form of SPD and ASD. [1 + 1]

Ans. Sensory Processing Disorder (SPD)
Autism Spectrum Disorder (ASD)

5. List any four changes happening in the muscular system due to exercising. [0.5 × 4]

Ans. Changes happening in the muscular system due to exercising are:

- (i) **Change in Size and Shape of Muscle:** Regular exercise helps in enlarging cells of muscles which in turn helps in changing size and shape of muscles.
- (ii) **Increase in the Strength of Muscles:** A person who does exercise daily has stronger muscles and such muscles work more. These become stronger by getting more nutritious food in the form of oxygen.
- (iii) **Increase in Coordination:** Regular exercise increases coordination in the muscles. These become stronger by doing exercise. As a result a person does not feel fatigue even by working for a long time. If the muscles do not have co-ordination or have incomplete co-ordination then the working becomes impossible.
- (iv) **Entrance of Greater Quantity of Oxygen in the Body:** Muscles have to do more work during exercise. The consumption of oxygen increases in the person who exercises. Thus blood reaches quickly in the muscles.
- (v) **Increase in Supply of Blood:** Muscles get chemical substances like glycogenephoscoratine, potassium etc. by doing regular exercise. These chemical substances increase the flow of blood.
- (vi) **Proper Blood Circulation:** During rest, the blood completes a round of the body in 21 seconds, but it completes the round in just 15, 10 or 8 seconds while exercising. The heart muscles work faster during exercise.
- (vii) **Effects on Bones and Joints:** By doing exercise our bones become hard and they can work for more time. It also has effects on our joints. Thus the bones and muscles become strong by doing exercise. Children’s bones happen to be very soft and fragile. Activities of muscles affect these a lot. By the lack of these the bones remain soft and deformity takes place in them.
- (viii) **Effective Respiration:** Regular exercise increases the capacity of chest muscles. As a result, the respiratory system gets effective.
- (ix) **Increase in the Resistance Power of Body:** Regular exercise develops the lungs in an equal way. By this the volume of lungs starts increasing. Thus develops the chest skeleton and by doing exercise the condition of breathing improves. Thus, as a result of this improved breathing capacity the resistance capacity of the body increases.

6. What is the meaning of the Isotonic method and it is used for developing which ability? [1 + 1]

Ans. **Isotonic Method:** Isotonic exercises were introduced by De Lorene in 1954. This term comes from the Greek word ‘iso’ which means ‘same or equal’ maintaining equal (muscle) tone or ‘tension’. In this one muscle group contracts while the opposite relaxes during which the muscle changes its length. These are those exercises in which direct movements are visible to the 3rd person. In this case, personal muscular efforts are evidenced by visible movements. In isotonic exercises rapid movements are accomplished by reflex alteration of contraction and relaxation of antagonistic flexors and extensors of the joints concerned. Type of contraction where we notice the movements of objects is called isotonic contraction e.g. doing exercise with light weight or dumbbells etc. Most of the exercises fall under this category. Isotonic method is used to develop strength.

7. Mention any two symptoms and causes of ADHD.

Ans. Symptoms and causes of ADHD are:

Symptoms of ADHD in children are:

- (i) They could not perform daily life activities.
- (ii) They tend to forget routine work.
- (iii) They indulge in daydreaming.
- (iv) They do not like performing activities that require sitting still.
- (v) They get easily distracted.
- (vi) They are weak in sports activities.
- (vii) They do not take rest and usually roam around.
- (viii) They could not have any control on their emotions.
- (ix) They lack concentration and work carelessly.

Symptoms in adults are:

- (i) They always remain worried.
- (ii) They remain impulsive.
- (iii) They have an inferiority complex.
- (iv) They are always disorganized.
- (v) They easily get irritated.
- (vi) They find difficulty in remembering things.
- (vii) Mood swings and depression are common in such adults.
- (viii) They cannot control their anger.
- (ix) They have problems with concentration.

Causes of ADHD are:

- (i) **Heredity:** If any parent is suffering from ADHD, there remains a high probability of occurrence of this disorder in their children.
- (ii) **Premature Birth:** If a child is delivered prematurely the nervous system is not fully developed which increases chances of occurrence of ADHD.
- (iii) **Less Efficiency of Brain and Deformity:** If there is deformity of brain shape that causes neural-imbalance which can cause ADHD.
- (iv) **Less Birth Body Weight:** If a child on birth has less body weight, ADHD, disorder remains a possibility.
- (v) **Consumption of Alcohol and Drugs:** Consumption of alcohol and drugs always adversely affects our brain cells and nervous system.
- (vi) **Exposure to Toxic Substance:** Exposure to some toxic substance like lead can cause ADHD.
- (vi) **Diet:** Few researches have proved that a particular type of food substance plays a role in causing ADHD.

8. What is Laceration and how can it be managed?

[1 + 1]

Ans. A laceration is an injury that results in an irregular break in the skin, more commonly referred to as a cut, but defined as a torn and ragged wound. Lacerations are caused when an object strikes the skin and causes a wound to open. Depending on a variety of characteristics (angle, force, depth, object), some lacerations can be more serious than others, reaching as far as deep tissue and leading to serious bleeding. The predominant symptoms of lacerations are mild to serious breaking of the epidermis, tears in the first layer of skin that can range from small slices to deep gashes. Depending on the depth of the laceration, there can be bleeding of different levels of severity. Mild lacerations may experience less bleeding accompanied by mild pain. Deeper lacerations will experience greater bleeding and more intense pain.

Treatment of laceration can be done through following steps:

- (i) Stop bleeding at the earliest by compression or by pressing.
- (ii) Clean the surface of the affected part using water and soap.
- (iii) Cover the affected part with medicinal cotton bandage or apply band aid.

- (iv) Repeat dressing or padding over the wound. If bleeding continues then apply further pads or dressing.
- (v) Apply ice or cold for compression.
- (vi) If injury is deep go for stitches at the earliest.

9. List down any two strategies to make physical activities accessible for CWSN. [1 + 1]

Ans. Strategies to make physical activities accessible for CWSN are:

- (i) **Interest:** Physical activities must be based on interest, ability and limitation of children with special needs to ensure maximum participation.
- (ii) **Ability:** The physical and mental state of children with special needs shall be considered.
- (iii) **Medical Check-up:** First, it is mandatory to have a medical check-up of all children with special needs. This is because without that we cannot know about the disability the child is having.
- (iv) **Pre-experiences:** Before deciding physical strategies, we shall know the children with their past experiences and convince them.
- (v) **Equipment:** The equipment used should be according to capability and level of children. It may vary in size, shape, colour and weight.
- (vi) **Specific Environment:** A healthy and democratic environment shall be created so that CWSN can perform freely.
- (vii) **Modified Rules:** According to CWSN, the rules shall be diluted and modified according to their nature of disability.
- (viii) **Easy to Difficult:** The exercise shall be in progression from easy to difficult.
- (ix) **Use of All Body Parts:** Physical strategies shall involve whole body parts and ensure whole body movement.
- (x) **Extra Care of Concern:** While deciding upon physical strategies for CWSN, extra care and concern shall be given like extra time, and to avoid stress light music.

SECTION B

10. List down and briefly explain any four techniques of motivation. [1 + (0.5 × 4)]

Ans. Techniques of motivation are:

- (i) **Goal Setting:** Goal setting is one of the most powerful techniques of motivation. The athlete should be very specific and clear about his goal. In other words, an athlete should be very clear what he has to do, how, and why. If these three things are clear in the mind of the athlete then there will be no problem in motivation and one will do the things accordingly. One should be prepared mentally to do the activity and work to achieve the goal. The goal should not be impossible to achieve, it should be in the reach of the individual. One should know the advantages of attaining the goal.
- (ii) **Reinforcement:** Reinforcement is the use of rewards and punishments that will work to either encourage a certain action or decrease it in the future. There are two ways of using reinforcement – a positive and a negative approach. The positive approach focuses on reward for appropriate behaviour this increases the likelihood of this behaviour happening again. The negative approach focuses on punishing undesirable behaviours and should lead to decrease of these behaviours in the future. Most coaches and instructors combine positive and negative approaches.
- (iii) **Knowledge of Progress:** The athlete should know fully about himself, his capacity, quality, behaviour, etc. Periodic positive results act as a strong motivational force. One should be made aware about his progress from time to time. Knowledge of progress is must because progress is also a reward in itself.
- (iv) **Rewards:** They can be effective for further progress and to achieve goal. This can be very effective to motivate the players. Various rewards and cash prizes act as a strong motivational force to perform.
- (v) **Jobs:** Outstanding sports persons can be offered good jobs according to their achievement and educational qualifications. There are various departments which provide jobs to good sports persons i.e. Police departments in various states, Indian railways, Banks, Air India, etc.

- (vi) **Social Awards:** The Government of India every year announces awards for outstanding sports persons who bring laurels for the country in various games and sports. They are honored with Arjuna Awards, Padma Shri, Rajiv Gandhi Khel Ratna Award, Dronacharya Award, Major Dhyan Chand Award, Padma Bhushan etc. Some special awards are also given for international achievements.
- (vii) **Positive Talks:** Positive talk by the teachers or coaches is one of the best methods to motivate an individual. It can help the athlete to change his thinking and behaviour. It is most important even for players and athletes at international level. At lower stages it works as a most successful tool for motivation.
- (viii) **To Provide Best Quality Equipment:** The players and athletes should be provided the best possible equipment, which will help the athlete to avoid sports injuries, best and easy practice without any tension in mind. Good quality equipment urges the participants to participate in the activity whereas old and sub-standard equipment may turn off the interest of the individual.

11. Explain cognitive disability along with its symptoms. [1 + 2]

Ans. Cognitive Disability: This disorder comes in the mental disorder category. Due to cognitive disorder, a person’s ability to learn, speak, memorize, and problem solving skills are disrupted. Due to cognitive disorder, the person suffers from dementia, and delirium disease. In addition, it adversely affects the memorizing power and reasoning power.

Symptoms of cognitive disability are:

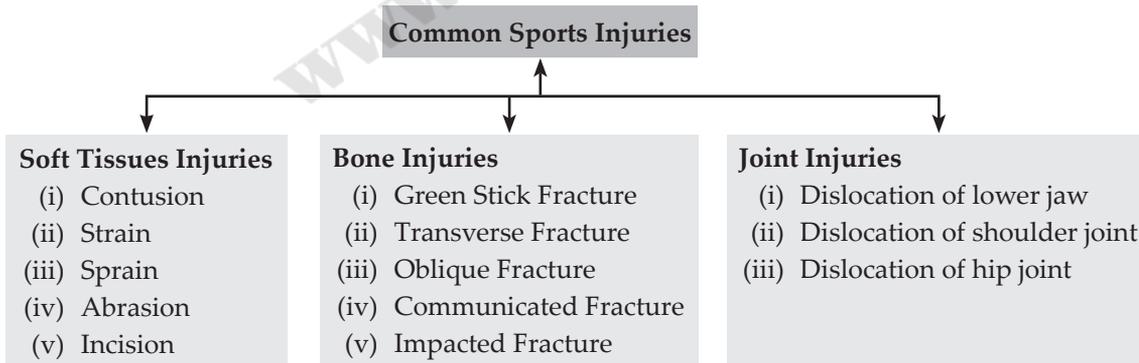
- (i) **Memory Disorder:** The person who has a problem in listening and then recalling things.
- (ii) **Hyper Activity:** The person tends to hyper during sitting, standing phase. The person remains in undue hurry.
- (iii) **Dyslexia:** The person who faces problems in reading, writing and memorizing.

Cause of Cognitive Disability are:

Cognitive disability normally occurs due to problems of the brain like tumour, head injury, shock, infection, harmful brain neurotoxins, heredity or any other brain related disease. It affects a person’s memorizing power, learning skills and ability to do routine activities like, in case of tumour or head injury on part of the brain which controls speech control, can affect the speaking skills of that person. In same way, if brain tumour or head injury on that part of the brain which can hamper the physical movement or delving other physical activities.

12. Create a flowchart to explain classification of sports injuries. [1 + 1 + 1]

Ans.



13. List down any three asanas used for preventing Asthma and write two benefits of each. [1 + 2]

Ans. Asthma disease is associated with the swelling of respiratory tracts, which makes the tracts very sensitive and makes this process pungent with the touch of any effective things. These reactions cause contractions in the tubes, this reduces the amount of air in the lungs due to which it becomes difficult to breathe. Common symptoms of asthma are coughing, heavy breathing, chest tightness, fatigue, pain in hands, feet, shoulders and back. Reasons are dust, smoke, pollen grains, animal skin, hair and feather etc. Asthma can be controlled by Matsyasana, Gomukhasana etc.

- (i) **Matsyasana:** This asana is performed in water body, hence it is called as Matsyasana.

Pre-Stage: Sit in Padmasana pose.

Method:

- Take support of your elbow and lie on your back, bend your neck with support of your hands and try to touch your head to the ground.
- Hold toes of the feet firmly with both hands and touch ground with the elbows.
- Stretch the stomach as up as possible.

Benefits:

- This asana is very useful for asthma patient, it provides relief from indigestion and other digestive problems, keeps the blood clean.
- Helps in cough and respiratory problems. It makes body and face attractive by bringing natural glow on it.

Contraindications:

- Abnormal blood pressure:** Individuals suffering from high or low blood pressure should avoid this posture.
 - Neck injury:** Neck injuries or injuries in any part of the lower back or middle back can make it difficult to practice this Fish pose and hence should be avoided.
- (ii) **Gomukhasana:** This asana gets its name because while doing this asana, body resembles a cow face pose.

Pre-stage: Sit in Sukhasana pose.

Method:

- Sit in sukhasana pose.
- Place the ankle of left leg near the right butt.
- Place the right leg over the left thigh, so that knees should place over each other.
- Sweep your left hand behind your back, facing palms upwards.
- Now interlock fingers of both hands behind your back.
- Stretch both the hands in their respective direction, look straight.
- Repeat with changing leg position.

Benefits: Helps in curing Asthma, reduces weight, makes body flexible.

Contraindications:

- People with very stiff shoulder may have to take it slow and easy.
- If you have sciatica, then crossing the knee may not be too good as there will be pressure at the sciatic nerve.

14. What are the salient features of the Fartlek training method?

[1 × 3]

Ans. Fartlek Training Method: The Fartlek method of training was introduced and practiced in Sweden. 'Fartlek' is a Swedish term which means 'speed play' (playing with speed). This training method was first introduced by Gosta Holmer. It is a type of cross country running. Fartlek is usually conducted over a hilly region track, and it allows variation in pace. It is one of the best methods of conditioning for most of the sports in which endurance is the basic requirement. This training can be performed at hilly path, river bed, forest, muddy road or sandy path etc. Self-discipline is most important and vital in this type of training. In Fartlek, the change of pace or speed is not pre-planned so some exercises can also be included in this method. These exercises may be performed by stopping and running temporarily at different intervals. The type of exercises that can be included along with running are hopping, jumping, squat jump, double hop jump etc.

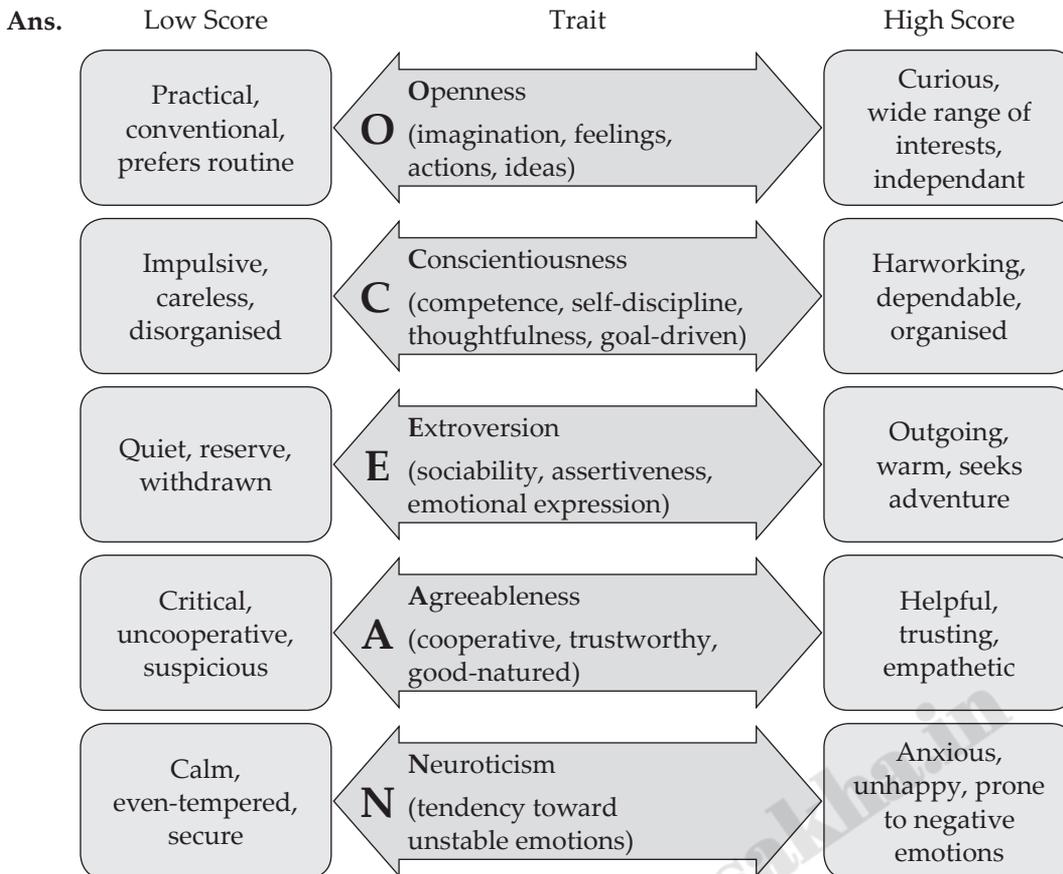
Advantage of Fartlek Training are:

- It is an off season training method but is very useful in developing endurance in athletes.
- It has a psychological advantage over the other training methods because the changing scenes help in delaying fatigue.
- It is the best method to improve endurance in sports where endurance is a basic requirement e.g. cross-country running.
- Balancing adjustments of ankles, knees and thighs improves due to the uneven surface.

SECTION C

15. Explain any three personality types of Big Five Theory.

[1 + 3]



16. Discuss physiological factors determining speed.

[1 × 4]

Ans. Physiological Factors determining speed are:

- Fast Twitch Muscle Fibre:** The muscle composition is genetically determined and cannot be changed by training. There are three main types of muscle fibers. These are slow-twitch (type I), fast-twitch (type Ia) and fast-twitch (type Ib). Fast twitch fibres are much better at generating short bursts of strength or speed than slow twitch fibre muscles. Thus, the greater the percentage of fast twitch muscle fibre one has, the faster he is at speed.
- Body Fat:** Fat acts as excess baggage when trying to run. Body fat of 6 to 10 percent of body weight for men and 12 to 17 percent of body weight for women is desirable for sprinting short distances. Lower range of body fat is unhealthy whereas higher range of body fat negatively affects speed.
- Anaerobic Capacity:** Speed is dependent on the anaerobic energy systems. Anaerobic capacity is the ability to produce energy without the use of oxygen. Short bursts of speed are anaerobic and are very intensive. Our body can only perform a certain number of quick bursts of speed before we experience the physiological response of pain and fatigue. Thus, an athlete having a better anaerobic capacity will have a better speed.
- Neuromuscular Responses:** Neuromuscular responses affect speed. Faster responses lead to faster muscle contraction thus leading to faster speed.
- Flexibility:** Another important factor contributing to optimum speed is joint flexibility. Good flexibility will help an athlete in maximum range of movement without much effort and resistance. Proper flexibility of the involved joints contributes to movements that are more fluid and coordinated, resulting in longer and faster strides and greater speed. Thus, flexibility plays an important role in determining speed.

17. Define flexibility and explain methods to develop flexibility.

[1 + 3]

Ans. Flexibility can be defined as the maximum range of motion at a joint that is the extent of movement possible about a joint without undue strain. Flexibility is not a general quality; it is specific to a particular

joint, such as the knee or to a series of joints. This means that an individual can have a better range of motion in some joints than in others.

Methods to improve Flexibility are:

- (i) **Ballistic Stretching:** The individual performs these stretching exercises while in motion. This dynamic method uses the momentum generated from repeated bouncing movements to stretch the muscles. Although it is very effective, most experts do not recommend this method because it may overstretch the muscles and can cause muscle soreness or injury. This method includes various exercises like swinging the trunk sideways, forward, backward, swinging the legs etc.
- (ii) **Static Stretching:** It is an extremely popular and effective technique. Static stretching involves gently and slowly moving into the stretch position and holding it for a certain period of time. Movement should take place through the full range of motion until a little tension or tightness is felt in the muscles or group of muscles. As the muscle relaxes, the stretch should be extended and held again. Stretching should not be painful. Care must be taken not to force the joint to move too far, which may cause an injury. Stretching should be held from 10 to 30 seconds and a maximum of five repetitions for each exercise.
- (iii) **Passive stretching:** Passive stretching techniques are usually performed with a partner who applies a stretch to a relaxed joint. Partner stretching requires closer communication between partners, and the slow application of the stretch in order to prevent injuries due to forceful manipulation of the body segment.
- (iv) **Proprioceptive Neuromuscular Facilitation (PNF) or Contract:** PNF technique is the most appropriate method for increasing or developing flexibility in the shortest possible time. This method is used by sportsmen for gaining flexibility. It involves use of muscle contraction before stretching to achieve maximum muscle relaxation. The following procedure is used for PNF technique :
 - (a) Move into the stretch position so that the stretch sensation can be felt.
 - (b) The partner holds the limb in this stretched position.
 - (c) Push against your partner for 6 to 10 seconds by contracting the antagonistic muscles and then relax. During contraction, the partner tries to resist any movement of the limb.
 - (d) The partner then moves the limb further into the stretch until the stretch sensation is felt.
 - (e) Repeat the whole procedure for 4 to 5 times.

18. Briefly explain the administration of Pawanmuktasana along with its contraindications and draw stick diagram. [2+1+1]

Ans. Procedure and contraindications of Pawanmuktasana are:

Procedure of the Pawanmuktasana are:

- (i) Lie on your back with your feet together and arms besides your body and relax, breathing deeply.
- (ii) With a deep inhalation raise your legs to 90° and completely exhale.
- (iii) Now with another inhalation bring both the knees close to your chest and press on the lower abdomen, holding the knees with your hands. Exhale completely.
- (iv) Remain with bent knees for a few breaths. With every exhalation press the thighs and knees on the abdomen and hold them with your hands.
- (v) With a deep breath raise your head, neck and chest and bring them close to your knees. If possible, bring your chin in between your knees. Ensure the head moves less and the knees come closer to the face. That way the pressure on the abdominal muscles will help in releasing the unwanted gas/wind around the abdominal organs.
- (vi) Remain in this posture for a few breaths focusing on maintaining the position of the head and neck in place. With every exhalation press the thighs closer and deeper into the chest and face deeper into the knees.
- (vii) Try to maintain the balance while breathing slowly and keeping the body relaxed.
- (viii) Now with an inhalation, release the neck and head and exhale completely. With another inhalation straighten the legs and bring them back to 90° and as you exhale release the leg from 90° to the relaxed posture. With complete exhalation, bring the legs stretched out on the floor and relax the neck.

- (ix) Take a few breaths, and then continue with the next round. The longer you hold in this posture the faster the muscles around the abdomen loosen.

Contraindications of the Pawanmuktasana are:

To be avoided or performed under guidance by those suffering from:

- (i) severe migraine
- (ii) high or low blood pressure
- (iii) asthma
- (iv) slip disc
- (v) advanced stages of spondylitis
- (vi) Girls/Women should avoid this asana or take the guidance of the teacher while practicing it during the menstrual cycle.



Posture for Pawanmuktasana





Sample Paper

1

Physical Education

SECTION A

1. What is the main physiological cause of Asthma?
2. Define acceleration runs.
3. Define sports psychology.
4. What is Attention Deficit or Hyperactivity Disorder (ADHD)?
5. What do you mean by soft tissue injuries?
6. What is coordinative ability?
7. What are the symptoms of ODD?
8. What kind of sports injury can be termed as "Abrasion"?
9. Name the type of Disorders.

SECTION B

10. What is the role of a spectators in creating a positive sports environment? Explain.
11. What are the various causes of ADHD?
12. Discuss the preventive measure of sports injuries.
13. What is the role of Yoga in preventing lifestyle diseases?
14. Explain any three principles of training in brief.

SECTION C

15. What is personality? Explain its different dimensions.
16. Explain any two methods for speed development.
17. What is movement speed? Explain the methods to develop speed endurance.
18. "Involvement in physical activities for longer period of time with moderate intensity can improve the quality of life." Justify your answer.

□□



Sample Paper

2

Physical Education

SECTION A

1. Which type of sports injury is known as "Strain"?
2. Define active flexibility.
3. Suggest any two isometric exercises for shoulder region.
4. What do you mean by the term 'Aggression' in sports?
5. What is first aid?
6. What type of sports injury can be termed as 'Laceration' in sports?
7. What is ADHD?
8. What do you mean by Intellectual Disability?
9. What is Hypertension?

SECTION B

10. What is meant by 'motivation'? Explain the different techniques of motivation to achieve high goals in sports.
11. What are the types of disability? Explain briefly.
12. Maintaining physical activities for a longer period, brings desirous changes in circulatory system. Justify your answer by highlighting three benefits of exercise.
13. What do you understand by 'First-Aid'? How will you manage joint injuries? Explain.
14. Dynamic strength is divided into three parts. Write in brief about each.

SECTION C

15. What are the benefits and contraindications of Vajrasana?
16. Explain in detail Goal setting and Reinforcement as technique of motivation.
17. Differentiate between 1 : 1 and 1 : 2 ratio interval training, with suitable examples.
18. What do you understand by coordinative ability? Discuss about different types of coordinative abilities.





Sample Paper

3

Physical Education

SECTION A

1. Explain Fartlek.
2. Why does involvement in regular exercise delay the onset of fatigue?
3. What is goal setting?
4. Mention any two disability etiquettes.
5. What type of fracture is known as Greenstick Fracture?
6. Explain the term 'Sports Training'.
7. What do you mean by ODD?
8. What is incision?
9. What is Intellectual Disability?

SECTION B

10. Discuss in detail any three techniques of motivation.
11. Discuss in detail any one type of disorder.
12. A famous cricket star Phillip Hughes was struck behind the ear by a ball while batting and died two days after the injury. He was wearing a helmet but the possible reason mentioned was that even when using a helmet, possibly a significant part of the neck remained exposed and the ball hit him there and now most of the top cricketers across the world would use deeper protection.
 - (i) Do you feel protective gears are important? Lay stress on your views.
 - (ii) What first aid should be provided during injury at the superficial layer of the skin?
13. Briefly explain different types of co-ordinative abilities.
14. "Asanas can be used as a preventive measure." Comment.

SECTION C

15. Write in detail about strength improving method—Isometric, Isotonic and Isokinetic.
16. What is endurance? Explain the various methods for its development.
17. Explain Sheldon's classification of personality and explain its importance in physical education and sports.
18. What are the steps and benefits of Vajrasana?





Answers

Sample Paper 1

SECTION A

1. The physiological cause of asthma is narrowing of airway passage and a subsequent interference with airflow.
2. Acceleration runs is a special kind of training in which running speed is gradually increased from jogging to striding and finally to sprinting at maximum speed. Each component is about 50 meter long. Its progressive nature reduces the risk of muscles injuries.
3. Sports psychology is the study of how psychology influences sports, athletic performance, exercise and physical activity. Some sports psychologists work with professional athletes and coaches to improve performance and increase motivation.
4. It is a brain disorder that includes inattentiveness, hyperactivity and impulsiveness. It is a medical condition that affects how well can someone sit still, focus and pay attention.
5. Soft-tissue injury includes damage of muscles, ligaments, and tendons throughout the body. The result can be pain, swelling, bruising, and damage. Soft-tissue injuries are classified as Contusions, Sprains, Tendonitis, Bursitis, Stress injuries, Strains.
6. Abilities of an individual which assist him to do a variety of interconnected activities correctly and competently are called coordinative abilities.
7. Symptoms of ODD are as follows:
 - (i) Rude, aggressive and non-cooperative.
 - (ii) Difficulty to make friends.
 - (iii) Often and easily loses temper.
 - (iv) Is frequently touchy and easily annoyed by others.
 - (v) Is often angry and argumentative.
 - (vi) Often argues with adults or people in authority.
 - (vii) Often actively refuses to comply with adults' requests or rules.
8. Abrasion is injury on the surface of the skin. In this injury skin is scrapped or rubbed by friction. It causes severe pain and sometimes bleeding from the affected part. Abrasions are very common sports injuries caused by fall on hard surfaces.
9. Types of disorders are:
 - (i) Attention Deficit Hyperactivity Disorder (ADHD)
 - (ii) Sensory Processing Disorder (SPD)
 - (iii) Autism Spectrum Disorder (ASD)
 - (iv) Oppositional Defiant Disorder (ODD)
 - (v) Obsessive Compulsive Disorder (OCD)

SECTION B

10. Positive sports environment is the conditions and circumstances which are favourable and beneficial for the sportspersons who perform sports activities. Behaviour and attitude of the spectators towards coaches, players and officials should be positive. They should not pass any negative comment towards players, referee, umpire and any other game officials. They should not indulge themselves in any type of violence. They should try to motivate the players so that they may put up better performance. In this way the spectators can play a vital role for creating positive sports environment.

11. The various causes of ADHD are as follows:
- Genetic Factors:** It is not a disorder that passed socially. Studies shows that parents, siblings, and children of people with ADHD may be up to five times more likely to have the disorder than the people who are not related to someone with ADHD.
 - Brain Injuries:** When a baby's brain is damaged before or after birth this could make the baby more likely to develop ADHD later on.
 - Low Birth Weight:** It is observed that children with low birth weight are more likely to develop ADHD.
 - Trauma and brain diseases:** Trauma during birth and brain diseases may lead to develop ADHD.
 - Diet:** There are a number of evidences which shows that taking a particular type of food or food additives play a significant role in causing ADHD.
12. "Sports injuries" are the type of injuries that occur during participating in sports or competition, training sessions or sports activities. One of the important objectives of sports medicine is preventing injuries. It also prevents other physical, mental, social and financial harm accompanying sports injuries. General techniques that can prevent sports injuries are:
- Warm-up and Cool-down:** A well-structured warm-up and cool-down is necessary to increase blood and nutrient flow and concentration. Also it helps in relaxation, improved flexibility and recovery of muscles.
 - Planning a Session:** Careful planning of training and rehabilitation sessions allows gradual specific adaptations. It reduces the damage to the tissues as a result of training.
 - Using Protective Equipment:** The use of protective equipment like proper footwear's, helmets, goggles, gum shield, shin pads and gloves prevent many sports injuries.
 - Psychological Training:** Some form of mental skills training and practice could reduce injuries by reducing anxiety and improving concentration.
 - Adherence to the Rules:** If all performers are aware of and adhere to the rules and laws of the particular sport, then injuries can be reduced to great extent.
13. Yoga places a great importance on a proper and healthy lifestyle whose main components are healthy activities, healthy relationships, healthy thoughts, healthy food, and healthy recreation. The holistic art and science of yoga is the best lifestyle ever designed and is effective in managing prevalent lifestyle disorders such as diabetes and hypertension. There are various lifestyle diseases like Obesity, Diabetes, Asthma, Hypertension and Backache. Through regular participation in yoga:
- Bones and joints become strong.
 - Muscles becomes stronger and flexible.
 - Circulation of blood becomes normal.
 - Respiratory organs become efficient.
 - Efficiency of digestive system increases.
 - Better neuro muscular coordination.
 - Strengthens the immune system.
14. Three principles of training are:
- Principle of Overload:** The overload principle is a basic sports fitness training concept. It means that in order to improve, athletes must continually work harder as their bodies adjust to existing workouts. Overloading also plays a role in skill learning.
 - Principle of Specificity:** The principle of specificity states that the more specific a training activity is to a given sport (muscle group, work load, velocity and pattern of movement, body posture, and range of motion) the more it will contribute to increasing performance in that sport.
 - Principle of Individualization:** This could also be called the snowflake principle, since it highlights that no two climbers or their optimal conditioning programs are the same. The best training program for a person will target his/ her specific weaknesses, address past or present injuries, provide sufficient time for recovery, and be structured to provide the greatest output for the available training input.

SECTION C

15. Personality is a combination of two words *i.e.*, PERSONAL + IDENTITY = Personality.

Thus, any variable or component that makes a person unique, different from all other constitutes a part of one's Holistic Personality.

Holistic personality means all round development of :

- (i) BODY
- (ii) MIND (Knowledge, communication and emotion)
- (iii) SOUL

There are 11 domains of personality :

R = Regularity

S = Safety

S = Self-Responsibility

M = Mental Activity

O = Occupational Activities

V = Vital

E = Environmental

S = Social

P = Physical

E = Emotional

S = Spiritual

T = Temporal (Physical Growth)

Personality Dimensions: The five-factor model is comprised of five personality dimensions (OCEAN): Openness to experience, Conscientiousness, Extraversion, Agreeableness and Neuroticism. The five dimensions are held to be a complete description of personality.

16. Speed means the velocity with which an individual can execute his movements. In other words, it means the capacity of moving a body part or the whole body with the greatest possible velocity. For example, the movements of a smasher's arm in volleyball, has the maximum speed or velocity at the time of smashing the volleyball. The following methods are usually adopted for the development of speed in sprinting events.

(i) **Acceleration Runs:** These are usually adopted to develop speed, especially in attaining maximum speed from stationary position. It should be kept in mind that the technique of any event should be learnt in the beginning. Only then, we should switch over to acceleration runs.

(ii) **Pace Races:** It means, running the whole distance of a race at a constant speed. In pace races, an athlete runs with uniform speed. Generally 800 meters and above races are included in pace races.

17. Movement speed is the time taken between the initiation of movement and the completion of the movement. It depends upon techniques, explosive strength, flexibility and coordinative abilities. It plays a vital role in boxing, gymnastics, swimming; throws jumps etc. where the minimum time is taken to complete the movement.

To develop the speed endurance more work has to be done on pace races because pace races means running the whole distance at a constant speed. Generally, 800 meters and above races are included in pace races. As a matter of fact, an athlete can run a distance of 300 meters at full speed but, in longer races such as 800 meters or above races he must conserve his energy by reducing his speed. For example, if there is a runner of 800 meters race his best time is 1 minute 40 seconds, so, he should run first 400 meters in 49 seconds and next 400 meters in 51 seconds.

18. Involvement in physical activities for longer period of time with moderate intensity can improve the quality of life in the following ways:

(i) **Exercise Helps in Healthy Growth and Development:** Exercise is an important part of keeping children healthy. Encouraging healthy lifestyles in children and adolescents is important when they grow older. Participating in organised sports and games is not only of great fun but is very essential for healthy growth and development.

- (ii) **Exercises Improve Self-esteem:** Exercise is necessary for the physical and mental health. Self-esteem can play a great role in how children feel about themselves and also how much they enjoy things or worry about things. Exercise reduces depressive symptoms and improves self-esteem in children.
- (iii) **Enhances Flexibility:** The stiffness of joints decreases due to exercising, in a way improving the flexibility. The elasticity of tendons, ligaments and joint capsules improves due to regular exercise.
- (iv) **Lessens Stress and Tension:** Regular exercise has a distinctive capability to slow down the depression process by reducing stress and tension. Actually, regular exercise lessens the levels of body's stress hormones like adrenaline and cortisol. The body's natural painkillers and mood elevators i.e., the endorphins are produced due to regular exercise. These benefits of work out facilitate in delaying the process of ageing.
- (v) **Connect with Others:** Spend time with positive people who enhance your life by instilling in you with positive thoughts. A strong support system will buffer you from the negative effects of stress.
- (vi) **Keep Your Sense of Humour:** This includes the ability to laugh oneself. The act of laughing helps the body to fight stress in a number of ways.

Sample Paper 2

SECTION A

1. Strain is an injury to muscle or tendon. Tendons are fibrous cords of tissue that attach muscles to the bone. Strains often occur in foot, leg (typically the hamstring) or back. It is a type of soft tissue injury.
2. Active flexibility focuses on improving soft tissue extensibility and increasing neuromuscular control. It includes foam rolling (self- myofascial release) as well as active – isolated stretching.
3. Two isometric exercises for shoulder region are:
 - (i) Pushing against the wall.
 - (ii) Holding push up position.
4. In sports, aggression means an intention to harm or injure a player outside the rules of game so as to gain a competitive advantage or late tackling to stop an opponent from scoring.
5. It is an immediate care given to an injured or ill person. It does not take the place of proper medical treatment. It is a temporary assistance before actual medical care is obtained.
6. Laceration is an irregular cut on the skin with a sharp object or sharp edged sports equipment.
7. Attention Deficit Hyperactivity Disorder (ADHD) is a group of behavioural symptoms that include inattentiveness, hyperactivity and impulsiveness. It is medical condition that affects how well can someone sit still, focus and pay attention. The individual with ADHD has some problems focusing in some activities. This type of disorder is found more common in boys than in girls.
8. It is a disability characterised by significant limitations both in intellectual functioning (reasoning, learning, problem solving) and in adaptive behaviour, which covers a range of everyday social and practical skills. Usually it occurs before the age of 18. It involves problems with general mental abilities that affect functioning in two areas:
 - (i) Intellectual functioning (such as learning, problem solving, judgement).
 - (ii) Adaptive functioning (activities of daily life such as communication and independent living).
9. Hypertension means the increased blood pressure. It may eventually cause health problems such as heart diseases.

SECTION B

10. Motivation means to be inspired to do something. Indeed, motivation is the inner condition of an individual that directs his behaviour towards a goal. The force of motivation incites individuals to perform some activities. It also determines individual's direction of action and his intensity of action.

There are two types of motivation:

- (i) **Intrinsic Motivation:** Intrinsic motivation is internal. It occurs when people are compelled to do something out of pleasure, importance or desire. Motivation is always intrinsic when the force comes from within oneself. For example, when a person indulges in any sport to have mastery, to display superiority or to gain social approval, it is an intrinsic motivation.
- (ii) **Extrinsic Motivation:** Extrinsic motivation is external. It occurs when external factors compel the person to do something. Motivation is always extrinsic, when external forces, positive or negative, produce a behavioural change. Reward, punishment, praise, blame or cash prize are example of extrinsic motivation. It has been found that such devices motivate some persons more strongly than others. Infact extrinsic motivation includes factors that motivate individual in achieving the goal.

11. Types of disability are:

- (i) **Cognitive Disability:** Cognitive disability generally refers to anyone with lower than average intellectual functioning. A person who has a cognitive disability has trouble in performing mental tasks that the average person would be able to do.
- (ii) **Intellectual Disability:** Intellectual disability is a disability characterised by significant limitations in both intellectual functioning (such as learning, problem solving, and judgement) and in adaptive behaviour (activities of daily life such as communication). This disability originates before the age of 18.
- (iii) **Physical Disability:** A physical disability is a long term loss or impairment of part of body's physical function. It can involve difficulties in walking and mobility, sitting and standing, use of hands and arms, sight, hearing, speech, muscle control etc.

12. Benefits of exercises are:

- (i) **Heart size increases:** The size of heart and strength of the cardiac muscles increase due to regular exercises as to the maximum extent the left ventricle adapts. The walls of the heart develop into stronger and thicker as shown in recent studies and the thickness of myocardial wall increases as well.
- (ii) **Resting heart rate decreases:** The resting heart rate decreases due to regular exercises. After duration of 10 week training programme, the resting heart rate may reduce up to 30 beats per minute from the normal of 72 beats per minute. The heart becomes more efficient due to regular exercises. In highly conditioned athletes the resting heart rate decreases to 30 beats/minute.
- (iii) **Stroke volume increases at resting conditions:** The stroke volume increases at resting conditions due to regular exercises. The stroke volume at rest remains up to 50–70 ml/beat in untrained individuals; in trained individuals it ranges from 70–90 ml/beat and in the elite endurance athletes it ranges from 90–110 ml/beat.

13. It is the immediate care given to an injured or ill person. It does not take the place of proper medical treatment. It is a temporary assistance before actual medical care is obtained.

Management of joint injuries:

- (i) Cold compression should be used immediately. The application of ice or cold water should not be used for more than 40 minutes persistently.
- (ii) The cold compression should be performed 5 to 6 times daily.
- (iii) If there is more swelling at the sight of contusion, the anti-inflammatory medicine should be given.
- (iv) If the swelling persists, consult the doctor immediately.
- (v) For the purpose of rehabilitation, the flexibility exercises should be performed carefully.

14. Dynamic strength is of following types:

- (i) **Maximum Strength:** In a single muscular contraction it is the ability of muscle to contract over resistance of utmost intensity of stimulus. The most excellent examples are weight lifting and throwing events in track and field.
- (ii) **Explosive Strength:** It can be stated as the ability to prevail over resistance by means of high speed. It combines strength and speed abilities and based on the nature of the blend of strength and speed, the explosive strength can be sub-divided further into start strength, power and speed strength.

- (iii) **Strength Endurance:** Similar to explosive strength, it is a result of two motor abilities as well. Under conditions of fatigue, it is the ability to work against resistance. Depending on the actuality whether the movement is static or dynamic, strength endurance can be in form of static or dynamic strength. The strength endurance can be divided further into proper strength endurance and strength endurance depending on the kind of the blend of strength and endurance.

SECTION C

15. As this pose is easy and can be practiced at any time of the day and by anyone, it has many benefits to the extent of healing ailments. This pose is used out of habit by yogis for meditative purposes.

Benefits of Vajrasana are:

- (i) **Heals body:** The end of the spinal column (*meru danda*) is so beautifully placed on the heels giving the body a great looking posture and helps in transporting the prana smoothly to the entire body. This flow of prana is the first stage to heal the body from within.
- (ii) **Increases flexibility in ankles:** The ankles are bent so well giving room for greater flexibility right up to the tips of the toes.
- (iii) **Improves blood circulation:** The folding of the knees and the thighs stretches these muscles and improves blood circulation and improves flexibility.
- (iv) **Strengthens pelvic muscles:** In this pose as the spine is elevated away from the floor, the flow of blood is altered along with the nervous impulses in the pelvic region and pelvic muscles are strengthened.
- (v) **Improves digestion:** As this is one of the few yoga poses which can be practiced even after a meal, it is considered as a good way to help in digestion and increases the efficiency of the digestive system.

Contraindications of Vajrasana are:

- (i) **Injured ankles or knees ligaments:** This pose can be hard on the knees and the ankles if one is not flexible with these muscles and joints. This pose should not be practiced if one is suffering from injured ligaments at the ankles or at the knees.
 - (ii) **Hernia or Ulcers:** Those suffering from hernia or intestinal ulcers should take medical advice and guidance before practicing this and should perform this pose with a trained yoga teacher. The pressure on the anus in this pose may bring unwanted pressure to the intestine.
 - (iii) **Runners with hamstring or calf injury:** Runners should avoid this if they have injury in their hamstrings or the calves.
 - (iv) **Arthritis in knees:** Not to be practiced by people who have severe arthritis of the knees.
16. Goal setting and Reinforcement as technique of motivation are:
- (i) **Goal Setting:** Achieving performance goals is a symbol of competency that affects motivation positively, hence it is essential to set realistic goals based on individual's own abilities. The level of the motivation gets adversely affected when goals are set up too high or too low. The goal should be realistic, precise and within reach but should at the same time be a difficult one. Goal settings have been acknowledged as an influential motivational technique as it mobilises an athlete's hard work and extends his determination.
 - (ii) **Reinforcement:** Reinforcement is a vital motivational means. It refers to some kind of occurrence that increases or decreases the possibility of a similar reaction taking place in future. Positive reinforcements enlighten the athlete at what time he is doing something accurate and support the continuance of the activity in the precise direction. Negative reinforcement is in general, of slight importance since it simply indicates that the actions are inaccurate devoid of providing information with respect to the accurate reaction or behaviour. It has been established that positive reinforcement to a large extent, has more motivational value than negative reinforcement.
17. 1 : 1 means load and the rest are equal. e.g., 1 minute exercise followed by 1 minute of rest. Similarly 1 : 2 means that the period of rest is double that of the load. e.g., 1 minute exercise followed by 2 minutes of rest.

The slow and extensive interval training methods can be given by using 1 : 1 and 1 : 2. Fast or intensive interval training methods are also given by using 1 : 1 and 1 : 2.

Example: Most of the games and sports are based on the principle of load and rest, again load and rest. The rest period during training work load should not exceed five minutes.

Another example can be of a sprinter:

100 m sprint 100 m walk 1 : 1

100 m sprint 200 m walk 1 : 2

18. Coordination is the ability to integrate separate motor systems with varying sensory modalities into efficient movements. These are those abilities which enable an individual to do various related activities accurately and efficiently. Coordinative abilities mainly depend on the Central Nervous System. The harmonious working together of the synchrony, rhythm, and sequencing aspect of one's movements is crucial to coordinate movement. Various parts of the body may be involved, such as eye-foot coordination, as in kicking a ball or walking upstairs. Eye-hand coordination is evident in fine motor activities such as bead stringing, tracing and clay modelling or in gross motor activities such as catching, striking or volleying a ball.

Following are different types of coordinative abilities:

- (i) **Coupling Ability:** Coupling ability is to synchronize movements and direction efficiently and to let different parts to cooperate in order to achieve a desired and smooth movement. Coupling ability of the body is considered as capacity of an individual to perform better coordination of different parts of the body. For example, while dribbling a basketball, the coordination of both the limbs is required.
- (ii) **Reaction Ability:** Reaction ability is a skill to react quickly to a stimulus. For example, chaser in Kho-Kho runs quickly after Kho is given.
- (iii) **Balance Ability:** Balance ability is known as capability of an individual to maintain balance while the body is in motion. Even during distributed balance regaining the lost balance is known as balance ability.
- (iv) **Orientation Ability:** The orientation ability is a skill to determine and change the position in complex situations. For example, defending an opponent in football, the position is changed according to the movement of opponent.
- (v) **Adaptation Ability:** Adaptation ability is the capability of a person to change the movement on the basis of predicted changes. This ability is achieved after mastering the skills.
- (vi) **Rhythm Ability:** Rhythm ability is to make out motor actions on a well- defined rhythm. Rhythm ability enables to grasp and express rhythm which is externally determined or contained in the motor activity itself.

Sample Paper 3

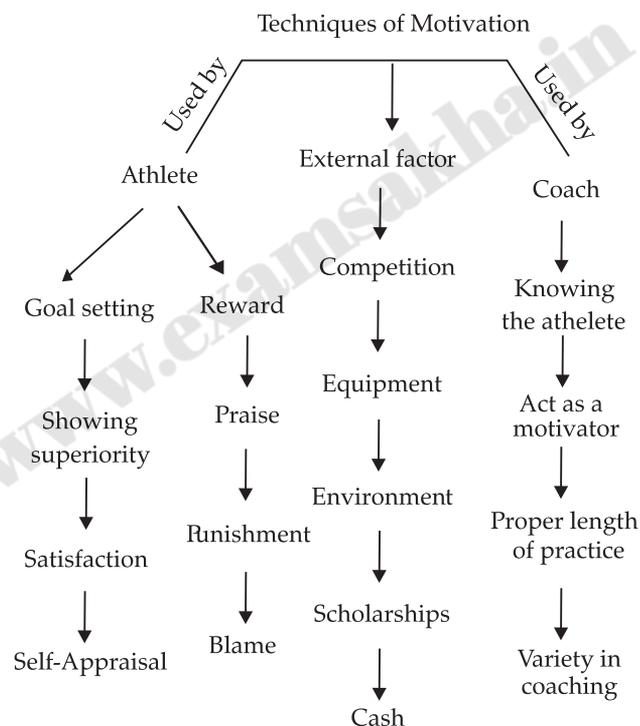
SECTION A

1. Fartlek, which means "speed play" in Swedish, is a training method that blends continuous training with interval training. The variable intensity and continuous nature of the exercise places stress on both the aerobic and anaerobic systems. It differs from traditional interval training as it is unstructured; intensity and/or speed varies, as the athlete wishes.
2. If we do regular exercise, our fitness level will be increased and it also develops endurance because of the fatigue level delays.
3. Goal setting involves establishing specific, measurable, achievable, realistic and time targeted (S.M.A.R.T) goals. The goal setting theory suggests that an effective tool for making progress is to ensure that participants in a group with a common goal are clearly aware of what is expected from them.
4. Two Disability Etiquette are:
 - (i) When you meet a person with visual impairment, always identify yourself and others who may be with you.
 - (ii) In case of introduction to a person with a disability, it is appropriate to shake hands.

- (iii) Always avoid asking personal questions to an individual who is differently abled.
 - (iv) Always have conversation at a normal tone of voice. Do not talk in high pitch to such individuals.
5. Greenstick fracture is a fracture in a young, soft bone. In greenstick, the bone bends and breaks. This fracture is very difficult to detect and is usually found in children.
 6. Sports training is a specialised process of all round physical conditioning aimed at the preparation of sports person for improving its performance in games and sports.
 7. Oppositional Defiant Disorder (ODD) is a childhood disorder that is defined by a pattern of hostile, disobedient, and defiant behaviours directed at adults or other authority figures.
 8. An incision wound is a cut in the skin caused by sharp object, such as knife, broken glass, scissors or surgeon's scalpel. Incision wounds are 'neat' and the edges of the skin are usually smooth.
 9. Intellectual disability is a disability characterised by significant limitations in both intellectual functioning (such as learning, problem solving, and judgement) and in adaptive behaviour (activities of daily life such as communication). This disability originates before the age of 18.

SECTION B

10. In games and sports performance does not depend upon a single factor. The performance of an athlete directly depends upon his/her coach, the environment in which he or she took training, his personal and social dimension, and the most important factor is motivation. Following are the techniques used in games and sports by an athlete and his/her coach.



Techniques of motivation for higher achievement in sports are:

- (i) **Knowing Your Athlete:** Each athlete comes from a different background with varied experiences and having different degrees of maturity.
- (ii) **Level of Aspiration or Goal Setting:** As we know that achieving performance goals is a sign of competence that affects motivation positively, it is necessary to set realistic goals based on one's own abilities.
- (iii) **Identifying Incentive Factors:** If an athlete perceives that any particular kind of experiences are available to him in a given sport and he feels that these will be pleasant, enjoyable or satisfying, then he will choose to participate in that game or sport and not any other.

11. Disorder is usually used for mental disabilities. Disorder is any element that disturbs the health of an individual. Disorder creates hindrance in an individual's performance and reduces his efficiency. In the beginning disorder seems to be ordinary but they usually grow or spread in a harmful manner in an individual. Most probably, a disorder cannot be detected on time, as a result of which, a simple disorder is changed into a disability. A disorder disrupts the normal functioning of an individual.
- Attention Deficit Hyperactivity Disorder (ADHD) is a group of behavioural symptoms that include inattentiveness, hyperactivity and impulsiveness. It is a state having medical conditions that affect how well can someone sit still, focus and pay attention. The individual with ADHD have some problems focusing in some activities. This type of disorder is found more common in boys than in girls.
12. In a sport like Cricket, protective gears or sport gears are very vital. In recent past, it is observed that when a forceful ball hit the batsman or fielder, it might cause injuries or even death.
- In the game of Cricket one should protect head, arms, chest, thighs, private parts, knees, legs and feet. There are various protective gears such as helmet, batting gloves, chest guard, thigh guards, arm pads, shoulder pads, abdominal guard, leg protector, shoes, wicket keeping gloves etc. These sport gears must be of good quality. The proper protective equipments play significant role in preventing the sports injury.
 - Clean the affected part with fresh water.
 - Use clean sterilised gauze to wipe the affected part.
 - Antiseptic ointment should be used.
 - Refer to the doctor in case of serious injury.
13. Different types of coordinative abilities are:
- Adaptive Ability:** According to predictable changes in circumstances, it is the capability of a sports-person to result in an effectual alteration in the movement.
 - Balance Ability:** It is the capability of a sports person to sustain balance of the body together in static and dynamic conditions.
 - Reaction Ability:** It is the ability to react quickly and effectively to a signal. To a great extent it depends on sense organs, coordinative processes of CNS, decision making, concentration and anticipation.
14. Asanas play an important role to prevent the lifestyle related diseases. The advantages are as follows:
- Maintain Weight:** Nowadays, obesity has become a challenging problem for the society. By doing asanas daily, we exercise entire organs of our body. By practising asanas regularly, it burns the excess fat of the body, and hence maintains healthy weight.
 - Normalize Endocrine Function:** Diabetes is one of the most common lifestyle related diseases. Diabetes occurs due to either the pancreas not producing enough insulin or the cells of the body not responding properly to the insulin produced. The asanas like Bhujangasana, Paschimotanasana, Pavanmuktasana, Ardh-Matsyendrasana etc., help to stimulate and regulate pancreas to produce insulin which helps to maintain glucose level in the body.
 - Respiratory Efficiency Increases:** Asthma is a common lifestyle related disease. It occurs due to narrowing of trachea, due to which oxygen supply to lungs and body is compromised. Asanas help in maintaining the trachea wide open, increase the lungs capacity and blood flow to lungs. Thus, oxygen supply is maintained and asthmatic episodes are reduced and respiratory efficiency is increased.
 - Regulate Blood Flow:** Yoga or Asanas regulate blood flow in the body and help to maintain a constant blood pressure. They help the body to relax and thus reduce the high blood pressure. Yoga calms down the body and the mind and thus blood pressure is normalised.

SECTION C

15. (i) **Isometric Exercises:** They are the exercises in which muscular tension is built without any visible movement of muscle being used. Contraction during such an exercise is called isometric contraction. Work done during isometric exercise is zero. Isometric exercises are practiced by pushing or pulling an immovable object like a wall or bar anchored to the floor. Isometric exercise increases muscle tension significantly but fails to change the length of the muscles. Today, it is primarily used for rehabilitation purposes.

Examples:

- (a) Balancing on one foot.
- (b) Pressing against the wall.
- (c) Standing with heavy load on head.
- (d) Maintaining a sitting posture without a chair.
- (e) Holding a weight at arm's length.
- (f) Attempting to lift an immovable object.

Characteristics of Isometric Exercise

- (a) The amount of heat generated and tension developed is higher than that of isotonic.
- (b) Increased muscular tension leads to tremor in muscles.

- (ii) **Isotonic Exercises:** Exercises where we can see movement of an object on application of force are called Isotonic exercises and contraction of the muscle during such an exercise is called isotonic contraction. Isotonic exercises are carried out against a fixed resistance. As each muscle moves through its complete range, isotonic contraction creates tension with maximum effort at the beginning and end of each exercise. Two types of muscular contraction take place while performing isotonic exercise—they are **concentric contraction** in which length of the muscle decreases from normal size and **eccentric contraction** in which length of the muscle increases from normal size.

Examples:

- (a) Light rhythmic exercises
- (b) Running downhill
- (c) Sit-ups and push up
- (d) Lifting free weights, like dumb-bells and barbells
- (e) Hammer throw
- (f) Triple Jump
- (g) Landing on the ground after a jump

- (iii) **Isokinetic Exercises:** These are the exercises in which speed remains same throughout the range of movement. It can be also called as a combination of isometric and isotonic contraction. Isokinetic exercise uses a machine that controls the speed of contraction within the range of motion. Cybex and Biodex machines provide this kind of workout, but these machines are generally used by physiotherapists and not readily available to most of the people. Exercises which are similar to isokinetic exercise in sports activity are:

- (a) Ice skating
- (b) Chin ups
- (c) Rope climbing
- (d) Rowing
- (e) Swimming

16. Endurance refers to the body's ability to continue using muscular strength and endure repeated contractions for an extended period of time. It is essential in exercise and when doing heavy tasks as it allows the muscles to perform for long periods of time without becoming tired. There are various methods of its development. Some are as follows:

- (i) **Continuous Training:** Continuous training is a type of sports training that involves activity of moderate intensity with a duration of more than 15 minutes with resting intervals. It is the most common type of training and is for maintaining general health and well being. Generally, this type of training is used to prepare the body for sustained workouts such as marathons and triathlons, but can also be effective for more casual athletes. It allows the body to work from its aerobic energy stored to improve overall fitness and endurance. Chief benefits of continuous training include fat burning, muscle building, and increasing maximum aerobic potential.
- (ii) **Interval Training:** Interval training involves periods of hard work followed by a timed period of rest, repeated several times in one training session. The periods of hard work are called high intensity activity. Rest can be active (walking, jogging etc). An example of interval training is 10 fast runs over 40 metres, with two minutes rest between each run. Variables to consider during interval training are distance/duration of activity, intensity of activity, duration of rest, activity during rest, number of sets, and frequency of training. By varying any of these variables athletes can be progressively overloaded. This form of training also increases fitness levels for people involved in exercises.
- (iii) **Fartlek Training:** Fartlek, which means “speed play” in Swedish, is a training method that blends continuous training with interval training. The variable intensity and continuous nature of the exercise places stress on both the aerobic and anaerobic systems. It differs from traditional interval training as it is unstructured; intensity and/or speed vary, as the athlete wishes. Fartlek training can be used to improve both the aerobic and anaerobic systems by mixing moderate activity with bursts of speed.
17. (i) **Endomorphic:** An endomorphic somatotype is also known as a viscerotonic. The characteristic traits of this somatotype usually includes being relaxed, tolerant, comfortable, and sociable. Psychologically, they are also fun-loving, good humoured, even-tempered, and they love food and affection. The Endomorph is physically “round”. They have wide hips and narrow shoulders that give a pear-shape.
They tend to have a lot of extra fat on their body and on their arms and thighs. They have skinny ankles and wrists that make the rest of their body look even bigger.
- (ii) **Ectomorphic:** An ectomorph is the complete opposite of the endomorph. Physically, they have narrow shoulders, thin legs and arms, little fat on the body, a narrow face and a narrow chest. They may eat just as much as the endomorph but never seem to gain any weight. They always stay skinny. Personality wise, they tend to be self-conscious, socially anxious, artistic, thoughtful, quiet, and private. They always keep to themselves and are afraid to branch out.
- (iii) **Mesomorphic:** The mesomorph is in between the endomorph and thin ectomorph. They have an attractive and desirable body. Physically, they tend to have a large head and broad shoulders with a narrow waist. They have a strong muscular body and strong arms and legs and little fat on their body. They work for the body they have so that they could have an attractive body. Psychologically, the mesomorph is adventurous and courageous. They are not afraid to break out and do new things with new people. They are assertive.
18. The steps and benefits of Vajrasana are:
- Steps of Vajrasana:**
- (i) Kneel down on the ground and stretch the lower legs back while you keep them together. Make sure that your big toes perfectly cross each other.
- (ii) Lower your body gently in such a manner that your buttocks rest on the heels with your thighs placed on the calf muscles.
- (iii) Now place both hands on the knees and focus your gaze forward while keeping your head perfectly straight.

- (iv) Direct your attention to the rhythm of your breathing. Enhancing the awareness of your breathing process and observe carefully the way you breathe in and breathe out.
- (v) Close your eyes for calming your mind and concentrating on your breathing process.
- (vi) Stay in this final position for at least 5-10 minutes.

Benefits of Vajrasana:

- (i) Vajrasana can ease out the labour pains during pregnancy and minimize menstrual cramps.
- (ii) It strengthens the sexual organs, cures joint pains, tones body muscles in the thighs, hips, and calves and removes urinary problems.
- (iii) It can help in minimizing belly fat and also assist in losing weight.
- (iv) Vajrasana can also help the practitioner to attain a calm and relaxed state of mind. It can help in improving the functioning of the nerves.
- (v) This asana can also help in improving the functions of the liver.
- (vi) It removes gas and flatulence.
- (vii) The asana can make the ankle and knee joints flexible, thus preventing some forms of rheumatic diseases.
- (viii) It can also remove the pain associated with arthritis.



Blueprint of the Sample Question Paper

S. No.	Chapter Name	Marks		
		2	3	5
	Section – A			
1	Semiconductors, Electronics Materials, Devices and Simple Circuits	✓		
2	Atoms	✓		
Or	Dual Nature of Radiation and Matter			
3	Semiconductors, Electronics Materials, Devices and Simple Circuits	✓		
	Section – B			
4	Atoms		✓	
5	Semiconductors, Electronics Materials, Devices and Simple Circuits		✓	
6	Nuclei		✓	
7	Wave Optics		✓	
8	Ray Optics and Optical Instrument		✓	
Or	Ray Optics and Optical Instrument			
9	Dual Nature of Radiation and Matter		✓	
10	Ray Optics and Optical Instrument		✓	
11	Electromagnetic Wave		✓	
Or	Wave Optics			
	Section – C			
12	Ray Optics and Optical Instrument			✓



Sample Question Paper

PHYSICS THEORY [Code (042)]

Term - II

Time : 2 Hrs.

Max. Marks : 35

General Instructions :

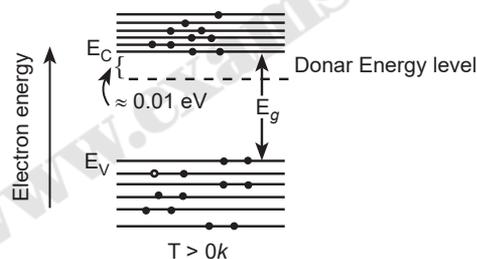
- There are 12 questions in all. All questions are compulsory.
- This question paper has three sections: Section A, Section B and Section C.
- Section A contains three questions of two marks each, Section B contains eight questions of three marks each, Section C contains one case study-based question of five marks.
- There is no overall choice. However, an internal choice has been provided in one question of two marks and two questions of three marks. You have to attempt only one of the choices in such questions.
- You may use log tables if necessary but use of calculator is not allowed.

SECTION A

- In a pure semiconductor crystal of Si, if antimony is added then what type of extrinsic semiconductor is obtained. Draw the energy band diagram of this extrinsic semiconductor so formed.

Ans. As antimony is added to pure Si crystal, then a n -type extrinsic semiconductor would be obtained, since antimony (Sb) is a pentavalent impurity.

Energy level diagram of n -type semiconductor:



- Consider two different hydrogen atoms. The electron in each atom is in an excited state. Is it possible for the electrons to have different energies but same orbital angular momentum according to the Bohr model? Justify your answer.

Ans. No, the electrons with different energies cannot have the same angular momentum. This is because according to Bohr model, $E_n = -\frac{13.6}{n^2}$ eV. When E_n is different, n must be different. And angular

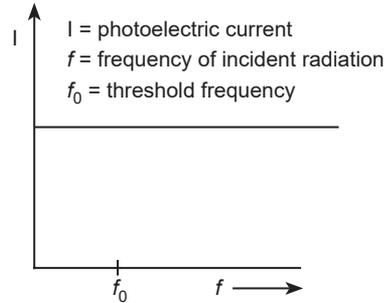
momentum, $mvr = \frac{nh}{2\pi}$ must be different for different n values.

OR

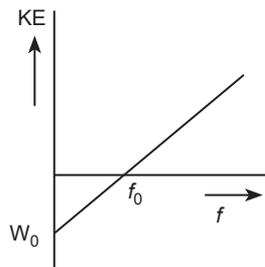
Explain how does (i) photoelectric current and (ii) kinetic energy of the photoelectrons emitted in a photocell vary if the frequency of incident radiation is doubled, but keeping the intensity same?

Show the graphical variation in the above two cases.

Ans. (i) The increase in the frequency of incident radiation has no effect on photoelectric current. This is because of incident photon of increased energy cannot eject more than one electron from the metal surface.



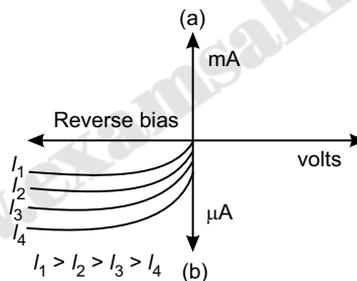
- (ii) The kinetic energy of photoelectrons becomes more than the double of its original energy. As the work function of the metal is fixed, so incident photon of higher frequency and hence higher energy will impart more energy to the photoelectrons.



3. Name the device which converts the change in intensity of illumination to change in electric current flowing through it. Plot I-V characteristics of this device for different intensities. State any two applications of this device.

Ans. Photodiodes are used to detect optical signals of different intensities by changing current flowing through them.

I-V characteristics of a Photodiode:



Applications of Photodiodes:

1. In detection of optical signals.
2. In demodulation of optical signals.
3. In light operated switches.
4. In speed reading of computer punched cards.
5. In electric counters.

SECTION B

4. Derive an expression for the frequency of radiation emitted when a hydrogen atom de-excites from level n to level $(n - 1)$. Also show that for large values of n , this frequency equals to classical frequency of revolution of an electron.

Ans. From Bohr's theory, the frequency f of the radiation emitted when an electron de-excites from level n_2 to level n_1 is given as:

$$f = \frac{2\pi^2mk^2z^2e^4}{h^2} \left[\frac{1}{n_1^2} - \frac{1}{n_2^2} \right]$$

Given,

$$n_1 = n - 1,$$

$$n_2 = n,$$

$$f = \frac{2\pi^2mk^2z^2e^4}{h^2} \frac{(2n-1)}{(n-1)^2 n^2}$$

For large values of n , $2n - 1 \approx 2n$,
 $n - 1 \approx n$

and $z = 1$

Thus,
$$f = \frac{4\pi^2mk^2e^4}{n^3h^3}$$

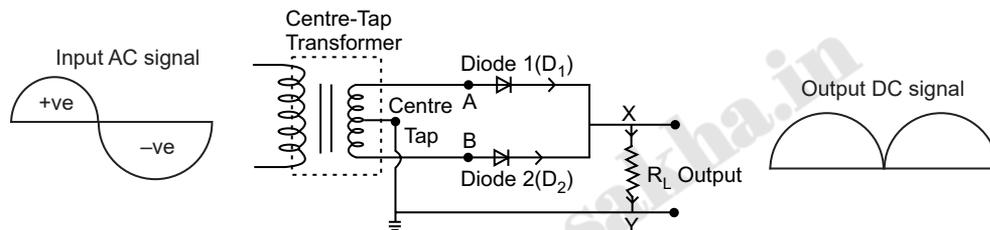
Which is same as orbital frequency of electron in n^{th} orbit.

$$f = \frac{v}{2\pi r} = \frac{4\pi^2mk^2e^4}{n^3h^3}$$

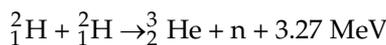
5. Explain with a proper diagram how an ac signal can be converted into dc (pulsating) signal with output frequency as double than the input frequency using $p-n$ junction diode. Give its input and output waveforms.

Ans. A junction diode allows current to pass only when it is forward biased. So, if an alternating voltage is applied across a diode the current flows only in that part of the cycle when the diode is forward biased. This property is used to rectify alternating voltages and the circuit used for this purpose is called a rectifier.

Circuit Diagram:



6. How long can an electric lamp of 100 W be kept glowing by fusion of 2 kg of deuterium? Take the fusion reaction as:



Ans. Number of atoms present in 2 g of deuterium = 6.023×10^{23}

$$\text{Number of atoms present in 2 kg of deuterium} = \frac{6.023 \times 10^{23} \times 2000}{2} = 6.023 \times 10^{26}$$

Energy released in fusion of 2 deuterium atoms = 3.27 MeV

Energy released in fusion of 2 kg of deuterium atoms

$$= \frac{3.27}{2} \times 6.023 \times 10^{26} \text{ MeV}$$

$$= 9.85 \times 10^{26} \text{ MeV}$$

$$= 15.75 \times 10^{13} \text{ J}$$

Energy consumed by bulb per sec = 100 J

$$\text{Time for which bulb will glow} = \frac{15.75 \times 10^{13}}{100} \text{ s} = 15.75 \times 10^{11} \text{ sec}$$

$$\text{Number of years} = \frac{15.75 \times 10^{11} \text{ sec}}{365 \times 24 \times 60 \times 60}$$

$$= 4.99 \times 10^4 \text{ years.}$$

7. Define wavefront. Draw the shape of refracted wavefront when the plane incident wave undergoes refraction from optically denser medium to rarer medium. Hence prove Snell's law of refraction.

Ans. (i) **Wavefront:** The continuous locus of all the particles of a medium, which are vibrating in the same phase is called a wavefront.

(ii) **Snell's law of refraction:** Let PP' represent the surface separating medium 1 and medium 2 as shown in figure.

Let v_1 and v_2 represent the speed of light in medium 1 and medium 2 respectively. We assume a plane wavefront AB propagating in the direction A'A incident on the interface at an angle i . Let t be the time taken by the wavefront to travel the distance BC.

$\therefore BC = v_1 t$ [distance = speed \times time]

In order to determine the shape of the refracted wavefront, we draw a sphere of radius $v_2 t$ from the point A in the second medium (the speed of the wave in second medium is v_2)

Let CE represent a tangent plane drawn from the point C. Then $AE = v_2 t$.

\therefore CE would represent the refracted wavefront.

In $\triangle ABC$ and $\triangle AEC$, we have

$$\sin i = \frac{BC}{AC} = \frac{v_1 t}{AC} \text{ and } \sin r = \frac{AE}{AC} = \frac{v_2 t}{AC}$$

where i and r are angles of incident and refraction respectively.

$$\therefore \frac{\sin i}{\sin r} = \frac{v_1 t}{v_2 t} \cdot \frac{AC}{AC}$$

$$\Rightarrow \frac{\sin i}{\sin r} = \frac{v_1}{v_2}$$

If c represents the speed of light in vacuum, then

$$n_1 = \frac{c}{v_1} \text{ and } n_2 = \frac{c}{v_2}$$

$$\Rightarrow v_1 = \frac{c}{n_1} \text{ and } v_2 = \frac{c}{n_2}$$

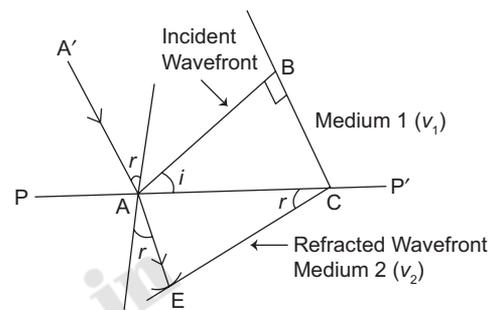
Where n_1 and n_2 are the refractive indices of medium 1 and medium 2.

$$\therefore \frac{\sin i}{\sin r} = \frac{c/n_1}{c/n_2}$$

$$\Rightarrow \frac{\sin i}{\sin r} = \frac{n_2}{n_1}$$

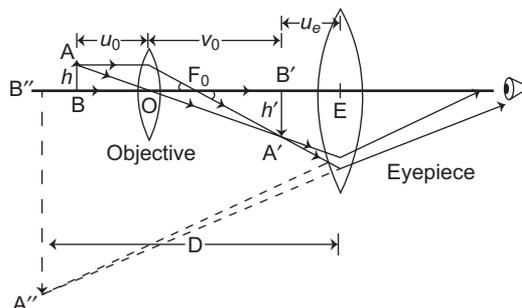
$$\Rightarrow n_1 \sin i = n_2 \sin r$$

This is the Snell's law of refraction.



8. (a) Draw a ray diagram of compound microscope for the final image formed at least distance of distinct vision?
 (b) An angular magnification of 30X is desired using an objective of focal length 1.25 cm and an eye piece of focal length 5 cm. How will you set up the compound microscope for the final image formed at least distance of distinct vision?

Ans. (a) Ray diagram of a compound microscope for the final image formed at least distance of distinct vision:



- (b) Given: $m = 30, f_0 = 1.25 \text{ cm}, f_e = 5 \text{ cm}$
 When image is formed at least distance of distinct vision,
 $D = 25 \text{ cm}$

Angular magnification of eyepiece

$$m_e = \left(1 + \frac{D}{f_e}\right) = 1 + \frac{25}{5} = 6$$

Total Angular magnification, $m = m_0 m_e$

$$\Rightarrow m_0 = \frac{m}{m_e} = \frac{30}{6} = 5$$

As the objective lens forms the real image.

$$m_0 = \frac{v_0}{u_0} = -5$$

$$\Rightarrow v_0 = -5u_0$$

Using lens equation, we get, $u_0 = -1.5 \text{ cm}, v_0 = -5 \times (-1.5) \text{ cm} = +7.5 \text{ cm}$

Given $v_e = -D = -25 \text{ cm}, f_e = +5 \text{ cm}, u_e = ?$

$$\text{Using again lens equation, we get, } u_e = \frac{25}{6}$$

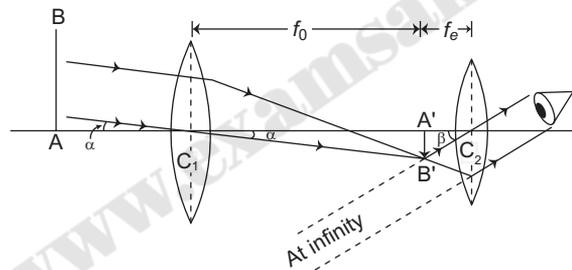
Thus, object is to be placed at 1.5 cm from the objective and separation between the two lenses should be

$$L = v_0 + |u_e| = 11.67 \text{ cm.}$$

OR

- (a) Draw a ray diagram of Astronomical Telescope for the final image formed at infinity.
- (b) A small telescope has an objective lens of focal length 140 cm and an eyepiece of focal length 5.0 cm. Find the magnifying power of the telescope for viewing distant objects when:
 - (i) the telescope is in normal adjustment
 - (ii) the final image is formed at the least distance of distinct vision.

Ans. (a) Ray diagram of a Astronomical telescope for the final image formed as infinity:



- (b) (i) Given:
 - Focal length of the objective lens, $f_0 = 140 \text{ cm}$
 - Focal length of the eyepiece, $f_e = 5 \text{ cm}$
 - Least distance of distinct vision, $D = 25 \text{ cm}$
 When the telescope is in normal adjustment, its magnifying power is given as:

$$m = -\frac{f_0}{f_e} = -28$$

- (ii) When the final image is formed at d , its magnifying power is given as:

$$m = -\frac{f_0}{f_e} \left(1 + \frac{f_e}{D}\right)$$

$$= -\frac{140}{5} \left(1 + \frac{5}{25}\right) = -33.6$$

9. Light of wavelength 2000 \AA falls on a metal surface of work function 4.2 eV .

- (a) What is the kinetic energy (in eV) of the fastest electrons emitted from the surface?
- (b) What will be the change in the energy of the emitted electrons if the intensity of light with same wavelength is doubled?

- (c) If the same light falls on another surface of work function 6.5 eV, what will be the energy of emitted electrons?

Ans. (a)

$$\lambda = 2000 \text{ \AA} = 2000 \times 10^{-10} \text{ m}$$

$$W_0 = 4.2 \text{ eV}$$

$$h = 6.63 \times 10^{-34}$$

$$\frac{hc}{\lambda} = W_0 + \text{KE}$$

or

$$\text{K.E.} = \frac{hc}{\lambda} - W_0$$

$$= \frac{(6.63 \times 10^{-34}) \times (3 \times 10^8)}{(2000 \times 10^{-10})} \times \frac{1}{1.6 \times 10^{-19}} \text{ eV} - 4.2 \text{ eV}$$

$$= (6.2 - 4.2) \text{ eV} = 2.0 \text{ eV.}$$

- (b) The energy of the emitted electrons does not depend upon intensity of incident light; hence the energy remains unchanged.
 (c) For this surface, electrons will not be emitted as the energy of incident light (6.2 eV) is less than the work function (6.5 eV) of the surface.

10. The focal length of a convex lens made of glass of refractive index (1.5) is 20 cm.

What will be its new focal length when placed in a medium of refractive index 1.25 ?

Is focal length positive or negative? What does it signify?

Ans. Given,

$$a_{\mu_g} = 1.5$$

Focal length of the given convex lens which it is placed in air is

$$f = +20 \text{ cm}$$

$$\frac{1}{f} = (a_{\mu_g} - 1) \left[\left(\frac{1}{R_1} \right) - \left(\frac{1}{R_2} \right) \right] \quad \dots(A)$$

Refractive index of the given medium with respect to air is

$$a_{\mu_m} = 1.25$$

New focal length of the given convex lens when placed in a medium is f' .

$$\frac{1}{f'} = (m_{\mu_g} - 1) \left[\left(\frac{1}{R_1} \right) - \left(\frac{1}{R_2} \right) \right] \quad \dots(B)$$

Dividing (A) by (B), we get

$$\frac{f'}{f} = \frac{(a_{\mu_g} - 1)}{(m_{\mu_g} - 1)} = \frac{(1.5 - 1)}{(1.2 - 1)} = \frac{0.5}{0.2} = \frac{5}{2} = 2.5$$

$$f' = 2.5f = (2.5 \times 20) \text{ cm} = +50 \text{ cm as } m_{\mu_g} = \frac{\mu_g}{\mu_m} = \frac{1.5}{1.25} = 1.2$$

New focal length is positive.

The significance of the positive sign of the focal length is that given convex lens is still converging in the given medium.

11. (a) Name the E.M. waves which are suitable for radar systems used in aircraft navigation. Write the range of frequency of these waves.
 (b) If the Earth did not have atmosphere, would its average surface temperature be higher or lower than what it is now? Explain.
 (c) An E.M. wave exerts pressure on the surface on which it is incident. Justify.

Ans. (a) Microwaves are suitable for radar systems used in aircraft navigation. The range of frequency for these waves is 10^9 Hz to 10^{12} Hz.

- (b) There would be no greenhouse effect on the surface of the Earth in the absence of atmosphere. As a result, the temperature of the Earth would decrease rapidly, making it difficult for human survival.
- (c) When the wave is incident on the metal surface, it is completely absorbed. Energy U and hence momentum ($p = E/C$) is delivered to the surface of the earth. The momentum delivered becomes twice when, the wave is totally reflected because momentum is changed from p to $-p$. Thus, force is acting and thereby pressure is exerted on the surface of the earth by EM waves.

OR

- (a) "If the slits in Young's double slit experiment are identical, then intensity at any point on the screen may vary between zero and four times to the intensity due to single slit".
Justify the above statement through a relevant mathematical expression.
- (b) Draw the intensity distribution as function of phase angle when diffraction of light takes place through coherently illuminated single slit.

Ans. (a) The total intensity at a point where the phase difference is ϕ , is given by $I = I_1 + I_2 + 2\sqrt{I_1 I_2} \cos \phi$.

Here I_1 and I_2 are the intensities of two individual sources which are equal *i.e.*, $I_1 = I_2$.

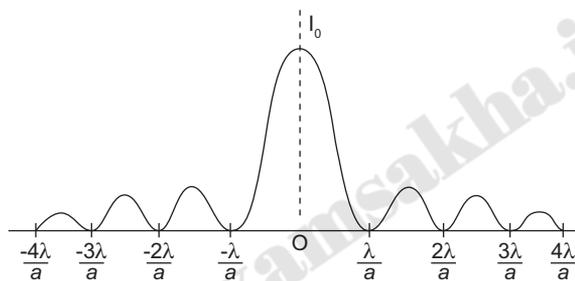
When ϕ is 0, $I = 4I_1$.

When ϕ is 180° , $I = 0$.

Thus intensity on the screen varies between $4I_1$ and 0.

- (b) Intensity distribution as function of phase angle, when diffraction of light takes place through coherently illuminated single slit.

The intensity pattern on the screen is shown in the given figure.



$$\text{Width of central maximum} = \frac{2D\lambda}{a}$$

SECTION C

12. CASE STUDY: MIRAGE IN DESERTS

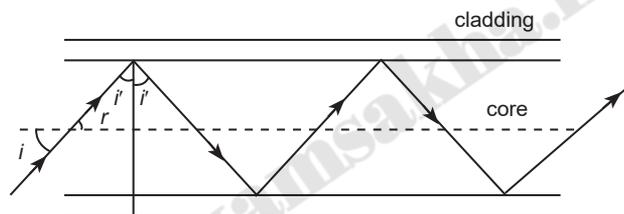


To a distant observer, the light appears to be coming from somewhere below the ground. The observer naturally assumes that light is being reflected from the ground, say, by a pool of water near the tall object.

Such inverted images of distant tall objects cause an optical illusion to the observer. This phenomenon is called mirage. This type of mirage is especially common in hot deserts.

Based on the above facts, answer the following questions:

- (a) Which of the following phenomena is prominently involved in the formation of mirage in deserts? [1]
- Refraction, Total internal Reflection
 - Dispersion and Refraction
 - Dispersion and scattering of light
 - Total internal Reflection and diffraction
- (b) A diver at a depth 12 m inside water ($\mu_{\text{water}} = \frac{4}{3}$) sees the sky in a cone of semi- vertical angle: [1]
- $\sin^{-1} \frac{4}{3}$
 - $\tan^{-1} \frac{4}{3}$
 - $\sin^{-1} \frac{3}{4}$
 - 90°
- (c) In an optical fibre, if n_1 and n_2 are the refractive indices of the core and cladding, then which among the following, would be a correct equation? [1]
- $n_1 < n_2$
 - $n_1 = n_2$
 - $n_1 \ll n_2$
 - $n_1 > n_2$
- (d) A diamond is immersed in such a liquid which has its refractive index with respect to air as greater than the refractive index of water with respect to air. Then the critical angle of diamond-liquid interface as compared to critical angle of diamond -water interface will: [1]
- depend on the nature of the liquid only
 - decrease
 - remain the same
 - increase.
- (e) The following figure shows a cross-section of a 'light pipe' made of a glass fiber of refractive index 1.68. The outer covering of the pipe is made of a material of refractive index 1.44. What is the range of the angles of the incident rays with the axis of the pipe for the following phenomena to occur? [1]



- $0 < i < 90^\circ$
- $0 < i < 60^\circ$
- $0 < i < 45^\circ$
- $0 < i < 30^\circ$

Ans. (a) (i) Refraction, Total internal reflection

Explanation: The mirage is formed because of Total Internal Reflection and refraction.

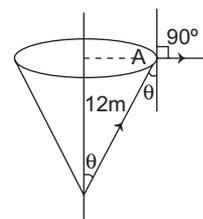
Mirage is a naturally occurring optical illusion in which light rays bend to produce a displaced image of distant objects or the sky.

- (b) (iii) $\sin^{-1} \left(\frac{3}{4} \right)$

Explanation: Given: $\mu = \frac{4}{3}$ and $\mu_{\text{air}} = 1$

The ray emerges out of water making an angle 90° with the water surface, i.e., Using Snell's law of refraction at point A:

$$\begin{aligned} \Rightarrow \mu \sin \theta &= \mu_{\text{air}} \sin r \\ \Rightarrow \frac{4}{3} \times \sin \theta &= 1 \times \sin 90^\circ \\ \Rightarrow \frac{4}{3} \times \sin \theta &= 1 \times 1 \\ \Rightarrow \sin \theta &= \frac{3}{4} \\ \Rightarrow \theta &= \sin^{-1} \left(\frac{3}{4} \right) \end{aligned}$$



- (c) (iv)
- $n_1 > n_2$

Explanation: The refractive index of the core should be greater than the refractive index of the cladding.

- (d) (iv) Increases

Explanation: ${}^i\mu_d = \frac{1}{\sin C} = \frac{\mu_d}{\mu_l}$, ${}^\omega\mu_d = \frac{1}{\sin C'} = \frac{\mu_d}{\mu_\omega}$

$$\mu_l > \mu_\omega$$

$$C > C'$$

Thus

- (e) (ii)
- $0 < i < 60^\circ$

Explanation: ${}^1\mu_2 = \frac{1}{\sin C'}$

$$\sin C' = \frac{1.44}{1.68} = 0.8571$$

$$\Rightarrow C' = 59^\circ$$

Total internal reflection will occur if the angle $i' > i'_c$.

i.e., if $i' > 59^\circ$ or when $r < r_{\max}$ where $r_{\max} = 90^\circ - 59^\circ = 31^\circ$.

Using Snell's law,

$$\frac{\sin i_{\max}}{\sin r_{\max}} = 1.68$$

or

$$\begin{aligned} \sin i_{\max} &= 1.68 \times \sin r_{\max} \\ &= 1.68 \times \sin 31^\circ \\ &= 1.68 \times 0.5150 \\ &= 0.8662 \end{aligned}$$

$$\therefore i_{\max} = 60^\circ$$

Thus all incident rays which makes angles in the range $0 < i$

60° with the axis of the pipe will suffer total internal reflections in the pipe.





Sample Paper

1

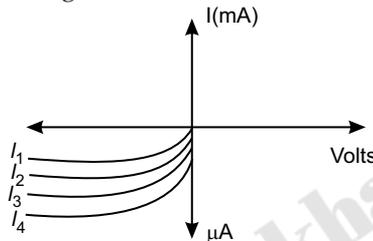
Physics

Section - A

1. In a $p-n$ junction diode the forward bias resistance is low as compared to the reverse bias resistance. Give reason.
2. The wavelength of the first line of Lyman series is 1215 \AA . Calculate the wavelength of first line of Balmer series.

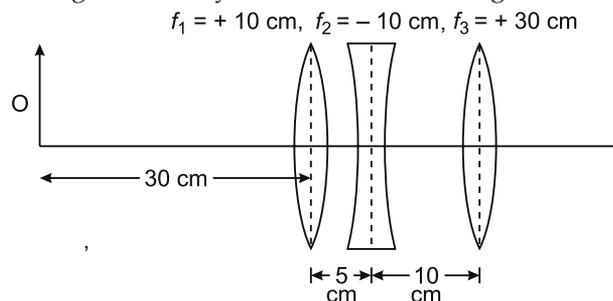
OR

- (a) For a given frequency, plot a graph between photoelectric current and intensity of light.
 - (b) Plot a graph between de-Broglie wavelength and the momentum of a particle.
3. Why is a photodiode operated in reverse bias mode? The given figure shows reverse bias current under different illuminating intensities I_1, I_2, I_3 and I_4 for a given photodiode. Arrange the intensities I_1, I_2, I_3 and I_4 in decreasing order of wavelengths.



Section - B

4. A slit of width 0.025 mm is placed in front of a lens of focal length 50 cm . The slit is illuminated with light of wavelength 5900 \AA . Calculate the distance between the centre and first dark band of diffraction pattern on a screen placed at the focal plane of the lens.
5. Consider the fusion reaction: ${}^4\text{He} + {}^4\text{He} \rightarrow {}^8\text{Be}$
For the reaction, find (i) mass defect, (ii) Q-value, (iii) is such a fusion energetically favourable?
Atomic mass of ${}^8\text{Be}$ is $8.0053 u$ and that of ${}^4\text{He}$ is $4.0026 u$.
6. Find the position of the image formed by the lens combination given in the figure.



7. Why are de-Broglie waves associated with a moving football not visible? The wavelength λ of a photon and the de-Broglie wavelength of an electron have the same value. Show that the energy of the photon is $\frac{2\lambda mc}{h}$ times the kinetic energy of the electron, where m, c and h have their usual meanings.
8. A beam of light consisting of two wavelengths 800 nm and 600 nm is used to obtain the interference fringes in a Young's double slit experiment on a screen placed 1.4 m away. If the two slits are separated by 0.28 mm , calculate the least distance from the central bright maximum where the bright fringes of the two wavelengths coincide.

OR

Answer the following questions:

- (a) A diver under water, looks obliquely at a fisherman standing on the bank of a lake. Would the fisherman look taller or shorter to the diver than what he actually is?
- (b) Does the apparent depth of a tank of water change if viewed obliquely? If so, does the apparent depth increase or decrease?
- (c) The refractive index of diamond is much greater than that of ordinary glass. Is this fact of some use to a diamond cutter?
9. Show that in Bohr's hydrogen atom $r \propto n^2$, where r is the radius and n is the principal quantum number.
10. In an intrinsic semiconductor the energy gap E_g is 1.2 eV. Its hole mobility is much smaller than electron mobility and independent of temperature. What is the ratio between conductivity at 600 K and that 300 K? Assume that the temperature dependence of intrinsic carrier concentration n_i is given by

$$n_i = n_0 \exp \left[-\frac{E_g}{2k_B T} \right]$$

Where n_0 is a constant.

11. The oscillating electric field of an electromagnetic wave is given by

$$E_y = 30 \sin [2 \times 10^{11} t + 300 \pi x] \text{ Vm}^{-1}.$$

- (a) Obtain the value of the wavelength of the electromagnetic wave.
- (b) Write down the expression for the oscillating magnetic field.

OR

Explain the following, giving reasons:

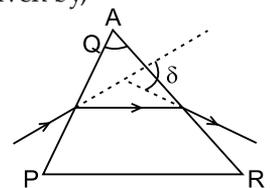
- (a) When monochromatic light is incident on a surface separating two media, the reflected and refracted light both have the same frequency as the incident frequency.
- (b) When light travels from a rarer to a denser medium, the speed decreases. Does this decrease in speed imply a reduction in the energy carried by the wave?
- (c) In the wave picture of light, intensity of light is determined by the square of the amplitude of the wave. What determines the intensity in the photon picture of light?

Section - C

12. Refraction through prism :

Prism is a glass structure which has two rectangular faced inclined at an angle. It has total 3 rectangular faces and 2 triangular faces. When light is allowed to pass through the prism, it refracts at two surfaces, due to refraction light deviates from its original path. This angle to deviation is given by,

$$\delta = (\mu - 1) A$$

Where $\delta \rightarrow$ Angle of deviation $\mu \rightarrow$ Refractive index of prism $A \rightarrow$ Angle of prism.

- (a) How many rectangular faced are there in a prism?
- (i) 4 (ii) 3 (iii) 2 (iv) 5
- (b) The number of triangular faces in prism are:
- (i) 5 (ii) 3 (iii) 2 (iv) None
- (c) In the above diagram, how many faces are taking part in refraction of light?
- (i) 1 (ii) 2 (iii) 3 (iv) 5
- (d) What will be the refractive index of prism in terms of A and δ ?
- (i) $\frac{A}{\delta} + 1$ (ii) $\frac{A}{\delta} - 1$ (iii) $\frac{\delta}{A} + 1$ (iv) $\frac{\delta}{A} - 1$
- (e) The deviation made by prism of angle 5° with refractive index 1.611 be:
- (i) 2.055 (ii) 1.055 (iii) 3.065 (iv) 3.055





Sample Paper

2

Physics

Section - A

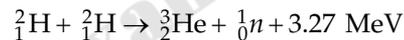
1. The number of silicon atoms per m^3 is 5×10^{28} . This is doped simultaneously with 5×10^{22} atoms per m^3 of Arsenic and 5×10^{20} per m^3 atoms of Indium. Calculate the number of electrons and holes. Given that $n_i = 1.5 \times 10^{16} \text{ m}^{-3}$. Is the material n -type or p -type?
2. (a) What is the shortest wavelength in the Balmer series?
(b) What is the maximum number of spectral lines emitted by a hydrogen atom when it is in the third excited state?

OR

- Find the de-Broglie wavelength of an electron beam accelerating through a potential difference of 60 V.
3. Why do we get a small current (in mA) through a p - n junction diode under reverse bias condition? In which direction does this current flow through the junction?

Section - B

4. Violet light is incident on a thin convex lens. If this light is replaced by red light, explain with reason, how the power of the lens would change?
5. State the main assumptions of Rutherford's model of atom.
6. Distinguish between conductors, insulators and semiconductors in terms of energy band diagrams. Draw the diagrams.
7. Calculate for how many years will the fusion of 2.0 kg deuterium keep 800 W electric lamp glowing. Take the fusion reaction as:



8. Two lenses of power 10 D and -5 D are placed in contact.
(a) Calculate the power of combination of lens.
(b) Where should an object be held from the lens, so as to obtain a virtual image of magnification 2?

OR

- (a) A small telescope has an objective lens of focal length 140 cm and an eyepiece of focal length 5.0 cm. Find the magnifying power of the telescope for viewing distant objects when:
(i) the telescope is in normal adjustment.
(ii) the final image is formed at the least distance of distinct vision.
(b) Also, find the separation between the objective lens and the eye piece in normal adjustment.
9. Describe briefly how a diffraction pattern is obtained on a screen due to a single narrow slit illuminated by a monochromatic source of light.
10. Following observations were made during an experiment on photoelectric emission:
(i) wavelength of the incident light = $2 \times 10^{-7} \text{ m}$
(ii) stopping potential = 3 V.
Using the above observations, find:
(a) kinetic energy of photoelectrons with maximum speed.
(b) work function
(c) threshold frequency ($h = 6.62 \times 10^{-34} \text{ Js}$)
11. (a) The amplitude of the magnetic field of a harmonic electromagnetic wave in vacuum is $B_0 = 510 \text{ nT}$. What is the amplitude of the electric field part of the wave?
(b) What is the frequency of electromagnetic waves produced by oscillating charge of frequency f ?

OR

In a single slit diffraction experiment, a slit of width d is illuminated by red light of wavelength 650 nm. For what value of d will (i) the first minimum fall at an angle of diffraction of 30° and (ii) the first maximum fall at an angle of diffraction of 30° ?

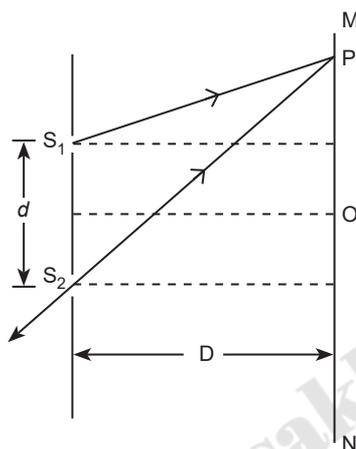
Section - C

12. Case Study : Young's double slit experiment

Young's Double slit experiment was done by Thomas Young to demonstrate experimentally the interference of light. In this, coherent sources of monochromatic light are used. Here two sources of monochromatic light are obtained by placing two slits before a single light source. As light rays pass from the slits and interference of light takes place. The interference fringes are obtained at screen MN. The fringe obtained at the centre of screen is a bright fringe

$$\text{Fringe width } (\beta) = \lambda D/d,$$

where β – Fringe width, D – Distance between screen and slit, d – Distance between slits.



- (a) What kind of light sources are used in this experiment?
 (i) Monochromatic (ii) Dichromatic (iii) Trichromatic (iv) None of these
- (b) How many slits are used in this experiment?
 (i) Two (ii) One (iii) Three (iv) None of these
- (c) The central fringe in the experiment is:
 (i) Dark (ii) Very dark (iii) Bright (iv) None of these
- (d) What kind of phenomena of light is demonstrated with this experiment?
 (i) Reflection (ii) Refraction (iii) Interference (iv) Diffraction
- (e) What will be the ratio of fringe width β_1 and β_2 obtained with red light of $\lambda_1 = 660$ nm and ultraviolet light of $\lambda_2 = 165$ nm ?
 (i) 1 : 4 (ii) 4 : 1 (iii) 2 : 1 (iv) 1 : 2





Sample Paper

3

Physics

Section - A

1. Plot a graph showing variation of current versus voltage for the material Ga.
2. State Huygens' principle.

OR

Two sources with intensity I_0 and $4I_0$ respectively, interfere at a point in a medium. Find the ratio of (i) maximum and minimum possible intensities, (ii) ratio of amplitudes.

3. How are p -type semiconductors produced?

Section - B

4. Do the frequency and wavelength change when light passes from a rarer to a denser medium?
5. The current in the forward bias is known to be more (\sim mA) than the current in the reverse bias (\sim μ A). What is the reason to operate the photodiodes in reverse bias?
6. A concave lens of refractive index 1.5 is immersed in a medium of refractive index 1.65. What is the nature of the lens?
7. Plot a graph showing variation of de-Broglie wavelength λ versus $\frac{1}{\sqrt{V}}$, where V is accelerating potential for two particles A and B carrying same charge but of masses m_1, m_2 ($m_1 > m_2$). Which one of the two represents a particle of smaller mass and why?
8. (a) How will you distinguish between a microscope and a telescope just by looking at them?
(b) A compound microscope has an objective of focal length 1 cm and an eye piece of focal length 2.5 cm. An object has to be placed at a distance of 1.2 cm away from the objective for normal adjustment. Find the angular magnification and length of the microscope tube.

OR

Explain why?

- (a) A diamond glitters in a brightly lit room, but not in a dark room.
 - (b) A crack in a window pane appears silvery.
 - (c) The bubbles of air rising up in a water tank appear silvery when viewed from top.
9. A beam of light consisting of two wavelengths, 650 nm and 520 nm is used to obtain interference fringes in a Young's double-slit experiment.
 - (a) Find the distance of the third bright fringe on the screen from the central maximum for wavelength 650 nm. If slit width 2 mm and distance of screen from slits is 1.2 m.
 - (b) What is the least distance from the central maximum where the bright fringes due to both the wavelengths coincide?
 10. Draw a plot of potential energy of a pair of nucleons as a function of their separation. Write two important conclusions which you can draw regarding the nature of nuclear forces.
 11. Write down properties of E.M. wave.

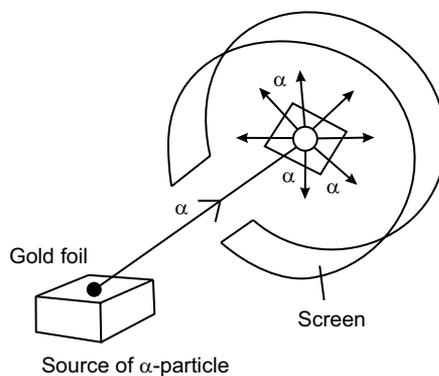
OR

What are electromagnetic waves? Give some characteristics of electromagnetic waves.

Section – C

12. Case Study:

Rutherford's model of atom: This model of atom was given by Rutherford. According to him each atom have tiny core at its centre which is called nucleus of the atom. In the nucleus whole mass and positive charge of the nucleus is concentrated. The size of the nucleus is of the order of 10^{-15} m and atomic size is about 10^{-10} m.



The nucleus of the atom is surrounded by a number of electrons. But whole atom is electrically neutral. These electrons revolve in certain orbits around the nucleus of an atom the electrons get centripetal force from the electrostatic force between nucleus and electrons.

- (a) The tiny core at the centre of atom is:
 (i) Electron (ii) Atom (iii) Nucleus (iv) Proton
- (b) Whole mass of the atom is concentrated at:
 (i) Periphery of atom (ii) Nucleus (iii) Proton (iv) None of these
- (c) The size of the nucleus is of the order of:
 (i) 10^{15} m (ii) 10^{-5} m (iii) 10^{-15} m (iv) 10^{10} m
- (d) The nucleus of the atom is surrounded by a number of:
 (i) Proton (ii) Neutron (iii) Electron (iv) None of these
- (e) Atom is electrically:
 (i) Positive (ii) Negative (iii) Earthed (iv) Neutral





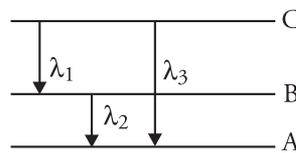
Sample Paper

4

Physics

Section - A

1. Define the V-I characteristics of junction diode.
2. Find the relation between the three wavelengths λ_1 , λ_2 and λ_3 from the energy level diagram shown.



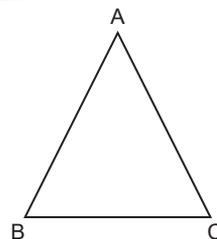
OR

Calculate the de-Broglie wavelength of an electron.

3. What is a photodiode ? Explain in brief. Mention some uses of photodiode.

Section - B

4. The optical density of turpentine is higher than that of water while its mass density is lower. Figure shows a layer of turpentine floating over water in a container. For which one of the four rays incident on turpentine in figure, the path shown is correct?
5. Draw a labelled diagram of a full wave rectifier circuit. Explain briefly the functions of its components. Sketch the input and output wave forms.
6. There are two sources of light A and B. the wavelength of light emitted from A is from 8000 \AA to 11000 \AA , while that from B is from 3000 \AA to 6000 \AA . The intensity of A is 4 times that of B. But when light of A falls on a metal, photoelectrons are not emitted, whereas light of B eject photoelectrons from the same metal. Explain its reasons.
7. (a) Name the radiations of electromagnetic spectrum which are used in:
 - (i) Warfare to look through haze.
 - (ii) Radar and geostationary satellites.
 - (iii) Studying the structure and properties of atoms and molecules.(b) Find the wavelength of electromagnetic waves of frequency $5 \times 10^{19} \text{ Hz}$ in free space. Give its two applications.
8. (a) A ray of light incident on face AB of an equilateral glass, shows minimum deviation of 30° . Calculate the speed of light through the prism.



- (b) Find the angle of incident of face AB so that the emergent ray grazes along the face AC.

OR

- (a) In a single slit diffraction pattern how is the angular width of central bright maximum changed, when:
 - (i) The slit width is decreased.
 - (ii) The distance between the slit and the screen is increased.
 - (iii) λ is decreased.

- (b) How does the intensity of central maximum change if the width of the slit is halved in a single slit diffraction experiment?
9. Suppose, we think of fission of a ${}^{56}_{26}\text{Fe}$ nucleus into two equal fragments, ${}^{58}_{13}\text{Al}$. Is the fission energetically possible? Argue by working out Q of the process.
Given: $m({}^{56}_{26}\text{Fe}) = 55.93494u$ and $m({}^{28}_{13}\text{Al}) = 27.981914$
10. (a) Why do we use a very thin gold foil in Rutherford's α -particle scattering experiment?
(b) What is the energy possessed by an electron in $n = \infty$?
11. Define magnifying power of a telescope. Write its expression.
A small telescope has an objective lens of focal length 150 cm and an eye piece of focal length 5 cm. If this telescope is used to view a 100 m high tower 3 km away, find the height of the final image when it is formed 25 cm away from the eye piece.

OR

- (a) Draw a ray diagram for the formation of image by a compound microscope.
(b) You are given the following three lenses. Which of these two lenses will you use as an eyepiece and as an objective to constructed a compound microscope?

Lenses	Power (D)	Aperture (cm)
L_1	3	8
L_2	6	1
L_3	10	1

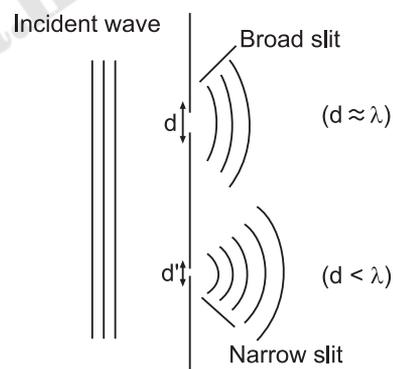
Section – C

12. Case Study:

Diffraction of light

The diffraction of light takes place when an object or obstacle comes in the path of light. In this phenomena bending of light takes place around the edges of the obstacle. The bending of light from its path is larger when the size of the obstacle is comparable to the wavelength of light.

If we place a narrow slit in the path of wavefront of light, then bending of diffracted wavefront will be more. The diffraction of sound waves also takes place. For visible light, diffraction can happen when an object of $\lambda \approx 10^{-6}$ m order comes in its path.



- (a) The phenomenon of bending of light around the edges is called:
(i) Interference (ii) Refraction (iii) Diffraction (iv) Polarisation
- (b) The diffraction of an incident wave will not happen when size aperture will be:
(i) Small (ii) Very small (iii) Very large (iv) None of these
- (c) The diffraction of light waves increases as the size of aperture of a hole:
(i) Increases (ii) Decreases (iii) Both (i) and (ii) (iv) Remain same
- (d) The diffraction of light can take place through:
(i) Sharp edges (ii) Very small apertures
(iii) Very large apertures (iv) Both (i) and (ii)
- (e) In which case diffraction of light will be more for an aperture (d)?
(i) $d > \lambda$ (ii) $d \approx \lambda$ (iii) $d < \lambda$ (iv) None of these





Sample Paper

5

Physics

Section - A

1. Show that maximum intensity in interference pattern is four times the intensity due to each slit. Hence show that interference involves only redistribution of energy.
2. (a) According to de-Broglie, when is the wave associated with matter?
(b) Write the expression for the de-Broglie wavelength associated with a charged particle having charge ' q ' and mass ' m ', when it is accelerated by a potential V .

OR

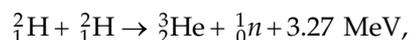
- If the radius of second electron orbit in hydrogen atom be r then what will be the radius of the third orbit will be?
3. Classify the dopants used in the doping process.

Section - B

4. A parallel beam of light of 450 nm falls on a narrow slit and the resulting diffraction pattern is observed on a screen 1.5 m away. It is observed that the first minimum is at a distance of 3 mm from the centre of the screen. Calculate the width of the slit.
5. Find the de-Broglie wavelength associated with an electron moving with a velocity of $0.5c$ and rest mass 9.1×10^{-31} kg. [Given $h = 6.6 \times 10^{-34}$ Js and $c = 3 \times 10^8$ ms $^{-1}$]
6. Following data was recorded for values of object distance and the corresponding values of image distance, in the study of real image formation by a convex lens of power +5 D. One of these observations is incorrect. Identify and give reason:

S. No.	1	2	3	4	5	6
Object distance (cm)	25	30	35	45	50	55
Image distance (cm)	97	60	37	35	32	30

7. In a typical nuclear reaction, *e.g.*,

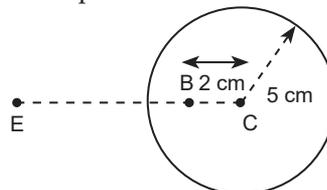


although number of nucleons is conserved, yet energy is released. How? Explain.

8. Deduce the relation $\mu = \frac{\text{Real depth}}{\text{Apparent depth}}$.

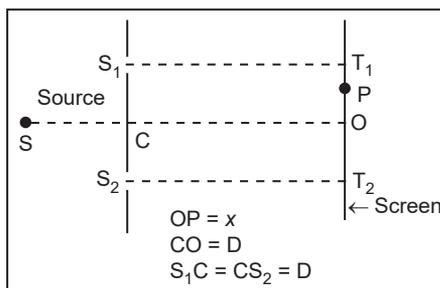
OR

- (a) A liquid of refractive index 1.5 is poured into a cylindrical jar of radius 20 cm, upto a height of 20 cm. A small bulb is lighted at the centre of the bottom of the jar. Find the area of the liquid surface through which the light of the bulb passes into air.



- (b) The above figure shows a solid glass sphere of radius 5 cm that has a small air bubble B trapped at a distance 2 cm from the centre C. The refractive index of the material of glass is 1.5. Find the apparent position of the bubble where it will appear, when seen through the surface of the sphere from an outside point E.

9. Using the Rydberg formula, calculate the wavelengths of the first four spectral lines in the Lyman series of the hydrogen spectrum.
10. Consider a two slit interference arrangement, (figure) such that the distance of the screen from the slits is half the distance between the slits. Obtain the value of D in terms of λ such that the first minima on the screen falls at a distance D from the centre O .



11. (a) What are the directions of electric and magnetic field vectors relative to each other and relative to the direction of propagation of electromagnetic waves?
 (b) Give four basic properties of electromagnetic waves.

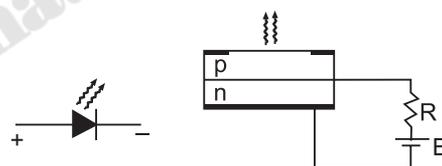
OR

In a plane electromagnetic wave, the electric field oscillates with a frequency of $2 \times 10^{10} \text{ s}^{-1}$ and amplitude of 40 Vm^{-1} .

- (a) What is the wavelength of the wave?
 (b) What is the energy density due to electric field?

Section - C

12. **Light Emitting Diode (LED):** LED is the photoelectric device which converts electrical energy into the light energy. It has heavily doped p - n junction diode and it gives spontaneous radiation when it is connected in forward bias. In this the upper layer is of p -type semiconductor and lower layer is of n -type.



To control the brightness of light emitted by LED, a resistance is connected in the circuit with battery.

The specific materials used for making LED's are Gallium-Arsenide-Phosphide (GaAsP) for yellow or red light, Gallium-phosphide (GaP) for red or green light etc.

LED's are used in making calculators digital watches, burglar alarms, computers, picture phones, remote control and traffic light etc.

- (a) LED is a:
 (i) Photo device (ii) Electrical device
 (iii) Mechanical device (iv) Photo electronic device
- (b) p - n junction diode used in LED's is:
 (i) Lightly doped (ii) Moderately doped (iii) Heavily doped (iv) None of these
- (c) The brightness of light is controlled by using _____ in the circuit.
 (i) Inductor (ii) Resistance (iii) Capacitor (iv) None of these
- (d) The lower layer of LED's is of _____ semiconductor.
 (i) p -type (ii) n -type (iii) q -type (iv) Both (i) and (ii)
- (e) What kind of material is used in making LED's:
 (i) GaAsP (ii) GaP (iii) GaAs (iv) All of these





Sample Paper

6

Physics

Section - A

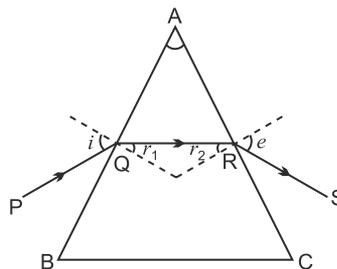
1. Suppose a pure Si crystal has 5×10^{28} atoms m^{-3} . It is doped by 1 ppm concentration of pentavalent As. Calculate the number of electrons and holes. [Given that $n_i = 1.5 \times 10^{16} \text{ m}^{-3}$.]
2. A beaker is filled with water to a height of 12.5 m. The apparent depth of these needle lying at the bottom of the tank as measured by a microscope is 9.4 cm. What is the refractive index of water? If water is replaced by a liquid of refractive index 1.63 upto the same height, by what distance would the microscope be moved to focus on the needle again?

OR

- Describe any two characteristic features which distinguish between interference and diffraction phenomena.
3. In half-wave rectification, what is the output frequency if the input frequency is 50 Hz. What is the output frequency of a full-wave rectifier for the same input frequency.

Section - B

4. (a) Draw a schematic labelled ray diagram of a reflecting type telescope.
(b) Write two important advantage justifying why reflecting type telescopes are preferred over refracting telescopes.
(c) The objective of a telescope is of larger focal length and of larger aperture (compared to the eyepiece). Why? Give reasons.
5. Using Bohr's postulates, derive the expression for the frequency of radiation emitted when electron in hydrogen atom undergoes transition from higher energy state (quantum number n_i) to the lower state (n_f). When electron in hydrogen atom jumps from energy state $n_i = 4$ to $n_f = 3$, identify the spectral series to which the emission lines belong.
6. The figure shows a ray of light passing through a prism. If the refracted ray QR is parallel to the base BC, show that (a) $r_1 = r_2 = \frac{A}{2}$, (b) angle of minimum deviation, $\delta_m = 2i - A$.



7. Find the energy equivalent of one atomic mass unit, first in Joules and then in MeV. Using this, express the mass defect of ${}^1_6\text{O}$ in MeV/c^2 .
8. (a) "Two independent monochromatic sources of light cannot produce a sustained interference pattern". Give reason.
(b) Light wave each of amplitude 'a' and frequency ' ω ', emanating from two coherent light sources superpose at a point. If the displacements due to these waves is given by $y_1 = a \cos \omega t$ and $y_2 = a \cos (\omega t + \phi)$ where ϕ is the phase difference between the two, obtain the expression for the resultant intensity at the point.

OR

Derive Snell's law of refraction using Huygens' principle.

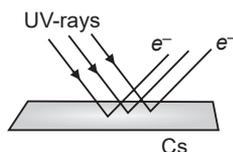
9. Explain solar cell in brief. Give some uses of solar cells.
10. The image of an object, formed by a plano-convex lens at a distance of 8 m behind the lens, is real and is one-third the size of the object. The wavelength of the light inside the lens is $\frac{2}{3}$ times the wavelength in free space. Find the radius of the curved surface of the lens.
11. (a) State clearly how a microwave oven works to heat up a food item containing water molecules.
(b) Why are microwaves found useful for the radar systems in aircraft navigation?

OR

- (a) Two monochromatic waves emanating from two coherent sources have the displacement represented by $y_1 = a \cos \omega t$ and $y_2 = a \cos (\omega t + \phi)$ where ϕ is the phase difference between the two displacements. Show that the resultant intensity at a point due to their superposition is given by $I = 4I_0 \cos^2 \phi/2$, where $I_0 = a^2$.
- (b) Hence obtain the conditions for constructive and destructive interference.

Section – C

12. Photoelectric effect refers to the emission of electrons from certain metal surfaces when irradiated with high frequency light (em radiation). (UV rays falling on cesium metal is a good example).



Number of electrons emitted is proportional to the intensity of light. KE of electron emitted depends on the frequency of incident light, it does not depend on intensity of light. The minimum frequency of light required to initiate photoelectric effect is called threshold frequency (ν_0). The minimum energy required to eject one electron from a metal surface is called its work function and is given by $\phi = h\nu_0$. Maximum KE of emitted electron when light of frequency ν falls on the metal surface is given by $KE_{\max} = h\nu - \phi$ (ϕ is the work function) Negative potential can be applied to the electrons to stop them first outside the metal surface.

- (a) The intensity of light is plotted against number of photoelectrons. The graph is a:
- (i) Straight line passing through origin (ii) Straight line with $a + y$ intercept
(iii) Parabola passing through the origin (iv) None of these
- (b) The work function of a metal corresponds to a frequency 2×10^{15} Hz of light. Which of the following frequency cannot cause photoelectric effect from the metal?
- (i) 1.5×10^{16} Hz (ii) 8.2×10^{14} Hz (iii) 6.5×10^{15} Hz (iv) 2.2×10^{15} Hz
- (c) A particular metal can emit electrons when green light falls on it. In which of the following case, the maximum KE of emitted electrons cannot be more, compared to this case?
- (i) Using blue light with the same metal
(ii) Using a metal of less work function with the same light (green)
(iii) Using red light with the first metal
(iv) Using UV light with the second metal
- (d) If frequency of incident light becomes n times the initial frequency ($\nu > \nu_0$), then KE of emitted electron becomes:
- (i) n times the initial KE (ii) More than n times the initial KE
(iii) Less than n times the initial KE (iv) No change in KE
- (e) Stopping potential (negative potential required to stop the electron just outside the metal surface is related to.
- (i) Mean wavelength (ii) Shortest frequency
(iii) Maximum KE of emitted electrons (iv) Intensity of light incident



Sample Paper

7

Physics

Section - A

1. What is the principle of a half wave rectifier?
2. The photoelectric cut-off voltage in a certain photoelectric experiment is 2.5 V. What is the maximum kinetic energy of photoelectrons emitted?

OR

The wavelength of some of the spectral lines obtained in hydrogen spectrum are 9,546 Å, 6,463 Å and 1,216 Å, which one of these wavelengths belongs to Lyman series?

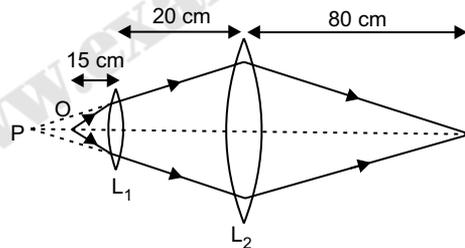
3. A photodiode is fabricated from a semiconductor with a band gap of 2.8 eV. Can it detect wavelength of 6000 nm? Justify.

Section - B

4. When four hydrogen nuclei combine to form a helium nucleus estimate the amount of energy in MeV released in this process of fusion. (Neglect the masses of electrons and neutrons)

Given :

- (i) Mass of ${}^1_1\text{H} = 1.007825 u$
 - (ii) Mass of helium nucleus = 4.002603 u
- $1u = 931 \text{ MeV}/c^2$.
5. In the following diagram, an object 'O' is placed 15 cm in front of a convex lens L_1 of focal length 20 cm and the final image is formed at I at a distance of 80 cm from the second lens L_2 . Find the focal length of the lens L_2 .



6. Write any two distinguishing features between conductors, semiconductors and insulators on the basis of energy band diagrams.
7. (a) Draw the intensity pattern for single slit diffraction and double slit interference.
(b) For a given single slit, the diffraction pattern is obtained on a fixed screen, first by using red light and then with blue light. In which diffraction pattern, have a larger angular width?
8. (a) Define magnifying power of a telescope. Write its expression.
(b) A small telescope has an objective lens of focal length 150 cm and an eye piece of focal length 5 cm. If this telescope is used to view a 100 m high tower 3 km away, find the height of the final image when it is formed 25 cm away from the eye piece.

OR

A slit of width a is illuminated by light of wavelength 6000 Å. For what value of a will the:

- (i) First maximum fall at an angle of diffraction of 30° ?
 - (ii) First minimum fall at an angle of diffraction 30° ?
9. Plot a labelled graph of stopping potential of photoelectrons (V_s) versus frequency (ν) of incident radiation. How will you use this graph to determine the value of Planck's constant? Explain.

10. In the original experiment, Geiger and Marsden calculated the distance of closest approach to the gold nucleus ($Z = 79$) of a 7.7 MeV α -particle before it comes momentarily to rest and reverses its direction. What is its value and how will the distance of the closest approach be affected when the kinetic energy of α -particle is doubled?
11. The magnetic field in a plane electromagnetic wave is given by

$$B_y = (2 \times 10^{-7} \text{ T}) \sin (0.5 \times 10^3 x + 1.5 \times 10^{11} t)$$

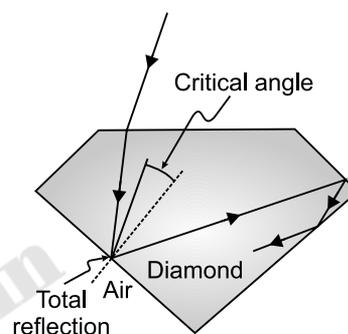
- (i) What is the wavelength and frequency of the wave?
 (ii) Write an expression for the electric field.

OR

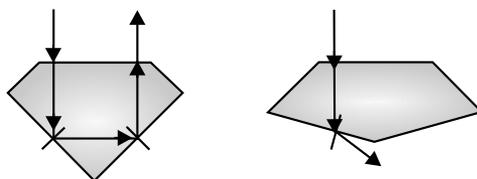
In Young's double slit experiment, describe briefly how bright and dark fringes are obtained on the screen kept in front of a double slit. Hence obtain the expression for the fringe width.

Section - C

12. Sparking Brilliance of Diamond: The total internal reflection of the light is used in polishing diamonds to create a sparking brilliance. By polishing the diamond with specific cuts, it is adjusted the most of the light rays approaching the surface are incident with an angle of incidence more than critical angle. Hence, they suffer multiple reflections and ultimately come out of diamond from the top. This gives the diamond a sparking brilliance.



- (a) Light cannot easily escape a diamond without multiple internal reflections. This is because:
- Its critical angle with reference to air is too large
 - Its critical angle with reference to air is too small
 - The diamond is transparent
 - Rays always enter at angle greater than critical angle
- (b) The critical angle for a diamond is 24.4° . Then its refractive index is:
- 2.42
 - 0.413
 - 1
 - 1.413
- (c) The basic reason for the extraordinary sparkle of suitably cut diamond is that:
- Low refractive index
 - High refractive index
 - High transparency
 - Very hard
- (d) A diamond is immersed in a liquid with a refractive index greater than water. Then the critical angle for total internal reflection will :
- depend on the nature of the liquid
 - Remain the same
 - Decreases
 - Increases
- (e) The following diagram shows same diamond cut in two different shapes.



The brilliance of diamond in the second diamond will be:

- Less than the first
- Same as first
- Greater than first
- Will depend on the intensity of light





Answers

Sample Paper 1

Section - A

1. When the p - n junction diode is forward biased, the diode's depletion layer or potential barrier shrinks. This can be considered as a practical short circuit.

Hence, resistance is negligible and current flow in forward bias is maximum.

Similarly, when it is reverse bias depletion layer width (or potential barrier) increases. Hence, resistance increases and very small amount of current flow in reverse bias.

2. Here, $\lambda_L = 1215 \text{ \AA}$

For the first line of Lyman series,

$$\frac{1}{\lambda_L} = R \left[\frac{1}{1^2} - \frac{1}{2^2} \right] = R \left[1 - \frac{1}{4} \right] = \frac{3R}{4}$$

$$\therefore \lambda_L = \frac{4}{3R} \quad \dots(i)$$

For first line of Balmer series,

$$\frac{1}{\lambda_B} = R \left[\frac{1}{2^2} - \frac{1}{3^2} \right] = R \left[\frac{1}{4} - \frac{1}{9} \right] = \frac{5R}{36}$$

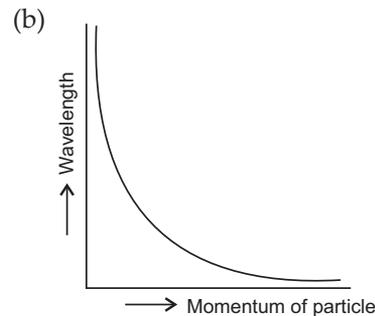
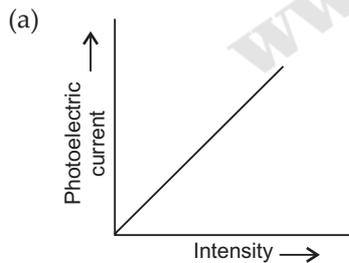
$$\therefore \lambda_B = \frac{36}{5R} \quad \dots(ii)$$

From equations (i) and (ii),

$$\frac{\lambda_B}{\lambda_L} = \frac{36/5R}{4/3R} = \frac{36 \times 3}{4 \times 5}$$

$$\therefore \lambda_B = \frac{108}{20} \times \lambda_L = \frac{108}{20} \times 1215 = 6561 \text{ \AA}.$$

OR



3. The photodiode is used in reverse bias condition because the change in reverse current through the photodiode due to change in light flux or light intensity can be measured easily, as the reverse saturation current is directly proportional to the light flux or light intensity. But it is not so when photodiode is forward biased. As the reverse saturation current through a photodiode increases with the increase in light intensity or light flux, so, $I_4 > I_3 > I_2 > I_1$.

Section - B

4. Given, $\lambda = 5900 \text{ \AA} = 5.9 \times 10^{-7} \text{ m}$ and $f = 50 \text{ cm} = 0.5 \text{ m}$.

Width of the slit = $a = 0.025 \text{ mm} = 2.5 \times 10^{-5} \text{ m}$

According to the formula,

$$\begin{aligned}\sin \theta &= \frac{\lambda}{a} \\ &= \frac{5.9 \times 10^{-7}}{2.5 \times 10^{-5}} = 0.0236\end{aligned}$$

As the diffraction pattern is formed in the focal plane of the lens,

$$\therefore \sin \theta = \tan \theta$$

$$\Rightarrow \frac{x}{f} = \frac{\lambda}{a}$$

$$\text{or } x = f \times \frac{\lambda}{a}$$

$$= 0.5 \times 0.0236 = 0.0118 \text{ m}$$



$$\begin{aligned}\text{(i)} \quad \Delta m &= 2 \times 4.0026 - 8.0053 \\ &= 8.0052 - 8.0053 = -0.0001 \text{ amu}\end{aligned}$$

$$\begin{aligned}\text{(ii)} \quad \text{Q} &= (2m_{\text{He}} - m_{\text{Be}})c^2 = (2 \times 4.0026 - 8.0053) \times 931 \text{ MeV} \\ &= -93.1 \text{ keV}.\end{aligned}$$

(iii) Since Q is negative, the fusion is not energetically favourable.

6. Image formed by the first lens (given by lens formula).

$$\frac{1}{v_1} - \frac{1}{u_1} = \frac{1}{f_1}$$

$$\therefore \frac{1}{v_1} - \frac{1}{-30} = \frac{1}{10}$$

$$\text{or } v_1 = 15 \text{ cm}.$$

The image formed by the first lens serves as the object for the second. This is at a distance of $(15 - 5) = 10$ cm to the right of the second lens. Though the image is real, it serves as a virtual object for the second lens, which means that the rays appear to come from it for the second lens.

$$\frac{1}{v_2} - \frac{1}{10} = \frac{1}{-10}$$

$$\text{or } v_2 = \infty$$

The virtual image is formed at an infinite distance to the left of the second lens. This acts as an object for the third lens.

$$\frac{1}{v_3} - \frac{1}{u_3} = \frac{1}{f_3}$$

$$\text{or } \frac{1}{v_3} = \frac{1}{\infty} + \frac{1}{30}$$

$$\text{or } v_3 = 30 \text{ cm}$$

The final image is formed 30 cm to the right of the third lens.

7. The magnitude of the wavelength of de-Broglie waves associated with a moving football is extremely small $\left(\lambda = \frac{h}{mv} < 10^{-34} \text{ m}\right)$ much less than that of visible region and are therefore, not visible.

Wavelength of photon = λ

$$\therefore \text{Energy of photon, } E_p = \frac{hc}{\lambda} \quad \dots\text{(i)}$$

$$\text{Kinetic energy of electron, } E_e = \frac{1}{2} mv^2$$

$$\text{or } mv^2 = 2 E_e$$

$$\Rightarrow mv = \sqrt{2E_e m}$$

de-Broglie wavelength of electron,

$$\lambda = \frac{h}{mv} = \frac{h}{\sqrt{2E_e m}}$$

$$\Rightarrow E_e = \frac{h^2}{2\lambda^2 m} \quad \dots(\text{ii})$$

Dividing equation (i) by equation (ii), we get

$$\frac{E_p}{E_e} = \frac{hc}{\lambda} \cdot \frac{2\lambda^2 m}{h^2} = \frac{2\lambda mc}{h}$$

$$\text{or } E_p = \frac{2\lambda mc}{h} \cdot E_e$$

8. Here, $d = 0.28 \text{ mm} = 0.28 \times 10^{-3} \text{ m}$, $D = 1.4 \text{ m}$

For $\lambda_A = 800 \text{ nm} = 800 \times 10^{-9} \text{ m} = 8 \times 10^{-7} \text{ m}$

Position of first bright fringe

$$\begin{aligned} X_A &= \lambda_A \cdot \frac{D}{d} \\ &= \frac{8 \times 10^{-7} \times 1.4}{0.28 \times 10^{-3}} = 40 \times 10^{-4} = 4 \times 10^{-3} \text{ m} \end{aligned}$$

For wavelength, $\lambda_B = 600 \text{ nm} = 600 \times 10^{-9} \text{ m} = 6 \times 10^{-7} \text{ m}$

Position of first bright fringe is

$$X_B = \frac{6 \times 10^{-7} \times 1.4}{0.28 \times 10^{-3}} = 30 \times 10^{-7} \times 10^3 = 3 \times 10^{-3} \text{ m}$$

The least distance, from the central maximum, where the bright fringes coincides

$$\begin{aligned} X_A - X_B &= 4 \times 10^{-3} - 3 \times 10^{-3} \\ &= 1 \times 10^{-3} \text{ m} \\ &= +1 \text{ mm.} \end{aligned}$$

OR

(a) The diver is in the water and the fisherman is on surface (*i.e.*, in air). Water is a denser medium than air. As diver is viewing the fisherman, this indicates that the light rays are travelling from a denser medium to a rarer medium. Hence, the refracted rays will move away from the normal resulting the fisherman will appear to be taller.

(b) Yes; Decrease

The apparent depth of a tank of water changes when viewed obliquely because light bends on travelling from one medium to another. The apparent depth of the tank when viewed obliquely is less than the near-normal viewing.

(c) Yes

The refractive index of diamond (2.42) is higher than that of ordinary glass (1.5). The critical angle for diamond is less than that for glass. A diamond cutter uses a large angle of incidence to ensure that the light entering the diamond is totally reflected from its faces. This is the reason for the sparkling effect of a diamond.

9. According to the Bohr's postulate, only those electronic orbits are permitted for which angular momentum

of electron is an integral multiple of $\frac{h}{2\pi}$.

$$mvr = n \frac{h}{2\pi}$$

or Linear velocity of electron, $v = \frac{nh}{2\pi mr}$... (i)

Also, centripetal force equals electrostatic force of attraction between electron and nucleus

$$\frac{mv^2}{r} = K \frac{Ze^2}{r^2}$$

Substituting the value of v from equation (i), we get

$$\frac{m}{r} \cdot \frac{n^2 h^2}{4\pi^2 m^2 r^2} = K \cdot \frac{Ze^2}{r^2}$$

or Radius of the orbit, $r = \frac{n^2 h^2}{4\pi^2 m K Z e^2}$

For hydrogen atom, $Z = 1$

\therefore Radius, $r = \frac{n^2 h^2}{4\pi^2 m K e^2}$

This shows that $r \propto n^2$.

\therefore The radius of orbit is proportional to the square of the principal quantum number *i.e.*, radii of stationary orbits are in the ratio $1^2 : 2^2 : 3^2 \dots$ or $1 : 4 : 9 \dots$ respectively, *i.e.*, the orbits are not equally spaced.

10. **Given:** Energy gap of the intrinsic semiconductor, $(E_g) = 1.2 \text{ eV}$.

The temperature dependence of the intrinsic carrier concentration is given by

$$n_i = n_0 \exp\left[-\frac{E_g}{2k_B T}\right]$$

Here, k_B = Boltzmann constant = $8.62 \times 10^{-5} \text{ eV/K}$ (T = Temperature, n_0 = Constant)

Initial temperature (T_1) = 300 K.

The intrinsic carrier-concentration at this temperature can be given by

$$n_{i1} = n_0 \exp\left[-\frac{E_g}{2k_B \times 300}\right] \dots (i)$$

Final temperature (T_2) = 600 K.

The intrinsic carrier-concentration at this temperature can be given as

$$n_{i2} = n_0 \exp\left[-\frac{E_g}{2k_B \times 600}\right] \dots (ii)$$

$$\frac{n_{i2}}{n_{i1}} = \frac{e^{\frac{1.2 \text{ eV}}{2k_B \times 600}}}{e^{\frac{1.2 \text{ eV}}{2k_B \times 300}}}$$

$$= e^{11.59} = 1.072 \times 10^5$$

The ratio between the conductive at 600 K and at 300 K is equal to the ratio between the respective intrinsic carrier-concentrations at these temperature *i.e.*, 1.072×10^5 .

11. Given,

$$E_y = 30 \sin [2 \times 10^{11} t + 300\pi x] \text{ V m}^{-1}$$

Standard equation is,

$$E_y = E_0 \sin \left[2\pi \left(\frac{x}{\lambda} - \frac{t}{T} \right) \right]$$

$$E_y = E_0 \sin \left[\frac{2\pi x}{\lambda} - \frac{2\pi t}{T} \right]$$

On comparing,

$$\frac{2\pi}{\lambda} = 300\pi \text{ and } E_0 = 30 \text{ V m}^{-1}$$

(a) Wavelength, $\lambda = \frac{2\pi}{300\pi} = \frac{1}{150} \text{ m}$

$$(b) \quad B_0 = \frac{E_0}{c} = \frac{30}{3 \times 10^8} = 10^{-7} \text{ T}$$

The magnetic field is perpendicular to the direction of propagation and the direction of the electric field. So, the expression for the magnetic field is

$$B_Z = 10^{-7} \sin [(2 \times 10^{11} t + 300 \pi x)] \text{ T.}$$

OR

- (a) Reflection and refraction arise through interaction of incident light with atomic constituents of matter which vibrate with the same frequency as that of the incident light. Hence frequency remains unchanged.
- (b) Energy carried by a wave depends on the frequency of the wave, not on the speed of wave propagation.
- (c) For a given frequency, intensity of light in the photon picture is determined by

$$I = \frac{\text{Energy of photons}}{\text{area} \times \text{time}} = \frac{n \times h\nu}{A \times t}$$

Where n is the number of photons incident normally on crossing area A in time t .

Section - C

12. (a) (ii) 3
 (b) (iii) 2
 (c) (ii) 2
 (d) (iii) $\frac{\delta}{A} + 1$

\therefore

$$\delta = (\mu - 1)A$$

\Rightarrow

$$\mu - 1 = \frac{\delta}{A}$$

\Rightarrow

$$\mu = \frac{\delta}{A} + 1$$

- (e) (iv) 3.055

We know,

$$\delta = (\mu - 1) A$$

given,

$$A = 5^\circ, \mu = 1.611$$

\therefore

$$\begin{aligned} \delta &= (1.611 - 1) \times 5 = 0.611 \times 5 \\ &= 3.055 \end{aligned}$$

Sample Paper 2

Section - A

1. Given,

$$\text{Number of silicon atoms (N)} = 5 \times 10^{28} \text{ atoms/m}^3$$

$$\text{Number of arsenic atoms } (n_{As}) = 5 \times 10^{22} \text{ atoms/m}^3$$

$$\text{Number of indium atoms } (n_{In}) = 5 \times 10^{20} \text{ atoms/m}^3$$

$$\text{Number of thermally-generated electrons } (n_i) = 1.5 \times 10^{16} \text{ electrons/m}^3$$

$$\text{Number of electrons } (n_e) = 5 \times 10^{22} - 1.5 \times 10^{16} \approx 4.99 \times 10^{22}$$

Let,

$$\text{number of holes} = n_h$$

In thermal equilibrium, the concentrations of electrons and holes in a semiconductor are related as

$$n_e n_h = n_i^2$$

or

$$n_h = \frac{n_i^2}{n_e} = \frac{(1.5 \times 10^{16})^2}{4.99 \times 10^{22}} \approx 4.51 \times 10^9$$

The number of electrons is approximately 4.99×10^{22} and the number of holes are 4.51×10^9 . Since the number of electrons is more than the number of holes, the material is an *n*-type semiconductor.

2. (a) For shortest wavelength in the Balmer series: $n_1 = 2, n_2 = \infty$

$$\begin{aligned} \therefore \frac{1}{\lambda_{\min}} &= R \left[\frac{1}{n_1^2} - \frac{1}{n_2^2} \right] = R \left[\frac{1}{2^2} - \frac{1}{\infty} \right] \\ &= \frac{R}{4} \\ \Rightarrow \lambda_{\min} &= \frac{4}{R} = \frac{4}{1.097 \times 10^7} \text{ m} = 364.6 \text{ nm.} \end{aligned}$$

The shortest wavelength in the Balmer series is 364.6 nm.

- (b) Number of spectral lines obtained due to transition of electron from third excited state ($n = 4$) to ground state,

$$N = \frac{n(n-1)}{2} = \frac{4(4-1)}{2} = 6.$$

OR

Potential difference $\Delta V = 60$ so energy $E = q\Delta V = 1.6 \times 10^{-19} \times 60 \text{ Joule} = 9.6 \times 10^{-18} \text{ Joule}$

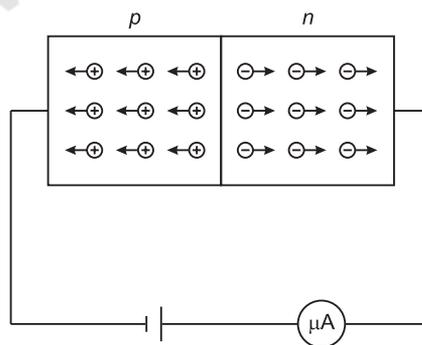
So de-Broglie wavelength $\lambda = \frac{h}{\sqrt{2mE}} \dots(i)$

As momentum, $p = mv = \sqrt{2mE}$

Putting $m = 9.1 \times 10^{-31} \text{ kg}$ and $h = 6.62 \times 10^{-34} \text{ Js}$ is in equation (i), we get

$$\lambda = 1.58 \times 10^{-10} \text{ meter} = 1.58 \text{ Angstrom.}$$

3. In the reverse biasing of a *p-n* junction diode, the depletion region, across the junction diode, increases, due to the flow of holes in *p*-region and electrons in *n*-region, away from the junction. But a very small current (order μA) flows across the junction due to the flow of minority carriers. This current flows through *n*-type to *p*-type semiconductor, across the junction.



Section - B

4. The power of a lens is given by

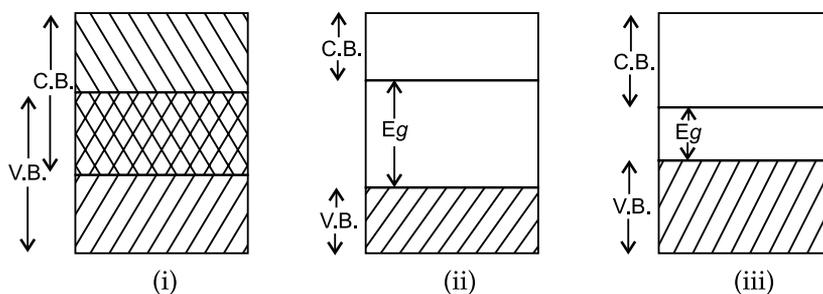
$$P = \frac{1}{f} = (n-1) \left(\frac{1}{R_1} - \frac{1}{R_2} \right)$$

Refractive index of lens for violet rays is more than that for red rays. So power of a lens will decrease, if violet light is replaced by red light.

5. Assumptions of Rutherford's model of atom:

- (i) An atom consists of a very small central core called the nucleus.
- (ii) The nucleus carries all the positive charge and most of the mass of the atom (99.9%).
- (iii) The size of the nucleus is of the order of 10^{-15} m which is very small in comparison to the size of the atom which is of the order of 10^{-10} m. Thus, major portion of atom is empty space.
- (iv) The negatively charged electrons revolve around the nucleus in circular orbits with nucleus at the centre of the orbit. The necessary centripetal force for circular motion is provided by the force of attraction between positively charged nucleus and negatively charged electron.
- (v) Positive charge on nucleus is exactly equal to the total negative charge of electrons so that atom is electrically neutral.

6.



[Here, C.B. → Conduction Band, V.B. → Valence Band, E_g → Forbidden Energy gap]

Conductors : Conductors are the substances which allow the flow of electric current through them. In a conductor, the valence band and the conduction band overlap. So no energy is required to move the electrons from valence band to conduction band. Free electrons are available in conduction band and thus electric current flows through it, when a potential difference is applied across it. For example : Magnesium, Silver etc.

Insulators: Insulators are the substances which do not allow the flow of electric current through them. In insulators, the valence electrons are very rigidly held in the inter atomic bands, even at high temperatures. In terms of band theory, insulator have a large energy gap between the conduction band and the valence band (greater than 5 eV). So electrons cannot jump from the valence band into the conduction band. (In the case of diamond the energy gap is 6 eV.) For example : Glass, Rubber etc.

Semiconductors: Semiconductors are the substances, whose conductivity lies in between that of a good conductors and an insulator (For example : Germanium, Silicon).

In terms of band theory, semiconductors have small energy gap between conduction band and valence band. At 0 K, the energy gap is 0.72 eV for germanium and 1.21 eV for silicon. This decreases with increase in temperature. At 0 K, the conduction band is empty and the semiconductor behaves as an insulator. With the increase in the temperature, the electrons from the valence band jump to conduction band and hence the conduction of electric current is possible.

7. Given,

$$m = 2 \text{ kg}; P = 800 \text{ W}$$

Here, two deuterium nuclei produces 3.27 MeV energy.

$$\therefore E = 3.27 \times 10^6 \times 1.6 \times 10^{-19} = 5.232 \times 10^{-13} \text{ J}$$

$$\text{or Energy per nuclei} = \frac{5.232 \times 10^{-13}}{2} = 2.616 \times 10^{-13} \text{ J}$$

$$\text{Number of deuterium atom in 2 kg} = \frac{6.023 \times 10^{23} \times 2000}{2} = 6.023 \times 10^{26} \text{ atoms}$$

$$\therefore \text{Total energy} = 6.023 \times 10^{26} \times 2.616 \times 10^{-13} \\ = 15.75 \times 10^{13} \text{ J}$$

$$\text{Power} = \frac{\text{Energy}}{\text{Time}}$$

$$\therefore \text{Time, } t = \frac{15.75 \times 10^{13}}{800} = 1.96 \times 10^{11} \text{ s}$$

or
$$t = \frac{1.96 \times 10^{11}}{365 \times 24 \times 60 \times 60}$$

$$= 6.2 \times 10^3 \text{ years.}$$

8. (a) Given: $P_1 = 10 \text{ D}, P_2 = -5 \text{ D}$
 Power of combination, $P = P_1 + P_2$
 $= 10 \text{ D} - 5 \text{ D} = 5 \text{ D.}$

(b) Focal length, $F = \frac{1}{P} = \frac{1}{5} = 0.20 \text{ m}$
 $= 20 \text{ cm}$

(Convex lens)

Magnification, $m = \frac{v}{u} = 2$

$\Rightarrow v = 2u$
 From lens formula, $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$
 $\frac{1}{20} = \frac{1}{2u} - \frac{1}{u}$
 $\Rightarrow \frac{-1}{2u} = \frac{1}{20}$
 $\Rightarrow u = -10 \text{ cm.}$

OR

(a) (i) Given, $f_0 = 140 \text{ cm}$ and $f_e = 5.0 \text{ cm}$
 When final image is at infinity, magnifying power,

$$m = -\frac{f_0}{f_e} = -\frac{140}{5.0} = -28$$

Negative sign shows that, the image is inverted.

(ii) When final image is at the least distance of distinct vision,

$$\text{Magnifying power, } m = -\frac{f_0}{f_e} \left(1 + \frac{f_e}{D} \right)$$

$$= -\frac{140}{5.0} \left(1 + \frac{5.0}{25} \right) = -33.6$$

(b) Separation between objective and eyepiece when final image is formed at infinity.

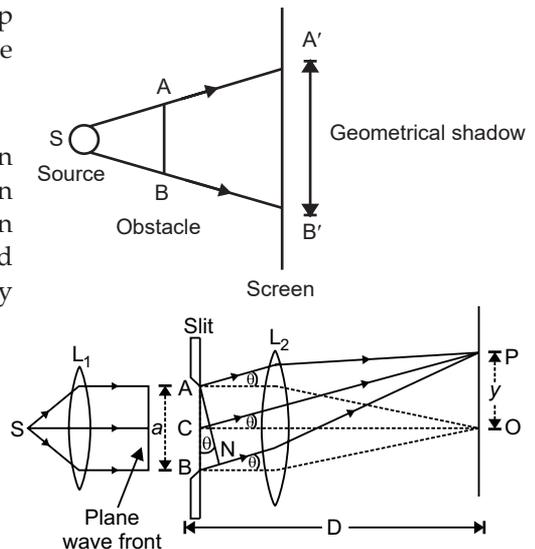
$$L = f_0 + f_e = 140 \text{ cm} + 5.0 \text{ cm} = 145 \text{ cm.}$$

9. The phenomenon of bending of light round the sharp corners of an obstacle and spreading into the regions of the geometrical shadow is called diffraction.

Expression for Fringes width :

Consider a parallel light beam from a lens is incident on slit AB. As diffraction happens, the pattern is focussed on screen XY with the help of lens L_2 . We will get a diffraction pattern that is a central maximum at the centre O flanked by a number of dark and bright fringes known as secondary maxima and minima.

Central Maximum : Each point on the plane wave front AB sends secondary wavelets in all directions. The waves from points equidistant from the centre C kept on the upper and lower half reach point O with zero path difference and so, reinforce each other, making maximum intensity at point O.



10. (a) Given, $V_s = 3 \text{ V}$ and $K_{\max} = eV_s$
 $\therefore K_{\max} = 3 \text{ eV}$
- (b) Given, $\lambda = 2 \times 10^{-7} \text{ m} = 2000 \text{ \AA}$
 and $hc = 12400 \text{ eV\AA}$
 Energy of incident photon (E) = $\frac{hc}{\lambda} = \frac{12400}{2000} \text{ eV}$
 $= 6.20 \text{ eV}$
 Work function, $W = E - K_{\max} = (6.20 - 3) \text{ eV} = 3.2 \text{ eV}$
- (c) $h\nu_0 = W = 3.2 \times 1.6 \times 10^{-19} \text{ J}$
 $\therefore \nu_0 = \frac{3.2 \times 1.6 \times 10^{-19}}{6.62 \times 10^{-34}} = 7.76 \times 10^{14} \text{ Hz.}$

11. (a) We know that, $\frac{E_0}{B_0} = c$
 $\Rightarrow E_0 = B_0 c$
 $= 510 \times 10^{-9} \times 3 \times 10^8$
 $= 153 \text{ NC}^{-1}.$
- (b) Frequency of the electromagnetic wave produced will be equal to the frequency f of the oscillating charge.

OR

- (i) For first minima, $d \sin \theta = n\lambda$
 $\therefore d \sin 30^\circ = n\lambda$
 $\Rightarrow \frac{d}{2} = n\lambda$
 $\Rightarrow d = 2n\lambda$
 $= 2 \times 1 \times 650 \times 10^{-9}$
 $= 1,300 \times 10^{-6} \text{ m}$
 $= 1.3 \text{ }\mu\text{m}.$
- (ii) For first maxima, $d \sin \theta = \left(n + \frac{1}{2}\right)\lambda$
 $\therefore d \sin 30^\circ = \frac{3}{2} \times 650 \text{ nm}$
 $\Rightarrow d = 3 \times 650 \times 10^{-9}$
 $= 1.95 \times 10^{-6} \text{ m}$
 $= 1.96 \text{ }\mu\text{m}.$

Section - C

12. (a) (i) Monochromatic
 (b) (i) Two
 (c) (iii) bright
 (d) (iii) Interference
 (e) (ii) 4 : 1

Given: $\lambda_1 = 660 \text{ nm}, \lambda_2 = 165 \text{ nm}$

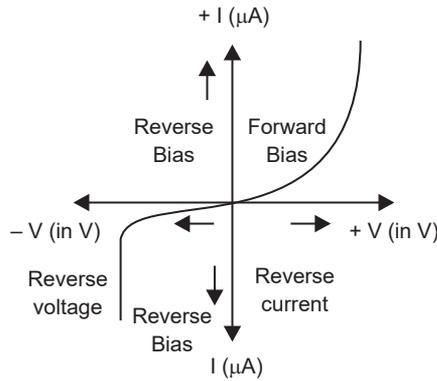
As $\beta = \frac{\lambda D}{d}$; D, d are same for lights

$$\frac{\beta_1}{\beta_2} = \frac{\lambda_1}{\lambda_2} = \frac{660}{165} = 4 : 1.$$

Sample Paper 3

Section - A

1. Current-Voltage characteristics graph of Ga.



2. **Huygens' principle:** Huygens' principle is a geometrical construction which is used to determine the position of a wavefront at a later time from its given position at any instant. It states that every point on a wavefront is a source of wavelets. These wavelets spread out in forward direction, at the same speed as source wave.

It is based on the following assumptions:

- (i) Each point on the given or primary wavefront acts as a source of secondary wavelets, sending out disturbance in all directions in a similar manner as the original source of light does.
- (ii) The new position of the wavefront at any instant (called secondary wavefront) is the envelope of the secondary wavelets at that instant.

OR

(i) Maximum intensity, $I_{\max} = (\sqrt{I_1} + \sqrt{I_2})^2$

Here, $I_1 = I_0$ and $I_2 = 4I_0$

$\therefore I_{\max} = (\sqrt{I_0} + \sqrt{4I_0})^2$

$$= I_0 + 4I_0 + 4I_0 = 9I_0$$

and Minimum intensity, $I_{\min} = (\sqrt{I_1} - \sqrt{I_2})^2$

$$= (\sqrt{I_0} - \sqrt{4I_0})^2$$

$$= I_0 + 4I_0 - 4I_0 = I_0$$

$$\Rightarrow \frac{I_{\max.}}{I_{\min.}} = \frac{9I_0}{I_0} = 9 : 1.$$

(ii) Ratio of intensities, $\frac{I_{\max.}}{I_{\min.}} = \left(\frac{r+1}{r-1}\right)^2$

where, $r = \frac{A_1}{A_2}$ = Ratio of amplitudes

$$\Rightarrow \frac{9}{1} = \left(\frac{r+1}{r-1}\right)^2$$

$$\Rightarrow 3 = \frac{r+1}{r-1}$$

$$\Rightarrow 3r - 3 = r + 1$$

$$\Rightarrow 2r = 4$$

$$\begin{aligned} \Rightarrow r &= 2 \\ \therefore r &= 2 : 1 \\ \therefore \frac{A_1}{A_2} &= 2 : 1. \end{aligned}$$

3. When a trivalent impurity like aluminium, indium, boron, gallium, etc., is doped with pure germanium (or silicon), then the conductivity of the crystal increases due to deficiency of electron *i.e.*, holes and such a crystal is said to be *p*-type semiconductor while the impurity atoms are called acceptors.

Section - B

4. When the light travels from a rarer to a denser medium, its frequency remains unchanged but wavelength decreases. It is because, frequency is an inherent property of light. Since, energy of a photon of light is $h\nu$, its energy will remain the same.
5. Consider the case of an *n*-type semiconductor. Obviously, the majority carrier density (n) is considerably larger than the minority hole density (*i.e.*, $n \gg p$). On illumination, let the excess electrons and holes generated be Δn and Δp , respectively.

$$\begin{aligned} n' &= n + \Delta n \\ p' &= p + \Delta p \end{aligned}$$

Here n' and p' are the electron and hole concentrations at any particular illumination and n & p are carriers concentration when there is no illumination. Remember $\Delta n = \Delta p$ and $n \gg p$. Hence, the fractional change in the majority carriers (*i.e.*, $\Delta n/n$) would be much less than that in the minority carriers (*i.e.*, $\Delta p/p$). In general, we can state that the fractional change due to the photo-effects on the minority carriers dominated reverse bias current is more easily measurable than the fractional change in the forward bias current. Hence, photodiodes are preferably used in the reverse bias condition for measuring light intensity.

6. We know that, focal length of a concave lens is negative.

Using lens maker's formula,

$$\frac{1}{f} = \left(\frac{\mu_l}{\mu_m} - 1 \right) \left(\frac{1}{R_1} - \frac{1}{R_2} \right)$$

Here

$$\mu_l = 1.5 \text{ and } \mu_m = 1.65$$

Also,

$$\frac{\mu_l}{\mu_m} < 1, \text{ so } \left(\frac{\mu_l}{\mu_m} - 1 \right) \text{ is negative}$$

And focal length of the given lens becomes positive. Hence, it behaves like a converging lens.

- 7.

$$qV = \frac{1}{2}mv^2$$

$$qV = \frac{p^2}{2m}$$

$$\Rightarrow p = \sqrt{2mqV} = \frac{h}{\lambda}$$

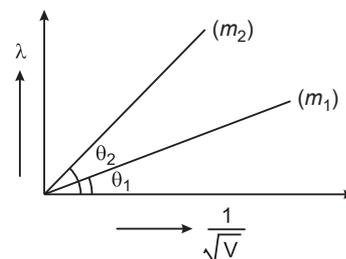
$$\Rightarrow \lambda = \frac{h}{\sqrt{2mqV}}$$

$$\Rightarrow \text{Slope} \propto \frac{1}{\sqrt{m}}$$

Since,

$$m_1 > m_2$$

\therefore Particle with lower mass (m_2) have greater slope as shown in figure.



8. (a) As aperture of objective of a microscope is much smaller and that of a telescope is much larger, therefore, front end of a microscope is narrow and front end of a telescope is much wider.
- (b) Given: $f_o = 1 \text{ cm}$, $f_e = 2.5 \text{ cm}$, $u_o = -1.2 \text{ cm}$, $m = ?$, $L = ?$

$$\frac{1}{v_0} - \frac{1}{u_0} = \frac{1}{f_0}$$

$$\frac{1}{v_0} = \frac{1}{f_0} + \frac{1}{u_0}$$

$$= \frac{1}{1} - \frac{1}{1.2} = \frac{0.2}{1.2}$$

$$\therefore v_0 = \frac{1.2}{0.2} = 6 \text{ cm}$$

As,

$$m = \frac{v_0}{|u_0|} \left(1 + \frac{D}{f_e} \right)$$

$$\therefore m = \frac{6}{1.2} \left(1 + \frac{25}{2.5} \right) = 55$$

$$L = v_0 + f_e = 6 + 2.5 = 8.5 \text{ cm.}$$

OR

- (a) A diamond glitters in a brightly lit room because light entering the diamond from any face suffers multiple total internal reflections and does not come out. The diamond appears illuminated from inside. This would not happen in a dark room.
- (b) A crack in a window pane appears silvery on a account of total internal reflection of light in the crack.
- (c) The bubbles of air rising up in a water tank appears silvery when viewed from top again on account of total internal reflection of light from the bubble.

9. Here,

$$d = 2 \text{ mm, } D = 1.2 \text{ m}$$

$$\lambda_1 = 650 \text{ nm} = 650 \times 10^{-9} \text{ m,}$$

$$\lambda_2 = 520 \text{ nm} = 520 \times 10^{-9} \text{ m}$$

- (a) Distance of third bright fringe from the central maximum for the wavelength 650 nm.

$$y_3 = \frac{3\lambda_1 D}{d} = \frac{3(650 \times 10^{-9})1.2}{2 \times 10^{-3}} = 1.17 \text{ mm.}$$

- (b) Let at linear distance 'y' from center of screen the bright fringes due to both wavelength coincides. Let n_1 number of bright fringe with wavelength λ_1 coincides with n_2 number of bright fringe with wavelength λ_2 .

We can write

$$y = n_1 \beta_1 = n_2 \beta_2$$

$$n_1 \frac{\lambda_1 D}{d} = n_2 \frac{D \lambda_2}{d} \text{ or } n_1 \lambda_1 = n_2 \lambda_2 \quad \dots(i)$$

Also at first position of coincide, the n^{th} bright fringe of one will coincide with $(n + 1)^{\text{th}}$ bright fringe of other.

If $\lambda_2 < \lambda_1$

So, then $n_2 > n_1$

then $n_2 = n_1 + 1$

... (ii)

Using equation (ii) in equation (i)

$$n_1 \lambda_1 = (n_1 + 1) \lambda_2$$

$$n_1 (650) \times 10^{-9} = (n_1 + 1) 520 \times 10^{-9}$$

$$65n_1 = 52n_1 + 52 \text{ or } 13n_1 = 52 \text{ or } n_1 = 4$$

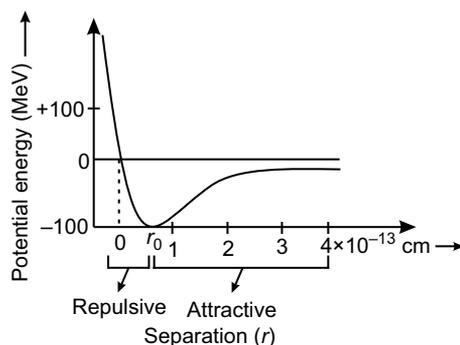
Thus,

$$y = n_1 \frac{\lambda_1 D}{d} = 4 \left[\frac{(6.5 \times 10^{-7})(1.2)}{2 \times 10^{-3}} \right]$$

$$= 1.56 \times 10^{-3} \text{ m} = 1.56 \text{ mm}$$

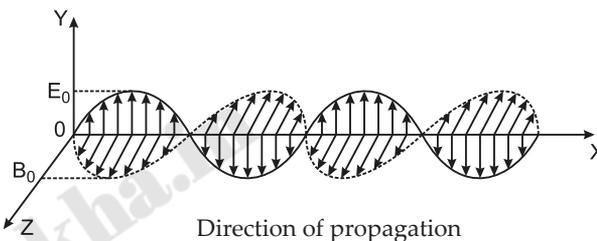
So, the fourth bright fringe of wavelength 520 nm coincides with 5th bright fringe of wavelength 650 nm.

10. Plot of potential energy of a pair of nucleus as a function of their separation is given in the figure.



Conclusions:

- (i) The nuclear force is much stronger than the coulomb force acting between charges or the gravitational forces between masses.
 - (ii) The nuclear force between two nucleons falls rapidly to zero as their distance is more than a few fermies.
 - (iii) For a separation greater than r_0 , the force is attractive and for separation less than r_0 , the force is strongly repulsive.
11. (i) Changes in electric and magnetic fields occur simultaneously. E.M. wave attain their maxima and minima at the same place and at the same time.
- (ii) The electric and magnetic fields directions are mutually perpendicular to each other and as well as to the direction of propagation of wave.
- (iii) The electric field vector (E) and magnetic field vector (B) are related by $c = E_0/B_0$, here E_0 and B_0 are the amplitudes of the respective fields and c is speed of light.
- (iv) The velocity of electromagnetic waves in free space, $c = 1/\sqrt{\mu_0\epsilon_0}$.
- (v) The velocity of electromagnetic waves in a material medium = $1/\sqrt{\mu\epsilon}$. Where μ and ϵ are absolute permeability and absolute permittivity of the material medium respectively.
- (vi) Electromagnetic wave follow the principle of superposition.
- (vii) Electromagnetic waves transfer energy as they propagate through space. This energy is divided equally between electric and magnetic fields.
- (viii) Electromagnetic waves can transfer energy as well as momentum to objects placed on their paths.
- (ix) Electromagnetic waves do not require material medium to travel.



OR

Electromagnetic waves: The waves propagating in space through electric and magnetic fields, varying in space and time simultaneously are called electromagnetic waves.

Characteristics of electromagnetic waves:

- (i) The electromagnetic waves travel in free space with the speed of light ($c = 3 \times 10^8$ m/s) irrespective of their wavelength.
- (ii) Electromagnetic waves are neutral, so they are not deflected by electric and magnetic fields.
- (iii) The electromagnetic waves show properties of reflection, refraction, interference, diffraction and polarisation.
- (iv) In electromagnetic waves the electric and magnetic fields are always in the same phase.
- (v) The ratio of magnitudes of electric and magnetic field vectors in free space in constant equal to c .

$$\frac{E}{B} = \frac{1}{\sqrt{\mu_0\epsilon_0}} = c = 3 \times 10^8 \text{ m/s}$$

(vi) The speed of electromagnetic waves in a material medium is given by

$$v = \frac{1}{\sqrt{\mu\epsilon}} = \frac{c}{\mu_r \epsilon_r} = \frac{c}{n}, \text{ where } n \text{ is the refractive index.}$$

(vii) In an electromagnetic wave, the energy is propagated by means of electric and magnetic field vectors in the direction of propagation of wave.

(viii) In electromagnetic wave the average values of electric energy density and magnetic energy density are equal.

$$\left(\frac{1}{2}\epsilon_0 E^2\right)_{av} = \left(\frac{B^2}{2\mu_0}\right)_{av}$$

(ix) The electric vector of electromagnetic wave is responsible for optical effects and is also called the light vector.

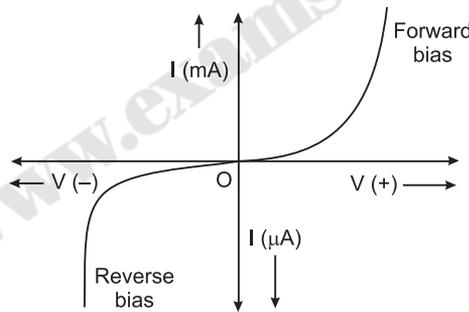
Section - C

12. (a) (iii) Nucleus
 (b) (ii) Nucleus
 (c) (iii) 10^{-15} m
 (d) (iii) Electron
 (e) (iv) Neutral

Sample Paper 4

Section - A

1. The V-I characteristic of the diode is the graph drawn between the voltage V and current I in forward bias and reverse bias of a junction diode.



2. We know that,

$$E_{CB} = \frac{hc}{\lambda_1}$$

⇒

$$E_{BA} = \frac{hc}{\lambda_2}$$

⇒

$$E_{CA} = \frac{hc}{\lambda_3}$$

Now,

where,

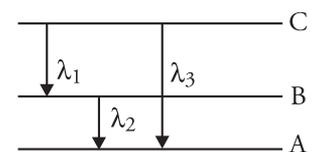
$$E_{CA} = E_{CB} + E_{BA}$$

E_{CB} = Energy gap between level B and C,

E_{BA} = Energy gap between level A and B,

E_{CA} = Energy gap between level A and C.

$$\frac{hc}{\lambda_3} = \frac{hc}{\lambda_1} + \frac{hc}{\lambda_2}$$



$$\frac{hc}{\lambda_3} = \frac{hc}{\lambda_1} + \frac{hc}{\lambda_2}$$

$$\lambda_3 = \frac{\lambda_1 \lambda_2}{\lambda_2 + \lambda_1}$$

OR

de-Broglie Wavelength $\lambda = \frac{h}{p} = \frac{h}{\sqrt{2mE}}$

$$\Rightarrow \lambda = \frac{6.66 \times 10^{-34}}{\sqrt{2 \times 9.1 \times 10^{-31} \times 1.6 \times 10^{-19} \times 10^3}}$$

$$= 0.38 \times 10^{-34+26}$$

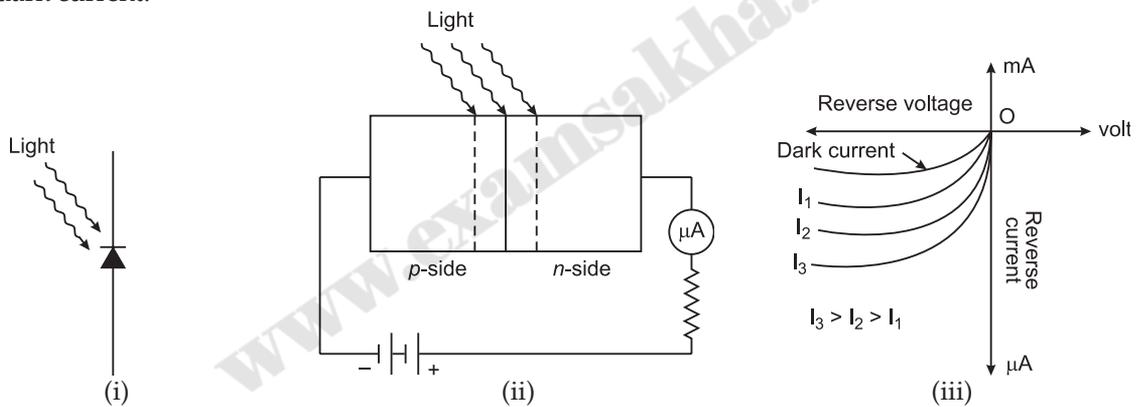
$$\Rightarrow \lambda = 38 \text{ \AA}$$

3. Photodiode is a *p-n* junction which is an opto-electronic device in which current carriers are generated by photons through photo-excitation, *i.e.*, photoconduction by light.

A photodiode is a special *p-n* junction diode made of photosensitive semiconducting material. It is operated under reverse bias below the breakdown voltage. The conductivity of *p-n* junction exists at the *p-n* junction. The conductivity of the *p-n* junction photodiode increases with the increase in intensity of light falling on it.

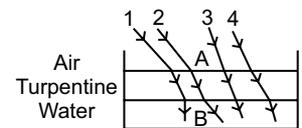
Symbolically, a photodiode is shown in the figure (i). Figure (ii) shows an experimental arrangement for the study of V-I characteristics of a photodiode in which the photodiode is reverse biased.

When the photodiode is reverse biased with voltage less than its breakdown voltage and no light is incident on its junction, the reverse current is extremely small (almost negligible). This current is called dark current.

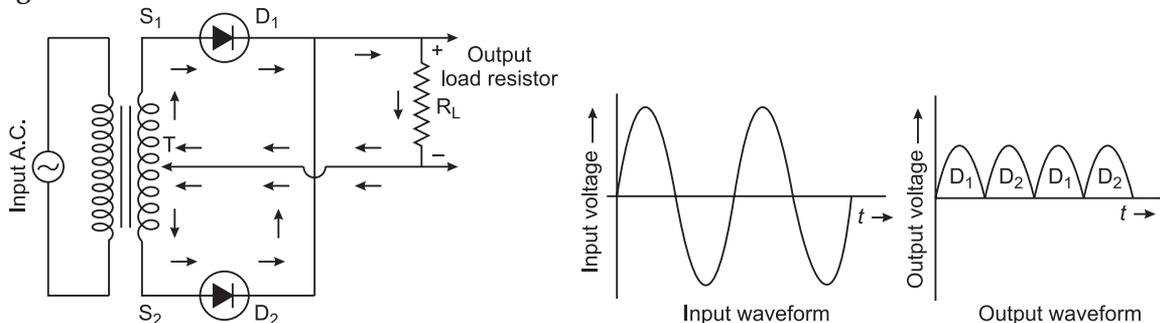


Section - B

4. In the figure, the path shown for the ray 2 is correct. The ray suffers two refractions: At A, ray goes from air to turpentine, bending towards normal. At B, ray goes from turpentine to water (*i.e.*, from denser to rarer medium), bending away from normal.



5. Diagram of a full wave rectifier circuit :



In a full wave rectifier, unidirectional pulsating output current is obtained for both halves of the a.c. input voltage. Essentially, it requires two junction diodes so connected that one diode rectifies one half and second diode rectifies the second half of the input.

During the first half cycle of the a.c. input voltage, the terminal S_1 is positive relative to T and S_2 is negative. In this situation, the junction diode D_1 is forward biased and D_2 is reverse biased. Therefore D_1 conducts and D_2 does not. The conventional current flows through diode D_1 , load R_L and the upper half of the secondary windings, as shown by the solid arrows. During the second half cycle of the input voltage, S_1 is negative relative to T and S_2 is positive. Now D_1 is reverse biased and does not conduct while D_2 is forward-biased and conducts. The current now flows through D_2 , load R_L and the lower half of the secondary windings, as shown by the solid arrows. It may be seen that the current in the load R_L flows in the same direction for both the half cycles of the a.c. input voltage. Thus, the output current is a continuous series of unidirectional pulses.

However, it can be made fairly steady by means of smoothing filters.

6. The photoelectrons from a metal can be emitted only when the energy of light-photons incident on the metal is not less than the work function of the metal. In other word, if the frequency of the incident light is below a certain minimum value or the wavelength is above a certain maximum value, the photoelectrons will not be emitted from the metal however high be the intensity of light. If the threshold wavelength of a metal lies between 6000 to 8000 Å, then the light source B (3000 – 6000 Å) will eject photoelectrons from that metal but not the light source A (8000 – 11000 Å) though the intensity of A is 4 times that of B.
7. (a) (i) Infrared rays
(ii) Microwaves
(iii) Gamma rays

(b) Given: Frequency (ν) = 5×10^{19} Hz

$$\text{Wavelength } (\lambda) = \frac{c}{\nu} = \frac{3 \times 10^8}{5 \times 10^{19}} = 6 \times 10^{-12} \text{ m}$$

This wavelength corresponds to either gamma rays or X-rays. These are used:

- (i) for treatment of cancer, and
(ii) for causing certain nuclear reactions.

8. (i) Given,

$$\delta_m = 30^\circ$$

$$A = 60^\circ$$

Refractive index of the prism,

$$\mu = \frac{\sin \left(\frac{\delta_m + A}{2} \right)}{\sin (A/2)}$$

$$\Rightarrow \mu = \frac{\sin \left(\frac{30^\circ + 60^\circ}{2} \right)}{\sin \left(\frac{60^\circ}{2} \right)}$$

$$\Rightarrow \mu = \frac{\sin (45^\circ)}{\sin (30^\circ)}$$

$$\Rightarrow \mu = \frac{1/\sqrt{2}}{1/2} = \frac{2}{\sqrt{2}} = \sqrt{2}$$

Now, we know,

$$\mu = \frac{c}{v}$$

$$\Rightarrow v = \frac{c}{\mu}$$

$$\Rightarrow v = \frac{3 \times 10^8}{\sqrt{2}} = \frac{3 \times 10^8}{1.414}$$

$$\Rightarrow v = 2.12 \times 10^8 \text{ m/s.}$$

(ii) Let c be the critical angle, then

$$\sin c = \frac{1}{\mu}$$

$$\Rightarrow \sin c = \frac{1}{\sqrt{2}}$$

$$\Rightarrow \sin c = \sin 45^\circ$$

$$\Rightarrow c = 45^\circ$$

$$\therefore r_2 = c = 45^\circ$$

$$r_1 + r_2 = A$$

$$\Rightarrow r_1 = A - r_2 = 60^\circ - 45^\circ$$

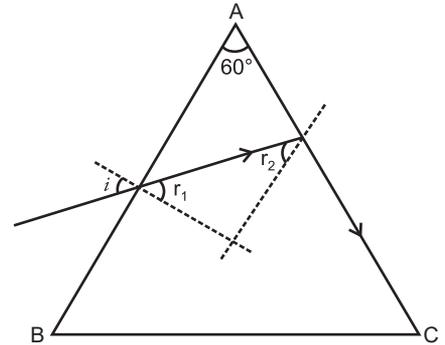
$$\Rightarrow r_1 = 15^\circ$$

$$\text{Now, } \mu = \frac{\sin i}{\sin r_1}$$

$$\begin{aligned} \sin i &= \mu \sin r_1 \\ &= \sqrt{2} \sin (15^\circ) = 1.414 \times 0.2588 \end{aligned}$$

$$\begin{aligned} \sin i &= 0.366 \\ \Rightarrow i &= 21^\circ \text{ (approx).} \end{aligned}$$

OR



(a) In a single slit diffraction pattern angular width of central maxima = $\frac{2\lambda}{d}$.

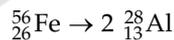
(i) When d is decreased, angular width will increase.

(ii) When the distance between the slit and the screen is increased, angular width remains unaffected.

(iii) When λ is decreased, angular width will also decrease.

(b) The width of central maxima is doubled and the intensity is reduced to one-fourth of its original value.

9. The fission of ${}^{56}_{26}\text{Fe}$ can be given by,



From data given in question

$$\text{Atomic mass of } m({}^{56}_{26}\text{Fe}) = 55.93494 \text{ u}$$

$$\text{Atomic mass of } m({}^{28}_{13}\text{Al}) = 27.98191 \text{ u}$$

The Q-value of this nuclear reaction given by

$$\begin{aligned} Q &= [m({}^{56}_{26}\text{Fe}) - 2m({}^{28}_{13}\text{Al})]c^2 \\ &= [55.93494 - 2 \times 27.98191]c^2 = (-0.02888c^2)u \end{aligned}$$

But

$$1u = 931.5 \text{ MeV}/c^2$$

\therefore

$$Q = -0.02888 \times 931.5 = -26.902 \text{ MeV}$$

The Q-value of the fission is negative. Therefore, the fission is not possible energetically. For an energetically possible fission reaction, the Q-value must be positive.

10. (a) A thin gold foil was taken because gold nucleus is heavy and so it can produce a large deflection in the path of α -particle and also these can be easily prepared.

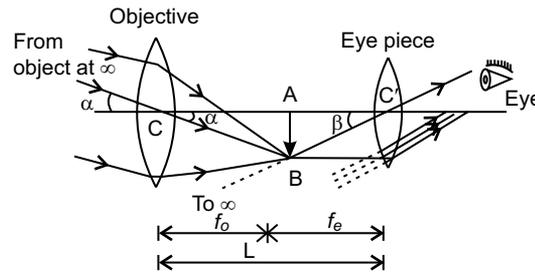
(b) Energy of an electron in the n^{th} orbit hydrogen atom is given by

$$E_n = -\frac{13.6}{n^2} \text{ eV}$$

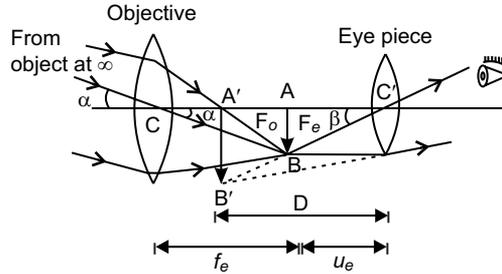
Here, $n = \infty$

$$\therefore E_\infty = -\frac{13.6}{\infty^2} = 0.$$

11. When final image is formed at infinity:



When the final image is formed at least distance of distinct vision:



Magnifying power of refracting telescope (M) is defined as the ratio of the angle subtended by the image (β) at the eye to the angle subtended by the distant object at the unaided eye (α).

$$M = \frac{\beta}{\alpha}$$

We can increase the magnifying power of telescope by:

1. Increasing the focal length of the objective.
2. Decreasing the focal length of eyepiece.

Two limitations of refractive telescope are:

1. The lenses used in refractive telescope are expensive.
2. The lenses used for making refractive telescope have chromatic aberration and distortions.

They can be minimised by using reflecting type telescope, which use concave mirror rather than a lens for the objective.

Reflecting type telescope has the following advantages:

1. They are free from chromatic aberration as mirror is used instead of lens.
2. There is no problem for mechanical support because weight of mirror is much less than the weight of the lens. It can be supported easily.

Here, $f_o = 150 \text{ cm}, f_e = 5 \text{ cm}$

Angle subtended by 100 m tall tower at 3 km is

$$\alpha = \frac{100}{3 \times 1000} = \frac{1}{30} \text{ rad}$$

If h is the height of image formed by the objective, then

$$\alpha = \frac{h}{f_o} = \frac{h}{150}$$

$$\frac{h}{150} = \frac{1}{30} \text{ or } h = \frac{150}{30} \text{ cm} = 5 \text{ cm}$$

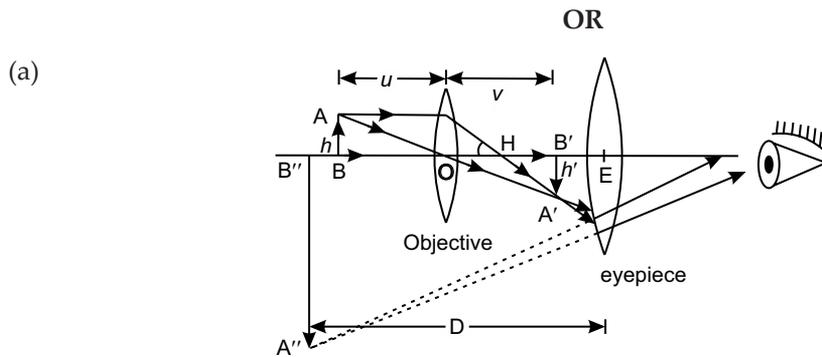
\therefore

Magnification produced by eyepiece

$$m_e = \left(1 + \frac{D}{f_e}\right) = \left(1 + \frac{25}{5}\right) = 6$$

\therefore

$$\text{Height of final image} = h \times m_e = 5 \times 6 = 30 \text{ cm}$$



- (b) For constructing compound microscope, L_3 should be used as objective and L_2 as eyepiece because both the lenses of microscope have short focal lengths and the focal length of objective lens should be smaller than the eyepiece lens.

Section - C

12. (a) (iii) Diffraction
 (b) (iii) Very large
 (c) (ii) Decreases
 (d) (iv) Both (a) and (b)
 (e) (iii) $d < \lambda$

Sample Paper 5

Section - A

1. Suppose the amplitude of waves from each slit is a . Therefore, intensity due to each slit = a^2 .
 When interference is destructive,
 \therefore Minimum intensity = $(a - a)^2 = 0$
 When interference is constructive,
 \therefore Maximum intensity = $(a + a)^2 = (2a)^2 = 4a^2 = 4$ times the intensity due to each slit, which was to be proved.
 Also, average intensity in the interference pattern = $\frac{0 + 4a^2}{2} = 2a^2 =$ sum of intensities due to two slits.
 Hence we conclude that interference involves only redistribution of energy keeping the total energy fixed.
2. (a) When it is in motion with any velocity.
 (b) de-Broglie wavelength associated with the particle.

$$\lambda = \frac{h}{p} = \frac{h}{\sqrt{2mqV}}$$

OR

$$r_n \propto n^2$$

$$\Rightarrow \frac{r_2}{r_3} = \frac{4}{9}$$

$$\Rightarrow r_3 = \frac{9}{4}r$$

$$\Rightarrow r_3 = 2.25r$$

3. There are two types of dopants:
 (i) **Pentavalent dopant:** The elements whose each atom has five valence electrons are known as pentavalent dopants.
 For example, Arsenic (As), Antimony (Sb), Phosphorus (P), etc.

- (ii) **Trivalent dopant:** The elements whose each atom has three valence electrons are known as trivalent dopants. For example, Indium (In), Gallium (Ga), Aluminium (Al), etc.

Section - B

4. The distance of the n^{th} minimum from the centre of the screen,

$$x_n = \frac{nD\lambda}{a}$$

Where,

D = Distance of slit from screen.

λ = Wavelength of the light.

a = Width of the slit.

For first minimum, $n = 1$,

$$x_1 = 3 \times 10^{-3} \text{ m}$$

$$D = 1.5 \text{ m}$$

$$\lambda = 450 \times 10^{-9} \text{ m}$$

$$3 \times 10^{-3} = \frac{1 \times (1.5) \times (450 \times 10^{-9})}{a}$$

$$a = \frac{1 \times (1.5) \times (450 \times 10^{-9})}{3 \times 10^{-3}}$$

$$a = 0.225 \text{ mm}$$

5. Given,

Velocity of electron, $v = 0.5c = 0.5 \times 3 \times 10^8 = 1.5 \times 10^8 \text{ ms}^{-1}$.

$$\begin{aligned} \text{Mass of electron} &= \frac{m_0}{\sqrt{1 - \frac{v^2}{c^2}}} \\ &= \frac{9.1 \times 10^{-31}}{\sqrt{1 - (0.5)^2}} \\ &= \frac{9.1 \times 10^{-31}}{\sqrt{0.75}} = 10.51 \times 10^{-31} \text{ kg.} \end{aligned}$$

de-Broglie wavelength,

$$\begin{aligned} \lambda &= \frac{h}{mv} \\ &= \frac{6.6 \times 10^{-34}}{10.51 \times 10^{-31} \times 1.5 \times 10^8} \\ &= 0.4187 \times 10^{-11} \text{ m} \\ &= 0.04187 \text{ \AA.} \end{aligned}$$

6. Here,

$$\begin{aligned} P &= +5D \\ f &= \frac{100}{P} = \frac{100}{5} \\ &= 20 \text{ cm} \end{aligned}$$

In observation 3, where $u = 35 \text{ cm}$, object lies between f and $2f$. The image must be beyond $2f$, i.e., $v > 40 \text{ cm}$. But $v = 37 \text{ cm}$, i.e., image also lies between f and $2f$, which is wrong.

7. In a given nuclear reaction, the sum of the masses of the target nucleus (${}^2_1\text{H}$) and the bombarding particle (${}^2_1\text{H}$) may be greater than the product nucleus (${}^3_2\text{He}$) and the outgoing neutron ${}_0^1n$. So from the law of conservation of mass – energy some energy (3.27 MeV) is released due to mass defect in the nuclear reaction. This energy is called Q – value of the nuclear reaction.

8. Consider an object O placed in a liquid. A ray of light OA is incident along the normal to the surface of the liquid. Another ray OB, on entering from air to water bends away from the normal. The two refracting rays appear to come from point I, therefore, object though lying at depth OA, appears to be at depth AI. Accordingly, AO is called 'real depth' and AI is called 'apparent depth' of the object O.

The refractive index of the medium air 'a' with respect to liquid 'l' is given by

$${}_l\mu_a = \frac{\sin i}{\sin r} \text{ and } {}_a\mu_l = \frac{\sin r}{\sin i}$$

But from $\triangle IAB$,

$$\sin r = \frac{AB}{IB}$$

and from $\triangle OAB$,

$$\sin i = \frac{AB}{OB}$$

\therefore

$${}_a\mu_l = \frac{AB/IB}{AB/OB} = \frac{OB}{IB}$$

\Rightarrow

$${}_a\mu_l = \frac{BO}{BI}$$

but $BO \approx AO$ and $BI \approx AI$, because A is very close to B.

\therefore

$${}_a\mu_l = \frac{AO}{AI}$$

or

$${}_a\mu_l = \frac{\text{Real depth}}{\text{Apparent depth}}$$

OR

(a) In $\triangle AOL$,

$$\tan C = \frac{AO}{OL}$$

\Rightarrow

$$AO = OL \tan C$$

\Rightarrow

$$r = 20 \tan C$$

Also,

$$\mu = \frac{1}{\sin C}$$

or

$$\sin C = \frac{1}{\mu} = \frac{1}{1.5} = \frac{2}{3}$$

\therefore

$$\tan C = \frac{2}{\sqrt{5}}$$

Thus,

$$r = 20 \times \frac{2}{\sqrt{5}}$$

Therefore, the required surface area,

$$A = \pi r^2$$

or

$$A = \pi \times \frac{40 \times 40}{5} = 320\pi \text{ cm}^2 = 1005.71 \text{ cm}^2.$$

(b) Since,

$$\frac{n}{v} - \frac{1}{u} = \frac{n-1}{R}$$

where,

$$n = {}_g\mu_a = \frac{1}{{}_a\mu_g} = \frac{1}{1.5} = \frac{2}{3}$$

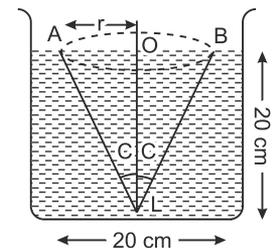
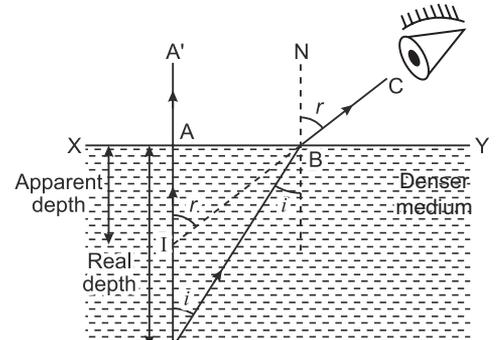
Also

$$u = -(5-2)$$

$$= -3 \text{ cm}$$

and

$$R = -5 \text{ cm}$$



Thus,
$$\frac{2/3}{v} - \frac{1}{-3} = \frac{\frac{2}{3}-1}{-5}$$

On solving
$$v = -2.5 \text{ cm.}$$

Thus, the apparent position of the bubble will be 2.5 cm inside the sphere from the centre.

9. The Rydberg formula is

$$\frac{hc}{\lambda_{if}} = \frac{me^4}{8\epsilon_0^2 h^2} \left(\frac{1}{n_f^2} - \frac{1}{n_i^2} \right)$$

The wavelengths of the first four lines in the Lyman series correspond to transitions from $n_i = 2, 3, 4, 5$ to $n_f = 1$. We know that

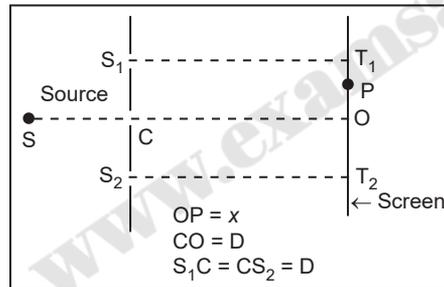
$$\frac{me^4}{8\epsilon_0^2 h^2} = 13.6 \text{ eV} = 21.76 \times 10^{-19} \text{ J}$$

Therefore,

$$\begin{aligned} \lambda_{i1} &= \frac{hc}{21.76 \times 10^{-19} \left(\frac{1}{1} - \frac{1}{n_i^2} \right)} \text{ m} \\ &= \frac{6.625 \times 10^{-34} \times 3 \times 10^8 \times n_i^2}{21.76 \times 10^{-19} \times (n_i^2 - 1)} \text{ m} \\ &= \frac{0.9134 \times 10^{-7} n_i^2}{(n_i^2 - 1)} = \frac{913.4 n_i^2}{(n_i^2 - 1)} \text{ \AA} \end{aligned}$$

Substituting $n_i = 2, 3, 4, 5$, we get $\lambda_{21} = 1218 \text{ \AA}$, $\lambda_{31} = 1028 \text{ \AA}$, $\lambda_{41} = 974.3 \text{ \AA}$ and $\lambda_{51} = 951.4 \text{ \AA}$.

10.



As it is clear from figure,

$$T_2P = T_2O + OP = S_2C + OP = D + x$$

$$T_1P = OT_1 - OP = CS_1 - OP = D - x$$

Now,

$$S_1P = \sqrt{S_1T_1^2 + T_1P^2} = [D^2 + (D - x)^2]^{1/2}$$

and

$$S_2P = \sqrt{S_2T_2^2 + T_2P^2} = [D^2 + (D + x)^2]^{1/2}$$

Path difference between the waves reaching P from S_1 and S_2

$$\begin{aligned} &= S_2P - S_1P \\ &= [D^2 + (D + x)^2]^{1/2} - [D^2 + (D - x)^2]^{1/2} \end{aligned}$$

For first minimum to fall at P, $n = 1$

$$\text{Path diff.} = S_2P - S_1P = \frac{1}{2} \lambda$$

or
$$[D^2 + (D + x)^2]^{1/2} - [D^2 + (D - x)^2]^{1/2} = \frac{\lambda}{2}$$

if
$$x = D$$

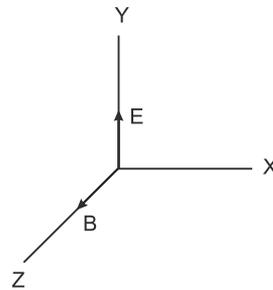
$$[D^2 + 4D^2]^{1/2} - D = \frac{\lambda}{2}$$

$$\Rightarrow D(\sqrt{5} - 1) = \frac{\lambda}{2}$$

$$\Rightarrow D(2.236 - 1) = \frac{\lambda}{2}$$

$$\text{or } D = \frac{\lambda}{2.472}$$

11. (a) Since electromagnetic waves are transverse in nature. We have electric and magnetic fields associated with an electromagnetic wave perpendicular to each other and perpendicular to the direction of propagation of electromagnetic waves.



Let the direction of electric field and magnetic field is along Y-axis and Z-axis then the direction of propagation of EM waves will be along positive X-axis.

- (b) (i) All electromagnetic waves travel with the speed of light.
 (ii) \vec{E} is perpendicular to \vec{B} and both are perpendicular to the direction of propagation.
 (iii) \vec{E} and \vec{B} oscillate in same phase.
 (iv) The ratio of their amplitudes is equal to the velocity of waves in free space *i.e.*, $\frac{E_0}{B_0} = c$.

OR

(a) Wavelength, $\lambda = \frac{c}{\nu}$
 $= \frac{3 \times 10^8}{2 \times 10^{10}} = 1.5 \times 10^{-2} \text{ m.}$

(b) Given: $E_0 = 40 \text{ Vm}^{-1}$

$$\begin{aligned} \text{Energy density due to electric field} &= \frac{1}{2} \epsilon_0 E_{\text{rms}}^2 \\ &= \frac{1}{2} \epsilon_0 \left(\frac{E_0}{\sqrt{2}} \right)^2 = \frac{1}{4} \epsilon_0 E_0^2 \\ &= \frac{1}{4} \times 8.85 \times 10^{-12} \times (40)^2 \\ &= 3.5 \times 10^{-9} \text{ J/m}^3. \end{aligned}$$

Section - C

12. (a) (iv) Photo electronic device
 (b) (iii) Heavily doped
 (c) (ii) Resistance
 (d) (ii) *n*-type
 (e) (iv) All of these

Sample Paper 6

Section - A

1. Note that thermally generated electrons ($n_i \approx 10^{16} \text{ m}^{-3}$) are negligibly small as compared to those produced by doping.

$\therefore n_e \approx ND$

Since $n_e n_h = n_i^2$

The number of holes $n_h = \frac{(2 \cdot 25 \times 10^{32})}{(5 \times 10^{22})} \approx 4.5 \times 10^9 \text{ m}^{-3}$

2. Refractive index, $n = \frac{\text{Real depth (H)}}{\text{Apparent depth (h)}}$

Given, $H = 12.5 \text{ cm}$, $h = 9.4 \text{ cm}$

\therefore Refractive index of water, $n_w = \frac{12.5}{9.4} = 1.33$

Refractive index of liquid, $n_l = 1.63$

\therefore Apparent height with liquid in tank, $h = \frac{H}{n_l} = \frac{12.5}{1.63} = 7.7 \text{ cm}$

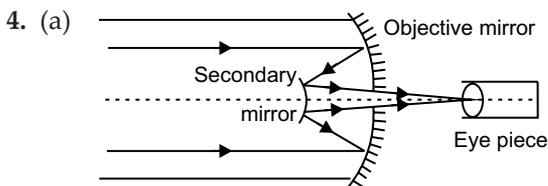
\therefore Displacement of microscope, $x = 9.4 - 7.7 = 1.7 \text{ cm}$

OR

Interference	Diffraction
1. Interference is caused by superposition of two waves starting from two coherent sources.	1. Diffraction is caused by superposition of a number of waves starting from the slit.
2. All bright and dark fringes are of equal width.	2. Width of central bright fringe is double of all other maxima.

3. Given, Input frequency = 50 Hz
 For a half-wave rectifier, the output frequency is equal to the input frequency.
 \therefore Output frequency = 50 Hz
 For a full-wave rectifier, the output frequency is twice the input frequency.
 \therefore Output frequency = $2 \times 50 = 100 \text{ Hz}$

Section - B



(b) **Advantages:**

- (i) It is free from chromatic aberration.
 - (ii) Its resolving power is greater than refracting telescope due to larger aperture of mirror.
- (c) (i) The objective of a telescope have a larger focal length to obtain large magnifying power and greater intensity of image.
- (ii) The aperture of objective lens of a telescope is taken as large because this increases the light gathering capacity of the objective from the distant object. Consequently, a brighter image is formed.

5. According to Bohr, energy is radiated in the form of a photon when the electron of an excited hydrogen atom returns from higher energy state to the lower energy state. So, energy is radiated in the form of a photon when electron jumps from higher energy orbit ($n = n_i$) to lower energy orbit ($n = n_f$).

$$n_i > n_f$$

The energy of the emitted photon is given by

$$h\nu = E_{n_i} - E_{n_f}$$

$$\text{Energy of } n^{\text{th}} \text{ orbit, } E_n = \frac{-me^4}{8h^2\varepsilon_0^2n^2}$$

$$\therefore h\nu = -\frac{me^4}{8\varepsilon_0^2n_i^2h^2} - \left(-\frac{me^4}{8h^2\varepsilon_0^2n_f^2} \right)$$

$$\nu = \frac{me^4}{8\varepsilon_0^2h^2} \left(\frac{1}{n_f^2} - \frac{1}{n_i^2} \right)$$

When electron jumps from $n = 4$ to $n = 3$ state, the spectral series is called Paschen series.

6. (a) We know that,

$$r_1 + r_2 = A$$

Since QR is parallel to BC

$$\text{So, } r_1 = r_2 \text{ and } i = e$$

$$\therefore 2r_1 \text{ or } 2r_2 = A$$

$$\Rightarrow r_1 = r_2 = \frac{A}{2}$$

(b) $\delta_m = \text{Deviation at the first face} + \text{Deviation at the second face}$
 $= (i - r_1) + (e - r_2) = (i + e) - (r_1 + r_2)$
 $= 2i - A$ [$\because i = e$]

7. Given,

$$1 \text{ a.m.u.} = 1.6605 \times 10^{-27} \text{ kg}$$

To convert it into energy units, we multiply it by c^2 and find that energy equivalent

$$= 1.6605 \times 10^{-27} \times (2.9979 \times 10^8)^2 \text{ kg m}^2/\text{s}^2$$

$$= 1.4924 \times 10^{-10} \text{ J}$$

$$= \frac{1.4924 \times 10^{-10}}{1.602 \times 10^{-19}} \text{ eV} = 931.5 \text{ MeV}$$

or

$$1 \text{ a.m.u.} = 931.5 \text{ MeV}/c^2$$

$$\text{O}_8^{16} = \text{Mass no.} = 16$$

$$\text{energy for 16 amu} = 16 \times 931.6 = 14905.6 \text{ MeV}$$

$$\text{Mass defect} = \frac{\text{energy}}{c^2}$$

$$= \frac{14905.6 \text{ MeV}}{c^2}$$

8. (a) The condition for the sustained interference is that both the sources must be coherent (*i.e.*, they must have the same wavelength and the same frequency, and they must have the same phase or constant phase difference).

Two sources are monochromatic if they have the same frequency and wavelength. Since they are independent, *i.e.*, they have different phases with irregular difference, they are not coherent sources.

(b) Let the displacement of the waves from the sources S_1 and S_2 at point P on the screen at any time t be given by:

$$y_1 = a \cos \omega t$$

and

$$y_2 = a \cos (\omega t + \phi)$$

Where, ϕ is the constant phase difference between the two waves.

By the superposition principle, the resultant displacement at point P is given by:

$$y = y_1 + y_2$$

$$y = a \cos \omega t + a \cos (\omega t + \phi)$$

$$y = 2a \left[\cos \left(\frac{\omega t + \omega t + \phi}{2} \right) \cos \left(\frac{\omega t - \omega t - \phi}{2} \right) \right]$$

$$y = 2a \cos \left(\omega t + \frac{\phi}{2} \right) \cos \left(\frac{\phi}{2} \right) \quad \dots(i)$$

Let $2a \cos (\phi/2) = A$

Then, equation (i) becomes

$$y = A \cos (\omega t + \phi / 2)$$

Now, we have

$$A^2 = 4a^2 \cos^2 \frac{\phi}{2} \quad \dots(iii)$$

The intensity of light is directly proportional to the square of the amplitude of the wave. The intensity of light at point on the screen is given by

$$I = 4a^2 \cos^2 \frac{\phi}{2}$$

OR

Laws of refraction: Consider a plane wavefront AB incident on a surface PQ separating two media (1) and (2). The medium (1) is rarer, having refractive index n_1 , in which the light travels with a velocity c_1 . The medium (2) is denser, having refractive index n_2 , in which the light travels with a velocity c_2 .

At time $t = 0$, the incident wavefront AB touches the boundary separating two medium at A. The secondary wavelets from point B advance forward with a velocity c_1 , and after time t seconds touches at D, thus covering a distance $BD = c_1 t$. In the same time interval of t seconds, the secondary wavelets from A, advance forward in the second medium, and travels with a speed of c_2 . With the point A as the centre and a distance $AC = c_2 t$, an envelope is drawn to obtain a new refracted wave front as CD.

Consider triangles BAD and ACD,

$$\sin i = \sin (\angle BAD) = \frac{BD}{AD} = \frac{c_1 t}{AD}$$

$$\sin r = \sin (\angle ADC) = \frac{AC}{AD} = \frac{c_2 t}{AD}$$

$$\Rightarrow \frac{\sin i}{\sin r} = \frac{c_1 t}{c_2 t} = \frac{c_1}{c_2}$$

$$\Rightarrow \frac{\sin i}{\sin r} = \frac{c_1}{c_2} = \text{constant}$$

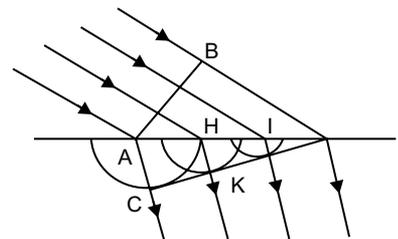
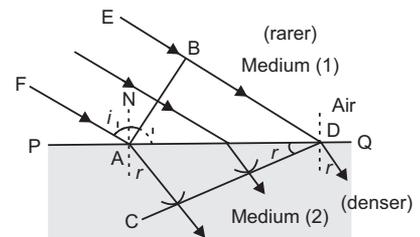
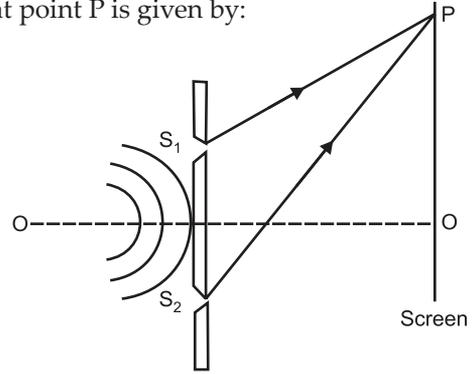
This constant is called the refractive index of the second medium with respect to the first medium.

$$\frac{c_1}{c_2} = \frac{n_2}{n_1}$$

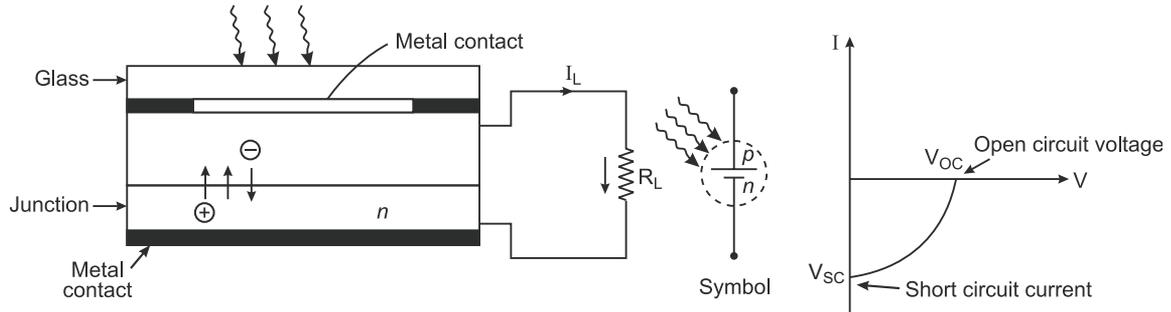
$$= {}_1n_2$$

$$\therefore \frac{\sin i}{\sin r} = \frac{c_1}{c_2} = \frac{n_2}{n_1} = {}_1n_2$$

This is known as the snell's law.



9. A solar cell is a junction diode which converts light energy into electrical energy. It is based on photovoltaic effect. The surface layer of *p*-region is made very thin so that the incident photons may easily penetrate to reach the junction which is the active region. In an operation in the photovoltaic mode (*i.e.*, generation of voltage due to bombardment of optical photons); the materials suitable for photocells are silicon (Si), gallium arsenide (GaAs), cadmium sulphide (CdS) and cadmium selenide (CdSe).



Working: When photons of energy greater than energy band gap of ($h\nu > E_g$) are made to incident on the junction, electron-hole pairs are created which moves in opposite directions due to junction field. These are collected at two sides of junction, thus producing photovoltage giving rise to photocurrent. The characteristic curve of solar cell is shown above.

Uses of solar cells:

- (i) Solar cells are used for charging storage batteries in day time, which can supply the power during night times.
 - (ii) The solar cells are also used in artificial satellite to operate the various electrical instruments kept inside the satellite.
 - (iii) They are used for generating electrical energy for cooking food and pumping water.
 - (iv) Solar cells are used in calculators, wrist watches and light meters (in photography).
 - (v) Solar cells are used to produce electric power in remote areas, where electric power supply is not available.
 - (vi) Solar cells are used in traffic signals.
 - (vii) Solar cells are used in remote radiotelephones.
10. Image is formed behind the lens.

$\therefore v = +8 \text{ m}$
 As the image is real,

$$m = \frac{I}{O} = \frac{v}{u} = -\frac{1}{3}$$

$$u = -3v = -3(8 \text{ m}) = -24 \text{ m}$$

According to lens formula

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$

$\Rightarrow \frac{1}{8} - \frac{1}{-24} = \frac{1}{f}$ or $f = 6 \text{ m}$

Refractive index of the material of the lens is

$$\mu = \frac{\text{Wavelength of the light in free space}}{\text{Wavelength of light inside the lens}} = \frac{\lambda_0}{\frac{2}{3}\lambda_0} = \frac{3}{2}$$

According to lens maker's formula

$$\frac{1}{f} = \frac{(\mu - 1)}{R} \text{ or } R = f(\mu - 1) \quad \dots(i)$$

Substituting the value of μ and f in eqn. (i), we get

$$R = (6 \text{ m})(1.5 - 1) = 3 \text{ m}.$$

11. (a) In microwave oven, the frequency of the microwaves is selected to match the resonant frequency of water molecules so that energy from the waves get transferred efficiently to the kinetic energy of the molecules. This kinetic energy raises the temperature of any food containing water.
- (b) Microwaves are short wavelength radio waves, with frequency of order of GHz. Due to short wavelength, they have high penetrating power with respect to atmosphere and less diffraction in the atmospheric layers. So these waves are suitable for the radar systems used in aircraft navigation.

OR

(a) $y_1 = a \cos \omega t, y_2 = a \cos (\omega t + \phi)$

where ϕ is phase difference between them. Resultant displacement at point P will be

$$y = y_1 + y_2 = a \cos \omega t + a \cos (\omega t + \phi)$$

$$= a[\cos \omega t + \cos (\omega t + \phi)]$$

$$= a \left[2 \cos \frac{(\omega t + \omega t + \phi)}{2} \cos \frac{(\omega t - \omega t - \phi)}{2} \right]$$

$$y_2 = 2a \cos \left(\omega t + \frac{\phi}{2} \right) \cos \left(\frac{\phi}{2} \right) \quad \dots(i)$$

Let $y = 2a \cos \left(\frac{\phi}{2} \right) = A$, the equation (i) becomes

$$y = A \cos \left(\omega t + \frac{\phi}{2} \right)$$

where A is amplitude of resultant wave,

Now, $A = 2a \cos \left(\frac{\phi}{2} \right)$

On squaring, $A^2 = 4a^2 \cos^2 \left(\frac{\phi}{2} \right)$

Hence, resultant intensity, $I = 4I_0 \cos^2 \left(\frac{\phi}{2} \right)$

- (b) Condition for constructive interference,

$$\cos \Delta\phi = +1$$

$$2\pi \frac{\Delta x}{\lambda} = 0, 2\pi, 4\pi \dots$$

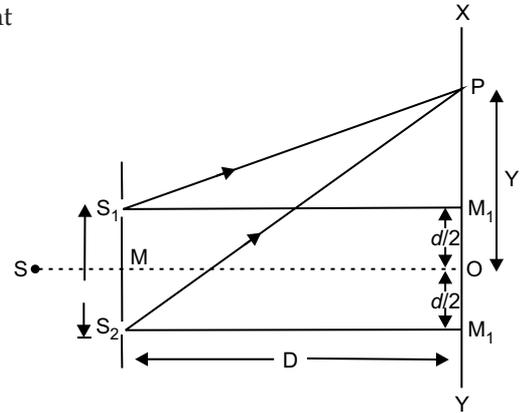
or $\Delta x = n\lambda; n = 0, 1, 2, 3, \dots$

Condition for destructive interference, $\cos \Delta\phi = -1$

$$2\pi \frac{\Delta x}{\lambda} = \pi, 3\pi, 5\pi \dots$$

or $\Delta x = (2n - 1) \frac{\lambda}{2}$

where $n = 1, 2, 3 \dots$



Section - C

12. (a) (i) Straight line passing through origin

Explanation: $n \propto I$ No. electrons are emitted without suitable light $\Rightarrow n = 0$ for $I = 0$

- (b) (ii) 8.2×10^{14} Hz

Explanation: Frequency of light should be more than threshold frequency for photoelectric emission.

- (c) (iii) Using red light with the first metal

Explanation: $KE_{\max} = (h\nu - \phi)$. Increasing ν and reducing ϕ will make KE_{\max} more

- (d) (ii) More than
- n
- times the initial KE.

Explanation:

$$KE_1 = h\nu - \phi : n KE_1 = nh\nu - n\phi$$

$$KE_2 = h\nu - \phi$$

$$\Rightarrow KE_2 > n KE_1$$

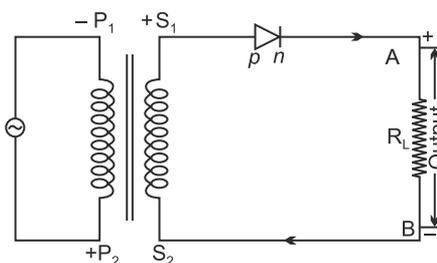
- (e) (ii) Shortest frequency

Explanation: Stopping potential is related to the maximum KE of emitted electrons.

Sample Paper 7

Section - A

1. **Principle:** It is based on the principle that the junction diode offers low resistance path, when forward biased and high resistance, when reverse biased. When a.c. input is applied to a junction diode, it gets forward biased during one half cycle and reverse biased during the next opposite half cycle. Thus, output is obtained during alternate half cycles of the a.c. input.



2. **Given:** Cut-off voltage, $V_o = 2.5$ V

Maximum kinetic energy of photoelectrons,

$$E_k = eV_o = 1.6 \times 10^{-19} \times 2.5$$

$$= 4 \times 10^{-19} \text{ J.}$$

OR

Lyman series lies in ultraviolet region. Therefore, wavelength of the spectral lines in Lyman series must be less than the wavelength in visible region *i.e.*, $3,900 \text{ \AA}$. Therefore, spectral line of wavelength $1,216 \text{ \AA}$ lies in Lyman series.

3. Wavelength, $\lambda = 6000 \text{ nm}$

$$\text{Energy of incident photon, } E = h\nu = \frac{hc}{\lambda}$$

$$= \frac{6.6 \times 10^{-34} \times 3 \times 10^8}{6000 \times 10^{-9}} \text{ J}$$

$$= 3.3 \times 10^{-20} \text{ J}$$

$$= \frac{3.3 \times 10^{-20}}{1.6 \times 10^{-19}} \text{ eV}$$

$$E = 0.206 \text{ eV}$$

As the energy of the photon is less than energy band gap ($E_g = 2.8 \text{ eV}$) of the semiconductor, so a wavelength of 6000 nm cannot be detected.

Section - B

- 4.

$$\text{Energy released} = \Delta m \times 931 \text{ MeV}$$

$$\Delta m = 4m({}_1^1\text{H}) - m({}_2^4\text{He})$$

$$\text{Energy released } Q = [4m({}_1^1\text{H}) - m({}_2^4\text{He})] \times 931 \text{ MeV}$$

$$= [4 \times 1.007825 - 4.002603] \times 931 \text{ MeV}$$

$$= 26.72 \text{ MeV.}$$

5. As per the figure,

The image formed by the lens L_1 is at P. Therefore

$$\text{using lens formula } \frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

As per the parameters given in the question

$$u = -15 \text{ cm, } f_{L_1} = 20 \text{ cm}$$

So, the image distance will be

$$\frac{1}{v} - \frac{1}{(-15)} = \frac{1}{20}$$

$$\Rightarrow v = -60 \text{ cm}$$

Now, this image is acting as an object for the lens L_2 .

We can again use the lens formula and other parameters given in the question and question figure to find the focal length of lens L_2 .

$$\frac{1}{v_{L_2}} - \frac{1}{u_{L_2}} = \frac{1}{f_{L_2}}$$

$$\begin{aligned} \text{Here, } u_{L_2} &= v + (-20) \\ &= -60 - 20 = -80 \text{ cm} \end{aligned}$$

$$\text{and, } v_{L_2} = 80 \text{ cm}$$

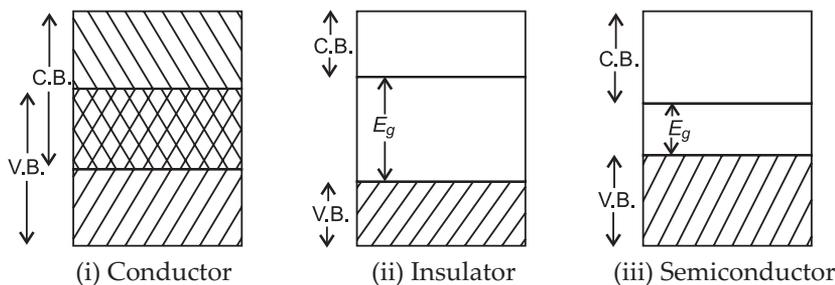
$$\frac{1}{80} - \frac{1}{(-80)} = \frac{1}{f_{L_2}}$$

$$\Rightarrow f_{L_2} = 40 \text{ cm}$$

So, the focal length of the lens $L_2 = 40 \text{ cm}$.

6. Conductors:

- (i) In case of conductors, the valence band is completely filled and the conduction band can have two cases-either it is partially filled with an extremely small energy gap between the valence and conduction bands or it is empty, with the two bands overlapping each other as shown in figure:
- (ii) Even when a small current is applied, conductors can conduct electricity.



[Here, C.B. → Conduction Band, V.B. → Valence Band, E_g → Forbidden energy gap]

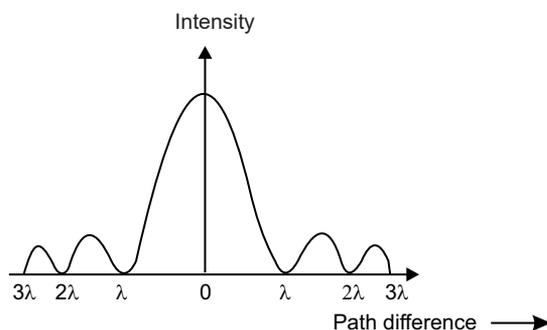
Insulators:

- (i) In case of insulators, the energy gap between the conduction and valence bands is very large and the conduction band is practically empty.
- (ii) When an electric field is applied to such kind of material, the electrons find hard to receive such a large amount of energy to reach the conduction band. Thus, the conduction band remains to be empty. That is why no current flows through insulators.

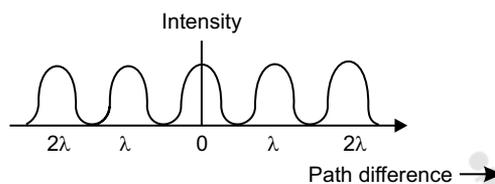
Semiconductors:

- (i) In case of semiconductor, the energy band structure of semiconductors is similar to insulators, but in this case, the size of forbidden energy gap is quite smaller than that of the insulators.
- (ii) When an electric field is applied to a semiconductor, the electrons in the valence band find it relatively easier to jump to the conduction band. So, the conductivity of semiconductors lies between the conductivity of conductors and insulators.

7. (a) Single slit diffraction



Double slit interference



- (b) Angular width of central maxima is given by

$$2\theta = \frac{2\lambda}{a}$$

Since,

$$\lambda_r > \lambda_b$$

Therefore, width of central maxima of red light is greater than the width of central maxima of blue light.

8. (a) Magnifying power of refracting telescope (
- M
-) is defined as the ratio of the angle subtended by the image (
- β
-) at the eye to the angle subtended by the distant object at the unaided eye (
- α
-).

$$M = \frac{\beta}{\alpha}$$

- (b) Here,

$$f_0 = 150 \text{ cm}, f_e = 5 \text{ cm}$$

Angle subtended by 100 m tall tower at 3 km is

$$\alpha = \frac{100}{3 \times 1000} = \frac{1}{30} \text{ rad}$$

If h is the height of image formed by the objective, then

$$\alpha = \frac{h}{f_0} = \frac{h}{150}$$

\therefore

$$\frac{h}{150} = \frac{1}{30}$$

or

$$h = \frac{150}{30} \text{ cm} = 5 \text{ cm}$$

Magnification produced by eyepiece

$$m_e = \left(1 + \frac{D}{f_e}\right) = \left(1 + \frac{25}{5}\right) = 6$$

∴ Height of final image = $h \times m_e = 5 \times 6 = 30$ cm.

OR

$$\Rightarrow \lambda = 6000 \text{ \AA} = 6000 \times 10^{-10} \text{ m} = 6 \times 10^{-7} \text{ m}$$

$$\theta_1 = 30^\circ$$

(i) For first maximum,
$$\sin \theta_m = \frac{\left(m + \frac{1}{2}\right)\lambda}{a}$$

$$\sin \theta_1 = \frac{3\lambda}{2a} \text{ or } a = \frac{3\lambda}{2 \sin \theta_1} = \frac{3 \times 6 \times 10^{-7}}{2 \times \sin 30^\circ} = 1.8 \times 10^{-6} \text{ m} = 1.8 \text{ \mu m}$$

(ii) For first minimum,
$$\sin \theta_m = \frac{m\lambda}{a}$$

∴
$$\sin \theta_1 = \frac{\lambda}{a}$$

$$\Rightarrow a = \frac{\lambda}{\sin \theta_1} = \frac{6 \times 10^{-7}}{\sin 30^\circ} = 1.2 \times 10^{-6} \text{ m} = 1.2 \text{ \mu m}.$$

9. The graph for V_s and ν is as follows:

Determination of Planck's constant: As from the graph it is clear that slope of the graph is given by

$$\text{Slope} = \frac{h}{e}$$

where, h = Planck's constant

e = Charge on an electron

Now, from Einstein's photoelectric equation

$$K_{\max} = h\nu - \phi$$

$$\Rightarrow eV_0 = h\nu - \phi$$

$$\Rightarrow V_0 = \left(\frac{h}{e}\right)\nu - \frac{\phi}{e}$$

Comparing this equation with $y = mx + c$.

$$\text{Slope of } (V_0 - \nu) \text{ graph} = \frac{h}{e}$$

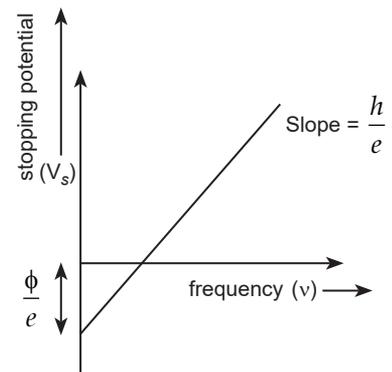
So, Planck's constant

$$h = \text{Slope } (V_0 - \nu) \text{ graph.}$$

10. Kinetic energy of α -particle,

$$\begin{aligned} E &= \frac{1}{2} m v^2 = 7.7 \text{ MeV} \\ &= 7.7 \times 1.6 \times 10^{-13} \text{ J} \\ &= 1.2 \times 10^{-12} \text{ J} \end{aligned}$$

Here, $Z = 79, e = 1.6 \times 10^{-19} \text{ C}$



$$r_0 = \frac{1}{4\pi\epsilon_0} \cdot \frac{(Ze)(2e)}{\frac{1}{2}mv^2}$$

$$r_0 = \frac{9 \times 10^9 \times 79 \times 2 (1.6 \times 10^{-19})^2}{1.2 \times 10^{-12}}$$

$$r_0 = \frac{9 \times 79 \times 2 \times 1.6 \times 1.6 \times 10^{-29}}{1.2 \times 10^{-12}}$$

$$r_0 = 3.0 \times 10^{-14} \text{ m}$$

$$= 30 \text{ fermi.}$$

If kinetic energy of α -particle is double, the distance of closest approach is halved.

11. (i) Comparing the given equation with the standard equation of electromagnetic wave,

$$B = B_0 \sin(kx + \omega t)$$

We have, $k = \frac{2\pi}{\lambda} = 0.5 \times 10^3$

$\therefore \lambda = \frac{2\pi}{0.5 \times 10^3} \text{ m} = 1.26 \text{ cm}$

$$\omega = 2\pi\nu = 1.5 \times 10^{11}$$

$\therefore \nu = \frac{1.5 \times 10^{11}}{2\pi} \text{ Hz} = 2.38 \times 10^{10} \text{ Hz}$

(ii) Given, $B_0 = 2 \times 10^{-7} \text{ T}$

$\therefore E_0 = B_0 c = 2 \times 10^{-7} \times 3 \times 10^8$
 $= 60 \text{ NC}^{-1}$

The electric field is perpendicular to both, the magnetic field and the direction of propagation of wave. Thus,

$$E_z = (60 \text{ NC}^{-1}) \sin(0.5 \times 10^3 x + 1.5 \times 10^{11} t)$$

OR

In Young's double slit experiment, the wave fronts from the two illuminated slits superpose on the screen. This results in formation of alternate bright and dark fringes because of constructive and destructive interference, respectively. The intensity of light is maximum at the centre C of the screen and it is called central maxima.

Let S_1 and S_2 be two slits separated by a distance d . GG' is the screen at a distance D from the slits S_1 and S_2 . Both the slits are equidistant from point C. The intensity of light will be maximum at this point due to the path difference of the waves reaching this point will be zero.

At point P, the path difference between the rays coming from the slits S_1 and S_2 is $S_2P - S_1P$.

Now,

$$S_1S_2 = d$$

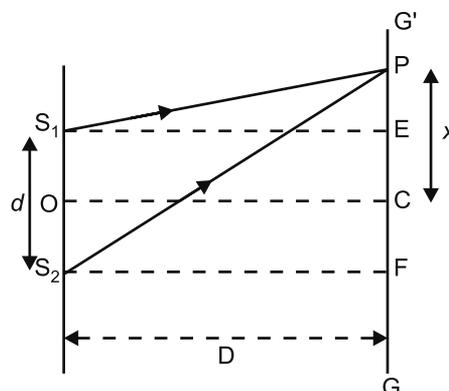
$$EF = d_1 \text{ and } S_2F = D$$

\therefore In ΔS_2PF ,

$$S_2P = [S_2F^2 + PF^2]^{1/2}$$

$$S_2P = \left[D^2 + \left(x + \frac{d}{2} \right)^2 \right]^{1/2}$$

$$= D \left[1 + \frac{\left(x + \frac{d}{2} \right)^2}{D^2} \right]^{1/2}$$



Similarly, in ΔS_1PE

$$S_1P = D \left[1 + \frac{\left(x - \frac{d}{2}\right)^2}{D^2} \right]^{\frac{1}{2}}$$

$$S_2P - S_1P = D \left[1 + \frac{\left(x + \frac{d}{2}\right)^2}{D^2} \right]^{\frac{1}{2}} - D \left[1 + \frac{\left(x - \frac{d}{2}\right)^2}{D^2} \right]^{\frac{1}{2}}$$

On expanding it binomially,

$$S_2P - S_1P = \frac{1}{2D} \left[4x \times \frac{d}{2} \right] = \frac{xd}{D}$$

For bright fringes (constructive interference), the path difference is an integral multiple of wavelength, *i.e.*, path difference is $n\lambda$.

$$\therefore n\lambda = \frac{xd}{D}$$

$$\Rightarrow x = \frac{n\lambda D}{d}, \text{ where } n = 0, 1, 2, 3, 4, \dots$$

For	$n = 0,$	$x_0 = 0$
	$n = 1,$	$x_1 = \frac{\lambda D}{d}$
	$n = 2,$	$x_2 = \frac{2\lambda D}{d}$
	$n = 3,$	$x_3 = \frac{3\lambda D}{d}$
	$n = n,$	$x_n = \frac{n\lambda D}{d}$

The separation between the centres of two consecutive bright interference fringes is the width of a dark fringes.

$$\therefore \beta_1 = x_n - x_{n-1} = \frac{\lambda D}{d}$$

$$x_n = (2n - 1) \frac{\lambda D}{2d}$$

For	$n = 1,$	$x_1 = \frac{\lambda D}{2d}$
-----	----------	------------------------------

For	$n = 2,$	$x_2 = \frac{3\lambda D}{2d}$
-----	----------	-------------------------------

The separation between the centres of two consecutive dark interference fringes is the width of a bright fringes.

$$\therefore \beta_2 = x_n - x_{n-1} = \frac{\lambda D}{d}$$

$$\beta_1 = \beta_2$$

All the bright and dark fringes are of equal width as $\beta_1 = \beta_2$.

Section - C

12. (a) (ii) Its critical angle with reference to air is too small
(b) (i) 2.42
(c) (ii) High refractive index
(d) (iv) Increases
(e) (i) Less than the first





Chemistry

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Blueprint of the Sample Question Paper

S. No.	Chapter Name	Marks		
		2	3	5
1	Aldehyde, Ketones and Carboxylic acids	✓		
2	Electrochemistry	✓		
3	Aldehyde, Ketones and Carboxylic acids	✓		
4	Amines		✓	
OR 4	Amines		✓	
5	Coordination compounds		✓	
OR 5	Coordination compounds		✓	
6	D and F block elements		✓	
7	Aldehyde, Ketones and Carboxylic acids		✓	
8	Surface Chemistry		✓	
9	Amines		✓	
OR 9	Amines		✓	
10	Electrochemistry		✓	
11	D and F block elements		✓	
OR 11	D and F block elements		✓	
12	Chemical Kinetics			✓



Sample Question Paper

Chemistry [Code (043)]

Term - II

Max. Marks : 35

Time : 2 Hours

General Instructions:

Read the following instructions carefully.

1. There are 12 questions in this question paper with internal choice.
2. Section A - Q. No. 1 to 3 are very short answer questions carrying 2 marks each.
3. Section B - Q. No. 4 to 11 are short answer questions carrying 3 marks each.
4. Section C- Q. No. 12 is case based question carrying 5 marks.
5. All questions are compulsory.
6. Use of log tables and calculators is not allowed

SECTION A

1. Arrange the following in the increasing order of their property indicated (any 2):
 - (a) Benzoic acid, phenol, picric acid, salicylic acid (pka values).
 - (b) Acetaldehyde, acetone, methyl tert butyl ketone (reactivity towards NH_2OH).
 - (c) Ethanol, ethanoic acid, benzoic acid (boiling point)

[1×2=2]

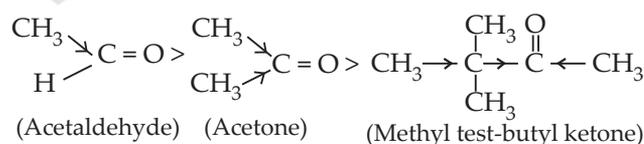
Ans. (a) Picric acid < salicylic acid < benzoic acid < phenol

$$\begin{aligned} p \text{ ka values (Picric acid)} &= 0.3 \\ p \text{ ka values (Salicylic acid)} &= 2.97 \\ p \text{ ka values Phenol} &= 10 \\ p \text{ ka values Benzoic acid} &= 4.20 \end{aligned}$$

Thus, order is:

Picric acid < salicylic acid < Benzoic acid < Phenol

(b) Methyl tert - Butyl ketone < Acetone < Acetaldehyde



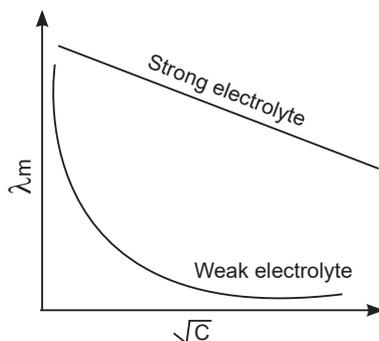
When NH_2OH reacts with a compound, the attacking species is a nucleophile OH^- . Therefore as the negative charge on compound increases, the reactivity with NH_2OH decreases in above compounds + I effect increases and steric hindrance also increases in the same.

(c) Ethanol < ethanoic acid < benzoic acid (boiling point of carboxylic acids is higher than alcohols due to extensive hydrogen bonding, boiling point increases with increase in molar mass)

2. Solutions of two electrolytes 'A' and 'B' are diluted. The Δm of 'B' increases 1.5 times while that of A increases 25 times. Which of the two is a strong electrolyte? Justify your answer. Graphically show the behaviour of 'A' and 'B'. [1+1]

Ans. B is a strong electrolyte. The molar conductivity increases slowly with dilution as there is no increase in number of ions on dilution as strong electrolytes are completely dissociated.

Molar conductivity $\lambda_m = \frac{K}{C}$ Where K is specific conductance C is molar concentration of electrolyte.



Electrolyte B is strong because in B the number of ions remains same on dilution but only interionic attraction decreases therefore λ_m increases only 1.5 times while in case of weak electrolyte on dilution, number of constituent ions decreases.

3. Give reasons to support the answer:

- Presence of alpha hydrogen in aldehydes and ketones is essential for aldol condensation.
- 3-Hydroxy pentan-2-one shows positive Tollen's test. [1×2=2]

- Ans.**
- The alpha hydrogen atoms are acidic in nature due to presence of electron withdrawing carbonyl group. These can be easily removed by a base and the carbanion formed is resonance stabilized.
 - Tollen's reagent is a weak oxidizing agent not capable of breaking the C-C bond in ketones. Thus, ketones cannot be oxidized using Tollen's reagent as itself gets reduced to Ag.

SECTION B

4. Account for the following:

- Aniline cannot be prepared by the ammonolysis of chlorobenzene under normal conditions.
- N-ethylethanamine boils at 329.3K and butanamine boils at 350.8K, although both are isomeric in nature.
- Acylation of aniline is carried out in the presence of pyridine. [1×3=3]

- Ans.**
- In case of chlorobenzene, the C-Cl bond is quite difficult to break as it acquires a partial double bond character due to conjugation. So, under the normal conditions, ammonolysis of chlorobenzene does not yield aniline.
 - Primary and secondary amines are engaged in intermolecular association due to hydrogen bonding between nitrogen of one and hydrogen of another molecule. Due to the presence of three hydrogen atoms, the intermolecular association is more in primary amines than in secondary amines as there are two hydrogen atoms available for hydrogen bond formation in it. Thus, butanamine boils at 350.8K while N-ethylethanamine boils at 329.3K.
 - During the acylation of aniline, stronger base pyridine is added. This done in order to remove the HCl so formed during the reaction and to shift the equilibrium to the right hand side.

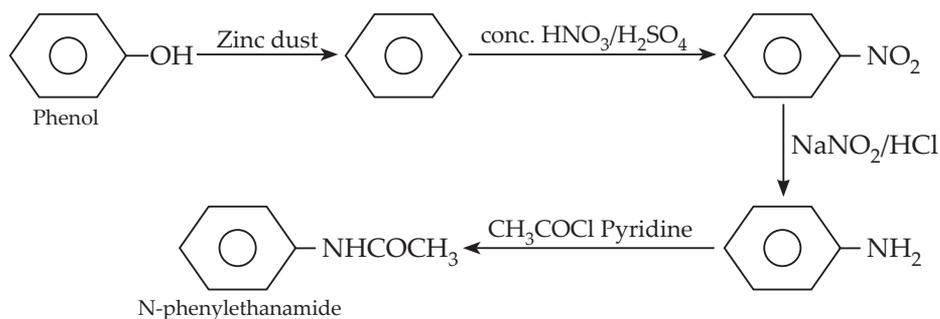
OR

Convert the following:

- Phenol to N-phenylethanamide.
- Chloroethane to methanamine.
- Propanenitrile to ethanal.

[1×3=3]

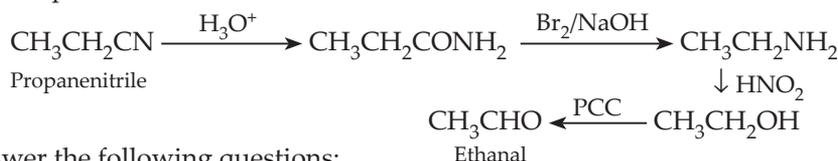
- Ans.** (a) Phenol into N-phenylethanamide



(b) Chloroethane to methanamine



(c) Propanenitrile to ethanal



5. Answer the following questions:

- (a) $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$ (aq) is green in colour whereas $[\text{Ni}(\text{H}_2\text{O})_4(\text{en})]^{2+}$ (aq) is blue in colour, give reason in support of your answer.
- (b) Write the formula and hybridization of the following compound—tris(ethane-1,2-diamine) cobalt(III) sulphate. [1+2]

OR

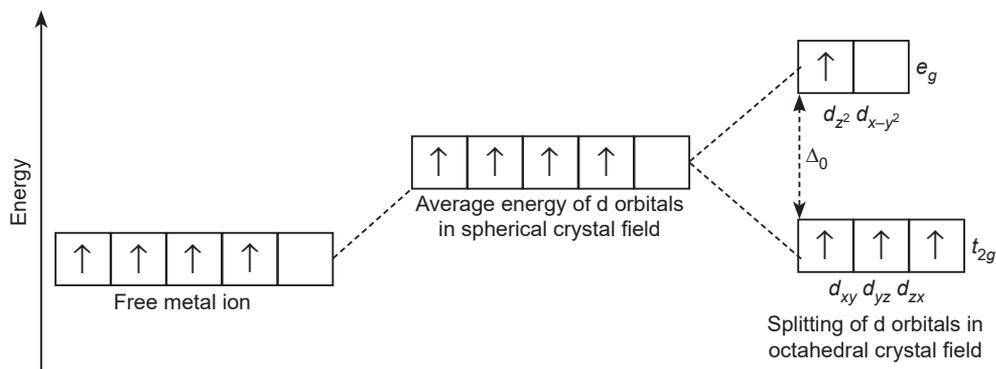
In a coordination entity, the electronic configuration of the central metal ion is $t_2g^3 e_g^1$.

- (a) Is the coordination compound a high spin or low spin complex?
 (b) Draw the crystal field splitting diagram for the above complex.

- Ans.** (a) The colour of coordination compound depends upon the type of ligand and d-d transition taking place. H_2O is weak field ligand, which causes small splitting leading to the d-d transition corresponding green colour, however, due to the presence of (en) which is strong field ligand, the splitting is increased. Due to the change in t_2g-e_g splitting, the colouration of the compound changes from green to blue.
- (b) Formula of the compound is $[\text{Co}(\text{H}_2\text{NCH}_2\text{CH}_2\text{NH}_2)_3]_2(\text{SO}_4)_3$
 The hybridisation of the compound is: d^2sp

OR

- (a) As the fourth electron enters one of the e_g orbitals giving the configuration $t_2g^3 e_g^1$, which indicates $\Delta_o < P$ hence forms high spin complex.
- (b)



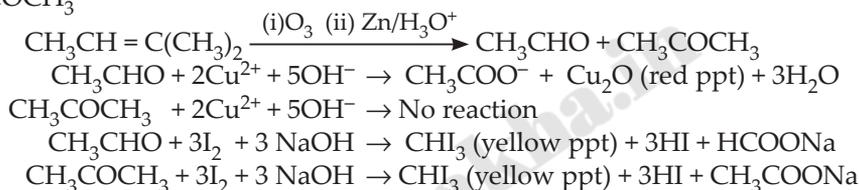
6. Account for the following:

- (a) Ti(IV) is more stable than the Ti (II) or Ti(III).
 (b) In case of transition elements, ions of the same charge in a given series show progressive decrease in radius with increasing atomic number.

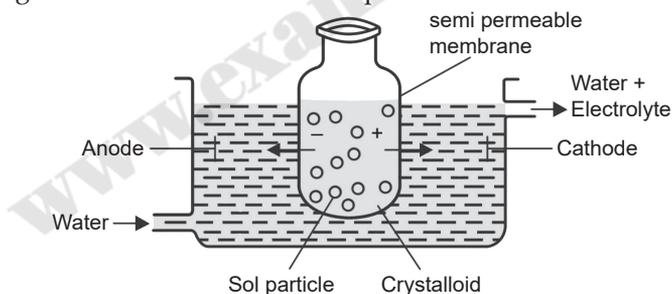
- (c) Zinc is a comparatively a soft metal, iron and chromium are typically hard. [1×3=3]
- Ans.** (a) The electronic configuration of Ti is [Ar] 3d² 4s². Ti (IV) is more stable than the Ti (II) or Ti (III) because on losing 4 electrons Ti(IV) will become more stable as it will acquire the nearest noble gas configuration.
- (b) In case of transition elements, ions of the same charge in a given series show progressive decrease in radius with increasing atomic number. This is because as the new electron enters a *d* orbital each time the nuclear charge increases by unity. The shielding effect of a *d* electron is not that effective, hence the net electrostatic attraction between the nuclear charge and the outermost electron increases and the ionic radius decreases.
- (c) Iron and chromium are typically hard metals because they have high enthalpy of atomization due to the presence of unpaired electrons, which accounts for their hardness. On the other hand, Zinc has low enthalpy of atomization as it has no unpaired electron. Hence zinc is comparatively a soft metal.

7. An alkene 'A' (Mol. formula C₅H₁₀) on ozonolysis gives a mixture of two compounds 'B' and 'C'. Compound 'B' gives positive Fehling's test and also forms iodoform on treatment with I₂ and NaOH. Compound 'C' does not give Fehling's test but forms iodoform. Identify the compounds A, B and C. Write the reaction for ozonolysis and formation of iodoform from B and C. [3]

- Ans.** Compound A is an alkene, on ozonolysis it will give carbonyl compounds. As both B and C have >C=O group, B gives positive Fehling's test so it is an aldehyde and it gives iodoform test so it has CH₃C=O group. This means the aldehyde is acetaldehyde C does not give Fehling's test, so it is a ketone. It gives positive iodoform test so it is a methyl ketone means it has CH₃C=O group
Compound A (C₅H₁₀) on ozonolysis gives B (CH₃CHO) + C (CH₃COCH₃)
So "C" is CH₃COCH₃



8. Observe the figure given below and answer the questions that follow: [3]



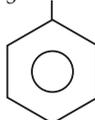
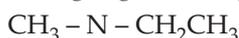
- (a) Which process is represented in the figure?
 (b) What is the application of this process?
 (c) Can the same process occur without applying electric field? Why is the electric field applied?
- Ans.** (a) Electrodialysis. (b) Purification of colloidal solution
 (c) Yes. Dialysis is a very slow process. To increase its speed, electric field is applied.

9. What happens when reactions:

- (a) N-ethylethanamine reacts with benzenesulphonyl chloride.
 (b) Benzylchloride is treated with ammonia followed by the reaction with Chloromethane.
 (c) Aniline reacts with chloroform in the presence of alcoholic potassium hydroxide. [1 × 3 = 3]

OR

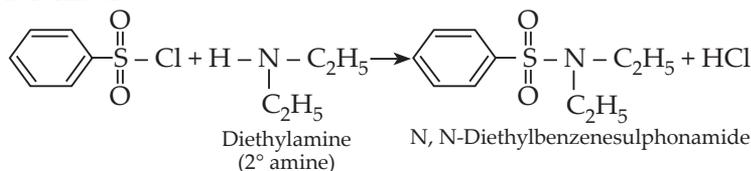
(a) Write the IUPAC name for the following organic compound:



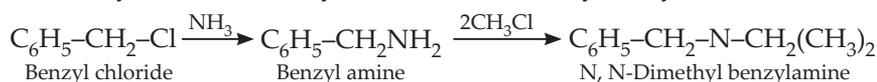
(b) Complete the following:



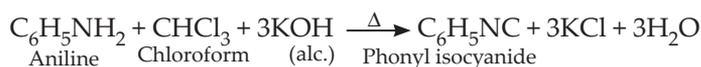
Ans. (a) When N-ethylethanamine reacts with benzenesulphonyl chloride, N, N-diethylbenzenesulphonamide is formed.



(b) When benzylchloride is treated with ammonia, Benzylamine is formed which on reaction with Chloromethane yields a secondary amine, N, N-dimethylbenzylamine.



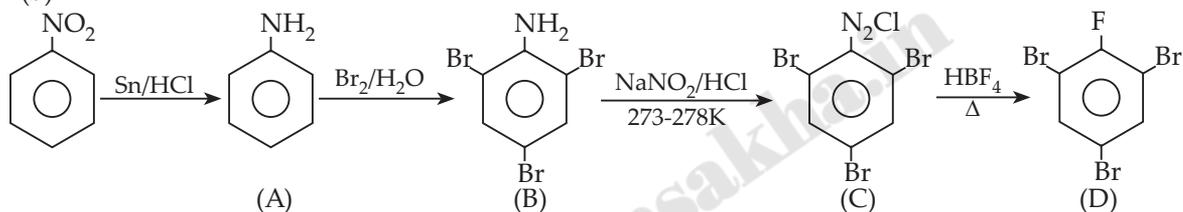
(c) When aniline reacts with chloroform in the presence of alcoholic potassium hydroxide, phenyl isocyanides or phenyl isonitrile is formed.



OR

(a) N-Ethyl-N-methylbenzenamine or N-Ethyl-N-methylaniline

(b)



10. Represent the cell in which the following reaction takes place. The value of E° for the cell is 1.260 V. What is the value of E_{cell} ?



Ans. $\text{Al}(s) / \text{Cd}^{2+}(0.1\text{M}) // \text{Al}^{3+}(0.01\text{M}) / \text{Cd}(s)$
 $2\text{Al}(s) + 3\text{Cd}^{2+}(0.1\text{M}) \rightarrow 3\text{Cd}(s) + 2\text{Al}^{3+}(0.01\text{M})$
 $\text{Al}(s) / \text{Al}^{3+}(0.01\text{M}) // \text{Cd}^{2+}(0.1\text{M}) / \text{Cd}(s)$

$$E_{\text{cell}} = E^\circ_{\text{cell}} - \frac{-0.059}{n} \log \frac{[\text{Al}^{3+}]^2}{[\text{Cd}^{2+}]^3}$$

$$E_{\text{cell}} = 1.26 - \frac{-0.059}{6} \log \frac{(0.01)^2}{(0.1)^3}$$

$$= 1.26 - \frac{-0.059}{6} (-1)$$

$$= 1.26 + 0.009 = 1.269 \text{ V}$$

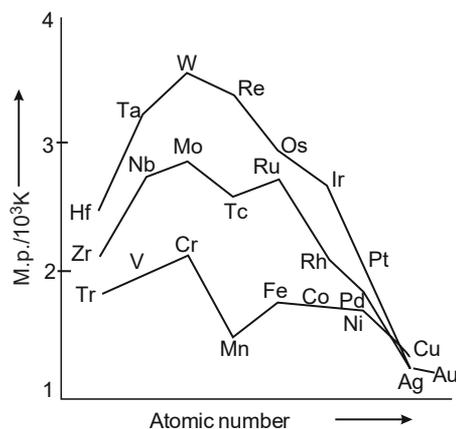
11. (a) Why are fluorides of transition metals more stable in their higher oxidation state as compared to the lower oxidation state?

(b) Which one of the following would feel attraction when placed in magnetic field: Co^{2+} , Ag^+ , Ti^{4+} , Zn^{2+}

(c) It has been observed that first ionization energy of 5d series of transition elements are higher than that of 3d and 4d series, explain why? [1 × 3 = 3]

OR

On the basis of the figure given below, answer the following questions:



- (a) Why manganese has lower melting point than Chromium?
 (b) Why do transition metals of 3d series have lower melting points as compared to 4d series?
 (c) In the third transition series, identify and name the metal with the highest melting point [1 × 3 = 3]

- Ans.** (a) The ability of fluorine to stabilize the highest oxidation state is attributed to the higher lattice energy or high bond enthalpy.
 (b) Co^{2+} has three unpaired electrons so it would be paramagnetic in nature, hence Co^{2+} ion would be attracted to magnetic field.
 (c) The transition elements of 5d series have intervening 4f orbitals. There is greater effective nuclear charge acting on outer valence electrons due to the weak shielding by 4f electrons. Hence, first ionisation energy of 5d series of transition elements are higher than that of 3d and 4d series.

OR

- (a) Manganese has lower melting point as compared to chromium, because manganese has 5 free electrons in its d orbital whereas chromium has 6 free electrons in its d orbital. More the number of electrons, more it will take part in the metallic bonding and thus more energy is required in breaking the bonds and thus the melting point will be high. Therefore, manganese has lower melting point than chromium.
 (b) There is much more frequent metal – metal bonding in compounds of the heavy transition metals *i.e.* 4d and 5d series, which accounts for lower melting point of 3d series.
 (c) Tungsten due to metallic bonding in tungsten. (M.P. = 3422°C).

SECTION C

12. Read the passage given below and answer the questions that follow:

Are there nuclear reactions going on in our bodies?

There are nuclear reactions constantly occurring in our bodies, but there are very few of them compared to the chemical reactions, and they do not affect our bodies much. All of the physical processes that take place to keep a human body running are chemical processes. Nuclear reactions can lead to chemical damage, which the body may notice and try to fix.

The nuclear reaction occurring in our bodies is radioactive decay. This is the change of a less stable nucleus to a more stable nucleus. Every atom has either a stable nucleus or an unstable nucleus, depending on how big it is and on the ratio of protons to neutrons. The ratio of neutrons to protons in a stable nucleus is thus around 1:1 for small nuclei ($Z < 20$). Nuclei with too many neutrons, too few neutrons, or that are simply too big are unstable. They eventually transform to a stable form through radioactive decay. Wherever there are atoms with unstable nuclei (radioactive atoms), there are nuclear reactions occurring naturally. The interesting thing is that there are small amounts of radioactive atoms everywhere: in your chair, in the ground, in the food you eat, and yes, in your body.

The most common natural radioactive isotopes in humans are carbon-14 and potassium-40. Chemically, these isotopes behave exactly like stable carbon and potassium. For this reason, the body uses carbon-14 and potassium-40 just like it does normal carbon and potassium; building them into the different parts of the cells, without knowing that they are radioactive. In time, carbon-14 atoms decay to stable nitrogen

atoms and potassium-40 atoms decay to stable calcium atoms. Chemicals in the body that relied on having a carbon-14 atom or potassium-40 atom in a certain spot will suddenly have a nitrogen or calcium atom. Such a change damages the chemical. Normally, such changes are so rare, that the body can repair the damage or filter away the damaged chemicals.

The natural occurrence of carbon-14 decay in the body is the core principle behind carbon dating. As long as a person is alive and still eating, every carbon-14 atom that decays into a nitrogen atom is replaced on average with a new carbon-14 atom. But once a person dies, he stops replacing the decaying carbon-14 atoms. Slowly the carbon-14 atoms decay to nitrogen without being replaced, so that there is less and less carbon-14 in a dead body. The rate at which carbon-14 decays is constant and follows first order kinetics. It has a half - life of nearly 6000 years, so by measuring the relative amount of carbon-14 in a bone, archeologists can calculate when the person died. All living organisms consume carbon, so carbon dating can be used to date any living organism, and any object made from a living organism. Bones, wood, leather, and even paper can be accurately dated, as long as they first existed within the last 60,000 years. This is all because of the fact that nuclear reactions naturally occur in living organisms.

- Why is Carbon -14 radioactive while Carbon -12 not? (Atomic number of Carbon: 6)
- Researchers have uncovered the youngest known dinosaur bone, dating around 65 million years ago. How was the age of this fossil estimated?
- Which are the two most common radioactive decays happening in human body?
- Suppose an organism has 20 g of Carbon -14 at its time of death. Approximately how much Carbon -14 remains after 10,320 years? (Given antilog 0.517 = 3.289)

OR

- Approximately how old is a fossil with 12 g of Carbon -14 if it initially possessed 32 g of Carbon -14? (Given $\log 2.667 = 0.4260$) [1+1+1+2]

- Ans.**
- Carbon-12 is stable because it contains 6 neutrons and 6 protons in its nucleus, due to this it never undergoes radioactive decay. On the other hand, Carbon-14 is unstable because it contains 6 protons and 8 neutrons in its nucleus which makes it unstable and therefore, it undergoes radioactive decay with a half-life of about 5,730 years.
 - Age of fossils can be estimated by C-14 decay. All living organisms have C-14 which decays without being replaced back once the organism dies.
 - The most common natural radioactive isotopes in humans are carbon-14 which decays to stable nitrogen atom and potassium-40 which decays to stable calcium atom. Chemically, these isotopes behave exactly like stable carbon and potassium.
 - $$t = 2.303 / k \log (C_0 / C_t)$$

$$C_0 = 20\text{g} \quad C_t = ?$$

$t = 10320$ years $k = 0.693/6000$ (half-life given in passage) substituting in equation:

$$10320 = 2.303 / (0.693/6000) \log 20 / C_t$$

$$0.517 = \log 20 / C_t \quad \text{antilog } (0.517) = 20 / C_t$$

$$3.289 = 20 / C_t$$

$$C_t = 6.17\text{g}$$

OR

$$t = 2.303 / k \log (C_0 / C_t)$$

$$C_0 = 32 \text{ g} \quad C_t = 12$$

$t = ?$ $k = 0.693/6000$ (half life given in passage) substituting in equation:

$$t = 2.303 / (0.693/6000) \log 32 / 12$$

$$t = 2.303 \times (6000) / 0.693 \log 2.667$$

$$t = 2.303 \times 6000 \times 0.4260 / 0.693$$

$$= 8494 \text{ years}$$





Sample Paper

1

Chemistry

Section - A

1. Arrange the following in the order of their property indicated (Any two):
 - (a) Formic acid is heated with Tollen's reagent?
 - (b) Acetaldehyde is treated with concentrated NaHSO_3 solution?
 - (c) 2-Pentanone is reacted with iodine in presence of sodium hydroxide?
2. Give reason to support your answer:
 - (a) Why does sky looks blue?
 - (b) Colloidal medicines are more effective. Why?
3. Answer the following:
 - (a) In a first order reaction the concentration of reactant is reduced from 0.6 mol L^{-1} to 0.2 mol L^{-1} in 5 minutes. Calculate the rate constant for the reaction.
 - (b) What would be the unit of rate equation in case of gaseous reaction?

Section - B

4. Account for the following:
 - (a) Why zinc, cadmium and mercury are not regarded as transition metals?
 - (b) Why Zr and Hf occur in nature together?
 - (c) In which industry AgBr is used?
- OR**
- (a) Why Cu^{2+} ion is stable in aqueous solution
 - (b) Trivalent Lanthanoid ions are coloured. Why?
 - (c) CuI_2 is not known. Why?
5. (a) Name the isomerism shown by the complex $[\text{Co}(\text{Pn})_2\text{Cl}_2]^+$ and $[\text{Co}(\text{tn})_2\text{Cl}_2]^+$.
 - (b) What type of bond is present between metal and carbon in metal carbonyls?
 - (c) $[\text{FeF}_6]^{3-}$ has five unpaired electrons while $[\text{Fe}(\text{CN})_6]^{3-}$ has only one unpaired electron. Explain.

OR

Answer the following questions:

- (a) Which type of compounds show linkage isomerism? What would be the structural formula for linkage isomer of $[\text{Co}(\text{NH}_3)_5(\text{NO}_2)]\text{Cl}_2$?
 - (b) How are the inner orbital complexes formed?
 - (c) What is a chelate ligand? Give one example.
6. Consider a first row transition metal M. M^{2+} ion has a $3d^6$ configuration. Its M(II) chloride is dissolved in water to give hexahydrated green coloured complex A. On progressive addition of bidentate ligand, ethane-1, 2-diamine(en), three different compounds are formed:

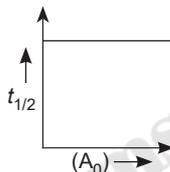
S.No.	en : M	Compound	Colour of compound
1.	1:1	B	Pale blue
2.	2:1	C	Blue/Purple
3.	3:1	D	Violet

What is the formula for compound A to D? Provide the sequence of reactions for the formation of compounds B to D.

7. Account for the following:
- What happens to ΔH and ΔS during adsorption of a gas on solid?
 - Gelatin is what type of sol?
 - Give one example of peptising agents.
8. Account for the following:
- What is electrochemical series? The cell potential of mercury cell remains constant during its lifetime. Why?
 - Define cell constant, what is its unit?
 - Limiting molar conductivity of an electrolyte cannot be determined experimentally. Why?
9. (a) Complete the following reactions:
- $\text{CH}_3\text{CH}_2\text{CHO} + \text{Cl}_2 \rightarrow$
 - $\text{C}_6\text{H}_5 - \text{COCH}_3 + \text{NH}_2\text{OH} \rightarrow$
- Which type of aldehydes undergo Cannizzaro's reaction?
 - Explain why the boiling points of aldehydes and ketones are lower than the corresponding alcohols?

OR

- How will you convert:
 - Benzoyl chloride to benzaldehyde.
 - Propanone to 2-propanol.
 - What happens when CH_3CHO is treated with $\text{K}_2\text{Cr}_2\text{O}_7$ in presence of H_2SO_4 ?
 - Ester of which acid is used in perfumery?
10. Complete the following equation:
- $\text{CH}_3\text{CHO} + \text{C}_6\text{H}_5\text{NHNH}_2 \rightarrow$
 - $\text{CH}_3\text{CHO} \xrightarrow{\text{NaOH}}$
 - $\text{C}_2\text{H}_5\text{NH}_2 \xrightarrow{\text{AgCl}}$
11. (a) Determine the order of reaction and also determine the units of rate constant:



- The activation energy of a reaction is zero. Will the rate constant of the reaction depend upon temperature? Give reason.
- Write rate law expression and order of the following reaction:
 Step 1. $\text{H}_2\text{O}_2 + \text{I}^- \rightarrow \text{H}_2\text{O} + \text{IO}^-$ (slow) Step 2. $\text{H}_2\text{O}_2 + \text{I}^- \rightarrow \text{H}_2\text{O} + \text{IO}^- + \text{O}_2$ (fast)

OR

Write three points of differences between rate of reaction and rate constant.

Section - C

12. Read the passage given below and answer the questions that follow:

Properties of Amines

Due to presence of lone pair of electrons in 'N' atoms the amines are basic in nature because these lone pair of electrons can be donated to electron deficient compound. Aliphatic amines are stronger bases than ammonia. The basicity increases with the increase in number of alkyl groups attached to the 'N' atom. However, the observed basic nature of amines is $2^\circ > 1^\circ > 3^\circ$.

Primary and secondary amines are soluble in water due to hydrogen bonding. Solubility decreases with increase in number of 'C' atoms.

- Boiling points of amines are less than the alcohols of similar molecular mass. Why?
- Amines behave as nucleophiles. Why?
- Which reaction is used for the test of primary aromatic amines?
- Lower aliphatic amines are soluble in water. Why?

OR

- Amines are less soluble in water than alcohols. Why?



Sample Paper

2

Chemistry

Section - A

1. Explain Perkin's reaction.
2. Answer the following questions:
 - (a) What is the relationship between cell potential and equilibrium constant?
 - (b) Why hydrogen is used as a Standard electrode?
 - (c) What is the effect of catalyst on Gibbs energy (ΔG)?
3. Answer the following questions:
 - (a) Tertiary amines do not undergo acylation reaction.
 - (b) o-Toluidine is less basic than aniline

Section - B

4. (a) On the basis of crystal field theory, write the electronic configuration for d_4 ion if $\Delta_0 > P$.
(b) $[\text{NiCl}_4]^{2-}$ is paramagnetic, while $[\text{Ni}(\text{CO})_4]$ is diamagnetic, though both are tetrahedral. Why? (Atomic number of Ni = 28)

OR

What is the electronic configuration of Co in $[\text{CoF}_6]^{3-}$ according to the valence bond theory of coordination compounds. Also predict the magnetic character of the $[\text{CoF}_6]^{3-}$.

5. From the following ions which are given:



Identify the ion which is:

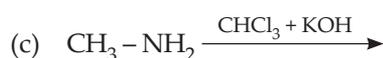
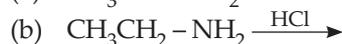
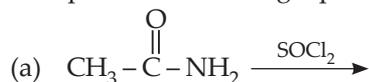
- (a) A strong reducing agent.
- (b) Unstable in aqueous solution.
- (c) A strong oxidising agent.

OR

Write down the electronic configuration of:

- (a) Cr^{3+}
- (b) Cu^+
- (c) Ce^{4+}
- (d) Co^{2+}
- (e) Mn^{2+}
- (f) Lu^{2+}

6. Complete the following equations:

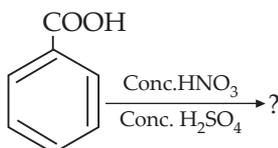


7. For the hydrolysis of methyl acetate in aqueous solution, the following results were obtained:

t/s	0	10	20
$[\text{CH}_3\text{COOCH}_3]/\text{mol L}^{-1}$	0.10	0.05	0.025

- (a) Show that it follows pseudo first order reaction, as the concentration of water remains constant.
- (b) Calculate the average rate of reaction between the time interval 10 to 20 seconds.
(Given: $\log 2 = 0.3010$, $\log 4 = 0.6021$)

- (c) A first order reaction takes 30 minutes for 50% completion. Calculate the time required for 90% completion of this reaction.
8. (a) Write the complete reaction for the following conversions mentioning the necessary conditions:
- Toluene to benzaldehyde
 - Aldelyde to acetal
- (b) Carbonyl carbon is an electrophilic centre where as carbonyl oxygen is a nucleophilic centre. Example.
- (c) Predict the product.



9. (a) Write the reaction indicating the conditions for the following conversions.
- Benzaldehyde to Benzyl alcohol
 - Acetaldehyde to acetone
 - Propyne to propanone.
- (b) Explain the following facts:
Treatment of benzaldehyde with HCN gives a mixture of two isomers which cannot be separated even by careful fractional distillation.

OR

An organic compound [A] having molecular formula C_3H_6O , gives iodoform reaction and forms a compound [B]. [B] on heating with Ag powder, gives compound [C]. [C] reacts with dil. H_2SO_4 and mercuric sulphate to obtain compound [D]. Compound [D] undergoes Aldol condensation. Write down the names and structures of all the compounds starting from [A] to [D] with the help of chemical equations.

10. Answer the following questions:
- What is the use of emulsion in photography?
 - Colloidal medicines are more effective. Why?
 - What is the difference between "Sol" and "gel"?
11. $FeSO_4$ solution mixed with $(NH_4)_2SO_4$ solution in 1 : 1 molar ratio gives the test of Fe^{2+} ion but $CuSO_4$ solution mixed with aqueous ammonia in 1 : 4 molar ratio does not gives the test of Cu^{2+} ion. Explain why?

OR

The crystal field theory assumes that the interaction between the metal ion and ligand is purely electrostatic. When ligands approach central metal atom/ion the five degenerate d-orbitals of the central metal atom becomes differential. In a complex, the central metal atom or ion is surrounded by various atoms or groups of atoms called ligands.

- What is the type of bond in metal complex according to crystal field theory?
- What is the number of ligands in $Cu_2 [Fe(CN)_6]$.
- Which one is lower energy set between t_{2g} and e_g , after splitting of five degenerate orbital or metal atom/ion on complexation in tetrahedral complex?
- Define crystal field splitting.
- What do you mean by weak field ligands?

Section – C

12. Read the passage given below and answer the questions that follow:

The potential of an electrode at a given temperature depends upon the concentration of the ions in the surrounding solution.

If the concentration of ions is unity and the temperature is 25°C, the potential of the electrode is termed as the "Standard Electrode Potential (E°_{cell})". For example, the standard electrode reduction potential for a substance having half cell reaction, $\text{Cu}^{+2} + 2e^- \rightarrow \text{Cu}$, has the value = + 0.34 V.

- (a) What is electrode?
- (b) What is the relation between free energy change and emf of a cell?
- (c) Which type of reaction occurs at anode and cathode during electrolysis?
- (d) Which substance is used as electrode in a dry cell?

OR

- (d) Mention the applications of electrochemical series.

□□



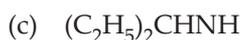
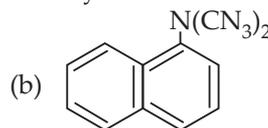
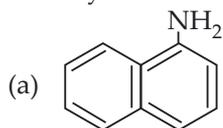
Sample Paper

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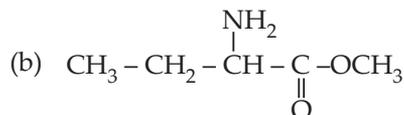
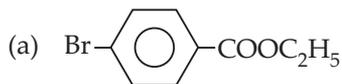
Chemistry

Section - A

1. Prove that for a first order reaction the time required for 99.9 % completion is about 10 times its half-life period.
2. Classify the following amines as primary, secondary or tertiary:



3. Write IUPAC names for the following:



Section - B

4. Answer the following questions:
 - (a) Why Zn, Cd and Hg are not regarded as transition metals?
 - (b) Explain why potassium dichromate is used as primary standard in volumetric analysis?
 - (c) What are inner transition elements? Decide which of the following atomic numbers are the atomic numbers of the inner transition elements : 29, 59, 74, 95, 102, 104.

OR

Answer the following questions:

- (a) Name two oxo-metal anions of the first series of the transition metals in which the metal exhibits the oxidation state equal to its group number.
 - (b) What are the different oxidation states exhibited by the lanthanoids?
 - (c) Complexes of which transition metals are useful in the polymerisation of alkynes?
5. Answer the following:
 - (a) Write the formula of the following coordination compound - Iron (III) hexacyanoferrate (II)
 - (b) Predict the number of unpaired electron in $[MnBr_4]^{2-}$.
 - (c) Write the hybridisation and number of unpaired electrons in the complex $[CoF_6]^{3-}$. (Atomic No. of Co = 27).

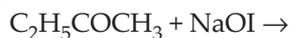
OR

$[Fe(H_2O)_6]^{3+}$ is strongly paramagnetic whereas $[Fe(CN)_6]^{3-}$ is weakly paramagnetic. Explain.

6. Explain giving reasons:
 - (a) Transition metals and many of their compounds show paramagnetic behaviour.
 - (b) The enthalpies of atomisation of the transition metals are high.
 - (c) The transition metals generally form coloured compounds.
7. What are lyophilic and lyophobic sols? Give one example of each type. Why hydrophobic sols are easily coagulated?
8. A first order reaction takes 20 minutes for 25% decomposition. Calculate the time when 75% of the

reaction will be completed. (Given: $\log 2 = 0.3010$, $\log 3 = 0.4771$, $\log 4 = 0.6021$)

9. (a) Write the chemical reaction involved in Cannizzaro reaction.
 (b) Write the reaction where aldehydes and ketones can be converted to alkanes on treatment with zinc and hydrochloric acid. What is the reaction called?
 (c) Predict the product of following reaction:



OR

- (a) What is aldol condensation?
 (b) Arrange in decreasing order of acidity:
 Benzoic acid, 4-Methoxy benzoic acid and 4-Nitrobenzoic acid
 (c) Give IUPAC names of following compounds:
 (i) $\text{OHCC}_6\text{H}_4\text{CHO}$
 (ii) $\text{CH}_3\text{CO}(\text{CH}_2)_4\text{CH}_3$
10. Complete the following reactions:
 (a) $\text{C}_6\text{H}_5 - \text{NH}_2 + \text{CHCl}_3 + \text{alc.KOH} \rightarrow$
 (b) $\text{C}_6\text{H}_5 - \text{N}_2\text{Cl} + \text{H}_3\text{PO}_2 + \text{H}_2\text{O} \rightarrow$
 (c) $\text{C}_6\text{H}_5\text{NH}_2 + (\text{CH}_3\text{CO})_2\text{O} \rightarrow$

11. Write the product formed when benzaldehyde reacts with the following reactants:

- (a) CH_3CHO in presence of dilute NaOH
 (b) $\text{H}_2\text{N} - \text{NH} -$ 
 (c) Conc. NaOH

OR

An organic compound A ($\text{C}_7\text{H}_6\text{Cl}_2$) on treatment with NaOH solution gives another compound B ($\text{C}_7\text{H}_6\text{O}$). B on oxidation gives an acid C ($\text{C}_7\text{H}_6\text{O}_2$) which on treatment with a mixture of conc. HNO_3 and H_2SO_4 gives compound D ($\text{C}_7\text{H}_5\text{NO}_4$). B on treatment with conc. NaOH gives a compound E ($\text{C}_7\text{H}_8\text{O}$) and $\text{C}_6\text{H}_5\text{COONa}$. Deduce the structure of [A], [B], [C], [D] and [E].

Section - C

12. Read the passage given below and answer the questions that follow:

The calculation of cell potential for emf requires only the addition of the emf. values for each half reaction. while the same cell potential calculation using standard potentials requires the usage of the following convention:

$$E^\circ_{\text{cell}} = E^\circ_{\text{cathode}} - E^\circ_{\text{anode}}$$

Each half-cell reaction has a specific standard potential reported as the potential of the reduction reaction vs. the Normal Hydrogen Electrode (NHE). In an electrochemical cell, there is a half-cell corresponding to the working electrode (WE), where the reactions under study take place, and a reference half-cell. Experimentally the cell potential is measured as the difference between the potentials of the WE half-cell and the reference electrode/reference half-cell. The archetypal reference electrode is the NHE, also known as the Standard Hydrogen Electrode (SHE) and is defined, by convention, as 0.000V for any temperature.

- (a) What is the role of salt bridge?
 (b) What is EMF of a cell?
 (c) How electrical conductance changes with temperature?
 (d) EMF of a cell depends, on which factors.

OR

- (d) Predict the value of EMF of a cell in which the chemical reactions achieve equilibrium.



Sample Paper

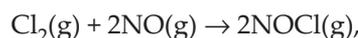
4

Chemistry

Section - A



2. At 291 K molar conductivities at infinite dilution of NH_4Cl , NaOH , NaCl are 129.8, 217.4, 108.9 $\text{ohm}^{-1}\text{cm}^2$ respectively. If molar conductivity of normal solution of NH_4OH is 9.33 $\text{ohm}^{-1}\text{cm}^2$. What is the degree of dissociation of NH_4OH solution?
3. For a reaction,



The rate law is expressed as; $\text{rate} = k[\text{Cl}_2][\text{NO}]^2$. What is the order of the reaction?

Section - B

4. Following are the transition metal ions of 3d series:



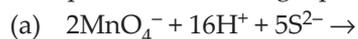
(Atomic numbers : Ti = 22, V = 23, Mn = 25, Cr = 24)

Answer the following:

- Which ion is most stable in an aqueous solution and why?
- Which ion is a strong oxidising agent and why?
- Which ion is colourless and why?

OR

Complete the following equation :



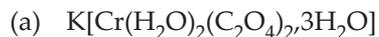
(c) What is the general electronic configuration of transition elements?

5. For the complex $[\text{NiCl}_4]^{2-}$, write.

- The IUPAC name
- Hybridization state of metal atom.
- The shape of the complex (At. no. of Ni = 28).

OR

Write down the IUPAC name for each of the following complexes and indicate the oxidation state electronic configuration and coordination number. Also give magnetic moment of the complex.



6. Answer the following questions:

- What is zeta potential? Explain.
- Why colloidal solutions differ in colour?
- What is added to gasoline to decrease knocking?.

7. This important class of organic compounds are derived by replacing one or more hydrogen atoms of ammonia molecule by alkyl or aryl group(s). The nitrogen atom in this class of compound is trivalent. There are many important natural and synthetic compounds of this class. A lot of important drugs also belong to this class of compounds.

Aliphatic aldehydes and ketones both are expressed by the general formula $C_nH_{2n}O$. For example both propanaldehyde (CH_3CH_2CHO) and acetone (CH_3COCH_3) can be represented by the molecular formula C_3H_6O .

The simplest aromatic aldehyde is benzaldehyde.

- What happens when acetaldehyde is reacted with a trace of H_2SO_4 .
- Which type of aldehydes undergo aldol condensation?
- Write one chemical reaction to exemplify Cannizzaro reaction.
- Which aldehyde is a gas? Why is it soluble in water?

OR

- Write the mechanism of addition of HCN to $>C=O$ group.





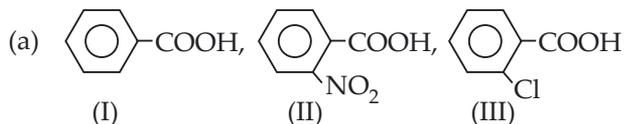
Sample Paper

5

Chemistry

Section - A

1. Arrange the following in the order of their property indicated (Any two):



decreasing values of K_a .

(b) Ethanol (I), acetic acid (II), Phenol (III), Benzoic acid (IV)

decreasing values of acidic strength

(c) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$, $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CHO}$, $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{COOH}$
(I) (II) (III)

increasing values of boiling point.

2. What pressure of H_2 would be required to make the e.m.f. of the hydrogen electrode zero in pure water at 25°C ?

3. Answer the following questions:

- (a) The boiling points of aldehydes and ketones are lower than that of the corresponding alcohols and acids? Explain why.
- (b) Oxidation of toluene to benzaldehyde with CrO_3 is carried out in presence of acetic anhydride. Why?

Section - B

4. Account for the following:

- (a) Tertiary amines do not undergo acylation reaction.
- (b) Silver chloride dissolves in methyl amine solution.
- (c) Amines are more basic than comparable alcohols.

OR

Convert the following:

- (a) Aniline to chlorobenzene
- (b) Nitrobenzene to phenol
- (c) Aniline to benzoic acid

5. (a) Give an example of an organometallic compound having sandwich structure.

(b) Write IUPAC name of the following compounds—

- (i) $\text{K}_3[\text{Fe}(\text{C}_2\text{O}_4)_3]$
- (ii) $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$.

OR

(a) $\text{Cu}(\text{OH})_2$ is soluble in NH_4OH but not in NaOH solution. Why?

(b) Draw the structure of Zeise's salt.

(c) Name the central metal atom present in haemoglobin and chlorophyll.

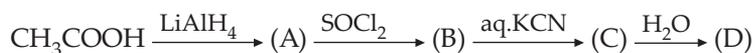
6. Account for the following:
- Europium(II) is more stable than Cerium(II)
 - Transition elements form interstitial compounds.
 - Separation of Zr and Hf from a mixture is difficult.
7. Two molecules of organic compound 'A' on treatment with a strong base gives two compounds 'B' and 'C'. compound 'B' on dehydration with Cu gives 'A' while acidification of 'C' yields carboxylic acid 'D' having molecular formula of CH_2O_2 . Identify the A, B, C, D.
8. Depict the galvanic cell in which the reaction:



- takes place. Further show:
- Which electrode is negatively charged?
 - The carriers of the current in the cell.
 - Individual reaction at each electrode.
9. What happens when:
- Amines react with carboxylic acid.
 - Aniline reacts with bromine water.
 - Aniline reacts with conc. HNO_3 and conc. H_2SO_4 .

OR

- Write IUPAC name of $(\text{CH}_3)_2\text{CH}-\text{NH}_2$
- Complete the following:



10. Explain what happens when an opposing external voltage is applied on a galvanic cell when it is (a) smaller than (b) equal to (c) greater than cell potential.
11. Answer the following questions:
- Why is KMnO_4 solution used to clean surgical instruments in hospitals?
 - Out of cobalt and zinc salts, which is attracted in a magnetic field. Explain with reasons.
 - Name a transition element which does not exhibit variable oxidation states.

OR

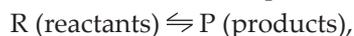
Answer the following questions:

- The melting and boiling points of Zn, Cd and Hg are low. Why?
- Write chemical equation for the disproportionation of Mn (IV) in acidic solution.
- Why do Zr and Hf exhibit similar properties?

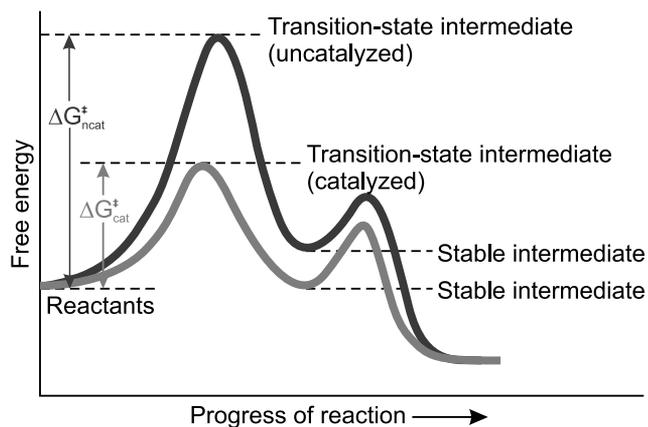
Section - C

12. Read the passage given below and answer the questions that follow:

All chemical reactions proceed through one or more transition-state intermediates whose content of free energy is greater than that of either the reactants or the products. For the simple reaction



we can write $\text{R} \xrightleftharpoons{K^\ddagger} \text{S} \xrightarrow{v} \text{P}$, where S is the reaction intermediate with the highest free energy; K^\ddagger is the equilibrium constant for the reaction $\text{R} \rightleftharpoons \text{S}$, the conversion of the reactant to the high-energy intermediate S; and v is the rate constant for conversion of S into the product P. The energetic relation between the initial reactants and the products of a reaction can usually be depicted as shown in Figure given below. The free energy of activation ΔG^\ddagger is equal to the difference in free energy between the transition-state intermediate S and the reactant R. Because ΔG^\ddagger generally has a very large positive value, only a small fraction of the reactant molecules will at any one time have acquired this free energy, and the overall rate of the reaction will be limited by the rate of formation of S.



- (a) What is the main difference between a photosensitizer and a catalyst?
- (b) Give reason, why the rate of a reaction generally increases with rise in temperature.
- (c) A reaction is found to be zero order, will its molecularity be zero?
- (d) A reaction is second order with respect to a reactant. How will the rate of reaction be affected if the concentration of this reactant is:
- (i) doubled and (ii) reduced to half.

OR

- (d) Why order of a reaction cannot be determined by looking at the balanced chemical reaction?





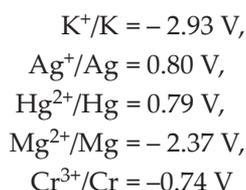
Sample Paper

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Chemistry

Section - A

1. Answer the following:
 - (a) What is Fehling's solution?
 - (b) To what oxidation state ethanal converts Fehling's solution.
2. Given the standard electrode potentials,



Arrange these metals in their increasing order of reducing power.

3. Explain what is observed
 - (a) When a beam of light is passed through a colloidal sol.
 - (b) An electrolytic NaCl is added to hydrated ferric oxide sol.

Section - B

4. (a) On the basis of crystal field theory, write the electronic configuration for d^4 ion if $\Delta_0 > P$.
(b) $[\text{NiCl}_4]^{2-}$ is paramagnetic, while $[\text{Ni}(\text{CO})_4]$ is diamagnetic, though both are tetrahedral. Why? (Atomic number of Ni = 28).
(c) What is meant by the chelate effect? Give an example.

OR

- (a) What are the oxidation state of Ni and Fe in $\text{Ni}(\text{CO})_4$ and $\text{Fe}(\text{CO})_5$.
 - (b) NH_3 acts as a ligand but NH_4^+ does not.
 - (c) CN^- is an ambidentate ligand.
5. (a) Co (iv) is a good analytical reagent. Explain.
(b) Unlike 4 f orbitals, 5 f -orbitals can take part in bond formation. Explain.

OR

- (a) State with the help of equations how solution of potassium dichromate can be used for strength determination of aqueous iron solutions.
 - (b) Why all the actinoid metals are attacked by hydrochloric acid but slightly affected by nitric acid?
6. Explain the bonding in coordination compounds in terms of Werner's postulates.
 7. (a) What is the use of Hinsberg test?
(b) How would you achieve aniline to benzonitrile?
(c) Why ethylamine is soluble in water but aniline is insoluble?
 8. For a reaction $A + B \rightarrow P$, the rate is given by $\text{Rate} = k[A][B]^2$.
 - (a) How is the rate of reaction affected if the concentration of B is doubled?
 - (b) What is the overall order of reaction if A is present in large excess?
 - (c) Define order of reaction.
 9. (a) Explain what is observed when electric current is passed through a colloidal sol.

- (b) Why is the ester hydrolysis slow in the beginning and becomes faster after sometime?
 (c) Why does physisorption decreases with rise in temperature?

OR

Explain what is observed when:

- (a) Silver nitrate solution is added to potassium iodide solution.
 (b) The size of the finest gold particles increases in a gold sol.
 (c) Two oppositely charged sols are mixed in almost equal proportions.
10. (a) Give a method to distinguish between formaldehyde and acetaldehyde.
 (b) What happens when:
 (a) Acetaldehyde reacts with hydrazine
 (b) Acetone reacts with hydroxylamine
11. The change in concentration of a reactant or product in unit time is called rate of reaction. The reaction $2\text{NO}_{(g)} + \text{O}_{2(g)} \rightarrow 2\text{NO}_{2(g)}$ was studied by the initial rate method. The following kinetic data was obtained.

Experiment	Initial [NO]/mol L ⁻¹	Initial [O ₂]/mol L ⁻¹	Initial rate of formation of NO ₂ /mol L ⁻¹ s ⁻¹
1.	0.30	0.30	0.096
2.	0.60	0.30	0.384
3.	0.30	0.60	0.192
4.	0.60	0.60	0.768

- (a) What do you understand by rate law?
 (b) What is the order of the reaction with respect to NO and O₂?
 (c) Find out the rate of formation of NO₂ when [NO] is 0.1 and [O₂] is 0.2 mol L⁻¹.

OR

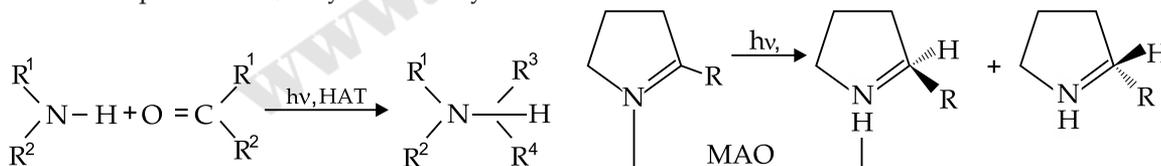
Calculate the half-life of a first order reaction from their rate constants given below :

- (a) 200 s⁻¹, (b) 2 min⁻¹, (c) 4 years⁻¹.

Section - C

12. Read the passage given below and answer the questions that follow:

The recently discovered photochemical reductive amination and the enantioselective amine synthesis by combined photoredox/enzymatic catalysis is reviewed.



In this mini review, we discuss recent advances in the area of photo-driven multi-electron transfer with a particular focus on our own work on reductive amination and the enantioselective synthesis of amines by combined photoredox and enzyme catalysis. Polarity-matched hydrogen atom transfer (HAT) between photochemically-generated α -amino alkyl radicals and thiols is a key step in these reactions. A cyclic reaction network comprised of light-driven imine reduction by an Ir-photocatalyst and enantioselective amine oxidation by the enzyme monoamine oxidase (MAO-N-9) was used to obtain enantioenriched amines from imines.

- (a) Give the IUPAC name of C₆H₅NH₂.
 (b) What is the final product obtained upon reaction of benzyl amine with 2 moles of methyl chloride?
 (c) Hoffmann bromamide degradation reaction is used for preparation of which type of amine?
 (d) Predict the product: $\text{C}_2\text{H}_5 - \text{NH}_2 \xrightarrow{\text{AgCl}}$

OR

- (d) Predict the product: $\text{RNC} \xrightarrow{\text{H}_2/\text{pt}}$



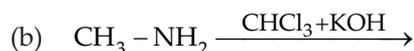
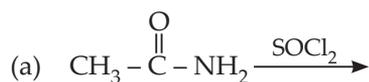
Sample Paper

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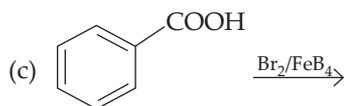
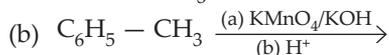
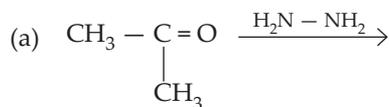
Chemistry

Section - A

- If the concentration is expressed in mol L⁻¹ units and time in seconds, what would be the unit of K*
 - For a zero order reaction
 - For a first order reaction
 - Why molecularity of a reaction cannot be zero?
- Complete the following equations:



- Predict the product of the following reactions:



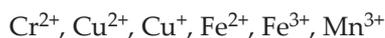
Section - B

- Name the isomerism shown by the complex $[\text{CO}(\text{NH}_3)_5(\text{NO}_2)]\text{Cl}_2$.
 - What type of bond is present between metal and carbon in metal carbonyls?
 - $[\text{FeF}_6]^{3-}$ has five unpaired electrons while $[\text{Fe}(\text{CN})_6]^{3-}$ has only one unpaired electron. Explain.

OR

The crystal field theory assumes that the interaction between the metal ion and ligand is purely electrostatic. When ligands approach central metal atom/ion the five degenerate d-orbitals of the central metal atom become differential. In a complex, the central metal atom or ion is surrounded by various atoms or groups of atoms called ligands.

- What is the type of bond in metal complex according to crystal field theory?
 - What is the number of ligands in $\text{Cu}_2 [\text{Fe}(\text{CN})_6]$.
 - Which one is lower energy set between t_{2g} and e_g after splitting of five degenerate orbital or metal atom/ion on complexation in tetrahedral complex?
- Following ions are given:



Identify the ion which is

- A strong reducing agent.
- Unstable in aqueous solution.
- A strong oxidizing agent.

Give suitable reason in each case.

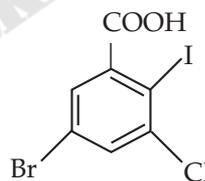
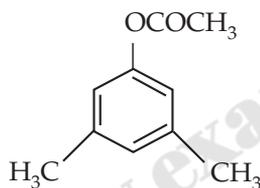
OR

Compare the general characteristics of the first series of the transition metals with those of the second and third series metals in the respective vertical columns. Give special emphasis on the following points:

- Electronic configurations
 - Oxidation states
 - Ionisation enthalpies.
6. (a) How would you account for the fact that, the transition elements have high enthalpies of atomisation?
 (b) Name the catalyst used in Ostwald's process for the manufacturing of nitric acid.
 (c) Transition metals generally form coloured compounds. Explain why?
7. Write one differences in each of the following:
 (a) Multimolecular colloid and Associated colloid
 (b) Coagulation and Peptization
 (c) Lyophobic sol and Lyophilic sol
8. (a) A galvanic cell consists of metallic zinc plate dipped in 0.1 M zinc nitrate solution and a lead plate dipped in 0.02 M lead nitrate solution. Write chemical equation for the electrode reaction and calculate the e.m.f. of the cell at 25°C.

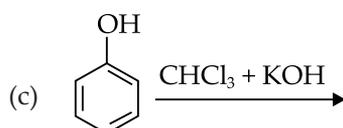
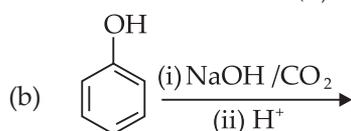
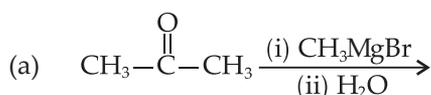
$$E^\circ_{\text{Zn}^{2+}/\text{Zn}} = -0.76 \text{ V}, E^\circ_{\text{Pb}^{2+}/\text{Pb}} = -0.13 \text{ V}$$

- Why does the conductivity of a solution decrease with dilution?
 - What is the use of salt bridge in an electrochemical cell?
9. (a) An organic compound X has molecular formula $\text{C}_5\text{H}_{10}\text{O}$. It does not reduce Fehling's solution but forms a bisulphate compound. It also gives positive iodoform test. What are possible structures of X? Explain your reasoning relating structure.
 (b) Write IUPAC name of the following:



OR

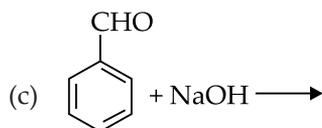
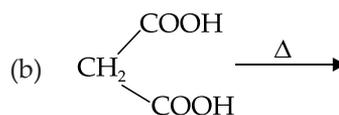
Predict the product:



10. Answer the following questions:

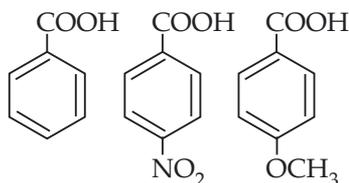
- What is Hinsberg reagent?
- Why do primary amines have higher boiling points than tertiary amines?
- Why are aliphatic amines stronger bases than aromatic amines?

11. Predict the product:



OR

(a) Arrange the following in increasing acidic strength:



(b) Distinguish between:

- (i) Acetone and formaldehyde
 (ii) $\text{C}_6\text{H}_5\text{COCH}_3$ and $\text{C}_6\text{H}_5\text{CH}_2-\text{CHO}$

Section - C

12. Read the passage given below and answer the questions that follow:

The term order of a reaction is the sum of exponents of concentration terms appearing in the rate equation. It is an experimentally determinable quantity. It may be whole number, fraction, zero or even negative. Knowledge of order does not require knowledge of mechanism. Order of a 'reaction' may change with change in experimental condition namely pressure, temperature etc.

A 1st order reaction is a reaction whose rate determining step (r.d.s) involves only one molecule. Thus the step is $\text{A} \rightarrow \text{Product}$.

A 2nd order reaction may be of two types:



or



- (a) Give the unit of rate constant of a reaction.
 (b) In what condition order and molecularity of a reaction becomes equal.
 (c) In which type of reaction order and molecularity are different.
 (d) Write expression for rate constant of first order reaction. Mention unit of rate constant of a first order reaction.

OR

- (d) Show that half life period of a first order reaction is independent of initial concentration of the reactant.

□□



Answers

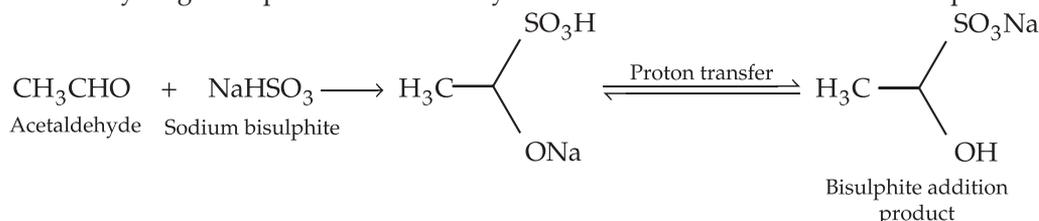
Sample Paper 1

Section - A

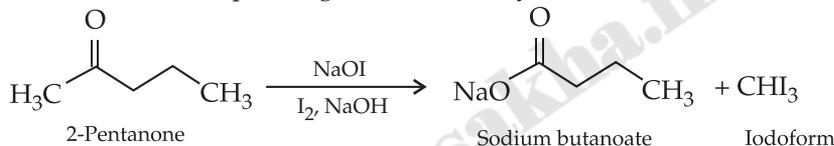
1. (a) Formic acid contains both aldehyde ($-\text{CHO}$) and acidic group ($-\text{COOH}$). Due to presence of aldehydic group, it acts as reducing agent and reduces Tollen's reagent to metallic silver (silver mirror test) according to the following reaction:



- (b) Sodium hydrogen sulphite adds to aldehydes and ketones to form the addition products.



- (c) 2-Pentanone would undergo iodoform reaction with I_2 and NaOH as it is a methyl ketone, to give CHI_3 (iodoform) and corresponding sodium carboxylate.



2. (a) The dust particles along with water suspended in the air reflect the sunlight coming from the sun and this is called scattering of light. The blue colour is scattered the most by the dust and gas particles present in the atmosphere hence, sky appears to be blue.
- (b) Medicines are more effective in colloidal state because colloids have a larger surface area which enhances their absorption in the body and therefore increases the effectiveness of medicines given in colloidal form. Thus, colloidal medicines easily gets assimilated, absorbed and digested in our body.
3. (a) For a first order reaction:

$$\text{Rate constant } k = \frac{2.303}{(t_2 - t_1)} \log \left(\frac{[\text{R}_1]}{[\text{R}_2]} \right)$$

Putting the values given:

$$k = \frac{2.303}{5 \text{ min}} \times \log \left(\frac{0.6 \text{ mol L}^{-1}}{0.2 \text{ mol L}^{-1}} \right)$$

$$= 0.4606 \times 0.477$$

$$= 0.22 \text{ min}^{-1}$$

- (b) Unit of rate equation in case of gaseous reaction would be atm s^{-1} .

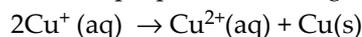
Section - B

4. (a) The elements such as Zn, Cd, and Hg are not transition elements because of their electronic configuration. The orbitals of these elements are completely filled both in their ground state as well as in their general oxidation state. Therefore, these elements are not transition elements.

- (b) As a consequence of lanthanoid contraction, the atomic radii of (160 pm) and Hf (159 pm) is almost similar. That is why Zr and Hf occur in nature together.
- (c) AgBr is widely used in photography industry.

OR

- (a) In an aqueous medium, Cu^{2+} is more stable because although energy is required to remove one electron from Cu^+ to Cu^{2+} , high hydration energy of Cu^{2+} compensates for it. Therefore, Cu^+ ion in an aqueous solution is unstable. It disproportionates to give Cu^{2+} and Cu.

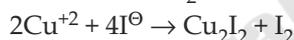


- (b) The lanthanide metals are silvery white but the trivalent lanthanide ions show different colours. Colour of the ions depend on the number of unpaired electrons because the elements with (x)f electrons often have a similar colour to those of (14-x)f electrons.

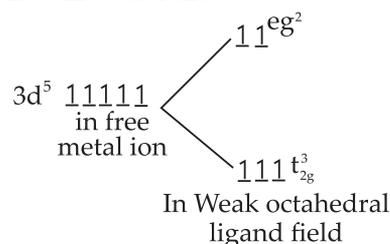
Number of unpaired electrons	Ions	colour
0	$\text{La}^{3+}, \text{Lu}^{3+}$	Colourless
1	$\text{Ce}^{3+}, \text{Yb}^{3+}$	Colourless
2	$\text{Pr}^{3+}, \text{Tm}^{3+}$	Green
3	$\text{Nd}^{3+}, \text{Er}^{3+}$	Red
4	$\text{Pm}^{3+}, \text{Ho}^{3+}$	Pink and Yellow respectively
5	$\text{Sm}^{3+}, \text{Dm}^{3+}$	Yellow
6	$\text{Eu}^{3+}, \text{Tb}^{3+}$	Pink
7	Gd^{3+}	Colourless

The colour of lanthanide ions is due to the presence of partially filled *f* orbitals. As a result, it is possible to absorb certain wavelength from the visible region of the spectrum. This results in transitions from one 4*f* orbital to another 4*f* orbital known as *f-f* transition.

- (c) CuI_2 is not known because Cu^{2+} oxidises I^- to I_2 as follows:

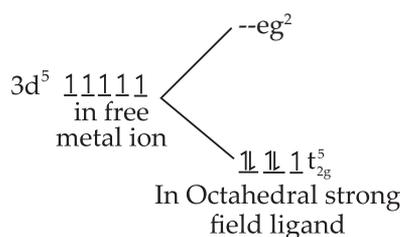


5. (a) Ligand isomerism.
- (b) It deals with both σ and π bonds. Here M – C σ bond is formed by the donation of lone pair of electrons from carbonyl carbon to the vacant orbital of metal. M – C π bond is formed by the backdonation of electrons from a filled d-orbital of metal into the vacant antibonding π^* orbital of carbon monoxide.
- (c) In $[\text{FeF}_6]^{3-}$, Fe(III) has got $3d^5$ system. As F^{\ominus} is a weak field ligand, according to crystal field theory (CFT) electronic arrangement will be as follows.



Hence, it has 5 unpaired electrons.

In $[\text{Fe}(\text{CN})_6]^{3-}$, Fe (III) has got $3d^5$ system. As CN^{\ominus} is a strong field ligand, according to CFT electronic arrangement will be as follows.



Hence, it has only one unpaired ligand.

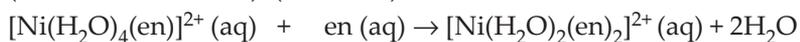
OR

- (a) Linkage isomerism arises in a coordination compound containing ambidentate ligand. The structural formula for linkage isomer of $[\text{Co}(\text{NH}_3)_5(\text{NO}_2)]\text{Cl}_2$ would be $[\text{Co}(\text{NH}_3)_5(\text{ONO})]\text{Cl}_2$.
- (b) Inner orbital complexes are coordination compounds composed of a central metal atom having hybridization of the atomic orbitals including d orbitals of inner shell and s, p orbitals from the outer shell. In other words, the central metal atom of these complexes uses inner shell d orbitals for the hybridization of atomic orbitals which means these complexes are formed due to the participation of $(n - 1)d$ orbitals. Therefore, these d orbitals are in a lower energy level than s and p orbitals. The most common hybridisation of the metal atom in inner orbital complexes is d^2sp^3 and their shape is octahedral.
- (c) Chelating ligand is a ligand which is mostly attached to a central metal ion by bonds that are from two or more donor atoms. Example, ethane-1, 2-diammine.
6. The M is Ni here ($3d^8$ configuration), the compound A is $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$ obtained after dissolving NiCl_2 in water.

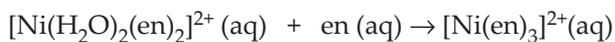
The complete set of reactions are :



(Ethane-1-2-diammine) (Pale blue)



Blue/Purple



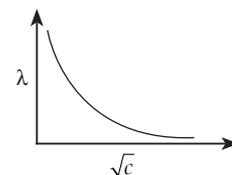
Violet

7. (a) During the adsorption of a gas on the surface of a solid there is always a decrease in residual forces of the surface i.e., there is decrease in surface energy which appears as heat. Adsorption, therefore is an exothermic process. Thus, ΔH for adsorption is always negative. Again when a gas is adsorbed, the freedom of movement of its molecules also becomes restricted. This leads to decrease in the entropy of the gas after adsorption. Therefore, ΔS is negative.
- (b) Lyophilic type of sol.
- (c) Sodium chloride (NaCl) is an example of peptising agent.
8. (a) Electrochemical series can be defined as the arrangement of various elements in the order of increasing value of their standard reduction potential values. The cell potential of a Mercury cell remains constant throughout its life because the overall reaction does not involve any ion in the solution whose concentration may change.
- (b) Cell constant of a conductivity cell is defined as the ratio of the distance between the electrodes divided by the area of cross-section of the electrodes. It is denoted by b and can be expressed as:

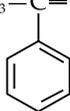
$$\therefore \text{Cell constant} = b = \frac{l \text{ cm}}{a \text{ cm}^2}$$

Thus, it is expressed in unit cm^{-1} or m^{-1} .

- (c) In weak electrolyte the conductivity of the solution increases very slowly with dilution of solution and goes on increasing upto infinity. Hence, it can not be measured experimentally.



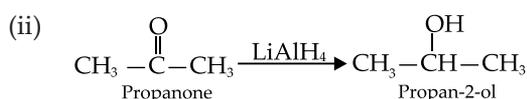
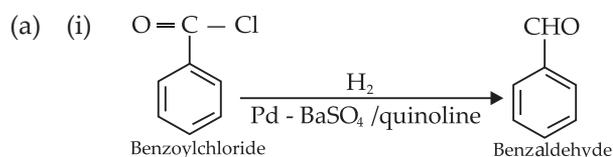
9. (a) (i) $\text{CH}_3\text{CH}_2\text{CHO} + \text{Cl}_2 \rightarrow \text{CH}_3\text{CH}_2\text{COCl} + \text{HCl}$
 (ii) $\text{C}_6\text{H}_5 - \text{COCH}_3 + \text{NH}_2\text{OH} \rightarrow \text{CH}_3 - \text{C} = \text{N} - \text{OH}$



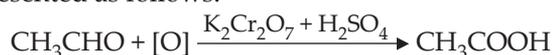
- (b) Aromatic and aliphatic aldehydes which do not contain α hydrogen undergoes cannizzaro's reaction e.g.,- HCHO , $\text{C}_6\text{H}_5\text{CHO}$ etc.

- (c) The presence of intermolecular hydrogen bonding increases the molecular association of a particular molecule and thereby increases the effective mass of that molecule which in turn is directly proportional to the boiling point. Thus, the absence of intermolecular H-bonding in aldehydes and ketones causes the lowering in the boiling points of aldehydes and ketones than the corresponding alcohols (which involve intermolecular hydrogen bonding due to the presence of -OH group).

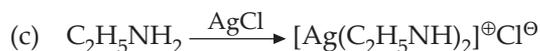
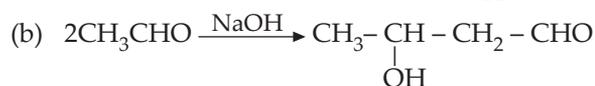
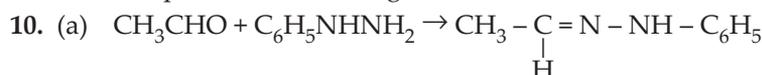
OR



- (b) When CH_3CHO is treated with $\text{K}_2\text{Cr}_2\text{O}_7$ in presence of H_2SO_4 , methanoic acid is formed. The reaction can be represented as follows:



- (c) Esters of benzoic acids are used in the perfumery industry. For example, ethyl benzoate is a component of some fragrances and artificial flavours.



11. (a) Order of Reaction: First order; Unit of rate constant : s^{-1} .

- (b) According to Arrhenius equation:

$$k = Ae^{-E_a/RT}$$

If $E_a = 0$, then $wf = A$. Frequency factor (a) does not depend upon temperature, therefore, rate constant and rate does not depend on temperature.

- (c) Rate = $K[\text{H}_2\text{O}_2][\text{I}^-]$ because step 1 is rate determining step and,

$$\text{Order} = 1 + 1 = 2$$

OR

Rate of Reaction	Rate Constant
1. It depends upon the concentration of reactant.	It is independent of the concentration of the reactant.
2. It is expressed in terms of consumption of reactants or formation of product per unit time.	It is proportionality constant in differential form in rate law or rate equation.
3. It generally decreases with the progress of the reaction.	It does not depend on the progress of the reaction.

Section - C

12. (a) Amines are less polar than alcohols because electronegativity difference between N-H is less than that of O-H. Intermolecular H-bond in amines is weaker than that in alcohols. Hence, boiling point of amines are less than the alcohols of similar molar mass.
- (b) Amines contain a lone pair of electrons on nitrogen atom. Therefore they behave as nucleophiles.
- (c) Diazo test is used to detect primary aromatic amines.

- (d) Lower aliphatic amines are soluble in water because they can form hydrogen bonds with water molecules.

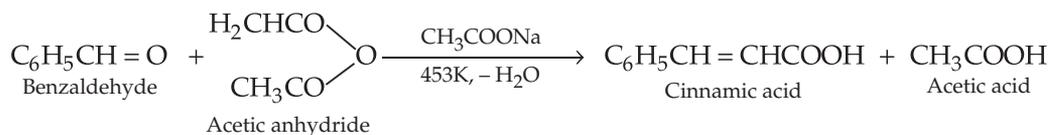
OR

- (d) Alcohol molecules form H-bond with water molecules more strongly than amines and therefore solubility of amine is less than that of alcohols.

Sample Paper 2

Section – A

1. The Perkin reaction is an organic reaction developed by English Chemist William Henry Perkin in the year 1868. i.e., used to make cinnamic acids. The reaction belongs to the Carbonyl compounds and it gives an α,β -unsaturated aromatic acid by the aldol condensation of an aromatic aldehyde and an acid anhydride, in the presence of an alkali salt of the acid. Perkin used this reaction to make cinnamic acids. In the reaction to make cinnamic acid, benzaldehyde (aromatic aldehyde) was treated with acetic anhydride in the presence of sodium acetate (weak base) to give cinnamic acid. The reaction can be represented as follows:



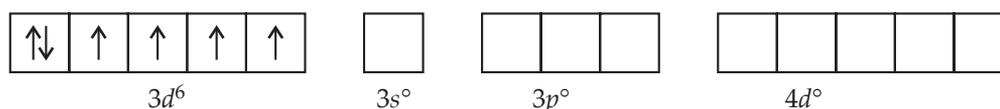
2. (a) At equilibrium, the value of cell potential is zero.
 (b) Hydrogen is used as a standard electrode because it is an inert electrode and its reduction potential is 0.
 (c) There will be no effect of catalyst on Gibbs energy.
3. (a) Tertiary amines cannot undergo acylation as they do not have any replaceable hydrogen atom. Tertiary amines thus are non-reactive towards acylation.
 (b) *o*-Toluidine is less basic than aniline because of ortho effect. The ortho position substitution makes it difficult for $-\text{NH}_2$ group to donate electron in spite of the electron donating tendency of (CH_3) methyl group as a substituent.

Section – B

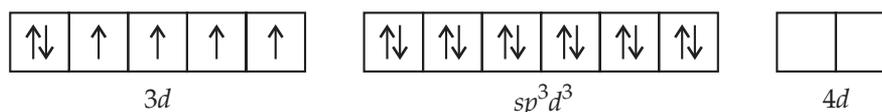
4. (a) On the basis of crystal field theory, for a d_4 ion, if $\Delta_o < P$, then the complex is a high spin complex formed by the association of weak field ligands with the metal ion. As a result, the fourth electron enters one of the e_g orbitals, thereby, exhibiting the electronic configuration $t_{2g}^3 e_g^1$.
 (b) In $[\text{NiCl}_4]^{2-}$, Ni is in the +2 state and Cl^- which is a weak field ligand does not cause pairing of unpaired 3d electrons. Hence, it is paramagnetic. On the other hand, in $[\text{Ni}(\text{CO})_4]$, Ni has 0 oxidation state and CO is a strong field ligand which causes pairing of unpaired 3d electrons. Since, no unpaired electrons are present, it is diamagnetic.

OR

Electronic configuration of Co^{3+} ion is: $3d$



Electronic configuration of sp^3d^2 hybridised (as F^- is a weak field ligand) orbitals of Co^{3+} , with six pairs of electrons from six F^- ions:



As there are 4 unpaired electrons, the $[\text{CoF}_6]^{3-}$ compound is paramagnetic.

5. (a) Cr^{2+} is a strong reducing agent as it is very easily oxidized to more stable Cr^{3+} (d^3) where it attains a stable half-filled t_{2g} configuration.
 (b) Cu^+ is unstable in aqueous solution because it disproportionates in water to form Cu^{2+} and Cu .
 (c) Mn^{3+} is a strong oxidising agent because it gets reduced to Mn^{2+} (d^5) in the process and attains an extra stable half-filled d orbital configuration.

OR

- (a) Cr (24) — $[\text{Ar}]^{18}3d^44s^1$
 Cr^{3+} : $1s^22s^22p^63s^23p^63d^3$
 Or, $[\text{Ar}]^{18}3d^3$
 (b) Cu (29) — $[\text{Ar}]^{18}4s^13d^{10}$
 Cu^+ : $1s^22s^22p^63s^23p^63d^{10}$
 Or, $[\text{Ar}]^{18}3d^{10}$
 (c) Ce (58) — $[\text{Xe}]^{54}4f^15d^16s^2$
 Ce^{4+} : $1s^22s^22p^63s^23p^63d^{10}4s^24p^64d^{10}5s^25p^6$
 Or, $[\text{Xe}]^{54}$
 (d) Co (27) — $[\text{Ar}]^{18}4s^23d^7$
 Co^{2+} : $1s^22s^22p^63s^23p^63d^7$
 Or, $[\text{Ar}]^{18}3d^7$
 (e) Mn (25) — $[\text{Ar}]^{18}4s^23d^5$
 Mn^{2+} : $1s^22s^22p^63s^23p^63d^5$
 Or, $[\text{Ar}]^{18}3d^5$
 (f) Lu (71) — $[\text{Xe}]^{54}4f^{14}5d^16s^2$
 Lu^{2+} : $1s^22s^22p^63s^23p^63d^{10}4s^24p^64d^{10}5s^25p^64f^{14}5d^1$
 Or, $[\text{Xe}]^{54}4f^{14}5d^1$

6. (a) $\text{CH}_3 - \overset{\text{O}}{\parallel}{\text{C}} - \text{NH}_2 \xrightarrow{\text{SOCl}_2} \text{CH}_3 - \text{CN}$
 (b) $\text{CH}_3\text{CH}_2 - \text{NH}_2 \xrightarrow{\text{HCl}} \text{CH}_3\text{CH}_2\text{NH}_3^+\text{Cl}^-$
 (c) $\text{CH}_3 - \text{NH}_2 \xrightarrow{\text{CHCl}_3 + \text{KOH}} \text{CH}_3 - \text{NC} + \text{KCl} + \text{H}_2\text{O}$

7. (a) $[\text{A}]_0 = 0.01 \text{ mol/L}$
 $[\text{A}] = 0.05 \text{ mol/L}$ at time $t = 10 \text{ s}$.

We know,

$$k = \frac{2.303}{t} \log \frac{[\text{A}]_0}{[\text{A}]}$$

$$k = \frac{2.303}{10} \log \frac{0.10}{0.05}$$

$$k = 0.0693 \text{ s}^{-1}$$

$$t = 20 \text{ s}$$

And,

$$k = \frac{2.303}{t} \log \frac{[\text{A}]_0}{[\text{A}]} = \frac{2.303}{20} \log \frac{0.10}{0.025}$$

$$k = 0.0693 \text{ s}^{-1}$$

Thus, its pseudo first order reaction.

- (b) The average rate constant is

$$\begin{aligned} \frac{-\Delta[\text{R}]}{\Delta t} &= \frac{\Delta[\text{CH}_3\text{COOCH}_3]}{\Delta t} \\ &= \frac{[0.025 \text{ mol L}^{-1} - 0.05 \text{ mol L}^{-1}]}{20 \text{ s} - 10 \text{ s}} = \frac{0.025}{10 \text{ s}} \text{ mol L}^{-1} \\ &= 0.0025 \text{ mol L}^{-1} \text{ s}^{-1}. \end{aligned}$$

- (c) We have,

$$t_{1/2} = 30 \text{ min.}$$

$$[\text{R}] = [\text{R}]_0 - 90\% \text{ of } [\text{R}]_0$$

$$= [\text{R}]_0 - \frac{90[\text{R}]_0}{100}$$

$$[R] = \frac{[R]_0}{10}$$

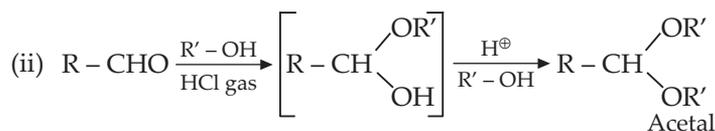
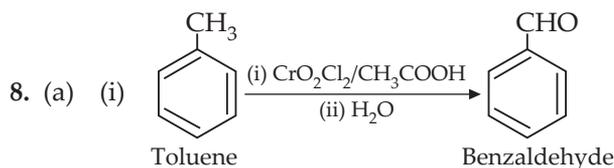
According to the first order,

$$k = \frac{0.693}{t_{1/2}} = \frac{0.693}{30} = 0.0231 \text{ min}^{-1}$$

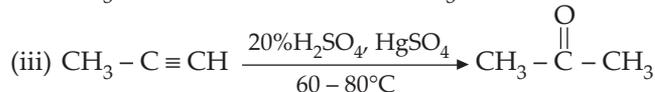
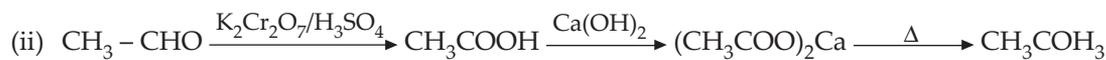
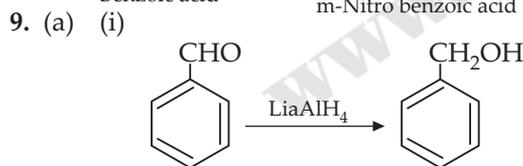
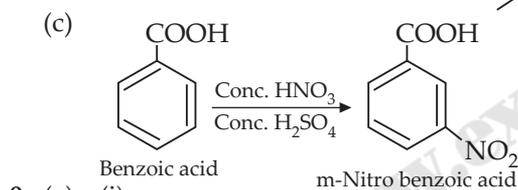
$$t = \frac{2.303}{K} \log \frac{[R]_0}{[R]}$$

$$t = \frac{2.303}{0.0231} \log \frac{[R]_0}{\frac{[R]_0}{10}} = \frac{2.303}{0.0231} \log 10$$

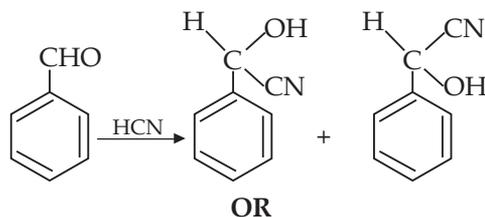
$$t = 99.7 \text{ min.}$$



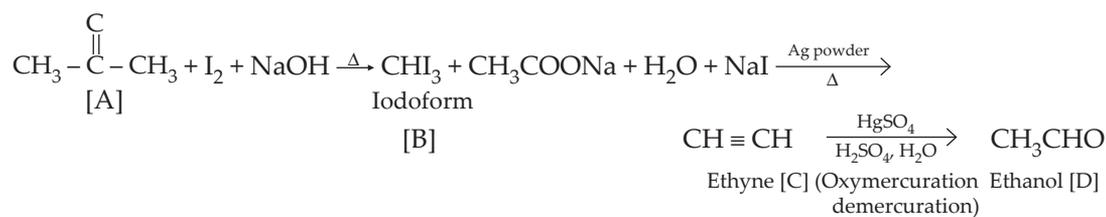
- (b) Carbonyl carbon is an electrophilic centre whereas carbonyl oxygen is a nucleophilic centre because of high electronegativity, electron density shifts towards oxygen and carbon becomes electron deficient and acts as electrophilic centre whereas oxygen acts as nucleophilic centre.



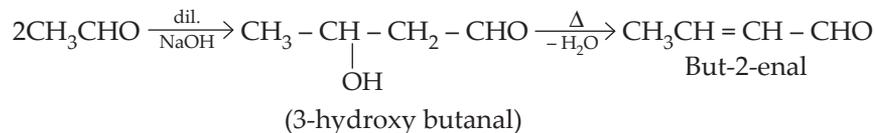
- (b) Benzaldehyde on treatment with HCN gives benzaldehyde cyanohydrin which is a chiral molecule and exists as two optical isomers which can not be separated by fractional distillation.



Compound [A] gives iodoform reaction hence it must have a (CH_3CO) group. $CH_3-C(=O)-CH_3$ must be [A]. Hence, the reactions are:

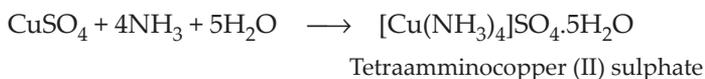
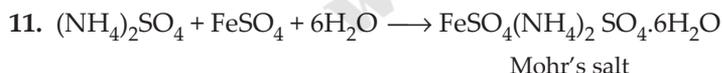


Aldol condensation of [D] *i.e.*, ethanol occurs.



10. (a) Emulsion is a light-sensitive material which is used to coat film and photographic paper so that images can be made to appear. The emulsion consists of light-sensitive crystals which are suspended in gelatin, creating a mixture which can be evenly applied to a base such as paper, glass, celluloid, or fabric.
- (b) Medicines are more effective in colloidal state because colloids have a larger surface area. Thus, they easily gets assimilated, absorbed and digested in our body.
- (c)

	Sol	Gel
1.	The liquid state of a colloidal solution is called sol.	The solid or semi solid state of a colloidal solution is called gel.
2.	The sol does not have a definite structure.	The gel possesses honey comb like structure.
3.	The dispersion medium of the sol may be water.	The dispersion medium of gel will be hydrated colloid particles.
4.	The sol can be converted to gel by cooling.	The gel can be converted to sol by heating.
5.	The sol can be easily dehydrated.	The gel cannot be dehydrated.
6.	The viscosity of the sol is very low.	The viscosity of the gel is very high.
7.	Sol is categorized into lyophobic and lyophilic sols. Example: Blood	There is no such classification of gel Example: Fruit jelly, cooked gelatin gelly.



Both the compounds *i.e.*, $\text{FeSO}_4(\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$ and $[\text{Cu}(\text{NH}_3)_4]\text{SO}_4 \cdot 5\text{H}_2\text{O}$ fall under the category of addition compounds. But Mohr's salt is an example of a double salt, while the latter is a coordination compound.

A double salt is an addition compound that is stable in the solid state but it dissociates up into its constituent ions in the dissolved state. Hence will give test of each individual constituent ions. For e.g., $\text{FeSO}_4(\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$ breaks into Fe^{2+} , NH_4^+ and SO_4^{2-} ions. Hence, it gives a positive test for Fe^{2+} ions. A coordination compound is an addition compound which retains its identity in the solid as well as in the dissolved state. However, the individual properties of the constituents are lost. In $[\text{Cu}(\text{NH}_3)_4]\text{SO}_4 \cdot 5\text{H}_2\text{O}$ does not show the test for Cu^{2+} because Cu^{2+} ion is present inside the complex entity, $[\text{Cu}(\text{NH}_3)_4]^{2+}$.

OR

- (a) Ionic bond or electrostatic bond.
 (b) Number of ligands = 6.
 (c) Lower energy set = eg.

- (d) The splitting of degenerate levels due to the presence of ligands in a definite geometry is termed as crystal field splitting.
- (e) If energy separation for octahedral crystal field is less than energy required for electron pairing energy in single orbital, then fourth electron enters eg orbital. So, ligands whose $D_0 < P$ are weak field ligands.

Section – C

12. (a) An electrode is a solid electric conductor that carries electric current into non-metallic solids, or liquids, or gases.
- (b) The maximum cell potential is directly related to the free energy difference between the reactants and the products in the cell.

$$\Delta G^\circ = -nF\epsilon^\circ$$

$\epsilon^\circ = \text{Volts} = \text{Work (J)} / \text{charge (c)}$

$F = \text{Faraday} = 96,485 \text{ coulombs of charge per mole of electrons}$

$n = \text{number of moles transferred per mole of reactant and product}$

- (c) Oxidation occurs at anode and reduction occurs at cathode during electrolysis.
- (d) Carbon rod as cathode and zinc (Zn) cup as anode.

OR

- (d) Applications of electrochemical series are:
1. Predicting feasibility of redox reaction.
 2. Predicting the capability of metal to displace H_2 gas from acid.
 3. Higher reduction potentials are strong oxidising agents while lower reduction potentials are strong reducing agents.

Sample Paper 3

Section – A

1. We know that,

$$\text{Formula : } k = \frac{2.303}{t} \log \frac{a}{a-x}$$

$$t_{1/2} = \frac{0.693}{k}$$

Now,

$$t_{99.9} = \frac{2.303}{t} \log \frac{100}{100-99.9}$$

$$= \frac{2.303}{k} \log \frac{100}{0.1}$$

$$= \frac{2.303}{k} \log 1000$$

$$t_{99.9} = \frac{2.303 \times 3}{k}$$

$$t_{99.9} = \frac{6.909}{k}$$

\therefore

$$t_{1/2} = \frac{0.693}{k}$$

$$\therefore k = \frac{0.693}{t_{1/2}}$$

$$\frac{t_{99.9\%}}{t_{1/2}} = \frac{6.909}{k} \times \frac{k}{0.693}$$

$$t_{99.9} = \frac{6.909}{0.693} \times t_{1/2}$$

$$t_{99.9} = 100 \times t_{1/2}$$

Time required for 99.9% completion of the reaction = $10t_{1/2}$

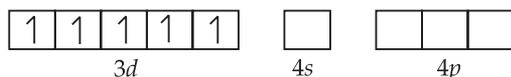
2. Primary (a) and (c) Secondary: (d) Tertiary: (b)
3. (a) Ethyl-4-Bromobenzoate
(b) Methyl 2-amine-butyrate/butanoate

Section - B

4. (a) Transition elements are characterised by partially filled ($n-1$) d subshells and Zn, Cd and Hg are not regarded as transition elements as they have completely filled ($n-1$)d subshell. This can be explained as follows:
1. The electronic configuration of zinc is $[\text{Ar}]3d^{10}4s^2$.
 2. The electronic configuration of cadmium is $[\text{Kr}]4d^{10}5s^2$.
 3. The electronic configuration of mercury is $[\text{Xe}]5d^{10}6s^2$.
- From the above electronic configuration, it is clear that zinc, cadmium and mercury have completely filled ($n-1$)d sub-shell. Therefore, they are not considered as transition elements.
- (b) $\text{K}_2\text{Cr}_2\text{O}_7$ is used as a primary standard in volumetric analysis because of the following reasons:
- (i) It is available in pure state.
 - (ii) It is non-hygroscopic in nature.
 - (iii) It does not decolourise in solution.
- (c) Inner transition metals are those elements in which the last electron enters the f-orbital. The elements in which the 4f and 5f orbitals are progressively filled are called f-block elements. The lanthanoids from atomic number ($Z = 58$ to 71) and actinoids from atomic number ($Z = 90$ to 103). Among the given atomic numbers, the atomic numbers of the inner transition elements are 59, 95 and 102.

OR

- (a) MnO_4^- : Mn has +7 oxidation state and group number is 7.
 CrO_4^{2-} : Cr has + 6 oxidation state and group number is 6.
- (b) In the lanthanide series, +3 oxidation state is most common *i.e.*, Ln(III) compounds are predominant. However, +2 and +4 oxidation states can also be found in the solution or in solid compounds.
- (c) Nickel (Ni) metal is useful in the polymerisation of alkynes.
5. (a) Molecular formula of Iron(III) hexacyanoferrate(II) is $\text{Fe}_4[\text{Fe}(\text{CN})_6]_3$.
- (b) $[\text{MnBr}_4]^{2-}$, Mn has (+ 2) oxidation state hence $4s^03d^5$ configuration. Br^- is a weak field ligand, five unpaired electrons. So, highly paramagnetic.

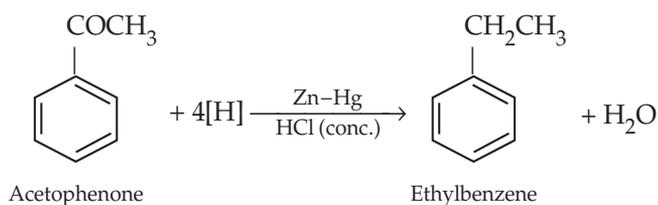


So highly paramagnetic.

- (c) Electronic configuration of Co^{3+} ion is,

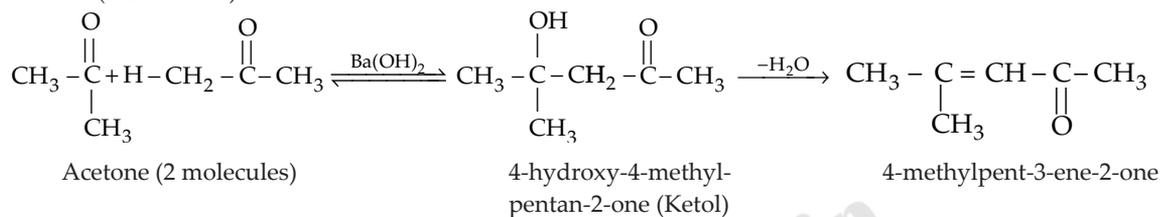
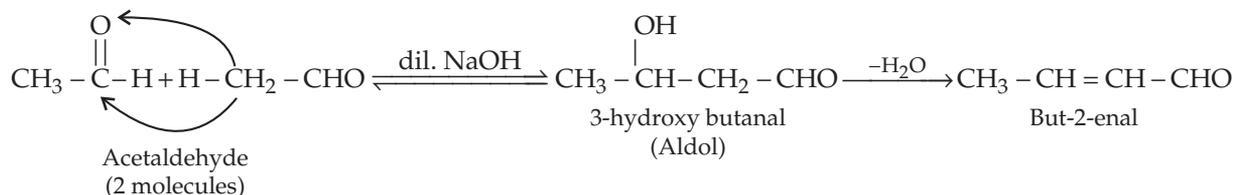


Electronic configuration of sp^3d^3 hybridized (as F^- is a weak field ligand) orbitals of Co^{3+} , with six pairs of electrons from six F^- ions :

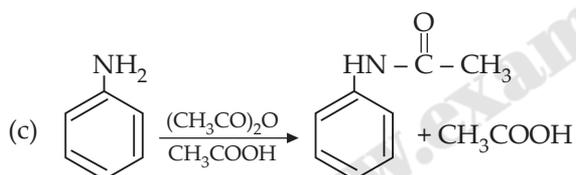


OR

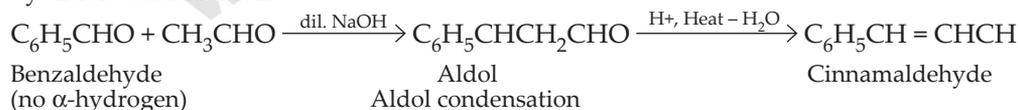
- (a) **Aldol condensation:** When two molecules of aldehydes or ketones containing at least one α -hydrogen atom on treatment with dilute alkali undergoes condensation to form β -hydroxy aldehyde (aldol) or β -hydroxy ketone (ketol) is known as aldol condensation.



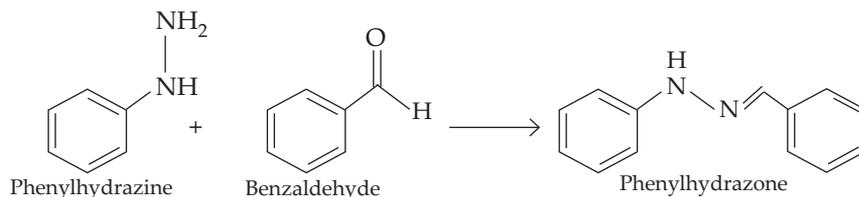
- (b) 4-Nitrobenzoic acid > Benzoic acid > 4-Methoxy benzoic acid.
 (c) (i) Benzene-1, 4-dicarbaldehyde (ii) Heptan-2-one
10. (a) $\text{C}_6\text{H}_5 - \text{NH}_2 + \text{CHCl}_3 + 3\text{KOH} \rightarrow \text{C}_6\text{H}_5 - \text{NC} + 3\text{KCl} + 3\text{H}_2\text{O}$
 (b) $\text{C}_6\text{H}_5\text{N}_2\text{Cl} + \text{H}_3\text{PO}_2 + \text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_5 - \text{N}_2 + \text{H}_3\text{PO}_3 + \text{HCl}$



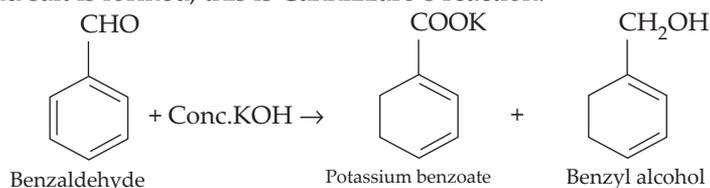
11. (a) Cinnamaldehyde is formed when benzaldehyde reacts with acetaldehyde in presence of dil. NaOH by aldol condensation.



- (b) Benzaldehyde reacts with phenylhydrazine to give phenylhydrazone.

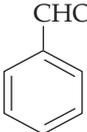
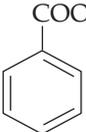


- (c) Benzaldehyde does not have α -hydrogen so on heating with concentrated KOH solution a mixture of alcohol and salt is formed, this is Cannizzaro's reaction.

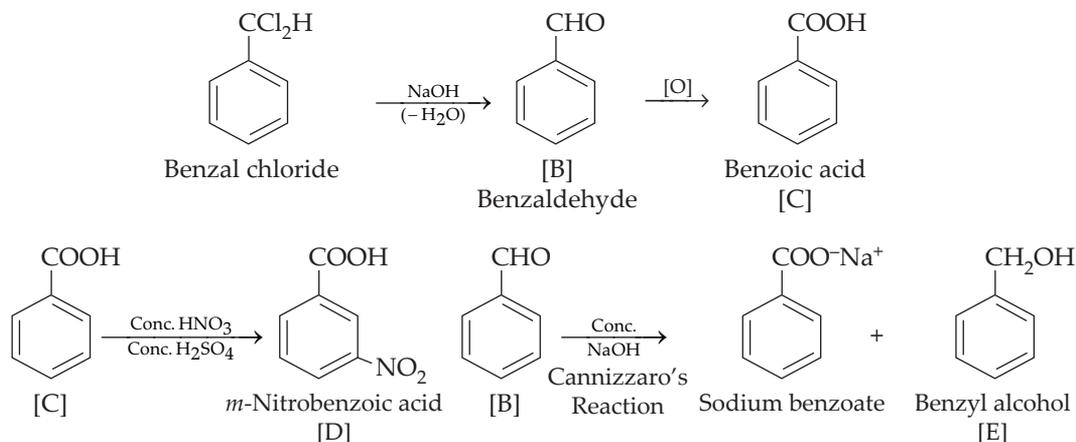


OR

[A] seems like an organic compound of benzene from formula $C_7H_6Cl_2$.

[B] on oxidation gives [C], hence [B] must be  and [C] must be 

Therefore [A] will be



Section - C

12. (a) A salt bridge maintains the electrical neutrality between solutions of both the half cells.
 (b) Cell potential is called EMF of the cell when no current is drawn through the cell.
 (c) Electrical conductance increases with increase in temperature.
 (d) EMF of a cell depends on:
1. Temperature
 2. Nature of electrolyte
 3. Concentration of electrolyte in two half cells.

OR

(d) At equilibrium, $\Delta G = 0$.

\therefore

$$\Delta G = -nFE^\circ$$

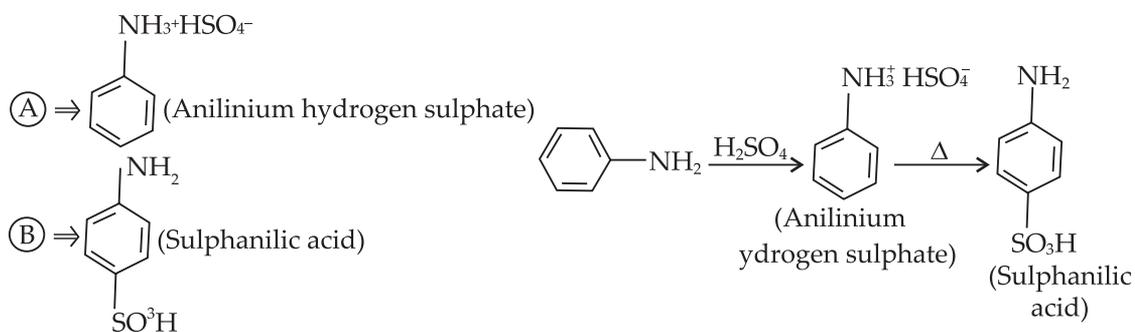
$$0 = -nFE^\circ$$

$$E^\circ = 0.$$

Sample Paper 4

Section - A

1.



2. $\Lambda_{\text{NH}_4\text{OH}} = \Lambda_{\text{NH}_4^+} + \Lambda_{\text{OH}^-}$
 $\therefore \Lambda_{\text{NH}_4\text{OH}} = \Lambda_{\text{NH}_4\text{Cl}} + \Lambda_{\text{NaOH}} - \Lambda_{\text{NaCl}}$
 $= 129.8 + 217.4 - 108.9$
 $= 238.3 \text{ ohm}^{-1} \text{ cm}^2$
 Given $\Lambda_c = 9.33 \text{ ohm}^{-1} \text{ cm}^2$
 \therefore Degree of dissociation, $\alpha = \frac{\Lambda_c}{\Lambda}$
 $= \frac{9.33}{238.3} = 0.039.$

3. Rate law; $R = k [\text{Cl}_2][\text{NO}]^2$
 order = 1 + 2 = 3

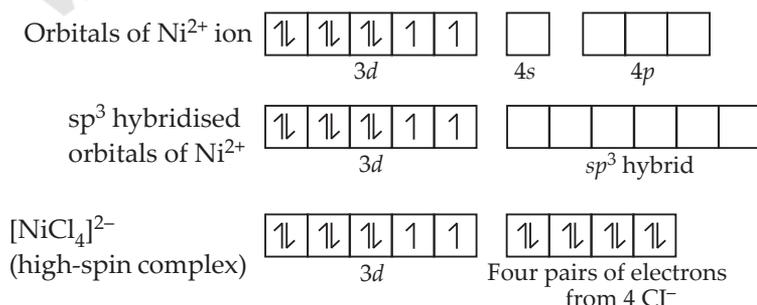
Hence, It is a third order reaction.

Section - B

4. $\text{Ti}^{4+} = 1s^2 2s^2 2p^6 3s^2 3p^6$
 $\text{V}^{2+} = 1s^2 2s^2 2p^6 3s^2 3p^6 3d^3$
 $\text{Mn}^{3+} = 1s^2 2s^2 2p^6 3s^2 3p^6 3d^4$
 $\text{Cr}^{3+} = 1s^2 2s^2 2p^6 3s^2 3d^3$
- (a) Ti^{4+} is most stable in an aqueous solution because of fully filled valence shell ($3s^2 3p^6$) configuration (noble gas configuration).
 (b) Mn^{3+} is the strong oxidising agent as it oxidises other species it will reduce itself by taking an e^- and will stabilise its configuration ($3d^5$).
 (c) Ti^{4+} is colourless due to absence of unpaired electrons ($3s^2 3p^6$).

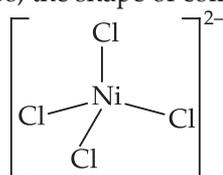
OR

- (a) $2\text{MnO}_4^- + 16\text{H}^+ + 5\text{S}^{2-} \longrightarrow 2\text{Mn}^{2+} + 5\text{S} + 8\text{H}_2\text{O}$
 (b) $2\text{KMnO}_4 \xrightarrow{\text{heat}} \text{K}_2\text{MnO}_4 + \text{MnO}_2 + \text{O}_2$
 (c) The general electronic configuration of transition elements is $(n-1)d^{1-10}ns^2$
5. (a) tetrachloridonickelate (II) ion.
 (b) Hybridization of Ni in the complex $[\text{NiCl}_4]^{2-}$ is sp^3 . The hybridisation scheme is shown in the following diagram.



Hence the hybridisation of Ni^{2+} in the complex is sp^3 .

- (c) As the hybridisation of Ni is sp^3 , so, the shape of complex is tetrahedral.



OR

- (a)
- $K[Cr(H_2O)_2(C_2O_4)_2 \cdot 3H_2O]$
- IUPAC Name: Potassium diaquadioxalatochromate (III) trihydrate.

Oxidation state of chromium = 3

Electronic configuration : $3d^3(t_{2g}^2, e_g^1)$

Coordination number = 6

Shape : Octahedral

Magnetic moment,

$$\begin{aligned}\mu &= \sqrt{n(n+2)} \\ &= \sqrt{3(3+2)} \\ &= \sqrt{15} = 3.87 \text{ BM} \\ &\sim 4\text{BM}\end{aligned}$$

- (b)
- $[Co(NH_3)_5Cl]Cl_2$

IUPAC name : Pentaamminechloridocobalt(III) chloride

Oxidation state of CO = + 3

Coordination number = 6

Shape: Octahedral.

Electronic configuration: $d^6 : (t_{2g}^6)$

Magnetic Moment:

$$\begin{aligned}\mu &= \sqrt{n(n+2)} \\ \mu &= \sqrt{0(0+2)} \\ &= 0.\end{aligned}$$

Since there are no unpaired electron thus the magnetic moment will be 0.

- (c)
- $CrCl_3(py)_3$

IUPAC name: Trichloridotripyridinechromium (III)

Oxidation state of chromium = + 3

Electronic configuration for $d^3 : t_{2g}^3$

Coordination number = 6

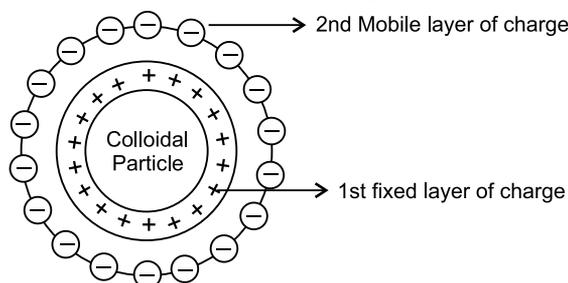
Shape: Octahedral.

Magnetic moment,

$$\begin{aligned}\mu &= \sqrt{n(n+2)} \\ &= \sqrt{3(3+2)} \\ &= \sqrt{15} = 3.87 \text{ BM} \\ &\sim 4\text{BM}\end{aligned}$$

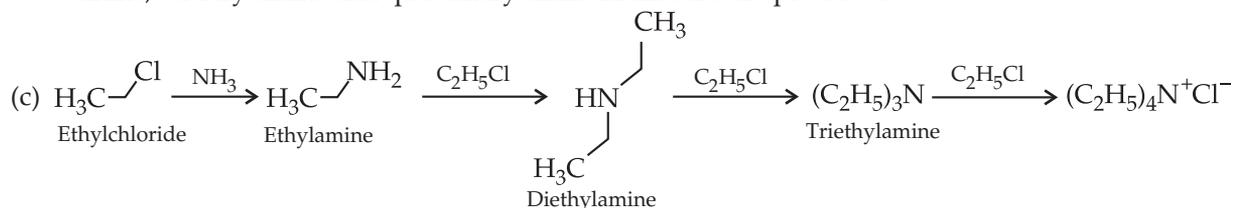
6. (a) As colloidal particles adsorb a specific charge on their surface, to acquire either negative or positive charge, they attract further oppositely charged ions from the dispersed medium which forms a second layer of mobile opposite charge which surrounds the first fixed layer. Such a double layer of opposite charges is called Helmholtz-double layer, as shown in figure.

The mobile layer diffuses into the bulk of the liquid. The potential difference between the fixed layer and the mobile diffused layer is called electrokinetic potential or zeta potential.

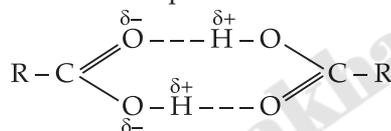


- (b) Colour of a colloidal solution depends upon the size and shape of dispersed phase and nature of dispersion medium. Hence, different colloidal solutions transmit different light of spectrum depending upon the variations and hence have different colours.

- (c) Tetraethyl lead (TEL).
7. (a) The class of compounds here is 'amines'. Hybridisation state of nitrogen in these class of compounds is sp^3 .
- (b) The process of cleavage of C-X bond of an alkyl halide molecule by ammonia molecule is known as ammonolysis. The halogen atom of alkyl or benzyl halide gets replaced by an amino ($-NH_2$) group. The primary amine thus obtained behaves as a nucleophile and in subsequent reactions, secondary amine, tertiary amine and quaternary ammonium salts are produced.



8. (a) Para nitro benzoic acid is more acidic than benzoic acid because of the NO_2 functional group which is an electron withdrawing group. Due to which the electron density on the hydrogen atom of the carboxylic acid becomes low, and it can be easily removed. Hence *p*-Nitrobenzoic acid is more acidic and has a higher K_a value.
- (b) Carboxylic acids have higher boiling point than alcohols due to more extensive association of carboxylic acid molecules through intermolecular hydrogen bonding. The hydrogen bond formed by the carboxylic acids is stronger than those in alcohols because O-H bond in $-\text{COOH}$ is more strongly polarised due to the presence of an electron withdrawing carboxyl group in adjacent position than the O-H bonds of alcohols. Therefore, the boiling points of carboxylic acids, particularly lower members, are higher than those of alcohols of comparable molecular masses.



- (c) Acetone is highly soluble in water because it can undergo hydrogen bonding with water molecules because of the presence of a polar carbonyl $\left(\begin{array}{c} \text{O} \\ || \\ \text{C} \end{array} \right)$ group. In case of benzophenone the carbonyl group is sterically hindered by two big phenyl groups ($\text{C}_6\text{H}_5\text{COC}_6\text{H}_5$), hence, the carbonyl oxygen is masked and cannot participate in hydrogen bonding with water.

$$\begin{aligned}
 9. (a) \quad k &= \frac{2.303}{t} \log \frac{[A_0]}{A} = \frac{2.303}{300} \log \frac{1.6 \times 10^{-2}}{0.8 \times 10^{-2}} \\
 &= \frac{2.303}{300} \log 2 = 2.31 \times 10^{-3} \text{ s}^{-1} \\
 &= \text{At } 600 \text{ s, } K = \frac{2.303}{t} \log \frac{[A_0]}{[A]} \\
 &= \frac{2.303}{300} \log \frac{1.6 \times 10^{-2}}{0.4 \times 10^{-2}} \\
 &= \frac{2.303}{600} \log 4 = 2.31 \times 10^{-3} \text{ s}^{-1}
 \end{aligned}$$

Since K is constant when using first order equation therefore it follows first order kinetics.

$$(b) \quad t_{1/2} = \frac{0.693}{k} = \frac{0.693}{2.31} \times 10^{-3} = 300 \text{ s}$$

Thus, the half life of the reaction is 300s.

OR

- (a) As we can see from the rate equation that its a first order reaction.

Initial concentration, let be = a Then concentration after time, $t = \frac{3}{4} a = x$

$$\therefore t = \frac{2.303}{k} \log \frac{a}{a-x} \text{ also } t_{1/2} = \frac{0.693}{k}$$

$$= \frac{2.303}{0.693} \log \frac{a}{a - \frac{3}{4}a}$$

$$\Rightarrow k = \frac{0.693}{37.9} = 0.0183 \text{ s}^{-1}$$

$$= \frac{2.303 \times 37.9}{0.693} \log 4. \quad [\log 4 = 0.6021]$$

$$= \frac{2.303 \times 37.9}{0.693} \times 0.6021 = 75.83 \text{ sec.}$$

$$(b) k = \frac{2.303}{t} \log \frac{[A_0]}{[A]}$$

$$t = 60 \text{ s}$$

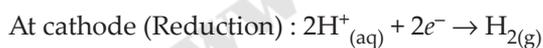
$$\log \frac{[A_0]}{[A]} = \frac{k \times 60}{2.303}$$

$$\log \frac{[A_0]}{[A]} = \frac{0.0183 \times 60}{2.303}$$

$$\log \frac{[A_0]}{[A]} = 0.4762$$

$$\text{Thus, } \frac{[A_0]}{[A]} = 2.99.$$

10. (a) (i) Dilute solution of
- H_2SO_4
- with Pt electrode have ions,
- H^+
- ,
- SO_4^{2-}
- and
- OH^-
- in it as Pt is an inert electrode.

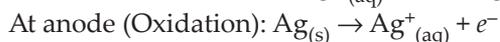
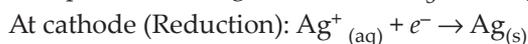


SO_4^{2-} will remain in solution as it has a higher discharge potential than OH^- .

So, H_2 gas is evolved at cathode and O_2 gas is evolved at anode.

- (ii) Aqueous solution of
- AgNO_3
- with Ag electrode.

Ions present are: Ag^+ , H^+ , OH^- , NO_3^- and Ag atom.



As Ag has highest discharge potential compared to all other ions hence it gets dissolved as $\text{Ag}^+_{(\text{aq})}$ ion.

Hence at cathode we get solid Ag deposit and at anode the silver electrode dissolves.

- (b)
- $\text{Pt, Fe}^{2+} | \text{Fe}^{3+}_{(\text{aq})} || \text{Ag}^+_{(\text{aq})} | \text{Ag}_{(\text{s})}$

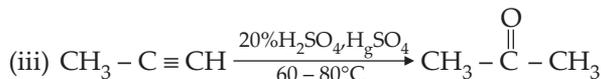
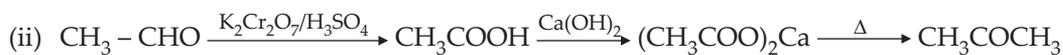
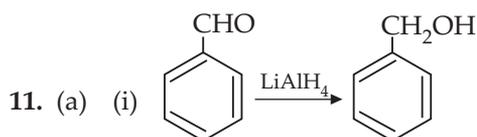
$$E^\circ_{\text{cell}} = E^\circ_{\text{Ag}^+/\text{Ag}} - E^\circ_{\text{Fe}^{3+}/\text{Fe}^{2+}}$$

$$= +0.80 \text{ V} - (+0.77 \text{ V}) = 0.03 \text{ V}$$

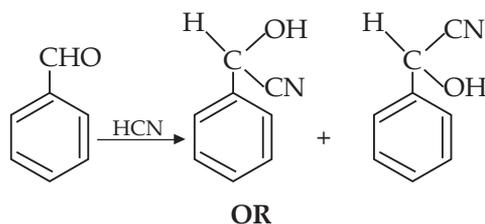
$$\Delta G^\circ = -nFE^\circ_{\text{cell}} \quad n = 1$$

$$\Delta G^\circ = -1 \times 96500 \text{ C mol}^{-1} \times 0.03 \text{ V}$$

$$= -2895 \text{ J mol}^{-1} = -2.895 \text{ kJ/mol}^{-1}.$$

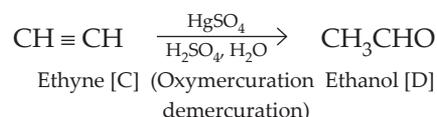
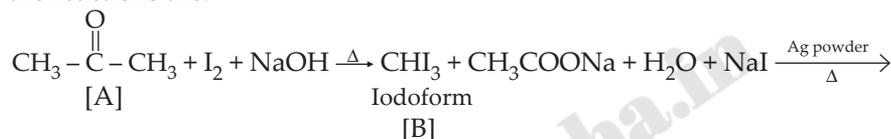


- (b) Benzaldehyde on treatment with HCN gives benzaldehyde cyanohydrin which is a chiral molecule and exists as two optical isomers or enantiomers which can not be separated by fractional distillation.

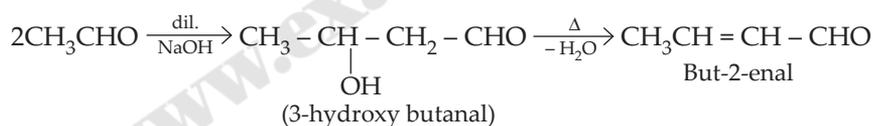


Compound [A] gives iodoform reaction hence it must have a (CH_3CO) group. $\text{CH}_3 - \overset{\text{O}}{\parallel} \text{C} - \text{CH}_3$ must be [A].

Hence, the reactions are:

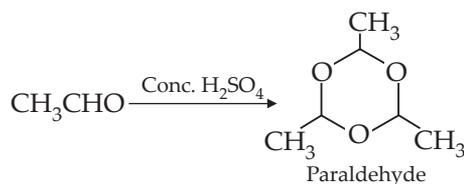


Aldol condensation of [D] *i.e.*, ethanol occurs.

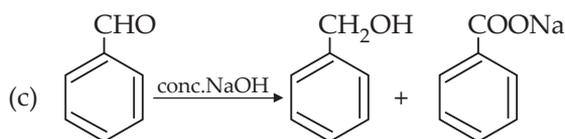


Section - C

12. (a) Acetaldehyde on reaction with trace of H_2SO_4 gives a cyclic trimer compound known as paraldehyde.

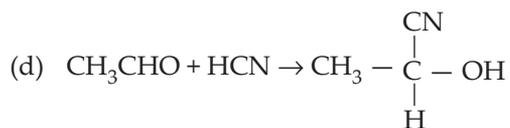


- (b) All the aldehydes which have α -hydrogen atom undergoes aldol condensation.



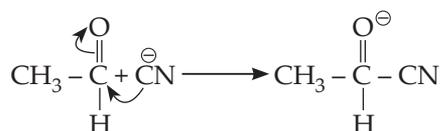
(d) Methanal is a gas. It is soluble in water because it form H-bond with water molecules.

OR

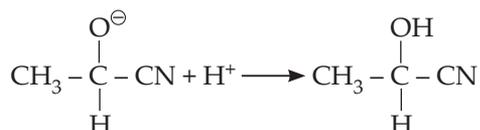


Mechanism for the addition of HCN to ethanal can be represented as follows:

Step I : Nucleophilic addition of CN^-

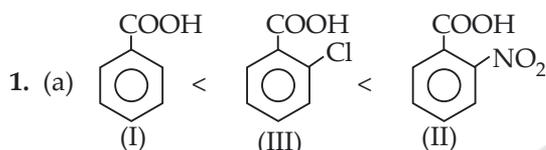


Step II : Addition of H^+ to O^-



Sample Paper 5

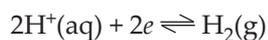
Section - A



(b) Ethanol (I) < Phenol (III) < acetic acid (II) < Benzoic acid (IV)

(c) $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{COOH}$ (III) > $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{OH}$ (I) > $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CHO}$ (II)

2. The cell reaction is :



According to Nernst equation,
$$E^\circ = E^\circ - \frac{0.059}{2} \log \frac{p(\text{H}_2)}{[\text{H}^+]^2}$$

Since, $E = 0$, $[\text{H}^+] = 10^{-7}$ M for pure water

$$0 = 0 - \frac{0.059}{2} \log \frac{p(\text{H}_2)}{[\text{H}^+]^2}$$

$$\therefore 0 = - \frac{0.059}{2} \log p(\text{H}_2) + \frac{0.059}{2} \log 10^{-14}$$

$$\therefore \log p(\text{H}_2) = \log 10^{-14}$$

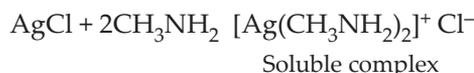
$$\therefore p(\text{H}_2) = 10^{-14} \text{ atm.}$$

3. (a) The boiling points of aldehydes and ketones are lower than that of corresponding alcohols and acids due to absence of intermolecular hydrogen bonding in aldehydes and ketones.

(b) Oxidation of toluene to benzaldehyde is carried out with CrO_3 in presence of acetic anhydride as it traps aldehyde as gem diacetate and further oxidation does not take place to give carboxylic acid.

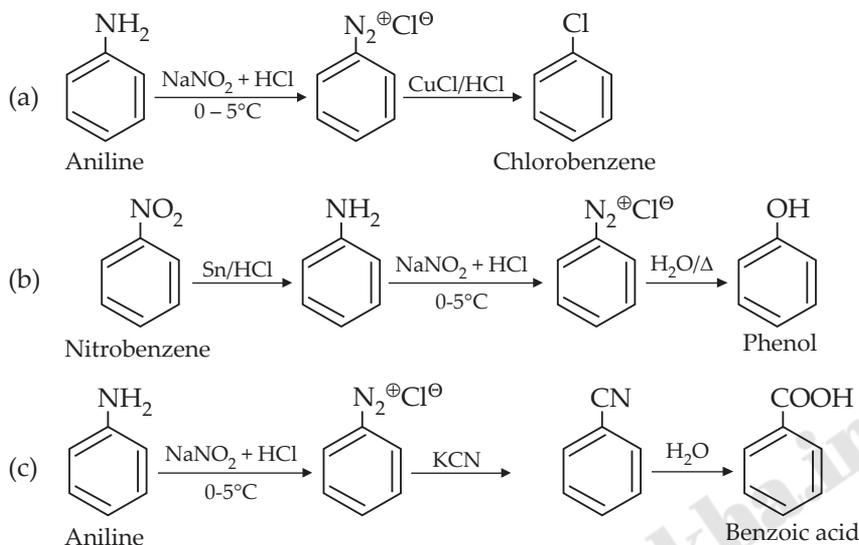
Section – B

4. (a) Due to the lack of acidic hydrogen, tertiary amines do not undergo acylation reaction.
 (b) Methylamine can act as a base or a ligand, with silver chloride it acts as a ligand. A silver methyl amine complex is formed:



- (c) Lone pair of 'N' is easily available for donation compared to oxygen as 'N' is less electronegative than 'O'. Therefore amines are more basic than corresponding alcohols.

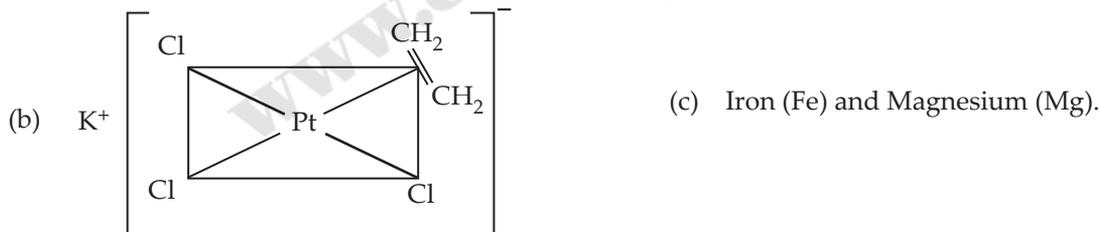
OR



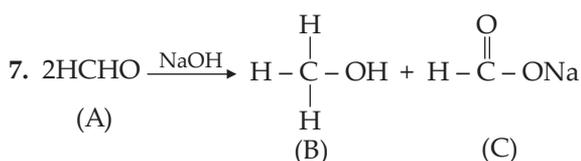
5. (a) Ferrocene
 (b) (i) Potassium trioxalatoferrate (III) (ii) Hexaamine cobalt (III) chloride

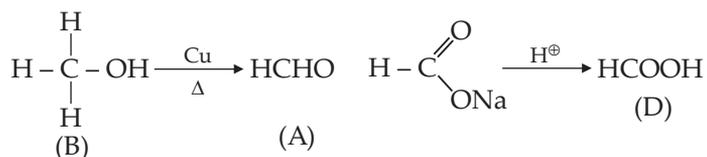
OR

- (a) $\text{Cu}(\text{OH})_2$ is soluble in NH_4OH due to the formation of soluble complex $[\text{Cu}(\text{NH}_3)_2](\text{OH})_2$. But no such complex is formed by the reaction of $\text{Cu}(\text{OH})_2$ with NaOH .



6. (a) Electronic configuration Eu^{2+} is $[\text{Xe}] 4f^7 5d^0$ while Ce^{2+} is $[\text{Xe}] 4f^2 5d^0$. Hence, $\text{Eu}(\text{II})$ has stable configuration as d-orbital is half filled whereas Ce^{2+} configuration has no such extra stability.
 (b) In transition metals small size atoms like carbon, boron, nitrogen etc., occupy the interstices or holes present in the metal lattice. e.g., TiC , $\text{VH}_{0.6}$, Fe_3H . These compounds are more malleable, have high melting point and are chemically inert.
 (c) Separation of Zr and Hf from a mixture is difficult due to their similar atomic radii they have common physical properties due to which their separation is difficult.

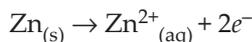




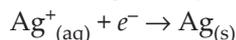
8. The galvanic cell in which the given reaction takes place is depicted as:



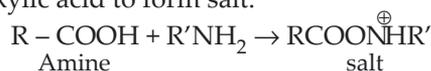
- (a) Zn electrode (anode) is negative charged.
 (b) Ions are carriers of current in the cell and in the external circuit, current will flow from silver to zinc. Ions are Zn^{2+} and Ag^{+} .
 (c) The reaction taking place at the anode is given by



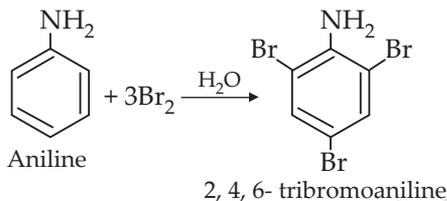
The reaction taking place at the cathode is given by,



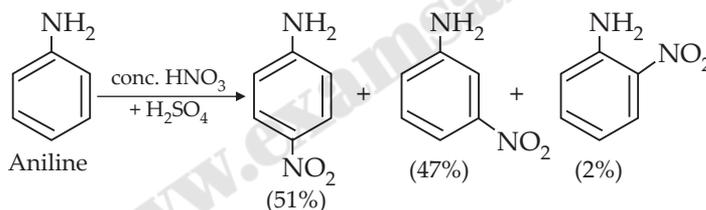
9. (a) Amines react with carboxylic acid to form salt.



- (b) Aniline reacts with bromine water to form 2, 4, 6-tribromoaniline

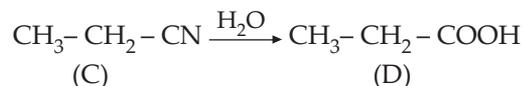
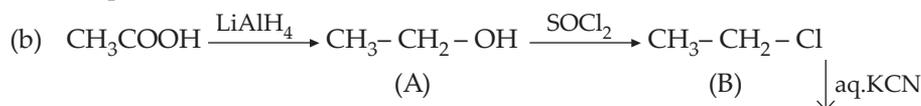


- (c) Aniline reacts with conc. HNO_3 and Conc. H_2SO_4 to form *o*, *m* and *p*-nitro aniline in different proportions.



OR

- (a) Propan-2-amine.



10. (a) Cell performs normally. Electrons flow from anode to cathode and conventional current in the opposite way.
 (b) No current flow. The external voltage balances cell potential, hence equilibrium is reached.
 (c) The cell now acts as an electrolytic cell, zinc acts as cathode and copper acts as anode. Flow of charge is from copper to zinc and conventional current flows from zinc to copper electrode.
11. (a) KMnO_4 solution is used to clean surgical instruments because of the germicidal action of KMnO_4 .
 (b) In cobalt salts, Co has d^7 electrons in the outer shell and hence it has three unpaired electrons. Therefore it will be attracted in a magnetic field. But in case of Zr, it has got d^{10} configuration, and therefore, will not be attracted by magnetic field.

- (c) Scandium ($Z = 21$) does not exhibit variable oxidation states.

OR

- (a) The metallic bonds present in Zn, Cd and Hg are weak as the electrons in d -subshell are paired for them. Hence, they have low melting and boiling points.
- (b) $2\text{MnO}_4^{2-} + 4\text{H}^+ \rightarrow 2\text{MnO}_4^- + \text{MnO}_2 + 2\text{H}_2\text{O}$.
- (c) Hf and Zn have almost similar size due to lanthanoid contraction. Hence, their properties are similar.

Section - C

12. (a) A catalyst can only change the speed of the reaction while a photosensitizer only initiates the reaction.
- (b) Increase in temperature causes a total increase in the energy of the reacting species. Therefore, more and more reacting species are able to cross the activation energy required to form the product. Hence overall rate of reaction increases.
- (c) No, molecularity of a reaction can not be zero.
- (d) $\text{Rate} = k[\text{A}]^2$.
- (i) When concentration of 'A' is doubled, the rate becomes 4 times.
- (ii) When concentration of 'A' is reduced to half, the rate becomes $\frac{1}{4}$ times.

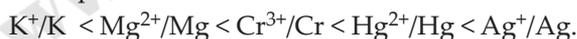
OR

- (d) The sum of the stoichiometric coefficients of the reactants in a balanced chemical reaction displays the total number of moles involved in the reacting species but may or may not depict the correct order of the reaction. If the reaction is not an elementary reaction then only the slowest step reactants decides the order of the reaction.

Sample Paper 6

Section - A

1. (a) Fehling's solution is alkaline solution of CuSO_4 along with some Rochelle salt.
- (b) Ethanol converts Cu(II) of Fehling's solution to Cu(I) *i.e.*, + 1 oxidation state.
2. The lower the reduction potential more the tendency to get oxidised, the higher is the reducing power. The given standard electrode potentials increase in the order of:



Hence, the reducing power of the given metals increases in the following order:



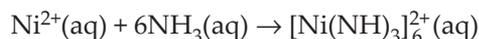
3. (a) When a beam of light is passed through a colloidal solution, then scattering of light is observed. This is known as the Tyndall effect. This scattering of light illuminates the path of the beam in the colloidal solution.
- (b) When NaCl is added to ferric oxide sol, it dissociates to give Na^+ and Cl^- ions. Particles of ferric oxide sol are positively charged. Thus, they get coagulated in the presence of negatively charged Cl^- ions.

Section - B

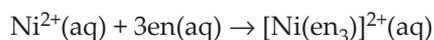
4. (a) If $\Delta_0 > P$, it becomes more energetically favourable for the fourth electron to occupy a t_{2g} orbital with configuration $t_{2g}^4 e_g$.
- (b) Though both $[\text{NiCl}_4]^{2-}$ and $[\text{Ni}(\text{CO})_4]$ are tetrahedral, their magnetic characters are different. This is due to a difference in the nature of ligands. Cl^- is a weak field ligand and it does not cause the pairing of unpaired $3d$ electrons. Hence, $[\text{NiCl}_4]^{2-}$ is paramagnetic. On the other hand, CO is a strong field ligand and it causes the pairing of unpaired $3d$ electrons. Hence, $[\text{Ni}(\text{CO})_4]$ is diamagnetic.
- (c) When a polydentate ligand attaches to the metal ion in a manner that forms a ring, then the metal-ligand association is found to be more stable. In other words, we can say that complexes

containing chelate rings are more stable than complexes without rings. This is known as the chelate effect.

For example:



$$\log b = 8.61$$



$$\log b = 18.28$$

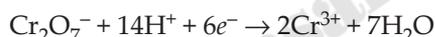
(more stable)

OR

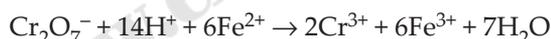
- (a) In $\text{Ni}(\text{CO})_4$ and $\text{Fe}(\text{CO})_5$ the oxidation state of Ni and Fe is zero oxidation state.
- (b) NH_3 acts as a ligand because it has lone pair of electrons, whereas NH_4^+ does not have lone pair of electrons.
- (c) CN^- is an ambidentate ligand because it can coordinate through either the nitrogen or the carbon atom to central metal ion.
5. (a) The E° value for $\text{Ce}^{+4}/\text{Ce}^{+3}$ is 1.74 V (This value shows that Ce^{+4} has sufficient kinetic stability due to which the reaction rate is very slow) which refers that it can oxidise water. Hence, Ce (iv) is a good analytical reagent.
- (b) Though the 5f-subshell resemble 4f-subshell in their angular part of the wave functions (because both 5f & 4f have $l = 3$.) but 5f are not buried as 4f (thus electrons present in 5f orbitals experience less nuclear attraction than electrons present in 4f orbitals) hence, 5f orbitals can take part in bonding to a far greater extent.

OR

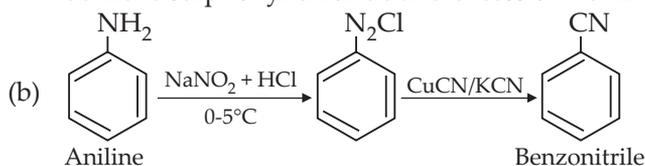
- (a) Potassium dichromate is a strong oxidising agent and is used as a primary standard in volumetric analysis done through titration. In acidic solution, its oxidising action can be represented as follow:



Thus, acidified potassium dichromate will oxidise iodides to iodine, sulphides to sulphur, iron(II) salts to iron(III) etc., and hence can be used to determine their concentrations in solutions of unknown strength.



- (b) Actinoid metals are only slightly affected by nitric acid due to the formation of protective oxide layers on coming in contact with nitric acid, which prevents any further reaction.
6. Werner's postulates explain bonding in coordination compounds as follows:
- (a) In a coordination compound a metal exhibits two types of valency namely, primary and secondary valency. Primary valency is satisfied by negative ions while secondary valency is satisfied by both negative and neutral ions. Primary valency corresponds to the oxidation number of the metal ion, whereas the secondary valency refers to the coordination number of the metal ion and is satisfied by ligands.
- (b) A metal ion has a definite number of secondary valency around the central atom. Also, this valency project in a specific direction in the space assigned to the definite geometry of the coordination compound.
- (c) Primary valency is usually ionisable, while secondary valency is non-ionisable.
- (d) The negative ligands satisfy both primary and secondary valency.
7. (a) Hinsberg test is used to distinguish between 1°, 2° and 3° amines. Here amines are treated with benzene sulphonyl chloride and excess of KOH.



- (c) Ethylamine when added to water forms intermolecular H-bonds with water. Hence it is soluble in water. But aniline can form H-bonding with water to a very small extent due to the presence of a large hydrophobic $-C_6H_5$ group. Hence aniline is insoluble in water..
8. (a) For a reaction, $A + B \rightarrow P$

$$R_1 = k[A][B]^2 \quad \dots(i)$$

If the concentration of B is doubled,

$$R_2 = k[A][2B]^2 \quad \dots(ii)$$

On dividing (i) and (ii)

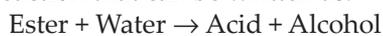
$$\frac{R_1}{R_2} = \frac{k[A][B]^2}{k[A][2B]^2}$$

$$\frac{R_1}{R_2} = \frac{B^2}{4B^2}$$

$$R_2 = 4R_1$$

The rate of reaction will be four times the initial rate.

- (b) If the concentration of B is doubled *i.e.*, $[B]^2$ the overall reaction will be two, because if A is present in large excess, then the reaction will be independent of the concentration of A and will be dependent only on the concentration of B. Order of reaction 2.
- (c) If A is present in large excess, then the rate of the reaction will be independent of A and will depend only on the concentration of B. The overall rate of the reaction will be 2.
9. (a) On passing electric current through a sol, colloidal particles start moving towards oppositely charged electrode where they lose their charge and get coagulated. This process is known as electrophoresis.
- (b) In simple ester hydrolysis reaction that can be written as:

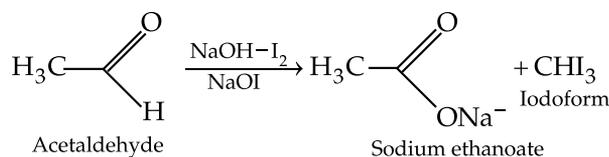


The acid *i.e.* product of the hydrolysis will release H^+ ions in solution which acts as catalyst (auto-catalysis) for the reaction. Therefore, the slow process of hydrolysis will become faster.

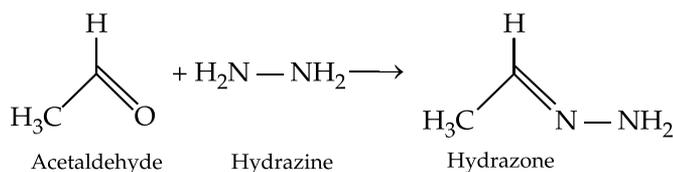
- (c) Physisorption is exothermic in nature (ΔH is negative) which means that the rise in temperature favours the reverse process *i.e.*, desorption. Therefore, physisorption decreases with rise in temperature.

OR

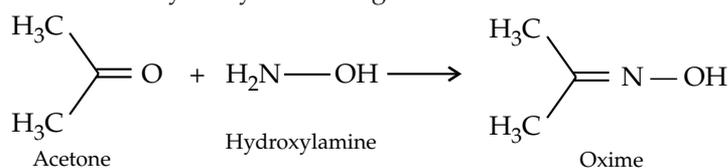
- (a) $AgNO_{3(aq)} + KI_{(aq)} \longrightarrow AgI_{(s)} + KNO_{3(aq)}$
(yellow)
- A yellow precipitate or coagulated silver iodide is formed.
- (b) On dissolution, a large number of gold atoms agitate. Thus, the size of the finest gold sol particles increases in the gold. A large number of atoms gold aggregate together to form species having size in the colloidal range (1–1000 nm).
- (c) When two oppositely charged sols are mixed in almost equal proportions, their charges are neutralized resulting in coagulation. This type of coagulation is called mutual coagulation or material coagulation.
10. (a) Formaldehyde and acetaldehyde can be distinguished with the help of iodoform reaction. Acetaldehyde bearing methyl carbonyl group when heated with I_2 and NaOH, gives a yellow precipitate of iodoform (Iodoform test) whereas formaldehyde does not give a yellow precipitate of iodoform.



- (b) (i) Acetaldehyde reacts with hydrazine to give hydrazone.



(ii) Acetone reacts with hydroxylamine to give oxime.



11. (a) Rate law is an experimentally determined expression which relates the rate of reaction with concentration of the reactants.

(b) Suppose the order of reaction w.r.t. NO is x and w.r.t. O_2 , it is y , then,

$$\text{Rate} = k [\text{NO}]^x [\text{O}_2]^y$$

$$0.096 = k (0.03)^x (0.30)^y \quad \dots(\text{i})$$

$$0.384 = k (0.60)^x (0.60)^y \quad \dots(\text{ii})$$

$$0.192 = k (0.30)^x (0.60)^y \quad \dots(\text{iii})$$

$$0.768 = k (0.60)^x (0.60)^y \quad \dots(\text{iv})$$

Dividing equation (ii), by (i), we get

$$\frac{0.384}{0.096} = \frac{k(0.60)^x(0.30)^y}{k(0.30)^x(0.30)^y}$$

$$4 = 2^x \text{ or } 2^2 = 2^x \text{ or } x = 2$$

Dividing (iv) by (ii), we get

$$\frac{0.768}{0.384} = \frac{k(0.60)^x(0.60)^y}{k(0.60)^x(0.30)^y}$$

$$2 = 2^y \text{ or } y = 1$$

Hence, order of reaction w.r.t. NO = 2

order of reaction w.r.t. O_2 = 1

(c) Rate = $k [\text{NO}]^2 [\text{O}_2]$

$$\text{Rate} = 11.85 (0.1)^2 (0.2) \text{ or rate} = 2.37 \times 10^{-2} \text{ mol}^{-2} \text{L s}^{-1}$$

OR

Calculate the half-life of a first order reaction from their rate constants given below :

(a) Half life,

$$t_{1/2} = \frac{0.693}{k}$$

$$= \frac{0.693}{200 \text{ s}^{-1}} = 3.47 \text{ s} \times 10^{-3} \text{ s}$$

(b) Half life,

$$t_{1/2} = \frac{0.693}{k}$$

$$= \frac{0.693}{2 \text{ min}^{-1}}$$

$$= 0.35 \text{ min (approximately) or } 3.5 \times 10^{-1} \text{ min}$$

(c) Half life,

$$t_{1/2} = \frac{0.693}{k}$$

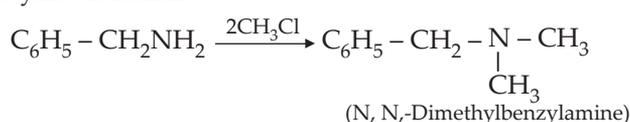
$$= \frac{0.693}{4 \text{ years}^{-1}}$$

$$= 0.173 \text{ years (approximately) or } 1.73 \times 10^{-1} \text{ year.}$$

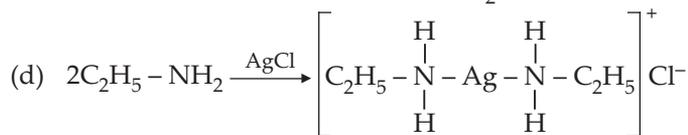
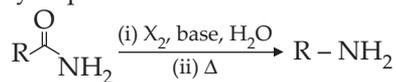
Section - C

12. (a) Benzenamine

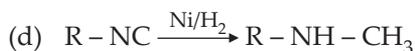
(b) N, N-Dimethylphenylmethanamine



- (c) It is used to prepare Primary aliphatic amines or aromatic amines.



OR



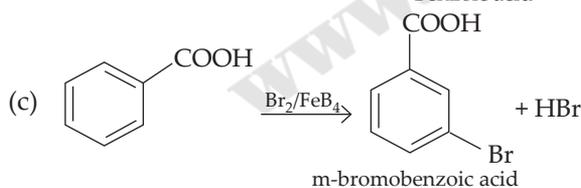
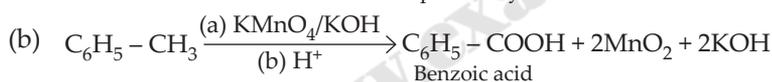
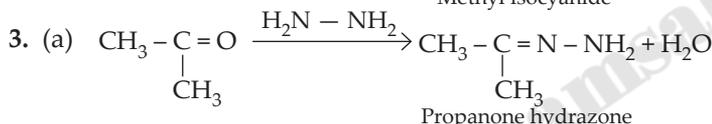
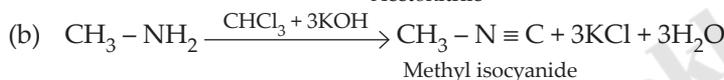
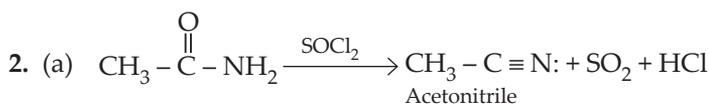
Sample Paper 7

Section - A

- (a) For zero order reaction unit of K is $\text{mol L}^{-1} \text{sec}^{-1}$.

(b) For first order reaction unit of K is sec^{-1} .

(c) Molecularity is the number of given reactant molecules or atoms that are colliding in the elementary reaction. Thus, a minimum of one reactant molecule, atom or ion is required to initiate a chemical reaction. Hence, molecularity cannot be zero.

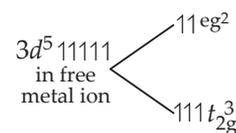


Section - B

- (a) Linkage isomerism occurs in complex compounds with ambidentate ligands like NO_2^- , SCN^- , CN^- , $\text{S}_2\text{O}_3^{2-}$. These ligands have two donor atoms but at a time only one atom is directly linked to central metal atom of the complex. Linkage isomerism is shown by $[\text{Co}(\text{NH}_3)_5(\text{NO}_2)] \text{Cl}_2$. The isomers are $[\text{Co}(\text{NH}_3)_5\text{NO}_2]\text{Cl}$ and $[\text{Co}(\text{NH}_3)_5\text{ONO}]\text{Cl}_2$.

(b) In a metal carbonyl, the metal - carbon bond possesses both σ and π character. Here M - C σ bond is formed by the donation of lone pair of electrons from carbonyl carbon to the vacant orbital of metal. M - C π bond is formed by the backdonation of electrons from a filled d -orbital of metal into the vacant antibonding π^* orbital of carbon monoxide (Carbonyl ligand).

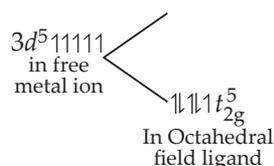
(c) In $[\text{FeF}_6]^{3-}$ Fe(III) has got $3d^5$ system. As F is a weak field ligand, according to crystal field theory (CFT) electronic arrangement will be as follows:



In weak octahedral ligand field

Hence, it has 5 unpaired electrons.

In $[\text{Fe}(\text{CN})_6]^{3-}$ Fe(III) has got $3d^5$ system. As CN^- is a strong field ligand, according to CFT electronic arrangement will be as follows:



Hence, it has only one unpaired electron.

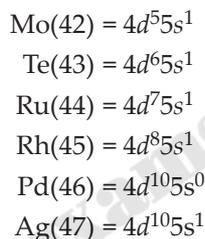
OR

- (a) Ionic bond or electrostatic bond.
 (b) Number of ligands = 6.
 (c) Lower energy set = eg.
5. (a) Cr^{2+} is a stronger reducing agent because it can lose one of its electron to become more stable Cr^{3+} in which the t_{2g} level of d -orbital is half filled and eg level is empty.
 (b) Cu^+ is unstable in aqueous solution because it disproportionates in water to form Cu^{2+} and Cu.
 (c) Mn^{3+} is a stronger oxidising agent because it has 4 electrons in its valence shell and when it gains one electron to form Mn^{2+} , it results in the half-filled (d^5) configuration that has extra stability.

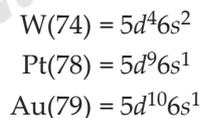
OR

- (a) In the 1st, 2nd and 3rd transition series, the $3d$, $4d$ and $5d$ orbitals are respectively filled. We know that elements in the same vertical column generally have similar electronic configurations. In the first transition series, two elements show unusual electronic configurations :
 Cr (24) = $3d^5 4s^1$ (Because of extra stability of half filled and fully filled orbitals)
 Cu (29) = $3d^{10} 4s^1$

Similarly, there are exceptions in the second transition series. These are:



There are some exceptions in third transition series as well. These are:



As a result of these exceptions, it happens many times that the electronic configurations of the elements present in the same group are dissimilar.

- (b) In each of the three transition series the number of oxidation states shown by the elements is the maximum in the middle and minimum at the extreme ends.

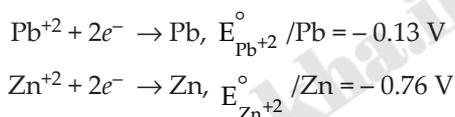
However, +2 and +3 oxidation states are quite stable for all elements present in the first transition series. All metals present in the first transition series form stable compounds in the +2 and +3 oxidation states. The stability of the +2 and +3 oxidation states decreases in the second and the third transition series, where in higher oxidation states are more common.

For example, chromate ion $(\text{CrO}_4)^{2-}$ is strong oxidant while molybdate $(\text{MoO}_4)^{2-}$ and tungstate $(\text{WO}_4)^{2-}$ are stable.

For example: WCl_6 , ReF_7 , RuO_4 , etc., are stable but no such compound of 1st transition series exists.

- (c) In each of the three transition series, the first ionisation enthalpy increases from left to right. The first ionisation enthalpies of the third transition series are higher than those of the first and second transition series. This occurs due to the poor shielding effect of 4f electrons in the third transition series. The removal of one electron alters the relative energies of 4s and 3d orbitals. Hence, their is marginal and irregular increase in ionisation enthalpies.

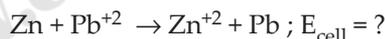
6. (a) Transition elements have large number of unpaired electrons in their atoms due to which they have stronger interatomic interactions and hence stronger bonding between atoms, leading to high atomisation enthalpies.
- (b) Platinised asbestos is used as catalyst in the Ostwald's process for the manufacturing of nitric acid.
- (c) Transition metals generally form coloured compounds because they generally possess one or more unpaired electrons. When visible light falls on a transition metal compound or ion, the unpaired electrons present in the lower energy *d*-orbital get promoted to high energy *d*-orbitals, called *d-d* transition, due to the absorption of visible light. Since, the energy involved in *d-d* transition is quantised, only a definite wavelength gets absorbed, remaining wavelengths present in the visible region get transmitted. Therefore, transmitted light shows some colour complementary to the absorbed colour.
7. (a) Multimolecular colloids: It consists of aggregates of a large number of atoms or smaller molecules. Its size is in the range of 1-1000nm.
Associated colloids: At low concentration, they act as strong electrolytes whereas at high concentrations form aggregates or micelles
- (b) Coagulation is the process of aggregating together the colloidal particles so as to change them into large sized particle by the addition of excess of an electrolyte whereas peptisation is the process of converting a fresh precipitate into colloidal particles by adding small amount of suitable electrolyte.
- (c) Lyophobic colloidal sols are not hydrated and have weak affinity with the dispersion medium whereas lyophilic colloidal sols are heavily hydrated and have strong affinity with the dispersion medium.
8. (a) The half cell reactions can be written as:



So,

$$\begin{aligned} E^{\circ}_{\text{cell}} &= E^{\circ}_{\text{cathode}} - E^{\circ}_{\text{anode}} \\ &= -0.13 \text{ V} - (-0.76 \text{ V}) \\ &= -0.13 + 0.76 = 0.63 \text{ V} \end{aligned}$$

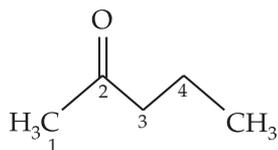
Now, overall reaction:



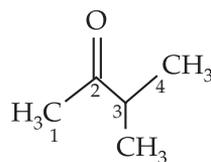
$$\begin{aligned} E_{\text{cell}} &= E^{\circ}_{\text{cell}} - \frac{0.0591}{2} \log \left[\frac{\text{Zn}^{+2}}{\text{Pb}^{+2}} \right] \\ &= 0.63 - \frac{0.06}{2} \log \left(\frac{0.1}{0.02} \right) \\ &= 0.63 - 0.03 \log 5 \\ &= 0.63 - 0.03 \times 0.6910 \\ &= 0.63 - 0.02 = 0.61 \text{ V} \end{aligned}$$

- (b) The conductivity of a solution is the conductance of ions present in a unit volume of the solution. The number of ions (responsible for carrying current) decreases when the solution is diluted. As a result, the conductivity of a solution decreases with dilution.
- (c) The purpose of the salt bridge is to act as a source of spectator ions that can migrate into each of the half cells to preserve electrical neutrality.
9. (a) As the compound gives adduct with bisulphite, *i.e.*, bisulphate compound, it contains a carbonyl group. But it does not reduce Fehling's solution so it must be a ketone. Now, as this gives a positive test with iodoform, it is methyl ketone.

So, based on the above information the following are the possible structures of the compound:

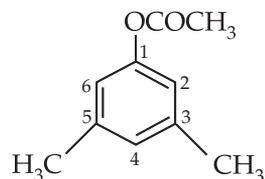


Pentan-2-one

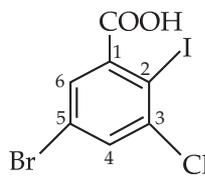


3-Methylbutane-2-one

(b)

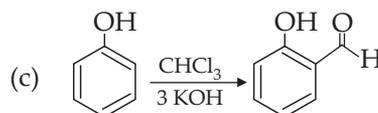
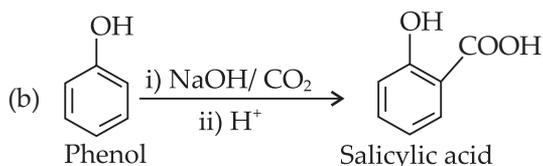
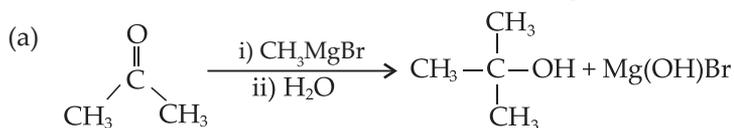


3, 5-Dimethylphenylethanoate

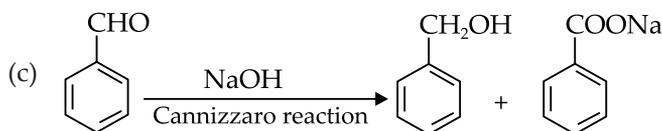
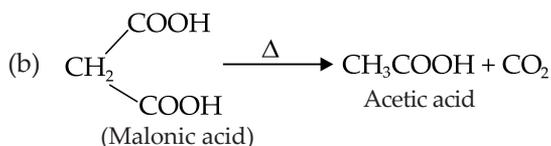
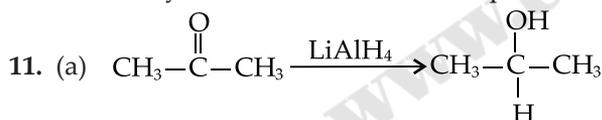


5-Bromo-3-chloro-2-iodobenzoic acid

OR

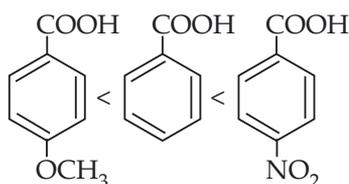


10. (a) Benzenesulphonyl chloride ($C_6H_5 - SO_2Cl$) is known as Hinsberg reagent.
 (b) Primary amines are involved in intermolecular association due to H-bonding. While 3° amines do not have intermolecular association due to lack of H-bonding. Thus, Molecular association of primary amine leads to the increase of its effective molar mass and thus, 1° amine has higher boiling point than 3° amine.
 (c) Due to the $-I$ effect of the benzene ring, the electrons on the N-atom are involved in resonance and are available as base. Therefore, the electrons on the N-atom in aromatic amines cannot be donated easily. This is the reason that aliphatic amines are stronger bases than aromatic amines.

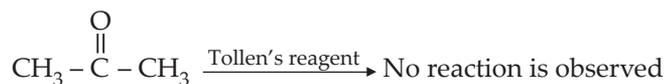
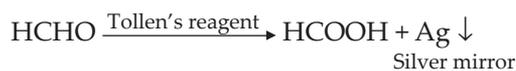


OR

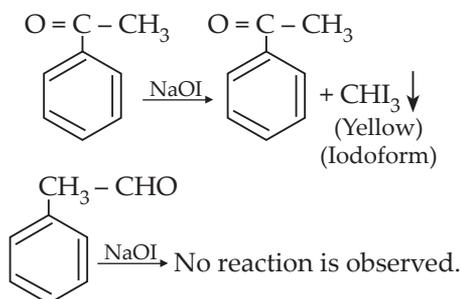
- (a) $-NO_2$ has $-I$ and $-R$, which is responsible for more acidic character. While $-OCH_3$ group has $+R$ effect.



(b) (i) Using Tollen's reagent:



(ii) Using Iodoform test



Section - C

12. (a) Unit of rate constant = (Concentration)¹⁻ⁿ Time⁻¹

When n = order of reaction

(b) In elementary reaction, order and molecularity are same.

(c) In complex multistep reaction, order and molecularity are different.

(d) Rate = $k [\text{R}]^1$, unit of k in first order reaction rate.

$$= \frac{\text{mol.L}^{-1}}{\text{s}} \times \frac{1}{(\text{mol.L}^{-1})} = \text{s}^{-1}.$$

OR

(d) From First order reaction:

$$k = \frac{2.303}{t} \log \frac{[\text{R}]_0}{[\text{R}]}$$

At $t_{1/2}$, $[\text{R}] = \frac{[\text{R}]_0}{2}$.

$$\therefore k = \frac{2.303}{t_{1/2}} \log \frac{[\text{R}]_0}{[\text{R}]_0 / 2}$$

$$\therefore t_{1/2} = \frac{2.303}{k} \log 2 = \frac{2.303 \times 0.3010}{k}$$

$$\therefore t_{1/2} = \frac{0.693}{k}$$

So, in first order reaction, $t_{1/2}$ is independent of initial concentration.

Blueprint of the Sample Question Paper

S. No.	Chapter Name	Marks		
		2	3	4
1	Human health and diseases	✓		
2	Human health and diseases	✓		
OR 2	Microbes in human welfare	✓		
3	Human health and diseases	✓		
4	Biodiversity and its conservation	✓		
5	Organisms and population	✓		
6	Organisms and population	✓		
OR 6	Organisms and population	✓		
7	Human health and diseases		✓	
OR 7	Human health and diseases		✓	
8	Human health and diseases		✓	
9	Biotechnology and its principle		✓	
10	Biodiversity and its conservation		✓	
11	Biodiversity and its conservation		✓	
12	Biotechnology and its applications		✓	
13	Biotechnology and its principle			✓
OR 13	Biotechnology and its applications			✓



Sample Question Paper

Biology [Code (044)]

Term - II

Time : 2 Hrs.

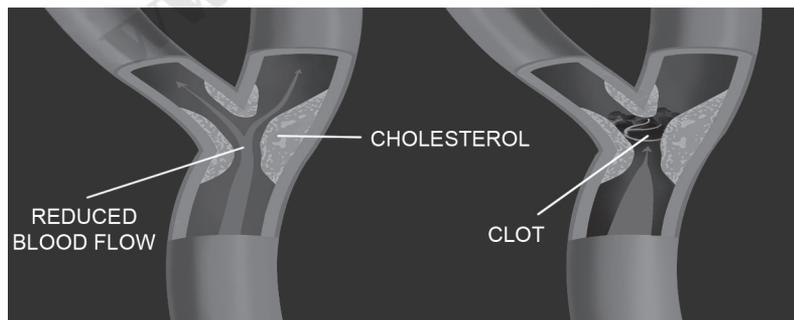
Max. Marks : 35

General Instructions:

1. All questions are compulsory.
2. The question paper has three sections and 13 questions. All questions are compulsory.
3. Section–A has 6 questions of 2 marks each; Section–B has 6 questions of 3 marks each; and Section–C has a case–based question of 5 marks.
4. There is no overall choice. However, internal choices have been provided in some questions. A student has to attempt only one of the alternatives in such questions.
5. Wherever necessary, neat and properly labeled diagrams should be drawn.

SECTION – A

1. Humans have innate immunity for protection against pathogens that may enter the gut along with food. What are the two barriers that protect the body from such pathogens? [2]
Ans. Pathogens enter the body through food and water and the two barriers that protect the body from such pathogens are:
 - (i) **Physical barriers:** Mucus coating of the epithelium lining the gastrointestinal tract and respiratory tract helps in trapping microbes entering our body.
 - (ii) **Physiological barriers:** Low pH in stomach and presence of bacteriolytic lysozyme in tears, saliva and other secretions of body prevent the growth of bacteria.
2. A patient admitted in ICU was diagnosed to have suffered from myocardial infarction. The condition of coronary artery is depicted in the image below.
Name two bioactive agents and their mode of action that can improve this condition.



OR

Substantiate by giving two reasons as to why a holistic understanding of the flora and fauna the cropland is required before introducing an appropriate biocontrol method. [2]

- Ans.** Myocardial infarction commonly known as a heart attack, occurs when there is insufficient supply of blood to some parts of heart, causing damage to the heart muscle.

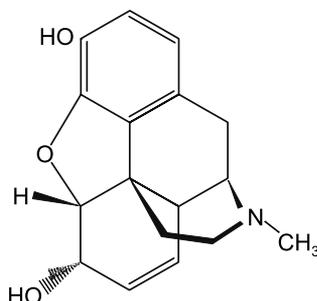
The two bioactive agents and their mode of action that can improve this condition are:

- (1) Streptokinase (produced by the bacterium *Streptococcus*) is used as a 'clot buster' for removing clots from the blood vessels of patients who have undergone myocardial infarction.
- (2) Statins (produced by the yeast *Monascus purpureus*) act as blood cholesterol lowering agents.

OR

Eradication of pests will disrupt predator-prey relationships, where beneficial predatory and parasitic insects which depend upon flora and fauna as food or hosts, may not be able to survive. Holistic approach ensures that various life forms that inhabit the field, their life cycles, patterns of feeding and the habitats that they prefer are extensively studied and considered.

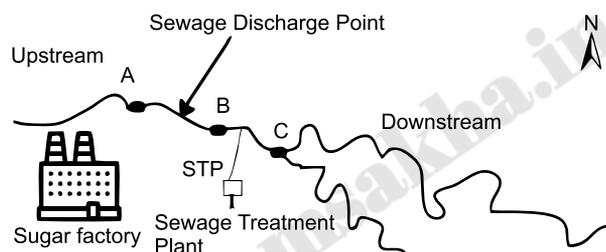
3. Identify the compound having chemical structure as shown below. State any three of its physical properties. [2]



Ans. The chemical structure is shown above is Morphine (alkaloid).

The physical properties are: It appears as a white, odourless, crystalline compound.

4. Water samples were collected at points A, B and C in a segment of a river near a sugar factory and tested for BOD level. The BOD levels of samples A, B and C were 400 mg/L, 480 mg/L and 8 mg/L respectively. What is this indicative of? Explain why the BOD level gets reduced considerably at the collection point C? [2]



Ans. At collection points A and B, the BOD level is high due to high organic pollution caused by sugar factory and sewage discharge in the river. At the collection point C, the water was released after secondary treatment/ biological treatment (where vigorous growth of useful aerobic microbes into flocs consume the major part of the organic matter present in the river water or effluent due to sugar factory and sewage discharge) which is clearly indicated by the reduced BOD.

5. An ecologist studied an area with population A, thriving on unlimited resources and showing exponential growth and introduced population B and C to the same area.

What will be the effect on the growth pattern of the population A, B and C when living together in the same habitat? [2]

Ans. This interaction of the populations A, B and C will lead to competition for resources. Since the supply of resources is limited for the combined needs of all individuals, natural selection plays an important role and eventually the 'fittest' individuals will survive and reproduce.

Since the resources for growth will become finite and limiting, and population growth will no longer remain exponential but becomes realistic.

6. With the decline in the population of fig species it was noticed that the population of wasp species also started to decline. What is the relationship between the two and what could be the possible reason for decline of wasps?

OR

With the increase in the global temperature, the inhabitants of Antarctica are facing fluctuations in the temperature. Out of the regulators and the conformers, which of the two will have better chances of survival?

Give two adaptations that support them to survive in the ambient environment? Give one suitable example. [2]

Ans. A mutualistic relationship is established between two organisms of different species that work together or live together and each is getting benefitted from the relationship. This is the example of the relationship between the plant and pollinator. Fig depends on wasp for pollination, and wasp depends on fig for obtaining food and shelter. With the decline in population of figs, wasp loses its source of food and shelter while if wasp is declined the fig will not get pollinated.

OR

Conformers: They are the organisms which cannot maintain a constant internal environment with respect to changing external environmental conditions like body temperature and osmotic concentration. Eg. fishes, etc.

Regulators: Organisms which can maintain homeostasis, maintain constant body temperature and osmotic concentration. Eg. mammals.

Hence regulators have better survival chances. The two adaptations that support them to survive in the ambient environment is thermoregulation (maintaining constant body temperature) and osmoregulation (maintaining osmotic pressure). E.g. Birds or mammals.

SECTION - B

7. How do normal cells get transformed into cancerous neoplastic cells? Elaborate giving three examples of inducing agent.

OR

A person is suffering from a high-grade fever. Which symptoms will help to identify if he/she is suffering from Typhoid, Pneumonia or Malaria? [3]

Ans. Normal cells get transformed into cancerous neoplastic cells due to the effect of carcinogens.

Carcinogenic agents could be physical, chemical or biological agents that changes the normal sequence of DNA. They are:

- Ionising radiations like X-rays and gamma rays
- Non-ionizing radiations like UV.
- Chemical carcinogens present in tobacco smoke
- Cellular oncogenes (c-onc) or proto-oncogenes, when activated under certain conditions cause cancer. Viruses with oncogenes can transform normal cells to cancerous cells.

OR

Typhoid which is caused by *Salmonella typhi* and transmitted through contaminated food and water. The person suffering from typhoid has sustained high fever (39° to 40°C), weakness, stomach pain, constipation, headache and loss of appetite.

Pneumonia is caused by *Diplococcus pneumonia* and spread through droplet infection. The person suffering from pneumonia has fever, chills, cough and headache; and the lips and fingernails turn gray to bluish.

Malaria is transmitted by the bite of female anopheles mosquito and is caused by *Plasmodium*. The person suffering from malaria has chills and high fever recurring every three to four days.

8. Recognition of an antigenic protein of a pathogen or exposure to a pathogen occurs during many types of immune responses, including active immunity and induced active immunity.

Specify the types of responses elicited when human beings get encountered by a pathogen. [3]

Ans. When our body encounters an antigenic protein or a pathogen for the first time it produces a response which is of low intensity and our body retains memory of the first encounter.

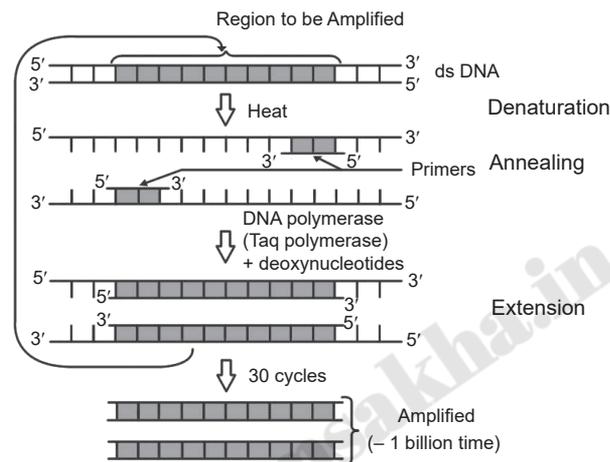
- The subsequent encounter with the same pathogen elicits a highly intensified response called as anamnestic response and is carried out with the help of two special types of lymphocytes present in our blood, B lymphocytes, and T-lymphocytes.
- The B-lymphocytes produce an army of proteins in response to these pathogens into our blood to fight with them. These proteins are called antibodies. Antibodies are specific against specific pathogens. The T-cells themselves do not secrete antibodies but help B-cells produce them and also play an important role in graft rejection.

9. In a pathological lab, a series of steps were undertaken for finding the gene of interest. Describe the steps, or make a flow chart showing the process of amplification of this gene of interest. [3]

Ans. PCR is the technique of amplification of small fragment of DNA. The technique was developed by Kary Mullis in the 1980s.

The flow chart shows the three steps involved in the process of PCR showing below:

- Denaturation:** The DNA strands are treated with a temperature of 94°C (Heat) which results in denaturation of DNA caused due to break down of hydrogen bonds which separates double-stranded DNA to single-stranded DNA. The temperature at which 50% of the dsDNA is denatured is known as the melting temperature (T_m) and is determined by G + C content, the length of the sample, and the concentration of ions (Mg^{2+}).
- Annealing:** The primers are added which get anneal to the complementary strands and provides the site of attachment of DNA polymerase. During this step, the sample is cooled to 40–60°C.
- Extension:** The DNA polymerase (Taq DNA polymerase) facilitates the extension of both the strands of DNA resulting in millions of copies in few cycles. This final step occurs at 70–75°C. At this temperature taq polymerase can synthesize and elongate the target DNA quickly and accurately.



10. (a) 'The Evil Quartet' describes the rates of species extinction due to human activities. Explain how the population of organisms is affected by fragmentation of the habitats.
- (b) Introduction of alien species has led to environmental damage and decline of indigenous species. Give any one example of how it has affected the indigenous species?
- (c) Could the extinction of Steller's sea cow and passenger pigeon be saved by man? Give reasons to support your answer. [3]

Ans. (a) The Evil Quartet is the concept which explains the reasons which cause a decrease in the number of species. The reasons are overexploitation, loss of habitat, introduction of the exotic species and co-extinction of species.

When a large habitat is broken into small fragments due to various activities, mammals and birds requiring large territories and certain animals with migratory habitats are badly affected, leading to population decline.

- (b) Invasive alien species are plants, animals that are non-native to an ecosystem, may cause environmental harm or may pose an adverse impact upon biodiversity, including decline or elimination of native species - through competition, predation, or transmission of pathogens and the disruption of local ecosystems and ecosystem functions.

E.g., Nile perch introduced in lake Victoria eventually led to the extinction of an ecologically unique assemblage of more than 200 species of cichlid fish. Parthenium/Lantana/water hyacinth caused environmental damage and threat to our native species. African catfish-*Clarias gariepinus* introduced for aquaculture purposes is posing a threat to the indigenous catfishes in our rivers.

- (c) Yes; the extinction of Steller's sea cow and passenger pigeon could be saved by man. Humans have overexploited natural resources for their 'greed' rather than 'need' leading to extinction of these animals. Sustainable harvesting could have prevented extinction of these species.

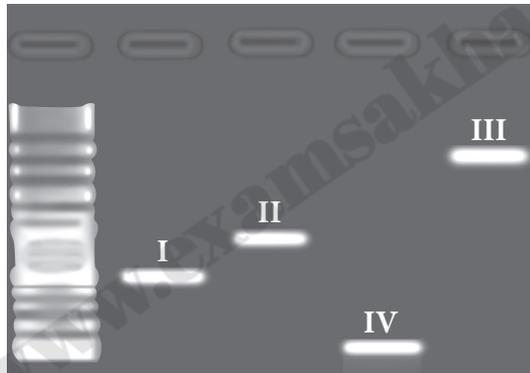
11. (a) The image shown below is of a sacred grove found in India. Explain how has human involvement helped in the preservation of these biodiversity rich regions.



- (b) Value of Z (regression coefficient) is considered for measuring the species richness of an area. If the value of Z is 0.7 for area A, and 0.15 for area B, which area has higher species richness and a steeper slope?

- Ans.** (a) India's history of religious and cultural traditions emphasized the protection of nature. In many cultures, tracts of forest are set aside, all the trees and wildlife within are venerated and given total protection. Sacred groves in many states are the last refuges for a large number of rare and threatened plants.
- (b) The value of regression coefficient is 0.7 for area A and thus Area A will have more species richness and a steeper slope. [3]

12. The image below depicts the result of gel electrophoresis



If the ladder represents sequence length upto 3000 base pairs (bp),

- (a) Which of the bands (I - IV) correspond to 2500 bp and 100 bp respectively?
- (b) Explain the basis of this kind of separation and also mention the significance of this process. [3]
- Ans.** (a) The maximum length of ladder of gel shown is 3000 bp. Band III corresponds to 2500 base pairs, and Band IV corresponds to 100bp.
- (b) The fragments will resolve according to their size. The shorter sequence fragments would move farthest from well as seen in Band IV (100 bp) which is lighter as compared to Band III which is heavier being 2500 base pairs.
- The significance of electrophoresis is to purify the DNA fragments for use in constructing recombinant DNA by joining them with cloning vectors.

SECTION - C

13. Some restriction enzymes break a phosphodiester bond on both the DNA strands, such that only one end of each molecule is cut and these ends have regions of single stranded DNA. BamH1 is one such restriction enzyme which binds at the recognition sequence, 5'-GGATCC-3' and cleaves these sequences just after the 5'- guanine on each strand.

- (a) What is the objective of this action?
 (b) Explain how the gene of interest is introduced into a vector.
 (c) You are given the DNA shown below.

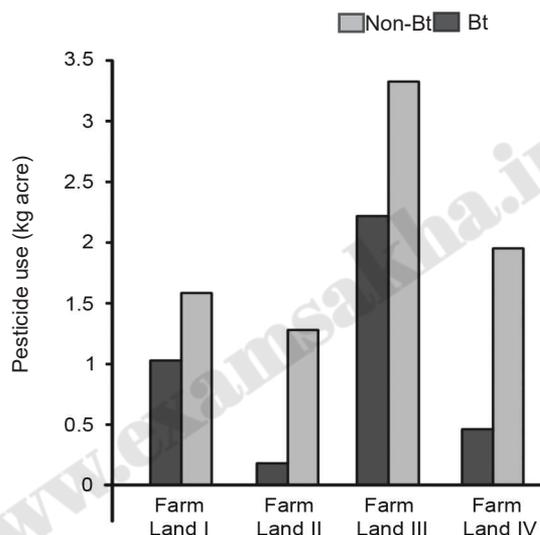
5' ATTTTGAGGATCCGTAATGTCCT 3'
 3' TAAAACTCCTAGGCATTACAGGA 5'

If this DNA was cut with BamHI, how many DNA fragments would you expect? Write the sequence of these double-stranded DNA fragments with their respective polarity.

- (d) A gene M was introduced into *E.coli* cloning vector pBR322 at BamHI site. What will be its impact on the recombinant plasmids? Give a possible way by which you could differentiate non recombinant to recombinant plasmids. [5]

OR

GM crops especially Bt crops are known to have higher resistance to pest attacks. To substantiate this, an experimental study was conducted in 4 different farmlands growing Bt and non Bt-Cotton crops. The farm lands had the same dimensions, fertility and were under similar climatic conditions. The histogram below shows the usage of pesticides on Bt crops and non-Bt crops in these farm lands.



- (a) Which of the above 4 farm lands has successfully applied the concepts of biotechnology to show better management practices and use of agrochemicals? If you had to cultivate, which crop would you prefer (Bt or non- Bt) and why?
 (b) Cotton bollworms were introduced in another experimental study on the above farm lands wherein no pesticide was used. Explain what effect would a Bt and non Bt crop have on the pest.

Ans. (a) The two different DNA molecules will have compatible ends to recombine when cut with same restriction enzymes.

- (b) Restriction enzyme cuts the DNA of the vector and then ligates the gene of interest into the DNA of the vector.

- (c) 2 fragments

5' ATTTTGAG 3' 5'GATCCGTAATGTCCT 3'
 3' TAAAACTCCTAG 5' 3'GCATTACAGGA 5'

- (d) BamHI site will affect tetracycline antibiotic resistance gene, hence the recombinant plasmids will lose tetracycline resistance due to inactivation of the resistance gene.

Recombinants can be selected from non-recombinants by plating into a medium containing tetracycline, as the recombinants will not grow in the medium because the tetracycline resistance gene is cut and non-recombinants will grow in medium containing tetracycline.

OR

- (a) Farm land II requires less application of pesticide.

I would prefer Bt crop as it involves no application of fertilizers and pesticides and shows more yield when compared to non Bt crop.

Because the use of pesticides is highly reduced for Bt crop. Decrease of pesticide used is also more significant for Bt crop.

- (b) In Bt cotton a cry gene has been introduced from bacterium *Bacillus thuringiensis* (Bt) which causes synthesis of a toxic protein. This protein becomes active in the alkaline gut of bollworm feeding on cotton, punching holes in the lining of the gut, causing death of the insect. However; a non-Bt crop will have no effect on the cotton bollworm and the yield of cotton will decrease, non-Bt will succumb to pest attack.

□□



Sample Paper

1

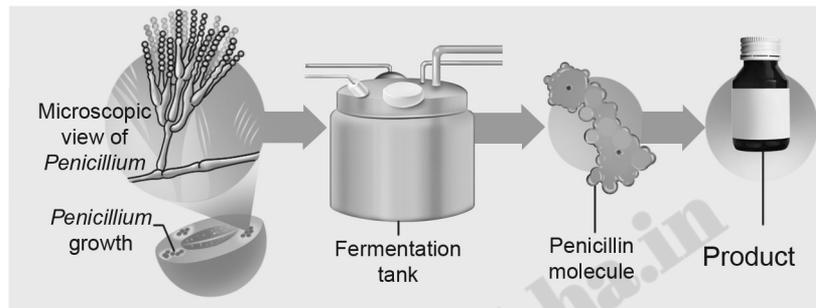
Biology

Section - A

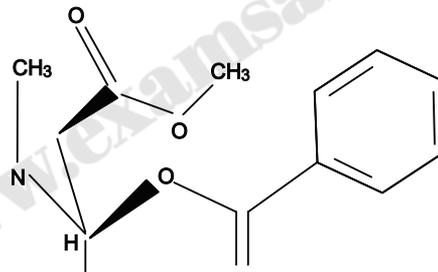
1. 'Prevention is better than cure' is an appropriate slogan to safeguard adolescents from drug abuse. List any six steps that could be taken in this regard?
2. Trying a particular drug even once may lead to addiction and complications. How should a youth under the influence of peer pressure to try a particular drug, be explained and convinced never to try a drug.

OR

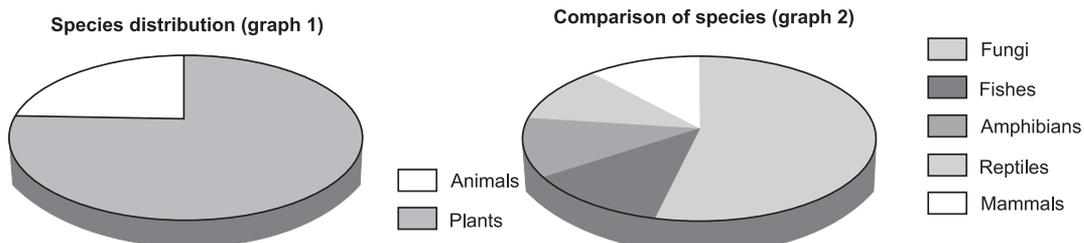
Study the figure below and Identify the nature of product produced:



3. Analyse the below given chemical structure and answer the questions based on it:



- (i) The given structure is of which chemical?
 - (ii) What is the common name of this chemical?
 - (iii) What are the physical attributes of this chemical?
 - (iv) This chemical is obtained from which plant?
4. Most living organisms cannot survive at the temperature above 45° C. How are some microbes able to live in habitats with temperatures exceeding 100° C?
 5. Apart from being the part of the food chain, predators play other important roles. Mention any two such roles supported by the examples.
 6. Analyse the following given pie chart and answer the questions based on it.



- (i) What conclusion can be derived from graph 1?
- (ii) What does graph 2 say?
- (iii) What is the ratio of fungi to the animals?

OR

Ecology at the organisms level is essentially physiological ecology which tries to understand how different organisms are adapted to their environments in terms of not only survival but also reproduction. The rotation of our planet around the Sun and the tilt of its axis cause annual variations in the intensity and duration of temperature, resulting in distinct seasons.

Give major abiotic factors governing the ecology and explain in short about temperature as a factor.

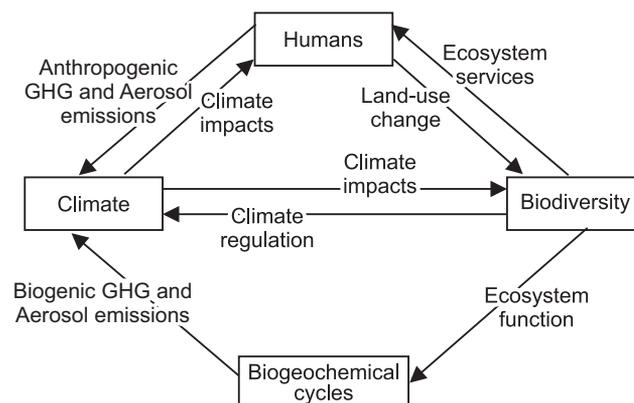
Section - B

7. Cancer is one of the most dreaded diseases of humans. Explain 'Contact inhibition' and 'Metastasis' with respect to disease. Name the groups of genes which have been identified in the normal cells that could lead to cancer and how they do so? Name any two techniques which are useful to detect cancers of internal organs. Why are cancer patients often given alpha interferon as part of the treatment?

OR

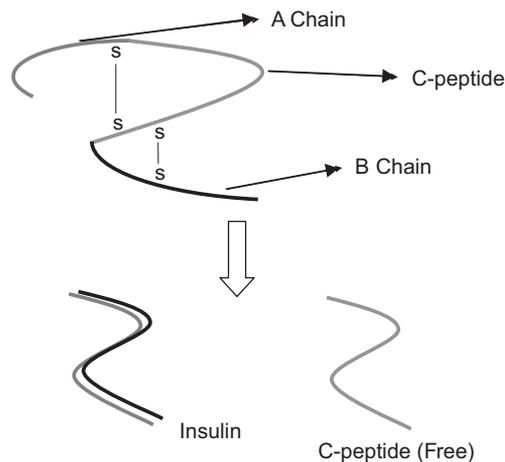
A woman was tested positive for AIDS. Name the pathogen that infected her. How does this pathogen weaken her immune system? Explain.

8. During a school trip to 'Rohtang Pass', one of your classmates suddenly developed 'altitude sickness'. But, she recovered after sometime.
 - (i) Mention one symptom to diagnose the sickness.
 - (ii) What caused the sickness?
 - (iii) How could she recover by herself after some time ?
9. A and B are the two different cloning vectors in two different bacterial colonies cultured in a chromogenic substrate. Bacteria with cloning vector A were colourless whereas, those with B were blue coloured. Explain giving reasons the cause of the difference in colour that appeared.
10. Some organisms suspend their metabolic activities to survive in unfavourable conditions. Explain with the help of any four examples.
11. Given below is a schematic representation. Analyse and answer the questions asked on the basis of it:



- (i) What does the graph show about?
- (ii) What is the importance of biodiversity as according to the graph?
- (iii) Do you think that climate has an adverse impact on biodiversity as according to the graph?

12. Analyse the diagram given below and answer the questions based on it:



- What does the above diagram represent?
- What does the insulin contain?
- What is the use of C-peptide in the diabetic patients?
- How is insulin formed?

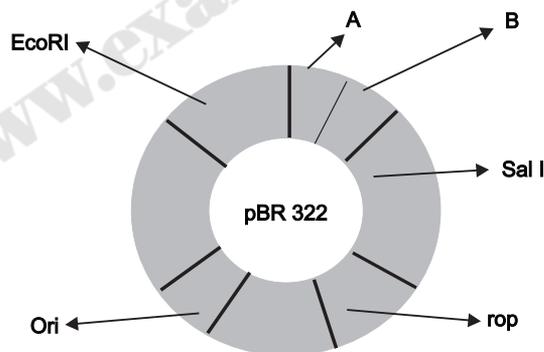
Section - C

13. Genetic engineering, also called recombinant DNA technology, involves the group of techniques used to cut up and join together genetic material, especially DNA from different biological species, and to introduce the resulting hybrid DNA into an organism in order to form new combinations of heritable genetic material.

With advancement in genetics, molecular biology and tissue culture, new traits have been incorporated into crop plants. Explain the main steps in breeding a new genetic variety of crop.

OR

Analyse the diagram given below and answer the questions based upon it:



- What does the above given diagram represent?
- In the diagram, what do A and B stand for?
- What does the rop code for?
- Is ori important? If we want to have many copies of target DNA, what should we do?



Sample Paper

2

Biology

Section - A

1. A bioreactor is important for commercial production of certain products. Explain.
2. A patient showed symptoms of constipation, abdominal pain and stools with excess mucous and blood clots. Name the disease and its pathogen. Where do these pathogens live in the patient's body? Name the mechanical carrier that transmits the parasite.

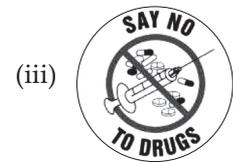
OR

"Growing *spirulina* on a large scale is beneficial both environmentally and nutritionally for humans." Justify.

3. There are certain pictures shown below. According to your sense, identify the picture which fits into the group that justifies the theme:

Theme: Awareness generation about alcoholism

Options:



4. Pollinating species of wasp shows mutualism with specific fig plants. Mention the benefits the female wasps derive from the fig trees from such an interaction.
5. Plants that inhabit a rain forest are not found in a wetland. Explain.
6. Temperature is the most important abiotic factor that governs the environment. Explain.

OR

An exotic variety of Prickly pear introduced in Australia turned out to be intensive. How was it brought under control?

Section - B

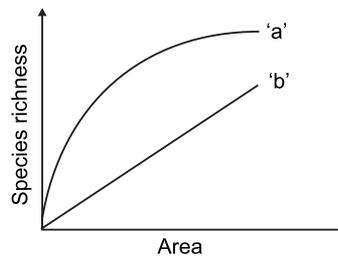
7. Principle of vaccination is based on the property of "memory" of the immune system. Taking one suitable example, justify the statement.

OR

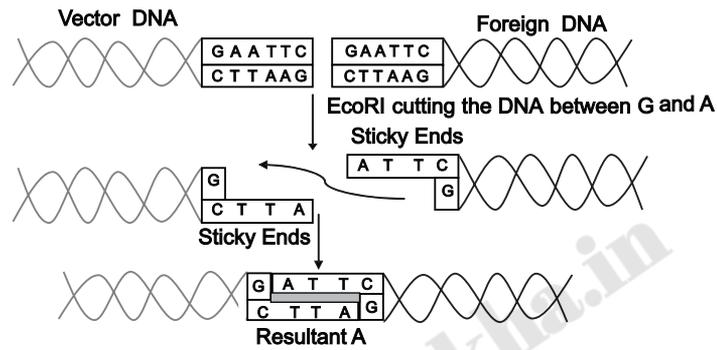
Bacteria cannot be seen with the naked eyes, but these can be seen with the help of a microscope. If you have to carry a sample from your home to your biology laboratory to demonstrate the presence of microbes under a microscope, which sample would you carry and why?

8. During a fire in an auditorium, a large number of assembled guests got burnt beyond recognition. Suggest and describe a modern technique that can help to hand over the dead bodies to their relatives.
9. Bt-toxins are released as inactive crystals in the bacterial body. What happens to it in the cotton boll worm body that it kills the boll worm?
10. The species diversity of plants (22 percent) is much less than that of animals (72 percent). What could be the explanation to how animals achieved greater diversification?
11. The graph given below shows the species-area relationship. Answer the following question as directed:
 - (i) Name the naturalist who studied the kind of relationship shown in the graph. Write the observation made by him?

- (ii) Write the situations as discovered by ecologists when the value of 'Z' (slope of line(s)) lies between
 (a) 0.1 and 0.2 (b) 0.6 and 1.2
 (iii) When would the slope of the line 'b' become steeper?



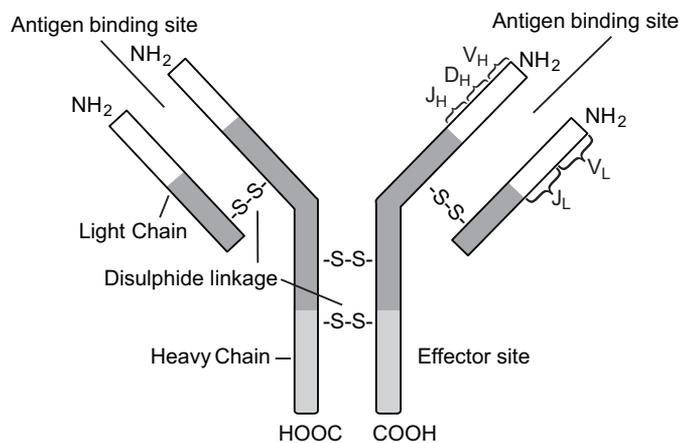
12. EcoRI is used to cut a segment of foreign DNA and that of a vector DNA to form a recombinant DNA. Show with the help of schematic diagrams and answer the following questions.



- (i) After the entire process shown in the above diagram, what is resultant A?
 (ii) EcoRI cuts the DNA between the bases. What does EcoRI stand for?
 (iii) What are sticky ends?

Section - C

13. Analyse the diagram given below and answer the questions based on it.
 (i) Why is an antibody designated as H_2L_2 ?
 (ii) What is humoral immune response?
 (iii) Give the functions of IgA, IgM, IgE and IgG.



OR



Nitrogen fixation occurs in nodules on legume roots.

Which of the Nitrogen fixer is involved in symbiotic association with legumes forming root nodules shown in the above figure?

□□



Sample Paper

3

Biology

Section - A

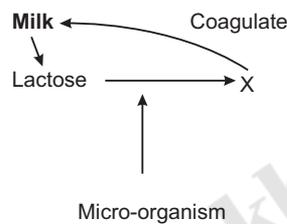
1. Person showing the withdrawal symptoms needs medical supervision. Explain.
2. Infectious diseases are disorders caused by organisms such as bacteria, viruses, fungi or parasites. Many organisms live in and on our bodies. They're normally harmless or even helpful. But under certain conditions, some organisms may cause diseases. What are the various public health measures, which you would suggest as safeguard against infectious diseases?

OR

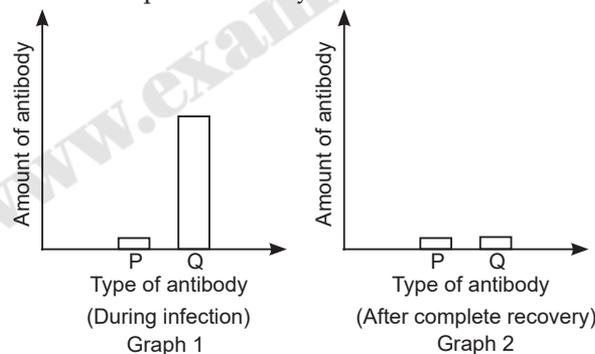
The diagram depicts the process of making yogurt at home.

Identify X, and the microorganism used in this process:

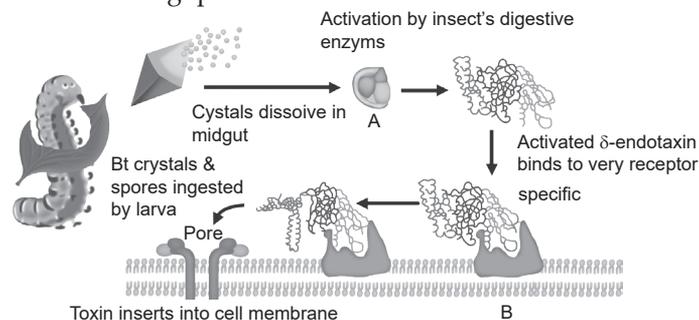
Yogurt making



3. The given graphs show the amount of different antibodies P and Q in the blood of a person during a pathogenic infection and after complete recovery.



- (i) What could be inferred from the given graphs?
 - (ii) Why is the level of Antibody P same in both the graphs?
4. The figure below shows the mode of action of *Bacillus thuringiensis* against X larvae. Study the figure below and answer the following questions:



- (i) The Bt toxin does not kill the *Bacillus* because the Bt toxin protein exists as inactive A. Identify A.
 (ii) To which cells (marked B) does the activated Bt toxin bind?

5. Cattle egret remains close to the cattle. Explain.
 6. "In a food-chain, a trophic level represents a functional level, not a species." Explain.

OR

Alien species are highly invasive and are threat to indigenous species. Substantiate this statement with any three examples.

Section - B

7. Antibody, also called immunoglobulin, is a protective protein produced by the immune system in response to the presence of a foreign substance, called an antigen. Antibodies recognize and latch onto antigens in order to remove them from the body. A wide range of substances are regarded by the body as antigens, including disease-causing organisms and toxic materials such as insect venom. Explain antibodies and describe about its structure. Where these antibodies are found in human body?

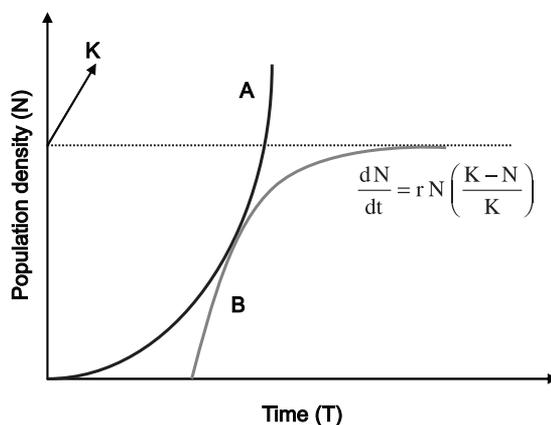
OR

Tumours are groups of abnormal cells that form lumps or growths. They can start in any one of the trillions of cells in our bodies. Tumours grow and behave differently, depending on whether they are cancerous (malignant), non-cancerous (benign) or precancerous. There are several types of tumours that get converted into cancer in later stage. Enlist any three causes of cancer that get induced in the human body.

8. The exaggerated response of the immune system to certain antigens present in the environment is called allergy. The substances to which such an immune response is produced are called allergens. The antibodies produced to these are of IgE type. Common examples of allergens are mites in dust, pollens, animal dander, etc. Symptoms of allergic reactions include sneezing, watery eyes, running nose and difficulty in breathing.

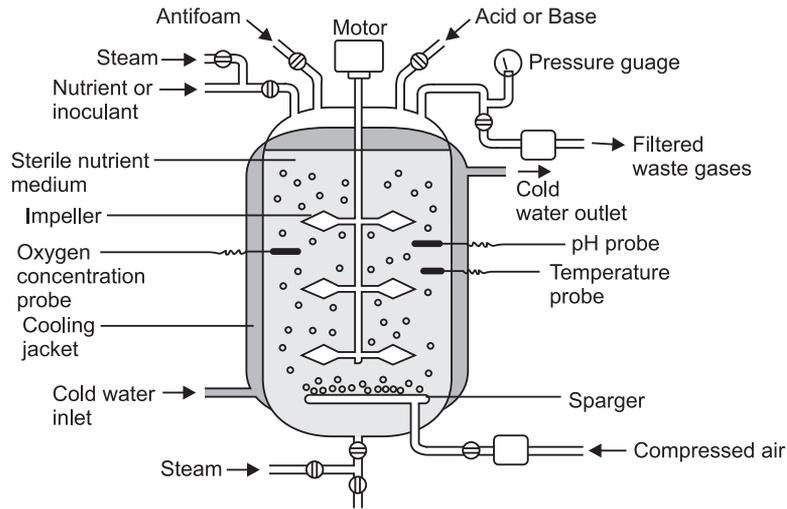
How is an allergic reaction caused by an allergen? Name a drug that can reduce the symptom of allergy.

9. β -galactosidase enzyme is considered a better selectable marker. Justify the statement.
 10. A corn farmer has perennial problem of corn-borer infestation in his crop. Being environmentally conscious he does not want to spray insecticides. Suggest solution based on your knowledge of biotechnology. Write the steps to be carried out to achieve it.
 11. Analyse the graph given below and answer the questions based on it?



12. Study the diagram given below and answer the questions asked in relation with it?
 (i) What role does the acid-base inlet play?

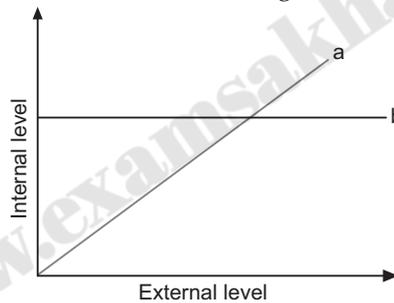
(ii) Name another type of bioreactor used commercially?



Section - C

13. Analyse the graph given below and answer the questions based upon it:

- (i) In what reference is the graph given above?
- (ii) What do 'a' and 'b' represent in the graph?
- (iii) What are the two regulatory mechanisms that are followed by the organisms to maintain homeostasis?
- (iv) Why tiny organisms are not found in the Polar Regions?



OR

There are many animals that have become extinct in the wild but continue to maintain in zoological parks.

- (i) What type of biodiversity conservation is observed in this case?
- (ii) Explain any two ways which help in this type of conservation.





Sample Paper

4

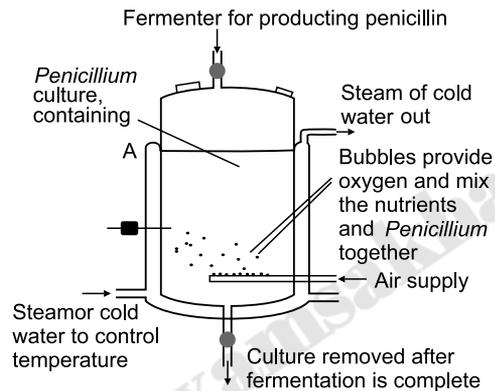
Biology

Section - A

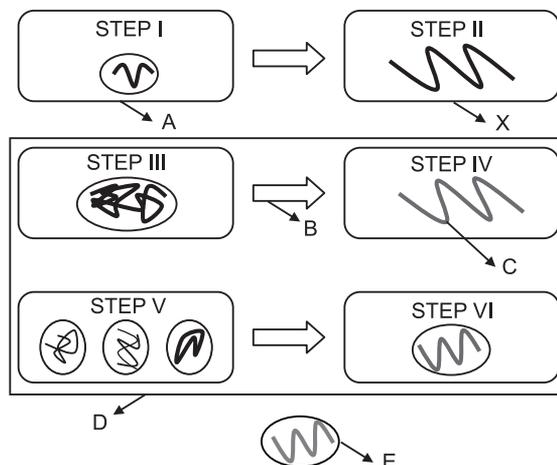
1. Neutrophils and macrophages are called the soldiers and scavengers of animal body. Why?
2. A tumour is an abnormal growth of cells that serves no purpose. They can start in any one of the trillions of cells in our bodies. Tumours grow and behave differently, depending on whether they are cancerous (malignant), non-cancerous (benign) or precancerous. Differentiate between benign and malignant tumours.

OR

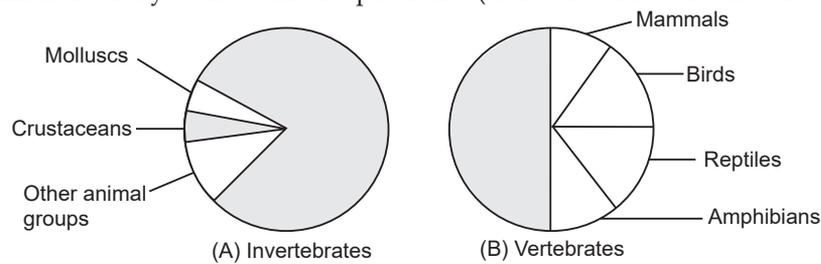
The figure below shows the production of antibiotic penicillin, identify the content A required for fermentation. Also identify the mould discovered by Alexander Fleming.



3. Study the diagram showing the replication of HIV in humans and answer the following questions accordingly:
 - (i) Write the chemical nature of coat 'A'.
 - (ii) Name the enzyme 'B' acting on 'X' to produce molecule 'C'. Name 'C'.
 - (iii) Mention the name of the host cell 'D' the HIV attacks first when it enters into the human body.
 - (iv) Name the two different cells where the new virus 'E' subsequently attack.



4. The global animal diversity is shown in the pie charts (A-Invertebrates and B-Vertebrates) drawn below:



- Identify the animal groups that are represented by the areas shaded black in A and B, respectively.
 - Of all the animal species recorded, what percent do insects comprise of?
5. An exotic variety of Prickly pear introduced in Australia turned out to be intensive. How was it brought under control?
6. Different animals respond to changes in their surroundings in different ways. Taking one example each, explain "some animals undergo aestivation while some undergo hibernation". How do fungi respond to adverse climatic conditions?

OR

India is the seventh largest country in the world and Asia's second largest nation, encompassing a varied landscape rich in natural resources. India has a great diversity of natural ecosystems from the cold and high Himalayan ranges to the sea coasts, from the wet north eastern green forests to the dry north western arid deserts, different types of forests, wetlands, islands and the oceans.

- Genetically different population with the same physical features is known as
- Xerocoles are:

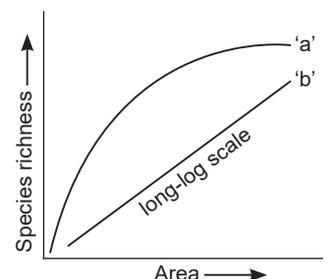
Section - B

7. A sedative or tranquilliser is a substance that induces sedation by reducing irritability or excitement. They are central nervous depressants and interact with brain activity causing its deceleration. Various kinds of sedatives can be distinguished, but the majority of them affect the neurotransmitters, for example, morphine. Morphine is used as a sedative as well as a pain killer drug. Give an account on various uses of Morphine. What are the precautionary measures before using this drug? What are the side effects of this kind of drug?

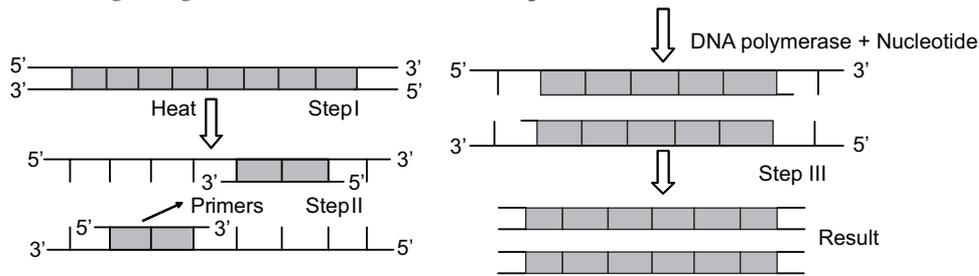
OR

In which way has the study of biology helped us to control infectious disease?

8. Bacteria cannot be seen with the naked eyes, but these can be seen with the help of a microscope. If you have to carry a sample from your home to your biology laboratory to demonstrate the presence of microbes under a microscope, which sample would you carry and why?
9. PCR (Polymerase Chain Reaction): It is the revolutionary method developed by Kary Mullis in the 1980s. PCR is based on using the ability of DNA polymerase to synthesise new strand of DNA complementary to the offered template strand. Because DNA polymerase can add a nucleotide only onto a pre-existing 3'-OH group, it needs a primer to which it can add the first nucleotide.
- Primer used for the process of polymerase chain reaction are:
 - Polymerase used for PCR is extracted from:
 - How many DNA duplex are obtained from one DNA duplex after 4 cycles of PCR?
10. Water is very essential for life. Write any three features both of plants and animals which enable them to survive in water scarce environment.
11. The graph given alongside shows the species area relationship. Study the graph and answer the following questions:
- Name the naturalist who showed this kind of relationship.
 - Name the region he explored.
 - Identify the situation when Z values are in the range of 0.6 to 1.2.



12. Analyse the diagram given below and answer the questions based on it:



- What does the above diagrammatic representation concern about?
- The diagram shows Step I, Step II and Step III. What are those?
- What is the result at the end of the above process?
- What are primers?

Section - C

13. Management of adult-onset diabetes is possible by taking insulin at regular time intervals. If a bacterium were available that could make human insulin, the whole process becomes so simple. Insulin used for diabetes was earlier extracted from pancreas of slaughtered cattle and pigs. Insulin from an animal source though caused some patients to develop allergy or other types of reactions to the foreign protein. Insulin consists of two short polypeptide Chains: Chain A and Chain B that are linked together by disulphide bridges.

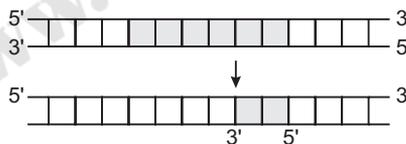
Explain the various steps involved in the production of artificial insulin.

OR

The figure below depicts the result of blue-white screening in using lac Z as selectable marker.

Answer the following in reference to the figure :

- What is X-gal?
- Lac Z codes for which enzyme?
- What is the colour of the product of X-gal conversion in presence of functional lac Z?
- What is the technique of inserting DNA in lac Z gene known as?
- Name a selectable marker used for screening in yeast cell.





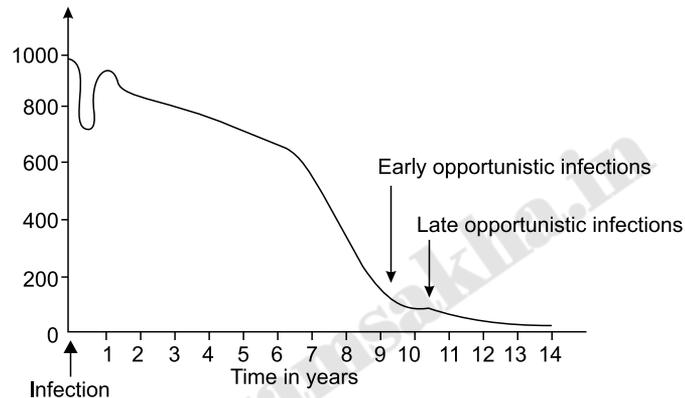
Sample Paper

5

Biology

Section - A

1. The Green Revolution succeeded in tripling the food supply but yet it was not enough to feed the growing human population. Increased yields have partly been due to the use of improved crop varieties, but mainly due to the use of better management practices and use of agro chemicals (fertilizers and pesticides). However, for farmers in the developing world, agrochemicals are often too expensive, and further increases in yield with existing varieties are not possible using conventional breeding.
What are the advantages and disadvantages of green revolution?
2. The graph in figure below shows how the number of X cells typically declines over a period of many years following the initial HIV infection. Study the graph below and answer the following questions:

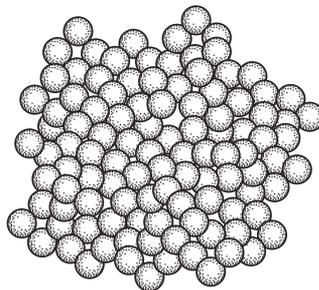


- (i) Name the cells X?
- (ii) Why there is a decline in number of cell X with time?

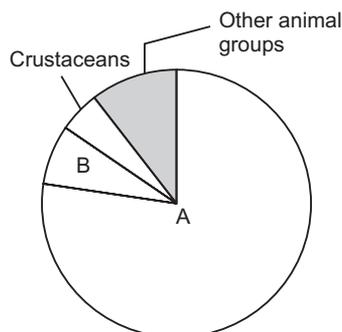
OR

Biogas is produced by anaerobic digestion with methanogens or anaerobic organisms, who digest material inside a closed system, or perform fermentation of biodegradable materials. This closed system is called an anaerobic digester, bio-digester or a bioreactor. Proper use of waste material can be achieved through biogas. The complex material is digested and is acted upon by several methanogenic bacteria.

- (i) Write about the microbial activity during production of a biogas.
 - (ii) Enlist any four advantages of it.
3. The bacteria below would best be described as a/an:



4. Identify the group A and B in the following pie diagram which represents the proportionate number of species of major groups of invertebrata.



5. In our biosphere immense diversity (or heterogeneity) exists not only at the species level but at all levels of biological organisation ranging from macromolecules within cells to biomes. Biodiversity is the term popularised by the sociobiologist Edward Wilson to describe the combined diversity at all the levels of biological organisation. Give an account of causes behind the loss of biodiversity and write a note on habitat loss and fragmentation.
6. The plant produces highly poisonous cardiac glycosides and that is why we usually do not see any cattle or goats browsing on this plant. Give two reasons as to why a weed such a *Calotropis* flourishes in abandoned fields.

OR

Populations rarely grow smoothly up to the carrying capacity and then remain there. Instead, fluctuations in population numbers, abundance, or density from one time step to the next are the norm. Which processes are responsible for the fluctuations of population density within the community ?

Section - B

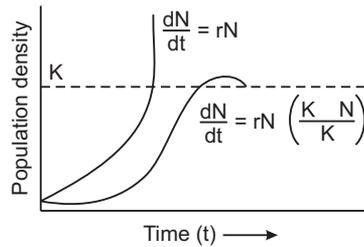
7. Cells when start to grow in an unruly manner may develop into a mass which eventually develops into cancer .Till so far we have identified more than 100 different types of cancer. It can develop almost anywhere in the body. Commonly these different types of cancers are named on the basis of their origin . For example, Cancer that develops in lungs is lung cancer and if develops in skin then it is called as skin cancer. It may remain confined to one place or may get dislodged. Symptoms and treatment depend on the type of cancer.
 - (i) Visual examination of Cancer is indicated by __ (a) __ and definitive diagnose is done by __ (b) __:
 - (ii) How the cancerous cells spread to the distant site?
 - (iii) Medical term for the cancerous state of blood is:

OR

What makes some viruses cause cancer in humans? How does benign tumour turn malignant? How does the latter harm the human body?

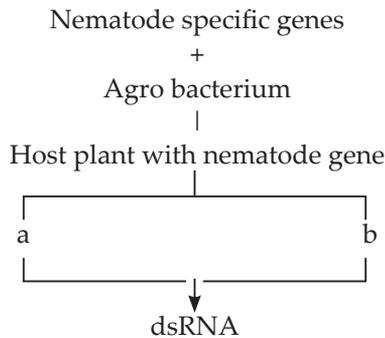
8. **Bioreactor:** A bioreactor is a vessel in which a biological reaction or change takes place. The biological systems involved include enzymes, microorganisms, animal cells, plant cells, and tissues.
 - (i) A culture system with constant environmental conditions maintained through continual provision of nutrient and removal of wastes is called _____ culture system.
 - (ii) For thorough mixing of medium and inoculum the part of fermenter useful is:
 - (iii) In agarose gel electrophoresis, DNA molecules are separated on the basis of their:
9. Tobacco plants are damaged severely when infested with *Meloidogyne incognita*. Name and explain the strategy that is adopted to stop this infestation. Name the vector used for introducing the nematode specific gene in the tobacco plant.
10. Edward Wilson described diversity at all levels of biological organisation ranging from macromolecules inside the cells to biomes. It is of three inter-related hierarchical levels-genetic diversity, species diversity and community ecosystem diversity. Species diversity is the variety in the number and richness of the species of a region. For example, the Western ghats have a greater amphibian species diversity than the Eastern ghats.
 - (i) The number of species per unit area is called:
 - (ii) What is the significance of species diversity?
 - (iii) How will increasing species diversity affect ecosystem?

11.



Observe the above graph and answer what for the letter N, r, k stand in the typical Verhulst-Pearl population growth curve.

12. The nematode infects the roots of tobacco plants and causes a reduction in yield. A unique strategy based was designed by Fire and Mello in 1998. This method involves silencing of a specific mRNA. Study the flow chart below and answer the following questions:

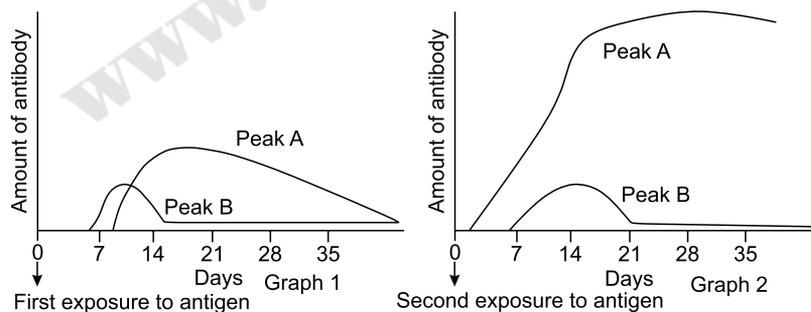


- (i) Specify a and b in the chart.
- (ii) The process of RNA inactivation by siRNAs is termed as _____
- (iii) Which nematode infects the roots of tobacco plants?

Section - C

13. The graph shows the level of antibody in serum following vaccination and a challenge with the same antigen 28 days later.

Study the graphs below and answer the following questions:



- (i) Which of the following graphs depicts primary immune response?
- (ii) What does peak A represents?
- (iii) In reference to the graph above, which graph 1 or 2 represent secondary response?

OR

Microorganisms include bacteria, fungi, protozoa, some algae, viruses, viroids and also prions. Microorganisms may be single-celled like bacteria, some algae and protozoa, or multicellular, such as algae and fungi. They are very useful and can be used for different purposes in day to day activities of the humans. Choose any three microbes, from the following which are suited for organic farming which is in great demand these days for various reasons. Mention one application of each one chosen. *Mycorrhiza; Monascus; Anabaena; Rhizobium; Methanobacterium; Trichoderma.*



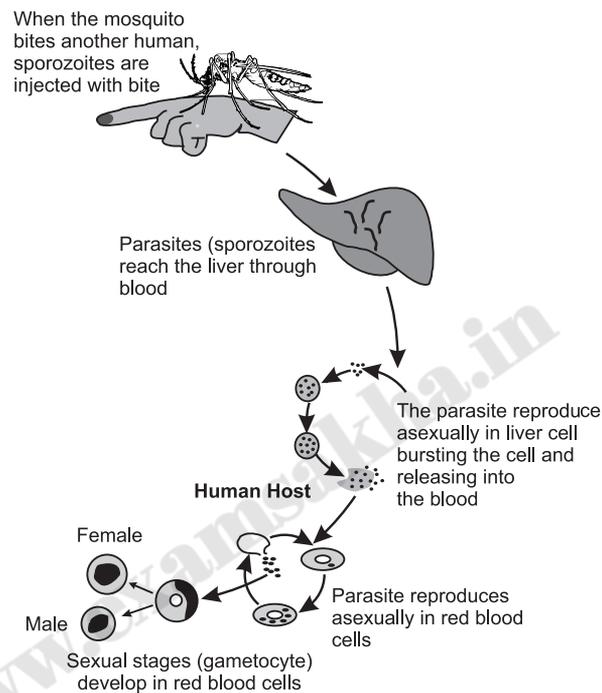
Sample Paper

6

Biology

Section - A

1. HIV (human immunodeficiency virus) is a virus that attacks the body's immune system. If HIV is not treated, it can lead to AIDS (acquired immunodeficiency syndrome). Learning the basics about HIV can keep you healthy and prevent HIV transmission. How does HIV differ from a bacteriophage?
- 2.

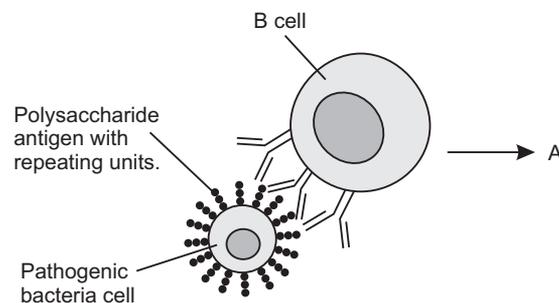


Write the scientific names of the causative agent and vector of above disease and write its symptoms.

OR

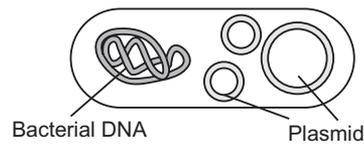
Biogas is produced by anaerobic digestion with methanogens or anaerobic organisms, which digest material inside a closed system, or perform fermentation of biodegradable materials. How does methanogen help in producing biogas?

- 3.



The B-lymphocytes produce an army of proteins in response to pathogens into our blood to fight with them. These proteins are called A. Refer to the figure below and identify what is "A"?

4. The given below diagram is naturally occurring in?



5. When organisms interact with the various environmental factors, be it the abiotic components or the biotic components, there comes a time when adaptations begin to form, for the better survival of the race. Substantiate with the help of one example that in an ecosystem mutualists:

- tend to co-evolve and
 - are also one of the major causes of biodiversity loss.
6. Explain the birth rate and death rate in the population with the help of an example. What is age pyramid?

OR

How is diapause different from hibernation?

Section - B

7. Cancer is one of the most feared diseases in the world and it affects over 11 lakh people every year in India alone. Worldwide, more than 10 million people succumb to this disease every year.

- Name the cancer that starts in the skin or the tissues that line other organs?
- Name the cancer that occurs in bone marrow and creates blood cells?
- The most common types of treatment of cancer are:

OR

Secondary treatment of the sewage is also called Biological treatment. Justify this statement and explain the process.

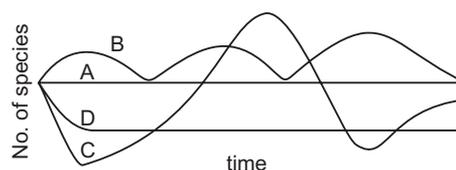
8. Adolescence is the period of dramatic physical and psychological changes in a person. An adolescent person is at high risk of falling in the trap of drug or alcohol abuse.

- Nicotine acts as a stimulant because it mimics the effect of:
- Continuous use of alcohol causes:
- Tobacco inhalation causes:

9. The bioreactor is a place where an optimum external environment is provided to meet the needs of the biological reaction system so that a high yield of the bio-process is achieved. Besides better aeration and mixing properties, what other advantages do stirred tank bioreactors have over shake flasks?

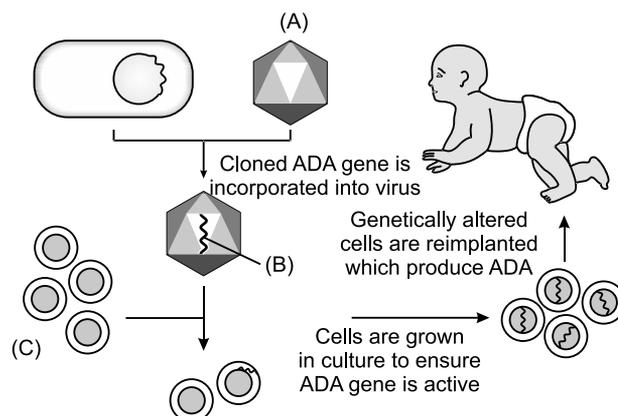
10. A transgenic animal is one whose genome has been altered by the transfer of a gene or genes from another species or breed.

- What are the method of transfection for making transgenic animals?
 - DNA microinjection into the egg has been used to produce which of the transgenic animals?
 - Transgenic goats produce a variant of human tissue type plasminogen activator protein in:
11. (i) The given graph represents the environment in the graph. Which from the graph would you expect to have experienced the greatest amount of change?



- Give various methodologies for conserving biodiversity.

12.



- (i) In gene therapy for the ADA deficient patients the type of vector "A" is used here to incorporate "B" into "C" type of cells. Identify A, B and C.
- (ii) Mention the cause and the body system affected by ADA deficiency in humans. Name the vectors used for transferring ADA-DNA into the recipient cell in humans. Name the recipient cell.

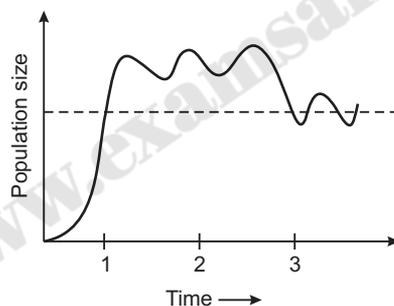
Section - C

13. The biological wealth of our planet has been declining rapidly and the accusing finger is clearly pointing to human activities. The colonisation of tropical Pacific Islands by humans is said to have led to the extinction of more than 2,000 species of native birds. The IUCN Red List (2004) documents the extinction of 784 species (including 338 vertebrates, 359 invertebrates and 87 plants) in the last 500 years.

'In-situ' conservation can help endangered or threatened species. Justify the statement.

What are the causes of biodiversity loss?

OR



- (i) What is the reason for the difference in population size between time 2 and time 3? The population size of a species over time is shown in the graph.
- (ii) What is the growth pattern demonstrated by population at time 1 of population size of a species over time is shown in the graph.
- (iii) Explain in brief logistic growth model using universal equation.

□□



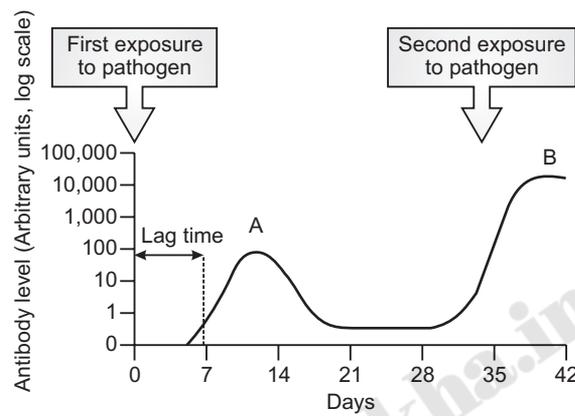
Sample Paper

7

Biology

Section - A

1. After getting vaccinated, you develop immunity to that disease, without having to get the disease first. How does a vaccine for a particular disease immunise the body against that disease ?
2. The graph below compares the primary and secondary immune responses to the same pathogen. The secondary response may eliminate the pathogens before any damage occurs.

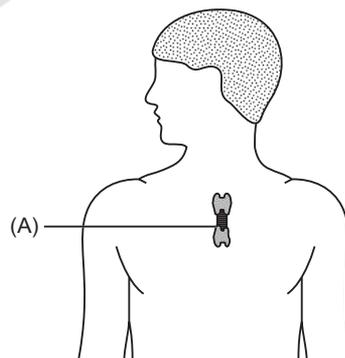


In reference to the graph above, which peak A or B represents secondary response?

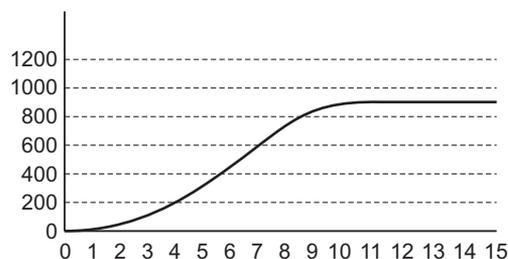
OR

Biofertilizers are living microbes that enhance plant nutrition by either by mobilizing or increasing nutrient availability in soils. How does mycorrhiza act as biofertilizer? Explain. Name a genus of a fungus that forms a mycorrhizal association with the plants

3. What is the function of organ labelled A?



4. At which point of time in the graph is when the population size reaches the carrying capacity for ecosystem?



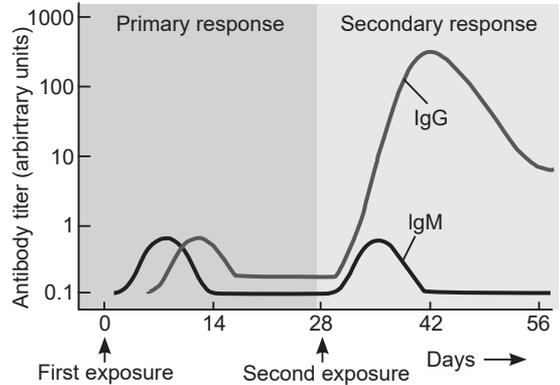
- What is an ecological principle behind the biological control method of managing with the insects?
- Certain animal species maintain homeostasis escaping the time period of unfavourable stress. Such animals are unable to migrate to another habitat. How do organisms like fungi, zooplanktons and bears overcome the temporary short-lived climatic stress conditions? Explain.

OR

What were the observations of Alexander Von Humboldt?

Section - B

- The entry of an antigen is sensed by the B-cells. The B-cells become active and synthesize specific protein molecule called the antibody, which is secreted into the plasma. Upon encountering the antigen, the antibodies bind with the antigen molecules and deactivate them. This whole process takes from days to weeks during first exposure but will be rapid upon second exposure due to the memory which was built up during first encounter with the pathogen. This phenomenon of recognizing an antigen is called as immunization and this lead to the basis of vaccination. Vaccination is the process by which an individual's immune system is strengthened against a particular infectious agent.



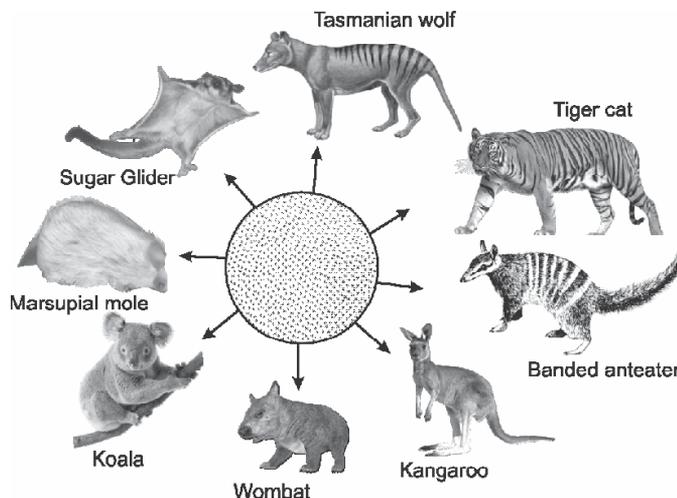
- The condition where immune system mistakes part of body like tissues, joints, skin, as foreign and attack them is:
- Vaccines set off immune response to pathogens by producing and storing:
- The antibody most likely be found in mucus is:

OR

Any substance (other than food) that is used to prevent, diagnose, treat, or relieve symptoms of a disease or abnormal condition. Drugs can also affect how the brain and the rest of the body work and cause changes in mood, awareness, thoughts, feelings, or behavior. Name an opioid drug and its source plant. How does the drug affect the human body?

- Uncontrolled cell-division occurs when a process called contact inhibition fails. In healthy organisms, during this process, when cells come in contact with other cells, the process of cell replication ceases. How are cancerous cells different from normal cells?
- Write a brief note on restriction enzymes. Explain the mechanism of action of restriction enzymes.
- Biodiversity refers to variety of life that can be studied on many levels. Give three hypothesis for explaining why tropics show greatest levels of species richness.

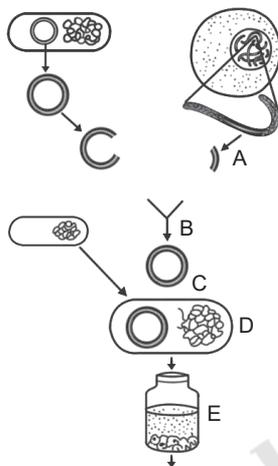
11.



- (i) Mention the specific geographical region where these organisms are found.
 - (ii) Name and explain the phenomenon that has resulted in the evolution of such diverse species in the region.
 - (iii) Explain giving reasons the existence of Placental wolf and Tasmanian wolf sharing the same habitat.
12. A cloning vector is a small piece of DNA that can be stably maintained in an organism, and into which a foreign DNA fragment can be inserted for cloning purposes. Describe the characteristics a cloning vector must possess. Why the DNA cannot pass through the cell membrane? Explain. How a bacterial cell is made 'competent' to take up recombinant DNA from the medium?

Section - C

13. Study the given figure showing production of Humulin and answer the questions that follows:



- (i) Identify the steps A, B, C, D and E.
- (ii) Active insulin consists of how many polypeptide chains?
- (iii) The Insulin A vector does not contain _____.
- (iv) What are the shortcomings of insulin obtained from slaughtered animals? Write down its disadvantages.

OR

DNA amplification is a powerful technique that has had an immense impact on scientific research in the past 2 decades. While polymerase chain reaction (PCR) is still the most popular method, alternative methods of DNA amplification are constantly being developed. In addition, the extraordinary versatility of PCR has led to its use in novel ways that have opened new avenues of research. These novel methods for DNA amplification and the versatility of PCR are highlighted in DNA Amplification: Current Technologies and Applications.

- (i) Expand VNTR and describe its role in DNA fingerprinting.
- (ii) List any two applications of DNA fingerprinting technique.
- (iii) How are DNA fragments visualised during gel-electrophoresis? What is elution?





Answers

Sample Paper 1

Section - A

- The steps are as follows:
 - Education and awareness is the first step to avoid such things.
 - Avoiding undue peer pressure as every child has his/her own personality and stamina to cope up with the existing society.
 - There should be regular monitoring of activities of adolescents behind them.
 - Parents must channelise the capacity of an individual into various recreational acts like sports, music and other such extra curricular activities.
 - Parents should seek professional and medical help from the experts and should insist the young generation to adopt activities like Yoga.
 - Parents must be able to identify the motivations for alcohols and drug abuse in the upcoming generation and keep a check on them.
- The first dose of a drug may be just an experimentation of curiosity that is hiked by the friends. Once the drug enters the body it may get assimilated into the blood and the abuser may become unable to escape from it. In young generation, due to rising competition in academics and sports, the youths are easily drawn towards drugs and alcohol. Another reason of abusing such things is the feeling of loneliness or avoidance of parents due to their busy work schedule. Unstable and unsupportive family structures and peer pressures have drawn the youths towards alcoholism and drugs. Further dependence leads the patient to ignore all social norms and evacuates him or her from the society. Regular dosage of alcohol or drugs induces the symptoms like anxiety, shakiness, nausea, sweating, and inability to concentrate and remain in the social structure.

OR

Penicillin is used as an antibiotic medicine. It was due to chemical produced by the mould and name was given penicillin after the mould *Penicillium notatum*.

- The chemical structure is of Morphine.
 - Heroin or Smack.
 - It is crystalline in nature, bitter in taste, white in colour and is odourless.
 - It is obtained from *Papaver somniferum*, commonly called as poppy plant.
- The organisms surviving in the extreme conditions are known as extremophiles. It has been found that certain organisms have colonised even in the underwater volcanic vents and hot springs. Such organisms are known as thermophiles. They have certain thermo resistant enzymes that carry out the metabolic processes even under high temperatures.
- Other such roles are:
 - Keeping the prey population under control. For example, wilder beast, the population is kept under control by the carnivores animals.
 - Act as a biological control agents to control specific species. For example, moths and lady bird beetle naturally feeding on the plant prickly pear.
- As according to the graph, there is maximum population of plants as compared to animals that comprise of 70 percent of the total species population.
 - As according to graph, in plants, the most species having its existence on earth is fungi.
 - The existing fungal species, their population is more than the total population of fishes, reptiles, amphibians and mammals. So, the ratio of fungi to animals will be more than 1.

OR

The balance of the ecology is due to the balance between the biotic and abiotic factors that govern the ecology. These factors are:

- (i) Biotic Factors
 - (a) Autotrophs
 - (b) Heterotrophs
 - (c) Decomposers
- (ii) Abiotic Factors
 - (a) Temperature
 - (b) Water
 - (c) Light
 - (d) Soil

Temperature is the most important abiotic factor that maintains the balance in the ecosystem and related processes. Temperature regulates the kinetics of the enzymes present in the body of an organism, thereby controlling the metabolic activities of the organism. All related physiological features are governed by the temperature. But certain organisms that tolerate the extreme temperatures have been found. These are extremophiles. The organisms that tolerate wide range of temperatures are called eurythermal and those who tolerate narrow range of temperatures are called stenothermal. They are found to be present in the underwater sea volcanic vents and hot springs as well as under freeze ice cap of polar regions respectively. Therefore the thermal variation decides the extent of a geographically habitual area.

Section - B

7. Contact inhibition refers to the phenomenon by which, the contact with other cells inhibits the uncontrolled growth of the cancerous cells. In Metastasis, the tumour cells reach the distant organs site through the blood. The group of gene are oncogenes. When activated under certain conditions there is oncogenic transformation of cells. The techniques to detect cancers are Biopsy, Radiography, CT and MRI through which the presence of cancer can be detected. The alpha interferon activates the immune system and destroys the tumours, so it is given to the cancer patients as the part of the treatment.

OR

The disease named AIDS (Acquired Immuno-Deficiency Syndrome) is caused due to the pathogen named Human Immuno Deficiency Virus (HIV). When HIV enters the helper T-lymphocytes, it replicates and produces progeny virus. This progeny virus is released in the blood that attacks the other T-lymphocytes. Due to lack of helper cells, the person lacks immune power and is attacked by multiple pathogens. In the last stage, the person faces multiple infections and complications that lead to death.

8. (i) The symptoms may be nausea, fatigue or heart palpitation.
 - (ii) The sickness was caused due to low atmospheric pressure which prevails at high altitude. The body does not get enough oxygen.
 - (iii) The body compensates low oxygen availability by increasing RBC production, decreasing the binding affinity of haemoglobin and by increasing breathing rate.
9. Alternative selectable markers have been developed which differentiate recombinants from non-recombinant DNA. In this procedure a recombinant DNA is inserted within the coding sequence of an enzyme called alpha galactose. It ends up in the inactivation of an enzyme which is called as insertional inactivation. The presence of chromogenic substrate gives blue-coloured colonies if the plasmid in the bacteria does not have an insert. The presence of insert results into the insertional inactivation of the alpha galactose and the colonies may not produce any colour.
10. The organisms that suspend their metabolic activities to survive in unfavourable conditions, their examples are:
- (i) **Polar bear:** They undergo hibernation, to escape from the unfavourable conditions. After getting favourable normal temperature, they come back and gain the exhausted energy.
 - (ii) **Seeds of large plant and fungal species:** Seeds undergo the state of dormancy in the extreme conditions. On getting the favourable conditions, the seeds germinate and grow. In context of fungal

species, they produce thick walled spores and with the help of them, survive in the unsuitable conditions.

- (iii) **Snails:** The snails enter the aestivation to escape the hot summers.
 - (iv) **Some species of zooplankton:** Zooplanktons enter diapause.
11. (i) It explains the link between the biodiversity and other components of the ecosystem.
- (ii) It is important because of the following points:
- (a) It regulates the climate.
 - (b) It controls the ecosystem functions like biogeochemical cycling of nutrients.
 - (c) It provides ecosystem services to the human beings.
- (iii) Yes, various anthropogenic processes and some ecosystem functions induce the changes in climatic patterns. This affects the biodiversity.
12. (i) It represents the maturation of pro-insulin into insulin.
- (ii) Insulin contains two short polypeptide chains that is chain A and chain B that are linked together with di-sulphide bridges.
- (iii) It is useful for monitoring residual beta cell function in the human body under insulin therapy.
- (iv) It is formed by chemical modification and cleavage of a precursor molecule.

Section - C

13. In the process of developing a new genetic variety of crop, following steps are involved:
- (i) The variability is collected through germplasm collection and preservation of different wild varieties.
 - (ii) Selecting the desired parents in order to identify plants with desirable combination of traits through which the pure lines are produced.
 - (iii) Carrying out cross-hybridisation among selected parents. Cross-hybridising the two parents produces the hybrids.
 - (iv) The suitable progeny that has desired characters and is superior over its both the parents. Such recombinants are selected and tested.
 - (v) Further, the selected recombinants are tested for commercial release as a new cultivar.

OR

- (i) The above given diagram is the *E. coli* cloning vector pBR322 depicting the restriction sites.
- (ii) A is Hind III and B shows BamHI which are the restriction sites on the vector.
- (iii) Rop codes for the proteins that are involved in the replication of the plasmid.
- (iv) Yes, ori is important as it is a starting site of replication. Then the target DNA should be cloned in such a vector whose origin supports high copy number.

Sample Paper 2

Section - A

1. A bioreactor can provide the required optimal conditions for producing desired product. Such optimal growth conditions may be ideal temperature, pH, substrate, salts, vitamins and oxygen. Thus, a bioreactor is important for commercial production of certain products.
2. According to the symptoms given, the disease that the patient is suffering from is amoebiasis. The pathogen responsible for this disease is *Entamoeba histolytica*. The pathogen lives in the large intestine of the human body. The pathogens are carried by houseflies from one place to another and is also directly contacted by the usage of contaminated water and food.

OR

Spirulina can easily be grown on materials like waste water from potato processing plant, straw, molasses, animal manure, sewage which helps to reduce environmental pollution. *Spirulina* also serves as food rich in proteins, carbohydrates, fats, vitamins and minerals.

3. The picture shown in option (i) is a correct answer. Picture (ii) is anti-smoking and picture (iii) is anti-drug.
4. The female wasp lays eggs in the fruit of fig plant for dual purpose. It gets the site for laying the eggs and it nurtures the larvae by feeding them the seeds. In turn, the wasp pollinates the fig inflorescence while searching the suitable site for egg laying. In favour of pollination, the wasp gets the developed seeds to nourish its young ones. This is a co-evolution.
5. Plant inhabiting a rain forest are not adapted to survive in aquatic conditions or wetlands. Plants are conformers. They are stenothermal. They cannot maintain a constant internal environment or temperature. The osmotic concentration of their body fluids affects the kinetics of enzymes through basal metabolic activity.
6. Temperature governs the kinetics of the enzymes that regulate the metabolism, its related activities and other related physiological functioning of an organism. Hence, it is an important abiotic factor governing the environment.

OR

The Prickly pear was controlled by using cactus feeding predator, a moth that feed on the plant.

Section - B

7. When a vaccine containing heat-killed or attenuated pathogen is introduced into the body to prevent chickenpox or measles, it produces antibodies against the antigen of the pathogen. This also generates B and T memory cells that recognise the pathogen quickly on subsequent exposure to produce large amount of antibodies which inactivate the pathogen causing the disease. This shows that vaccination is based on the memory of the immune system.

OR

A sample of curd can be used to study the microbes under microscope. A drop of curd contains millions of bacteria. A curd contains Lactic Acid Bacteria (LAB) called *Lactobacillus*. They digest and coagulate milk proteins by producing acids. Simple to study and easy to carry, a sample of curd can be preferred.

8. DNA fingerprinting is the modern technique that can help the authorities to hand over the dead bodies to their relatives. It includes series of steps which are as follows:
 - (i) Isolation and digestion of DNA by restriction endonuclease.
 - (ii) Separation of DNA fragments by electrophoresis and transferring them to synthetic membranes such as the nitro-cellulose or nylon membrane.
 - (iii) Hybridisation using labelled probe.
 - (iv) Detection of hybridised DNA fragments by autoradiography.
 - (v) Matching banding pattern of DNA, DNA fingerprints or autoradiograms of the guests who lost their lives during the accident and that of their relatives.
9. In the cotton boll worm body, Bt-toxin is converted into an active protein due to the alkaline pH of its gut. The toxin binds to the midgut cells, create pores and causes swelling and lysis of the cells. This kills the boll worm.
10. About more than 70% of species recorded on the earth are animal species. Only 22% plant species exist. So analysing the data, we can understand that, there is quiet a large difference in their percentage. This is because animals have adapted themselves to ensure their survival in changing environments in comparison to plants. For example, insects and other animals have developed a complex nervous system to control and coordinate their body structure.
11. (i) The naturalist Alexander Von Humboldt explained about the above given graph. His observations suggested that, the species richness increases with an increase in explored area but upto certain limit.
 - (ii) (a) It shows unaffected distribution in an area. It is a normal range.
 - (b) The value shows steeper slope of regression, that can be analysed when the species area relationship is studied on very large area say, for example, an entire continent.
 - (iii) The slope of the line 'b' becomes steeper when the species richness will be between 0.6 to 1.2.

12. (i) The above diagram shows the action of restriction endonuclease and thus forms a recombinant DNA after completion of entire process.
- (ii) Eco stands for *Escherichia coli*, R stands for the name of the strain and Roman I indicates the order in which the enzymes were isolated from the strains of the bacteria.
- (iii) They are the resultant of hydrogen bonding that act as the site for attachment for the separated DNA fragments and facilitate the action of enzyme called DNA ligase.

Section - C

13. (i) Each antibody molecule consists of two light chains and two longer chains called heavy chains. So to represent the number of chains it is designated as H_2L_2 .
- (ii) It is the response given by the antibodies that are found in blood, such responses are called humoral immune response.
- (iii) The functions are as follows:
- IgA:** The Immunoglobulin A is a neutralising antibody that acts as the first line of defence against mucosal pathogens. It gets attached to the epithelial surfaces and prevents the invasion of pathogens. It comprises about 10 to 15 % of the total antibodies present in the body.
 - IgM:** It functions in production of B-cells. It is the first antibody to appear in response to the exposure of an antigen. It appears in the early course of infection and can reappear from time to time as per the growth of infection. It is also responsible for reactions of blood transfusion in ABO blood system.
 - IgE:** This specific antibody is found in lungs, skin and mucous membrane that travels to the cell and releases the chemicals causing allergic reactions.
 - IgG:** This immunoglobulin is responsible for deciding the Rh-factor of the blood. They function in protecting the body from viral and bacterial infections. It comprises about 70 to 80 % of the total antibodies present in the body.

OR

Rhizobium

The symbiotic relationship between soil bacteria, collectively known as rhizobia (which includes the genera *Rhizobium*, *Bradyrhizobium*, *Mesorhizobium*, and *Sinorhizobium*), and legume roots, generates nodules (a new differentiated organ), which fix atmospheric dinitrogen (N_2) through the action of the nitrogenase enzyme.

Sample Paper 3

Section - A

- Withdrawal syndrome is the manifestation of unpleasant characteristic when a regular dose of a drug or alcohol is discontinued abruptly. The withdrawal symptoms can be characterised by anxiety, shaking of hands, nausea, vomiting and severe sweating which can be life threatening in some cases. Person may get irreversible mental disturbance for his/her life. In order to reduce the effects of withdrawal symptoms, person may need proper medical supervision.
- Certain public health measures as safeguard against infection and related diseases are:
 - Proper education and awareness about various modes of infection and related disease should be spread within the population.
 - The individual that shows the symptoms of infection must be isolated so as to prevent further spread of pathogens.
 - So as to avoid infections, the program of vaccination should be conducted.
 - Proper sanitary measures should be taken so as to manage the sewage and waste water.
 - The vectors that are responsible for transmitting the pathogens should either be sterilised or completely eradicated.

OR

X: Lactic acid

Bacteria (usually *Streptococcus thermophilus* and *Lactobacillus bulgaricus*) are used to ferment milk. Lactic acid is produced which helps to coagulate the milk.

3. (i) Graph 1 shows rise of antibodies Q level during pathogenic infection, as its amount was very high during infection which reduced significantly after recovery.
- (ii) Antibody P is present in small amount consistently in the person's blood which indicates that they are memory cells and the person is either vaccinated for this pathogen (artificial active immunity) or has contracted the pathogenic disease and recovered from it (natural active immunity).
4. (i) **Prototoxins:** The *Bacillus* is not killed by its own Bt toxin because this Bt toxin protein exists as inactive protoxins in it. This toxin converts into an active form in an alkaline pH. This later on form crystals which lead to the death of that insect.
- (ii) **Epithelial cells:** The activated Bt toxin binds to the midgut epithelial cells. These cells line the inner and outer surface of our bodies such as skin, alimentary canal, urinary tract, and organs.
5. The cattle egret and grazing animals are in close association with each other. This association is termed as commensalism. The cattle egret always forge close to where the cattle are grazing because, as the cattle move, they stir and flush out the insects from the vegetation which may be difficult to find out by themselves. Hence closely associated to the cattle egrets remain close to them.
6. Position of a species in any trophic level is determined by the function performed by that mode of nutrition of species in a particular food chain. A given species may occupy more than one trophic level in the same ecosystem at a given time. If the function of the mode of nutrition of species changes, its position shall change in the trophic levels. The same species can be at the primary level of consumer in one food chain and at the secondary consumer level in another food chain in the same ecosystem at a given time.

OR

Alien species invasion is the species that is not of an area and invades rapidly, thereby causing partial or complete extinction of the native, indigenous species. Also they cause an environmental damage by disturbing the ecosystem.

The plant species for example, *Lantana camara* and *Eichhornia crassipes* are of such type. Animal species such as African catfish threat to the indigenous catfish are among the type.

Section - B

7. Antibodies, also known as immunoglobulins are a type of protein molecule produced by B-lymphocytes in response to pathogens. Each antibody consists of four polypeptides—two heavy chains (H) and two light chains (L) joined to form a “Y” shaped molecule.

Variable region is the amino acid sequence in the tips of the “Y” varies greatly among different antibodies. This is composed of 110-130 amino acids and give the antibody its specificity for binding antigen. An antibody is represented as H_2L_2 molecule. Antibodies are divided into five major classes, IgM, IgG, IgA, IgD, and IgE, based on their constant region structure and immune function. Response via antibodies is also called as humoral immune response. These antibodies are found in blood.

OR

Cancer is one of the most deadly diseases of human beings. The major causes behind cancerous growth are:

- (i) Over consumption of any cancer inducing carcinogenic or oncogenic agent. For example Lathyrus (Kesar).
 - (ii) Over smoking and alcoholism along with dietary factors.
 - (iii) Chemical and environmental factors.
8. Allergy is because of release of certain chemicals like Histamine and Serotonin from the mast cells. Common examples of allergens are pollens, mites in dusts and animal dander. The drugs that can reduce the symptoms are anti-histamine, steroids and adrenaline.

9. The non-recombinants can be differentiated from recombinants on the basis of colour change when β -galactosidase is used as a selectable marker. When grown on a chromogenic substrate the non-recombinants show a colour change from colourless to blue whereas the recombinants are not able to show any colour change due to insertional activation. Moreover, the procedure involving β -galactosidase is single step, easy and non-cumbersome.
10. With the advent of genetic engineering, genes for insect resistance now can be moved into plants with more resistance and deliberately. Bt technology is only one example of ways genetic engineering may be used to develop insect resistant crops now and in the future. Bt proteins are lethal to insects and transfer the gene into crop plants.
- Steps Involved are:
- Identification of a strain of Bt that kills the targeted insect.
 - Isolation of gene that produces the lethal protein.
 - Gene is removed from the Bt bacterium and a gene conferring resistance to a chemical usually antibiotic or herbicide is attached.
11. (i) The graph represents a population growth curve.
- (ii) A is the situation where responses are not limiting the growth showing exponential growth. B is the situation where responses are limiting the growth showing logistic growth.
- (iii) K is the value of carrying capacity. It is the upper limit of environment to bear the growth of population.
12. (i) The acid-base inlet enables to control the pH of the mixture in the bioreactor vessel.
- (ii) Another such type of bioreactor is sparged stirred-tank bioreactor through which the sterile air bubbling is done.

Section - C

13. (i) It is the response given by the organism to the abiotic factors. When plotted on the graph they can be represented as above.
- (ii) 'a' denotes the conformer organisms whereas 'b' denotes regulator organisms.
- (iii) Organisms either thermoregulate (Regulation of temperatures) or osmoregulate (Regulation of osmotic pressure) to maintain homeostasis.
- (iv) Tiny organisms expose maximum surface area through which large amount of heat produced in the body is given out. So in order to generate the energy again, they have to expand much more energy. Therefore, they are not found in the polar region.

OR

- It is Ex-situ conservation approach.
- The approaches which will help in this type of conservation are botanical gardens, wildlife sanctuaries, seed and gene banks etc.

Sample Paper 4

Section - A

- The neutrophils and macrophages tend to dispose the microbes and dead cells by feeding on such entities. The dead cells may clog the homeostasis of the body and the dead microbes may start to decompose in the animal body which will lead to toxicity. So, they are termed as soldiers and scavengers in the animal body.

2.

S. No.	Benign tumour	Malignant tumour
1.	It is non-cancerous.	It is cancerous.
2.	It occurs by expansive growth.	It occurs by invasive growth.
3.	Mitotic activity of cells is not high.	Mitotic activity of cells is frequently high.
4.	There are no or few symptoms.	Symptoms are associated with pain and disability.
5.	No metastasis. For Example: Papilloma, Adenoma	Frequent metastasis. For Example: Liposarcoma, Adenocarcinoma

OR

A-Media containing carbohydrates and amino acids

Alexander Flemming was the first to produce an antibiotic (named penicillin) from *Penicillium notatum*. The fungus is grown in a culture medium containing carbohydrates and amino acid. However, full potential as an effective antibiotic was established by Ernest Chain and Howard Florey.

3. (i) Chemically the structure of a coat shown in the diagram is viral protein coat.
- (ii) Enzyme B is reverse transcriptase through which the viral DNA is produced. X is the viral RNA introduced into human cell and C is the viral DNA.
- (iii) D-Macrophage is the host cell.
- (iv) The two different cells the new virus 'E' subsequently attacks are macrophage and helper T-lymphocytes.
4. (i) A: Insects; B: Fishes
- (ii) Among animals, insects are said to be the most species-rich taxonomic group. Insects are hexapod invertebrates belonging to phylum Arthropoda. Out of all known animal species, 70 percent is comprised of insects.
5. The Prickly pear was controlled by using cactus feeding predator, a moth that feed on the plant.
6. (i) Some animals go into aestivation to avoid summer related problems such as heat and desiccation e.g., snails or fish.
- (ii) Some animals go into hibernation to avoid winter related problems e.g., polar bear.
- (iii) Fungi forms thick walled spores and suspend their activities to respond to adverse climatic conditions.

OR

- (i) Ecotype
- (ii) Animals adapted to live in deserts

Section - B

7. Morphine is used to help relieve moderate to severe pain. Morphine belongs to a class of drugs known as opioid (narcotic) analgesics. It works in the brain to change how the body feels and responds to pain.

Precautions: Before taking morphine, tell your doctor or pharmacist if you are allergic to it, or to other opioid pain medications or if you have any other allergies. This product may contain inactive ingredients which can cause allergic reactions or other problems. Talk to your pharmacist for more details.

Side effects: The common side effects are nausea, vomiting, constipation, light-headedness, dizziness, drowsiness or sweating may occur. Some of these side effects may decrease after you have been using this medication for a while. If any of these effects persist or worsen, tell your doctor or pharmacist promptly.

OR

It has helped us in many ways as follows:

- (i) It has given knowledge to know the nature of disease.
- (ii) It has given information to search the mode of transmission and related vectors.

- (iii) It has provided treatment to the infected person through proper medication.
- (iv) Vaccination and immunisation for avoiding the spread of the disease have been developed..
8. A sample of curd can be used to study the microbes under microscope. A drop of curd contains millions of bacteria. A curd contains Lactic Acid Bacteria called *Lactobacillus*. They digest and coagulate milk proteins by producing acids. Simple to study and easy to carry, a sample of curd can be preferred.
9. (i) Single stranded DNA oligonucleotide
 (ii) *Thermus aquaticus*
 (iii) 16
10. The first form of life originated in water. Water plays an essential role in various metabolic and catabolic processes of the organisms.
- Plants survive in water scarce environment through:
- (i) Completing the life cycle in a short period (Ephemeral mode).
 (ii) Mechanisms like developing deep tap roots, deciduous leaves and sunken stomata to avoid transpiration loss. Also there is thick cuticular covering for this purpose.
 (iii) Succulence to store the water.
- In animals they possess the features like:
- (i) Body avoids sweating to avoid loss of water.
 (ii) The kidney functioning is uricotelic.
 (iii) There is a fatty sebaceous deposition under the skin to avoid loss of water.
11. (i) The naturalist who investigated the relationship shown in the graph was Alexander Von Humboldt. He found that species richness increased within a region with an increase in the area explored, but only to a maximum.
 (ii) Alexander von Humboldt explored wilderness of South American jungles.
 (iii) Ecologists have discovered that the value of Z lies in the range of 0.1 to 0.2, regardless of the taxonomic group or the region (whether it is the plants in Britain, birds in California or molluscs in New York state, the slopes of the regression line are amazingly similar). But, if we analyse the species-area relationships among very large areas like the entire continents, the slope of the line to be much steeper (Z values in the range of 0.6 to 1.2).
12. (i) The diagram explains about the steps in PCR technique to amplify the gene of interest.
 (ii) The Step I is Denaturation, Step II is Annealing and Step III is Extension.
 (iii) At the end of PCR the result is an amplified DNA segment at the rate of 1 billion copies. Now, the amplified fragment can be used to ligate with the vector for further cloning.
 (iv) These are small, chemically synthesised oligonucleotides which are complementary to the regions of DNA.

Section - C

13. Steps involved in production of artificial insulin are:
- (i) The plasmid of *E.coli* is removed and isolated using specific techniques.
 (ii) The isolated plasmid is opened by specified enzyme.
 (iii) In the open site of the bacterial plasmid the segment of DNA which codes for human insulin is inserted.
 (iv) After insertion, the plasmid is closed by using another special enzyme to make it a recombinant plasmid.
 (v) This recombinant plasmid is again introduced into *E. coli* host cells.
 (vi) Now, *E. coli* cells become capable of synthesising human insulin. These bacteria are then cultivated in fermenters to produce a large amount of insulin.
 (vii) Insulin is then extracted from bacterial culture and purified

OR

- (i) X-gal is an organic compound consisting of galactose linked to a substituted indole.
- (ii) lacZ encodes β -galactosidase (LacZ), an intracellular enzyme that cleaves the disaccharide lactose into glucose and galactose.
- (iii) The enzyme is well known to signal its presence by hydrolyzing X-gal to produce a blue product.
- (iv) In some transformation experiments, a color-processing gene such as LacZ gene is utilized for confirmation of the molecular cloning (inserting a DNA fragment of interest into a plasmid vector). Plasmids with an uninterrupted LacZ gene turn their bacteria blue.
- (v) URA3, an orotidine-5' phosphate decarboxylase from yeast is a positive and negative selectable marker.

Sample Paper 5

Section - A

1. The Green revolution was a brainchild of Dr. Norman Borlaug and Dr. M.S Swaminathan who are considered as the pioneers of green revolution. The advantages and disadvantages of green revolution are:

Advantages:

- (i) It has lead to introduction of high yielding varieties of crops.
- (ii) Through green revolution, it is now possible to grow number of crops on small piece of land.
- (iii) Green revolution enabled food and nutritional security, which is an important aspect for developing countries.
- (iv) Now more deforestation for conversion into agricultural land necessary as there is no need of shifting agriculture.

Disadvantages:

- (i) Over use of synthetic and chemical products degraded the land and soil fertility.
 - (ii) It increased the soil and water pollution and gave rise to soil erosion.
 - (iii) The high yielding varieties consume large amount of water which puts pressure on natural and ground water table reserves.
2. (i) helper T- cells, HIV infects and destroys helper T cells.
 - (ii) HIV enters into helper T-lymphocytes (T_H), replicates and produce progeny viruses. The progeny viruses released in the blood attack other helper T-lymphocytes. This is repeated leading to a progressive decrease in the number of helper T lymphocytes in the body of the infected person.

OR

- (i) Biogas is produced by anaerobic digestion with methanogens or anaerobic organisms, which digest material inside a closed system or perform fermentation of biodegradable materials. Biogas is primarily methane (CH_4) and carbon dioxide (CO_2) and may have small amounts of hydrogen sulphide (H_2S), moisture and siloxanes. The gases such as methane, hydrogen and carbon monoxide (CO) can be combusted or oxidised with oxygen. This energy release allows biogas to be used as a fuel; it can be used for any heating purpose, such as cooking. It is used in a gas engine to convert the energy in the gas into electricity and heat.
- (ii) Advantages of using Biogas:
 - (a) It is an eco-friendly source of energy.
 - (b) Biogas generation reduces soil and water pollution.
 - (c) The process of producing biogas yields organic manure.
 - (d) It is a healthy cooking alternative as it is low cost technology and economic for developing nations.

3. **Staphylococcus:** *Staphylococcus* is a genus of gram-positive bacteria. Under the microscope, they appear spherical (cocci), and form in grape-like clusters. These species are facultative anaerobic organisms that are capable of growing both aerobically and anaerobically.
4. A = insects, B = molluscs
Among all the species approximately 70% are animals. Insects account for 70% of animal population which is the maximum (represented as A) (2009). There are 10,25,000 species of molluscs (represented as B).
5. In today's time it has been observed that the rate of extinction of the species has accelerated. The four major causes that has resulted into accelerated extinction are:
- Loss of habitat and fragmentation.
 - Over-exploitation of available natural resources.
 - Invasion of alien species and their dominance.
 - Co-extinction of host and parasite species simultaneously.
- Habitat loss and fragmentation is one of the most important causes for loss of biodiversity. This drives most plant and animal towards extinction. Due to certain anthropogenic (human) activities, larger habitats get fragmented into the small units. Due to such fragmentation, the species that require larger space may enter into competition with other species. The best example is human animal conflict. As man has converted the forest area into agricultural land by way of deforestation and conversion of tropical rainforests into soya cultivation and conversion into grasslands for rearing beef cattle, the wildlife residing in the forests have entered the human territory. Hence further fragmentation may lead to either migration of the species or may result into their extinction.
- Similarly, co-extinction is another reason responsible for loss of habitat. The entities of ecosystem are interconnected to each other through food chain. Decline in the population in one species may hamper the related or associated species. Hence, it may lead to the extinction of related or associated species too. This is ecologically termed as co-extinction.
6. *Calotropis* flourish in abandoned fields because *Calotropis* thrives on poor soils, particularly where overgrazing has removed competition from native grasses. Moreover, *Calotropis* produces highly poisonous cardiac glycosides as a means of chemical defences against herbivores such as cattle or goats.

OR

The processes responsible for such fluctuations are:

- Natality
- Mortality
- Emigration
- Immigration.

Section - B

7. (i) (a) Uncontrolled growth of tissues forming lumps or bumps
(b) Biopsy: Cancer is uncontrolled proliferation of the cells and is caused by damage to genes that regulates the cell cycle. The cells lose the control and divide indefinitely leading to the formation of mass of cells. They can be detected by a new bump formed usual and final examination is done by using biopsy.
- (ii) Cancerous cells when remain fixed at the site they form tumor and when they dislodge and circulate in the blood stream they reach to other sites and spread cancer.
- (iii) Cancer of blood cells is called as leukemia.

OR

The cancer-causing viruses possess the genes known as viral oncogenes. The normal proto-oncogenes get activated into oncogenes through some viruses that result in oncogenic transformation of cells. A benign tumour can turn malignant if it remains sustained in the body for longer period of time. The cancerous cells are carried by blood or lymph towards other parts of the body where they spread secondary cancer or metastasis. Once the tumour turns malignant, it starts invading the surrounding tissue and the cancer starts to spread in the whole body.

8. (i) Continuous
(ii) Impeller
(iii) Size only
9. The genetically resistant tobacco cultivars have been evolved through biotechnological applications. The infestation of the nematodes called *Meloidogyne incognita* can be prevented by the process of RNA interference. It is present in all the eukaryotic organisms. This method envisages the silencing of a specific mRNA of the parasite due to complementary dsRNA molecule that binds to and prevents translation of the mRNA (silencing). The source of this complementary RNA could be from an infection from viruses having RNA genomes or mobile genetic elements called transposons. They replicate via RNA intermediate. The vector used for the entire process is *Agrobacterium tumefaciens*.
- The nematode resistant genes from agrobacterium were introduced into the host plant. This produced both, the sense and anti sense RNA in the host cell. Both of them were complementary and formed double stranded RNA that initiated the above said process called RNA interference.
10. (i) Species richness
Species richness can be defined as the number of species per unit area. There is a wide variation in the distribution of species on this planet. The equatorial region is usually rich in biodiversity and this richness decreases from the equator to the polar region.
- (ii) The species interacts with its environment and thus performs certain functions. In a natural state, these interactions and consequently the system is in balance. The loss of one species affects many other species and causes imbalance.
- (iii) By increasing species diversity in an ecosystem, both the efficiency and the productivity of an ecosystem will increase. A greater species richness and diversity may cause ecosystems to function more efficiently and productively by making more resources available for other species.
11. N-population density at the given time, r-intrinsic rate of natural increase in population and k-carrying capacity.
Logistic growth model is given by $dN/dt = rN(1 - N/k)$ where N is no. of individual at time t, K is carrying capacity r is intrinsic growth rate.
12. (i) Using *Agrobacterium* vectors, nematode-specific genes are introduced into the host plant. The introduction of DNA produces both sense and anti-sense RNA in the host cells. These two RNAs being complementary to each other formed a dsRNA which initiated RNAi. Thus 'a' is sense RNA and 'b' is antisense RNA.
- (ii) Double stranded RNA is cleaved by a nuclease called as dicer and small fragments are generated, they are about 22 nucleotides long and are known as short interfering RNAs (siRNA). The process is called RNA interference (RNAi).
- (iii) *Meloidogyne incognita* is the nematode that infects the roots of tobacco plants. It is also known as 'root-knot nematode'. It is a plant-parasitic nematode. It affects both monocots as well as dicot plants.

Section - C

13. (i) Graph 1, primary immune response is the reaction of the immune system when it contacts an antigen for the first time.
- (ii) Level of IgM only. In a primary immune response, naive B cells are stimulated by antigen, become activated, and differentiate into antibody-secreting cells that produce antibodies specific for the eliciting antigen. A large amount of IgM and a small amount of IgG are produced during the primary immune response.
- (iii) Graph 2. During the primary immune response to the first encounter with a specific pathogen, some lymphocytes called memory cells develop with the ability to confer long-lasting immunity to that pathogen, often for life. These memory cells recognize antigens on the pathogens they have encountered before, triggering the immune system to respond faster and more effectively than on the first exposure.

OR

A mycorrhiza is a symbiotic (generally mutualistic) association between a fungus and the roots of a vascular plant. In a mycorrhizal association, the fungus colonises the host plant's roots, either

intracellularly as in arbuscular mycorrhizal fungi (AMF), or extra-cellularly as in ectomycorrhizal fungi. They are an important component of soil fertility and reduce fertilizer use, watering costs and plantation management costs. The *Azolla-Anabaena* association is important agronomically owing to its capacity to fix atmospheric nitrogen at cheaper and faster rates and making it available to crop plants. Bacteria of the genus *Rhizobium* plays a very important role in agriculture by inducing nitrogen-fixing nodules on the roots of legumes such as peas, beans, clover and alfalfa. This symbiosis can relieve the requirements for added nitrogenous fertilizer during the growth of leguminous crops.

Sample Paper 6

Section - A

1. HIV or Human Immunodeficiency Virus is a member of group of viruses known as retrovirus; they possess an envelope enclosing the RNA genome. The phage virus has an envelope that encloses the DNA genome.
2. *Plasmodium vivax*, *P. malaria* and *P. falciparum* are causative agents of malaria. Female *Anopheles* mosquito is the vector of malaria and symptoms include chill and high fever recurring every three to four days.

OR

Some bacteria, such as methanogens, are commonly found in the anaerobic sludge during the sewage treatment. Biogas is a mixture of gases produced during the microbial activities and which is used as fuel. The type of the gas that is produced depends upon the type of microbes and the organic substrates they utilise. Methanogens produce methane, CO₂, hydrogen gas by anaerobic digestion of cellulosic plant part.

3. Antibody

The B-lymphocytes produce an army of proteins in response to pathogens into our blood to fight with them. These proteins are called antibodies. T-cells do not secrete antibodies but help B-cells to produce them.

4. Circular duplex DNA

Circular double-standard DNA is double stranded and has no terminal ends and is circular. Such type of DNA is found in bacteria.

5. (i) In case of fig species, it is pollinated only by its partner wasp species. The female wasp uses the fruit of the fig as a site for egg laying and nourishing its larvae. They tend to co-evolve, e.g., the moth and the yucca plant cannot complete their life cycle without each other. The moth deposits its eggs in the locule of the ovary and the flower in turn gets pollinated by the moth.
(ii) When any of the two species becomes extinct, the other species associated with it in an obligatory way also becomes extinct and leads to biodiversity loss.
6. The birth rate is number of births per unit population per unit time whereas death rate is number of deaths per unit population per unit time. Birth rate is called Natality whereas, death rate is called Mortality. Under favourable conditions, the death rate is minimal and the birth rate is high making the population to grow at faster rate. Under stressful conditions, the death rate is high making the population to decrease.

A population at a given time is composed of individuals of different ages. If the age distribution that is the percent individuals of a given age group is plotted for these populations, the resulting structure will be referred as an age pyramid.

OR

Diapause is a stage of suspended development of an organism in order to cope up with the changing environment. Many species including zooplanktons and certain insects exhibit diapause to cope with the adverse climatic stress. On the other hand, hibernation is a state of sleep or resting phase where the organism suspends itself from the adverse climatic conditions. The metabolic activity slows down and the organism experiences near death situation. Certain rodents and bears follow such mechanisms.

Section – B

7. (i) Carcinoma
 (ii) Leukemia
 (iii) Chemotherapy, Surgery, Radiation therapy

OR

It is called biological treatment because it involves living organisms such as aerobic or anaerobic bacteria and fungi to digest organic waste.

The primary effluent is passed into an aeration tank where vigorous growth of aerobic microbes (flocs) takes place as a result of which BOD gets reduced. The effluent is passed to a settling tank where flocs sediment to produce activated sludge. The sludge is pumped to an anaerobic sludge digester to digest the bacteria and fungi.

8. (i) Acetylcholine
 (ii) Gastritis, neuritis, swelling of liver.
 (iii) Nerve stimulation, heart diseases, decrease in O₂ carrying capacity, lung cancer, chronic bronchitis etc.
9. Some of the other advantages that the stirred tank bioreactors have over shake flasks are:
 (i) Small volumes of culture can be taken out from the reactor for sampling or testing.
 (ii) It has a foam breaker for regulating the foam.
 (iii) It has a control system that regulates the temperature and pH.
10. (i) Transfer of whole nuclei. Transfer of whole individual chromosomes or fragment. Transfer of DNA.
 (ii) Mice, chicken, pigs
 (iii) milk
11. (i) Environment C
 Environment A is stable or uniform, environment B follows cyclic pattern, environment C shows an irregular fall and rise in the rate of speciation.
 (ii) In order to conserve and protect biodiversity of a region, we can adopt certain desirable approaches as given below:
 (a) **In-situ conservation:** The conservation strategies when implemented on the same place where the species is habituated, such conservation strategies are referred as in-situ conservation strategies. For example, conserving endemic species that are confined to the biological hotspots which have very high species richness. The establishments such as National parks, wild life reserves, sanctuaries etc. can be grouped under this method.
 (b) **Ex-situ conservation:** In this type of conservation strategy, the species is shifted to an artificial environment so as to preserve and to conserve. For example, zoological parks, seed and gene banks, botanical gardens can be grouped under this type of strategies. Conservation of marine sea turtles by shifting the eggs nested by female to an artificial hatchery and further release of them into the sea is another such example of ex-situ type of conservation. The only disadvantage of this method is the detachment of the species from its natural habitat.
12. (i) A : Retrovirus, B : DNA, C : Lymphocytes
 Retrovirus is used as a vector that helps in incorporation of C-DNA which is functional and thus can produce adenosine deaminase enzyme. This C-DNA is transferred in the cultured lymphocytes which are then subsequently returned to the patient.
 (ii) Gene therapy is an advanced technique for correcting a defective gene with the help of gene manipulation. It involves the delivery of a normal gene into the individual to replace the defective gene. Introduction of gene for Adenosine Deaminase (ADA) in ADA deficient individual is an example. The Adenosine Deaminase enzyme plays a vital role in maintaining the normal functioning of the immune system. The individual suffering from this disorder can be cured by transplantation of bone marrow cells. The initial step involves the extraction of lymphocyte from the patient's

bone marrow. Then, a functional gene for ADA is introduced into lymphocytes with the help of retrovirus. These treated lymphocytes containing ADA gene are then introduced into the patient's bone marrow. Thus, the gene gets activated producing functional T-lymphocytes thereby activating the patient's immune system.

Section - C

13. In "In-situ" conservation, the threatened organisms are conserved in their natural habitat or ecosystem. Such habitats are legally protected as hotspots, biosphere reserves, national parks, sanctuaries, sacred groves or Ramsar sites.

Causes of biodiversity loss are:

- (i) **Habitat loss or fragmentation:** The Amazon rain forest is being cut out and cleared for raising cattle, or conversion to grasslands or cultivating soyabeans. The large habitats are broken up into small fragments due to human activities. Mammals and birds which require large territories are badly affected leading to decline in population.
- (ii) **Over-exploitation:** When "need" turns to "greed", it leads to over-exploitation of natural resources. E.g., stellar's sea cow, passenger pigeon, marine fish population were overexploited.
- (iii) **Alien species invasions:** When alien species are introduced deliberately, some of them turn invasive and cause decline in indigenous species e.g., Carrot grass, African catfish (*Clarias gariepinus*) poses a threat to the indigenous cat fishes.

OR

- (i) Decline in available food resources

As the population size decreases between 2 and 3 time there is decline in available food which results in decline in size of population between 2 and 3 time.

- (ii) Exponential

The population in above graph increase exponentially at time = 1 as this type of graph is shown when resources available to population are unlimited.

Represented by, $\frac{dN}{dt} = rN$.

- (iii) Growth of population of one species can either harm or can be useful for the related species. The growth of the population mainly depends upon the resources available over the habitat where the population has developed. Similarly, there is a constant competition between the species residing over the area for food, shelter, reproduction and protection. These factors govern the population growth. In order to study this growth of population density of a specific geographical unit over a period of time, several growth models have been developed that are:

(a) Exponential Growth Model

(b) Logistic Growth Model

Logistic Growth Model states that there is no such population of any species in the nature that ideally grows without any hindrance. Two important factors that govern population growth is food availability and disease outbreak. Initially, the growth of population shows the lag phase. Further the lag phase is followed by phases of acceleration and deceleration and finally an asymptote till the population density reaches the carrying capacity.

If the values are plotted on the curve, it results in sigmoid curve. This type of population growth is called Verhulst – Pearl logistic growth. The equation can be given as:

Where, $\frac{dN}{dt} = rN \left[\frac{k - N}{k} \right]$

N = Population density at time t

r = Intrinsic rate of natural increase

K = Carrying capacity.

Sample Paper 7

Section – A

1. A vaccine is a suspension of killed or attenuated pathogenic microorganisms which act as antigen. This, when administered in the body, leads to the stimulation of T-cells and B-cells which produce antibodies for fighting the antigenic preparation. In the process, some T-cells form memory cells which may fight the infection if occurred in future.

2. Peak B

During the primary immune response to the first encounter with a specific pathogen, some lymphocytes called memory cells develop with the ability to confer long-lasting immunity to that pathogen, often for life. These memory cells recognise antigens on the pathogens they have encountered before, triggering the immune system to respond faster and more effectively than on the first exposure. Hence, the response is more effective as the antibodies produced in second exposure are much larger as compared to the first exposure to same antigen.

OR

The mycorrhiza is a symbiotic association between the fungus and the roots of higher plants. Such fungi in the association tend to absorb phosphorus from the soil and pass it on to the plant for completing its metabolic and catabolic processes. The genus *Glomus* forms a mycorrhizal association with the plants.

3. Site of T-lymphocyte differentiation.

The thymus is a lymphoid organ located in the mediastinal space. Thymus is the site of T-lymphocyte differentiation. The mature T-cells leave the thymus and migrate to secondary lymphoid organs like the spleen, lymph nodes, and other lymphoid tissues where they control cell-mediated immune responses. Thymus provides micro-environment for development and maturation of T-lymphocytes.

4. Carrying capacity refers to the maximum size of population of a species that a certain environment can support for an extended period of time. In given graph, 12 represent the point with maximum population size.

5. The basic principle behind the biological control method is predation. Predation is an act of capturing and preying on the other organism. This maintains the population of prey. Accordingly, the insect pests are controlled by using another insect that prey on them. For example, larvae of green lace wing feeds on the aphids reducing their population to the minimum.

6. The fungal species form thick-walled spores which help them survive in unfavourable conditions. On the availability of suitable environment, they germinate. The zooplanktons under stressful conditions enter diapause. The bears in extreme low temperature escape the winter by entering the state of hibernation.

OR

A German naturalist and a geographer named Alexander Von Humboldt quoted some observations during his exploration in the forests of South America. These observations were:

- (i) Within a region, species richness increased with an increase in area but only up to certain limit.
- (ii) When plotted on graph the species area relation shows rectangular hyperbola.
- (iii) There are wide range of factors that determine the slope of curve namely, predation-prey dynamics, immigration, extinction and clustering of the species.

Section – B

7. (i) **Autoimmunity:** Autoimmunity is the disease when an immune system could not distinguish between self and non self antigens and attack self cells. E.g., Rheumatoid arthritis, Multiple sclerosis, Type 1 diabetes mellitus
- (ii) **Antibodies:** Vaccines reduce risks of getting a disease by triggering the natural defense system of body. It produces antibodies which fight immediately against pathogen and keeps the memory for future defense as well.

- (iii) **IgA:** Immunoglobulin A (IgA) is found secretions of body such as saliva, tears, respiratory, gastrointestinal, and mucus.

OR

An example of opioid drug is heroin or smack or it is popularly known as morphine. It is obtained from the plant called poppy plant, scientifically known as *Papaver somniferum*. The drug action is that the opioid receptors bind to the central nervous system or the gastro-intestinal tract thereby slowing down the system.

8. They are different from each other based on the following points:
- As compared to normal cells, cancerous cells undergo vigorous mitotic cell division.
 - Contact inhibition is not seen in the cancerous cells which can be seen in normal cells.
 - Cancerous cells lead to the formation of tumours.
 - The cancerous cells possess short life as compared to normal cells which have long life.
 - The cancerous cells show high invasiveness that is not with the normal cells.
9. The restriction enzymes act as molecular scissors that cut the DNA segment at the specific sites. The discovery of two such enzymes was made in 1963, one of which one was identified later as restriction endonuclease. The first restriction endonuclease was Hind II, the function of which is to recognise the specific sequence of six base pairs and cut the segment at that location.
- The restriction enzyme belongs to a larger class named nucleases. The two types of such enzymes are endonuclease and exonucleases. The exonucleases play a role in removing the nucleotides from the ends of DNA. It also inspects the length of DNA sequence. The endonuclease makes a cut at specific positions of DNA fragment.
- Once the restriction endonuclease finds a specific location, that has a capacity to recognise the palindromic nucleotide sequence, the enzyme gets bind to DNA and makes a cut at specific points in sugar-phosphate backbone of each of the two strands of the double helix.
- After the cutting, the overhanging sticky portion plays its role. The sticky end allows joining of two counterparts of DNA strand with the help of another enzyme called DNA ligase. The cuts made by restriction endonuclease give similar sticky ends at both the strands. After cutting, separation and getting attached to the host DNA, the recombinant DNA is formed.
10. There are three different hypothesis proposed by ecologists for explaining species richness in the tropics, they are:
- As we come towards the tropical latitude, there is high species diversity as compared to temperate region because of receiving maximum solar energy.
 - Tropical latitude faces less seasonal variations and have more or less a constant environment. This results in niche specialisation giving rich species diversity.
 - The temperate regions undergo the process of glaciations, while the tropical regions have no such processes, which give rise to species richness in tropics.
11. (i) Australia
- Adaptive radiation (Divergent evolution) . The process of evolution of different species in a given geographical area starting ,from a point and literally radiating to other areas of geography (habitats) is called adaptive radiation. It is the development of different function structures from a common ancestral form.
 - Placental wolf and Tasmanian Wolf share similar habitat due to convergent evolution and evolved into unrelated groups of organisms.
12. The cloning vector must possess following characteristic features:
- Origin of replication (ori):** It is the initiation point from where the replication process starts and any piece of DNA when linked to this sequence can be made to replicate the DNA within the host cell. The ori is also responsible for controlling the number of copies of the linked DNA.
 - A selectable marker:** The vector must have a selectable marker which will help it in identifying and eliminating the non-transformants and selectively permitting the growth of transformants only.
 - It must possess the cloning site or recognition site for a restriction enzyme to recognise.

As DNA is a hydrophilic molecule, it cannot pass through the cell membrane. The bacterial cell is made competent through treating it with the specific concentration of Ca^{2+} ions. Further incubation of the cells on the ice and providing short heat shocks can make the bacterial cell competent to take up the recombinant DNA available in the medium.

Section - C

13. (i) A-Isolation of human insulin gene, B-Insertion of human insulin gene into plasmid, C-Formation of rDNA, D-Production of multiple copies of rDNA, E- Multiplication of transformed cells.
- (ii) Active insulin consists of two polypeptide chains, the A chain and the B chain. The A chain consists of 21 amino acids and the B chain consists of 30 amino acids. The chains are joined together by two disulphide linkages.
- (iii) The Insulin A vector does not contain B-chain, it contains the A chain. A separate pBR322 vector is needed for the production of the B-chain known as the insulin B vector.
- (iv) Insufficient in quantity and contain antigens which can cause allergy.

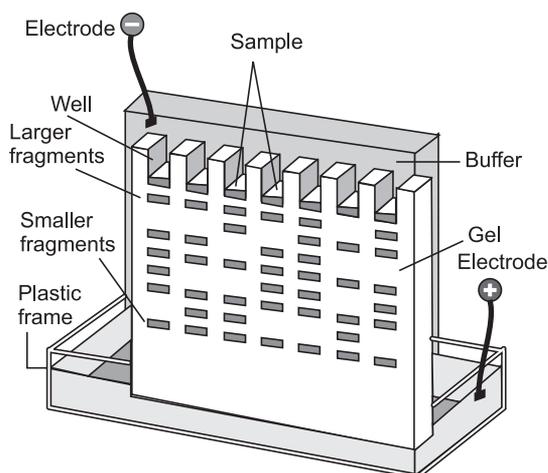
Following are the disadvantages of insulin from slaughtered animals:

- (i) Demand for insulin is very high which necessitates slaughtering of a large number of animals.
- (ii) Slaughtering of animals amounts to cruelty against animals.
- (iii) Insulin from animal origin can result in allergic reactions because of body's tendency to encounter foreign substance.
- (iv) The slaughtered animal can be infected with some dangerous microbes. This can contaminate the insulin.

OR

- (i) VNTR—Variable Number of Tandem Repeats. It is used as a probe because of its high degree of polymorphism.
- (ii) (a) DNA fingerprinting is used for paternity testing through the use of PCR technique which produces the genetic fingerprint and is highly specific for each individual.
- (b) It is used in the data security where DNA regions used for individual identification are specific isolated genetic loci in the non-coding regions of the genomic DNA.
- (iii) To visualise the DNA, the gel is stained with a fluorescent dye that binds to the DNA, and is placed on an ultraviolet transilluminator that shows up the stained DNA as bright bands. The dye can also be mixed with the gel before it is poured. The DNA fragments glow, allowing to see the DNA present at different locations along the length of the gel.

In gel-electrophoresis, the separated bands of DNA are cut out from the agarose gel and extracted from the gel piece. This step is called elution.



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