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# **QUESTION BANK**

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**CLASS XII**

**SCIENCE STREAM**

**2008 - 2009**

**NOT FOR SALE**

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**DIRECTORATE OF EDUCATION  
GOVT. OF NCT OF DELHI**

# **PRODUCTION TEAM**

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## PREFACE

It gives me immense pleasure in presenting this Question Bank to the students and teachers of Government schools of Delhi. This handy tool is part of our endeavour to improve the quality of education in Delhi. The purpose is to significantly improve the performance of our students in the Board examinations by giving them practice material for applying the concepts learned in classroom teaching. It is directly relevant as it bases itself on the latest syllabus prepared by NCERT and adopted by the CBSE for the academic year 2008-09. We hope that the students and the teachers will use this book to sharpen their skill in handling the Board Examination.

I would also like to commend the efforts of Dr. R.K. Sharma, Addl. Director of Education (School/Act/Exam) who headed the mission and his team members Dr. (Mrs) Suman Rekha, Asst. Director of Education (School) MARCEL EKKA, Asst. Director of Education (Exam) and Dr. R.C. Tewari, OSD (Exam) whose sincere efforts made it possible to accomplish the work in time.

My best wishes are with all the students appearing for the Board examinations!

**Chandra Bhushan Kumar**



**Dr. R.K. Sharma**  
Addl. Director of Education  
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## FOREWORD

I feel honoured in writing the foreword to this question bank for class XII, I sincerely hope this question bank achieves its objective of helping the students of this class to get a flavour of the board examination and enhance their performance. Our teams tried to visualize how it would be beneficial for the students facing the board examinations and guide to achieve this objective from a student's perspective.

These Question Banks adhere to the latest syllabus prescribed by NCERT and adopted by the CBSE. The questions reflect the deep expertise of subject teachers who have had a long experience in helping students perform well in their respective fields. Its various salient features such as valuable key points, questions, Key to short answer and hint to difficult questions on each chapter try to inculcate an effective and comprehensible approach for taking the questions in the board examinations. For real time practice one solved model paper and one unsolved model paper have also been incorporated which are based on sample papers issued by CBSE for the 2009 examinations.

This year Hindi (Elective) subject also introduced by the Directorate due to sincere efforts by Exam. Branch. It is an appreciable efforts by department.

Principal Sh. B.K. Sharma, RPVV Raj Niwas Marg, kindly made the school available as a venue for holding the Question Bank workshop while the staff of DBTB provided valuable co-operation in printing of Question Banks. I would like to express my sincere gratitude to the above.

Finally I also extend my thanks to Dr. (Mrs.) Suman Rekha, ADE (School) Marcel Ekka, Asst. Director of Education (Exam.) who coordinated the mission, Dr. R.C. Tewari, OSD (Exam) and the staff of the Examination Branch for their continuous devotion to this project.

**Dr. R.K. Sharma**

*Addl. Director of Education (Exam/School/Act)*

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Dear Student and Teachers

Here is a treasure of questions for you. Attempt all of them from July to December. Make a separate notebook for English. Do it sincerely.

You will surely come out with flying colours.

Best of luck!

Group Leader and Members of Team.

## **ENGLISH CORE – XII**

### **DESIGN OF SAMPLE PAPER**

S. No.	Section	Type of Questions	Marks	Total Marks	Testing Objectives
Q. 1.	Reading			20	
	1.1	(a) SA (b) VSA (c) SA (d) SA (e) SA	2 M 1M 2M 2M 2M	9	Comprehension Comprehension Comprehension Understanding Comprehension
	1.2	(a) VSA (b) VSA (c) VSA	1M 1M 1M	3	Vocabulary Testing Vocabulary Testing Vocabulary Testing
QR (2nd Opinion)					
Q. 1.	1.1	(a) SA (b) SA (c) SA (d) SA	2M 2M 3M 2M		Comprehension Comprehension Interpretative Interpretative
	1.2	(a) VSA (b) VSA (c) VSA	1M 1M 1M		Vocabulary Testing Vocabulary Testing Vocabulary Testing
Q. 2.	2.1 2.2	Note Making Summary Writing	5M 3M	3	Study Skills Summarising Skills
	Writing (1st Option)	Short Writing	5M	35	Providing factual
Q. 3.		Skill			Details organization fluency and coherence
	or (2nd Option)	or Short Writing Skill	or 5M	or	or Providing factual details organization fluency and coherence
Q. 4.	(1st Option)  (2nd Option)	Long Writing Skill  Long Writing Skill (factual Reporting)	10M 10M	10	Presenting factual details, format, fluency and coherence  or Presenting factual details, format, Exp fluency and coherence

Q. 5.	(1st Option)	Letter Writing	10M	10	Formatting, organization, coherence, Fluency
	or (2nd Option)	or Letter Writing	or 10M	or	or Formatting, organization, coherence, Fluency
Q. 6.	(1st Option)	Article	10M		Organization, coherence, fluency
	or (2nd Option)	or Article	or 10M	or	or Organization, coherence, fluency
Text Book				45	
Q. 7. (a)	(1st Option)	(a) SA (b) VSA (c) VSA	2M 1M 1M		Poetry, appreciation Interpretative Interpretative
	or (2nd Option)	or (a) SA (b) VSA (c) VSA	or 2M 1M 1M	or	or Poetry appreciation Interpretative Interpretative
Q. 7. (b)	Any three	(1) SA (2) SA (3) SA (4) SA	2M 2M 2M 2M		Comprehension Interpretative Understanding Interpretative
Q. 8.		(a) SA (b) SA (c) SA (d) SA (e) SA	2M 2M 2M 2M 2M		Comprehension Comprehension Interpretative Understanding Understanding and Interpretative
Q. 9.	(1st Option)	Long Answer	10M		Content, organization, Fluency, coherence, Understanding
	or (2nd Option)	or Long Answer	or 10M	or	or Content, organization, Fluency, coherence, Understanding
Q. 10.	(1st Option)	Long Answer	07M		Content, organization, Fluency, coherence, Understanding
	or (2nd Option)	or Long Answer	or 07M	or	or Content, organization, Fluency, Coherence, Understanding
Q. 11.		(a) SA (b) SA (c) SA (d) SA	2M 2M 2M 2M		Understanding Understanding Understanding Understanding

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# **QUESTION PAPER**

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## **ENGLISH (CORE)**

**MARCH, 2008**

**Time : 3 hours**

**Maximum Marks : 100**

***General Instructions***

1. *This paper is divided into three Section : A, B, and C. All the sections are compulsory.*
2. *Separate instruction are given with each section and question, wherever necessary. Read these instruction very carefully and follow them faithfully.*
3. *Do not exceed the prescribed would limit while answering the question.*

### **Section A : READING**

**20**

**1. Read the passage given below and answer the questions the follow :**

1. The word 'depressed' in common usage means sad, frustrated, fed up, bored up and pessimistic. The mood of a depressed person is much lower at his or her best moments than the mood of the normal person at his or her worst. Depression is a state of mind. It is specifically a mental disorder characterised by a lowering of the individual's vitality, his mood, desires, hopes, aspirations and of his self-esteem.
2. Depression arising out of environmental factors is called reactive depression whereas depression arising out of some biochemical changes in the brain is called endogenous depression. If depression is mild or moderate and if the individual is in touch with his surroundings, it is known as neurotic depression. If the individual is severely disturbed and is not able to comprehend what is happening around, such a state is called psychotic depression.
3. Old age is one of the stages of human development, where a person attains wisdom, maturity, social and economic stability with social recognition and emotional fulfillment. Generally, societies show a great respect and consideration for the aged. In ancient times old people were considered as the guiding stars in Indian families, since they were symbols of tradition, respect, wisdom and experience. In primitive, ancient and medieval cultures, old persons had a recognized social role. They were of great value because they could impart knowledge and skill to youngsters. The old people were considered as repositories of wisdom and traditions and were not perceived as problems.
4. At present, social structures and values are undergoing transformation from traditional to modern. There is a rapid stride in urbanization and industrialization leading to the breaking up of joint families and property. This has ultimately weakened the traditional families, social position and

status of the aged in the family. From time to time changes in the institutions of marriage and family have diminished the control of parents over their children. It has increased the freedom of children and they view the aged as a useless and non-productive entity. Modernization has eventually led to the degradation of their status and authority. Consequently the integrity of the family and the existence of the elderly as an integral part of the family are being uprooted. The importance of their functional positions thus declines and consequently their authority and much of the respect and prestige that they enjoyed earlier get faded. These changes generally bring about depression in older people.

5. As old age advances events at home may also contribute more to their problems. The 'empty nest' feeling arising as a result of the grown up children leaving the home, daughters departing as a result of wedlock and sons leaving station in pursuit of higher education or jobs may make the aged more lonely. The loneliness also arises because of premature loss of spouse. This would deprive the person of a long standing emotional bond that had provided plenty of emotional succour and security. The loss wherever it might occur in the later years leaves the individual terribly lonely and at the mercy of the sons and daughters-in-law. Added to these the increasing gap and interactional stress and strain in the family may leave the elderly without peace of mind. The elderly as a result of these developments feel marginalised, alienated and left out of the main stream. The foregoing are the common problems faced by most of the elderly. These either directly or indirectly lead to a state of depression and make ageing for many an unwanted and unpleasant event to be abhorred.

6. Usually, the mild depression which is caused due to environmental factors is temporary. The person reconciles within a short time and tries to forget the loss. Kind words, and timely support of friends, relatives and family members help one recover from depression.

(a) (i) What does 'depressed' mean in common usage? 2  
(ii) What is reactive depression? 1  
(iii) What was the status of the old people in ancient India? 2  
(iv) What are the causes for disintegration of joint family system? 2  
(v) How does one recover from mild depression? 2

(b) Pick out the words from the passage that mean the same as the following :  $3 \times 1 = 3$

(i) Decreased (para 4)  
(ii) to feel that they do not belong to a group (para 5)  
(iii) a husband or wife (para 5)

2. Read the passage given below and answer the questions that follow :

A vast blanket of population stretching across South Asia is cutting down sunlight by 10 per cent over India, damaging agriculture, modifying rainfall patterns and putting hundred of thousands of people at risk, according to a new study.

The startling findings of scientists working with the United Nations Environment Programme indicate that the spectacular economic growth seen in this part of the world in the past decade may soon falter as a result of this pollution.

Research carried out in India indicates that the haze caused by pollution might be reducing winter rice harvests by as much as 10 per cent, the report said.

"Acids in the haze may, falling as acid rain, have the potential to damage crops and trees. Ash falling on leaves can aggravate the impacts of reduced sunlight on earth's surface. The pollution that is forming the haze could be leading to several hundreds of thousands of premature deaths as a result of higher levels of respiratory diseases," it said. Results from seven cities in India alone, including Delhi, Mumbai, Ahmedabad and Kolkata, estimate that air pollution was annually responsible for 24,000 premature deaths in the early 1990s. By the mid 1990s they resulted in an estimated 37,000 premature fatalities.

"The haze has cut down sunlight over India by 10 per cent (so far)—a huge amount! As a repercussion, the North West of India is drying up," Prof. V. Ramanathan said when asked specifically about the impact of the haze over India. Stating that sunlight was going down every year, he said. "We are still in an early stage of understanding of the impact of the haze."

Asked whether the current drought in most parts of India after over a decade of good monsoon was owing to the haze, he said, "it was too early to reach a conclusion. If the drought persists for about four to five years, then we should start suspecting that it may be because of the haze."

India, China and Indonesia are the worst affected owing to their population density, economic growth and depleting forest cover. The preliminary results indicate, that the build up of haze, a mass of ash, acids, aerosols and other particles is disrupting weather systems, including rainfall and wind patterns and triggering droughts in western parts of the Asian Continent. The concern is that regional and global impacts of the haze are set to intensify over the next 30 years as the population of the Asian region rises to an estimated five billion people.

- (a) On the basis of your reading of the above passage make notes on it using headings and sub-headings. Use recognizable abbreviations, wherever necessary. 5
- (b) On the basis of your reading of the above passage make notes on it using headings and sub-headings. Use recognizable abbreviations, wherever necessary. 3

## **Section B : ADVANCED WRITING SKILLS**

- 3. You lost your wrist watch in your school auditorium. Write a notice in not more than 50 words for your school notice board giving a detailed description of the watch. You are Anirudh/Arundhati of class XII of Springfields School, Pune.

### **OR**

You are Dr. Madhu, M.D. You are looking for an independent house in Ghaziabad on a reasonable rent for your residence-cum-clinic. Draft a suitable advertisement in not more than 50 words to be published in Hindustan Times, New Delhi. Your telephone no is 12341234. 5

- 4. Your are Amrit/Anuradha of B.M.B. Public School, Dalmianagar. Recently your school celebrated Environment Week. Giving details of the celebrations write a report in 100-125 words for your school magazine. 10
- 5. You are Akash/ Ambika. You attended a seminar arranged for class XII students by AMC School, Chennai on the topic, 'How to face the examination with confidence.' Write a report in 100-125 words for your school magazine. Invent the necessary details.

**OR**

6. National Cadet Corps is an organization which not only inculcates discipline in the youth but also prepares them for the defence of the country. It also provides an opportunity to the students to participate in various other activities such as adventure, culture etc. Write an article in 150-200 words on the need to make N.C.C. Compulsory in all schools in the country. 10

**OR**

Joint family system is gradually disintegrating in the country. Many elderly people get neglected because of the nuclear set up of families. It increases the need of homes for the aged. Write an article in 150-200 words on the topic entitled "Should there be Homes for the Aged in India."

### **Section C : LITERATURE**

7. (a) Read the extract given below and answer the question that follow :

..... put that thought away, and  
looked out at young  
trees sprinting, the merry children spilling  
out of their homes.

- (i) Who looked out at young trees? 1  
(ii) Which thought did she put away? 2  
(iii) What do young sprinting trees signify? 1

**OR**

Perhaps the Earth can teach us  
as when everything seems dead  
and later proves to be alive.

Now I'll count up to twelve  
and you keep quiet and I will go.

- (i) What does the earth teach us? 2  
(ii) why does the poet count up to twelve? 1  
(iii) What will keeping quiet help us achieve? 1

- (b) Answer any *three* of the following question in 30-40 words each : 3 × 2 =6

- (i) What was the place of the folk who had put up the roadside stand?  
(ii) What does the poet wish for the children of the slums?  
(iii) How does the poet describe Aunt Jennifer's tigers?  
(iv) What makes human beings love life in spite of troubles and suffering? (A Thing of Beauty)

8. Answer the following question in 30-40 words each :  $5 \times 2 = 10$

- (a) Garbage to them is gold. Why does the author say so about the rag-pickers?
- (b) How was the scene in the school on the morning of the last lesson different from that on other days?
- (c) How do we know that ordinary people too contributed to the freedom movement?
- (d) Why did everybody in the studio think of giving the author some work to do?
- (e) State the reason for the huge success of the novel, 'The Name of the Rose.'

9. Answer the following question in 125-150 words :

What was Douglas's fear? How did he overcome that fear?

**OR**

Compare and contrast the character of the iron master with that of his daughter.

10. Answer the following question in 125-150 word :

How did Mr. Lamb's meeting with Derry become a turning point in Derry's life?

**OR**

The world's geological history is trapped in the Antarctica. How is the study of this region useful to us?

11. Answer the following question in 30-40 words each

$4 \times 2 = 8$

- (a) Do you think that the third level was a medium of escape for Charlie?  
Why?
- (b) How did the tiger king celebrate his victory over the killing of the 100<sup>th</sup> tiger?
- (c) How did the gardener react when Dr. Sadao told him about the wounded American soldier?
- (d) How does Jo want the story to end and why?

**MARKING SCHEME**

**SUGGESTED VALUE POINTS  
SECTION A : READING**

---

1      1      1      **Comprehension Passage**

- 
- (a)      (a)      (a)      Note : No mark(s) should be deducted for mistakes of grammar, spelling, or word limit. Full marks may be awarded if a student has been able to

identify the core ideas. If a student literally lifts a portion of the given passage as an answer to a question, no mark(s) to be deducted for this as long as it is relevant.

(i)	(i)	(i)	unhappy/sad/frustrated/fedup/mental disorder/bored up and pessimistic	2 marks
(ii)	(ii)	(ii)	depression arising out of environmental factors	1 marks
(iii)	(iii)	(iii)	<ul style="list-style-type: none"> <li>- Considered as guiding stars</li> <li>- had a recognised social role</li> <li>- were of great value as they could impart knowledge (any two)</li> </ul>	2 marks
(iv)	(iv)	(iv)	<ul style="list-style-type: none"> <li>- transformation of social structures and values from traditional to modern</li> <li>- rapid stride in urbanisation and industrialization</li> </ul>	2 marks
(v)	(v)	(v)	<ul style="list-style-type: none"> <li>- with kind words</li> <li>- timely support of friends, relatives and family members</li> </ul>	2 marks
(b) (i)	(b) (i)	(b) (i)	diminishing/degradation/declines/wakened	1 mark
(ii)	(ii)	(ii)	alienated/marginalised/left out	1 mark
(iii)	(iii)	(iii)	spouse	1 mark

- Note**

  - If a student has attempted only summary or only notes, due credit should be given.
  - 1 mark allotted for title be given if the student has written the title either in Q2(a) or Q2(b) part.
  - Min. 3 main headings and 3 sub-headings to form content.

The notes provided below are only guidelines. Any other title, main points and sub-points should be accepted if they are indicative of the candidate's understanding of the given passage, and the notes include the main points, with suitable and recognizable abbreviation. *Complete sentences not to be accepted as notes.*

Numbering of points can be indicated in different ways, and these should be accepted as long as a consistent pattern is followed.

(a)	(a)	(a)	<b>Note Making</b>	
			Distribution of Marks	
			<b>Abbreviations/Symbols</b> (with/without key) – any four	1 marks
			<b>Title</b>	1 marks
			<b>Content</b> (minimum 3 sub-headings, with proper Indentation and notes)	3 marks

### **Suggested Notes**

### Distribution of Marks

**Abbreviations/Symbols** (with/without key) – any four

### Title

**Content** (minimum 3 sub-headings, with proper Indentation and notes)

1 marks

1 marks

3 marks

---

Suggested Notes

**Title :** Pollution/Effect of Pollution/Global Impact of Pollution/Any other suitable title)

1. Effect of Polln. (in S.E. Asia)
    - 1.1 cuts sunlight – 10% in India
    - 1.2 damages agri.
    - 1.3 modifies rainfall patterns
    - 1.4 people at risk/hindering eco. growth.
  2. Findings of UNEP
    - 2.1 blanket of polln. across S.E. Asia
    - 2.2 growth may falter
    - 2.3 might reduce winter rice harvest
  3. Research about India

- 3.1 acid rains damage crops and trees
- 3.2 ash on leaves reduces sunlight
- 3.3 respiratory diseases
- 3.4 2400 premature deaths
- 3.5 N.W. India drying up due to drought.
- 4. Far reaching global impact
  - 4.1 esp. in India, China, Indonesia due to
    - popu. density
    - economic growth
    - depleting forest cover
  - 4.2 effect
    - haze disrupts weather system
    - triggers drought in West Asia.

(b) (b) (b) **Summary**

The summary should include all the important points given in the notes.

<b>Content</b>	2 marks
<b>Expression</b>	1 mark

## **SECTION B : ADVANCED WRITING SKILLS**

**Note :** The objective of the section on Advanced Writing Skills is to test a candidate's writing ability. Hence, expression assumes as much importance as the content of the answer.

3 3 3 **Notice**

<b>Format</b>	1 mark
<b>Content</b>	2 marks
<b>Expression</b>	2 marks

**Suggested value points**

(Lost/Lost Wrist Watch/Lost and Found)

- day and date/time/location
- description of wristwatch – make, looks, design, shape etc.
- whom to contact/where
- incentive for finder

*OR*

**Advertisement**

<b>Content</b>	3 marks
<b>Expression</b>	2 marks

**Suggested Value Points**

(Accommodation Wanted)

- location
- facilities required for house-cum-clinic
  - 24 hours water
  - electricity backup
  - fully furnished
  - big rooms

- approximate rent
- contact address/phone

---

4      4      4      **Report Writing**

---

**Format**

- |                           |        |
|---------------------------|--------|
| 1. title, reporter's name | 1 mark |
|---------------------------|--------|

**Content**

4 marks
---------

**Expression**

5 marks
---------

Grammatical accuracy, appropriate words and spellings (2½)

Coherence and relevance of ideas and style (2½)

---

**Suggested Value Points :**

(Environment Week)

- when
  - where
  - activities/programmes conducted during the week
  - any other special feature(s)
- 

*OR*

---

**Suggested Value Point**

(Seminar on how to face the Examination with Confidence)

- when
  - where
  - details of seminar
    - e.g., panel of experts/student interaction/response
  - any other special feature(s)
- 

5.    –    –    **Letter Writing**

---

[Note : No marks are to be awarded if only the format is given. Credit should be given to the candidate's creativity in presentation of ideas. Use of both the traditional and the new format is permitted.]

**Format**

2 marks
---------

1. sender's address, 2. date, 3. receiver's address, 4. subject heading,
  5. salutation, 6. complimentary close.
- 

**Content**

4 marks
---------

**Expression**

4 marks
---------

Grammatical accuracy, appropriate words and spelling [2]

Coherence and relevance of ideas and style [2]

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(Details of Scholarship)

**Suggested Value Points**

- mention the categories
- what excellence has been achieved
- how to apply for scholarship

*OR*

(Order for Books)

**Suggested Value Points**

- list of books/author/no. of copies
  - request for bulk discount
-

- mode of payment
- deadline for delivery of books

6	6	6	<b>Article Writing</b>	
			<b>Format :</b> (Title and Writer's Name)	1 mark
			<b>Content</b>	4 marks
			<b>Expression</b>	5 marks
			Grammatical accuracy, appropriate words and spelling [2½] Coherence and relevance of ideas and style [2½]	

**Suggested Value Points**

(NCC/A must for all Schools/NCC and schools/any other suitable title)

- activities of NCC
- how it inculcates discipline in youth
- what do children learn as a cadet
- motivates youth to be adventurous
- grooms youth
- close to culture
- prepares for defence forces
- reasons to make NCC compulsory
- any other relevant point

*OR*

**Suggested Value Points**

(Should There be Homes for the Aged in India?)

**Reasons**

- joint family disintegrating – setting up of nuclear families
- elderly alienated – children getting married/going abroad

**Solutions**

<b>Yes</b>	<b>No</b>
– safety for elders	– basically a western concept
– combats loneliness	– against Indian culture
– medical attention	– the aged need physical and mental support from family members.
– like-minded people stay together	– families can utilise their maturity /wisdom
– have freedom–no burden on burden on children.	– provide support system for the family

(any four)

(any four)

**Section C : Literature**

**Note :** The objective of the section on Literature is to test a candidate's ability to understand and interpret the prescribed text through short answer and long answer type questions. Hence both content and expression in answer to the given question deserves equal importance while awarding marks.

- 7(a)    7(a)    7(a)    [This question has been designed to test the student's understanding of the text and their ability to interpret, evaluate and respond to the questions based on the given stanza. In other words, it attempts to test their

reading comprehension ONLY]

Value Points :

(i)	(i)	(i)	– the poet/Kamala Das/narrator	1 mark
(ii)	(ii)	(ii)	– thought of separation/death/unpleasant thoughts of old age	2 marks
(iii)	(iii)	(iii)	– continuity of life/life/youthfulness/energy/passage of time	1 mark

*OR*

(i)	(i)	(i)	– everything not dead on this earth/there is life under apparent stillness – teaches us to be alive/regeneration/power to recover from loss	2 marks
(ii)	(ii)	(ii)	– there are twelve markings on the clock to measure time/there are 12 months/taking time to calm down	1 mark
(iii)	(iii)	(iii)	– understanding of ourselves/peace and tranquility/ceasing of all cruel activities/introspection	1 mark

**7(b) 7(b) 7(b) Short answer type questions (Poetry)**

Distribution of marks :

<b>Content</b>	1 mark
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<b>Expression</b>	1 mark
-------------------	--------

(deduct  $\frac{1}{2}$  mark for two or grammatical/spelling mistakes)

Value Points :

(i)	(i)	(i)	– desired the city dwellers to buy goods. – wanted flow of cash for better standard of living	2 marks
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(ii)	(ii)	(ii)	– for the governors, inspectors, visitors/authorities to bring about a change – to widen their horizons – to take the children closer to nature/liberate them from their miserable condition – provide good education	2 marks
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(any two)

(iii)	(iii)	(iii)	– topaz/golden coloured – prancing, bright-eyed denizens – free and fearless – sleek and chivalric	2 marks
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(any two)

(iv)	(iv)	(iv)	– nature is the best healer – brings beauty and joy to our life – the memory of the beautiful experiences help us to bear our sorrows/ provide a bower/a peaceful retreat	2 marks
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(any two)

**8 8 8 Short answer type questions (Prose)**

Questions are to be answered in 30–40 words

Distribution of marks:

<b>Content :</b>	1 mark
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<b>Expression</b>	1 mark
-------------------	--------

(Deduct  $\frac{1}{2}$  mark for two or more grammatical/spelling mistakes)

**Value Points :**

- (a) (a) (a)
- expect to get some coins, notes or valuable
  - sometimes they find a rupee or even a ten-rupee note
  - for children garbage is wrapped in wonder
  - for adults—a means of livelihood
- (any two)
- 

- (b) (b) (b)
- Other days
- 2 marks

## Days of the last Lesson

- unusually silent/M. Hamel dressed in his best suit/classmates already in their places/village people sitting quietly in the class.
- 

- (c) – –
- thousand of people demonstrated around the court room where Gandhi was summoned which made the Britishers feel challenged and baffled.
  - Prof. J.B. Kriplani received Gandhiji at the station with a large body of students.
  - sharecroppers from Champaran came barefooted to see Gandhiji
  - Muzzafarpur lawyers too called upon him
  - Raj Kumar Shukla, a peasant initiated Gandhiji's fight in Champaran
- (any two)
- 

Q. 9 and 10. [These questions have been set to test the students' understanding of the text and their ability to interpret, evaluate and respond to the issues raised therein. Hence no particular answer can be accepted as the only correct answer. All presentations may be accepted as equally correct provided they have been duly supported by the facts drawn from the text. The important thing is that the student should be able to justify his or her viewpoint.]

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- 9 – – Distribution of marks :

- Content** 5 marks
- 

- Expression** 5 marks

Grammatical accuracy, appropriate words and spelling [2½]

Coherence and relevance of ideas and style [2½]

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**Value Points :**

## Fear

- aversion to water since childhood (California beach and YMCA pool incidents)

## Overcoming Fear

- decided to get an instructor to learn swimming and conquer his fear.
  - instructor made him practise five days a week.
  - taught him how to exhale under water and inhale above water.
  - made a swimmer out of Douglas piece by piece.
  - dived off a dock at Triggs Island
  - Swam two miles across Lake Wentworth in New Hampshire
  - practised different kinds of strokes in swimming.
- 

**OR**

---

**Ironmaster**

- commits judgemental error – mistakes the stranger as his old regimental friend, requests him to come home.
- shows friendliness by sending his daughter when the stranger declines invitation
- attitude changes when the truth revealed that the stranger not his friend
- calls him dishonest and threatens to hand him over to the sheriff.

**Daughter**

- more sedate, understanding and affectionate
- intervenes to stop her father from ill treating the stranger
- treats him like a captain and gifts him a suit
- provides him with peaceful atmosphere
- is able to bring about a change in the peddler's attitude

(any five points)

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10      10      10      Distribution of marks :

**Content :**

4 marks

**Expression**

3 marks

Grammatical accuracy, appropriate words and spelling [1½]

Coherence and relevance of ideas and style [1½]

**Value Points :**

- Both Lamb and Derry handicapped
- Derry in the beginning withdrawn and defiant
- couldn't stand people staring at him
- Lamb open-minded and generous.
- kept garden gate open and welcomed all
- had a positive attitude, taught Derry not to indulge in self pity/love life
- taught him the ways of dealing with people
- Derry confessed to his mother that Lamb talked of things that nobody had ever talked of – things that gave him an optimistic outlook.
- even defied his mother.
- Derry's return to Lamb's garden shows his appreciation for Lamb/ restored confidence.

(any four points)

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**OR**

- Antarctica – only place in the world remaining pristine (never sustained human populations)
- holds in its ice-cores half million year-old carbon records
- only place to study Earth's past, present and future

can enable to use

- Study problems of global warming (glacier retreating, ice shelves collapsing)
- concept of evolution and extinction
- significance of Cordilleran folds and granite shields; ozone and carbon

11(a)	11(a)	11(a)	If Yes	2 marks
			<ul style="list-style-type: none"> <li>- it was a waking dream</li> <li>- a wish fulfilment</li> <li>- provided escape from modern day fear, insecurity, worry.</li> </ul>	
			If No	
			<ul style="list-style-type: none"> <li>- then the place really existed as Charley describes vividly railway station, people dresses, newspaper and counters.</li> <li>- Same exchanging money, disappearance, letter in the first day cover</li> </ul> <p>(any two)</p>	
(b)	-	-	<ul style="list-style-type: none"> <li>- filled with joy</li> <li>- exclaimed that his vow had been fulfilled.</li> <li>- ordered the tiger to be brought in a grand procession</li> <li>- turned his attention to his son.</li> <li>- gave him a special gift on his birthday.</li> </ul> <p>(any two).</p>	2 marks
(c)	-	-	<ul style="list-style-type: none"> <li>- old gardener pulled a few hairs on his upper lip</li> <li>- strongly opposed his master for treating the wounds of the enemy</li> <li>- said that the sea wished to kill him</li> <li>- the gun-wound intended to kill him</li> <li>- refused to obey the orders</li> </ul> <p>(any two)</p>	2 marks

## SECTION A

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# READING SKILLS

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**20 MARKS**

7 Reading comprehension passage – 12 marks

7 Note making Passages – 8 marks

### COMPREHENSION

#### PASSAGE 1

**A1. Read the passage given below and answer the questions that follow :**

1. All of us carry the seeds of genius which are capable of producing great thoughts or actions. We possess inner powers enabling us to see visions, and at the same time we have ability to give them creative expression.
2. It means that the positive thoughts pattern of our inner genius can be put to test in the production of new ideas. The habit of seeing everyday things from new angles is the fundamental trait of all geniuses. It is by such methods that new discoveries have been made. A genius probes beneath the surface of things and forms new combinations of facts and ideas which refuse to be defeated until positives have been obtained.
3. Such an attitude of mind is bound to be unusual for the simple reason that few of us are willing to change our old routines. Original ways of looking at things appear to be far too strange and unsettling. There may be a risk involved which might mean ridicule, contempt or even cold indifference from colleagues and contemporaries.
4. We tend to equate a high intelligence quotient with genius. Genius seem to be a quality of mind apart from intelligence. This is partly the reason why many geniuses have found schools and universities dull places. They were pursuing their own lines of thought. Reynolds preferred to cover his school books with sketches and drawings. John Stuart Mill and Sir Francis Gallon were scholars from a very early age. John Stuart Mill Greek classics at six, while Sir Francis Gallon knew his capital letters by twelve months. A genius usually spends a great deal of time in using his or her talents for producing great works in any field of human endeavour. Newton spent 19 years before he could understand the significance of falling apple.
5. An important aspect of genius is critical judgement. By such action subconscious forces begin to work until a flash of inspiration floods the mind with new solutions to old problems. The process could almost be compared with an electrical spark jumping between two terminals of a power unit and lighting up unexplored territory.
6. Geniuses are often assumed to possess good memories, but once again we find that such a distinguishing feature is not always characteristic of the best minds. Einstein used hundred dollar notes as book marks, and often forgot them.

7. In achieving their goals they are largely self-taught. It is the self-taught methods in conjunction with independent thoughts and views which produce originality. Genius is known for serious quest for truth in art, science, literature, and life. From this viewpoint we can well understand that they will dream and make new discoveries.
8. What we call inspiration of the genius is not a spell of divine blessing. It is a climax and crescendo of diligent work put in by the artist, musician or writer. It is the mind behind the brain which is important. The genius looks inside himself and finds creative energy on a vast dimension. Hence, anyone who observes carefully and resolves steadily grows into a genius of his own kind.
9. What changes need to be made in the working and living habits of adults? By removing unfavourable conditions and providing additional opportunities, we can do much to encourage and foster creative thought. We all, at one time or another have wondered how a certain work of art, or invention, or a scientific discovery was made. We marvel at the excellence of the product and wonder how it was conceived. We wonder how the writer, artist, musician inventor, or scientist thought to produce the great work of literature, music, art or the new invention.
10. Creative thinking is behind every work of art or science and behind every invention : it has advanced the progress of civilization. Without creative thinking we would have none of the luxuries and comfort of modern life.

***On the basis of reading the above passage, answer the following questions :***

- |  |   |
|--|---|
| 1. What do our inner powers equip us with?                                       | 2 |
| 2. What is the fundamental characteristic of all geniuses? What does it lead to? | 2 |
| 3. Why are the original ways of thinking unsettling?                             | 1 |
| 4. How does critical judgement work? What can it be compared with?               | 2 |
| 5. How can creative thoughts be encouraged?                                      | 1 |
| 6. Why is creative thinking vitally important for our program?                   | 1 |
| 7. Vocabulary  | 3 |
| (i) Effort – Para 4  |   |
| (ii) Long Search – Para 7  |   |
| (iii) Careful, Hard work – Para 8  |   |

## **PASSAGE 2**

**A1. Read the following passage and answer the questions that follow :**

1. In India, we keep translating every moment of our life and most of us are bilingual if not multilingual by necessity. We often mix languages and shift from one to another almost unconsciously in our everyday speech. This is true not only of the middle-classes—unfortunately turning increasingly monolingual under the impact of modern education—but even more of the poor who are forced

to learn more than one language to earn their livelihood. I have seen fish-sellers at Delhi's INA market announcing the day's arrivals in Malayalam as the fish-loving Keralites frequent market, and the rickshaw pullers of Hyderabad switching over from Telugu to Tamil, Hindi or Urdu, depending on the mother tongue of the passenger. We need translators to hold India together and help us understand one another's culture, literature and world view. Multilingualism is the very soul of our collective being and our great poet-visionaries like Kabir, Nanak, Vidyapati and Meera each composed their verses in many tongues, adapting therein speech to the people they addressed.

2. The story of Indian literatures until the 19th century is the story of creative translation, adaptations, retellings and interpretations of classical texts wholly or in part. Translations from and into Sanskrit, Persian, Arabic and modern Indian languages knit together religions, communities, cultures and languages. The translations during the colonial days, despite their selective appropriation and canonisation, also kept the process alive.
3. In our post-colonial days, translation is a way of retrieving our people's histories and recording their past and present. It is a positive celebration of creative difference and a reinventing of cultural identities that is crucial cultural mission in these days of globalisation and the consequent standardisation of cultures.
4. One of the anxieties that surrounds the act of translation is that of the possible losses the text suffers in the process of transmission. It is believed that poetry suffers most in translation : "Poetry is what is lost in translation" is an extreme statement of the concern. And the other negative injunctions follow : "Translators are traitors" (an Italian saying); "Translation is the wandering existence in a perpetual exile" (Hillis Miller); and the like.
5. Yes, poetry often loses its original verbal music in translation, its specific tone and at times even its original syntax and structure. Prose, too, suffers losses, especially fictional prose that has a dialectal bias. The tonalities of dialects in one language are difficult to carry into another language. The degree of faithfulness in translation often depends on the degree of the kinship between the original and the target languages. I have seen how Tamil translates well into Malayalam and vice-versa. This may be true also of Punjabi and Dogri, Hindi and Rajasthani or Assomiya and Bangla. But what is gained is certainly more than what is lost. If the original tone and music are lost, they are also replaced by those of the target language and the transmission loss is mostly compensated by the gains : a new syntax and structure, new associations, the text's rebirth in another culture.
6. There was a time in India, not so long ago, when the translated works seldom carried the translator's name and translation was looked upon as a lot inferior to creative writing. The prejudice still persists in certain circles. But translators are slowly gaining visibility and translations are beginning to find a committed readership. There is also a new academic interest in the theory and practice of translation as testified to by the newly set up department of translation studies in our universities, new research in the area and the spurt in the number of books related to translation. Publishers have also begun to show a new interest in bringing out translations, even if mostly of fiction. The Frankfurt Book Fair and the Paris Book Fair with India as the 'guest country' and the Festival of Foreign Literature in France have also helped to bring the West's attention to the great literature in our languages despite the domination of Indian writing in English for various reasons, the chief of them being the availability of translators from English to the European languages.

7. The Sahitya Akademi and the National Book Trust have played their role in translating contemporary classics. In the private sector, Katha, has been one publisher devoted to quality English translations from Indian languages. MacMillan brought out some important works of fiction in English translation, a work that now the Oxford University Press seems to be carrying on in earnest. Penguin, Orient Longman, Affiliated East-West, New Horizons, Zuban, Women Unlimited, The Book Review Literary Trust, Rupa, Harper Collins and other established and emerging publishers are also making their contribution.
8. We also need to strengthen mutual translations in our languages so that we come to know ourselves better. What we gain from translation is not only what the text gains, but what the whole culture gains in terms of fresh perspectives of life and literature.

**On the basis of reading the above passage, answer the following questions :**

- |  |   |
|--|---|
| 1. How do most of us become bilingual unconsciously?   | 1 |
| 2. "Translations play an important role in the society". How?  | 2 |
| 3. How does poetry suffer in the process of translation?   | 2 |
| 4. What was the prejudice against translated works? How is it gradually changing?  | 2 |
| 5. Why should we promote mutual translations in Indian languages?  | 2 |
| 6. Find words from the passage which mean the same as the following :<br><br>(i) speaking many languages – Para 1<br>(ii) Continuous – Para 4<br>(iii) Belonging to the same period – Para 7 | 3 |

## **COMPREHENSION A1**

### **PASSAGE 3**

**A1. Read the following passage and answer the question that follow :**

1. In the social milieu today, inequality is pervasive but it is more pronounced in the case of women. All through her life a woman faces, innumerable obstacles, preventing the realisation of her dreams and, sadly, the community does a splendid job in giving preference to the man from day one. This difference in attitude towards men and women exists at all levels of society and faced in the fields of education, job opportunities, health etc., basically those that fall within the basic rights of a person.
2. Though India has been on the move since independence, it is only in a few lives that a difference has been made. One may be taken in by the self-confident, brave and go getter new woman projected in the media, but that is the reality of only a minuscule percentage that constitute our billion plus population.
3. The disparity is even more conspicuous in the rural areas and among the poor. A girl finds herself being left without necessities like nutritious food and education. While her brother goes

to school, she, the young girl, attends to the household chores, looks after the younger siblings and even participates in agricultural tasks. What makes matters worse is the tag of being the weaker sex that propagates the cultural belief that she is inferior and useful only as a housewife and in producing babies, thereby limiting her potential. Further, the insensitive and gender-biased attitude of the teachers and textbooks, and lack of good schools within reasonable distance, all contribute in making her and her family members reluctant and de-motivated towards education.

4. There has been a tremendous increase in mobility—whether social or geographical and the awareness regarding opportunities has also increased with increasing industrialization. However rampant ignorance and illiteracy, coupled with several other factors, has led to limited result. In order to make good the situation, various efforts have been envisaged for girls.

These include provision of facilities such as separate toilets for girls, separate primary and upper primary school for girls, provision for women teachers and childcare facilities in schools, attendance scholarships, etc. however, there needs to be greater emphasis and initiative with regard to interventions such as alternative schooling, flexible school timings, residential schools, a more gender-sensitive curricula and textbooks.

5. Whether, or not any progress has been made in this direction will be reflected through many indicators. The flexibility of gender division of labour is one such indicator, is there some kind of social punishment or is there increased tolerance for transgression of conventional gender roles? More often than, not, it may be noticed that development interventions rarely made efforts to change the ideology that domestic work and day-to-day takes of family maintenance and caring for must be done by women. Besides, self-sacrifice, multiple burden of work and denial of pleasure have been important part of their socialization. Importantly, leisure is not a function of enjoyment, but a function of self-development, and thereby a function of production and empowerment, too. In a more equitable set up focus on self is likely.
6. Male control and violence towards women (such as dowry deaths in India, honour killings in Pakistan female foeticide in India and China) generate a climate of fear which then tempers women's behaviour in ways that perpetuate their status of subordination and exclusion.
7. Understanding gender discrimination, enables people not only to become better equipped to help women and children realize their human rights, but also to better understand other kinds of inequalities, such as those based on age, race or class. And it can help in working towards the shaping of a truly progressive and egalitarian society.

***On the basis of reading the above passage, answer the following questions :***

- |  |   |
|--|---|
| 1. In which fields do we find discrimination against women in the society?                           | 2 |
| 2. Why are the parents reluctant to send the girls to schools in rural areas?                        | 2 |
| 3. What steps have been initiated to promote education for girls?                                    | 2 |
| 4. Define 'leisure'.   | 1 |
| 5. What are the factors responsible for thrusting women into a state of subordination and exclusion? | 2 |
| 6. Find out words from the passage which mean the same as the following :                            | 3 |

- (i) Noticeable – Para 3
- (ii) crossing the limits – Para 5
- (iii) showing belief in equal rights – Para 7

## A1. PASSAGE 4

### A1. Read the following passage carefully and answer the question that follow :

1. It was all very, very romantic. The night sky above the Amber fort, atop the craggy hills overlooking what is now Jaipur city, was at its most enchanting. And on a terrace watching the moon and the stars were a princess and a king. The princess had only that day been rescued by the king from a gang of brigands. They were both comely and in love with each other.
2. But, alas for romance. Though the princess did say it was heavenly, with something of a sigh of rapture, the question she asked was one that no Hollywood or Bombay film script writer would have ever thought of putting into the mouth of any of his heroines. The question was, How far away are these stars and the moon?"
3. If the lover in the king was abashed by the question, so also was the astronomer in him. For the king, Sawai Jai Singh II, who had long been interested in astronomy, did not know the answer. Then the princess gently chided him for his ignorance, all thoughts of romance fled and he decided that he must find the answer to her question. The princess he had rescued, a Muslim, thus set the Hindu king to a course that made him one of the greatest astronomers and mathematicians of his time.
4. Astronomers were invited to his court for study and discussions and the king read all the treatises he could find on the subject. Although history has forgotten the name of that beautiful princess, the *Jantar Mantar* (observatories) which the king built to gain her love and admiration still stand in New Delhi, jaipur, Varanasi and Ujjain. Unfortunately, the one at Mathura was destroyed by building contractors who wanted the stones.
5. When Jai Singh was born in 1686, the Mughul Empire was about to disintegrate. He managed to keep good relations with Emperor Aurangzeb from the age of 13, when he succeeded to the throne of Amber. He even won the Emperor's heart when in 170 he defeated the Marathas in battle and captured the Vishalgarh fort. The Emperor honoured him with the title of "Sawai", meaning that he was a quarter more than a man.
6. With the death of Aurangzeb in 1707, the Moghul empire began to crumble. Conspiracy, assassination and dirty politics became a part of the proceedings at the Delhi court. Finally, Muhammad Shah, a young lad of 19, was installed on the throne in Delhi in 1719 and surprisingly survived all attempts to dethrone and assassinate him. His 20-year rule ended when Nadir Shah defeated him in the battle of Panipat, sacked Delhi and took away the famous Peacock. Throne.
7. During those turbulent times, King Jai Singh was consolidating not only his political position but his stature as astronomer and architect. In 1727 he planned and designed a new capital Jaipur (Jai's City), marvellous example of town planning and architecture. He made Pandit Jagannathy, a Maratha Brahmin well versed in Persian, Sanskrit and Arabic, his *guru*. He collected astronomical treatises and tables from Portugal, Arabia and Europe. His collection included the English

astronomer, John Flamsteed's *Historia Coelestis Britannica*, Pere de la hire's *Tabulae Astronomicae*, Ulug Beg's tables, *Zij Ulugh Begi*, and Ptolemy's *Almagest*.

8. He ordered the translation of these treatises into Sanskrit and gave them Sanskrit names. For instance, he called Ptolemy's treatise *Siddhantasurikaustubha*, Ulugh Beg's tables *Turusurni* and la Hire's tables *Mithajeevachayyasurni*. He also got a telescope from Europe and even began to build telescopes.
9. In 1724, the first *Jantar Mantar* was built in Delhi and in 1734 Jai Singh published his observations made in Delhi in the form of tables in Persian titled *Zij Muhammad Shahi* in honour of his patron, the Emperor. *Jantar Mantar* is the distorted form of the word which in Sanskrit means "instruments and formulae." For designing these massive instruments Jai Singh consulted Pandit Vidyadhar Bhattacharya, who later also assisted him in designing Jaipur city. In those days, small brass instruments were in use in Europe, but jai Singh preferred the huge masonry structures of lime and plaster he built similar in design to those in Ulugh Beg's huge observatory in Samarkand. He claimed that these were far more accurate. He made his observatories available to anyone who wanted to study astronomy, hoping to make the science popular.
10. Among the instruments he designed himself are is *Samrat Yantra*, *Ram Yantra*, and *Jai Prakash*. The first is basically a huge right-angled gnomon, a kind of sundial, which measures time to an accuracy of half a minute. It is also used to determine the altitude of the sun and the positions of equinoxes and solstices. The *Ram Yantra*, a tall pillar inside a graduated cylinder, measures the altitude and azimuth of heavenly bodies to a high degree of accuracy.
11. Jai Singh made two fundamental contribution to astronomy. One is the measurement of the precession of the equinoxes and the other the obliquity of the ecliptic. His findings are far more accurate than those of his predecessors like Ptolemy and Ulugh Beg.
12. Surprisingly, Jai Singh confined himself to observation. He never gave thought to whether the earth moves round the sun or vice versa. He accepted Ptolemy's geocentric concept of the universe. Copernicus's heliocentric concept, which claims that the sun is at the center, and all the planets, including the earth, move round it, a widely accepted view then in Europe, made no impression on him. it is possible that he deliberately ignored the Copernicus concept fearing that his support to it would upset the priests.

***On the basis of reading the above passage, answer the following questions :***

1. What did the princess ask the king? Why was he abashed by the question? 2
2. What does the word Jantar Mantar mean? Why did Jai Singh build Jantar Mantar? 2
3. How did the political condition of Delhi deteriorate after the death of Aurangzeb. 2
4. Who was the guru of Jai Singh? 1
5. What are the two fundamental contributions of Jai Singh to astronomy? 2
6. Find out words from the passage which mean the same as the following : 3
  - (i) Steep and rocky – Para 1.
  - (ii) long written work dealing thoroughly with one subject – Para 8.
  - (iii) Intentionally – Para 12.

## A1 PASSAGE 5

### A1. Read the following passage carefully and answer the question that follow :

1. "Can it be true" King Vikramaditya asked in anguish, looking around the well-lit and crowded court. On one replied. All were shocked by the royal astrologer's prediction. "Yes , my lord, this is so, however bitter it may be for you," replied the royal astrologer, breaking the silence. His voice was full of grief. Yet it was authoritative. The position of the planets predicts the death of the prince at the age of 18."
2. While the King controlled his emotions, the Queen, sitting beside him, could not contain herself. "No! No!" she wailed. "my lord, you should see to it that this prediction proves false."
3. Though the King had full faith in his astrologer, Mihira, he took every precaution to save his son. But, on the predicted day, a boar killed the prince. When the news reached the King, he immediately summoned Mihira to his court. "I am defeated, you have won," he told Mihira. The astrologer was as sad as the king. he said, "My Lord, I have not won. It is the science of astronomy and astrology that has won." "Whatever it may be, my respected astrologer," said the King, "it has convinced me that your science is nothing but truth. And for your mastery of the subject, i now confer upon you the Magadha kingdom's greatest award, the emblem of the varahan (boar)." From that time Mihira came to be known as Varahamihira.
4. Varahamihira was born in 499 A.D. into a family of Brahmins settled at Kapiththa, a village near Ujjain. His father, Adityadasa, was a worshipper of the sun god and it was he who taught Mihira astrology . On a visit to Kusumapura (Patna) young Mihira met the great astronomer and mathematician, Aryabhata. The meeting inspired him so much that he decided to take up astrology and astronomy as a lifetime pursuit.
5. At that time, Ujjain was the centre of learning, where many schools of arts, science and culture were blooming in the prosperity of the Gupta reign. Mihira, therefore, shifted to this city, where scholars from distant lands were gathering. In due course, his astrological skills came to the notice of Vikramaditya Chandragupta II, who made him one of the Nice Gems of his court. Mihira travelled widely, even as far as Greece. He died in 587.
6. Varahamihira was learned in the *Vedas*, but was not a blind believer in the supernatural. He was a scientist. Like Aryabhata before him, he declared that the earth was spherical. In the history of science he was the first to claim that some "force" might be keeping bodies stuck to the round earth. The force is now called gravity.
7. He committed one blunder, however. He was sure that the earth was not in motion. "Had it been so," he said, "a bird moving in the direction opposite to the earth's motion (which is westwardly) would return to its nest as soon as it had flown from it."
8. Varahamihira made some significant observations in the fields of ecology, hydrology and geology. His claim that plants and termites serve as indicators of underground water is now receiving attention in the scientific world. He was also a prolific writer. His mastery of Sanskrit grammar and poetic metre enabled him to express himself in unique style.
9. His encyclopedic knowledge and his lively presentation of subjects, as dry as astronomy, made him a celebrated figure. His treatises such as *Panchasiddhantika* (Five Principles), *Brihatsamhita*

(Master Collection), *Brahjataka* (Astrological work), have put him on as high a pedestal in astrology as Kautilya's in political philosophy, Manu's in law, Panini's in grammar.

10. About his own treatises Varahamihira says: "The science of astrology is a vast ocean and it is not easy for everyone to cross it. May treatises provide a safe boat." That was no boast. Even now they are acknowledged as masterpieces.

**On the basis of reading the above passage, answer the following questions :**

1. Who was Mihira? Why was everyone shocked by his prediction? 2
2. How did Mihira come to be known as Varahamihira? 2
3. Why did Mihira decide to take up astrology and astronomy? Where did he study these subjects? 2
4. What is his greatest contribution to the history of science? 1
5. "Mihira was a versatile genius". Justify. 2
6. Find out words from the passage which mean the same as the following :
  - (i) Cried – Para 2.
  - (ii) Stupid mistake – Para 7.
  - (iii) Recognized – Para 10.

**A1. Read the following passage and answer the question that follow :**

1. What is poetry? poetry means saying something in a very expressive way using beautiful words which have a much deeper meaning than the words used in ordinary writing (which is called prose), and intense and ardent feeling in our minds. In prose, we may write things in a strong, forceful manner, but in a poem we give expression to our feelings and sentiments in highly emotional ways. Prose is usually matter of fact, but poetry is full of sentiment.
2. Many figures of speech are used while writing poetry. A poet may think quite a lot before finding the right word to describe his feelings. A great deal of rhyme and rhythm also is used. Owing to which poetry produces a musical effect apart from intense emotional feelings, when it is read aloud. Poetry also uses much imagery, that is, the poet's effort to create visual pictures by the words he uses.
3. Sometimes poets go beyond strict rules of grammar and syntax while writing poetry so that they can create the right effect or the right rhyme. Such action of taking liberty is called "Petic licence".
4. *A poet's imagination is not done till he flies beyond the sun.* Shall we take an example? Let us say that we want to say something about how we can learn to grow and develop by following the good examples of the lives of great people who lived in the past. We can, no doubt, write convincingly and forcefully about the advantage of following the principles of men and women who have led successful lives. But let us see how the same idea was expressed by a poet in a few poetic lines :

*Live of great men remind us  
We can make our lives sublime  
And departing leave behind us*

5. *Footprints on the sands of time."*
6. Do you know the name of the poet? Henry W. Longfellow.
7. Take another example. Let us imagine we want to write about our strong desire to keep our word. Life has many attractions and we may find many temptations in our way, which may prevent us from fulfilling our commitments. But we have chosen a certain career and dedicated ourselves to certain goal. We are determined to achieve the goal at any cost.
8. Now let us see how the poet. Robert Frost expressed the same idea in words which are deep and filled with feelings!

*'The woods are lovely, dark and deep  
But I have promises to keep  
And miles to go before I sleep  
And miles to go before I sleep.'*

Do you know the name of the poem?

Have you heard of the poem in which the poet Wordsworth says :

*And then my heart with pleasure fills  
And dances with the daffodils*

Usually poetry is written in short lines. A set of such lines is known as a stanza. In many cases rhyme is used, both at the end of the lines and sometimes at the beginning or in between too. In that case such a rhyme is called "alliteration". But we should remember that a rhyme alone does not make poetry. Poetry lies in the selection of beautiful and meaningful words. A rhyme is only an added attraction. Beginners who are learning to write poetry may use rhyme to a large extent. As an example of rhyme, we can recall nursery rhymes where rhyme was the leading method of teaching to the little ones.]

*Jack and Jill,  
Went up the hill  
To fetch a pail of water  
Jack fell down and broke his crown  
And Jill came tumbling after.*

10. We can see several examples of rhymes in nursery rhymes and other poems. But what about alliteration?
11. In the line by Wordsworth quoted, there is alliteration also. See the words dances and daffodils,. The use of many figures of speech, especially those dealing with soul effects and the use of rhythm and selection of words with appropriate sounds brings poetry close to music, song and dance.

12. In the olden days, people wrote plays in poetic style. Shakespeare and some other dramatists wrote their plays in the form of poetry. Shakespeare chose iambic pentameter. That is to say, each line has five feet and each foot has two syllables. The accent is placed on the second syllable.
13. There are many forms in which poetry is written. In general, poetry is called “Poem” or “verse.” The *sonnet* is a special type of poem which has 14 lines. Shakespeare has written many sonnets, though we are more familiar with his plays. Other well-known poets who have written sonnets are Keats,.....

Milton and Wordsworth. The name sonnet has come from the Italian word *sonetto* meaning sound.

14. Another poetic form is the “ode.” This is a poem which is usually written in praise of some person, object or a concept. The ode is of Greek origin. (The Greek word *oide* means song.) You must have heard of Shelley’s *Ode to a Nightingale*.
15. A “lyric” is a poem written usually briefly and in stanzas. Lyrical poems are meant to be sung. We read about the lyrics of a movie and the lyricist who writes the songs for the movies.
16. Another type of poetry is called the “ballad.” This is a song which describes the greatness of a popular, historical hero or narrates a heroic story in song form. This was developed in Europe in the Middle Ages. Poets like Sir Walter Scott, William Wordsworth and Samuel Taylor Coleridge wrote ballads.

An “epic” is a long historical poem concerned with heroism. Have you heard of the epic called *The Iliad* written by Homer, the Greek poet? You must have surely heard of Milton’s *Paradise Lost*.

***On the basis of reading the above passage, answer the following questions :***

1. Mention any two differences between poetry and prose. 2
2. How does poetry produce a musical effect? 1
3. Why do poets want to go beyond rules for writing poetry? 1
4. Explain ‘alliteration’ in poetry. 2
5. What kind of poetry did Milton, Wordsworth and Keats write? 1
6. What is the theme of a ‘ballad’? 2
7. Find words from the passage :
  - (i) very great or severe – Para 2. 1
  - (ii) To stop somebody to do something – Para 7. 1
  - (iii) To give or devote oneself thing – Para 7. 1

## PASSAGE 7

### A1. Read the following passage and answer the question that follow :

1. Bang! A bird fluttered for seconds and fell to the ground. A ten-year old bespectacled boy, who had shot the bird, ran and picked it up. The bird looked like a house sparrow but, to the boy's surprise, it had a yellow patch on its throat. Puzzled, the boy took the sparrow to his uncle, Amiruddin Tyabji, a big game hunter and asked him what kind of bird it was. His uncle did not know, but took the boy to the office of the Bombay Natural History Society, a tiny room in a huge building in Apollo Street. The boy was introduced to W.S. Millard, the honorary secretary of the society.
2. Millard was amused to find an Indian boy keen to know the kind of sparrow he had bagged. He took him around the room, showing the many varieties of stuffed birds preserved there. One after another, drawers were opened and birds were displayed to the boy, who had not even imagined that so many kinds of them existed. He gasped when Millard opened a drawer, which contained a large variety of sparrows. Examining carefully, Millard picked up one and showed it to the boy sure enough, the bird was exactly like the one he had brought with him—a yellow throated sparrow. "Uncle Millard," the boy exclaimed. "I didn't know there were so many kinds of birds! I wish to learn about them all! Millard smiled and nodded. He had till then not seen so much enthusiasm about birds even in an adult. Thereafter, the boy became a frequent visitor to that office. He began to learn how to identify a bird and stuff it for preservation.
3. The boy was Salim Moizuddin Abdual Ali, better known as Salim Ali, bird watcher extraordinary. Born on November 12, 1986, Salim Ali was interested in birds till the end. He was a recipient of the J. Paul Getty Wild Life Conservation Prize for his contributions to ornithology the study of birds. He won several national honours and awards as well.
4. Surprisingly, Salim Ali had no university degree. Although he joined college, his intense dislike of algebra and logarithm did not allow him to continue his studies. He left for Burma to help his brother in wolfram mining. But here again he proved a failure. In the jungles of Burma he looked for birds instead of wolfram.
5. When he returned home he did a course in Zoology and was appointed a guide at the museum of the Bombay Natural History Society. For some advanced training in stuffing and skinning of birds he went to Germany. But when he returned a year later, he found himself on the streets. For lack of funds his post in the museum had been abolished in his absence.
6. Salim Ali was a married man and badly needed a job. But the best he could hope for was a clerk's post and that would leave him little time to pursue his interest in birds. Luckily, his wife had a small income and could support him. They moved to a small house at Kihim, across the harbour. It was a quiet place set in the midst of trees. When the monsoon came that year, salim Ali found a colony of weaver birds on a tree near his house. Not much was known about weaver birds then and it was a golden opportunity for Salim Ali to study them. For three to four months he patiently watched the activities in the colony for hours on end. The publication of his findings in 1930 brought him recognition in the field of ornithology and he won high acclaim.
7. The months he had spent watching the weaver birds also taught Salim Ali the importance of making first-hand observations and not to accept blindly the notions of anyone, however famous. He checked his observations several times and did not jump to conclusions. This gave his

opinions great authority and sometimes brought him into confrontation with others considered to be doyens among ornithologists.

8. A famous instance was his observations on the growth of the tail feathers of the racket-tailed drongo. A leading ornithologist claimed that Salim Ali's observations were wrong. But eventually, Salim Ali was proved right. His discovery of Finn's Baya is also a major one. This bird was believed to have been extinct for 100 years until he discovered it in the Kumaon hills.
9. As a boy Salim Ali had felt the need for a good book on Indian birds. The few books then available were without illustrations and contained long, dual descriptions, which were more likely to kill than kindle interest in birds, especially among young readers. In 1941 he tried to remedy this. *The Book of Indian Birds* that he wrote contained lively descriptions and coloured pictures of every species. It made spotting a bird easy for the layman.
10. In 1948 he began an ambitious project in collaboration with S. Dillon Ripley, an ornithologist of international repute, to bring out in ten volumes *Handbook of the Birds of India and Pakistan*. The work contains all that is known of birds of the subcontinent, their appearance, where they are generally found, their breeding habits, migration and what remains to be studied about them.
11. Salim Ali travelled all over the country on his birdwatching surveys. It is claimed that there is hardly a place in the country where his heavy rubber shoes have not left their mark. Salim Ali died in 1987.

**On the basis of reading the above passage, answer the following questions :**

1. How did Millard feel seeing the boy at the office of the Bombay Natural History Society? 1
2. What was Salim's passion? Which award was conferred upon him? 2
3. Why couldn't Salim continue his studies? What did he do then? 2.
4. How did Salim's visit to Germany put him into trouble? 2
5. Which project did Salim start? How is it significant for study of birds? 2
6. Find words from the passage which mean the same as the following : 3
  - (i) Post for which no payment is made – Para 1.
  - (ii) Shelter for ships – Para 6.
  - (iii) Persons engaged in scientific study of birds – Para 7.

## **NOTE-MAKING**

### **PASSAGE 1**

**A2. Read the following Passage Carefully and answer the questions that follow :**

Most men and women dream of leading thousands of people. Actually, however, leadership always begins with two people. If you can give one other person besides yourself a feeling of the worthwhileness of his life; if you can help him with his problems, and enable him to see where his abilities can lead, you will be a leader in his eyes.

That is the first step every leader must take; to influence and help one person. No man, as John Donne once pointed out, is an island detached from other man. We are all pieces of the main land. Therefore, it is perfectly natural that we should all want to make ourselves count with others.

What is leadership? How can we achieve it? You must make yourself count in a group. The nice, weak-chinned individuals who never dare put forth their own views are not sought after. Says Dr. Bonney, "To be popular a person must make himself count in a group."

It is equally evident that no adult is liked because of any particular traits, but because of the total impression he makes. A person is well accepted more because of what he is and does in the way of making a contribution than because of one or more of the traits, is usually considered necessary for winning friends.

Even if you have a moderate amount of obnoxious traits, such as being bossy or untidy, you may yet be the most popular if you have strong, aggressive traits which contribute to success.

Try to do things for the groups and promote your group, not yourself.

Put service ahead of self. In the same way, every adult who puts service ahead of self can become important in what he is seriously interested.

Find an activity you consider worthwhile. Most organisations are in need of workers willing to do all kinds of difficult jobs. Since desirable activities often start in a small way, the important step is to make sure that you consider the job worthwhile before you undertake it.

The men who do not have the coverage of their own convictions are submissive, compliant, have a narrow range of interests, unable to make decisions, and are poor leaders.

Those who cling to their opinions when they are right, even though others hold contrary views, are efficient, capable, persuasive, self-reliant and independent in judgement, they are very effective leaders.

Among the other traits found in leaders are tolerance, social participation, and a sense of responsibility.

You can become a leader if your motivation is strong. Anyone can if he/she is filled with a sense of importance of the job he/she wants to do. To become a leader, you must begin with something in which you earnestly believe.

Listen to others. Always allow your schedule to be flexible, so that if someone comes to you for advice or help, you will find time at least to listen to him. Try to be a source of comfort and help at least to your acquaintances and friends.

Give some part of yourself away everyday. The more you give, the more you will get back, in terms of a richer, fuller life.

***On the basis of reading the above passage, answer the following questions :***

1. On the basis of your reading of the above passage make notes on it using leadings and subheadings. Use recognizable abbreviation (minimum four) wherever necessary. Suggest a suitable title. 5
2. Write a summary of the above passage in about 80 words, using the notes made. 3

## PASSAGE 2

### A2. Read the following Passage Carefully and answer the questions that follow :

1. The Approach between Kulu-Manali and Lahaul-Spiti via the Rohtang Pass did not exist in ancient times. The ancients called *Kullu Valley Kulantapitha* (the end of the habitable world). Perhaps they tried to climb out of Kullu Valley into Lahaul via the Rohtang Pass but did not succeed. According to a legend, the Lahaulis came to know about the existence of profitable markets in the south through the birds and the winds. Forthwith they *beseeched* Lord Shiva to open the ice-bound high barrier separating the two valleys. Lord Shiva *acceded* to their request and struck down the barrier but cautioned them to beware of the strong winds at the Pass. But now there are three *distinct* routes up the Pass. A short cut, with steps cut of mountain slope much of the way. Second : a mule *track* which is a bit less uncomfortable. Lastly the tarred road which climbs from Manali to the top of the Pass in 51 very pleasant and memorable kilometres. An adventurous tourist may take any of the three routes.
2. The road from Manali to Rohtang climbs through some of the most breath-taking scenery. The lower reaches pass through pine, fir and birch clad hills and small sheltered valleys. The vegetation on these hills is *lush* and varied. Wild flowers lie in abundance on the slopes. As one climbs, trees give way to grassy slopes and these in turn are replaced by rugged cliffs and deep, dark gorges resounding with raging torrents.
3. When one reaches the top, one does not find any narrow opening in the mountain range. The pass is one kilometre wide and one can have a majestic, *panoramic* view. One wonders why this place came to be called a pass. On both the sides there are vast meadows. This is the place where Kullu ends and Lahaul with *lunar landscape* begins.
4. *Straddling* the Pir Panjal range, this 13400-foot high pass lies on the old trade route to Central Asia. This has also been a gateway to Lahaul and Spiti and over the *Baralacha Pass* to Ladakh and far away Tibet. For centuries Ladakhi and Tibetan traders have passed-along this route with their merchandise. They brought salt and borax on their *pack ponies* and carried back loads of sugar, tea, foodgrains, oil etc. Via this route also came the famous Yarkand horses from Central Asia.
5. The word Rohtang is of Tibetan origin and means 'of lost souls'. This is strictly a fair weather pass. At the top *blizzards* rage almost all the year round except during three or four months and that also not always. Even at the height of summer it is bitterly cold. *Hurricane* winds hit the pass almost every day and around mid-day. Tourists are repeatedly warned not to stay up after mid-day or they might be blown off. Making an afternoon drive up or down the road is a very dangerous venture. There have been many cases in which men and sheep crossing the Pass were blown off. Many people are also known to have been buried under snow-drifts at the top of Pass.

**On the basis of reading the above passage, answer the following questions :**

1. Give the suitable title of the passage and make notes on it using appropriate format and abbreviations, (minimum 4) wherever necessary. 5
2. Write the summary of the passage in about 80 words. 3

## PASSAGE 3

### A2. Read the passage given follow and answer the question that follow :

There is nothing more damning and deplorable than the fact that it is not just India's national animal 'tiger' which is in danger at the hands of poachers but other animals in the wild such as elephants, rhinos and critically endangered *gharial*s who are equally under threat of being poached and rendered extinct in the years to come. Official figures, if not fudged, suggest in no uncertain terms that India's wildlife has been under threat for quite some time. A few steps taken by the Central and State governments, it seems to our dismay, have not deterred the poachers and others of their ilk from playing havoc with Indian's diverse and unique wildlife spread across the landscape of varying shapes and colours, climate and topography. The 'Wake-up call' is there is rise and act now or never. There is no option but to address the problem in all seriousness by taking such effective and pragmatic steps as are urgently required to protect our wildlife it gets too late to mend the matters.

In order to meet the challenge posed, the Finance Minister announced a special grant of Rs. 50 crore in the Budget (2008-09) to raise a tiger protection force and thus enable the National Tiger Conservation Authority to redouble efforts to protect the big cat.

In the case of *gharial*s the reason for their decline over the years has been attributed to possibility of nephro-toxin entering the food chain and loss of habitat due to illegal sand mining. These aberrations, coupled with poaching, shrinking of the forest areas as a result of urbanisation, mining and industrialisation need to be rectified by devising such ways and means as are practical and do not come in the way of economic development.

The constitution of multidisciplinary Tiger and other Endangered Species Crime Control Bureau, comprising officers from the police, forest, customs and other enforcement agencies, is one of the most effective ways to control illegal trade in wildlife. An increase in patrolling and co-ordination with other lawenforcing agencies at the State level can go a long way in addressing the problem and thus protecting the wild-life in India.

### ***On the basis of reading the above passage, answer the following questions :***

1. On the basis of your reading of the above passage, make notes on it using headings and subheadings. Use recognizable abbreviations (minimum 4) wherever necessary. Give a suitable title to the passage. 5
2. Write a summary of the passage in about 80 words using the notes. 3

## PASSAGE 4

### A2. Read the passage given below and answer the questions that follow :

There is no denying that urban India is getting congested and crowded beyond its known means of tackling day-to-day needs of its people, as a result of which the entire urban scenario tends to get vitiated with all hues and types of crime and violence. The ground realities call for deep introspection on the part of those who are supposed to run the affairs of the State and take such suitable and stringent steps as can ensure safety for urban citizens, both at homes and on the roads. It is nobody's demand that we should have a utopian State where milk and honey flows and people can leave their hearths and homes unlocked without any trace of anxiety and angst on their faces, What a civilised

society like ours requires is an atmosphere of reasonable safety and security in the fast growing urban millieu. In order to realise such as ambience of peace, certain measures have to be taken to establish the rule of law where it has either been allowed to disappear or implemented half-heartedly.

No doubt, urban India offers a multitude of opportunities, both for those who come to earn as also to those who are eager to learn. Coupled with this rosy side of the picture, is the growing perception that there are too many hazards that urban dwellers have to face day in and day out. The increasing incidents of chain/purse snatchings, road-rage, dacoities, house breakings, cold-blooded murder of elderly people by domestic help, are some of the dark spots that send the chill down the spine of urban dwellers. Eve-teasing and molestation of women, kidnapping of children are all signs of a worsening law and order situation. In order to meet the menace head-on and make urban life safe, it is incumbent on law enforcing agencies to strengthen their intelligence network and the urban dwellers, particularly the women to be vigilant all the time.

The tendency on the part of 'Powers-that-be' to remit sentences of those undergone jail-terms for serious crimes, is not only a practice bad in law but also suspect in intent and purpose. Such an uncalled-for generosity should be avoided because it sends a wrong signal to other prospective law-breakers.

**On the basis of reading the above passage, answer the following questions :**

1. On the basis of your reading of the above passage, make notes on it using headings and subheadings. Use recognizable abbreviations (minimum 4) wherever necessary. Give a suitable title to the passage. 5
2. Write a summary of the passage in about 80 words using the notes. 3

## PASSAGE 5

**A2. Read the following passage and answer that question that follow :**

### PRACTICAL HINTS FOR WRITING

Do you ever complain that you "can't get ideas"? The biggest block to the flow of ideas"? The biggest block to the flow of ideas is lack of action. You have to work. When you have an idea that calls for creative effort, *begin immediately*.

Your first job, then, is to get started, and the sooner the better. You have time to weigh and consider and to select the important from the unimportant. You have time to stumble on a lot of good ideas that you need.

The subconscious comes up with a lot of assistance. You may be reading a newspaper when suddenly an idea comes for solving the problem or helping in some phase of it. For instance, something you read or see may prompt you to remark, "say, I could change that a little, and it would be the very thing I need."

Something you read gives you a hint although it may have nothing to do with the problem.

If a report or paper is due in week, for example, you might plan it like this : Allow four days for getting ideas and gathering information, one day for writing the first draft of the paper, and two days

for revising and putting it in its final form. As a general rule, you should always allow more time for getting ideas and information than for writing the paper, or whatever is called for.

In planning your time, you should also outline on paper your tentative plans. Write down the skeleton ideas around which your project will be based. These ideas you will undoubtedly change or enlarge later.

Ideas that seem perfectly clear will escape you later—if you do not write them down. Besides, if you dash off thoughts when they occur to you, you are more likely to express them in a fresher, livelier manner.

Read books, magazines and newspapers or any source of information you find. Do not hesitate to ask librarians for help. They are experts at finding information.

Do not forget the dictionary! It is an excellent source of information and ideas. You can often pick up a lot of thoughts by simply thumbing through the dictionary and investigating the words that pertain to your project.

Other good sources are : General encyclopedias such as *American peoples Encyclopedia*, almanacs such as the *World or Information please* almanacs, handbooks such as the *Readers' handbook* or those published in radio and engineering, biographical dictionaries, *Who's Who*, and Year Books.

All the ideas, facts, information, and plans you have should be put on paper.

Seek new ways of doing the job. Look for new angles or twists that you can apply to it. When you do this with an inquisitive mind, you often can take something old and give it a brand new look, or take something new and improve it considerably.

Things in motion tend to remain in motion; things at rest tend to remain at rest. When you act, you get ideas; when you remain inactive (inert), you can do little except complain, "I can't think of anything."

The work part can be fun—it is the waiting, indecision, and frustration that cause most of the trouble or unhappiness that is often experienced by some.

The technique of taking good notes is the most valuable skill you can acquire, its mastery will require planned practice on your part.

The very act of writing key ideas and information multiplies your chances of learning and remembering them.

When you hear an idea, this makes an impression on your mind: when you write the idea, you see it.

In the learning process, most of us are more "eye-minded" than "ear-minded. That is, a rule, we grasp eye impressions more quickly and retain them longer. In fact, it is estimated that over 85 per cent of what we have learned has been gained through the eyes.

***On the basis of reading the above passage, answer the following questions :***

1. On the basis of your reading of the above passage, make notes on it using headings and subheadings. Use recognizable abbreviations (minimum 4) wherever necessary. Give a suitable title to the passage. 5
2. Write a summary of the above passage in about 80 words using the notes. 3

## PASSAGE 6

### A2. Read the following passage and answer the question that follow :

If there are some people having a sound knowledge of country's economy, its future prospects and also the likely impact of continuing subsidies on certain inputs and products on the economic health of States, there are others equally well-versed with the socio-economic conditions of the masses who need subsidies to subsist, and hence are strong advocates of giving subsidies where they are needed the most. In an economy plagued by disparities of income, we cannot afford to do away with subsidies, simply because they are a drain on the State's finances. Subsidy by itself is not a dirty tool, as it is made out to be by some. It is a support badly needed by the marginalised groups who cannot stand up against big, fish whether individuals or nation-States. Freebies and not subsidies are a drain on the economic resources of a State. To farmers with small land holdings, subsidised fertilisers and other inputs are a boon and not a bane. Even subsidised essentials of life, distributed through the Public Distribution System for those living below the poverty line, are justified both on moral economic grounds. The problem arises only when funds meant for socio-economic uplift of the down-trodden are swindled and subsidised food articles for the poor and the deprived find their way to the open market.

No doubt, offering subsidies where they are needed the most is the government's prerogative. But this should not be done at the cost of the State's financial health. They should be need-based and in no case should they be used to feed and fuel 'vote-bank' politics. If populism is bad, doles and sops for ulterior motives and purposes is worse.

Some right thinking people have described subsidies as a necessary evil that needs to be rationalised by following a need-based and transparent approach. As for the adverse impact on the economy, it can surely be negated by improving tax collection, attracting investment and cutting down on wasteful government expenditure. All said and done, the critics of subsidies, and especially of freebies of any kind or sort, describe them as crutches. If used long, these will not allow the beneficiaries to pick up the strength on their own. Anything given free or subsidised will only give rise to corruption and other malpractices.

### *On the basis of reading the above passage, answer the following questions :*

1. On the basis of your reading of the above passage, make notes on it using headings and subheadings. Use recognizable abbreviations (minimum 4) wherever necessary. Give a suitable title to the passage. 5
2. Write a summary of the above passage in about 80 words using the notes. 3

## PASSAGE 7

### A2. Read the following passage and answer the question and that follow :

The dictionary defines luck as good fortune, events in life that cannot be controlled and seem to happen by chance. There are often too many people who explain their failures and ascribe them to ill luck. "Lady Luck did not favour me." "I ran into major bad luck." "I am one of the unlucky ones around not to have landed a promotion" and several other statements like that. The idea in a defeatist mind is merely to pin the blame instead of working out the real reasons and to get going again in case results have not been in favour. Luck is a very small component of the outcome and has little say. Though to

the contrary, the factor has been wrongly understood as a miraculous property that will bring about success against all odds, including indolence and apathy.

The prerequisites of success are actually sound vision, diligence, being passionate about goals, striving to build lasting relationships, enduring effort at self-improvement, self-discipline and taking risks without them being quixotic. Beyond that, all that remains is simply luck. Edison had defined genius thus : One per cent inspiration, 99 per cent perspiration. It is now a cliche but there is nothing else that captures the spirit of the theme as it does. People who seemingly are the world's envy and possess much of the world's wealth did not merely strike luck. These are the people who have worked hard at arriving where they are currently and keeping it that way.

It is, however, a different story that there may be people who live lives of inaction and train guns at the 'lucky' guys who have all the wealth and power due to a stroke of fate, some part of which could otherwise have been theirs. What they choose to selectively ignore is that the successful people work hard to put themselves into a position where good fortune can find them.

There is still further an catch to it. If merely hard work was the key, a lot of people would have struck gold by now. But simply working hard does not pay. Edward de Bono, one of the well known motivational writers of today clearly puts it. "Certainly there are people who seem to think that hard work is a substitute for strategy, but filling time is not the same as time management. Being busy is not the same as working. Dealing with the urgent is not the same as dealing with the important."

There will be many people who exhort to others to put in hard work, to add sincerity to purpose but there are only a handful of them who know that thinking clearly, encompassing all factors and then taking a call are the first steps towards progress. Successful people do often enjoy their work that it does not seem like work. The process of clear thinking should be taught to the children early on so that they do not swim in the waters of confusion, wasting precious time. The children as well as young adults have to identify goals step-by-step. It is undoubtedly true that everybody wants to be rich, but the people visualize themselves in future is extremely abstract and cannot be laid in concrete, measurable terms that can be worked upon. The better defined a goal is the chance of attaining it are equally better.

Everything you are and have today is the exact summation of countless thousands of little choices and decisions you made from the day you were first consciously able to make such choices. And stating it simply, those choices were mainly between action and inaction. Or putting it another way, between action and laziness. I'm not talking big, life-changing decisions here. I'm talking about tens of thousands of day by day, minute by minute choices like "shall I get up or lie in bed for another half hour?" It is the small choices which matter. The little day by day disciplines build into an inexorable force propelling you towards success and wealth.

Therefore to wail about the fickle nature of Lady Luck is not a great idea, getting on with life of action and working towards attaining goals is.

***On the basis of reading the above passage, answer the following questions :***

1. On the basis of your reading of the above passage, make notes on it using headings and subheadings. Use recognizable abbreviations (minimum 4) wherever necessary. Give a suitable title to the passage. 5
2. Write a summary of the above passage in about 80 words using the notes. 3

## **SECTION B**

**35 marks**

### **ADVANCED WRITING SKILL**

- Q.      3–5 marks
- 4–10 marks
- 5–10 marks
- 6–10 marks

### **ADVERTISEMENTS**

#### **Points to Remember**

- (a) **Types**
  - (i) Classified
  - (ii) Display

Classified Advertisements are covered through different headings :

- Property/To let/For sale/Accommodation available :
- Employment-Situation jobs vacant/Jobs wanted/lost and Found/Vehicles/Pets and Kennels.
- Educational/Missing Persons? Language courses/ Hobby classes.
- Utility services : Packers and Movers/ Tour and Travels
- Vehicles : For sale
- Tenders

- (b) **How to Write an Advertisement**

- Write in a box
- Specify the category of the advertisement, underline it.
- Educational. To Let/For Sale etc.
- Be brief, give only relevant information.
- Information in abbreviated and short forms is acceptable.
- Must mention contact address and telephone no.
- classified advertisements should not be spread out but should be written in running lines.

- Language-formal and concise, not in complete sentence.
- Display ads. may be spread out, written in Catchy and persuasive language to make them attractive; language to be in complete sentence, Visual and slogans may be used, designed for commercial purpose.

## PROPERTY

### FOR SALE/PURCHASE/TO-LET ADVERTISEMENTS CHECKLIST

#### **Points to Remember**

- Details of the kind of house (Flat/ independent house/ first floor/ farm house).
- Details about surrounding-centrally located, facing park, near railway station, airport/shopping complex.
- Covered area and kind of colony-posh colony.
- details of inside of the house : no. of rooms, drawing-cum-dining, kitchen, baths, servant quarters, garage, lawn etc.
- Use adjectives like airy, well-Ventilated, fully furnished, brand new, newly constructed etc.
- Whether to be given on company lease.
- Expected rent/ price.
- contact address and telephone number; e-mail address.
- Begin with 'Available' if you are to sell/ let out your house.
- Begin with 'Wanted' if you require an accommodation on rent/for purchase.

## DISPLAY ADVERTISEMENTS

Details to be included :

- Name of company/institute/organisation.
    - Details regarding product, event, educational courses etc.
    - Special offers/discounts, if any.
    - Address of the company/institute/organisation.
1. M/S Wing Sung have launched a new washing machine named 'Soft Wash'. Draft an advertisement for a local daily to promote the sale of the new model. Offer a Festival bonanza : free mobile phone.
  2. You are the Manager of Himalaya Publications, Kashmere Gate, Delh. Draft a display advertisement for a book fair that your publishing house is going to organize next week.

3. You have opened a readymade garment shop in Lajpat Nagar, Delhi. As inaugural offer, you are giving 20% discount on all garments. Design a display advertisement in not more than 50 words.

## **MISSING PERSON/PET ANIMALS**

### **Point to Remembers**

Details to be given :

- Name, age, sex of Child/Person/Pet.
  - Built-tall/medium built/slim/fat etc.
  - Height (person).
  - Complexion, colour of hair, eyes (Person).
  - Specify when and where he/she was seen last and in which clothes.
  - Any particular mark/scar or characteristic which will help in locating the person.
  - Specify any message. Reward.
  - Contact-name/address.
  - Pet (specific)-breed, colour of fur/skin etc.
1. Your friend Rajshree aged 13, 160 cms fair scar on forehead, dressed in pink shirt and blue jeans has been missing for three days. Draft a suitable advertisement for the "missing persons" column of a newspaper in about 50 words.
  2. Your grandmother aged 70, wearing spectacles blue sari, mentally upset has been missing for a week. Draft an advertisement for the 'missing persons' column of a newspaper in about 50 words.
  3. You are Malay/Malvika of B-1/63 Yamuna Vihar, Delhi. Your pet dog is missing since August 10, 2008. Draft an advertisement for the 'Missing' column of a newspapers giving details about the breed of the dog, name, sex, age, mark of identification, contact address etc.

## **MATRIMONIALS**

### **Points to Remember**

Write in a box seeking details regarding the girls/boy like :

- (a) Age, height and appearance
- (b) Caste, religion etc.
- (c) Education : Graduate/Post Graduate M.Phil/MBBS/B.Ed. etc.
- (d) Profession : e.g., Working in reputed company or doing own practice/govt. office/hospital etc. capacity/status.

- (e) Income : e.g., drawing very high salary/in five figures.
1. You are looking for a suitable bridegroom for your convent educated, beautiful sister who is an engineer, prepare a suitable advertisement to be published under matrimonial column in a newspaper.
  2. Draft an advertisement to be published under matrimonial columns of a newspaper for your brother who is an architect and doing his own practice. You want a suitable match for him. Give necessary details.
  3. You are seeking a suitable match for your sister who is a doctor working in 'Get Well Clinic,' Delhi as a dentist. Draft an advertisement for matrimonial column of a newspaper giving necessary details.
  4. Your sister is a divorcee with no children. She is a school teacher teaching Maths in a senior secondary school. Draft an advertisement to be published in a newspaper under matrimonial column for a suitable match for her.
  5. After completing his M.B.A. from I.I.M., Ahmedabad, your son is working as a manager in U.S.A. He wants to marry an Indian girl. Draft an advertisement for the matrimonial column of a newspaper.

## LOST AND FOUND

### For Newspapers/School Notice-board

- Essential Details-to be involved.
  - Use the word 'Lost' or 'Found' at the beginning so that it is clear whether the article/object has been lost or found.
  - Name of the object/article lost or found.
  - Brand. Colour, condition – VIP, brown, leather bag.
  - Where/ when – in a bus, school?
  - What time –
  - Reward/ Contact.
  - For Lost' give all the details whereas for 'Found' the details need not be given completely.
- Q.1. You have found a mobile phone in a park in your colony. Draft an advertisement to be published in a local daily under the column 'Lost and Found.'
- Q.2. You have found a sports Kit in your school playground. Write a notice for the 'Lost and Found' notice-board of the school to this effect, specially details required to prove the ownership. You are Partak of class XII Govt. Boy Sr. Sec. School, Bhongarh.
- Q.3. You have found a Wallet containing some Indian and foreign currency notes and two credit cards in the compartment of A.P. Express while travelling from Delhi to Bhopal. Draft an advertisement to this effect. Give necessary details.

- Q.4. You have lost a cycle outside the coaching center. Draft a notice for the 'Lost and Found' Notice Board of the coaching center giving details of the cycle, contact address and reward. You are Sneha/Siddharth of 15A, Manav Vihar, Delhi.
- Q.5. You have lost your digital camera in the school on Teacher's Day. Draft a notice for the 'Lost and Found' notice Board of your school giving details of the camera, contact address and reward. You are Mudit/Mudita of Sarvodaya Co-Education Vidyalaya, Khera Kalan, Delhi.
- Q.6. You lost your wrist watch in your school Auditorium. Write a notice in not more than 50 words for your school Notice Board giving a detailed description of the watch. You are Anirudha/Arundhati of Class XII Springfields School, Pune.

### **SALE : MOTOR VEHICLES**

#### **Points to Remember**

- Model No., Year of manufacturing, colour.
- Accessories (new seat cover, new mats, stereo etc.).
- Single-hand driven, good condition, non-accidental, mileage, mat, invite for test drive.
- Paper-Insurance papers, pollution under control certificate.
- Any other details-Brokers excuse.
- Expected Price
- Contact address, telephone number.

### **FOR SALE (HOUSEHOLD / OFFICE GOODS)**

- Item name, Brand name and year of manufacturing.
  - General condition-excellent, working condition, looks brand new etc.
  - Reasonable Price
  - Contact address and telephone no. Also mention the day and time on which to contact.
1. You want to sell your Honda Civic car as you are going abroad. Draft an advertisement in about 50 words to be published in 'For Sale' column of the 'Amar Ujala', giving details of the car, expected price, contact address etc. You are Harshit/Harshita of 25B, Adarsh Nagar.
  2. Your cousin Shweta wants to sell his Bajaj Pulsor motorbike as he has been transferred to Chennai. Draft an advertisement on his behalf for a local newspaper under the column 'For Sale.'
  3. Manish/Manisha wants to sell his computer as he has purchased a laptop. Write an advertisement in about 50 words to be published in 'For Sale' column of a local daily.
  4. Your father wants to sell the old furniture of your house. Draft an advertisement to be published

in the 'For Sale' column of a newspaper. Invent relevant details; the category of furniture, material, condition, price expected etc.

5. You are Shantanu, the manager of Shan Multinational Company, Noida. Draft an advertisement offering your washing machine and fridge for sale as you have purchased a new washing machine and a fridge.
6. Your cousin Malvika has been transferred to Delhi. He wants to buy second hand household furniture. Draft an advertisement on his behalf to purchase the household furniture in good condition for the 'Sale and Purchase' Column of the newspaper.
7. You want to purchase a flat in Sector 20, Rohini. Draft an advertisement in about 50 words giving your requirements and preference.
8. You are Manas/Mansi of 31C, Anubhav Apartments, Sector 13, Rohini. You want to purchase a second hand computer in good condition. Draft an advertisement for 'Sale and Purchase' column of the newspaper giving details of your requirement, cost and address.

## TO LET

### Points to Remember

- Give essential details of the item on sale/for purchase to be let out such as location, details.
  - Size of the accommodation.
- Q.1. Anishi Kulshreshtha a Govt, servant, wants to let out third floor of her flat. Draft an advertisement in not more than 50 words for the 'To Let' column of a newspaper giving details of the flat, expected rent, contact address etc.
- Q.2. You are Vipul of 120, Preet Vihar, Delhi. You wish to let out your newly renovated office accommodation in a posh locality of Delhi. Draft an advertisement for publication in the 'To Let' column of the times of India. [words : 50 words].
- Q.3. You are Dr. Madhu, M.D. you are looking for an independent house in Ghaziabad on a reasonable rent for your residence-cum-clinic. Draft a suitable advertisement in not more than 50 words to be published in The Hindustan Times, New Delhi.
- Q.4. You want let to out the ground floor of your newly constructed independent bungalow with all the modern facilities. Write an advertisement to be published in 'To Let' classified column of the 'Indian Times'. (words limit : 50 words).
- Q.5. Mrs. Khosla of 26, G.S. Apartment, Rohini wants to let out three rooms of the house as paying guest accommodation exclusively for girls. Draft a suitable advertisement for publication in a newspaper, giving all necessary details like location. Type of accommodation, facilities available, contact address, telephone number etc.

## **ACCOMMODATION WANTED**

- Q.5. You are Fatima of Dwarka II, Delhi. You are looking for a house on reasonable rent in Gurgaon. Draft an advertisement for 'Accommodation Wanted' column of The Hindu. Giving essential details of your requirements.
- Q.6. You are Ravi Maurya the Chairman of Indra Gandhi Indoor Stadium. You require suitable accommodation on rent to be used as a Guest House for the players coming for Commonwealth Games. Draft an advertisement to be published in a newspaper under the column 'Accommodation Wanted'.
- Q.7. You want to purchase a building to run a playway school in Yamuna Vihar. Draft an advertisement in about 50 words for a newspaper giving your requirements and preference.
- Q.8. Your friend Dr. Atul wants to open a 'Eye Care Clinic' in Nathupura. Draft an advertisement on his behalf in about 50 words for purchasing suitable space for clinic for publication in a newspaper under the classified column 'Property for Sale'.
- Q.9. You are Rashi/Rishab of B-31, Rashmi Apartments, Rani Bagh. You want to sell the Second and Third floor of your house. Draft an advertisement in about 50 words for 'Property for Sale'.
- Q.10. Your father wants to start a coaching center for teaching 'Proficiency in English'. Draft a suitable advertisement for purchasing a spacious hall and an office in Shakarpur, Delhi. Draft an advertisement on his behalf to be published in the newspaper under the column 'Sale and Purchase.'

## **SITUATION VACANT**

### **Points to Remember**

#### ***Value Points (Sample)***

- Name of Employer with address.
- Nature of the Post Vacant.
- No. of Posts.
- Required qualification (Eligibility).
- Expected Experience.
- Salary offered.
- Whom to apply (with necessary contacts).
- Time limit for submission of application.
- Put your advertisement in a box.

- Q.1. You are the Personal Assistant to the General Manager in Satyam Software Company. Draft an advertisement for the 'Situation Vacant' Column for the post of two Managers in your company.

- Q.2. You are Romi/ Reena, running Cute Beauty Parlour in Prashant Vihar. You require two ‘Trained female beauticians’ for your Parlour. Draft an advertisement for the ‘Situation Vacant’ Column of a local newspaper stating your specific requirements.
- Q.3. Your school requires two trained experienced coaches for Basketball and Cricket. On behalf of the manager of the school draft an advertisement for the ‘Situation Vacant’ column of a local newspaper giving necessary details of eligibility condition for the posts.
- Q.4. Draft an advertisement to be published in a newspaper to fill in the vacancy of a librarian cum information officer. Mention necessary details such as qualification, salary offered, experience required etc. Draft this advertisement on behalf of the manager of Blue Bird Public School, Aligarh.
- Q.5. You are the senior Administrator of American Library, Delhi. You want to recruit people for the following posts :
1. Computer Assistant
  2. Assistant Librarian
  3. Peon

Draft an advertisement asking interested people to apply for any of the posts given above. Mention other necessary details for the information of the applicants.

### **SITUATION WANTED**

- Q.1. You are an MBa and have a two years experience as sales Manager in Vatika Company in Delhi. Now, you are looking for a better job in Delhi only. Draft an advertisement to be published in the newspaper.
- Q.2. Draft an advertisement to be published in a newspaper offering your service as a tourist guide. Mention necessary details.
- Q.3. You are a computer Engineer from D.C.E. working as a software developer at Satyam Company want a change, state your preference. Draft an advertisement to this effect stating necessary details.
- Q.4. You are a post graduate in Fine Arts. You are looking for a job in an institution running Hobby Classes. Draft an advertisement to be published in the newspaper giving other necessary details.
- Q.5. Your brother is an architect with specialization in designing schools and other academic institutions. Draft an advertisement on his behalf to be published in the newspaper giving other necessary details.

## WRITING NOTICES

### Points to Remember

#### ***Format :***

1. Name of the issuing agency (school).
2. Word : Notice
3. Date of issue
4. Subject (Heading)
5. (a) Signature of the authorised person.  
(b) Designation of the issuing authority.

#### ***Content :***

Mention	What	:	Event/Activity
	When	:	Date and Time
	WHERE	:	Venue
	WHO	:	Participants, organisers.
	People involved	:	Chief guest. If any

1. Your school has been selected as the center for N.S.D. (National School of Drama) Training for students of 8 to 18 years during the summer vacation. Write a notice for your school Notice Board. You are Shyam, the cultural in-charge of Sarvodaya Bal Vidyalaya, Babana, Delhi.
2. You are the in-charge of Yuva Club of Govt. Sarvodaya Vidyalaya, Sarai Rohilla. You are shocked to notice some of the students smoking outside the school campus. You decide to call an emergency meeting of the members of the Yuva Club to discuss the increasing problem of smoking and tobacco chewing. Write a notice for the Notice Board.
3. You are Neeta/Nitin, the Head girl/the Head boy of Rajkiya Pratibha Vikas Vidyalaya, Shalimar Bagh, Delhi. Write a notice for your school Notice Board informing the bright students of Class X, XI and XII to apply to go to Singapore for achieving above 90% marks. Invent other necessary details.
4. Sarvodaya Bal Vidyalaya, Badli is organising an educational tour to North Eastern states for the students of Classes XI and XII. Write a notice for your school Notice Board inviting students to join the tour. Invent other details. You are Sanchit, the Head boy of the school.
5. You are Antara/Antariksh of Sarvodaya Girls Sen. Sec. School, Kailash Enclave, Pitam Pura. As the Captain of NCC wing of your school write a notice for the students of Classes IX to XII to give their names for the NCC Camp to be organised in Kerala for ten days. Invent other details.
6. You are Ayush/Ayushi the House Captain of Sarvodaya Girls Sen. Sec. School, A Block, Jahangir Puri. Write a notice for your school Notice Board inviting the students for participating in cultural programme to commemorate the 150 year of First War of Independence.

7. You are Asit/Asita of Govt. Co.-Educational School, Shakur Basti. You have to organise a Debate Competition in the school on the topic ‘Should there be Uniforms in the Schools?’ As the Head Boy/Head Girl of the school. Write a notice for your school Notice Board.
8. You are Fatima/Fahad of Sarvodaya Co.-Educational School, Rani Jhansi Road. There is an acute shortage of water in your area. As the secretary of ‘Good Society Club’ of your school write a notice for your school Notice Board informing the students about the shortage of water and requesting them to bring their own water bottle.
9. As the Captain of ‘Sports’ Club of your school. Write a notice for your school Notice Board inviting names for various team events on ‘Sports’ Day’ to be celebrated in your school. Give necessary instructions regarding last date, kit, etc.
10. You are the Editor of your school magazine, ‘Dream World’. Write a notice for your school Notice Board inviting Poems and Paintings from students.

## INVITATIONS

### FORMAL INVITATIONS / FORMAL REPLIES

#### **Points to Remember**

- To be written in a rectangle box.
- To be written in third person; no abbreviation to be used.
- Generally simple present tense is used.
- There is no signature of the writer.
- No punctuation at the end of the lines.
- Each entry to be mentioned in a separate line, e.g., (a) the name of the person who is/are invited  
(b) formal expressions like ‘request the pleasure of your company’ (c) time and date of event  
(d) purpose and occasion of invitation.
- In official invitations, specially time by which the guests are to be seated, name of the chief guest, programme may be given.
- ‘Valid for one/two only’ be given at the end, in case the number of invitees is to be limited.

### FORMAL REPLIES : ACCEPTANCE / REFUSAL

#### **Points to Remember**

- Acknowledge the invitation.
- Use third person
- Not to be signed at the end.

- When accepting, confirm dates and time, venue need not be confirmed.
- If declining give reasons (&) Convey your best wishes for the function.
- Give date and address at top left hand corner.

## INFORMAL INVITATION

### **Points to Remember**

- Use first person – ‘I’, ‘we’ and ‘you’ and avoid using ‘he’, ‘she’ and ‘they’.
- Do not write : ‘subject’ and ‘Receiver’s address’.
- Write in warm and personalised style.
- Avoid writing unnecessary details
- Begin with ‘Dear’ – (name)

### **Formal Invitations**

1. On the Eve of World Environment Day, Sarvodaya Bal Vidyalaya, Mehrauli is organising a symposium to create awareness about environmental issues. Draft a formal invitation, giving details of the venue, time and date.
2. The Kids’ Paradise is opening a show room in Rohini, Delhi. The inaugural ceremony is fixed for Sunday, at 10 a.m.. Prepare a draft of formal invitation for the purpose. Also mention inaugural discounts if any and attractions.
3. Centre for ‘First War of Independence’, Meerut is organising a light and sound programme at Central Park of Cannought Place, Delhi. Write an invitation letter inviting Mrs. Sheila Dikshit, the Chief Minister of Delhi to inaugurate the programme. You are the secretary of the centre.
4. You are Mudita/Mudit of 21B, Geeta Colony. Write a reply accepting the invitation you got from Jitin Shridhar on the occasion of his getting highest marks in Rajkiya Pratibha Vikas Vidyalaya, Shalimar Bagh.
5. You are Anubha/Anubhav of B-64, Sharda Niketan. Write a reply refusing the invitation you got from your friend Asita/Asit who was selected for IIM, Ahmedabad.
6. You are Swapnil of 25, Buradi. Write a reply accepting the invitation you got from Richa/Rachit on the occasion of his being selecting for the T-20 matches in Dare Devils of Delhi.

## POSTERS

### **Points to Remember**

**Posters** generally spread a social message to create awareness about an issue or an event of common interest.

- Highlight the main topic of the poster by writing it in bold and capital letters in order to draw attention.

- Include all the important details like :
 

What	Event
When	Date and time
Where	Venue.
  - Write within a box. Name of the agency responsible for release of the poster.
  - Maintain the prescribed word limit of fifty words.
  - Use persuasive language catchy phrases, slogans and emotional appeal and amusing style according to the situation.
  - Can use graphics, varying font size shape.
  - Can make letters light or dark to create the requisite effect.
- Q.1 The Eco club of your school is going to organise a cleanliness Drive to clean the water tank, drains and other surroundings of the colony. Design a poster for the cleanliness drive highlighting the importance of cleanliness. You are Salim/Seema of Sarvodaya Vidyalaya, Alipore
- Q.2 On the occasion of platinum jubilee of your school you are directed to organise a colourful cultural evening in your school. Draft an informative poster to invite the parents of the students and alumni of the school to make the evening a memorable event.
- Q.3 As Head boy/girl of Sarvodaya Girls School, Civil Lines. You have to draft a poster against child labour urging people to participate in large number in rally, which is being organised to protest against the exploitation of children specially working in the Cracker-manufacturing factories and Tobacco Industry. Draft this poster in not more than 50 words.
- Q.4 One week International-book-fair is going to be held at Pragati Maidan from 21<sup>st</sup> to 27<sup>th</sup> August, 2008. As the manager to International Trade Authority draft a poster in not more than 50 words informing the general public about this book fair.
- Q.5 'Muskaan' is an organization formed by a few committed professionals, artists and journalists who take out time from their office/home to help thousands of deprived people. Draft a poster on their behalf asking people to donate clothes, toys, utensils etc. for the needy.
- Q.6 In collaboration with WHO, the Ministry of Health will organise the fifth phase of Pulse Polio Campaign in September 2008. Draft an attractive and informative poster giving all the relevant details.
- Q.7 On the occasion of World Earth Day design a poster highlighting the need to take care of Climatic changes of our country. You are Veena/Varun President of the cultural club.
- Q.8 'Sanskar', an NGO is organising an awareness programme regarding the importance of obeying traffic rules. Design a poster to be put up in your school to make the students aware to the 'Traffic Rules'.
- Q.9 To create awareness among the people regarding the importance of rain water harvesting, prepare a poster in not more than 50 words about it to be displayed at an exhibition.
- Q.10 Design a poster in not more than 50 words highlighting the need to conserve electricity to brighten the future of the country by saving our resources. You are secretary of Amber Society.

## **REPORT WRITING**

### **Points to Remember**

Reports record happening of events in the recent past.

- Be brief, to the point and systematic, objective and balanced.
- Report an event in the order in which things have happened (Maintain sequence of events.)
- Give it—

#### **A. Format :**

- a. A bold heading>Title.
- b. Name of the reporter.
- c. Date of Report alongwith name of the place (city).

#### **B. Content**

- Write the report in 3-4 paragraphs

Para-1. Brief introduction of the incident, like what, who, when, where.

Para-2. 3 Give details of the incident.

Para-4. Concluding remarks regarding action taken or required.

In case of report for school magazine, date and place need not be written.

- Put the Report in a box.
- Use Past Tense as Reports are written after the event is over. Use of Passive voice is also recommended.
- Follow the prescribed word limit. (*i.e.* 100-125 words)
- Basic points for content :

- a. What              Event and other details
- b. Where              Venue
- c. When              Day and date
- d. Who              Participants, guests, chief guests, visitors etc.

1. You are Shruti/Shekhar a student of R.P.V. Vidyalaya, Surajmal Vihar. Principals of two schools from Pakistan visited your school as part of a Cultural Exchange Programme. Students of your school put up a Cultural Show in their honour. Write a report about it for your School Magazine.

## **REPORT**

2. You are Rahul//Reva, the Headboy/Headgirl of Govt. Coed. Sr. Sec. School, Bawana, Delhi. Recently your school hosted the Regional level CBSE Science Exhibition. Write a report of this event for your School Magazine in about 125 words.
3. As you were driving back home from work you were witness to an accident between a Maruti car and a truck. The driver of the car was seriously injured. There was confusion and chaos prevailing on the road. Describe the scene in about 100-125 words. You are Sanjay/Sonika.
4. You are Raman/Rashmi. Your team of seventy students participated in the Health Mela. About twenty schools participated in the Health Mela. Your team won the first prize. Write a report about different stalls, team of doctors, blood donation camp and different models displayed by the students.
5. You are a reporter from the Hindustan Times. You visited the victims of serial cycle blasts at Jaipur, where many people lost their lives and hundreds of them got injured. Prepare a report in about 125 words.
6. Recently thousands of people lost their lives in earthquakes in China. Earthquakes have caused disaster in India also. Keeping in view the frequent occurrence of earthquakes, your school arranged a talk on 'Disaster Management'. Identifying the areas of your state most prone to earthquakes, the speaker explained the precautionary measures to be taken by the public and Government in case of emergency. As a student write a report of the event in 100-125 words for your school magazine.
7. You are Ravi/Rani, secretary Yuva Club of your school. Your school celebrated a 'Yuva-week' by organising a cultural programme in your school, in which many students and teachers took active part. Write a report of the programme for your school magazine, in 100-125 words.
8. Recently the Chief Minister of Delhi inaugurated the "Clean Yamuna Campaign" in which about 250 schools participated. You were shocked to see the miserable condition of the River Yamuna, which reflected a dirty drain of a small town. Write a report in about 125 words about the campaign, for publication in the newspaper. You are Vipul/Meenakshi, a staff correspondent of Rashtriya Sahara.
9. You are Kartik/Kriti, the Head boy/Head girl of Sarvodaya School, Rohini. The Deputy Director of Education of your District inaugurated Multi Media Lab for teaching English in your school. Write a report in about 125 words about the inauguration for publication in a news paper.
10. A group of 40 students of Sarvodaya School, Pitam Pura, Delhi was selected for an adventure camp to Nainital where the students were given training in mountaineering boating and rafting. It was a seven day adventure camp in Summer Vacation. You were one of students who participated in the camp. Write a report of the camp relating. Your experiences at the camp.

## **FACTUAL DESCRIPTION**

Be clear that a report is a kind of factual description of certain events. It is reported in the past tense as the report is written only after an event is over.

Factual description of an event includes as thing seen/observed. But factual description of an

object, person or a place presents photographs, view, as the things., person or a place, building is.

It is written in the present tense (except description only after the event is over).

All major aspects parts of the building, place are covered under factual description.

1. The International Book Fair was inaugurated by the chairman of Children's Book Trust, Dr. Kumar. The theme this year was Illustrated Works of Children. You are Abhay/Abha a Class XII student of A.K. International School, Mathura. You visited the exhibition and were impressed with the range of books on display. Write a factual description in about 125 words.
2. You are Gaurav/Garima of Class XII at G. Sr. Sec. School, Surajmal Vihar, Delhi. You recently visited a hill station along with your parents. It was an exhilarating, adventurous and joyful experience. Write factual description of your visit for school magazine, sharing your experiences in 150-200 words.
3. You are Kamal/Kamini of Sarvodaya Vidyalaya, Pooth Kalan, Delhi. A well-planned auditorium has been built in your school, to hold academic and cultural programmes. You have been asked by the editor of your school magazine to write a factual description of the auditorium for school magazine. Write description in not more than 125 words.
4. You are Bhavya/Bhavuk of Bal Bharti Public School, Dwarka. Recently you got a chance to travel by metro-train from Dwarka to Rohini. You had to change twice, at Rajiv Chowk and then at Kashmere Gate station. You were very much impressed with the cleanliness, system of security-check, escalators and lifts for physically challenged. Write factual description of metro-stations and metro train in about 100-125 words.
5. A move has been started by Directorate of Education, Delhi for the modernisation of libraries in Govt. School of Delhi, so that students may take interest in reading and learning a computer and an over-head projector with screen have been installed in it. The librarians have also been provided with educative and informative CD's, so that they can show various interesting programmes to students in their respective library periods. Write a factual description of the modernised library of your school in about 125 words. You are Drishti/Daksh of Sarvodaya School, Nanak Pura, Delhi.
6. Give the factual description of your City Hospital.
7. Give the factual description of Rail Museum in Delhi.
8. You are Rohan/Rohini. 25 students in a school at Pitampura got ill after eating the midday meal. Describe this incident in about 125 words as an eye witness.
9. A group of 50 students of Sarvodaya Vidyalaya Kerala, visited Science Centre during an educational tour. You are Ajay/Abha Head boy/girl of the school. You are asked to write the factual description of the Science Centre in about 200 words.
10. You are Arun/Aruna. A few days ago you went to a bank. Outside the bank you saw that a businessman was robbed of a huge sum when he came out of the bank. Give a factual description of this incident in about 125 words.

## WRITING LETTERS

The best letters give the most important information in the shortest time and most accessible form.

### Points to Remember

- Time available 15-20 minutes.
- Always plan your letter. Think before you write.
- Avoid ambiguity, cliches and be straight forward.
- Give complete information.
- Don't use abbreviations, e.g., Inst., govt. etc. Though contractions (don't, can't etc.) are permissible in modern letter writing, one should avoid them.
- Be polite, courteous and correct even if you are in bad mood.
- Use short and crisp language.
- Write one idea in one paragraph. Use different paragraphs for different points with appropriate linkers.
- Always edit your rough draft.
- Avoid long-winded and rambling turns of phrase. For example, write 'please let me know' 'Not I would appreciate your informing me.....'
- Use correct/appropriate format.
- Avoid vague closing like 'Hoping to hear from you' or 'Thanking you in anticipation-these are outdated. Instead end on a firm and positive note. Such as-this should suit you, I'm sure.
- Follow block style (latest). Do not mix it up with the traditional semi-block style.
- Leave one line space between paragraphs.
- No punctuation in address/date/salutation.
- Don't leave any space at the beginning of a new paragraph, as was done in traditional paragraphs.
- In the complimentary close-write :
  - Yours obediently to the Principal
  - Yours sincerely-When writing to the editor or to employer etc. (or whenever you write Dear Sir/ Madam as salutation.
  - Yours sincerely-to friends and to all the people whom you are addressing by name.
  - Yours affectionately-to relatives
  - Yours truly-to unknown persons or editor at the end, signature of the sender followed by his name in block letters alongwith designation.

- In modern letter writing, 'Yours Sincerely' is often used for business letters, to editor also.

## **LETTERS TO THE EDITOR OR A NEWSPAPER**

Such letters are written to draw attention of the public authorities towards certain irregularities and common problems.

Such letters are also written to raise certain current issues and express writer's own view point.

### **Point to Remember**

- Raise the issue by giving certain news items or events.
- Analyze the issue-try to find causes.
- Offer suggestions to face the problem.

### **DON'T WRITE THAT THE EDITOR SHOULD TAKE ACTION**

- Be courteous, even if critical.
1. You are Saurabh/Swati of Rani Bagh, Delhi. The road leading to your school is full of potholes, causing a lot of congestion. Students and parents are often caught in traffic jams. Inspite of several representations MCD has done nothing to improve the conditions. Write a letter to the editor of Local Daily highlighting the problems and drawing the attention of the authorities to take concrete steps at the earliest.
  2. You are Mohan Lal/ Sunita residing at C-25, Model Town, Delhi-7. Write a letter to the editor, Times of India expressing your concern over the govt.'s decision to cut down trees in the Delhi university area to provide a space for rugby field for the Commonwealth Games 2010.
  3. You are Mansi/Manish of M.G. Road, Delhi. You are worried about the hike in prices of essential commodities like LPG gas, petrol, diesel, vegetables, pulses etc. Write a letter to the editor of Hindustan Times, Delhi to draw the attention of Government to take concrete steps to curb the rising prices/inflation in the benefit of a common man.
  4. You are Vipin/Vidya a student of Class XII of Sarvodaya Vidyalaya, Nithari. The students are required to cope with lot of pressure in today's competitive environment. Write a letter to the editor of a national daily highlighting the increasing stress faced by students and suggest ways to combat the same.
  5. Write a letter to the editor of Hindustan Times, B.S.Z. Marg, Delhi-2 . Drawing attention to a newly opened liquor shop in your colony, which has become a menace for the residents. You are Frahan Ahmad, resident of D-32, New Light Colony, Delhi.
  6. Having observed that crime against women is increasing day by day in big cities. You feel that self-defence training should be made compulsory for girls in schools. Write a letter to the editor of 'The Hindu' highlighting the need for such training and drawing the attention of the Government to take concrete steps for safety of women. You are Navin/Naina, a student of class XII, Happy Public School, Delhi.
  7. Write a letter to the editor of The Times of India, New Delhi, expressing your concern for the

youngsters who start smoking at a very early age which further leads them to drug addiction. Give your suggestion to check smoking and drug addiction. You are the prefect of Eco-club of your school.

8. You are Puneet/Pallavi of Govt. S.S. School, Pushp Vihar, Delhi. You are very much moved to know about the killing of innocent people in serial blasts of Jaipur. Write a letter to the editor of Times of India over the wide spread terrorism not only in India but through-out the world; and suggest ways to over come it.
9. You travel by 'Blue Line' buses in Delhi everyday. You are the witness and experience the rash and negligent driving by the bus drivers. You have also read in the news paper about the death of dozens of people only due to these buses. Write a letter to the editor of Hindustan Times highlighting the related problems. Also give some suggestions.
10. You are Vimal/Vimla of 97, Safderjung Enclave, New Delhi. You have observed that subways in Delhi are seldom used by the pedestrians to cross heavy-traffic roads, resulting in accidents and traffic jams. Write a letter to the editor of Hindustan Times highlighting the need for creating awareness among the people about it.

## **LETTERS OF MAKING ENQUIRIES**

### **Points to Remember**

These are formal letters to seek clarification. Making enquiries about certain missing pieces of information in any advertisement or a notice or a poster.

### **While Writing such Letters**

1. Refer to the source of information.
2. Make specific enquiry about
  - Accommodation in a hostel
  - Tariff
  - Type of food available etc.
  - Language : Formal but courteous
1. You are Sakshi/Sanjay of Govt. Sr. Sec. School, Sangam Vihar. You have appeared in class XII examination in Humanities Steam. Write a letter to the Director of YMCA, Delhi, requesting for sending the details regarding Short-Term Courses, duration and fee structure of the course offered by them.
2. You are Ravi/ Akash residing at 20. A13 Dwarka, D.D.A. Flats, New Delhi. You have appeared for class 12th exam (CBSE) this year. As your result is awaited, you wish to do English speaking course from 'The British School', West Patel Nagar, Delhi. Write a letter to the Principal of the Institute requesting for sending the details regarding the course, duration and fee etc.
3. You are Head Boy/Head Girl of Sarvodaya Vidyalaya, Vikas Puri, Delhi. Write a letter to State organising Commissioner of Delhi State Bharat Scouts and Guides, requesting him to provide

details of affiliation fee and other conditions for becoming a member of the organisation. You are Vishal/Vinita of Class XII.

4. You are A. Bose, H.R. Manager of IBM, Lakshya, Delhi. You want to take 25 voice Trainers of your organisation on a trip from Delhi to Mumbai by a deluxe bus. Write a letter to Yatri Global, 23, Palika Enclave, Delhi. Enclave, Delhi. Enquiring their terms and conditions for package tours. Ask about duration of the trip, boarding and lodging charges, mode of payment and discount available if any etc.
5. You are Lalit/Lakshmi of Sarvodaya School, Sharda Niketan, Delhi. You have passed Class XII CBSE Exam. in commerce stream obtaining 85% marks in aggregate. Write a letter to the Director, H.P. University Shimla for brochure and Prospectus for admission to 'B.Com. (H).

### **LETTERS OF COMPLAINT**

Such letters are written to officials of different Departments and business organisations for necessary action or redressal.

These complaints may be related to untimely/short/defective supply or irregular public services such as buses, electrical or water supply.

#### **Points to Remember**

- Use appropriate format
  - (i) Company's name and address.
  - (ii) Date
  - (iii) Ref. if any
  - (v) Salutation
  - (vi) Closing and signature
- **Content:** Complete/all necessary points.
- Request for action required.
- **Language :** Formal and courteous.

### **OFFICIAL / BUSINESS COMPLAINTS**

1. You are Ankit/ Ankita of 34, Lajpat Nagar, Delhi. Last month you purchased double door frost-free refrigerator from Divya Electronics, against a warranty of two years. For one month, it worked well but now you find that it is making an unbearable noise and not cooling things properly. Write a letter to the Manager/Dealer of Divya Elec. Complaining about the problem you are facing and requesting him for the replacement immediately.
2. You are Ishaan/ Meeta the Head Boy/Girl of Janki Public school., Kirti Nagar, Delhi. There is a heavy flow of traffic just outside your school gate, causing a lot of inconvenience to the school going children. There are frequent cases of accidents also. Write a letter to the Commissioner of Traffic Police, Delhi requesting him to take necessary measures to control the traffic.

3. You are Vandana/Vinod residing at 4 c, Pocket-A Paschim Vihar Delhi. People feed stray animals on the side of the roads. This creates chaos on the roads also. Write a letter to the commissioner of M.C.D, highlighting the problem faced by the people living there and the possibilities of road accidents due to stray animals.
4. You are Somesh/Surabhi residing at C-27, Model Town, New Delhi. Last month you bought a Microwave oven from Neha Electronics, Kamla Nagar, New Delhi. Now you find it is not working properly. Write a letter to the dealer asking/requesting him to replace it immediately as it is within the guarantee period.
5. You are Ajay/Anita of Class XII at Sarvodaya Vidyalaya, Kanjhawala. You happened to watch a lesson of class X in CAL LAB set up in your school by Directorate of Education, Delhi. You are very much impressed by the technique and methodology of teaching through computer. Write a letter to the Director of Education Delhi requesting him to start such programme for students of Class XI and XII.

### **PLACING ORDERS**

1. You are Librarian of R.N. Public School, Saket. Write a letter to Messers Suman Publishers, Delhi, Placing an order for some books for your School library. Mention the details of books (at least 5) and ask for the discount available on the purchase.
2. You are store incharge of G.S.S. School, Najafgarh. Placing an order for at least four items of School furniture like chairs, tables, Almirahs, desks etc. to Pragati furnitures, Hari Nagar, New Delhi.
3. You are sports incharge of Abhinav Public School, Shahdara. Write a letter to Messers Raman Sports Equipments, Darya Ganj, placing an order for sports material (at least 5 items) giving complete details. Ask for the discount available on purchase.
4. You are Prabhat/Pratibha of Sarvodaya Vidyalaya, Jahangir Puri, Delhi. You had placed an order for supply of sports material to Messers Laxmi Sport Equipment, Darya Ganj. You have not yet received the material write a letter to the dealer asking for the immediate supply of the material.
5. You are Science Lab incharge of Divine Public School, Okhla. Write a letter to Messers, Ahmad scientific instruments co. Okhla, for supply of scientific equipments (at least four) giving complete details) for your school science lab.

### **WRITING APPLICATIONS FOR JOBS**

Unemployed people respond to the vacancies advertised under SITUATION VACANT column.

While writing applications for such vacancies REMEMBER

- To write correct contact address.
- To refer to the advertisement write date and name of the newspaper (source of Information).
- Forwarding note to offer your candidature.

- To enclose your curriculum vitae (C.V.. or Bio data) duly signed

C.V should include

- Personal details : Name , D.O.B, Address.
- Academic qualifications.
- Details of Experience.
- Salary expected
- References (Two)

1.

## RAM MANOHAR LOHIA HOSPITAL, NEW DELHI

### REQUIRES

#### *Junior Residents in the following faculties*

1. Paeditrics – 2 posts
2. Orthopaedics – 3 posts.
3. Ophthalmic – 2 posts
4. Gynecology – 3 posts.

Minimum Qualification – MBBS (with Ist Div.)

Age – not more than 35 years.

Desirable Qualification – Specialisation in the respective field.

Apply to the Director on prescribed proforma Available from the office (from 10.00 A.M. to 2.00 P.M.) Last Date of submission of forms. – 15.6.08

You are Mohit/Medha of 26, Lajpat Nagar, Delhi. You find the above advertisement suitable for yourself and apply for one of the posts. Write the application with complete Bio-data in response to the above advertisement.

2. You are Sumit/Samila. You come across the following advertisement in a national daily. You consider yourself suitable and eligible for the post. Write an application in response to the advertisement.

Applications are invited for the post of a Nursery Teacher in a reputed school of Delhi. The candidate must have at least 5 years experience of teaching tinytots. The applicant must have a pleasant personality. He/She should be creative and innovative. Attractive salary. Interested candidates should apply to the Principal; AKS International, Indirapuram, New Delhi within 10 days with detailed resume.

3. You are Anil/Asha staying at 24, Gandhi Nagar, Delhi. You have come across an advertisement in Times of India for recruitment of Ground Staff in Kingfisher Airlines. Apply to the Director in response to the advertisement, giving your detailed bio-data (Curriculum Vitae).

4. Required T.G.T.s in N. Science in Govt. School of Delhi. Essential Qualifications – (a) B.Sc. with 50% marks (b) B.Ed. from a recognised University, Desirable Qualification. Teaching experience of 5 years in a secondary school. Apply to Director of Education Govt. of NCT. Delhi within one month from date of Publication of the advertisement in a prescribed form available on payment from the Directorate office. Vijay/Laxmi of 30, Moti Nagar, Delhi comes across the advertisement in Delhi Times dated 7th May 2008 and decides to apply for the above mentioned post. Write the application giving your detailed curriculum Vitae.
5. The General Manager, Axis Bank, Kolkata requires a few Business Development Managers for the Credit Card Section. Write an application for the post, offering your services giving your complete bio-data. You are Shanky/Shreja of Tyag Raj Nagar, Kolkata.

## WRITING ARTICLES

### **Point to Remember**

- Give the title at the top.
- Write the name of the writer below it.
- Break the subject matter into 3-4 paragraphs :
  - (i) Para 1- introduction-brief (raise the issue) by showing its existing status.
  - (ii) Para 2 and 3- Body should comprise of analysis. Cause/effects/types and other relevant information.
  - (iii) Para 4- conclusion- should be focussed and brief-It should contain suggestions/reminders etc.
- Systematic presentation of ideas is a must.
- Pay attention to grammatical accuracy. Good vocabulary and spellings. Use sentence linkers to ensure continuity.
- Take care of coherence and relevance of ideas and style.
- Always make a rough draft, following; acronym CODE, collect content  
 Organise → Draft → examine and edit

## FOR PRACTICE

1. In a study at Universities of California and Los Angles, research findings show that the pregnant women, who used mobile phones were 54 percent more likely to have children with behavioural problems. The likelihood increased with amount of potential exposure to radiation, said Britain's "The Independent." You come across this report in the newspaper and thought of writing an article on uses and hazards of Mobile Phones. Write the article in about 200 words.
2. Neha/Nalin, a student of class XII, comes across the following newsreport :  
 500 child workers suspected of being employed in hazardous industrial units in central Mumbai, were rescued by an NGO

She/He writes an article on the ills of child labour highlighting how it can be abolished.

3. Tourism plays an important role in promoting economy and culture of a place.

In order to promote tourism in North-Eastern States, our government has introduced new schemes for encouraging Govt. Employees to visit these states. Write an article in about 150–200 words for your school magazine giving ideas on the steps that our government should take to promote tourism. You are Rohan/Rehana of Sarvodaya Co-ed-s. School, G.T. Road, Shahadara.

4. A Seminar was conducted by the Directorate of Education of Govt. of NCT of Delhi, on making moral values and life skills as a part of school curriculum. Write an article giving your views on this matter. You are Vipin/Vibha of G.S.S.S. School, Budh Vihar, Delhi.
5. You are Amita/Amit, a member of Yuva Club of your school. Your team visited Tihar Jail and was much worried on noticing the most pitiable insanitary condition, poor diet and negligence of the jail authorities. Write an article on the need to protect the prisoners and provide them better human treatment.
6. Some colleges conduct entrance test for admission to undergraduate courses like B.Led, English (Hons.) and journalism (Hons). Do you think that the entrance test is the right method of selecting students. Write an article in about 150–200 words. You are Raman/Radhika, a student of class XII at Govt. Coed. Sr. Sec. School, Mayur Vihar.
7. India is a country with diverse cultures, traditions, religious and political beliefs. To keep such a country together, to bind the people and take the nation ahead on the path of progress, democracy is the most suitable form of government. Write an article in 150–200 words. You are Akshay/Asha a class XII student at Rosary Public School, Delhi.
8. Pooja of R.P.V.V. R.K. Puram is happy that the Government has started a campaign to remove encroachment on public land to make Delhi clean and beautiful for the forthcoming Common Wealth Games. Many flyovers, underpasses, hotels parks are also being constructed. Write an article on common Wealth Games 2010– “A Gateway to Beautiful Delhi.”
9. A recent survey shows that inspite of Govt. efforts there are still many communities in India which do not welcome the birth of a girl child. Write an article in about 200 words, giving your opinion on this topic and steps we should take to solve this problem. You are Atul/Aditi living at Delhi.
10. You are Manish/Malvika a class XII student of SV. Rani Bagh. You are quite disturbed to read in newspaper about the number of students committing suicide right after the CBSE results. This is mainly due to academic family and social pressures and expectations from friends and relatives. You strongly feel the need to open guidance and counselling centres in all the schools of Delhi. Write an article expressing your views and concern over this. Supply a suitable title to your article.

## DEBATE / SPEECH

### Point to Remember

1. Always make a rough draft, edit keeping time (15-18 minutes) in mind.

2. Begin with—"Honourable chairperson, Judges, teachers and my dear friends, I stand before you to express my views for/against the motion "TOPIC"-----.
3. Total agreement or disagreement with the topic should be expressed forcefully and clearly. You can use polite sarcasm and humor but no indecorous language should be used.
4. Use argumentative style and logical reasoning.
5. Back up arguments with relevant information.
6. At the end write "Thank you" at extreme end on the left.
7. Use powerful expressions like :
  - I'd like to argue
  - In my opinion-----.
  - I fail to understand-----
  - May I ask?
  - I disagree----etc.
8. Refer to your opponent's view/ views.

## SPEECH

1. A recent survey by the Ministry of health shows that the growing tendency of obesity among children of well off families is caused by addiction to junk food and lack of physical exercise and it adversely affects their learning power. Write a speech to be delivered in the morning assembly of the school highlighting the importance of good health and motivating the children to eat healthy, balanced diet.
2. Vinny/ Vishesh is concerned about the spread of waterborne diseases with the on set of the summer season. School children being the most vulnerable to these, she/ he decided to deliver a speech in the morning assembly of the school about precautions to be taken to prevent such diseases. Write the speech in about 200 words.
3. You are the Head girl of Sonia public School, Karol Bagh, Delhi. You feel now a days students are overburdened by the tuition classes after long school hours. There is a lot of pressure on them by their parents to attend the tuition classes. More over they are pressurised to achieve better results. So, much disturbed be this current problem of the students, you decide to deliver a speech in the morning assembly of your school. Write a speech and also give some suggestions to lighten the burden.
4. Global Warming and rapid melting of glaciers has become the concern of every Nation. As incharge of Eco-Club of your school. Write a speech to be delivered in school's Morning Assembly, in order to make the students aware about it. You are Abhinav/Asha of Yuva Public School, Anand Vihar.
5. Computer Games and Video games have become popular with children today. As a result outdoor games seem to have no place in their life any more. You are Saurabh/Surabhi, You had

an opportunity of playing Hide-n-seek, with your cousins, on your visit to their small town in summer vacation. You decide to write a speech on your experiences about the joys of playing outdoor games to be delivered in morning assembly in your school. Write the speech in about 150–200 words.

6. You are Ajay/Nainika. Recently you came across a newspaper report on the burning of a young woman as her parents could not meet the dowry demands. You feel that even after 60 yrs of independence we have not really progressed as a nation. Write an article for newspaper expressing your views and also give suggestions to improve the status of women in Indian society.
7. Many parts of Delhi face the problem of water shortage in summer. Similar conditions prevail in other states also. Write a speech on techniques and advantages of “Rain Water Harvesting”. You are Bhushan/Bala, a student of Eco-Club of your school.
8. Shantanu/Shweta of S.V., Shalimar Bagh is disturbed to see the increasing incidents of road-range in metropolitan cities, resulting in irrational killings, She/He decides to write a speech highlighting the causes of road-rage and suggesting steps to make people more tolerant and disciplined on roads. Write the speech in not more than 200 words.
9. Lack of quality education is said to be the main cause of poverty, unemployment, backwardness and all social evils in our country. Write a speech on importance of quality education, motivating the youth to participate actively in co-curricular activities, projects, excursions, and multidimensional development of personality. You are Arun/Aruna of R.P.V.V. Shalimar Bagh, Delhi.
10. Information technology has brought about a global revolution in all fields; computer aided education is fast becoming the order of day. The market is also flooded with educational CDs and on-line learning. It is a new phenomenon. Write a speech expressing your views about computer-aided-learning. Can it replace teachers? Supply a suitable title to your speech. You are Seema/Samir of S.V. Saraswati Vihar.

## SECTION C

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# LITERATURE

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7-11 Poetry and Prose

Text Book

Flamingo

### POEMS

#### 1. MY MOTHER AT SIXTY-SIX

– *Kamala Dass*

##### STANZA 1

Driving from my parent's  
home to Cochin last Friday  
morning, I saw my mother,  
beside me,  
doze, open mouthed, her face  
ashen like that  
of a corpse and realized with pain.

##### Questions

- (a) Where was the poet driving to? Who was sitting beside her?
- (b) What did the poet notice about her mother?
- (c) Why was her mother's face looking like that of a corpse?
- (d) Find words from the passage which mean :
  - (i) half asleep
  - (ii) dead body
  - (iii) felt.

##### STANZA 2

“..... and looked out at young  
Trees sprinting, the merry children spilling  
Out of their homes, but after the airport's  
Security Check, standing a few yards.  
away, I looked again at her”

### **Questions**

1. What did the speaker look out of the window?
2. What do the words ‘Young trees’ and ‘merry children’ signify?
3. Who was standing at a few yards and why did she look at her?
4. What seemed to be the state of poet’s mind?

### **STANZA 3**

“I looked again at her, wan, pale  
as a late winter’s moon and felt that old  
familiar ache, my childhood fear,  
but all I said was, see you soon, Amma,  
All I did was smile and smile and smile”

### **Questions**

1. Who looked wan and pale and why?
2. What is the speaker’s childhood fear?
3. How did the parting words of the poet and her smile contrast to her feelings?
4. Specify the comparison in the stanza?

### **Short Answer Type Questions**

1. Where was the poet going and who was with her?
2. What does the poet’s mother look like? What kind of image has the poet used to signify her aging decay?
- \*3. What does the poet realise with pain? Why does the poet “Put that thought away” and look outside?
4. Why does the poet look outside? What does she see happening outside?
5. How has the poet contrasted the scene inside the car with the activities going outside?
6. Why has the poet brought the image of the merry children—spilling out of their homes?
7. What does she notice?
8. Why is the poet’s mother compared to the late winter’s moon?
9. What is the poet’s familiar ache and why does it return?
10. Why does the poet smile and what does she say while bidding good bye to her mother?
11. What poetic devices have been used by Kamala Das in ‘My Mother at Sixty-Six’?

12. How is the world inside the car different from the outside world?

## 2. AN ELEMENTARY SCHOOL CLASSROOM IN A SLUM

– *Stephen Spender*

### STANZA 1

Far far from gusty waves these children's faces.  
Like rootless weeds,  
the hair torn around their pallor :  
The tall girl with her weighed-down head.  
The paper-seeming boy,  
with rat's eyes.

#### Questions

- (a) Who are these children' and where are they sitting?
- (b) How do the faces and hair of these children look like?
- (c) Why is head of the tall girl 'weighed down'?
- (d) What do you understand by 'The paper-seeming boy, with rat's eyes'?
- (e) What do the image 'rootless weeds,' 'weighed-down', 'Paper-seeming' and 'rat's eyes' suggest?

### STANZA 2

The stunted,  
unlucky heir of twisted bones,  
reciting a father's gnarled disease,  
His lesson, from his desk.  
At back of the dim class one unnoted,  
sweet and young.  
His eyes live in a dream,  
of squirrel's game,  
in tree room,  
other than this.

#### Questions

- (a) Who is the 'unlucky heir' and what did he inherit?
- (b) What is the stunted boy reciting?
- (c) Who is sitting at the 'back of the dim class'?
- (d) 'His eyes live in a dream'—what dreams does he have?
- (e) Pick two images of despair and disease from these lines. What do they hint at?

## **STANZA 3**

On sour cream walls,  
donation.  
Shakespeare's head,  
cloudless at dawn,  
civilized dome riding all cities  
Bellied,  
flowery Tyrolese valley,  
Open-handed map awarding the world its world.

### **Questions**

- (a) What is the colour of the classroom walls? What does this colour suggest?
- (b) What do these classroom walls have?
- (c) Which two worlds does the poet hint at? How is the contrast in the two worlds presented?
- (d) Explain :
  - (i) 'Openhanded'
  - (ii) 'Awarding the world its world'.
- (e) Find words from the passage which mean the following:
  - (i) unpleasant,
  - (ii) institutions of the civilized world/ society.

## **STANZA 4**

.....And yet,  
for these children,  
these Windows,  
not this map,  
their world,  
where all their future's painted with a fog.  
a narrow street sealed in with lead sky far far from rivers.  
capes, and stars of words.

### **Questions**

- (a) What do 'these windows' and 'this map' represent? To which of them do the children in the slum school belong?
- (b) What is the future of these children?
- (c) What do these children crave for? What do they want to get rid of?

(d) Find words from the passage which mean the following :

- (i) cloudy thick air,
- (ii) distant.

### **STANZA 5**

Surely, Shakespeare is wicked,  
the map a bad example,  
with ships and sun and love tempting them to steal-  
for lives that style turn in their cramped holes from  
fog to endless night?

#### **Questions**

- (a) Why is the Shakespear wicked? Why is the map a bad example?
- (b) What tempts them and why?
- (c) How do they live in their ‘holes’?
- (d) Explain” ‘From fog to endless night’?
- (e) Find words from the passage which mean :
  - (i) secretly,
  - (ii) narrow.

### **STANZA 6**

..... On their slag heap,  
these children wear skins peeped,  
through by bones and spectacles of  
steel with mended glass,  
like bottle bits on stones.  
All of their time and  
space are foggy slum.  
So blot their maps with  
slums as big as doom.

#### **Questions**

- (a) What two images are used to describe these slums? What do these images convey?
- (b) What sort of life do such children lead?
- (c) What ‘blot’ their maps? Whose maps?
- (d) What does the poet convey through ‘So blot their maps with slums as big as doom?’

- (e) Find words from the passage which mean :
- (i) Waste material/ lava,
  - (ii) pieces,
  - (iii) hell/ruin.

## STANZA 7

Unless,  
governor, inspector, visitor,  
this map becomes their window  
and these windows that,  
shut upon lives like catacombs.

### Questions

- (a) Why does the poet invoke ‘governor’, ‘inspector’, and ‘visitor’? What functions are they expected to perform?
- (b) How can ‘this map’ become their window?
- (c) What have ‘these windows’ done to their lives?
- (d) What do you understand by ‘catacombs’?
- (e) Which literary device has been used in these lines?

## STANZA 8

Break O break open till they break the  
Town and show the children to green fields,  
and make their world run azure on gold sands,  
and let their tongues run naked into book  
the white and green leaves open history  
their whose language is the sun.

### Questions

- (a) ‘Break O break open’, What should they ‘break’?
- (b) Explain : ..... till they break the town’.
- (c) Where will; ‘their world’ extend up to then?
- (d) What other freedom should they enjoy?
- (e) Who create history?
- (f) What poetic device is used in the last line of the stanza?

### **Short Answer Type Questions (30-40 words each)**

1. Why does Stephen Spender use the image of the despair and disease in the first stanza in the poem and with what effect?
2. Inspite of despair and disease the condition of the slum children, they are not devoid of hope. Give an example of their hope and dream.
3. How does the poet picture the condition of the slum children?
4. What is the theme of the poem? How it has been presented?
- \*5. Which images of the slums in the third stanza present the picture of social disparity, injustice and class inequalities?
6. "So blot their maps with slum as big as room" says Stephen Spender. What does the poet want to convey?
- \*7. How can powerful persons-viz governor, inspector, visitor contribute to improve the lot of slum children?
8. Which world these children do belong to? Which world is inaccessible to them?
9. How does the poet begin the poem with all the despair and ends with hope?
10. What does the poet mean by "Shakespeare is wicked and the map is a bad example"?

### **3. KEEPING QUIET**

*– Pablo Neruda*

**Read the following extracts and answer the questions that follow each :**

#### **STANZA 1**

"Now we will count to twelve  
And we will all keep still.  
For once on the face of the Earth  
let's not speak in any language,  
lets stop for one second,  
and not move our arms so much.  
It would be an exotic moment  
without rush, without engines,  
we would all be together  
in a sudden strangeness,"

#### **Questions**

- (i) What is the poet's suggestion?
- (ii) What does the poet want us to realise through total peace and inactivity?

- (iii) How there will be sudden strangeness?
- (iv) Explain 'exotic moment'.

## STANZA 2

"Fishermen in the cold sea  
would not harm whales  
and the man gathering salt  
would look at his hurt hands.  
Those who prepare green wars,  
wars with gas, wars with fire,  
victory with no survivors'  
would put on clean clothes  
and walk about with their brothers  
in the shades, doing nothing."

### Questions

- (i) What is poet's holy wish?
- (ii) What will be the thought of salt-gatherer while looking at his hurt hands?
- (iii) How will the few moments of introspection affect the mood, thought and action of the people?
- (iv) Explain 'Victory with no survivors'?

## STANZA 3

"What I want should not be confused  
with total inactivity.  
Life is what it is about;  
I want no truck with death.  
If we were not so single-minded  
about keeping our lives moving,  
and for once could do nothing."

### Questions

- (i) How the total inactivity may be confused?
- (ii) What is our single mindedness?
- (iii) Why does the poet want all the people to do nothing for a moment?
- (iv) Explain : 'Life is what it is about'?

## **STANZA 4**

“Perhaps a huge silence  
might interrupt this sadness  
of never understanding ourselves  
and of threatening ourselves with death.  
Perhaps the Earth can teach us  
as when everything seems dead  
and later proves to be alive.  
Now I'll count up to twelve.  
and you keep quiet and i will go.”

### **Questions**

- (i) How does the poet interpret sadness?
- (ii) What can earth teach us?
- (iii) Why does the poet recommend peace for a moment and temporary inactivity?
- (iv) Explain : ‘never understanding ourselves.’

### **Short Answer Type Questions**

***Answer the following in about 30-40 words each***

- 1. Why does the poet want everyone to stand still and count upto twelve?
- 2. What is the Sadness that poet refers to in the poem?
- \*3. How does the poet suggest that there is life in nature under apparent stillness?
- 4. Does the poet suggest total inactivity and death? Give reasons.
- \*5. In what way does the poet condemn the people who prepare green wars? What is his advice to them?

## **4. A THING OF BEAUTY**

**Read the following stanzas carefully and answer the questions that follow each :**

## **STANZA 1**

A Thing of beauty is a joy forever  
Its loneliness increases, it will never  
Pass into nothingness; but will keep  
a bower quiet for us and a sleep  
full of sweet dreams,  
and health, and quiet breathing.

### **Questions**

- (i) Why does the poet appreciate a thing of beauty?
- (ii) How is beauty a joy for ever?
- (iii) How is beauty helpful in making us have sweet dreams?
- (iv) Explain—‘It will never pass into nothingness’.

### **STANZA 2**

Therefore on every morro, are we wreathing  
A flowery band to bind us to the earth,  
spite of Despondence, of the inhuman deatrh  
of noble natures, of the gloomy days,  
of all the unhealthy and o'er darkened ways.

### **Questions**

- (i) Why does the poet feel that we are wreathing a flowery band?
- (ii) Is the poet happy with the human beings? Why not?
- (iii) What is the contrast between human nature and beautiful things?
- (iv) Explain : o'er darkened ways.

### **STANZA 3**

For simple sheep; and  
such are daffodils  
with the green world they live in;  
and clear rills  
That for themselves a cooling covert make.  
'Gainst the hot season; the mid forest brake.

### **Questions**

- (i) Why does the poet say ‘Such are Daffodils’?
- (ii) What does the poet mean by the ‘green world’?
- (iii) How do daffodils lead a difficult life?
- (iv) Why does the poet give the reference of daffodils here?

### **STANZA 4**

Rich with a sprinkling of fair musk rose blooms;  
And such too is the grandeur of the dooms

we have imagined for the mightily dead;  
All lovely-tales that we have heard or read;  
An endless fountain of Immortal drink,  
Pouring unto us from the heaven's brink.

### Questions

- (i) How does the rose beautify the earth?
- (ii) Why does the poet call the dooms to be full of grandeur?
- (iii) How does the heaven bless the mighty dead.
- (iv) Explain : immortal drink.

### Short Answer Type Questions

**Answer the following in about 30-40 words each :**

- 1. Why does the poet call a thing of beauty a joy for ever?
- 2. How does beauty enrich the human beings?
- 3. How do we try to face the gloomy days?
- \*4. Why does the poet criticize the human beings?
- 5. Name the shapes which help us in fighting against the darkness?
- 6. How are sheep blessed by nature?
- 7. How do the daffodils adjust to the hot season?
- 8. How does the heaven help the mighty dead?
- \*9. Why is grandeur associated with the mighty dead?
- 10. What image does the poet use to describe the beautiful bounty of the earth?

## 5. A ROADSIDE STAND

**Read the following stanzas carefully and answer the questions the follow each :**

### STANZA 1

A roadside stand that too pathetically pled'  
It would not be fair to say for a dole of bread  
But for some of the money, the Cash, whose flow supports  
The flower of cities from sinking and withering faint.

### Questions

- (i) Why has the roadside stand been set up?

- (ii) What is the importance of money for cities?
- (iii) Explain “pathetically pled”.
- (iv) What quality of the people who set up the roadside stand is exuded in the above lines?

## STANZA 2

The polished traffic passed with a mind ahead,  
Or if ever aside a moment, then out of sorts  
At having the land scape marred with the artless paint.  
Of signs that with N turned wrong and s turned wrong.

### Questions

- (i) What does “polished traffic” refer to?
- (ii) In what manner does the traffic pass that way?
- (iii) Explain “out of sorts”.
- (iv) Why and at what are they feeling out of sorts?

## STANZA 3

Sometimes I feel myself i can hardly bear,  
The thought of so much childish longing in vain,  
The sadness that lurks near the open window there,  
That waits all the day in almost open prayer,  
for the squeal of brakes

### Questions

- (i) What can the poet not tolerate?
- (ii) Who has been longing and for what?
- (iii) Why is the longing referred to as childish?
- (iv) What do the expressions ‘open window’ and ‘open prayer’ signify?

## STANZA 4

Here far from the city we make our roadside stand  
And ask for some city money to feel in hand  
To try if it will not make our being expand,  
And give us the life of the moving pictures promise  
That the party in power said to be keeping from us.

### **Questions**

- (i) Who are ‘we’ and what do they want to feel in their hands?
- (ii) How do “we” plan to earn money?
- (iii) What life do they aspire for?
- (iv) Pick out an instance of political interface in the lines of “we”?

### **Short Answer Type Questions**

***Answer the following in about 30-40 words each :***

- 1. Why and where was the roadside stand set up?
- 2. What role does money play in the development of cities?
- 3. What things are for sale at the roadside stand?
- \*4. Why are the “greedy good-doers” swarming over these people?
- 5. With what purpose do Cars stop at roadside stand? Mention any two?
- 6. What were the things about which the travellers Complained?
- \*7. How does the ‘roadside stand’ present the pathetic state of rural people?
- 8. Why did the farmers wish to earn money and what did they think of city people?

## **6. AUNT JENNIFER’S TIGERS**

**Read the following stanzas carefully and answer the questions that follow each :**

### **STANZA 1**

Aunt Jennifer’s tigers prance across a screen,  
Bright topaz denizens of a world of green.  
They do not fear men beneath the tree,  
They pace in sleek chivalric certainty.

### **Questions**

- (i) Where do the tigers appear?
- (ii) What is the attitude of tigers towards the men?
- (iii) What does the pace of the tiger reflect?
- (iv) Bring out the difference between the qualities of the tiger and their creator.

### **STANZA 2**

Aunt Jennifer’s fingers fluttering through the wool  
Find even the ivory needle hard to pull.

The massive weight of Uncle's wedding band  
Sits heavily upon Aunt Jennifer's hand.

#### Questions

- (i) Why are Aunt Jennifer's fingers fluttering?
- (ii) What is the result of the fluttering?
- (iii) How has Aunt Jennifer's life been effected by the marriage?
- (iv) Explain : 'have the "wedding band" as a massive weight'.

### STANZA 3

"When Aunt is dead, her terrified hards will lie  
Still ringed with ordeals she was mastered by.  
The tigers in the panel that she made  
Will go on prancing, proud and unafraid."

#### Questions

- (i) Why are Aunt Jennifer's hands called terrified?
- (ii) What are they still ringed with?
- (iii) Where did she make the tigers?
- (iv) What will happen to her tigers after her death?
- (v) Find words from the stanza which mean:
  - (a) Scared
  - (b) Surrounded by
  - (c) board

#### Short Answer Types Questions

**Answer the following in about 30-40 words each :**

1. Answer the following in about 30-40 words each :
2. Pick two qualities of the tigers as depicted in the poem?
- \*3. Bring out the significance of the wedding ring in Aunt Jennifer's life?
4. Has Aunt Jennifer led a happy married life? Why not?
- \*5. The tigers made by Aunt Jennifer are symbolic of her Aspirations? Do you agree? Why? Why not?
6. What do you understand about-mental state of Aunt Jennifer?

## II.

### 1. THE LAST LESSON

#### SHORT ANSWER TYPE QUESTIONS

*Answer the following questions in about 30-40 words each :*

- Q.1. Why was Franz afraid to go to school?
- Q.2. What temptation was Franz able to overcome and proceed to School?
- Q.3. What is the significance of the bulletin? Why was there a crowd in front of it?
- Q.4. How and why was the teacher dressed differently that day?
- Q.5. What noise Franz couldn't hear on reaching school?

OR

What was unusual view in the school when he reached the school?

- Q.6. What was the order from Berlin? How was it going to affect learning of Franz?
- Q.7. How did Franz's views regarding his books change?
- Q.8. What was felt by Franz in his attitude towards Mr. Hamel?
- Q.9. Why were the old men of the village present in the class?
- Q.10. When Franz turned to recite participles what had really happened?
- Q.11. According to Mr. Hamel what is wrong with Alsace?
- Q.12. What will others tell the French people after the implementation of the Berlin orders?
- Q.13. How does the teacher hold the parents responsible for the children not studying?
- Q.14. What blame does M. Hamal take upon himself for poor performance level of the children?
- Q.15. What did M. Hamel say about the French language?
- \*Q.16. How is the mother tongue important for the people who are enslaved?
- Q.17. Why was Franz able to understand everything very well on the last day?
- Q.18. What was the atmosphere in the class on the last day?
- Q.19. What changes had taken place in the school in forty years?
- Q.20. "I never saw him look so tall". Who is the person mentioned? What does the speaker mean by saying "I never saw him so tall"?
- Q.21. How did Franz react to the news that teaching of French would be discontinued?
- Q.22. How did M. Hamel gesture to the students at the end of the class to formally announce?

- Q.23. What did M. Hamel write on the blackboard at the end of the class? What is its significance?
- Q.24. Why did Franz remember the last lesson?
- \*Q.25. Why was the last lesson of French an emotional moment for m. Hamel?

### **LONG ANSWER QUESTIONS**

***Answer the following Questions in about 150 words each :***

- Q.1. "The importance of a thing dawns upon us when it is no longer with us". Do you agree? Give reasons based on the text?
- Q.2. In the story M. Hamel emerges not only as a dedicated teacher but also as a sensitive and understanding human being". Discuss the character of M. Hamel in light of the above statement.
- \*Q.3. Language becomes a tool in the lands of the conquerors to establish their superiority over the losers. Critically analyse the statement with reference to the lesson.
- Q.4. Describe the classroom scene on the last day as painted in the story.
- Q.5. Do you think the title 'The Last Lesson' is appropriate. Give a reasoned answer.
- \*Q.6. "When a people are enslaved, as long as they held fast to their language it is as if they had the keys to their prison." Discuss the significance of this statement in light of The Lesson.

## **2. LOST SPRING**

### **SHORT ANSWER TYPE QUESTIONS**

***Answer the following Questions in about 30-40 words each***

- Q.1. What is the irony in the name Saheb-e-Alam?
- Q.2. What are the living conditions in Seemapuri?
- Q.3. How does an adult and a child rag picker look at garbage differently?
- Q.4. From where has Saheb's family come? Why?
- Q.5. What is the priority of the ragpickers?
- \*Q.6. "Garbage to them is gold", What does this statement mean?
- Q.7. What explanation is given for children (the Red pickers) not wearing footwear?
- \*Q.8. How had rag picking "acquired the proportions of fine art?
- Q.9. What happens when a child rag picker finds a coin in the garbage?
- Q.10. From where has Saheb managed to procure a pair of shoes?
- \*Q.11. How do children of rag pickers become "partners in survival"?
- Q.12. What is one thing that is out of Sheb's reach? What has he to be content with?

- Q.13. Why did the rag pickers leave their “beautiful land of green fields and rivers”?
- Q.14. What is Saheb’s new job? Mention the two things he gets from it?
- Q.15. Why has Saheb “Lost his carefree look”?
- Q.16. Explain “Saheb is no longer his own master”.
- Q.17. What is the Common lament in Firozabad?
- Q.18. Why don’t the bangle workers organise themselves into a cooperative?
- Q.19. What is the significance of Mukesh’s dream to become a motor mechanic?
- Q.20. Mention two hazards of working in the glass bangle industry?
- Q.21. Which are the two distinct worlds which have become a burden on the child in Firozabad?
- Q.22. What rights of the children are the people unaware of in Firozabad?
- Q.23. What is the significance of bangles for an Indian woman?
- Q.24. Has any change come about with time in Firozabad? Give reasons.
- Q.25. How does the belief in destiny add to the misery of the workers of Firozabad?
- Q.26. What is the city Firozabad famous for?

### **LONG ANSWER QUESTIONS**

- Q.1. The Lesson “Lost spring vividly depicts the lives of street children. Discuss.
- Q.2. Mukesh is a street child, which traits of Mukesh appeal to you most? Why?
- Q.3. The beauty of the bangles of Firozabad is in direct contrast to the life of the people who make them’. Elaborate.
- Q.4. “Survival in Seemapuri means rag picking”. Give a brief account of the life and activities of squatters from Bangladesh settled in Seemapuri.
- \*Q.5. Banning of child labour is not the only solution. Do you agree? Give reasons and also suggest what should be done to improve their lot?
- Q.6. Bring out the significance of Mukesh’s dream of becoming a mechanic of motor cars?
- Q.7. How different is the attitude of Mukesh from that of Saheb?
- \*Q.8. There is a vast gulf that separates dreams from reality. Discuss with special reference to Mukesh and Saheb.

### **3. DEEP WATER**

#### **SHORT ANSWER TYPE QUESTIONS**

*Answer the following 30-50 words each*

- Q.1. What made the Y.M.C.A. pool safe for learner?
- Q.2. What did William Douglas mother warn him about and why?
- Q.3. How did Douglas develop an aversion to water?
- Q.4. How did Douglas try to feel at ease in the Y.M.C.A. pool?
- Q.5. What did Douglas plan while he was drowning?
- Q.6. Who had thrown Douglas into the pool and why?
- Q.7. What was the immediate effect on Douglas of the drowning incident?
- Q.8. Mention any two long term consequences of the drowning experience?
- Q.9. How did this incident (Douglas drowning) deprive him of the pleasures of water sports?
- Q.10. What did the author do to overcome the fear of water? Did he succeed? Give reasons for your belief?
- Q.11. Who helped him overcome his fear of water? How did he do so?
- \*Q.12. Why did the experience of Conquering his fear of water have a deeper meaning for Douglas?
- Q.13. What were the two sensations Douglas had experienced?
- Q.14. Which two incidents made Douglas fear water?
- Q.15. Mention two qualities of Douglas that helped him conquer his fear?
- Q.16. "The instructor was finished. But I was not finished. What had the instructor finished? Why did 'I' not feel "finished"?
- Q.17. How did Roosevelt prove to be an inspiration for Douglas?

#### **LONG ANSWER QUESTIONS**

- Q.1. "Piece by piece, he built a swimmer". How did the instructor help the author to become a swimmer and overcome his fear of water?
- Q.2. What emotion did the author experience while he was drowning in the (Yakima) Y.M.C.A. pool? How did he face the frustrating moments?
- \*Q.3. How did the 'near death' experience in the (Yakima) Y.M.C.A. pool have a far reaching effect on the author's life?
- Q.4. 'If we surrender to our fears they overpower us, if we face them they fade away. Do you agree? Why, Why not? Discuss with reference to the lesson.

- Q.5. Imagine you are a student counsellor. Prepare a speech to be delivered in the morning assembly on the topic "Fight your fears."
- Q.6. "There is terror only in fear of death". Comment.

#### 4. THE RAT TRAP

##### SHORT ANSWER TYPE QUESTIONS

***Answer the following questions in about 30-40 words each :***

- Q.1. How did the peddler earn his livelihood?
- Q.2. What entertaining thought crossed his mind one day?
- Q.3. "The world is a big rat trap". How?
- Q.4. How was the crofter's hospitality a pleasant surprise for the peddler?
- Q.5. Why was the crofter so talkative and friendly with the peddler though he was a stranger?
- Q.6. How did the crofter reveal treat the peddler?
- Q.7. What did the crofter reveal about his past?
- Q.8. Why did he show the thirty kronors to the peddler?
- Q.9. How did the peddler abuse the trust that crofter had reposed in him?
- Q.10. What precautions did the peddler take to avoid being caught after leaving the cottage?
- Q.11. Why did the blacksmith treat the peddler's arrival as a routine affair?
- Q.12. How was the iron master's reaction to the peddler different from the blacksmith's?
- Q.13. Why did the peddler not reveal his real identity to the iron master at once?
- Q.14. Why did the peddler decline the ironmaster's invitation?
- Q.15. Why did the ironmaster send Edla his daughter to the peddler?
- Q.16. What made the peddler accept Edla's invitation?
- Q.17. What doubt did Edla have about the peddler?
- \*Q.18. When did the ironmaster realise that he had mistaken the peddler to be his old acquaintance?
- Q.19. How did the peddler defend himself in the ironmaster's house?
- Q.20. Why did ironmaster not call the sheriff?
- Q.21. Why did Edla insist on entertaining the peddler even after he was exposed?
- Q.22. How did the peddler spend his time at Ramsjo the ironmaster's house?
- Q.23. What news did Edla get at the church?

- Q.24. Why was Edla happy to see the gift left by the peddler?
- Q.25. Why did the peddler sign himself as Captain Van Stahle?
- Q.26. What message does the story put across?

### **LONG ANSWER TYPE QUESTIONS**

***Answer the following about 250 words***

- Q.1. "The reader's sympathy is with the peddler". Do you agree? Why/not?
- Q.2. The story is not only entertaining but also philosophical. Bring out the entertaining and philosophical elements of the story.
- \*Q.3. "A simple act of mercy and kindness can bring about a change of heart". Discuss the significance of love and kindness with reference to the story 'Rattrap'.
- Q.4. "Man is a social animal. He can survive but not live in isolation." Do you agree? Give a fully reasoned answer with illustration from the text.
- \*Q.5. Imagine you are the Rattrap peddler. Write a letter to Edla thanking her for the change she has brought about in you.
- Q.6. Describe the difference between the ironmaster's behaviour towards the peddler on two different occasions. Why did he behave in different ways.
- Q.7. The iron master and his daughter are poles apart. Discuss.

### **5. INDIGO**

#### **SHORT ANSWER TYPE QUESTIONS**

***Answer the following Questions in about 30-40 words each :***

- Q.1. Who was Raj Kumar Shukla? Why was he keen on meeting Gandhi?
- Q.2. How did Shukla pursue Gandhi to visit Champaran?
- Q.3. Why was Gandhi not allowed to draw water from the well of Rajender Prasad's house?
- Q.4. Where did Gandhi stay in Muzaffarpur? How does he comment about it?
- Q.5. What did the peasants of Champaran pay the British landlords as rent?
- Q.6. What would be the impact of synthetic indigo on the price of natural indigo?
- \*Q.7. How did Gandhi make the British realise that Indians could challenge their might?
- Q.8. What did the landlords do when they learnt that Germany had developed synthetic indigo?
- Q.9. How did the sharecroppers react to the landlord's agreement to release them of the fifteen percent agreement?

- Q.10. Why did Gandhi agree to a settlement of 25 percent refund to the farmers?
- Q.11. Was there any change in the plight of the peasants after this episode? Support your answer on basis of the text.
- Q.12. Why did Gandhi receive summons to appear in the court?
- Q.13. "Civil Disobedience had triumphed the first time in India". How did it happen?
- Q.14. Why and when did Gandhi say 'The battle of Champaran is won'?
- Q.15. How did Gandhi supervise the working of his Ashram at Allahabad while he was in Champaran?
- Q.16. What steps did Gandhi take to remove the social and cultural backwardness of the Champaran villagers?
- Q.17. How was Gandhiji's style of politics different from the usual politicians?
- Q.18. Why did Gandhi oppose the inclusion of Charles Freer Andrews in the Champaran movement?
- Q.19. What message does the Champaran episode give?
- Q.20. What were the contents of Gandhi's statement pleading guilty?

### **LONG ANSWER TYPE QUESTIONS**

***Answer the following Questions in about 150 words each :***

- Q.1. Why do you think the sharecropping arrangement was troublesome to the peasants?
- Q.2. Who was Raj Kumar Shukla? How did he persuade Gandhi to come to his place?
- Q.3. "He began by trying to get the facts." What different facts did he (Gandhiji) collect? What was the outcome.
- \*Q.4. How did Gandhiji negotiate for settlement of refund to peasants? Was it justified? Give reasons.
- Q.5. "Dialogue not violence can resolve situations of conflict and Injustice. Do you agree? Answer with illustrations from the lesson 'Indigo'
- Q.6. "The visit undertaken casually on the entreaty of an unlettered peasant occupied almost a year of Gandhi's life". What events unfolded and with what results?

### **6. POETS AND PANCAKES**

#### **SHORT ANSWER TYPE QUESTIONS**

***Answer the following questions in about 30-40 words each:***

- Q.1. What was 'Pancake'? Why was it in great demand in Gemini Studio?
- Q.2. How did the make-up room of the Gemini Studio look like?
- Q.3. Did the person who was subjected to make up feel Comfortable in the make up room? Give reasons.

- Q.4. How was Gemini Studio an example of national integration?
- Q.5. What was the skill/ ability/forte of the make up men of Gemini Studio?
- Q.6. How was hierarchy maintained in the make up department?
- Q.7. What work did the office boy do at Gemini Studio?
- Q.8. With what purpose had the office boy joined Gemini Studio?
- Q.9. Why did the author appear to be doing nothing at Gemini Studio?
- Q.10. How did the lawyer lose his job?
- Q.11. What notion prevailed about Communists at Gemini Studio?
- Q.12. Why was the office boy frustrated? Whom did he vent his anger upon?
- Q.13. What made the lawyer stand out from other's at Gemini Studio?
- Q.14. What were the political affiliations of the people at Gemini Studio?
- Q.15. How did the plays staged by MRA influence Tamil plays deeply?
- Q.16. On what basis did the staff conclude that the poet from England was an editor?
- Q.17. Why is the Englishmen's visit Referred to as Unexplained mystery?
- Q.18. According to the author what are the qualities of a prose writer?
- Q19. How did the author discover who was the Englishman who visited the studio?
- Q.20. What feeling did the discovery of the identity of the poet give rise to?
- Q.21. What does "The God that failed" refer to?
- Q.22. Why did the book assume significance for the author?
- Q.23. Why did Stephen Spender visit Gemini Studio?
- Q.24. What do you understand about the author's literary inclination from the account?
- Q.25. From where did the author Procure the book "The God that failed"?

### **LONG ANSWER TYPE QUESTIONS**

***Answer in about 125-150 words each :***

- Q.1. Give a detailed account of the structure and functioning of the make up department at Gemini Studio.
- Q.2. Subbu was the man "Who gave direction and definition to Gemini Studio". In light of the above statement determine Subbu's character.
- Q.3. How did the lawyer bring an end to an acting career? How did he stand apart from the group?

- Q.4. "The purpose of the English poet's visit remained an unexplained mystery for the audience". What was the purpose of the visit and why did it remain a mystery?
- \*Q.5. What was the Moral Rearmament Army? Why did it visit Madras and what effect did it make?
- Q.6. Asokamitran has used humor and Satire effectively in poets and Panckes' discuss.

## 7. THE INTERVIEW

### SHORT ANSWER TYPE QUESTIONS

*Answer the following Questions in about 30-40 words each :*

- Q.1. What are the two diverse views on interviews?
- Q.2. Why did Lewis Carroll not consent to be interviewed?
- Q.3. What is Kipling's view towards interview?
- Q.4. What does Umberto Eco mean by "empty spaces"?
- Q.5. How was Eco's first Doctoral dissertation different from others?
- Q.6. How is Eco's style of writing different from the regular academic style?
- Q.7. Why does Eco lay emphasis on the narrative aspect?
- Q.8. Bring out the difference between Roland Barthes and Eco.
- Q.9. Why is Eco uncomfortable being branded a "novelist"
- Q.10. What myth about readers "The name of the Rose" shattered?
- Q.11. how does an interviewer hold a position of power and influence?
- Q.12. According to Eco what is unusual about the success of "The Name of the Rose"?
- Q.13. Who, in today's world is our chief source of information about personalities?

### LONG ANSWER TYPE QUESTIONS

*Answer in about 125-150 words each :*

- \*Q.1. "The interview is both a much maligned and a supremely Serviceable medium of communication." Do you agree? Why/Why not?
- Q.2. "I can't understand how a man can do all the things he does". Discuss the statement with reference to Umberto Eco.
- Q.3. 'Umberto Eco Escapes being compartmentalised either as an Essay it or a novelist'. Discuss.
- Q.4. What is "The name of the Rose" about? Why did it become an Unprecedented success?
- Q.5. What are the Distractive traits of Unberto. Eco's works?

Q.6. Why are the journalists and the publisher puzzled at the success of the 'Name of the Rose'?

## 8. GOING PLACES

### SHORT ANSWER QUESTIONS

**Answer the following Questions in about 30-40 words each :**

- Q.1. Mention two differences in the character of Jansie and Sophie?
- Q.2. Mention the incident when Geoff plays the role of the protective elder brother to Sophie?
- Q.3. Why did Sophie want to keep her meeting with Danny a secret from Jansie?
- Q.4. How does Sophie's father react when Geoff tells him that Sophie has met Danny Casey?
- Q.5. Pick two instances from the text to prove that Danny Casey is a Celebrity.
- Q.6. How did Geoff give Sophie away?
- Q.7. Why did Sophie like to walk by the canal?
- Q.8. What improvement did Sophie want Geoff to make in his appearance?
- Q.9. Who was Danny Casey? Which country did he play for?
- Q.10. Do you think Sophie had actually met Danny Casey? Why/Why not?
- Q.11. Why did Sophie feel jealous of her brother's silence?
- Q.12. What were the options that Sophie was dreaming of? Why does Jansie discourage her for having such dreams?

### LONG ANSWER TYPE QUESTIONS

**Answer in about 125-150 words each :**

- Q.1. Bring out various aspects of the brother sister relationship with illustration from the text.
- Q.2. "Going places" is a story that borders on fantasy and reality". Discuss.
- Q.3. 'The meeting of Sophie with Danny Casey is a figment of her imagination". Do you agree? Why/ Why not?
- Q.4. Bring out the difference in the character of Sophie and Jansie.
- Q.5. On the basis of the text discuss what socio-economic background did Sophie belong to?
- Q.6. Which member of the family was Sophie Closest to? Why?
- Q.7. Sophie is a middle class girl who longs like any other teenager to reach out to the horizons. Justify the statement.

## VISTAS

### 1. THE THIRD LEVEL

#### SHORT ANSWER TYPE QUESTIONS

**Answer the following Questions in about 30-40 words each :**

- Q.1. How does the psychiatrist interpret Charley's visit to the third level?
- Q.2. Why did the psychiatrists interpretation upset Charley's Wife? How died the psychiatrist pacify her?
- Q.3. What is a first day cover?
- Q.4. Why do stamp collectors mail envelops to themselves on the first day of the sale?
- Q.5. What was Sam's wish and how did he fulfil it?
- Q.6. How did people spend their time in Galesburg in 1984?
- Q.7. Why did Charley decide to take the subway from the Grand Central?
- Q.8. Why did the Clerk at the third level refuse to accept the money from Charley?
- Q.9. How were Charley and Louisa convinced about the existence of the third level?
- Q.10. What preparation did Charley make to go to Galesburg?
- Q.11. What makes Galesburg a wonderful town?
- Q.12. What did Charley come to know from Sam's letter?
- Q.13. Why couldn't Sam go back to his old business in Galesburg?

#### LONGER ANSWER TYPE QUESTIONS

- Q.1. What differences did Charley observe at the 3rd level of the Grand Central?
- \*Q.2. Hobbies provide a refuge from reality from our otherwise hundrum lives. Elaborate the statement in light of the lesson.
- Q.3. Charley is so engrossed with fiction that he loses touch with reality. Do you agree? Give reasons.
- \*Q.4. In our times we have to strike a balance between flights of fancy and practicality. Discuss the statement will reference to the 3rd level.

## **2. THE TIGER KING**

### **SHORT ANSWER TYPE QUESTIONS**

***Answer the following Questions in about 30-40 words each :***

- Q.1. What did the astrologers foretell when the king was born?
- Q.2. Why was the chief astrologer surprised when the infant spoke?
- Q.3. Why was the tiger a danger for the infant?
- Q.4. How did the king justify the killing of the tigers?
- Q.5. In what manner was the prince brought up?
- Q.6. How was the Maharajah in danger of losing his throne?
- Q.7. What alternative to the tiger hunt did the secretary come up with?
- Q.8. How did the Maharajah manage to retain his throne?
- Q.9. What unforeseen hurdle brought the tiger hunt to a standstill?
- Q.10. Why and on what condition did the Maharajah want to marry?
- Q.11. How did the Maharajah reward and later punish the villagers who had discovered the hundredth tiger?
- Q.12. What did the hunters discover about the hundredth tiger after the Maharajah had shot it?
- Q.13. How and why was the 100th tiger honoured?
- Q.14. Why didn't the shopkeeper quote the real price of the wooden tiger?
- Q.15. How did the wooden tiger lead to the death of the Maharajah?
- Q.16. Pick out two instances to prove that Maharajah neglected everything for the sake of tiger hunting.
- Q.17. Why wasn't the Maharajah informed about the hundredth tiger's survival?
- Q.18. How did the Deewan help the Maharajah achieve his mission?
- Q.19. Hundredth tiger was a Comic figure. Explain.
- Q.20. Why did the Deewan advise the Maharajah against increasing the land tax?
- Q.21. How did the Maharajah exercise his exclusive right on all the tigers of his kingdom?
- Q.22. What did the astrologer promise to do if the king killed the hundredth tiger? Why did he say so?
- Q.23. Why didn't the Maharajah agree to the suggestion of the British officer's Secretary?

## **LONGER ANSWER TYPE QUESTIONS**

***Answer the following in about 150 words.***

- Q.1. The Diwan in the story is a very resourceful person. Discuss with reference to the lesson.
- Q.2. How did the Maharajah dispel the danger that loomed over his throne?
- \*Q.3. Bring out the element of humour and irony in the story "The Tiger King".
- Q.4. The King was capricious, arbitrary and whimsical. Do you agree? Give a reasoned answer.
- Q.5. The hundredth tiger played a decisive role in the fate of the Maharajah of Pratibhadapuram. Explain.

## **3. JOURNEY TO THE END OF THE EARTH**

### **SHORT ANSWER TYPE QUESTIONS**

***Answer the following Questions in about 30-40 words each :***

- Q.1. What emotion did the author experience on reaching Antarctica?
- Q.2. Why was the author surprised at the Sight of Antarctica?
- Q.3. Bring out the difference between Gondwana and present day Antarctica?
- Q.4. How were the Himalayas formed?
- Q.5. Why has the average global temperature increased?
- Q.6. Why is Antarctica Still pristine?
- Q.7. Why is Antarctica a crucial element in the debate on climate change?
- Q.8. What is the objective of 'Students on Ice' Programme?
- Q.9. Why is the involvement of Students crucial in the 'students on Ice' Programme?
- Q.10. Where and how can one experience the real threat of global warming?
- Q.11. How have human beings created a ruckus in 12,000 years of their existence?
- Q.12. Who is Geoff Green? What did he get tired of and why?
- Q.13. Why has the 'student on Ice' programme been so successful?
- Q.14. How will the depletion of ozone layer affect the Carbon Cycle?
- Q.15. Why did Geoff Green prefer to include the high school students in 'Student on Ice' programme?

## **LONGER ANSWER TYPE QUESTIONS**

***Answer the following Question in about 125-150 words each :***

- Q.1. A lot can happen in a million years, but what a difference a day makes. In the light of this statement examine the role of the younger generation in protecting the environment.
- Q.2. By whom and with what purpose was the ‘students on Ice’ programme started? How far has it achieved its goals?
- \*Q.3. ‘The pristine purity of Antarctica is under grave threat from humans.’ How are human beings threatening Antarctica?
- Q.4. Imagine you are the author. Write a letter to your friend sharing with him your experience of the trip to Antarctica.
- Q.5. You are President of the Environment Club., prepare a speech to be delivered on world Environment Day creating awareness about human interference in environment with special reference to Antarctica?

## **4. THE ENEMY**

### **SHORT ANSWER TYPE QUESTIONS**

***Answer the following in about 30-40 words each :***

- Q.1. Why did Sadao wait before falling in love with Hana?
- Q.2. Give two reasons why Sadao was not sent abroad with the troops.
- Q.3. What was keeping Sadao away from Prof. Harley’s House?
- Q.4. Pick two instances from the story which reflect chauvinism in Sadao’s father?
- Q.5. How did Hana and Sadao establish the identity of the man washed ashore?
- Q.6. What superstitious belief of the servants made them oppose Sadao’s decision to give shelter to the injured man?
- Q.7. Why did Sadao decide to treat the injured man?
- Q.8. What did the servants think about Sadao sheltering an enemy?
- Q.9. What is the scar on the prisoner’s neck an indication of?
- Q.10. What two events happened on the seventh day of the injured man’s arrival?
- Q.11. Why was Sadao called by the General?
- Q.12. Hana’s fears on the messenger’s arrival proved false. How?
- Q.13. How did Hana react to the servants leaving the house?
- Q.14. What was moral dilemma in front of the couple?

- Q.15. What two contradictory foreign elements did the General want Sadao to combine in himself?
- Q.16. Why didn't the old General trust the other surgeons?
- Q.17. What plan did the General suggest to get rid of the prisoner?
- Q.18. Why were private assassins essential in Japan?
- Q.19. Why couldn't the General's plan see the light of the day?
- Q.20. Why did Sadao feel that the General was in the palm of his hand?
- Q.21. How did Sadao's visit of Prof. Harley's home prove significant?
- Q.22. What things did Sadao provide for the wounded prisoner on the boat?
- Q.23. In America Sadao had faced as well as practiced prejudice. Support with instances from the lesson.

### **LONG ANSWER TYPE QUESTIONS**

- \*Q.1. Dr. Sadao and Hana rise above narrow feelings of patriotism to serve the nobler cause of humanity. Justify with reference to the story.
- Q.2. Give an account of the efforts made by Dr. Sadao and Hana to save the life of the injured man.
- Q.3. Discuss the reaction of the servants to the survival and departure of an American in the house.
- \*Q.4. "Prejudices are obstacles in interaction among human beings." In the light of the lesson discuss the statement.
- Q.5. Without his wife's help Sadao wouldn't have been able to save the injured man. Assess the role of Hana in light of this statement.

## **5. SHOULD WIZARD HIT MOMMY**

### **SHORT ANSWER TYPE QUESTIONS**

***Answer the following Questions in about 30-40 words each :***

- Q.1. How did the custom of story telling degenerate into a futile rite?
- Q.2. Pick out instances to prove that Jo was no longer a credulous child.
- Q.3. What was unique about the story that Jack told?
- Q.4. How did the wizard solve as well as create problems?
- Q.5. What was the cause of Roger Skunk's sadness?
- Q.6. Who came to Roger Skunk's help and what did he do?
- Q.7. Pick out the autobiographical elements in Roger Skunk's story?

- Q.8. How did Roger Skunk's mother react to his newly acquired smell?
- \*Q.9. How does the character of the wizard suit Jack?
- Q.10. Did Jo accept Roger Skunk's mother's violence to the wizard? What did she want?
- Q.11. How does Jack justify his ending of the story?
- Q.12. Why does Jo want a different ending to the story?
- Q.13. What is the moral issue of the story?

### **LONG ANSWER TYPE QUESTIONS**

- Q.1. Is the title "Should Wizard Hut Mommy". Justified?
- Q.2. Bring out the difference and the widen implication of Roger Skunk's and his mother's attitude towards the Skunk's smell?
- \*Q.3. Adults should not impose their perspective on kids. Do you agree? Give a reasoned answer.
- Q.4. Why does Jo want wizard to hit Mommy? Justify your answer on the basis of the story?
- \*Q.5. What are the deeper issued raised in the story?
- Q.6. Jack's handling of the ending of his story projects him in a poor light as a father. Discuss with reference to the story?

## **6. ON THE FACE OF IT**

### **SHORT ANSWER TYPE QUESTIONS**

*Answer the following Questions in about 30-40 words each :*

- Q.1. What had happened to Derry's face? How did it affect him?
- Q.2. Who is Mr. Lamb? How does Derry enter his garden?
- Q.3. Why does Derry feel surprised on entering the garden?
- Q.4. How does Mr. Lamb look at the weeds?
- Q.5. Why do the children call Mr. Lamb "Lamey Lamb"?
- Q.6. How does the reader realise that Mr. Lamb is a lonely man?
- Q.7. What draws Derry to Mr. Lamb?
- \*Q.8. How does Mr. Lamb make Derry realise the uselessness of being a recluse?
- Q.9. What did Derry think about the garden before he entered it?
- Q.10. What did Derry overhear his parents talking about?

Q.11. Why does Derry's mother object his going to Mr. Lamb?

Q.12. Why were there no curtains in Mr. Lamb's house?

### **LONG ANSWER TYPE QUESTIONS**

***Answer the following Questions in about 125-150 words each :***

\*Q.1. The play ends on a tragic note but reaffirms hope. Discuss with reference to the story.

Q.2. Derry suffers from a sense of insecurity and alienation. Comment.

Q.3. Inspite of his show of bravado, Mr. Lamb is a lonely man. Do you agree? Give a reasoned answer.

Q.4. Rather than feeling sad and merciful towards the physically disabled we should try to integrate them into the mainstream. In light of the story establish the truth of this statement.

\*Q.5. Mr. Lamb infuses Derry with a zest for living. How does he succeed in doing so?

### **7. EVANS TRIES AN O-LEVEL**

#### **SHORT ANSWER TYPE QUESTIONS**

***Answer the following Questions in about 30-40 words each :***

Q.1. What was unusual about the request received by the Examination Board?

Q.2. What did the governor tell the secretary about Evan's previous record?

Q.3. What is the nickname Evans has got and why?

Q.4. Pick out an instance to show that Evans was not genuinely interested in learning German.

Q.5. What preparations were made for Evans to appear for the exam in prison?

Q.6. Who were the visitors who visited Evans at 8.30 am on the day of the exam?

Q.7. What reason does Evans give for not taking off his hat?

Q.8. What duty had been assigned to Reverend Stuart Macleery and what material was he carrying?

Q.9. What was the real reason behind Evans not taking his hat off.

Q.10. Why did the Governor decide to turn on the speaker while the scam has been held?

Q.11. Why had Maclery brought a rubber ring with him? What was its real purpose?

Q.12. What slight irregularity about Evans did Stephens notice?

Q.13. What did Stephen suspect Evans would do? Why did he (Stephen) drop the line of thought?

Q.14. What did Stephen discover in Evan's cell after Mcleery had left?

Q.15. Who had impersonated whom in the plan to escape?

- Q.16. How did Evans manage to get blood and how was its clotting prevented?
- Q.17. What was Evans actually doing when the pen was stuck in his mouth?
- Q.18. What two changes are noticed in Mcleery when he leaves after the scam is over?
- Q.19. How did the correction slip help in Evans' escape?
- Q.20. How is Evans able to manage his escape in absence of visitors and letters?
- Q.21. Why did Evans leave the question paper with German written on it in the cell?
- Q.22. What fate did the real Mcleery meet?
- Q.23. How did Evans manage to give a slip to the Governor at the end?

### **LONG ANSWER TYPE QUESTIONS**

***Answer the following Questions in about 125-150 words each :***

- Q.1. Evans was able to turn the table on his captors. What did he do?
- Q.2. Do you agree that the governor was just another good for giggle gullible governor? Give reasons.
- \*Q.3. "Where there is a will, there is a way." To what extent does the story prove it?
- Q.4. What steps were taken by the prison authorities to ensure that the exam was conducted in a fair manner without compromising the security.

## **8. MEMORIES OF CHILDHOOD**

### **SHORT ANSWER TYPE QUESTIONS**

***Answer the following Questions in about 30-40 words each :***

- Q.1. Why wasn't Zitkala-Sa not feeling at home in her new surroundings?
- Q.2. Why did she pine for her lost freedom?
- Q.3. Why did Zitkala-Sa watch the "three young braves"?
- Q.4. "I felt like sinking to the floor"! Who felt so and why?
- Q.5. Why was Zitkala-Sa being keenly watched?
- Q.6. What information did Judewin give to Zitkala-Sa?
- Q.7. Why was Zitkala-Sa resisting the cutting of her hair?
- Q.8. How did Judewin and Zatkala-Sa react differently to the cutting of hair?
- Q.9. When did Zitkala-Sa lose her spirit?
- Q.10. What indignities did Zitkala-Sa have to suffer after she was separated from her mother?

- Q.11. How did Zitkala-Sa resist when she was discovered under the bed?
- Q.12. Why did Bama take unusually long to reach home from school?
- Q.13. What were the entertaining sights which caused her delay in reaching home?
- Q.14. What was the usual scene at the coffee clubs in the bazaar?
- Q.15. Why did Bama feel like shrieking with laughter at the sight of the elderly man?
- Q.16. What was the elderly man carrying and for whom?
- Q.17. Why was Annan not amused when Bama told him the story of the elderly man?
- Q.18. How did Bama react when she came to know the reality of the elderly man carrying the packet?
- Q.19. Why does Bama feel that the landlord has lost all human feelings?
- Q.20. Where did Bama's elder brother study? Why did he often go to the neighbouring village?
- Q.21. Why did the landlords man ask Annan where he lived?
- Q.22. What reason did Annan give for not getting honour and dignity in society?
- Q.23. What advice did Annan give Bama regarding honour and dignity?
- Q.24. What impact did Annan's words have on Bama and with what effect?
- Q.25. Bring out two similarities between Bama and Zitkala-Sa.

### **LONG ANSWER TYPE QUESTIONS**

***Answer the following Questions in about 125-150 words each :***

- Q.1. "The cutting of my Hair" shows insensitivity of the mainstream culture toward marginalized communities. Discuss.
- Q.2. Zitkala-Sa did not tamely surrender but put up a brave fight. How did she show her resistance to the cutting of her hair?
- \*Q.3. The resistance of Zitkala-Sa to the cutting of her hair and Bama's determination to study are sparks which can ignite a change. Discuss in the light of the chapter.
- Q.4. What was Bama's initial reaction to the incident on the street? How did she react to it differently later on.

# **SAMPLE PAPER No. 1**

## **Section A**

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### **READING SKILLS**

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**Maximum Marks : 20**

**A1. Read the passage given below and answer the questions that follow :**

1. Human progress is largely the result of human effort and skill. Once we learn to expect great things of ourselves and prepare to receive the good things of life, they not only can but will be ours. There is genius within us, but we are like sleeping giants. Unless we awaken to this fact and use the larger power, we sleep on and on. The source of all power is within reach of us. "The kingdom of God is within us." To improve, and further improve, is the constant struggle of life's greatest successes. A marked characteristic of a successful man is that he is always improving something somewhere. His daily resolution, upon arising every morning is to make today a better day than yesterday by improving something.
2. "Man is not pulled from in front nor is he pushed from behind," says Paul Meyer. "Rather, he is driven from within, first, by what he thinks, subsequently by what he feels and does." He further reiterates : "People are conditioned beings. Their basic habits of thoughts or attitudes are formed early in childhood, in an environment over which they have little or no control. Yet, they carry these attitudes and act out their entire adult lives with little change. They are regulated in their response to their environment by the negatively conditioned image they hold of themselves and society. People have the unlimited potential to make themselves whatever they choose; their only limitations are those which they place on their own minds."
3. Success is not a relationship between how well one person is doing in comparison with another, but a relationship between what a person is and what a person can become. Success is related to one's own progressive realisation of one's own predetermined worthwhile goals. Success becomes a progressive development of one's potential, an individual journey rather than a destination, a striving towards a goal worthy of that person.
4. To make people change in order to fulfil this progressive realisation of potential requires motivation. A motive is that which leads men into action. It is that which creates the interest and urge, and drives people to act in a specific manner. The two commonly used methods for motivating people are fear and incentive. Fear motivation is based on punishment and works only initially. People learn either to ignore the pressure of fear or flee from it. Incentive motivation is based on reward and appetitive. It is simply a process of "luring" people by offering a "prize" for something they should be done anyway. It creates a second serious problem by causing what was once provided as a privilege to become a right, and the "price" must be continually increased. This creates a behaviour response of causing people to do less and less for more and more reward, developing in them finally a tendency to say, "Why make any effort? I can get all I want for doing nothing at all."

5. A better way is by effecting a positive change in attitudes. Attitudes Motivation does not depend on outside pressure or incentive and ultimately results in a lasting and permanent change. An attitude is a collection of habits of thoughts that are basically consistent with each other. Since the habit is formed through the repeated exposure to an idea or through the repetition of a behaviour pattern, a planned positive change in thought and subsequently in attitude can be effected through the use of the same fundamental learned process of "spaced repetition". If people are to be motivated to their fuller potential on a continuous, lasting basis, they must be willing to undergo a fundamental change in attitude.
6. Personally motivated people learn to recognise existing opportunities by relating the normally unrelated and by seeing usual things in an unusual way. A man's purpose is to realise this potential.
7. There has been a growing volume of research by social scientists on the motives of people who work. The most simple definition of motivation is that "which induces action or determines choice". In their famous book, *Success Through A Positive Mental Attitude*, Hill and W. Clement Stone observe : "A motive is the 'inner urge' only within the individual which induces him to action, such as an idea, emotion, desire or impulse." A lot of theoretical work has been done at the Psychological Service of Pittsburgh in the field of motivation. One important piece of research was based on careful interviews with some 200 engineers and accountants who worked for eleven different firms in the Pittsburgh area. It was clear that with this group of engineers and accountants the real motivators were opportunities to become more expert and to handle more demanding assignments. Pay, job security and working conditions were "hygienic factors".

**A1. On the basis of reading the above passage, answer the following questions :**

- |  |   |
|--|---|
| (a) What is the distinguishing characteristic of a successful man?                 | 1 |
| (b) How can we say that people are conditioned beings?                             | 2 |
| (c) Bring out the difference between the fear and incentive methods of motivation. | 2 |
| (d) What is the most effective way of motivation? Why?                             | 2 |
| (e) What is motive? How does it motivate a person?                                 | 2 |
| (f) Find out words from the passage which mean the same as the following :         | 3 |
| (i) Firm decision – Para 1.  |   |
| (ii) Inherent quality that can be developed – Para 3.                              |   |
| (iii) Uncommon – Para 6.   |   |

**A2. Read the passage given below and answer the questions that follow :**

The International Labour Organization (ILO) has estimated that 218 million children between the ages of five and seventeen work in developing countries. Of these, 122.3 million children work in the Asia-Pacific region, 49.3 million work in sub-Saharan Africa, and 5.7 million work in Latin America and Caribbean. Most working children in rural areas are found in agriculture; many children work as domestic help; urban children work in trade and services, with fewer in manufacturing and construction.

Child labour ranges from four-year olds tied to rug looms to keep them from running away, to seventeen years old helping out on the family farm. In some cases, a child's work can be helpful to him or her and to the family; working and earning can be a positive experience in a child's growing up. This depends largely on the age of the child, the conditions in which the child works, and whether work prevents the child from going to school.

The Children's Right Division at Human Rights Watch has focused its effort on the worst forms of child labour, those prohibited by the ILO's Worst Form of Child Labour Convention. Children, who work long hours, often in dangerous and unhealthy conditions, are exposed to lasting physical and psychological harm. Working at rug looms, for example, has left children disabled with eye damage, lung disease, stunted growth, and a susceptibility to arthritis as they grow older. Children making silk thread in India dip their hands into boiling water that burns and blisters them, breathe smoke and fumes from machinery, handle dead worms that cause infections, and guide twisting thread that cut their fingers. Children harvesting sugar cane in El Salvador use machetes to cut cane for upto nine hours a day in the hot sun; injuries to their hands and legs are common and medical care is often not available.

Denied an education and a normal childhood, some children are confined and beaten, reduced to slavery. Some are denied freedom of movement—the right to leave the workplace and go home to their families. Some are abducted and forced to work. The human right abuses in these practices are clear and acute. We have found similar problems in Asia, the Middle East, Latin America, and the United States. Children who work for too many hours and too many days, for too little, or sometimes no pay, are subjected to physical abuse, exposed to dangerous pesticides and made to work with dangerous tools. The need of the hour is to start a debate on child rights and work issues.

### **Questions**

1. On the basis of your reading of the above passage, make notes on it, using headings and sub-headings. Use recognizable abbreviations where ever necessary (minimum 4). Give a suitable title to the passage. 5
2. Write the summary of the passage in about 80 words making use of the notes made. 3

## **Section B**

# **ADVANCED WRITING SKILLS**

**(35)**

3. You are Mahip/Mahima the secretary of Consumer Club of Govts.S.S. School, Nanak Pura. Write a notice in not more than 50 words for your school Notice Board inviting students to participate in a competition of web designing/Project on Mass Media at I.I.M. Indore. Invent other necessary details. (5)

**OR**

You are Prateek/Pratima of Govt. Sarvodaya Vidyalaya A. Block, Shalimar Bagh. Design an attractive and meaningful poster regarding Disaster Management Workshop to be organised in your school. (5)

4. You are Aditi/Aditya of Sarvodaya Vidyalaya, Sharda Niketan, Delhi. You made a visit to the Exhibition and Light and Sound Programme Organised at Central Park, Connaught Place, New Delhi to commemorate the 150th anniversary to Indian Revolt in 1857. You were fascinated at the enthusiasm and patriotism of the people in celebrating the day. Write a report about the cultural programme in about 125 words for your School Magazine. (10)

**OR**

You are Shravan/Shruti. Yesterday you witnessed a car accident. When a teenager driving very carelessly hit many people standing on a bus-stop. Six persons got injured and one died on the spot. Describe this incident in about 125 words as an eye witness.

5. You are a Music Teacher of Govt. Sr. Sec. School, Palam Vihar, Delhi. You have to purchase a number of musical instruments for Music room. Place an order to Messers. Sargam Electronics, Darya Ganj, Delhi for supply of required instruments. Invent the details yourself. You are Seema/ Samir. (10)

**OR**

You are Prasoon/Pallavi, a member of Eco-club of Blue-Bells School, Kailash Colony, Delhi. You are pained over the increasing level of Environmental Pollution in Delhi. You decide to write a letter to the editor, to be published in local daily, highlighting the causes of environmental pollution and measures to check it. (10)

6. You are Smriti/Sameer studying in Class XII in Bal Bharti Public School, Rohini. You have to deliver a speech on the importance of Mothers on “Mother’s Day” highlighting the role played by a mother in multidimensional development of a person. (10)

**OR**

You are Amit/Amita of Bright Public School, Saket. Write an article on Drug Addiction, highlighting the reasons why youngsters start smoking and taking drugs. Give your suggestion to check smoking and drug addiction. (10)

## Section C

# LITERATURE

**Maximum Marks : 45**

**Q.7(A) Read the stanza given below and answer the questions that follow : (4 Marks)**

“Aunt Jennifer’s fingers fluttering through the wool.  
Find even the ivory needle hard to pull  
The massive weight of Uncle’s wedding band  
Sits heavily upon Aunt Jennifer’s hand.”

- (i) Why are Aunt Jennifer’s fingers fluttering?
- (ii) What is the impact of fluttering?
- (iii) How has Aunt Jennifer’s life been affected by the marriage?
- (iv) Explain : ‘Have the wedding band as a massive weight’.

**OR**

“I looked again at her, wan, pale face  
as late winter moon and felt that  
old familiar ache, my childhood’s fear,  
but all I said was, see you soon, Amma,  
all I did was smile and smile and smile.”

- (i) Whom do ‘I’ and ‘her’ refer to?
- (ii) What does childhood fear refer to?
- (iii) What is the difference between appearance and reality in last two lines?
- (iv) Why the poet has compared mother’s face to the late winter moon? (2 × 3 = 6 Marks)

**Q.7(B) Answer any *three* of the following in about 30-40 words each :**

- (i) How do the children of the elementary school classroom in a slum look?
- (ii) How is a thing of beauty a joy for ever according to the poet?
- (iii) What was the reason given by the folk for putting up the roadside stand?
- (iv) Why does the poet criticise the people who prepare green wars?

**Q.8 Answer the following questions in about 30-40 words each (2 × 5 = 10 Marks)**

- (i) Why was Franz tempted to miss the school that day? (The Last Lesson)

- (ii) Describe the plight of the people working at the glass furnaces.
- (iii) What was the misadventure William Douglas spoke about?
- (iv) Why was Edla happy on opening the gift left by the peddler?
- (v) How was the make-up room of the Gemini Studio an example of national integration? (Poets and Pancakes)

**Q.9 Answer in about 125-150 words**

**(10 Marks)**

- 1. With reference to the lesson "Indigo" give a detailed account of the problem of Sharecroppers in Champaran.

**OR**

Interview as a form of journalism is both loved and hated. Give reasons.

**Q.10 Answer in about 100 words**

**(7 Marks)**

- 1. Doctor Sadao's final solution to the problem was the best possible one in the circumstances. Explain with reference to the lesson 'Enemy'.

**OR**

Imagination is a temporary refuge from reality. Comment with reference to 'The Third Level.'

**Q.11 Answer the following Questions in about 30-40 words each**

**(2×4= 8 Marks)**

- (i) How did the hundredth tiger come to be killed by the Maharaja? What was funny about it?
- (ii) Why did Geoff Green prefer to include high school students in 'Students on Ice' programme?
- (iii) What is the moral of the story 'Should Wizard Hit Mommy'?
- (iv) What had happened to Derry's face? How did it affect him?

## A1. MARKING SCHEME

### SECTION A

#### VALUE POINTS

- (a) Always trying to improve, making today better than yesterday.
- (b) (i) basic habits, thoughts, attitudes formed in early childhood.  
(ii) carry these attitudes and activities in their adult life without change.  
(iii) regulated in response to their environment *(any two)*
- (c) Fear motivation based on punishment  
□ works only initially
- Incentive Motivation  
□ based on reward and appetitive  
□ process of luring people by offering a prize.
- (d) (i) Attitudes motivation  
(ii) does not depend on outside pressure or inventive.  
(iii) results in lasting and permanent change.
- (e) (i) inner urge within the individual  
(ii) induces him to action
- (f) (i) Resolution  
(ii) Potential  
(iii) Unusual

## A2. MARKING SCHEME

# NOTE MAKING

**Suggested Title** – Child Labour : A Global Problem/Child Labour : Violation of Human Rights.

### Notes

1. Meaning of Child Labour
  - 1.1. Children made to work between 5-7 years.
2. Children employed as
  - 2.1. Domestic help
  - 2.2. In agriculture
  - 2.3. In trade and services
  - 2.4. Manufacturing and construction
3. Global Scenario
  - 3.1. 218 million child labourers in developing countries.
  - 3.2. 122.3 million in Asia-Pacific region.
  - 3.3. 49.3 million in sub-Saharan Africa.
  - 3.4. 5.7 million in Latin America and Caribbean.
4. Sometimes a Positive Experience
  - 4.1. helpful to the family
  - 4.2. helps in child's growth.
  - 4.3. Determined by (i) age, (ii) working condition (iii) whether preventing the child from school going.
5. Worst Forms of Child Labour according to ILO.
  - 5.1. Working long hrs.
  - 5.2. In dangerous, unhealthy conditions
  - 5.3. At rug looms, making silk thread.
6. Hazardous effects of child labour
  - 6.1. Exposed to dangerous pesticides
  - 6.2. Eye damage

- 6.3. Lung disease
  - 6.4. Stunted growth
  - 6.5. Burns and blisters
  - 6.6. Breathing problems.
- 7. Against Human Rights
    - 7.1. Deprived of education.
    - 7.2. Denied joys of childhood
    - 7.3. No medical facilities
    - 7.4. Physical abuse of children
    - 7.5. No freedom of movement.
  - 8. Need of the Hour
    - 8.1. Debate on
      - (i) Child rights and work issues.

## Section B

# ADVANCED WRITING SKILLS

**Note :** The objective of the section on Advanced Writing skills is to list a candidate's writing ability. Hence expression assumes as much importance as the content of the answer.

### **3. NOTICE**

Format	1 mark
Content	2 marks
Expression	2 marks

- Suggested Value Points
  - Notice
  - Day and Date of Competition
  - Venue of the Competition
  - Rules for Participating if any
  - Whom to Contact

Or

- Poster**

Content	3 marks
Expression	2 marks
  - Value Points :** Details like date, time and venue of the workshop
    - Chief guest (if any)
    - Need of the day to train people.

## 4. REPORT WRITING

- |          |  |                |
|----------|--|----------------|
| <b>I</b> | <b>Format</b>  |                |
|          | 1. title, reporter's name  | 1 mark         |
| <b>I</b> | <b>Content</b>   | <b>4 marks</b> |
| <b>I</b> | <b>Expression</b> : Grammatical accuracy, appropriate words, spellings<br>Coherence and relevance of ideas and style | 2½             |

## □ Suggested Value Points

150<sup>TH</sup> ANNIVERSARY CELEBRATIONS OF INDIAN REVOLT IN 1857

- When
  - Where
  - Activities/Programmes conducted
  - Contents of Exhibition
  - Any other special feature(s)

OR

## □ Suggested Value Points

## CAR ACCIDENT

- When, where
  - How many injured/died.
  - Action taken by people/police.

## **5. LETTER WRITING**

**Note :** No marks are to be awarded if only format is given. Credit should be given to the candidate's creativity in presentation of ideas. Use of both the traditional and new format is permitted.

## Format

- |                     |                        |           |
|---------------------|------------------------|-----------|
| 1. Sender's address | 2. Date                |           |
| 3. Receiver's       | 4. Subject heading     |           |
| 5. Salutation       | 6. Complimentary Close | (2 Marks) |

## Content

## □ Expression

Grammatical accuracy, appropriate words and spellings (2)

## Coherence and relevance of ideas and style(2)

## □ Suggested Value Points

## **ORDER FOR MUSICAL INSTRUMENTS**

- List of Musical Instruments
  - Make
  - Mode of Payment

- Dead line for delivery

OR

### **ENVIRONMENTAL POLLUTION**

- Mention the causes
- Measures/Steps to check
- Role of Public
- Role of Government

## **6. ARTICLE WRITING**

- **Format :** Title and Writer's Name (1 Mark)
- **Content**
- **Expression**
  - Grammatical accuracy, appropriate words and spellings (2½)
  - Coherence and relevance of ideas and style (2½)
- **Suggested Value Points**

### **ROLE OF MOTHER'S**

- Physical attachment
- Emotional attachment
- Development of a person

OR

### **DRUG ADDICTION**

- Reasons of diversion to smoking
- Reason of Drug Addiction
- Steps to be taken

## SECTION C

7. (i) Nervous, tense / moving the puppets. (1 mark)  
(ii) Lack of strength, entangled in the wool. (1 mark)  
(iii) Leads a restricted, subjugated, dominated life, unhappy and dissatisfied (1 mark)  
(iv) Responsibilities that come with marriage have burdened her. (1 mark)

**OR**

- (i) "I" refers to poetess – Kamala Dass  
"Her" refers to her mother (1 mark)  
(ii) Fear of separation from her mother (1 mark)  
(iii) In reality poetess – sad, hopeless  
In appearance poetess – smiles, tries to hide real emotions (1 mark)  
(iv) Both are pale.
- 7.(b) (i) Unkempt, Hungry, Diseased (1 mark expression) (1 mark content)  
(ii) \* Loveliness increases with time (1 mark content)  
\* Never comes to an end (1 mark expression)  
(iii) \* Add to their income (1 mark content)  
\* Raise their standard of living like those in the city (1 mark expression)  
(iv) \* Destroy the environment (1 mark content)  
\* Endangering the human race (1 mark expression)
8. (i) \* Unprepared on participles (1 mark content)  
\* Pleasant whether outside (1 mark expression)  
(ii) \* Extreme heat (1 mark content)  
\* Go blind (1 mark expression)  
(iii) \* Throw into the pool. (1 mark content)  
\* Escaped death, scarred for life (1 mark expression)  
(iv) \* Contained three then Knonor notes (1 mark content)  
\* Proof that he had changed (1 mark expression)  
(v) \* People from different states of India under the same roof (1 mark content)  
(1 mark expression)

9.  Tenants forced to grow indigo (5 mark content)  
 Synthetic indigo introduced (1 mark expression)  
 Problem until the agreement  
 Gandhi engaged administration in dialogue  
 Mass demonstrations by peasants  
 Landlords had to bow down

### *Loved because*

- An art, source of truth, helps one know about his contemporaries

### *Hated because*

- Unwanted interference
  - Deminishes a person
  - Interviewer unduly powerful

10.  Sadeo torn between patriotism and stress.

Honour, family at stake if caught

As a doctor can't let the prisoner die

Adopts the middle path

(5 marks content) (5 marks expression)

OR

- Modern day life – hectic, strain and stress.
  - Unfulfilled hopes and aspirations
  - Imagination provides temporary comfort
  - Balance to be established between imagination and reality.

11. (i) 100th tiger infact killed by hunter. (1 content)  
as tame as a dog,  
refused to get out of the car (1 expression)

(ii)  Create awareness among the leaders, decision makers of tomorrow.  
 Sensitise them to the dangers looming ahead. (1 content) (1 expression)

(iii)  Open ended story  
 Parents should be accomodative of the child's perspective. (1 content)  
(1 expression)



# SAMPLE PAPER No. 2

## Section A

### READING SKILLS

**Maximum Marks : 20**

#### A1. Read the passage given below and answer the questions that follow :

1. Any kind of mental deformity continues to be a subject of extreme social disgrace and trauma in India. When a child is diagnosed with such disorders, the parents are at first staggered, shocked, numbed, and thus spend a considerable period in this bewilderment. Then comes the gradual acceptance of facts as they stand. This brings forth a fiercely combative approach, making parents extremely defensive, and anxious to protect their children from harassment. More often than not, the child's education takes a back seat in this web of perplexity and despair. The tag of 'abormality' that the child is labelled with, sadly even in the subconscious minds of parents, ruthlessly strikes out the route to an educated life that he/she otherwise would have led. For all our claims on the celebration of linguistic and cultural diversities, the differently abled among us still continue to be called the 'disabled', to be looked upon with disdainful pity and worse still, made the bulk of all jokes.
2. But you can make a difference in the lives of such children by opting for a career in teaching the differently-abled. Think mental disability and there is a string of visuals that come to mind. Amir Khan's worthy attempt in Tare Zameen Par, Russell Crowe's Oscar Winning Act in 'A Beautiful Mind'. Rani Mukherjee's deaf, dumb and blind role in 'Black' would probably hover in, though it is nowhere in the purview of a mental disorder. Dig a bit deeper into memory, and you will probably come up with hazy images of Ajay Devgan helping a limping child with severe speech impairment. This is the aggravatingly cumulative picture that these films have registered in the minds of the average viewer. How many of us remember that Amir Khan's unfortunate student in TZP suffered from dyslexia.
3. All attempts at bringing such anomalies to public awareness have failed to imbibe the minor intricacies of these disorders in people's minds. With the result that the populace is largely ignorant about the existence of disorders like the aspergar syndrome, autism, and the downs syndrome and more importantly, how each demands a different treatment and approach. This article attempts to bring to light one such disorders – autism.
4. According to Merry Barnah, Chairperson, Action for Autism, "In law terms, it is a neurological disorder that affects the way the child reacts to people and the environment, bonds socially, learns a language or communicates needs. The key point is that it is not a short term illness, but a disorder." The characteristics are generally apparent by age three.
5. According to WHO reports, typically about 20 in a population of 10,000 people will be autistic or have autistic symptoms; 80 per cent of those affected by autism are boys. Over 20 laks people are living with autism in India. Over the last five years, the number of diagnosed cases has increased by almost 35 percent. Current research indicates that anything that can produce

structural or functional damage to the central nervous system can also produce the condition of autism.

6. Being a developmental disorder, autistic individuals have difficulty in performing acts which come naturally to others. "Basic behavioural actions like the way we stand, neck movements, motor skills, and the understanding of special areas like social skills, speech and communication are different in autistic people. Hence the basic criterion for diagnosis is the observation of behaviour", explains Baruah.
7. According to Mythily Chari, Founder and Director, Indian Institute for Intervention Services, (IRIS), "Autism, if defined by an educator, can be termed as a learning disability. Children with autism are visual rather than auditory learners. These children display an excellent ability to learn by rote and this is essentially what is required in elementary education. So, often parents put their children into mainstream schools in the early years and they do well. The problems start coming in when they approach class IV to V."
8. Some autistic children do not ever develop speech, while others may develop speech but still have difficulty using language to communicate. Often, there is an unusual speech pattern, such as echoing whatever is said to them, repeating a word over and over, and speaking only to express needs, rather than emotions. "What these children require is essentially, learning by experience," sums up Baruah. Children with autism do have the potential to build up their skills and they can be helped if they receive early, well focused intervention. Depending on the child's individual skill profile and the appropriateness and intensity of intervention he or she receives, children with autism can lead relatively independent lives.

**A1. On the basis of reading the above passage, answer the following questions :**

- (a) How do the parents initially react when their child is diagnosed with mental disorder? 2
- (b) What is autism? How does it affect the child? 2
- (c) How are differently able children looked upon by the people? 2
- (d) Mention any two points of behavioural differences between the autistic and non-autistic children. 2
- (e) Why do the autistic children perform well at the elementary stage of school education? 1
- (f) Find out the words from the passage which mean the same as the following :
  - (i) Vague (Para 2)
  - (ii) Graphic (Para 7)
  - (iii) Suitability (Para 8)

**A2. Read the passage given below and answer the questions that follow :**

Does the prospect of driving fill you with dread? Do you start cursing the moment you sit behind the wheel? Do you dream of the day when you can hire a driver so that your commute to the office, to a party, to anywhere can be made without giving you high blood pressure? If you are nodding yes to all of the above, you have problem.

With the mercury rising, driving in cities – not a task for the fainthearted anyway – has become even difficult. This is because now you don't only have to deal with incessant honking, overtaking from the wrong side and drivers who learned to drive at video game parlours – you also have to deal with the heat.

The problem, however, is that rising temperatures mean rising tempers, so often you just want to take a cricket bat and smash the car that has been honking at you at every red light since you started your journey.

But that won't be pretty, so read our tips on how to stay cool on the road and see which works best for you.

**Roll up the windows, switch on the AC and put on your favourite music :** This works like a charm. The uncouth world outside can't enter your cocoon as your favourite music, whatever it may be, soothes your nerves.

Some people sing in the bathroom, others sing in the car. Singing makes journalist Pranav Shukla happy, So when he drives, he sings for the world. He ensures the windows are rolled down so people can hear him.

"Singing relaxes me and I do it whenever I feel stressed," he says. "So I sing when I drive. It is also a great way to get back at people. You can tick them off without offending anybody or creating a scene. So, if someone comes too close to my car, I sing a song like '*E bhai zara dekh ke chalo...*' loud and clear and with a smile. The guilty part can't help but smile, apologise and move away," he says.

So the next time you see the driver in the car next to you wearing a scowl on his face, sing to him.

**Stay cool with a drink :** No, we don't mean an alcoholic drink. With the sun beating down on you, nothing will cool you better during your drive than a chilled fruit juice, lemon juice or iced tea.

**Eat before you drive :** This is something the doctor ordered. You must have noticed that you get irritable when you are hungry. So it's important that you are not hungry when you drive because your hunger pangs will increase the chances of you picking a fight over a minor issue.

"It is a well-known fact that a healthy meal is a great energy booster," say GP Dr. Sanjay Srinivasan.

"We tend to lose our tempers when we are not at our energetic best. An empty stomach is a cause for irritation for a log of people. So it's important to keep it filled with something that makes you happy."

So have a good meal or snack before you start driving. You may just be happier on the road.

**Take your lane, drive on and let the world pass you by :** Yes it is difficult to stick on one lane when people drive you crazy zig-zagging past you. But that is actually the correct way to drive. So it keeps you on the safe side of the law.

"It keeps you disciplined and chances of you getting a *challan* are also very low," says executive Anand Mishra. Mishra also advises drivers to mind their own business. "If you don't bother about who is doing what on the road, chances are that you won't get angry either," he says.

So next time you drive, have a joyride.

## Questions

1. Make notes on the above passage using headings, sub-headings, and recognizable abbreviations (minimum 4). Suggest a suitable title. (5)
2. Write a summary of the above passage in about 80 words, using the notes made

## Section B

# ADVANCED WRITING SKILLS

(35)

3. Your father has been transferred to the Dubai based branch of his office. He wants to sell his house before leaving for good. Draft an advertisement for the 'For Sale' column of the newspaper for selling your three room flat in Lajpat Nagar in not more than 50 words. (5)

OR

You are Kapil/Kapila of Govt. Sarvodaya Vidyalaya, Mangolpuri. You have been selected to go to Singapore for achieving the highest marks in English, Maths and Economics in the District. Write an informal letter of invitation inviting your friends to the party you are giving in hotel Taj. (5)

4. You are Sumit/Sunita of Govt. Sr. Sec. School, Rohini. Recently you participated in a three day workshop on disaster management where you were trained by the officers of Fire Services, how to evacuate the premises in case of fire and safety measures to be taken at the time of fire, flood and earthquakes. Write a report in not more than 125 words giving details of the workshop. (10)

OR

Write a report on Career-Mela organised by your school. The mela was inaugurated by the Regional Director of Education, Delhi. Give the details of activities performed. You are Jatin/Jaya of A.P. Public School, Punjabi Bagh.

5. You are Siddharth/Sneha of 85, Sadiq Nagar, New Delhi. Read the advertisement given below and write an application to the Advertiser, applying for the post. Also attach your detailed resume with your application.

### SHUBHAM MEDICAL EQUIPMENTS

*requires for its Mumbai Unit*

#### Manager – Accounts

Qualification	Chartered Accountant/M.Com.
Experience	1-2 years for C.A./10 years for M.Com.
Competency	Knowledge in Finance Management command in communication skill.
Salary	Commensurate with qualification and experience.

*Apply to*

**Shubham Medical Equipments,**

22, Sector 54, Gurgaon.

**OR**

You are Atul/Anita of Lajpat Nagar, Delhi. You are worried over increasing incidents of thefts, day light and road side robbery, chain snatching etc. Write a letter to the SHO of Police Station of your locality, requesting him to depute PCR Vans and Constables at prime locations so that people can move about fearlessly in their locality. (10)

6. You are Shubha/Shubham of Vidya Mandir School. You are worried over the trend of sending tiny-tots to play way school in order to prepare them for tests and interviews for admission to renowned schools. Write an article for a popular magazine expressing your views, give reasons and suggest what needs to be done to counter the adverse effects on the growth of the children at that tender age. Give your article a suitable title. (10)

**OR**

You Prachi happened to take part in a medical camp organised by your club in a remote village of Delhi. You are surprised to find that most of the people have no awareness of basic health or hygiene among school students. As a concerned citizen you decide to take up their cause and organise workshops where the students can be told about the importance of hygiene. Write a speech for the Morning Assembly emphasising the need of health and hygiene.

## Section C

# LITERATURE

**Maximum Marks : 45**

**Q.7(A) Read the stanza given below and answer the questions that follow : (1 × 4 = 4 Marks)**

"Break O break open till they break the town and show the children to green fields, and make their world run azure on gold sands, and let their tongues run naked into books the white and green leaves open history theirs whose language is the Sun."

- (i) 'Break O break open'. What should they 'break'?
- (ii) Explain : '.... till they break the town'.
- (iii) Where will 'their world' extend up to then?
- (iv) What other freedom should they enjoy?

**Or**

"What I want should not be confused with total inactivity.  
Life is what it is about;  
I want not truck with death.  
If we were not so single-minded about keeping our lives moving,  
and for once could do nothing."

- (i) How the total inactivity may be confused?
- (ii) What is our single mindedness?
- (iii) Why does the poet want all the people to do nothing for a moment?
- (iv) Explain : 'Life is what it is about'.

**Q.7(B) Answer *any three* of the following in about 30-40 words each : (2 × 3 = 6 Marks)**

- (i) How has the poet contrasted the scene inside the car with the activities going outside in 'My Mother at Sixty-Six'?
- (ii) How does beauty enrich the human beings? Explain with reference to 'A hing of Beauty is a Joy Forever'.

- (iii) With what purpose do cars stop at the roadside stand? Mention any two?
- (iv) Bring out the significance of the wedding ring in Aunt Jennifer's life.

**Q.8. Answer the following questions in about 30-40 words each : (2 × 5 = 10 Marks)**

- (i) What change did Franz notice when he reached the school? Mention any two points as referred to in 'The Last Lesson'.
- (ii) Mention hazards of working in the glass bangle industry.
- (iii) Why did Edla insist on entertaining the peddler even after he was exposed?
- (iv) What would be the impact of synthetic indigo on the price of the natural indigo?
- (v) Mention two differences in the character of Jansie and Sophie as depicted in 'Going Places'?

**Q.9. Answer the following in about 125-150 words (10 Marks)**

"Piece by piece, he built a swimmer." How did the instructor help William Douglas to become a swimmer and overcome his fear of water?

**Or**

"Dialogue not violence can resolve situations of conflict and injustice." Do you agree with this statement? Answer with instances from the lesson 'Indigo'.

**Q.10. Answer the following in about 100-125 words (7 Marks)**

How did the prediction of the chief astrologer about the Maharaja's death come true?

**Or**

The resistance of Zitkala-Sa to the cutting of her hair and Bama's determination to study are sparks which can ignite a change. Discuss in the light of 'Memories of Childhood.'

**Q.11. Answer the following in about 30-40 words (2 × 4 = 8 Marks)**

- (i) What was the scene under the frozen ice as described by the author in 'Journey to the end of the Earth'.
- (ii) Give two reasons why Dr. Sadao was not sent abroad with the troops.
- (iii) What was the physical appearance of the wizard as depicted in 'Should Wizard Hit Mommy'?
- (iv) What makes Galesburg a wonderful town? (The Third Level).

# CLASS XII

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# MATHEMATICS

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<b>Units</b>	<b>Weightage (Marks)</b>
(i) Relations and Functions	10
(ii) Algebra (Matrices and Determinants)	13
(iii) Calculus	44
(iv) Vector and Three dimensional Geometry.	17
(v) Linear Programming	06
(vi) Probability	10
<b>Total : 100</b>	

## Design

<b>Type of Questions</b>	<b>Weightage of each question</b>	<b>Number of questions</b>	<b>Total Marks</b>
(i) Very short answer (VSA)	01	10	10
(ii) Short Answer (SA)	04	12	48
(iii) Long Answer (LA)	06	07	42

## Internal Choice

There will be internal choice in 4 questions of short answer type and in 2 questions of Long answer type.

## NOTE

Questions requiring Higher Order thinking skills (HOTS) have been added in every chapter. Such questions are marked with a star, and to help the students, hints to their solutions are given along with the answers.

# CHAPTER 1

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## RELATIONS AND FUNCTIONS

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### POINTS TO REMEMBER

1. **Empty relation** is the relation  $R$  in  $X$  given by  $R = \emptyset \subset X \times X$ .
2. **Universal relation** is the relation  $R$  in  $X$  given by  $R = X \times X$ .
3. **Reflexive relation**  $R$  in  $X$  is a relation with  $(a, a) \in R, \forall a \in X$ .
4. **Symmetric relation**  $R$  in  $X$  is a relation satisfying  $(a, b) \in R \Rightarrow (b, a) \in R$ .
5. **Transitive relation**  $R$  in  $X$  is a relation satisfying
$$(a, b) \in R \text{ and } (b, c) \in R \Rightarrow (a, c) \in R.$$
6. **Equivalence relation**  $R$  in  $X$  is a relation which is reflexive, symmetric and transitive.
7. A function  $f : X \rightarrow Y$  is *one-one* (or *injective*) if
$$f(x_1) = f(x_2) \Rightarrow x_1 = x_2, \forall x_1, x_2 \in X$$
8. A function  $f : X \rightarrow Y$  is *onto* (or *surjective*) if given any  $y \in Y, \exists x \in X$  such that  $f(x) = y$ .
9. A function  $f : X \rightarrow Y$  is called *bijection* if it is one-one and onto.
10. For  $f : A \rightarrow B$  and  $g : B \rightarrow C$ , the function  $\text{gof} : A \rightarrow C$  is given by  $(\text{gof})(x) = g[f(x)] \forall x \in A$ .
11. A function  $f : X \rightarrow Y$  is *invertible* if  $\exists g : Y \rightarrow X$  such that  $g \circ f = I_x$  and  $f \circ g = I_y$ .
12. A function  $f : X \rightarrow Y$  is invertible if and only if  $f$  is one-one and onto.
13. A binary operation  $*$  on a set  $A$  is a function  $* : A \times A \rightarrow A$ .
14. An operation  $*$  on  $A$  is *commutative* if  $a * b = b * a, \forall a, b \in A$ .
15. An operation  $*$  on  $A$  is *associative* if  $(a * b) * c = a * (b * c) \forall a, b, c \in A$ .
16. An element  $e \in A$ , is the identity element for  $* : A \times A \rightarrow A$  if
$$a * e = a = e * a, \forall a \in A.$$
17. An element  $a \in A$  is *invertible for  $*$*  :  $A \times A \rightarrow A$  if there exists  $b \in A$  such that  $a * b = e = b * a$ , where  $e$  is the identity for  $*$ . The element  $b$  is called inverse of  $a$  and is denoted by  $a^{-1}$ .

## VERY SHORT ANSWER TYPE QUESTIONS

1. If A is the set of students of some boys school then write, which types of following relations are. (Universal, Empty or neither of the two).

$$R_1 = \{(a, b) : a, b \text{ are ages of students and } |a - b| \geq 0\}$$

$$R_2 = \{(a, b) : a, b \text{ are weights of students, and } |a - b| < 0\}$$

$$R_3 = \{(a, b) : a, b \text{ are weights of students and } |a - b| > 0\}$$

$$R_4 = \{(a, b) : a, b \text{ are students studying in same class}\}$$

$$R_5 = \{(a, b) : \text{age of } a \text{ is greater than age of } b\}$$

2. If  $A = \{2, 3, 4, 5\}$  then write whether each of the following relations on set A is a function or not? Give reasons also.

$$(i) \quad \{(2, 3), (3, 4), (4, 5), (5, 2)\}$$

$$(ii) \quad \{(2, 4), (3, 4), (5, 4), (4, 4)\}$$

$$(iii) \quad \{(2, 3), (2, 4), (5, 4)\}$$

$$(iv) \quad \{(2, 3), (3, 5), (4, 5)\}$$

$$(v) \quad \{(2, 2), (2, 3), (4, 4), (4, 5)\}$$

- \*3. If  $f : R \rightarrow R, g : R \rightarrow R$  defined by

$$f(x) = \frac{3x - 7}{8}, \quad g(x) = \frac{8x + 7}{3} \text{ then}$$

find (i)  $(fog)(7) =$

(ii)  $(gof)(7) =$

4. If  $f, g$  are the functions,

given by  $f = \{(1, 2), (2, 3), (3, 7), (4, 6)\}$

$$g = \{(0, 4), (1, 2), (2, 1)\}$$

find fog.

5. If  $f(x) = \frac{x}{x+1} \quad \forall x \neq -1$

write  $(fof)(x)$

6. If  $f : R \rightarrow R$  defined by

$$f(x) = \frac{2x - 1}{5}, \text{ find } f^{-1}(x) = ?$$

7. Check the following functions for one-one. Also, give the reason for your answer.

- (i)  $f : R \rightarrow R$  s.t  $f(x) = x^2 + 1 \quad \forall x \in R$
- (ii)  $f : R - \{0\} \rightarrow R - \{0\}$  such that  $x \cdot f(x) = 1$
- (iii)  $f : R \rightarrow R$  such that  $f(x) = |x|$ .
- (iv)  $f : R \rightarrow R$  such that  $f(x) = x^3$ .
- (v)  $f : R \rightarrow R$  such that  $f(x) = (x - 1)(x - 2)(x - 3)$
- (vi)  $f : R \rightarrow R$  such that  $f(x) = [x] \quad \forall x \in R$   
where  $[ \cdot ]$  denotes the greatest integer function.
- (vii)  $f : R \rightarrow R$ ,  $f(x) = \sin x \quad \forall x \in R$
- (viii)  $f : [0, \pi] \rightarrow [-1, 1]$ ,  $f(x) = \cos x \quad \forall x \in [0, \pi]$
- (ix)  $f : \left(-\frac{\pi}{2}, \frac{\pi}{2}\right) \rightarrow R$ ,  $f(x) = \tan x$ .

8. Check whether the following functions are onto or not. Give one reason for your Answer.

- (i)  $f : [-1, 1] \rightarrow \left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$ ,  $f(x) = \sin^{-1} x$ .
- (ii)  $f : R \rightarrow \left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$ ,  $f(x) = \tan^{-1} x$ .
- (iii)  $f : R \rightarrow R$ ,  $f(x) = x^3$
- (iv)  $f : R - \{0\} \rightarrow R$ ,  $f(x) = \frac{1}{x}$ .
- (v)  $f : N \rightarrow N$ ,  $f(x) = x^3$ .
- (vi)  $f : (0, \infty) \rightarrow R$ ,  $f(x) = x^2$ .
- (vii)  $f : R \rightarrow \{-1\} \rightarrow R$ ,  $f(x) = \frac{x}{x+1}$ .
- (viii)  $f : R \rightarrow [-1, 1]$ ,  $f(x) = \frac{\sin \pi[x]}{x^2 + 1}$  where  
 $[ \cdot ]$  denotes the greatest integer function.

9. If '\*' is a Binary operation defined on  $R$  then if

- (i)  $a * b = a^2 - b^2$ , write  $8 * (3 * 1)$
- (ii)  $a * b = \frac{ab}{2}$  write  $(4 * 2) * 6$

(iii)  $a * b = \frac{|a - b|}{3}$  then write  $10 * (7 * 3)$

(iv)  $a * b = \frac{a}{b^3}$  find  $5 * (3 * 1)$ .

### SHORT ANSWER TYPE QUESTIONS

10. Check the following relations for each of (i) Reflexivity; (ii) Symmetricity; (iii) Transitivity; (iv) Equivalence Relation.

(a)  $R_1 = \{(A, B); |A| = |B|, A, B \text{ are line segments in the same plane}\}$

(b)  $R_2 = \{(a, b), (b, b), (c, c), (a, c), (b, c)\} \text{ in the set } A = \{a, b, c\}$

(c)  $R_3 = \{(a, b) : a \geq b, a, b \in R\}$

(d)  $R_4 = \{(a, b) : a \text{ divides } b, a, b \in A\} \text{ where } A = \{2, 3, 4, 5\}$

(e)  $R_5 = \{a, b), (b, a), (a, a)\} \text{ in } \{a, b, c\}$ .

(f)  $R_6 = \{(a, b) : a \geq b, a, b \in N\}$

(g)  $R_7 = \{(a, b) : a, b \in R, a \leq b^3\}$

(h)  $R_8 = \{(a, b) : a - b \text{ is multiple of } 5, a, b \in R\}$

(i)  $R_9 = \{(a, b) : b = 3a \text{ and } a, b \in R\}$

(j)  $R_{10} = \{(a, b) : a - b \text{ is an integer}, a, b \in R\}$

11. Check the injectivity and surjectivity of the following functions.

(i)  $f : R \rightarrow R, f(x) = \frac{3x - 7}{5}$ .

(ii)  $f : N \rightarrow N$ , defined by  $f(x) = x \quad \forall x \in N$ .

(iii)  $f : R \rightarrow R$ , defined by  $f(x) = x^2$ .

(iv)  $f : R \rightarrow R$ , defined by  $f(x) = |x|$ .

(v)  $f : N \rightarrow N$ , defined by  $f(x) = \begin{cases} x + 1, & \text{if } x \text{ is odd} \\ x - 1, & \text{if } x \text{ is even.} \end{cases}$

(vi)  $f : R \rightarrow R$ , defined by  $f(x) = (x + 1)^2 + 4$ .

(vii)  $f : R \rightarrow \left(-\frac{\pi}{4}, \frac{\pi}{4}\right)$  defined by  $f(x) = \tan^{-1} 2x$ .

(viii)  $f : R \rightarrow [-1, 1]$  defined by  $f(x) = \sin 2x$ .

\*(ix)  $f : R \rightarrow R$ , defined by  $f(x) = \frac{x}{x^2 + 1}$ .

(x)  $f : R \rightarrow Z$ , defined by  $f(x) = [x]$ , where  $[ . ]$  denotes the greatest integer function.

(xi)  $f : R - \{-1\} \rightarrow R$ , defined by  $f(x) = \frac{x}{x + 1}$ .

\*(xii)  $f : R \rightarrow R$ , defined by  $f(x) = (x - 1)(x - 2)$ .

\*12. If  $A = N \times N$  and a Binary operation '\*' is defined on  $A$  as  $* : A \times A \rightarrow A$  such that  $(a, b) * (c, d) = (ac, bd)$ . Check whether '\*' is commutative and Associative. Find the identity element for '\*' on  $A$  if any.

13. Let '\*' is a Binary operation defined on  $R$  by  $a * b = |a^2 - b^2|$ , then

(i) Is '\*' commutative?

(ii) Show that '\*' is not associative by giving one example for it.

14. If '\*' is a Binary operation defined on  $R - \{0\}$  defined by  $a * b = \frac{2a}{b^2}$ , then

(i) Is '\*' Commutative?

(ii) Is '\*' Associative?

15. Let '\*' be a binary operation on  $Q - \{1\}$  such that  $a * b = a + b - ab$ .

(i) Prove that '\*' is commutative and associative

(ii) Also find the identity element in  $Q - \{1\}$  (if any)

16. If  $f : R \rightarrow R$ , defined by  $f(x) = \frac{3x - 1}{4}$  find  $f^{-1}(x)$  if after checking  $f(x)$  for one-one and onto.

17. If  $f : R \rightarrow \{-1, 1\}$ , defined by  $f(x) = \sin x$  invertible? If not, give reason. If yes, find  $f^{-1}(x)$ .

\*18. If  $f : R \rightarrow R$ ,  $f(x) = \frac{2x - 1}{3}$ , then find  $(fog)(x)$  and  $(gof)(x)$ . Are they equal?

19. If  $f(x) = \sin x$ ,  $g(x) = x^2$  then find fog and gof. Are they equal?

## CHAPTER 2

# INVERSE TRIGONOMETRIC FUNCTIONS

### POINTS TO REMEMBER

Principal value branches of the branches of the inverse trigonometric function with their domains and Ranges :

Function : Domain  $\rightarrow$  Range

$$\sin^{-1} : [-1, 1] \rightarrow \left[ -\frac{\pi}{2}, \frac{\pi}{2} \right].$$

$$\cos^{-1} : [-1, 1] \rightarrow [0, \pi].$$

$$\text{cosec}^{-1} : R - (-1, 1) \rightarrow \left[ -\frac{\pi}{2}, \frac{\pi}{2} \right] - \{0\}.$$

$$\sec^{-1} : R - (-1, 1) \rightarrow [0, \pi] - \left[ \frac{\pi}{2} \right].$$

$$\tan^{-1} : R \rightarrow \left( -\frac{\pi}{2}, \frac{\pi}{2} \right).$$

$$\cot^{-1} : R \rightarrow (0, \pi)$$

Note :  $(\sin x)^{-1} = \frac{1}{\sin x}$ ,  $\sin^{-1} x \neq (\sin x)^{-1}$  etc.

### VERY SHORT ANSWER TYPE QUESTIONS (1 Mark for Each Part)

1. Write the principal value of

(i)  $\sin^{-1}(-\sqrt{3}/2)$

(ii)  $\sin^{-1}(\sqrt{3}/2)$ .

(iii)  $\cos^{-1}(-\sqrt{3}/2)$

(iv)  $\cos^{-1}(\sqrt{3}/2)$ .

(v)  $\tan^{-1}\left(-\frac{1}{\sqrt{3}}\right)$

(vi)  $\tan^{-1}\left(\frac{1}{\sqrt{3}}\right)$ .

(vii)  $\text{cosec}^{-1}(-2)$ .

(viii)  $\text{cosec}^{-1}(2)$

(ix)  $\cot^{-1}\left(-\frac{1}{\sqrt{3}}\right)$

(x)  $\cot^{-1}\left(\frac{1}{\sqrt{3}}\right)$ .

(xi)  $\sec^{-1}(-2)$ .

(xii)  $\sec^{-1}(2)$ .

$$(xiii) \quad \sin^{-1}\left(\frac{-\sqrt{3}}{2}\right) + \cos^{-1}\left(\frac{-1}{2}\right) + \tan^{-1}\left(-1/\sqrt{3}\right)$$

2. Simplify each of following using principal value :

$$(i) \quad \tan^{-1}\left(\frac{1}{\sqrt{3}}\right) - \sec^{-1}\left(\frac{2}{\sqrt{3}}\right).$$

$$(ii) \quad \sin^{-1}\left(-\frac{1}{2}\right) - \cos^{-1}\left(\frac{\sqrt{3}}{2}\right).$$

$$(iii) \quad \tan^{-1}(1) - \cot^{-1}(-1).$$

$$(iv) \quad \cos^{-1}\left(-\frac{1}{2}\right) + \sin^{-1}\left(-\frac{1}{2}\right).$$

$$(v) \quad \tan^{-1}(\sqrt{3}) + \cot^{-1}\left(\frac{1}{\sqrt{3}}\right).$$

$$(vi) \quad \operatorname{cosec}^{-1}(\sqrt{2}) + \sec^{-1}(\sqrt{2}).$$

$$(vii) \quad \tan^{-1}(1) + \cot^{-1}(1) + \sin^{-1}(1).$$

$$(viii) \quad \cot^{-1}(\sqrt{3}) - \sin^{-1}\left(-\frac{1}{2}\right).$$

$$(ix) \quad \sin^{-1}\left(\sin\frac{4\pi}{5}\right).$$

$$(x) \quad \cos^{-1}\left(\cos\frac{7\pi}{5}\right).$$

$$(xi) \quad \tan^{-1}\left(\tan\frac{5\pi}{6}\right).$$

$$(xii) \quad \operatorname{cosec}^{-1}\left(\operatorname{cosec}\frac{3\pi}{4}\right).$$

### SHORT ANSWER TYPE QUESTIONS (4 Marks for Each Part)

$$3. \text{ Show that } \tan^{-1}\left(\frac{\sqrt{1+\cos x} + \sqrt{1-\cos x}}{\sqrt{1+\cos x} - \sqrt{1-\cos x}}\right) = \frac{\pi}{4} + \frac{x}{2}.$$

$$4. \text{ Prove } \sin^{-1}x + \sin^{-1}y = \sin^{-1}[x\sqrt{1-y^2} + y\sqrt{1-x^2}].$$

$$5. \text{ Prove } \sin^{-1}x - \sin^{-1}y = \sin^{-1}[x\sqrt{1-y^2} + y\sqrt{1-x^2}].$$

$$6. \text{ Prove } \cos^{-1}x + \cos^{-1}y = \cos^{-1}[xy - \sqrt{(1-x^2)(1-y^2)}].$$

$$*7. \text{ Prove } \tan^{-1}\left(\frac{a \cos x - b \sin x}{b \cos x + a \sin x}\right) = \tan^{-1}\left(\frac{a}{b}\right) - x, \quad \frac{a}{b} \tan x + 1 > 0.$$

$$8. \text{ Prove } \tan^{-1}\left(\frac{\cos x}{1 - \sin x}\right) - \cot^{-1}\left(\frac{\sqrt{1 + \cos x}}{\sqrt{1 - \cos x}}\right) = \frac{\pi}{4} \quad x \in (0, \pi/2).$$

$$9. \text{ Prove } \tan^{-1}\left(\frac{x}{\sqrt{a^2 - x^2}}\right) = \sin^{-1}\frac{x}{a} = \cos^{-1}\left(\frac{\sqrt{a^2 - x^2}}{a}\right).$$

$$10. \text{ Prove } \cot^{-1}\left[2 \tan \cos^{-1}\frac{8}{17}\right] + \tan^{-1}\left[2 \tan \sin^{-1}\frac{8}{17}\right] = \tan^{-1}\frac{300}{161}.$$

11. Prove  $\tan^{-1} \frac{\sqrt{1+x^2} + \sqrt{1-x^2}}{\sqrt{1+x^2} - \sqrt{1-x^2}} = \frac{\pi}{4} + \frac{1}{2} \cos^{-1} x^2$ .

12. Solve  $\cot^{-1} 2x + \cot^{-1} 3x = \frac{\pi}{4}$ .

13. Solve  $\tan^{-1} 2x + \tan^{-1} 3x = \frac{\pi}{4}$ .

14. Prove  $\cot \left[ \tan^{-1} x + \tan^{-1} \frac{1}{x} \right] + \cos^{-1} (1 - 2x^2) + \cos^{-1} (2x^2 - 1) = \pi$ .

15. (i) Prove  $\tan^{-1} \left( \frac{a-b}{1-ab} \right) + \tan^{-1} \left( \frac{b-c}{1+bc} \right) + \tan^{-1} \left( \frac{c-a}{1+ac} \right) = 0, \quad a, b, c > 0$ .

(ii) Find the value of  $\cot^{-1} \left[ \sin \left( -\frac{\pi}{2} \right) \right]$ .

\*16. Prove that

(i)  $3 \sin^{-1} x = \sin^{-1} (3x - 4x^3), \quad x \in \left[ -\frac{1}{2}, \frac{1}{2} \right]$ .

(ii)  $3 \cos^{-1} x = \cos^{-1} (4x^3 - 3x), \quad x \in \left[ \frac{1}{2}, 1 \right]$ .

# CHAPTER 3 and 4

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## MATRICES AND DETERMINANTS

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### POINTS TO REMEMBER

**Matrix :** A matrix is an ordered rectangular array of numbers or functions. The numbers or functions are called the elements of the matrix.

**Order of Matrix :** A matrix having ' $m$ ' rows and ' $n$ ' columns is called the matrix of order  $m \times n$ .

**Zero Matrix :** A matrix having all the elements zero is called zero matrix or null matrix.

**Diagonal Matrix :** A square matrix is called a diagonal matrix if all its non diagonal elements are zero. The diagonal elements may or may not be zero.

**Scalar Matrix :** A diagonal matrix in which all diagonal elements are equal is called a scalar matrix.

**Identity Matrix :** A scalar matrix in which each diagonal element is  $1$ , is called an identity matrix or a unit matrix.

$$\begin{aligned}\therefore \quad A &= [a_{ij}]_{n \times n} \\ a_{ij} &= 0 \text{ when } i \neq j \\ &= 1 \text{ when } i = j \text{ is a identity matrix.}\end{aligned}$$

**Transpose of a Matrix :** If  $A = [a_{ij}]_{m \times n}$  be an  $m \times n$  matrix then the matrix obtained by interchanging the rows and columns of  $A$  is called the transpose of the matrix. If  $A = [a_{ij}]_{m \times n}$ . Then transpose  $A = A' = [a_{ji}]_{n \times m}$ . Transpose of  $A$  is denoted by  $A'$  or  $A^T$ .

**Symmetric Matrix :** A square matrix  $A = [a_{ij}]$  is said by symmetric if  $A' = A$ .

**Skew symmetric Matrix :** A square matrix  $A = [a_{ij}]$  is said to be a skew symmetric matrix if  $A' = -A$ .

**Inverse of a Matrix :** Inverse of matrix.

$$A^{-1} = \frac{\text{Adj } A}{|A|}.$$

where  $(\text{Adj } A)$  is the adjoint matrix which is the transpose of the cofactor matrix.

**Singular Matrix :** A square matrix is called singular if  $|A| = 0$ , otherwise it will be called a nonsingular matrix.

**Determinant :** To every square matrix  $A = [a_{ij}]$  of order  $n \times n$ , we can associate a number (real or complex) called determinant of  $A$ . It is denoted by  $\det A$  or  $|A|$ .

If  $A$  is a nonsingular matrix then its inverse exists and  $A$  is called invertible matrix.

$$(AB)' = B'A'$$

$$(AB)^{-1} = B^{-1}A^{-1}$$

$$(A')^{-1} = (A^{-1})'$$

If  $A$  is any non singular matrix of order  $n$ , then  $|\text{adj } A| = |A|^{n-1}$

If  $A$  be any given square matrix of order  $n$ . Then  $A(\text{adj } A) = (\text{adj. } A) \cdot A = |A|I$ .

Where  $I$  is the identity matrix of order  $n$ .

$|AB| = |A||B|$  where  $A$  and  $B$  are square matrices of same order.

**Area of triangle** with vertices  $(x_1, y_1)$ ,  $(x_2, y_2)$  and  $(x_3, y_3) = \Delta = \frac{1}{2} \begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix}$

The points  $(x_1, y_1)$ ,  $(x_2, y_2)$ ,  $(x_3, y_3)$  are collinear if  $\begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix} = 0$ .

### VERY SHORT ANSWER TYPE QUESTIONS (1 Mark Each)

1. What is the matrix of order  $2 \times 2$  whose general element  $a_{ij}$  is given by  $a_{ij} = \begin{cases} i - j & \text{if } i \geq j \\ i + j & \text{if } i < j \end{cases}$
2. If the matrix  $P$  is the order  $2 \times 3$  and the matrix  $Q$  is of order  $3 \times m$ , then what is the order of the matrix  $PQ$ ?
3. If  $A = \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix}$  find  $A^2$ . [6]
4. If  $A = [1 \ 3 \ 2]$  and  $B = \begin{bmatrix} 2 \\ 3 \end{bmatrix}$ , find  $AB$ .
5. What is the element  $a_{23}$  in the matrix  $A = \lambda[a_{ij}]_{3 \times 3}$  where  $\lambda \in R$  and  $a_{ij} = \begin{cases} |2i - j| & \text{if } i > j \\ 2i + j + 3 & \text{if } i \leq j \end{cases}$
6. Let  $P$  and  $Q$  be two different matrices of order  $3 \times n$  and  $n \times p$  then what is the order of the matrix  $4Q - P$ , if it is defined.
7. Let  $A$  be a  $5 \times 7$  type matrix, then what is the number of elements in the second column.
8. If  $\begin{bmatrix} a+b & 2 \\ 5 & 3a-b \end{bmatrix} = \begin{bmatrix} 3 & 2 \\ 5 & 5 \end{bmatrix}$ , find the value of  $a$ .
9. Write the matrix  $X$  if  $3X - \begin{bmatrix} 8 & -2 \\ 6 & 0 \end{bmatrix} = \begin{bmatrix} 7 & 5 \\ 0 & 0 \end{bmatrix}$ .

- \*10. How many matrices of order  $2 \times 3$  are possible with each entry 0 or 1?
11. Give an example of two non zero  $3 \times 3$  matrices  $A$  and  $B$  such that  $AB = 0$ .
12. If  $A = \begin{bmatrix} 2 & -3 & 0 \\ -1 & 4 & 5 \end{bmatrix}$ , then find  $(3A)^{-1}$ .
13. If  $A = \begin{bmatrix} 2 & 3 \\ 1 & 0 \end{bmatrix} = P + Q$  where  $P$  is symmetric and  $Q$  is skew-symmetric matrix, then find the matrix  $P$ .
14. If  $A = \begin{bmatrix} \cos 20^\circ & \sin 20^\circ \\ \sin 70^\circ & \cos 70^\circ \end{bmatrix}$ , what is  $|A|$ ?
15. Find the value of the determinants  $\begin{vmatrix} a+ib & c+id \\ -c+id & a-ib \end{vmatrix}$ .
16. Find the value of  $xy$  if  $\begin{vmatrix} 3x^3 & 8 \\ -4 & 4y^3 \end{vmatrix} = -4$ .
17. Write the cofactor of the element 5 in the determinants  $\begin{vmatrix} 2 & -3 & 6 \\ 6 & 0 & 4 \\ 1 & 5 & -7 \end{vmatrix}$ .
18. Write the minor of the element  $b$  in the determinant  $\begin{vmatrix} a & d & g \\ b & e & h \\ c & f & i \end{vmatrix}$ .
- \*19. If  $\begin{vmatrix} 3x & 1 \\ 5 & -x \end{vmatrix} = \begin{vmatrix} -1 & 1 \\ 5 & 2 \end{vmatrix}$ , find the values (s) of  $x$ .
- \*20. If  $x \in R$ ,  $0 \leq x \leq \frac{\pi}{2}$ , and  $\begin{vmatrix} 2 \sin x & -1 \\ 1 & \sin x \end{vmatrix} = \begin{vmatrix} 3 & 0 \\ -4 & \sin x \end{vmatrix}$ , then find the values of  $x$ .
21. If  $A = [a_{ij}]$  is  $3 \times 3$  matrix and  $A_{ij}$  is denote the co-factors of the corresponding elements  $a_{ij}$ 's, then what is the value of  $a_{21}A_{11} + a_{22}A_{12} + a_{23}A_{13}$ ?
- \*22. If  $A$  is a square matrix of order 3 and  $|A| = -2$ , find the value of  $-3|A|$ .
23. Find the area of triangle with vertices  $A(0, 2)$ ,  $B(0, 4)$ ,  $C(1, 2)$ .
24. For what value(s) of  $\lambda$ , the points  $(\lambda, 0)$ ,  $(2, 0)$  and  $(4, 0)$  are colinear?
25. If  $A = [a_{ij}]$  is a  $3 \times 3$  matrix and  $M_{ij}$ 's denotes the minors of the corresponding elements  $a_{ij}$ 's then, write the expression for the value of  $|A|$  by expanding  $|A|$  by third column.

26. If  $0 < x < \frac{\pi}{2}$  and the matrix  $\begin{bmatrix} 2 \sin x & 3 \\ 1 & 2 \sin x \end{bmatrix}$  is singular, find the value of  $x$ .
27. For what value of  $\lambda$ , the matrix  $\begin{bmatrix} -3 & 5 \\ \lambda & \lambda + 1 \end{bmatrix}$  has no inverse?
- \*28. If  $A$  is a square matrix of order 3 such that  $|\text{adj } A| = 125$ , find  $|A|$ .
29. In the system of equations  $A_x = B$ , write the condition that the given system of equations has infinite solutions.
30. If  $A = \begin{bmatrix} 5 & -3 \\ 6 & 8 \end{bmatrix}$ , find  $\text{adj}(\text{adj } A)$
31. If  $A = 2B$ , where  $A$  and  $B$  are square matrices of order  $3 \times 3$  and  $|B| = 5$ . What is  $|A|$ ?
32. If the matrix  $A = \begin{bmatrix} \sin \alpha & \cos \alpha \\ -\cos \alpha & \sin \alpha \end{bmatrix}$ , find  $AA'$ .
33. If  $B = \begin{bmatrix} -2 & -1 \\ 3 & 0 \end{bmatrix}$ , and  $C = \begin{bmatrix} 3 & 0 \\ -1 & 2 \end{bmatrix}$ . Find  $2B - 3C$ .
- \*34. Let  $A$  be a non singular matrix of order  $3 \times 3$  such that  $|A| = 5$ . What is  $|\text{adj } A|$ ?
35. Find a  $2 \times 2$  matrix  $B$  such that.
- $$\begin{bmatrix} 6 & 5 \\ 5 & 6 \end{bmatrix} B = \begin{bmatrix} 11 & 0 \\ 0 & 11 \end{bmatrix}$$
36. If  $\begin{bmatrix} 2x+1 & 3y \\ 0 & y^2+5y \end{bmatrix} = \begin{bmatrix} x+3 & y+2 \\ 0 & 6 \end{bmatrix}$ , find  $x$  and  $y$ .
37. If  $A = \begin{bmatrix} 3 & 0 & 0 \\ 0 & x & 0 \\ 0 & 0 & 3 \end{bmatrix}$ . For what value of  $x$ ,  $A$  will be a scalar matrix.
- \*38. Find  $\Delta$  if  $\Delta = \begin{bmatrix} a-b & b-c & c-a \\ b-c & c-a & a-b \\ c-a & a-b & b-c \end{bmatrix}$
39. Determine the value of  $x$  for which the matrix  $A = \begin{bmatrix} -2 & 4 \\ 6 & 3x \end{bmatrix}$  is singular?
40. If  $A = \begin{bmatrix} 5 & -2 \\ 3 & -2 \end{bmatrix}$ , write the matrix  $A(\text{adj } A)$ .
41. Write the adjoint of the matrix  $A = \begin{bmatrix} 2 & 3 \\ 1 & 4 \end{bmatrix}$ .

- $\begin{bmatrix} P & 0 & 0 \end{bmatrix}$
42. Find the value of  $\begin{bmatrix} a & q & 0 \\ b & c & r \end{bmatrix}$ .
43. If  $A$  is a  $2 \times 2$  matrix and  $A(\text{adj } A) = \begin{bmatrix} 12 & 0 \\ 0 & 12 \end{bmatrix}$ , what is  $|A|$ .
- \*44. If  $A = \begin{bmatrix} 0 & 0 \\ -3 & 0 \end{bmatrix}$ , Find  $A^{20}$ ?
- \*45. If  $A, B, C$  are angles of triangle. Find the value of  $\Delta$  if  $\Delta = \begin{vmatrix} \sin(A+B+C) & \sin B & \cos C \\ -\sin B & 0 & \tan A \\ \cos(A+B) & -\tan A & 0 \end{vmatrix}$ .
46. If  $A = \begin{vmatrix} x+y & y+z & z+x \\ z & x & y \\ 1 & 1 & 1 \end{vmatrix}$ . Write the value of  $\det A$ .
47. If  $A = \begin{bmatrix} 4 & x+2 \\ 2x-3 & x+1 \end{bmatrix}$  is symmetric matrix, then find  $x$ .
48. If  $A = \begin{bmatrix} 4 & -2 \\ 2 & 1 \end{bmatrix}$ , find  $|5A|$ .
49. If  $A = \begin{bmatrix} 3 & -4 \\ 1 & 2 \end{bmatrix}$ . Find  $2|A|$ .
50. If  $A = \begin{bmatrix} \sin x & -\cos x \\ \cos x & \sin x \end{bmatrix}$ ,  $0 < x < \frac{\pi}{2}$  and  $A + A' = I$  where  $I$  is unity matrix, find the value of  $x$ .
- SHORT ANSWER TYPE QUESTIONS (4 Marks Each)**
51. Construct a matrix  $A = [a_{ij}]_{3 \times 4}$  whose entries are given by  $a_{ij} = \frac{i-j}{i+j}$ .
52. Find  $x, y, z$  and  $w$  if  $\begin{bmatrix} x-y & 2x+z \\ 2x-y & 3x+w \end{bmatrix} = \begin{bmatrix} -1 & 5 \\ 0 & 13 \end{bmatrix}$ .
53. Find  $A$  and  $B$  if  $2A + 3B = \begin{bmatrix} 1 & -2 & 3 \\ 2 & 0 & -1 \end{bmatrix}$  and  $A - 2B = \begin{bmatrix} 3 & 0 & 1 \\ -1 & 6 & 2 \end{bmatrix}$ .
54. Let  $A = \begin{bmatrix} 1 & 0 \\ 2 & 3 \end{bmatrix}$ ,  $B = \begin{bmatrix} 0 & 1 & 2 \\ 3 & 2 & 1 \end{bmatrix}$  and  $C = \begin{bmatrix} 1 & 0 & 4 \\ -2 & 1 & 0 \\ 3 & 2 & 6 \end{bmatrix}$ , verify that  $(AB)C = A(BC)$ .

55. Find the matrix  $X$  so that  $X \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix} = \begin{bmatrix} -7 & -8 & -9 \\ 2 & 4 & 6 \end{bmatrix}$ .

56. If  $A = \begin{bmatrix} -1 \\ 2 \\ 3 \end{bmatrix}$  and  $B = \begin{bmatrix} -2 & -1 & -4 \end{bmatrix}$ , verify that  $(AB)' = B'A'$ .

57. Express the matrix  $A = \begin{bmatrix} 3 & -4 \\ 1 & -1 \end{bmatrix}$  as the sum of a symmetric and a skew symmetric matrix.

58. Express the matrix  $\begin{bmatrix} 3 & 3 & -1 \\ -2 & -2 & 1 \\ -4 & -5 & 2 \end{bmatrix} = P + Q$  where  $P$  is a symmetric and  $Q$  is a skew symmetric matrix.

59. Find the inverse of the following matrix by using elementary transformations  $\begin{bmatrix} 7 & 6 \\ 2 & 2 \end{bmatrix}$ .

60. Find the inverse of the matrix  $\begin{bmatrix} 1 & -1 \\ 2 & 3 \end{bmatrix}$  by using elementary transformations.

\*61. If  $A = \begin{bmatrix} 0 & -\tan \frac{\theta}{2} \\ \tan \frac{\theta}{2} & 0 \end{bmatrix}$  and  $I$  is the identity matrix of order 2, show that

$$I + A = (I - A) = \begin{bmatrix} \cos \theta & -\sin \theta \\ \sin \theta & \cos \theta \end{bmatrix}.$$

62. Find the value of  $x$  such that  $\begin{bmatrix} 1 & 3 & 2 \\ 1 & x & 1 \\ 15 & 3 & 2 \end{bmatrix} \begin{bmatrix} 1 \\ 2 \\ 5 \\ 1 \\ 2 \\ x \end{bmatrix} = 0$ .

63. If  $A = \begin{bmatrix} 4 & 3 \\ 2 & 5 \end{bmatrix}$ , find  $x$  and  $y$  such that  $A^2 - xA + yI = 0$ .

\*64. If  $A = \begin{bmatrix} \cos \theta & \sin \theta \\ -\sin \theta & \cos \theta \end{bmatrix}$ , then prove that  $A^n = \begin{bmatrix} \cos n\theta & \sin n\theta \\ -\sin n\theta & \cos n\theta \end{bmatrix}$   $n \in N$ .

65. If  $A = \begin{bmatrix} 3 & -4 \\ 1 & -1 \end{bmatrix}$ , then prove that  $A^n = \begin{bmatrix} 1+2n & -4n \\ n & 1-2n \end{bmatrix}$ , where  $n$  is any positive integer.

66. Find  $A$  ( $\text{adj } A$ ) without finding ( $\text{adj } A$ ) if  $A = \begin{bmatrix} 1 & 2 & 3 \\ 3 & 1 & 2 \\ 1 & 0 & 3 \end{bmatrix}$ .

67. Given that  $A = \begin{bmatrix} 2 & -3 \\ -4 & 7 \end{bmatrix}$ . Compute  $A^{-1}$  and show that  $9I - A = 2A^{-1}$ .

68. Given that matrix  $A = \begin{bmatrix} 2 & -1 \\ 3 & 2 \end{bmatrix}$ . Show that  $A^2 - 4A + 7I = 0$ . Hence find  $A^{-1}$ .

69. If  $A = \begin{bmatrix} 3 & 8 \\ 2 & 1 \end{bmatrix}$ , verify that  $\frac{1}{13}A - \frac{4}{13}I = A^{-1}$ .

70. Show that  $A = \begin{bmatrix} 2 & -3 \\ 3 & 4 \end{bmatrix}$  satisfies the equation  $x^2 - 6x + 17 = 0$ . Hence find  $A^{-1}$ .

71. Prove that the product of two matrices.

$\begin{bmatrix} \cos^2 \theta & \cos \theta \sin \theta \\ \cos \theta \sin \theta & \sin^2 \theta \end{bmatrix}$  and  $\begin{bmatrix} \cos^2 \phi & \cos \phi \sin \phi \\ \cos \phi \sin \phi & \sin^2 \phi \end{bmatrix}$  is zero when  $\theta$  and  $\phi$  differ by an odd multiple of  $\frac{\pi}{2}$ .

72. If  $A$  is any square matrix. Then show that  $(A - A)$  is a skew symmetric matrix.

\*73. If  $x, y, z$  are the 10th, 13th and 15th terms of a G.P. find the value of  $D$  if  $\Delta = \begin{vmatrix} \log x & 10 & 1 \\ \log y & 13 & 1 \\ \log z & 15 & 1 \end{vmatrix}$ .

74. Show that :

$$\begin{vmatrix} \sin \alpha & \cos \alpha & \sin(\alpha + \delta) \\ \sin \beta & \cos \beta & \sin(\beta + \delta) \\ \sin \gamma & \cos \gamma & \sin(\gamma + \delta) \end{vmatrix} = 0.$$

75. Using the properties of determinant, prove the following questions (75 to 79).

$$\begin{vmatrix} b^2 + c^2 & a^2 & a^2 \\ b^2 & c^2 + a^2 & b^2 \\ c^2 & c^2 & a^2 + c^2 \end{vmatrix} = 4a^2 b^2 c^2.$$

$$76. \begin{vmatrix} b+c & c+a & a+b \\ q+r & r+p & p+q \\ y+z & z+x & x+y \end{vmatrix} = 2 \begin{vmatrix} a & b & c \\ p & q & r \\ x & y & z \end{vmatrix}.$$

77. 
$$\begin{vmatrix} a^2 & bc & ac + c^2 \\ a^2 + ab & b^2 & ac \\ ab & b^2 + bc & c^2 \end{vmatrix} = 4a^2b^2c^2.$$

78. 
$$\begin{vmatrix} x+a & b & c \\ a & x+b & c \\ a & b & x+c \end{vmatrix} = x^2(x+a+b+c).$$

79. Show that :

$$\begin{vmatrix} x & y & z \\ x^2 & y^2 & z^2 \\ yz & zx & xy \end{vmatrix} = (y-z)(z-x)(x-y)(yz+zx+xy).$$

80. (i) If the points  $(a, b)$ ,  $(a', b')$  and  $(a - a', b - b')$  are collinear. Show that  $ab' = a'b$ .

(ii) If  $A = \begin{bmatrix} 2 & 5 \\ 2 & 1 \end{bmatrix}$  and  $B = \begin{bmatrix} 4 & -3 \\ 2 & 5 \end{bmatrix}$  verify that  $|AB| = |A||B|$ .

81. Given  $A = \begin{bmatrix} 0 & -1 & 2 \\ 2 & -2 & 0 \end{bmatrix}$  and  $B = \begin{bmatrix} 0 & 1 \\ 1 & 0 \\ 1 & 1 \end{bmatrix}$ . Find the product  $AB$  and also find  $(AB)^{-1}$ .

82. (i) Using determinants find the area of the triangle whose vertices are  $(-3, 1)$ ,  $(2, 4)$  and  $(5, 1)$ .

(ii) If  $\begin{bmatrix} x-2 & -3 \\ 3x & 2x \end{bmatrix} = 3$ , find the value of  $x$ .

83. Solve the following equations for  $x$ .

$$\begin{vmatrix} a+x & a-x & a-x \\ a-x & a+x & a-x \\ a-x & a-x & a+x \end{vmatrix} = 0.$$

84. Verify that  $(AB)^{-1} = B^{-1}A^{-1}$  for the matrices  $A = \begin{bmatrix} 2 & 1 \\ 5 & 3 \end{bmatrix}$  and  $B = \begin{bmatrix} 4 & 5 \\ 3 & 4 \end{bmatrix}$ .

85. Show that  $\begin{bmatrix} 1 & \tan \theta \\ -\tan \theta & 1 \end{bmatrix}^{-1} \begin{bmatrix} 1 & -\tan \theta \\ \tan \theta & 1 \end{bmatrix} = \begin{bmatrix} \cos 2\theta & -\sin 2\theta \\ \sin 2\theta & \cos 2\theta \end{bmatrix}$

86. Using matrix method to solve the following system of equations :  $5x - 7y = 2$ ,  $7x - 5y = 3$ .

### LONG ANSWER TYPE QUESTIONS (6 Marks Each)

\*87. Let  $A = \begin{bmatrix} 2 & 3 \\ -1 & 2 \end{bmatrix}$  and  $f(x) = x^2 - 4x + 7$ . Show that  $f(A) = 0$ . Use this result to find  $A^5$ .

88. If  $A = \begin{bmatrix} \cos \alpha & -\sin \alpha & 0 \\ \sin \alpha & \cos \alpha & 0 \\ 0 & 0 & 1 \end{bmatrix}$ , find  $\text{adj } A$  and verify that  $A \cdot (\text{adj } A) = (\text{adj } A) A = |A| I_3$ .

\*89. Find the matrix  $X$  for which

$$\begin{bmatrix} 3 & 2 \\ 7 & 5 \end{bmatrix} X \begin{bmatrix} -1 & 1 \\ -2 & 1 \end{bmatrix} = \begin{bmatrix} 2 & -1 \\ 0 & 4 \end{bmatrix}.$$

90. If  $A = \begin{bmatrix} 1 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix}$ . Show that  $A^3 - 3A - 2I = 0$ . Hence find  $A^{-1}$ .

91. Using elementary transformations, find the inverse of each of the matrices in Question 91 to 93.

$$\begin{bmatrix} 2 & -3 & 3 \\ 2 & 2 & 3 \\ 3 & -2 & 2 \end{bmatrix}.$$

$$92. \begin{bmatrix} 1 & 2 & -2 \\ -1 & 3 & 0 \\ 0 & -2 & 1 \end{bmatrix}.$$

$$93. \begin{bmatrix} 0 & 0 & -1 \\ 3 & 4 & 5 \\ -2 & -4 & -7 \end{bmatrix}.$$

94. Show that  $\Delta = \begin{vmatrix} (y+z)^2 & xy & zx \\ xy & (x+z)^2 & yz \\ xz & yz & (x+y)^2 \end{vmatrix} = 2xyz(x+y+z)^3$ .

95. By using properties of determinants prove that

$$\begin{vmatrix} 1+a^2+b^2 & 2ab & -2b \\ 2ab & 1-a^2+b^2 & 2a \\ 2b & -2a & 1-a^2-b^2 \end{vmatrix} = (1+a^2+b^2)^3.$$

96. Solve the system of linear equations by using matrix in equation 96 to 98.

$$2x - y + 4z = 1$$

$$3x - z = 2$$

$$x - y - 2z = 3$$

97.  $2x - y - z = 7$

$$3x + y - z = 7$$

$$x + y - z = 3$$

98.  $x + y - 5z = 26$

$$x + 2y + z = -4$$

$$x + 3y + 6z = -29$$

$$\begin{bmatrix} 3 & 2 & 1 \end{bmatrix}$$

\*99. If  $A = \begin{bmatrix} 4 & -1 & 2 \\ 7 & 3 & -3 \end{bmatrix}$  find  $A^{-1}$  and hence solve the system of linear equations

$$3x + 4y + 7z = 14, \quad 2x - y + 3z = 4, \quad x + 2y - 3z = 0.$$

$$\begin{bmatrix} 1 & 2 & -3 \end{bmatrix}$$

100. Find  $A^{-1}$ , where  $A = \begin{bmatrix} 2 & 3 & 2 \\ 3 & -3 & -4 \end{bmatrix}$ , hence solve the system of linear equations :

$$x + 2y - 3z = -4$$

$$2x + 3y + 2z = 2$$

$$3x - 3y - 4z = 11$$

101. Solve by matrix method the following system of linear equations :

$$x - 2y = 10$$

$$2x + y + 3z = 8$$

$$-2y + z = 7$$

\*102. The sum of three numbers is 2. If we subtract the second number from twice the first number, we get 3. By adding double the second number and the third number we get 0. Represent it algebraically and find the numbers using matrix method.

103. Compute the inverse of the matrix.

$$A = \begin{bmatrix} 3 & -1 & 1 \\ -15 & 6 & -5 \\ 5 & -2 & 5 \end{bmatrix} \text{ and verify that } A^{-1} A = I_3.$$

$$\begin{bmatrix} 1 & 1 & 2 \end{bmatrix} \quad \begin{bmatrix} 1 & 2 & 0 \end{bmatrix}$$

\*104. If the matrix  $A = \begin{bmatrix} 0 & 2 & -3 \\ 3 & -2 & 4 \end{bmatrix}$  and  $B^{-1} = \begin{bmatrix} 0 & 3 & -1 \\ 1 & 0 & 2 \end{bmatrix}$ , then compute  $(AB)^{-1}$ .

105. Determine the product  $\begin{bmatrix} -4 & 4 & 4 \\ -7 & 1 & 3 \\ 5 & -3 & -1 \end{bmatrix} \begin{bmatrix} 1 & -1 & 1 \\ -2 & -2 & 1 \\ 2 & 1 & 3 \end{bmatrix}$  and use it to solve the system of equations.

$$x - y + z = 4, \quad x - 2y - 2z = 9, \quad 2x + y + 3z = 1.$$

- \*106. Solve the following system of equations using matrix method.

$$\frac{2}{x} + \frac{3}{y} + \frac{10}{z} = 4$$

$$\frac{4}{x} - \frac{6}{y} + \frac{5}{z} = 1$$

$$\frac{6}{x} + \frac{9}{y} - \frac{20}{z} = 2.$$

107. For the matrix  $A = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 2 & -3 \\ 2 & -1 & 3 \end{bmatrix}$ . Show that  $A^3 - 6A^2 + 5A + 11I = 0$  and hence find  $A^{-1}$ .

# CHAPTER 5

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## DIFFERENTIATION

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### POINTS TO REMEMBER

- **Continuity of a Function :** A function  $f(x)$  is said to be continuous at  $x = c$  if  $\lim_{x \rightarrow c} f(x) = f(c)$   
i.e., L.H.L. at  $x = c =$  R.H.L. at  $x = c = f(c)$ .  
 $f(x)$  is continuous in  $[a, b]$  iff :  
 $f(x)$  is continuous at  $x = c \forall c \in [a, b]$ .
- If  $f$  and  $g$  are two continuous function then  $f + g$ ,  $f - g$ ,  $f \cdot g$ ,  $cf$ ,  $|f|$  are all continuous function.
- $\frac{f}{g}$  is continuous at  $x = a$  provided  $g(a) \neq 0$ .
- Every polynomial function is a continuous function.
- $f(x)$  is said to be derivable at  $x = c$  iff  $\lim_{x \rightarrow c} \frac{f(x) - f(c)}{x - c}$  exists and value of this limit is denoted by  $f'(c)$ .  
$$\frac{d}{dx}(u \cdot v) = u \cdot \frac{dv}{dx} + v \cdot \frac{du}{dx}, \quad \frac{d}{dx}\left(\frac{u}{v}\right) = \frac{v \frac{du}{dx} - u \cdot \frac{dv}{dx}}{v^2}.$$
- If  $y$  is a function of  $u$  and ' $u$ ' is function of  $x$  them,  $\frac{dy}{dx} = \frac{dy}{du} \times \frac{du}{dx}$  [chain rule].
- If  $x = \phi_1(t)$ ,  $y = \phi_2(t)$  then  $\frac{dy}{dx} = \frac{\phi_2'(t)}{\phi_1'(t)} = g(t)$  say then  $\frac{d^2y}{dx^2} = g'(t) \cdot \left(\frac{dt}{dx}\right)$ .
- **Rolle's theorem :** If  $f(x)$  is continuous in  $[a, b]$  and derivable in  $(a, b)$  and  $f(a) = f(b)$  then there exists atleast one real no  $c \in (a, b)$  s.t.  $f'(c) = 0$ .
- **L.M.V.T. :** If  $f(x)$  is continuous in  $[a, b]$  and derivable in  $(a, b)$  then  $\exists$  atleast one point  $c \in (a, b)$  s.t.  $f'(c) = \frac{f(b) - f(a)}{b - a}$ .

### VERY SHORT ANSWER TYPE QUESTIONS (1 Mark Each)

1. At what point  $f(x) = |3x - 5|$  is not differentiable.

- \*2. What is derivative of  $f(x)$  if  $f(x) = |x|$ ,  $x \neq 0$ .
3. At what point  $f(x) = |x - 1| - 2$  is not differentiable.
4. Write the points of discontinuity of  $f(x) = \frac{x^2 + x + 1}{x^2 - 5x + 6}$ .
5. Write all the points of discontinuity of  $f(x) = [x]$ , where  $[x]$  is the greatest integer function.
- \*6. At what point,  $f(n)$  is discontinuous where,  $f(x)$  is signum function defined as
- $$f(x) = \begin{cases} \frac{x}{|x|} & x \neq 0 \\ 0 & x = 0 \end{cases}.$$
7. Write the interval in which  $f(x)$  is continuous where  $f(x) = e^x \log x$ .
8. For what value of  $\lambda$ ,  $f(x) = \begin{cases} \lambda x^2 + 1 & x \geq 2 \\ -1 & x < 2 \end{cases}$  is continuous on  $R$ .
- \*9. Write the interval in which  $f(x)$  is continuous where  $f(x) = \frac{\log x}{\sqrt{1 - 9x^2}}$ .
- \*10. Write the value of  $K$  given that  $f(x) = \begin{cases} \frac{\sin x}{x} & x \neq 0 \\ K & x = 0 \end{cases}$ .
- \*11. What is the derivative of  $x^6$  with respect to  $x^3$ .
- \*12. What is the Derivative of  $f(\log x)$  is  $f(x) = \log x$ .
13. If Mean value theorem holds for  $f(x) = e^x$ ,  $x \in [0, 1]$ , then for what value of  $x$ , M V T is verified.
- \*14. What is  $\frac{d}{dx} (\sin^{-1} x + \cos^{-1} x)$  if  $-1 \leq x \leq 1$ .
15. Given  $g(0) = 2$  and  $f(x) = x g(x)$   $f'(x)$  and  $g'(x)$  exist then what is  $f'(0)$ .
16. Write the derivative of the following function w.r.t.  $x$ .
- (a)  $\tan^{-1} \left( \frac{\sqrt{a} - \sqrt{x}}{1 + \sqrt{a} \sqrt{x}} \right)$ ,  $x > 0$ ,  $a > 0$ .      (b)  $\sec^{-1} \left( \frac{1}{2x^2 - 1} \right)$ .
- (c)  $\log_5 (3x - 5)$ .      \*(d)  $\tan^{-1} \left( \frac{x}{1 + 12x^2} \right)$ .
- (e)  $\tan^{-1} \left( \frac{3x - x^3}{1 - 3x^2} \right)$ .      (f)  $e^{\tan^{-1} x^2}$ .
- (g)  $\cos x^3 \cdot \sin^2 x^5$ .      (h)  $\sqrt{e^{\sqrt{x}}}$ .

$$(i) \quad \sin^{-1}(x\sqrt{x}) \quad 0 \leq x \leq 1.$$

$$(j) \quad \sin^{-1}(\sqrt{\cos x}).$$

### SHORT ANSWER TYPE QUESTION (4 Marks)

Discuss the continuity of the following functions at indicated points.

$$17. \quad f(x) = \begin{cases} \frac{x}{|x|} & x \neq 0 \\ 0 & x = 0 \end{cases} \quad \text{at } x = 0.$$

$$18. \quad f(x) = \begin{cases} \frac{x - |x|}{x} & x \neq 0 \\ 2 & x = 0 \end{cases} \quad \text{at } x = 0.$$

$$19. \quad f(x) = \begin{cases} \frac{e^x - 1}{\log(1 + 3x)} & x \neq 0 \\ 5 & x = 0 \end{cases} \quad \text{at } x = 0.$$

$$20. \quad f(x) = \begin{cases} x \sin \frac{1}{x} & x \neq 0 \\ 0 & x = 0 \end{cases} \quad \text{at } x = 0.$$

$$21. \quad f(x) = |x - 1| + |x + 1| \quad \text{at } x = -1, x = 1.$$

$$22. \quad f(x) = \begin{cases} \frac{\sin x}{x} & x < 0 \\ x + 1 & x \geq 0 \end{cases} \quad \text{at } x = 0.$$

$$23. \quad f(x) = \begin{cases} \frac{\sqrt{1+x} - \sqrt{1-x}}{\delta m x} & x \neq 0 \\ 1 & x = 0 \end{cases} \quad \text{at } x = 0.$$

$$24. \quad f(x) = \begin{cases} \frac{|\sin x|}{x} & x \neq 0 \\ 1 & x = 0 \end{cases} \quad \text{at } x = 0.$$

$$25. \quad \text{For what value of } K, \quad f(x) = \begin{cases} 3 - 2x & 0 < x < 2 \\ 4x^2 - 3kx & 2 \leq x < 5 \end{cases} \quad \text{is continuous in it's domain.}$$

26. For what values of  $a$  and  $b$

$$f(x) = \begin{cases} \frac{x+2}{|x+2|} + a & \text{if } x < -2 \\ a+b & \text{if } x = -2 \\ \frac{x+2}{|x+2|} + b & \text{if } x > -2 \end{cases} \quad \text{is continuous at } x = 2.$$

\*27. If  $f(x) = \frac{1}{1-x}$  then find the point of discontinuity if any of  $f[f\{f(x)\}]$ .

28. Prove that  $f(x) = |x - 2|$  is continuous at  $x = 2$  but not differentiable at  $x = 2$ .

$$\begin{cases} \frac{3x - \tan x}{5x - \sin x} & x < 0 \\ K & x = 0 \\ 3x^2 - 4x + \frac{1}{2} & x > 0 \end{cases}$$

29. For what value of  $K$ ,  $f(x) = \begin{cases} K & x = 0 \\ 3x^2 - 4x + \frac{1}{2} & x > 0 \end{cases}$  is continuous at  $x = 0$ .

30. Show that  $f(x) = x - [x]$  is discontinuous at  $x = 2$ . Also discuss the continuity at  $x = \frac{5}{2}$ , where  $[ ]$  represents greatest integer function.

31. Check the differentiability of  $f(x) = |x - 1| + |x - 2|$  at  $x = 2$ .

\*32. If  $f(x) = \begin{cases} x^p \sin \frac{1}{x} & x \neq 0 \\ 0 & x = 0 \end{cases}$  is differentiable at  $x = 0$ , then find value of  $p$ .

33. For what value of  $a$  and  $b$   $f(x) = \begin{cases} 5 & \text{if } n \leq 2 \\ ax + b & \text{if } 2 < x < 10 \\ 21 & \text{if } x \geq 0 \end{cases}$  is continuous.

34. If  $y = (\log x)^x + x^{\log x}$  then find  $\frac{dy}{dx}$ .

35. If  $y = \frac{1}{2} \left[ \tan^{-1} \frac{2x}{1-x^2} + 2 \tan^{-1} \frac{1}{x} \right]$  find  $\frac{dy}{dx}$ .

36. If  $y = \sin \left[ 2 \tan^{-1} \frac{\sqrt{1-x}}{\sqrt{1+x}} \right]$  then find  $\frac{dy}{dx}$ .

37. If  $x^{2/3} + y^{2/3} = a^{2/3}$  then show that  $\frac{dy}{dx} = -\frac{(y)^{\frac{1}{3}}}{x}$ .

38. If  $y = \tan^{-1} x$ , show that  $(1+x^2) \frac{d^2y}{dx^2} + 2x \frac{dy}{dx} = 0$ .

39. If  $f(x) = \log(x^x + \sec^3 x)$ , find  $f'(x)$ .

40. If  $x\sqrt{1+y} + y\sqrt{1+x} = 0$  then prove that  $\frac{dy}{dx} = \frac{-1}{(1+x)^2}$ ,  $x \neq y$ .

41. If  $x\sqrt{1-y^2} + y\sqrt{1-x^2} = a$  then prove that  $\frac{dy}{dx} = \sqrt{\frac{1-y^2}{1-x^2}}$ .

42. If  $(x+y)^{m+n} = x^m \cdot y^n$  then prove that  $\frac{dy}{dx} = \frac{y}{x}$ .

43. If  $\alpha^x + \alpha^y = \alpha^{x+y}$  where  $\alpha > 0$  then prove that  $\frac{dy}{dx} + \alpha^{y-x} = 0$ .

\*44. If  $y = \cot^{-1} \left[ \frac{\sqrt{1+\sin x} + \sqrt{1-\sin x}}{\sqrt{1+\sin x} - \sqrt{1-\sin x}} \right]$  where  $\pi/2 < x < \pi$ , find  $\frac{dy}{dx}$ .

\*45. If  $y = \sin^{-1} \left[ 2ax\sqrt{1-a^2x^2} \right]$  find  $\frac{dy}{dx}$  when  $\frac{-1}{\sqrt{2}} \leq ax \leq \frac{1}{\sqrt{2}}$ .

46. Find the derivative of  $\tan^{-1} \left( \frac{2x}{1-x^2} \right)$  w.r.t.  $\sin^{-1} \left( \frac{2x}{1+x^2} \right)$ .

47. If  $x = \sin \left( \frac{1}{a} \log y \right)$  then show that  $(1-x^2)y_2 - xy_1 - a^2y = 0$ .

48. If  $y = \tan^{-1} \left( \frac{1-x}{1+x} \right) + \tan^{-1} \left( \frac{x+2}{1-2x} \right)$  then show that  $\frac{dy}{dx} = 0$ .

49. If  $y = f \left( \frac{2x-1}{x^2+1} \right)$  and  $f'(x) = \sin x^2$ , then find  $\frac{dy}{dx}$ .

50. If  $x^y + y^x + x^x = a^b$ , then find  $\frac{dy}{dx}$ .

51. If  $x = a \left( \theta + \frac{1}{\theta} \right)$

$y = a \left( \theta - \frac{1}{\theta} \right)$  then find  $\frac{dy}{dx}$ .

52. if  $x = a \cos^3 \theta$

$y = a \sin^3 \theta$  then find  $\frac{d^2y}{dx^2}$ .

53. If  $x = ae^\theta (\sin \theta - \cos \theta)$

$y = ae^\theta (\sin \theta + \cos \theta)$ , then show that  $\frac{dy}{dx}$  at  $x = \frac{\pi}{4}$  is 1.

54. Find  $\frac{dy}{dx}$  if  $x = \frac{2t}{1+t^2}$ ,  $y = \frac{1-t^2}{1+t^2}$ .

\*55. If  $y = \sin^{-1} [x\sqrt{1-x} - \sqrt{x}\sqrt{1-x^2}]$  then find  $\frac{dy}{dx}$ .

56. If  $y = \frac{\sqrt{x-1}(\tan^{-1} x)^2}{e^{2x-3} \sin^2 2x}$ , find  $\frac{dy}{dx}$ .

57. If  $y = a \sin t$ ,  $x = a [\cos t + \log \tan \frac{t}{2}]$ , find  $\frac{dy}{dx}$ .

58. If  $y = \cos^{-1} \frac{3 \sin x - 4 \cos x}{5}$ , find  $\frac{dy}{dx}$ .

59. If  $y = \sin^{-1} \frac{12x + 5\sqrt{1-x^2}}{13}$ , find  $\frac{dy}{dx}$ .

60. If  $y^x = x^y$ , find  $\frac{dy}{dx}$ .

61. If  $\sin y = x \sin(a+y)$  then show that  $\frac{dy}{dx} = \frac{\sin^2(a+y)}{\sin a}$ .

62. If  $y = \cos^{-1} x$ , find  $\frac{d^2y}{dx^2}$  in terms of  $y$ .

63. If  $x = \sin \frac{(\sin^{-1} y)}{m}$ , then prove that  $(1-x^2) \frac{d^2y}{dx^2} - x \frac{dy}{dx} + m^2 y = 0$ .

64. If  $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$  then show that  $\frac{d^2y}{dx^2} = \frac{-b^4}{a^2 y^3}$ .

65. If  $y^3 - 3ax^2 + x^3 = 0$  then prove that  $\frac{d^2y}{dx^2} + \frac{2a^2 x^2}{v^5} = 0$ .

66. Find  $\frac{d^2y}{dx^2}$  when  $y = \log \left( \frac{x^2}{e^x} \right)$ .

# CHAPTER 6

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## APPLICATIONS OF DERIVATIVES

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### POINTS TO REMEMBER

- **Rate of Change :** If  $x$  and  $y$  are connected by  $y = f(x)$  then  $\frac{dy}{dx}$  represents the rate of change of  $y$  w.r.t.  $x$ .
- Equation of tangent to the curve  $y = f(x)$  at the point  $P(x_1, y_1)$  is given by  $y - y_1 = \left. \frac{dy}{dx} \right|_P (x - x_1)$ .  
Similarly equation of normal is  $y - y_1 = -\left. \frac{1}{\frac{dy}{dx}} \right|_P (x - x_1)$ .

The angle of intersection between two curves is the angle between the tangents to the curves

at the point of intersection.  $\tan \theta = \left| \frac{m_1 - m_2}{1 + m_1 m_2} \right|$ , where  $m_1, m_2$  are slopes of tangent at the point of intersection  $P$ .

- A function  $f(x)$  is said to be strictly monotonic in  $(a, b)$  if it is either increasing or decreasing in  $(a, b)$ .
- A function  $f(x)$  is said to be strictly increasing in  $(a, b)$  if  $\forall x, x_2$  in  $(a, b)$  s.t.  $x_1 < x_2 \Rightarrow f(x_1) < f(x_2)$ . Alternatively,  $f(x)$  is increasing in  $(a, b)$  if  $f'(x) > 0 \quad \forall x \in (a, b)$ .
- A function  $f(x)$  is said to be strictly decreasing in  $(a, b)$  if  $\forall x_1, x_2$  in  $(a, b)$  s.t.  $x_1 < x_2 \Rightarrow f(x_1) > f(x_2)$ . Alternatively,  $f(x)$  is strictly decreasing in  $(a, b)$  if  $f'(x) < 0 \quad \forall x \in (a, b)$ .
- A function  $f(x)$  is said to have local maximum value at  $x = c$ , if there exists a neighbourhood  $(c - \delta), (c + \delta)$  of  $c$ , s.t.  $f(x) < f(c) \quad \forall x \in (c - \delta, c + \delta) \quad x \neq c$ . Similarly, local minimum value can be defined.
- Local maximum and local minimum values of  $f(x)$  may not be maximum and minimum value of  $f(x)$ .
- **Critical Point :** A point  $c$  is called critical point of  $y = f(x)$  if either  $f'(c) = 0$  or  $f'(c)$  does not exist.

Some useful results :

Figure Surface area	Curved S.A.	Total S.A.	Volume
Sphere	$4\pi r^2$	$4\pi r^2$	$\frac{4}{3}\pi r^3$
Cone	$\pi r l$	$\pi r^2 + \pi r l$	$\frac{1}{3}\pi r^2 h$
Cylinder	$2\pi r h$	$2\pi r h + 2\pi r^2$	$\pi r^2 h$

### VERY SHORT ANSWER TYPE QUESTIONS (1 Mark Each)

1. Write minimum value of  $f(x) = x^2 + x + 1$  in  $[0, 1]$ .
- \*2. If Rolle's theorem is applicable for the function  $f(x) = x^2 - 3x + 1$  in  $[-1, 4]$  then find the real no 'c' verifying Rolle's theorem.
3. Find the interval where  $f(x) = \cos x$  defined in  $[0, 2\pi]$  is decreasing.
4. Find the interval where  $f(x) = x^2$ ,  $x \in (-\infty, \infty)$  is decreasing.
- \*5. For what value (s) of  $\lambda$ , the function,  $f(x) = \sin x - 3\lambda x$  is always strictly increasing.
- \*6. Write the interval in which  $f(x) = x^x$  is increasing (where  $x > 0$ ).
7. Examine if  $f(x) = x^9 + 2x^5 + 3x^3 + 1$  is increasing or decreasing  $(0, \infty)$ .
- \*8. Write the least value of  $f(x) = x + \frac{1}{x}$ ,  $(x > 0)$ .
9. Write the maximum value of  $f(x) = \frac{1}{x^2 - 2x + 3}$  in  $[0, 2]$ .
- \*10. Find the maximum and minimum value of  $f(x) = |2 \sin 2x + 3|$ .
- \*11. On the curve  $f(x) = \frac{3}{2}x^2$ , find the points at which tangent is parallel to the chord joining the points  $A(-1, \frac{3}{2})$  and  $B(2, 6)$ .
- \*12. If the tangent to the curve at a point  $P$  is perpendicular to  $x$ -axis, then what is the value of  $\frac{dy}{dx}$  (if it exists) at the point  $P$ .
- \*13. If normal to the curve at a point  $P$  on  $y = f(x)$  is parallel to  $y$ -axis, then write the value of  $\frac{dy}{dx}$  at  $P$ .
14. What is the slope of the tangent to the curve  $y = x^2$  at  $(-1, 1)$ .

- \*15. If the tangent to the curve  $y = 2x^2 - x$  at any point  $P$  is parallel to the line  $x - y = 0$ , then find the coordinates of  $P$ .
16. If the tangent to the curve  $x = at^2$ ,  $y = 2at$  is perpendicular to  $x$ -axis then write the coordinates of the point of contact of tangent.
- \*17. If curves  $y = 3e^{2x}$  and  $y = be^{-2x}$  cut each other orthogonally, then find  $b$ .
- \*18. At which point on  $y^2 = 4x$ , the tangent makes an angle of  $45^\circ$  with the positive direction of  $x$ .
- \*19. If  $kx + y = P$  is normal to the curve  $y^2 = 12x$  at  $(3, 6)$  then what is value of  $k$ .
20. How many extreme values [maximum or minimum] are there of  $f(x) = x$ .
21. What is equation of normal to the curve  $y = \sin x$  at origin.

### **SHORT ANSWER TYPE QUESTIONS (4 Marks Each)**

22. Sand is pouring out from a pipe at the rate of  $12 \text{ Cu cm/s}$ . The falling sand forms a cone on the ground in such a way that the height of the cone is always one sixth of the radius of the base. How fast is the height of sand cone increasing when the height is  $4 \text{ cm}$ .
23. A particle moves along the curve  $y = x^5 + 2$ . Find the points on the curve at which  $y$  co-ordinate is changing 5 times as fast as the  $x$  co-ordinate.
24. Find points of local maxima/minima for  $f(x)$ . If  $f(x) = \sin x - \cos x$  where  $0 < x < 2\pi$ . Also find the local maximum or minimum values.
25. Find the intervals in which the function  $f(x) = x^4 - \frac{x}{3}$  is increasing or decreasing.
- \*26. If  $f(x) = x^2 - 2x + 3$  then using differentials, find the approximate value of  $f(1.9)$ .
27. Find the value (s) of  $a$  for which :
- (i)  $f(x) = x^3 - ax$  is increasing on  $R$ .
  - (ii)  $g(x) = \sin x + ax$  is increasing on  $R$ .
28. If radius of right circular cone is increasing at the rate of  $10\pi \text{ cm}^3/\text{sec}$ , find the rate at which the height of the cone is hanging at the instant when radius  $5 \text{ cm}$  and height  $4 \text{ cm}$ .
- \*29. Find the least value of the function.  $f(x) = ax + \frac{b}{x}$ , ( $a, b > 0$ ).
30. For the curve  $y = 2x^3 - 3x^2$ , find all the points on the curve at which the tangent passes through the origin.
31. Prove that the function :  

$$f(x) = x^{50} + \sin x - 1 \text{ is strictly increasing on } \left(\frac{\pi}{2}, \pi\right).$$

32. Show that the normal at any point  $\theta$  to the curve  $x = a \cos \theta + a\theta \sin \theta$ ,  $y = a \sin \theta - a\theta \cos \theta$  is at a constant distance from the origin.
33. Using errors and approximations find the approximate value of the following.
- (i)  $\frac{1}{(2.002)^2}$ ; (ii)  $\sqrt{0.082}$ ; (iii)  $\sqrt{0.005}$ .
34. Find the interval in which  $f(x) = \sin x - \cos x$ ,  $0 < x < 2\pi$ , is increasing or decreasing.
- \*35. If  $\log 2 = 0.3010$   
and  $\log_{10} e = 0.4343$   
find approximate value of  $\log_{10} (2.2)$ .
36. Find the interval (s) in which  $y = x^2 (x - 3)^2$  increases.
37. Find the interval (s) in which function  $f(x) = 2x^3 - 15x^2 + 36x + 1$  is strictly increasing or decreasing.
38. Find the point of the curve  $y = 3x^2 - 2x$  where the tangent is parallel to  $x$ -axis?
39. Find the equation of the tangent to the curve  $y = 2e^{-x/3}$  at the point where curve cuts  $y$ -axis.
40. If  $8k^2 = 1$  then show that the curves  $y^2 = x$  and  $xy = k$  cut at right angles.
41. Determine the interval in which function,  $f(x) = \sin x + \cos x$  in  $[0, 2\pi]$  is strictly increasing or decreasing.
42. Find the maximum value of  $f(x) = 3 \sin x + 4 \cos x$  in  $[0, \pi/2]$ .
43. Find the two positive numbers  $x$  and  $y$  such that their sum is 35 and product  $x^2y^3$  is maximum.
44. Find the least value of 'a' such that the function  $f(x) = x^2 + 2ax + 3$  is strictly increasing on  $(3, 4)$ .
45. Show that the acute angle of intersection between the curves  $xy = 6$  and  $x^2y = 12$  is  $\tan^{-1}\left(\frac{3}{\pi}\right)$ .
46. Find approximate value of  $\sqrt{0.037}$  using differentials.
47. Find all the points of the curve  $\frac{x^2}{9} - \frac{y^2}{16} = 1$  at which the tangent is  
(i) Parallel to the  $x$ -axis; (ii) Parallel to  $y$ -axis.
- \*48. Find all values of  $a \in R$  such that the function  $f(x) = (a+2)x^3 - 3ax^2 + 9ax - 1$  decreases for all  $x \in R$ .
- \*49. Find the condition that the line  $x \cos \alpha + y \sin \alpha = p$  be a tangent to the curve  $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ .
50. Find equation of tangent at  $x = \frac{\pi}{4}$  to the curve  $y = \cot^2 x - 2 \cot x + 2$ .

### LONG ANSWER TYPE QUESTION (6 Marks Each)

51. Show that the point  $(1, 3)$  on  $y = x^2 + 2$  is nearest to the point  $(3, 2)$ .
52. A point on the hypotenuse of a right triangle is at a distance ' $a$ ' and ' $b$ ' from the sides of the triangle. Show that the minimum length of the hypotenuse is  $(a^{2/3} + b^{2/3})^{3/2}$ .
53. If the length of three sides of a trapezium other than base are equal to 10cm, then find the area of trapezium when it is maximum.
54. A given quantity of metal is to be cast into half cylinder with a rectangular base and semi-circular ends. Show that when total surface areas is minimum, the ratio of length of cylinder to the diameter of its semi-circular ends is  $\pi : (\pi + 2)$ .
55. Show that  $f(x) = \sin^4 x + \cos^4 x$ ,  $x \in [0, \pi/2]$  is increasing on  $\left[\frac{\pi}{4}, \frac{\pi}{2}\right]$  and decreasing on  $\left[0, \frac{\pi}{4}\right]$ .
56. Find the interval in which  $f(x) = 2 \log(x - 2) - x^2 + 4x + 1$  is increasing or decreasing,
57. Find the equation of tangent to the curve  $y = x^3 - 1$  ( $x - 2$ ) at the points where the curve cuts the  $x$ -axis.
58. Show that the semi-vertical angle of a cone of maximum volume and given height is  $\tan^{-1} \sqrt{2}$ .
59. Prove that the radius of the right circular cylinder of greatest curved surface which can be inscribed in a given cone is half of that of the cone.
60. A rectangular sheet of tin  $45 \text{ cm} \times 24 \text{ cm}$  is to be made into a box without top by cutting off square from each corner and folding up the flaps. What should be the side of the square to be cut off so that the volume of the box is maximum?
61. A wire of length 28 m is to be cut into two pieces. One of the pieces is to be made into a square and the other into a circle. What should be the lengths of the two pieces so that the combined area of the square and the circle is minimum?
62. For a given curved surface of a right circular cone when volume is maximum, prove that semi-vertical angle is  $\sin^{-1} \left(\frac{1}{3}\right)$ .
63. Show that the volume of the greatest cylinder which can be inscribed in a cone of height  $h$  and semi-vertical angle  $\alpha$  is  $\frac{4}{27} \pi h^3 \tan^2 \alpha$ .
64. Prove that the volume of the largest cone that can be inscribed in a sphere of radius  $R$  is  $\frac{8}{27}$  of the volume of the sphere.
65. A jet of an enemy is flying along the curve  $y = x^2 + 2$ . A soldier is placed at the point  $(3, 2)$ . What is the nearest distance between the soldier and the jet?

66. A rectangular window is surmounted by an equilateral triangle. Given that the perimeter is 16m, find the width of the window so that the maximum amount of light may enter.
67. Cost of fuel for running a car is proportional to the square of speed generated in km/hr. It costs Rs. 48 per hour when the car is running the speed of 16 km/hr. What is the most economical speed if the fixed charges are Rs. 300 per hour over and above the running cost.
68. Two sides of a triangle are of lengths  $a$  and  $b$  and angle between them is  $\theta$ . What value of  $\theta$  will maximize the area of triangle? Also find the maximum area.

# CHAPTER 7

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# INTEGRATION

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## POINTS TO REMEMBER

Integration is inverse process of Differentiation.

## STANDARD FORMULAE

$$1. \int x^n dx = \begin{cases} \frac{x^{n+1}}{n+1} + c & n \neq -1 \\ \log|x| + c & n = -1 \end{cases}$$

$$2. \int (ax+b)^n dx = \begin{cases} \frac{(ax+b)^{n+1}}{n+1} + c & n \neq -1 \\ \frac{1}{a} \log|ax+b| + c & n = -1 \end{cases}$$

$$3. \int \sin x dx = -\cos x + c.$$

$$4. \int \cos x dx = \sin x + c.$$

$$5. \int \tan x dx = -\log|\cos x| + c = \log|\sec x| + c.$$

$$6. \int \cot x dx = \log|\sin x| + c.$$

$$7. \int \sec^2 x dx = \tan x + c.$$

$$8. \int \operatorname{cosec}^2 x dx = -\cot x + c.$$

$$9. \int \sec x \cdot \tan x dx = \sec x + c.$$

$$10. \int \operatorname{cosec} x \cot x dx = -\operatorname{cosec} x + c.$$

$$11. \int \sec x dx = \log|\sec x + \tan x| + c.$$

$$12. \int \operatorname{cosec} x dx = \log|\operatorname{cosec} x - \cot x| + c.$$

$$13. \int \frac{1}{\sqrt{1-x^2}} dx = \sin^{-1} x + c, |x| < 1.$$

$$14. \int \frac{1}{1+x^2} dx = \tan^{-1} x + c.$$

$$15. \int \frac{1}{x\sqrt{x^2-1}} dx = \sec^{-1} x + c, |x| > 1.$$

$$16. \int \frac{1}{a^2-x^2} dx = \frac{1}{2a} \log \left| \frac{a+x}{a-x} \right| + c.$$

$$17. \int \frac{1}{x^2-a^2} dx = \frac{1}{2a} \log \left| \frac{x-a}{x+a} \right| + c.$$

$$18. \int \frac{1}{a^2+x^2} dx = \frac{1}{a} \tan^{-1} \frac{x}{a} + c.$$

$$19. \int \frac{1}{\sqrt{a^2-x^2}} dx = \sin^{-1} \frac{x}{a} + c.$$

20.  $\int \frac{1}{\sqrt{a^2 + x^2}} dx = \log|x + \sqrt{a^2 + x^2}| + c.$     21.  $\int \frac{1}{\sqrt{x^2 - a^2}} dx = \log|x + \sqrt{x^2 - a^2}| + c.$
22.  $\int \sqrt{a^2 - x^2} dx = \frac{x}{2}\sqrt{a^2 - x^2} + \frac{a^2}{2} \sin^{-1} \frac{x}{a} + c.$
23.  $\int \sqrt{a^2 + x^2} dx = \frac{x}{2}\sqrt{a^2 + x^2} + \frac{a^2}{2} \log|x + \sqrt{a^2 + x^2}| + c.$
24.  $\int \sqrt{x^2 - a^2} dx = \frac{x}{2}\sqrt{x^2 - a^2} - \frac{a^2}{2} \log|x + \sqrt{x^2 - a^2}| + c.$
25.  $\int e^x dx = e^x + c.$
26.  $\int a^x dx = \frac{1}{\log a} \cdot a^x + c.$

### INTEGRATION BY SUBSTITUTION

1.  $\int \frac{f'(x)}{f(x)} dx = \log|f(x)| + c.$
2.  $\int [f(x)]^n f'(x) dx = \frac{[f(x)]^{n+1}}{n+1} + c.$
3.  $\int \frac{f'(x)}{[f(x)]^n} dx = \frac{(f(x))^{-n+1}}{-n+1} + c.$

### INTEGRATION BY PARTS

$$\int f(x) \cdot g(x) dx = f(x) \cdot \lceil \int g(x) dx \rceil - \int f'(x) \cdot \lceil \int g(x) dx \rceil dx.$$

### PROPERTIES OF DEFINITE INTEGRALS

$$\int_a^b f(x) dx = F(b) - F(a), \text{ where } F(x) = \int f(x) dx.$$

1.  $\int_a^b f(x) dx = - \int_b^a f(x) dx.$
2.  $\int_a^b f(x) dx = \int_a^b f(t) dt.$

$$3. \int_a^b f(x) dx = \int_a^c f(x) dx + \int_c^b f(x) dx.$$

$$4. \int_a^b f(x) dx = \int_a^b f(a+b-x) dx.$$

$$5. \int_{-a}^a f(x) dx = 0; \text{ if } f(x) \text{ is odd function.}$$

$$6. \int_0^{2a} f(x) dx = 2 \int_0^a f(x) dx, \quad \text{if } f(2a-x) = f(x). \\ = 0 \quad \text{if } f(2a-x) = -f(x).$$

Integral as limit of sum :

$$\int_a^b f(x) dx = \lim_{h \rightarrow 0} h [f(a) + f(a+h) + f(a+2h) + \dots + f(a+(n-1)h)]$$

$$\text{where } h = \frac{b-a}{n}.$$

### VERY SHORT ANSWER TYPE QUESTIONS (1 Mark Each)

1. Evaluate the following integrals

$$(i) \int (\sqrt{x} + \frac{1}{\sqrt{x}}) dx.$$

$$(ii) \int \frac{1}{1 - \sin^2 x} dx.$$

$$(iii) \int \frac{\cos x}{1 - \cos^2 x} dx.$$

$$(iv) \int_1^2 \frac{1}{x \sqrt{x^2 - 1}} dx.$$

$$(v) \int_0^{\pi/2} \log \frac{4 + 3 \sin x}{4 + 3 \cos x} dx.$$

$$(vi) \int \frac{1}{x \log x \log(\log x)} dx.$$

$$(vii) \int \operatorname{cosec} x (\operatorname{cosec} x + \cot x) dx.$$

$$(viii) \int (8^x + x^8 + \frac{8}{x} + \frac{x}{8}) dx.$$

$$(ix) \int \frac{dx}{\sin(\cos^{-1} x)}.$$

$$(x) \int_1^1 x^{99} \cos^4 x dx.$$

2. Evaluate the following integrals.

$$(i) \int \frac{x^2 + x - 1}{\sqrt{x}} dx.$$

$$(ii) \int (\sqrt{ax} - \frac{1}{\sqrt{ax}})^2 dx.$$

- (iii)  $\int (\sin 3x - 3e^{4x} + \sec^2 \frac{x}{2}) dx.$       (iv)  $\int \frac{1 + \cos 2x}{1 - \cos 2x} dx.$
- (v)  $\int \frac{x}{\sqrt{2x+1}} dx.$       (vi)  $\int \frac{\sec x \cosec x}{\log \tan x} dx.$
- (vii)  $\int \frac{\cos 2x + 2 \sin^2 x}{\cos^2 x} dx.$       (viii)  $\int (e^{a \log x} + e^{x \log a}) dx.$
- (ix)  $\int \sqrt{1 - \sin x} dx, \left( \frac{\pi}{2} < x < \pi \right).$       (x)  $\int \frac{1}{x(2 + 3 \log x)} dx.$
- (xi)  $\int \frac{\sin \sqrt{x}}{\sqrt{x}} dx.$       (xii)  $\int \frac{x^2 \tan^{-1} x^3}{1+x^6} dx.$
- (xiii)  $\int 2 \log x dx.$       (xiv)  $\int \frac{ax+b}{ax^2+2bx+c} dx.$
- (xv)  $\int \frac{\sin x}{a+b \cos x} dx.$       (xvi)  $\int (c^x + x^c) dx.$
- (xvii)  $\int \frac{1}{3x+x \log x} dx.$       (xviii)  $\int \frac{1}{16+25x^2} dx.$
- (xix)  $\int \frac{dx}{e^{2x}+e^{-2x}}.$       (xx)  $\int \frac{1}{9x^2-4} dx.$
- (xxi)  $\int \frac{1}{16-25x^2} dx.$       (xxii)  $\int \frac{1}{\sqrt{4x^2-9}} dx.$
- (xxiii)  $\int \frac{1}{a^2-b^2x^2} dx.$

3. Evaluate the following definite integrals :

- (i)  $\int_0^{\frac{\pi}{2}} \frac{\sin^{3/2} x}{\sin^{3/2} x + \cos^{3/2} x} dx.$       (ii)  $\int_{-1}^1 e^{|x|} dx.$
- (iii)  $\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \sin^7 x dx.$       (iv)  $\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \frac{\sin^3 x}{\sin^4 x + \cos^4 x} dx.$

$$(v) \int_0^1 \frac{1}{1+x^2} dx.$$

$$(vi) \int_0^{\frac{\pi}{2}} \frac{\sin x}{1+\cos^2 x} dx.$$

$$(vii) \int_0^1 \frac{\sqrt{\tan^{-1} x}}{1+x^2} dx.$$

$$(viii) \int_0^1 \frac{e^x}{1+e^{2x}} dx.$$

$$*(ix) \int \frac{e^{5\log x} - e^{4\log x}}{e^{3\log x} - e^{2\log x}} dx.$$

$$(x) \int_0^1 x e^x dx.$$

### SHORT ANSWER TYPE QUESTIONS (4 Marks Each)

4. Evaluate the following integrals :

$$(i) \int \frac{x \operatorname{cosec}(\tan^{-1} x^2)}{1+x^4} dx.$$

$$(ii) \int \frac{\sqrt{x+1} - \sqrt{x-1}}{\sqrt{x+1} + \sqrt{x-1}} dx.$$

$$(iii) \int \frac{1}{\sin(x-a)\sin(x-b)} dx.$$

$$(iv) \int \frac{\cos(x+a)}{\cos(x-a)} dx.$$

$$(v) \int \cos x \cos 2x \cos 3x dx.$$

$$(vi) \int \cos^5 x dx.$$

$$(vii) \int \sin^2 x \cos^4 x dx.$$

$$(viii) \int \sin^5 x \cos^4 x dx.$$

$$(ix) \int \cot^3 x \operatorname{cosec}^4 x dx.$$

$$(x) \int \frac{\sin x \cos x}{\sqrt{a^2 \sin^2 x + b^2 \cos^2 x}} dx.$$

$$(xi) \int \frac{1}{\sqrt{\cos^3 x \cos(x+a)}} dx.$$

$$(xii) \int \frac{\sin^6 x + \cos^6 x}{\sin^2 x \cos^2 x} dx.$$

$$*(xiii) \int x^6 \sqrt{x} (1+x^2 \sqrt{x})^{\frac{1}{2}} dx$$

$$(xiv) \int \frac{\sin x + \cos x}{\sqrt{\sin 2x}} dx.$$

$$(xv) \int \frac{1}{x(x^4+1)} dx.$$

$$*(xvi) \int \frac{dx}{1+3\sin^2 x}.$$

$$(xvii) \int \frac{\sin x}{\sin 3x} dx.$$

$$*(xviii) \int 5^{5^x} 5^{5^x} 5^x dx.$$

5. Evaluate :

$$(i) \int \frac{x}{x^4 + x^2 + 1} dx.$$

$$*(ii) \int \frac{1}{x \lceil 6(\log x)^2 + 7 \log x + 2 \rceil} dx.$$

- (iii)  $\int \frac{dx}{1 + 3x - x^2}.$
- (iv)  $\int \frac{1}{\sqrt{9 + 8x - 2x^2}} dx.$
- (v)  $\int \frac{1}{\sqrt{2x^2 + 3x - 2}} dx.$
- (vi)  $\int \frac{1}{\sqrt{(x-a)(x-b)}} dx.$
- (vii)  $\int \sqrt{\frac{\sin(x-\alpha)}{\sin(x+\alpha)}} dx.$
- (viii)  $\int \frac{5x-2}{3x^2+2x+1} dx.$
- (ix)  $\int \frac{x^2}{x^2+6x+12} dx.$
- (x)  $\int \frac{x+2}{\sqrt{4x-x^2}} dx.$
- (xi)  $\int x \sqrt{1+x-x^2} dx.$
- (xii)  $\int (3x-2) \sqrt{x^2+x+1} dx.$
- \*(xiii)  $\int \sqrt{\sec x + 1} dx.$
- (xiv)  $\int \frac{2 \sin 2\theta - \cos \theta}{6 - \cos^2 \theta - 4 \sin \theta} dx.$

6. Evaluate :

- (i)  $\int \frac{dx}{x(x^7+1)}.$
- \*(ii)  $\int \frac{x}{(x^2-a^2)(x^2-b^2)} dx.$
- (iii)  $\int \frac{\sin x}{(1+\cos x)(2+3\cos x)} dx.$
- (iv)  $\int \frac{x-1}{x^3+x^2-6x} dx.$
- (v)  $\int \frac{x^2+1}{(1+\cos x)(2+3\cos x)} dx.$
- (vi)  $\int \frac{x-1}{(x+1)(x-2)(x+3)} dx.$
- (vii)  $\int \frac{x^2+x+2}{(x-2)(x-1)} dx.$
- (viii)  $\int \frac{(x^2+1)(x^2+2)}{(x^3+3)(x^2+4)} dx.$
- \*(ix)  $\int \frac{x^4}{x^4-16} dx.$
- (x)  $\int \frac{dx}{(2x+1)(x^2+4)}.$
- (xi)  $\int \frac{dx}{\sin x(1-2\cos x)}.$
- \*(xii)  $\int \frac{dx}{\cos x(2-\sin x)}.$
- (xiii)  $\int \frac{\sin x}{\sin 4x} dx.$
- (xiv)  $\int \frac{x^2-1}{x^4+x^2+1} dx.$
- (xv)  $\int \sqrt{\tan x} dx.$
- (xvi)  $\int \frac{x^2+9}{x^4+81} dx.$
- \*(xvii)  $\int \frac{x \log x}{\sqrt{(x^2-1)^3}} dx.$

\*(xviii)  $\int_1^2 [x^2] dx$ , where  $[x]$  is greatest integer function

7. Evaluate :

(i)  $\int x^5 \sin x^3 dx.$

(ii)  $\int \sec^3 x dx.$

(iii)  $\int e^{ax} \cos(bx + c) dx.$

\*(iv)  $\int \sin^{-1} \frac{6x}{1+9x^2} dx.$

(v)  $\int \cos \sqrt{x} dx.$

(vi)  $\int x^n (\log x^2) dx.$

\*(vii)  $\int \frac{x^2}{(x \sin x + \cos x)^2} dx.$

(viii)  $\int (\sin^{-1} \sqrt{x} - \cos^{-1} \sqrt{x}) dx.$

\*(ix)  $\int \sin^{-1} \sqrt{\frac{x}{a+x}} dx.$

(x)  $\int x^3 \tan^{-1} x dx.$

(xi)  $\int \frac{\sqrt{x^2+1} [\log(x^2+1) - 2 \log x]}{x^4} dx.$

(xii)  $\int e^{2x} \left( \frac{1+\sin 2x}{1+\cos 2x} \right) dx.$

(xiii)  $\int e^x \left( \frac{x-1}{2x^2} \right) dx.$

(xiv)  $\int e^x \left( \frac{1-x}{1+x^2} \right)^2 dx.$

(xv)  $\int e^x \left( \frac{x^2+1}{(x+1)^2} \right) dx.$

(xvi)  $\int e^x \left( \frac{2+\sin 2x}{1+\cos 2x} \right) dx.$

(xvii)  $\int \left[ \frac{1}{\log x} - \frac{1}{(\log x)^2} \right] dx.$

\*(xviii)  $\int \left[ \log(\log x) + \frac{1}{(\log x)^2} \right] dx.$

(xix)  $\int \sin(\log x) + \cos(\log x) dx.$

8. Evaluate the following definite integrals :

(i)  $\int_0^{\frac{\pi}{4}} \frac{\sin x + \cos x}{9 + 16 \sin 2x} dx.$

(ii)  $\int_0^{\frac{\pi}{2}} \cos 2x \log \sin x dx.$

\*(iii)  $\int_0^1 x \sqrt{\frac{1-x^2}{1+x^2}} dx.$

(iv)  $\int_0^{\frac{1}{\sqrt{2}}} \frac{\sin^{-1} x}{(1-x^2)^{3/2}} dx.$

(v)  $\int_0^{\frac{\pi}{2}} \frac{\cos x}{(1+\sin x)(2+\sin x)(3+\sin x)} dx.$

(vi)  $\int_0^{\frac{\pi}{2}} \frac{\sin 2x}{\sin^4 x + \cos^4 x} dx.$

$$(vii) \int_0^{\frac{\pi}{2}} 2 \sin^4 x \, dx.$$

$$(ix) \int_1^2 \frac{5x^2}{x^2 + 4x + 3} \, dx.$$

$$(viii) \int_{\frac{1}{4}}^{\frac{1}{2}} \frac{dx}{\sqrt{x - x^2}} \, dx.$$

$$*(x) \int_0^{\frac{\pi}{2}} \frac{x + \sin x}{1 + \cos x} \, dx.$$

9. Evaluate :

$$(i) \int_1^3 \{|x - 1| + |x - 2| + |x - 3| \, dx\}.$$

$$*(ii) \int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} (\sin|x| - \cos|x|) \, dx.$$

$$(iii) \int_0^{\frac{\pi}{4}} \frac{x}{1 + \sin x} \, dx.$$

$$(iv) \int_0^{\frac{\pi}{4}} \log(1 + \tan x) \, dx.$$

$$(v) \int_0^{\frac{\pi}{2}} \log \sin x \, dx.$$

$$(vi) \int_0^{\frac{\pi}{2}} \frac{x \sin x}{(1 + \cos^2 x)} \, dx.$$

$$(vii) \int_{-2}^2 f(x) \, dx \text{ where } f(x) = \begin{cases} 2x - x^3 & \text{when } -2 \leq x < 1 \\ x^3 - 3x + 2 & \text{when } -1 \leq x < 1 \\ 3x - 2 & \text{when } 1 \leq x < 2. \end{cases}$$

$$(viii) \int_0^{\frac{\pi}{2}} \frac{x \sin x \cos x}{\sin^4 x + \cos^4 x} \, dx.$$

$$(ix) \int_0^{\frac{\pi}{2}} \frac{x}{a^2 \cos^2 x + b^2 \sin^2 x} \, dx.$$

10. Evaluate the following integrals as limit of a sum

$$(i) \int_1^3 x^2 \, dx.$$

$$(ii) \int_{-1}^1 e^x \, dx.$$

$$(iii) \int_0^1 x \, dx.$$

$$(iv) \int_0^2 e^{-x} \, dx.$$

$$(v) \int_0^2 (2x + 3) \, dx.$$

$$(vi) \int_{-1}^2 (7x - 5) \, dx.$$

11. Evaluate the following integrals.

$$(i) \int \frac{\tan x + \tan^3 x}{1 + \tan^3 x} dx.$$

$$(ii) \int \frac{\tan^4 \sqrt{x} \sec^4 \sqrt{x}}{\sqrt{x}} dx.$$

$$(iii) \int_1^3 |x^2 - 2x| dx.$$

$$(iv) \int_0^1 \sin^{-1} \left( \frac{2x}{1+x^2} \right) dx.$$

$$*(v) \int_{-1}^1 \log \left( \frac{1+\sin x}{1-\sin x} \right) dx.$$

$$*(vi) \int_{-1}^1 \log |x + \sqrt{x^2 + 1}| dx.$$

$$(vii) \int_2^8 \frac{\sqrt{10-x}}{\sqrt{x} + \sqrt{10-x}} dx.$$

$$(viii) \int_0^\pi \frac{e^{\cos x}}{e^{\cos x} + e^{-\cos x}} dx.$$

$$*(ix) \int_{-3}^3 \frac{1}{1+a^x} dx.$$

$$(x) \int \frac{1-x^2}{x(1-2x)} dx.$$

### LONG ANSWER TYPE QUESTIONS (6 MARKS EACH)

12. Evaluate the following integrals :

$$(i) \int \frac{x^5 + 4}{x^5 - x} dx.$$

$$(ii) \int \frac{dx}{(x-1)^2(x^2+4)} dx$$

$$(iii) \int \frac{2x^3}{(x+1)(x-3)^2} dx$$

$$(iv) \int \frac{x^4}{x^4 - 16} dx$$

$$(v) \int_0^{\frac{\pi}{2}} (\sqrt{\tan x} + \sqrt{\cot x}) dx.$$

$$(vi) \int \frac{1}{x^4 + 1} dx.$$

$$(vii) \int_0^\infty \frac{x \tan^{-1} x}{(1+x^2)^2} dx.$$

$$(viii) \int_0^1 \cot^{-1} (1-x+x^2) dx.$$

$$*(ix) \int_0^1 \frac{\log(1+x)}{(1+x^2)} dx.$$

$$*(x) \int \frac{\sqrt{1+\cos x}}{(1-\cos x)^{5/2}} dx.$$

$$*(xi) \int \frac{dx}{(\sin x - 2\cos x)(2\sin x + \cos x)}$$

$$(xii) \int \frac{\sin^{-1} \sqrt{x} - \cos^{-1} \sqrt{x}}{\sin^{-1} x + \cos^{-1} \sqrt{x}} dx.$$

$$(xiii) \int \sqrt{\frac{1+\sqrt{x}}{1-\sqrt{x}}} dx.$$

$$(xiv) \int_{-1}^{3/2} |x \sin \pi x| dx.$$

13. Evaluate the following integrals as limit of sums :

$$(i) \int_2^4 (2x + 1) dx.$$

$$(ii) \int_0^2 (x^2 + 3) dx.$$

$$(iii) \int_1^3 (3x^2 - 2x + 4) dx.$$

$$(iv) \int_0^4 (3x^2 + e^{2x}) dx.$$

$$(v) \int_2^5 (x^2 + 3x) dx.$$

$$(vi) \int_0^3 (2x^2 + 3x + 5) dx.$$

## CHAPTER 8

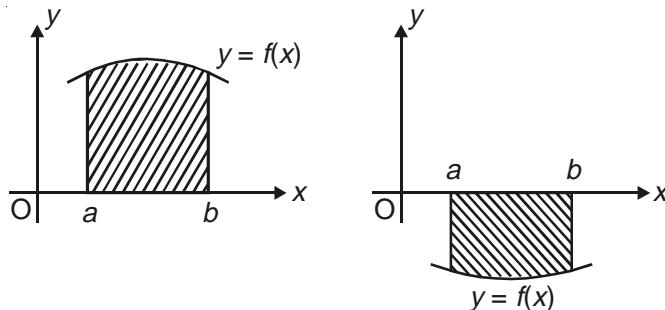
# APPLICATIONS OF THE INTEGRALS

### POINTS TO REMEMBER

#### AREA OF BOUNDED REGION

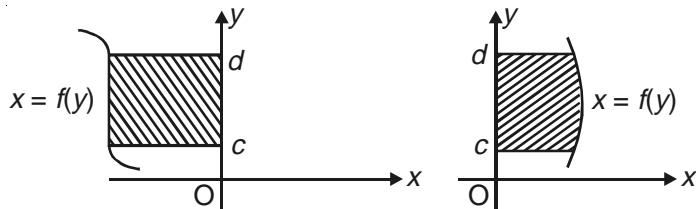
1. Area bounded by the curve  $y = f(x)$ , the  $x$  axis and between the ordinate.  $a^+ x = a$  and  $x = b$  is given by

$$\text{Area} = \left| \int_a^b f(x) dx \right|$$



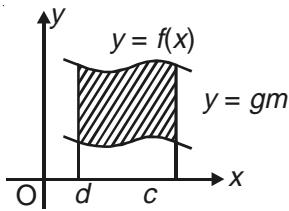
2. Area bounded by the curve  $x = f(y)$  the  $y$ -axis and between abussa  $a^+ y = c$  and  $y = d$  is given by

$$\text{Area} = \left| \int_c^d x dy \right| = \left| \int_c^d f(y) dy \right|$$



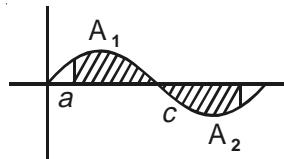
3. Area bounded by two curves  $y = f(x)$  and  $y = g(x)$  such that  $0 \leq g(x) \leq f(x)$  for all  $x \in [ab]$  and between the ordinate at  $x = a$  and  $x = b$  is given by

$$\text{Area} = \int_a^b [f(x) - g(x)] dx$$



4. If the curve  $y = f(x)$  interest the axis ( $x$ -axis) then the area of shaded region is given by

$$\text{Area} = |A_1| + |A_2|.$$



$$\text{Area} = \int_a^c f(x) dx - \int_c^b f(x) dx.$$

### SHORT ANSWER TYPE QUESTIONS (4 Marks Each)

1. Find the area enclosed by circle  $x^2 + y^2 = a^2$ .
2. Find the area of region bounded by  $y^2 = 4x$ ,  $x = 1$ ,  $x = 4$  and  $x$  – axis in first quadrant.
3. Find the area enclosed by the ellipse
$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1 \quad a > b.$$
4. Find the area of region in the first quadrant enclosed by  $x$ –axis the line  $y = x$  and the circle  $x^2 + y^2 = 32$ .
5. Find the area of region  $\{(x, y) : y^2 \leq 4x, 4x^2 + 4y^2 \leq 9\}$
6. Prove that the curve  $y = x^2$  and,  $x = y^2$  divide the square bounded by  $x = 0$ ,  $y = 0$ ,  $x = 1$ ,  $y = 1$  into three equal parts.
7. Find smaller of the two areas enclosed between the ellipse  $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$  and the line  $bx + ay = ab$ .

### LONG ANSWER TYPE QUESTIONS (6 Marks Each)

8. Find the common area bounded by the circles  $x^2 + y^2 = 4$  and  $(x - 2)^2 + y^2 = 4$ .
9. Using integration find area of region bounded by the triangle whose vertices are
  - (a)  $(-1, 0)$ ,  $(1, 3)$  and  $(3, 2)$

(b)  $(-2, 2)$   $(0, 5)$  and  $(3, 2)$

10 Using integration find the area bounded by the lines.

(i)  $x + 2y = 2$ ,  $y - x = 1$  and  $2x + y - 7 = 0$

(ii)  $y = 4x + 5$ ,  $y = 5 - x$  and  $4y - x = 5$ .

11. Find the area of the region  $\{(x, y) : x^2 + y^2 \leq 1 \leq x + y\}$ .

12. Find the area of the region bounded by

$$y = |x - 1| \text{ and } y = 1.$$

\*13. Using integration find the area enclosed by the curve  $y = \cos x$ ,  $y = \sin x$  and  $x$ -axis in the interval  $(0, \pi/2)$ .

\*14. Sketch the graph  $y = |x - 5|$ . Evaluate  $\int_0^6 |x - 5| dx$ .

\*15. Find the area enclosed by the curve

$$y = |x - 1| \quad \text{and} \quad y = 3 - |x|$$

16. Find the area enclosed by the curve  $y = \sin x$  between  $x = 0$  and  $x = \frac{3\pi}{2}$  and  $x$ -axis.

17. Find the area bounded by semi circle  $y = \sqrt{25 - x^2}$  and  $x$ -axis.

18. Find area of region given by  $\{(x, y) : x^2 \leq y \leq |x|\}$ .

19. Find area of smaller region bounded by ellipse  $\frac{x^2}{9} + \frac{y^2}{4} = 1$  and straight line  $2x + 3y = 6$ .

20. Find the area of region bounded by the curve  $x^2 = 4y$  and line  $x = 4y - 2$ .

\*21. Find the area bounded by the ellipse  $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$  and ordinate  $x = ae$  and  $x = 0$ , where  $b^2 = a^2(1 - e^2)$  and  $e < 1$ .

22. Find the area enclosed by parabola  $y^2 = 4ax$  and the line  $y = mx$ .

23. Find the area of region bounded by  $y = x^2$  and the line  $y = x$ .

24. Using integration find the area of region in first quadrant enclosed by  $x$ -axis the line  $x = \sqrt{3}y$  and the circle  $x^2 + y^2 = 4$ .

25. Draw a sketch of the region  $\{(x, y) : x^2 + y^2 \leq 4 \leq x + y\}$  and find its area.

26. Find the area enclosed between the  $y$ -axis the line  $y = 1$  and the curve  $x^2 + y^2 - 2x = 0$ .

27. Find smaller of two areas bounded by the curve  $y = |x|$  and  $x^2 + y^2 = 8$ .

# CHAPTER 9

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## DIFFERENTIAL EQUATION

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### POINTS TO REMEMBER

- **Differential Equation :** Equation containing derivatives of a dependant variable with respect to an independent variable is called differential equation.
- **Order of a Differential Equation :** The order of a differential equation is defined to be the order of the highest order derivative occurring in the differential equation.
- **Degree of a Differential Equation :** The degree of differential equation is defined to be the degree of highest order derivative occurring in it after the equation has been made free from radicals and fractions. Solving a differential equation.

(i) Type  $\frac{dy}{dx} = f(x).g(y)$  : Variable separable method separate the variables and get  $f(x)$

$dx = h(y) dy$ . The  $\int f(x) dx = \int h(y) dy + c$  is the required solution.

(ii) **Homogenous differential equation :** A differential equation of the form  $\frac{dy}{dx} = \frac{f(x, y)}{g(x, y)}$

where  $f(x, y)$  and  $g(x, y)$  are both homogeneous functions of the same degree in  $x$  and

*y* i.e., of the form  $\frac{dy}{dx} = F\left(\frac{y}{x}\right)$  is called a homogeneous differential equation. Substituting

$y = vx$  and then  $\frac{dy}{dx} = v + x \frac{dv}{dx}$ , we get variable separable form.

(iii) **Linear differential equation :** Type I :  $\frac{dy}{dx} + py = q$  where  $p$  and  $q$  are functions of  $x$ . Its solution is  $y . (I. F.) = \int q(I. F.) dx$  where  $I. F. = e^{\int p dx}$ .

### VERY SHORT ANSWER TYPE QUESTIONS

1. Write the order and degree of the following differential equations.

(i)  $\frac{dy}{dx} + \cos y = 0.$

(ii)  $\left(\frac{dy}{dx}\right)^2 + 3 \frac{d^2y}{dx^2} = 4.$

(iii)  $\frac{d^4y}{dx^4} + \sin x = \left(\frac{d^2y}{dx^2}\right)^5.$

(iv)  $\frac{d^5y}{dx^5} + \log\left(\frac{dy}{dx}\right) = 0.$

$$*(v) \quad \sqrt{1 + \frac{dy}{dx}} = \left( \frac{d^2y}{dx^2} \right)^{1/3}.$$

$$(vi) \quad \left[ 1 + \frac{dy}{dx}^2 \right]^{3/2} = K \frac{d^2y}{dx^2}.$$

$$(vii) \quad \left( \frac{d^3y}{dx^3} \right)^2 + \left( \frac{d^2y}{dx^2} \right)^3 = \sin x.$$

2. Write the general solution of following differential equations.

$$(i) \quad \frac{dy}{dx} = x^5 + x^2 - \frac{2}{x}.$$

$$(ii) \quad (e^x + e^{-x}) dy = (e^x - e^{-x}) dx$$

$$(iii) \quad \frac{dy}{dx} = x^3 + e^x + x^e.$$

$$(iv) \quad \frac{dy}{dx} = 5^{x+y}.$$

$$(v) \quad \frac{dy}{dx} = \frac{1 - \cos 2x}{1 + \cos 2y}.$$

$$(vi) \quad \frac{dy}{dx} = \frac{1 - 2y}{3x + 1}.$$

$$(vii) \quad \frac{dy}{dx} = x \sec^2 x.$$

$$(viii) \quad \frac{dy}{dx} = \frac{y}{x \log x}.$$

3. What is the integrating factor in each of the following linear differential equations.

$$(i) \quad \frac{dy}{dx} + y \cos x = \sin x.$$

$$(ii) \quad \frac{dy}{dx} + \frac{y}{\cos^2 x} = \sin x \cos x.$$

$$(iii) \quad x^2 \frac{dy}{dx} + y = x^2 \cos x.$$

$$(iv) \quad x \frac{dy}{dx} + \log x \cdot y = \tan x \cdot e^x.$$

$$(v) \quad \frac{dy}{dx} - \frac{3}{x} \cdot y = \log x.$$

$$(vi) \quad \frac{dx}{dy} + (\tan y) x = \sec^2 y.$$

$$(vii) \quad \frac{dx}{dy} + \frac{1}{1 + y^2} \cdot x = \sin y.$$

$$(viii) \quad \frac{dx}{dy} - x = 3y + 2.$$

### SHORT ANSWER TYPE QUESTIONS (4 Marks Each)

4. (i) Verify that  $y = e^{m \sin^{-1} x}$  is a solution of  $(1 - x^2) \frac{d^2y}{dx^2} - x \frac{dy}{dx} - m^2 y = 0$ .

(ii) Show that  $y = \sin(\sin x)$  is a solution of diff. equation

$$\frac{d^2y}{dx^2} + \tan x \frac{dy}{dx} = -y \cos^2 x.$$

(iii) Show that  $y = Ax + \frac{B}{x}$  is a solution of

$$x^2 \cdot \frac{d^2y}{dx^2} + x \frac{dy}{dx} - y = 0.$$

(iv) Show that function  $y = a \cos(\log x) + b \sin(\log x)$  is the solution of

$$x^2 \cdot \frac{d^2y}{dx^2} + x \frac{dy}{dx} + y = 0.$$

(v) Verify that  $y^2 = 4a(x + a)$  is a solution of  $y = \left[1 - \frac{dy}{dx}\right]^2 = 2x \frac{dy}{dx}$ .

(vi) Show that  $y = ae^{2x} + be^{-x} + ae^{-x} + be^{2x}$  is a solution of  $\frac{d^2y}{dx^2} - \frac{dy}{dx} - 2y = 0$ .

\*(vii) Verify that  $y = \log\left(x + \sqrt{x^2 + a^2}\right)$  satisfies the diff. equation.

$$(a^2 + x^2) \frac{d^2y}{dx^2} + x \frac{dy}{dx} = 0.$$

\*(viii) Find the differential equation of family of all circles having centres on  $x$ -axis and radius 2 units.

(ix) Find the differential equation of the family of curves  $y = e^x(A \cos x + B \sin x)$ , where  $A$  and  $B$  are arbitrary constants.

(x) Find the differential equation of an ellipse with major and minor axes  $2a$  and  $2b$  respectively.

(xi) Find the differential equation corresponding to the family of curve  $ay^2 = (x - c)^3$ , where  $c$  is an arbitrary constant.

(xii) By eliminating the constants 'a' and 'b' obtain the differential equation for which  $xy = ae^x + be^{-x} + x^2$  is a solution.

\*(xiii) Form the differential equation corresponding to the family of curves  $y = c(x - c)^2$ .

(xiv) Form the differential equation representing the family of curves  $(y - b)^2 = 4(x - a)$ .

5. Solve the following diff. equations.

\*(i)  $(x - y + 2) \frac{dy}{dx} = 1.$

(ii)  $\frac{dy}{dx} + y \cot x = \sin 2x.$

(iii)  $x \frac{dy}{dx} + 2y = x^2 \log x.$

\*(iv)  $(\tan^{-1} y - x) dy = (1 + y^2) dx$

(v)  $(1 + y^2) + \left(x - e^{\tan^{-1} y}\right) \frac{dy}{dx} = 0.$

(vi)  $\frac{dx}{dy} + \frac{1}{x} \cdot y = \cos x + \frac{\sin x}{x}, \quad x > 0.$

$$(vii) \frac{dx}{dy} + x = 1 + e^{-y}.$$

$$(viii) \cos^3 x \frac{dy}{dx} + \cos x = \sin x.$$

$$(ix) y e^y dx = (x^3 + 2xe^y) dy.$$

6. Solve each of the following differential equations :

$$(i) y - x \frac{dy}{dx} = 2 \left( y^2 + \frac{dy}{dx} \right).$$

$$(ii) \cos y dx + (1 + 2e^{-x}) \sin y dy = 0.$$

$$(iii) x\sqrt{1-y^2}dy + y\sqrt{1-x^2}dx = 0.$$

$$(iv) \sqrt{(1-x^2)(1-y^2)} dy + xy dx = 0.$$

$$(v) (xy^2 + x) dx + (yx^2 + y) dy = 0; y(0) = 1.$$

$$(vi) \frac{dy}{dx} = y \sin^3 x \cos^3 x + xy e^x.$$

$$(vii) \tan x \tan y dx + \sec^2 x \sec^2 y dy = 0$$

$$(viii) \tan 2y \frac{dy}{dx} = \sin(3x + 2y) + \sin(3x - 2y).$$

$$(ix) \frac{dy}{dx} = e^{2+x-2y} + x^2 e^{2-2y}.$$

$$(x) (1 + e^{2x}) dy + (1 + y^2) e^x dx = 0, \quad y(0) = 1.$$

7. Solve the following differential equations :

$$(i) x^2 y dx - (x^3 + y^3) dy = 0.$$

$$(ii) x^2 \frac{dy}{dx} = x^2 + xy + y^2.$$

$$(iii) (x^2 - y^2) dx + 2xy dy = 0, \quad y(1) = 1.$$

$$*(iv) \frac{x}{1 + e^y} dx = e^y \left( 1 - \frac{x}{y} \right) dy = 0.$$

$$(v) \left( y \sin \frac{x}{y} \right) dx = \left( x \sin \frac{x}{y} - y \right) dy.$$

$$(vi) \frac{dy}{dx} = \frac{y}{x} + \tan \left( \frac{y}{x} \right).$$

$$(vii) \frac{dy}{dx} = \frac{2xy}{x^2 + y^2}$$

$$(viii) \frac{dy}{dx} = e^{x+y} + x^2 e^y.$$

$$*(ix) x \frac{dy}{dx} = -y (\log x - \log y - 1).$$

$$(x) x \frac{dy}{dx} = 1 - x + y - xy.$$

$$(xi) \frac{d^2y}{dx^2} = xe^x + x \sin x.$$

$$(xii) \frac{dy}{dx} = \sqrt{\frac{1-y^2}{1-x^2}}.$$

8. (i) Form the differential equation of the family of circles touching  $y$ -axis at  $(0, 0)$ .
- \*(ii) Form the differential equation of family of parabolas having vertex at  $(0, 0)$  and axis along the (i) positive  $y$ -axis (ii) +ve  $x$ -axis.
- (iii) Form the differential equation of the family of hyperbols centred at  $(0, 0)$  and axes along the coordinate axis.
- \*(iv) Form differential equation of all circles passing through origin and whose centre lie on  $x$ -axis.
- (v) Form the differential equation of family of curves,  $y = a \sin(bx + c)$ ,  $a, b, c$  are arbitrary constants.

9. Show that the differential equation :  $y(x dy + y dx) \cos \frac{x}{y} = x(y dx - x dy) \sin \frac{x}{y}$ .

is homogeneous and solve it.

10. Show that the differential equation  $\frac{dy}{dx} = \frac{x+2y}{x-2y}$  is homogeneous and solve it.

11. Show that the differential equation :

$(x^2 + 2xy - y^2) dx + (y^2 + 2xy - x^2) dy = 0$  is homogeneous and solve it.

12. Solve the following differential equations :

$$(i) \quad \frac{dy}{dx} - 2y = \cos 3x.$$

$$(ii) \quad \sin x \frac{dy}{dx} + y \cos x = 2 \sin^2 x \cos x \text{ given that } y = 1 \text{ when } x = \frac{\pi}{2}.$$

### LONG ANSWER TYPE QUESTIONS (6 Marks Each)

13. Solve the following differential equations :

$$(i) \quad (x^3 + y^3) dx = (x^2y + xy^2) dy. \quad (ii) \quad x dy - y dx = \sqrt{x^2 + y^2} dx.$$

$$(iii) \quad y \left[ x \cos \frac{y}{x} + y \sin \frac{y}{x} \right] dx - x \left[ y \sin \frac{y}{x} - x \cos \frac{y}{x} \right] dy = 0.$$

$$(iv) \quad x^2 dy + y(x+y) dx = 0 \text{ given that } y = 1 \text{ when } x = 1.$$

$$(v) \quad x e^{\frac{y}{x}} - y + x \frac{dy}{dx} = 0 \text{ given that } y = 0 \text{ when } x = e.$$

$$(vi) \quad (x^3 - 3xy^2) dx = (y^3 - 3x^2y) dy.$$

## CHAPTER 10-11

# VECTORS AND THREE DIMENSIONAL GEOMETRY

### POINTS TO REMEMBER

- **Vector :** A directed line segment represents a vector.
- **Addition of vectors :** If two vectors are taken as two sides of a triangle taken in order then their sum is the vector represented by the third side of triangle taken in opposite order (triangle law).
- **Multiple of a vector by a scalar :**  $\overrightarrow{a}$  is any vector and  $\lambda \in R$  then  $\lambda \overrightarrow{a}$  is vector of magnitude  $|\lambda| |\overrightarrow{a}|$  in a direction parallel to  $\overrightarrow{a}$ .
- If  $|\overrightarrow{a}| \neq 0$  then  $\frac{\overrightarrow{a}}{|\overrightarrow{a}|}$  is unit vector in direction  $\overrightarrow{a}$ .
- **Scalar Product :**  $\overrightarrow{a} \cdot \overrightarrow{b} = |\overrightarrow{a}| |\overrightarrow{b}| \cos \theta$  where  $\theta$  is the angle between  $\overrightarrow{a}$  and  $\overrightarrow{b}$ .
- Projection of  $\overrightarrow{a}$  along  $\overrightarrow{b}$  is  $\frac{\overrightarrow{a} \cdot \overrightarrow{b}}{|\overrightarrow{b}|}$ .
- $\overrightarrow{a} \cdot \overrightarrow{a} = |\overrightarrow{a}|^2$
- Vectors  $\overrightarrow{a}$  and  $\overrightarrow{b}$  are perpendicular iff  $\overrightarrow{a} \cdot \overrightarrow{b} = 0$ .
- **Cross Product :**  $\overrightarrow{a} \times \overrightarrow{b} = |\overrightarrow{a}| |\overrightarrow{b}| \sin \theta \hat{n}$  where  $\hat{n}$  is a unit vector perpendicular to  $\overrightarrow{a}$  and  $\overrightarrow{b}$ , and  $\theta$  is the angle between  $\overrightarrow{a}$  and  $\overrightarrow{b}$ .
- Unit vector perpendicular to plane of  $\overrightarrow{a}$  and  $\overrightarrow{b}$  is  $\pm \frac{\overrightarrow{a} \times \overrightarrow{b}}{|\overrightarrow{a} \times \overrightarrow{b}|}$ .
- Vector  $\overrightarrow{a}$  and  $\overrightarrow{b}$  are collinear if  $\overrightarrow{a} \times \overrightarrow{b} = \overrightarrow{0}$ .

$$\overrightarrow{a} \times \overrightarrow{b} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \end{vmatrix}$$

where  $\overrightarrow{a} = a_1 \hat{i} + a_2 \hat{j} + a_3 \hat{k}$  and

$$\overrightarrow{b} = b_1 \hat{i} + b_2 \hat{j} + b_3 \hat{k}$$

- Area of a triangle whose two sides are  $\overrightarrow{a}$  and  $\overrightarrow{b} = \frac{1}{2} |\overrightarrow{a} \times \overrightarrow{b}|$ .
- Area of a parallelogram whose adjacent sides are  $\overrightarrow{a}$  and  $\overrightarrow{b} = |\overrightarrow{a} \times \overrightarrow{b}|$ .
- If  $\overrightarrow{a}, \overrightarrow{b}$  represents the two diagonals of a parallelogram, then area of parallelogram  $= \frac{1}{2} |\overrightarrow{a} \times \overrightarrow{b}|$ .

### THREE DIMENSIONAL GEOMETRY

- Distance between  $P(x_1, y_1, z_1)$  and  $Q(x_2, y_2, z_2)$  is

$$|PQ| = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2}.$$

- The coordinates of point  $R$  which divides line segment  $PQ$  where  $P(x_1, y_1, z_1)$  and  $Q(x_2, y_2, z_2)$  in ratio  $m : n$  are  $\left( \frac{mx_2 + nx_1}{m+n}, \frac{my_2 + ny_1}{m+n}, \frac{mz_2 + nz_1}{m+n} \right)$ .
- If  $\alpha, \beta, \gamma$  are the angles made by any line with coordinate axes respectively then  $l, m, n$ . Where  $l = \cos \alpha, m = \cos \beta, n = \cos \gamma$  are called the, direction cosines of the line and  $l^2 + m^2 + n^2 = 1$ . If  $a, b, c$  are the direction ratios then direction cosines are

$$l = \pm \frac{a}{\sqrt{a^2 + b^2 + c^2}}, m = \pm \frac{b}{\sqrt{a^2 + b^2 + c^2}}, n = \pm \frac{c}{\sqrt{a^2 + b^2 + c^2}}.$$

- Direction ratios of a line joining  $(x_1, y_1, z_1)$  and  $(x_2, y_2, z_2)$  are  $x_2 - x_1 : y_2 - y_1 : z_2 - z_1$ .
- Vector equation of straight line :

(i) Through a point  $A(\overrightarrow{a})$  and parallel to vector  $\overrightarrow{b}$  is  $\overrightarrow{r} = \hat{a} + \lambda \overrightarrow{b}$ .

(ii) Passing through two points  $A(\overrightarrow{a})$  and  $B(\overrightarrow{b})$  is  $\overrightarrow{r} = \overrightarrow{a} + \lambda(\overrightarrow{b} - \overrightarrow{a})$ .

(iii) Line passing through two given points  $(x_1, y_1, z_1)$  and  $(x_2, y_2, z_2)$  is

$$\frac{x - x_1}{x_2 - x_1} = \frac{y - y_1}{y_2 - y_1} = \frac{z - z_1}{z_2 - z_1}, \text{ in cartesian form.}$$

- Angle  $\theta$  between two lines with DC's  $l_1, m_1, n_1$  and  $l_2, m_2, n_2$  is given by

$$\cos \theta = l_1 l_2 + m_1 m_2 + n_1 n_2$$

**OR**

with D.R's  $a_1 b_1 c_1$  or  $a_2, b_2, c_2$

$$\cos \theta = \frac{a_1 a_2 + b_1 b_2 + c_1 c_2}{\sqrt{a_1^2 + b_1^2 + c_1^2} \sqrt{a_2^2 + b_2^2 + c_2^2}}.$$

If lines are  $\vec{r} = \vec{a}_1 + \lambda \vec{b}_1$  and  $\vec{r} = \vec{a}_2 + \mu \vec{b}_2$ .

then,  $\cos \theta = \frac{\vec{b}_1 \cdot \vec{b}_2}{|\vec{b}_1| |\vec{b}_2|}$ .

□ Equation of plane :

(i) Passing through  $A(\vec{a})$  and perpendicular to  $(\vec{n})$  is  $(\vec{r} - \vec{a}) \cdot \vec{n} = 0$  Or

$$\vec{r} \cdot \vec{n} = d \text{ where } \vec{a} \cdot \vec{n} = d.$$

(ii) Passing through three given points is  $\begin{vmatrix} x - x_1 & y - y_1 & z - z_1 \\ x_2 - x_1 & y_2 - y_1 & z_2 - z_1 \\ x_3 - x_1 & y_3 - y_1 & z_3 - z_1 \end{vmatrix} = 0$ .

(iii) Having intercepts  $a, b, c$  on coordinate axes is  $\frac{x}{a} + \frac{y}{b} + \frac{z}{c} = 1$ .

□ Angle between two planes  $\vec{r} \cdot \vec{n}_1 = d_1$  and  $\vec{r} \cdot \vec{n}_2 = d_2$  is  $\cos \theta = \frac{\vec{n}_1 \cdot \vec{n}_2}{|\vec{n}_1| |\vec{n}_2|}$ .

□ Distance of a point  $(x_1, y_1, z_1)$  from a plane  $ax + by + cz + d = 0$  is  $\frac{|ax_1 + by_1 + cz_1 + d|}{\sqrt{a^2 + b^2 + c^2}}$ .

□ Equation of plane passing through intersection of two planes  $a_1x + b_1y + c_1z + d_1 = 0$  and  $a_2x + b_2y + c_2z + d_2 = 0$  is  $(a_1x + b_1y + c_1z + d_1) + \lambda(a_2x + b_2y + c_2z + d_2) = 0$ .

□ Equation of plane passing through intersection of two planes  $\vec{r} \cdot \vec{n}_1 = d_1$  and  $\vec{r} \cdot \vec{n}_2 = d_2$  is  $\vec{r} \cdot (\vec{n}_1 + \lambda \vec{n}_2) = d_1 + \lambda d_2$ .

□ Angle between a plane  $\vec{r} \cdot \vec{n} = d$  and a line  $\vec{r} = \vec{a} + \lambda \vec{m}$  is  $\sin \theta = \frac{|\vec{m} \cdot \vec{n}|}{|\vec{m}| |\vec{n}|}$ .

### VERY SHORT ANSWER TYPE QUESTIONS (1 Mark Each)

- \*1. What is the horizontal and vertical components of a vector  $\vec{a}$  of magnitude 5 making an angle of  $150^\circ$  with the direction of  $x$ -axis.
- 2. What is  $a \in R$  such that  $|a \vec{x}| = 1$ , where  $\vec{x} = \hat{i} - 2\hat{j} + 2\hat{k}$ ?
- 3. Write when  $|\vec{x} + \vec{y}| = |\vec{x}| + |\vec{y}|$ .
- 4. What is the area of a parallelogram whose sides are given by  $2\hat{i} - \hat{j}$  and  $\hat{i} + 5\hat{k}$ ?
- \*5. What is the angle between  $\vec{a}$  and  $\vec{b}$ , If  $\vec{a} \cdot \vec{b} = 3$  and  $|\vec{a} \times \vec{b}| = 3\sqrt{3}$ .

6. If  $A$  is the point  $(4, 5)$  and vector  $\overrightarrow{AB}$  has components 2 and 6 along  $x$ -axis and  $y$ -axis respectively then write point  $B$ .
7. What is the point of trisection of  $PQ$  nearer to  $P$  if position of  $P$  and  $Q$  are  $3\hat{i} + 3\hat{j} - 4\hat{k}$  and  $9\hat{i} + 8\hat{j} - 10\hat{k}$ .
8. What is the vector in the direction of  $2\hat{i} + 3\hat{j} + 2\sqrt{3}\hat{k}$ , whose magnitude is 10 units?
- \*9. What are the direction cosines of a vector equiangular with co-ordinate axes?
10. What are the angles which  $3\hat{i} - 6\hat{j} + 2\hat{k}$  makes with coordinate axes.
11. Write a unit vector perpendicular to both the vectors  $3\hat{i} - 2\hat{j} + \hat{k}$  and  $-2\hat{i} + \hat{j} - 2\hat{k}$ .
12. What is the projection of the vector  $\hat{i} - \hat{j}$  on the vector  $\hat{i} + \hat{j}$ ?
13. If  $|\overrightarrow{a}| = 2$ ,  $|\overrightarrow{b}| = 2\sqrt{3}$  and  $\overrightarrow{a} \perp \overrightarrow{b}$ , what is the value of  $|\overrightarrow{a} + \overrightarrow{b}|$ ?
14. For what value of  $\lambda$ ,  $\overrightarrow{a} = \lambda\hat{i} + \hat{j} + 4\hat{k}$  is perpendicular to  $\overrightarrow{b} = 2\hat{i} + 6\hat{j} + 3\hat{k}$ ?
15. What is  $|\overrightarrow{a}|$ , if  $(\overrightarrow{a} + \overrightarrow{b}) \cdot (\overrightarrow{a} - \overrightarrow{b}) = 3$  and  $2|\overrightarrow{b}| = |\overrightarrow{a}|$ ?
16. What is the angle between  $\overrightarrow{a}$  and  $\overrightarrow{b}$ , if  $|\overrightarrow{a} - \overrightarrow{b}| = |\overrightarrow{a} + \overrightarrow{b}|$ ?
- \*17. In a parallelogram  $ABCD$ ,  $\overrightarrow{AB} = 2\hat{i} - \hat{j} + 4\hat{k}$  and  $\overrightarrow{AC} = \hat{i} + \hat{j} + 4\hat{k}$ . What is the length of side  $BC$ ?
18. What is the area of a parallelogram whose diagonals are given by vectors  $2\hat{i} + \hat{j} - 2\hat{k}$  and  $-\hat{i} + 2\hat{k}$ ?
19. Find  $|\overrightarrow{x}|$  if for a unit vector  $\hat{a}$ ,  $(\overrightarrow{x} - \hat{a}) \cdot (\overrightarrow{x} + \hat{a}) = 12$ .
20. If  $|\overrightarrow{a} + \overrightarrow{b}|^2 = |\overrightarrow{a}|^2 + |\overrightarrow{b}|^2$ , then what is the angle between  $\overrightarrow{a}$  and  $\overrightarrow{b}$ .
21. If  $\overrightarrow{a}$  and  $\overrightarrow{b}$  are two unit vectors and  $\overrightarrow{a} + \overrightarrow{b}$  is also a unit vector then what is the angle between  $\overrightarrow{a}$  and  $\overrightarrow{b}$ ?
22. If  $\hat{i}, \hat{j}, \hat{k}$  are the usual three mutually perpendicular unit vectors then what is the value of  $i \cdot (j \times \hat{k}) + j \cdot (i \times \hat{k}) + \bar{k} \cdot (j \times i)$ ?
23. What is the angle between  $\overrightarrow{x}$  and  $\overrightarrow{y}$  if  $\overrightarrow{x} \cdot \overrightarrow{y} = |\overrightarrow{x} \times \overrightarrow{y}|$ ?
24. Write a unit vector in  $xy$ -plane, making an angle of  $30^\circ$  with the +ve direction of  $x$ -axis.
- \*25. Two adjacent sides of a parallelogram are  $2\hat{i} - 4\hat{j} + 5\hat{k}$  and  $\hat{i} - 2\hat{j} - 3\hat{k}$ . Find a unit vector parallel to the diagonal, which is coinitial with  $\overrightarrow{a}$  and  $\overrightarrow{b}$ .

26. If  $\vec{a}$ ,  $\vec{b}$  and  $\vec{c}$  are unit vectors with  $\vec{a} + \vec{b} + \vec{c} = \vec{0}$ , then what is the value of  $\vec{a} \cdot \vec{b} + \vec{b} \cdot \vec{c} + \vec{c} \cdot \vec{a}$ ?
- \*27. If  $|\vec{a}| = |\vec{b}| = |\vec{a} - \vec{b}| = 1$ , then what is the value of  $|\vec{a} + \vec{b}|$ ?
- \*28. For any vector  $\vec{a}$ , what is the value of  $i \cdot (\vec{a} \times j) + j \cdot (\vec{a} \times i) + \hat{k} \cdot (\vec{a} \times \hat{k})$ .
29. If  $\vec{a}$  and  $\vec{b}$  are unit vectors such that  $(\vec{a} + 2\vec{b})$  is perpendicular to  $(5\vec{a} - 4\vec{b})$ , then what is the angle between  $\vec{a}$  and  $\vec{b}$ ?
30. Write a unit vector which makes an angle of  $\frac{\pi}{4}$  with  $x$ -axis and  $\frac{\pi}{3}$  with  $z$ -axis and an acute angle with  $y$ -axis.
31. What is the ratio in which  $xy$  plane divides the line segment joining the points  $(-1, 3, 4)$  and  $(2, -5, 6)$ ?
32. If  $x$  coordinate of the point  $P$  on the join of  $Q(2, 2, 1)$  and  $R(-5, 1, -2)$  is 4, then in what ratio  $P$  divides  $QR$ .
33. What is the distance of a point  $P(a, b, c)$  from  $x$ -axis?
34. Write the equation of a line passing through  $(1, -1, 2)$  and perpendicular to plane  $2x - 3y + 4z = 7$ .
35. What is the angle between the lines  $2x = 3y = -z$  and  $6x = -y = -4z$ ?
- \*36. If a line makes angle  $\alpha$ ,  $\beta$ , and  $\gamma$  with co-ordinate axes, then what is the value of  $\sin^2 \alpha + \sin^2 \beta + \sin^2 \gamma$ ?
37. What is the perpendicular distance of plane  $2x - y + 3z = 10$  from origin?
38. What is the  $y$ -intercept of the plane  $x - 5y + 7z = 10$ ?
39. Write the value of  $\lambda$ , so that the lines given below are perpendicular to each other
- $$\frac{1-x}{3} = \frac{2y-1}{4} = \frac{z-1}{\lambda} \text{ and } \frac{x-2}{4} = \frac{y-5}{2} = \frac{3-z}{5}.$$
40. A  $(3, 2, 0)$ ,  $B(5, 3, 2)$  and  $C(5, 8, -10)$  are the vertices of  $\Delta ABC$ .  $D$  and  $E$  are mid points of  $AB$  and  $AC$  respectively. What are the direction cosines of  $DE$ ?
41. What is the equation of the line, which passes through the point  $(-2, 4, -5)$  and parallel to  $\frac{x+3}{5} = \frac{y-4}{5} = \frac{z+8}{-6}$ ?
- \*42. What is the equation of a line passing through point  $(-1, 2, 3)$  and equally inclined to the axes?
- \*43. The foot of perpendicular from point  $(1, 6, 3)$  on line  $\frac{x}{1} = \frac{y-1}{2} = \frac{z-2}{3}$  is  $(1, 3, q)$ ; what is the value of  $q$ ?

44. What is the angle between the straight lines :

$$\frac{x+1}{2} = \frac{y-2}{2} = \frac{z+3}{4}, \quad \frac{x-1}{1} = \frac{y+2}{2} = \frac{z-3}{-3}?$$

45. If the direction ratios of a line are proportional to 1, -3, 2 then what are the direction cosines of the line?
46. If a line makes angles  $\frac{\pi}{2}$  and  $\frac{\pi}{4}$  with x-axis and y-axis respectively then what is the acute angle made by the line with z axis?
47. What is the acute angle between the planes  $2x + 2y - z + 2 = 0$  and  $4x + 4y - 2z + 5 = 0$ ?
48. What is the distance between the planes  $2x + 2y - z + 2 = 0$  and  $4x + 4y - 2z + 5 = 0$ .
49. What is the equation of the plane which cuts off equal intercepts of unit length on the coordinate axes.
50. Are the planes  $x + y - 2z + 4 = 0$  and  $3x + 3y - 6z + 5 = 0$  intersecting?
51. What is the equation of the plane through the point (1, 4, -2) and parallel to the plane  $-2x + y - 3z = 7$ ?
52. Write the vector equation of the plane which is at a distance of 8 units from the origin and is normal to the vector  $(2\hat{i} + \hat{j} + 2\hat{k})$ .
53. What is equation of the plane if the foot of perpendicular from origin to this plane is (2, 3, 4)?
54. What is the angle between the line  $\frac{x+1}{3} = \frac{2y-1}{4} = \frac{2-z}{-4}$  and the plane  $2x + y - 2z + 4 = 0$ ?
55. If O is origin  $OP = 3$  with direction ratios proportional to -1, 2, -2 then what are the coordinates of P?
56. What is the distance between the line  $\vec{r} = 2\hat{i} - 2\hat{j} + 3\hat{k} + \lambda(\hat{i} + \hat{j} + 4\hat{k})$  from the plane  $\vec{r} \cdot (-\hat{i} + 5\hat{j} - \hat{k}) + 5 = 0$ .
- \*57. What is the distance between the line  $\vec{r} = \hat{i} - \hat{j} + \lambda(2\hat{i} - \hat{j} + \hat{k})$  from the plane  $\vec{r} \cdot (\hat{i} + \hat{j} + \hat{k}) = 3$ .

### SHORT ANSWER TYPE QUESTIONS (4 Marks Each)

58. If ABCDEF is a regular hexagon then using triangle law of addition prove that :

$$\overrightarrow{AB} + \overrightarrow{AC} + \overrightarrow{AD} + \overrightarrow{AE} + \overrightarrow{AF} = 3\overrightarrow{AD} = 6\overrightarrow{AO}$$

O being the centre of hexagon.



73. Prove that the normal vector to the plane containing three points with position vectors  $\vec{a}$ ,  $\vec{b}$  and  $\vec{c}$  lies in the direction of vector  $\vec{b} \times \vec{c} + \vec{c} \times \vec{a} + \vec{a} \times \vec{b}$ .
74. If  $\vec{a}$ ,  $\vec{b}$ ,  $\vec{c}$  are position vectors of the vertices  $A$ ,  $B$ ,  $C$  of a triangle  $ABC$  then show that the area of  $\triangle ABC$  is  $\frac{1}{2} |\vec{a} \times \vec{b} + \vec{b} \times \vec{c} + \vec{c} \times \vec{a}|$ .
75. If  $\vec{a}$ ,  $\vec{b}$ ,  $\vec{c}$  are three vectors forming a  $DABC$  then prove that area of  $\triangle ABC = \frac{1}{2} |\vec{a} \times \vec{b}|$   
 $= \frac{1}{2} |\vec{b} \times \vec{c}| = \frac{1}{2} |\vec{c} \times \vec{a}|$ .
76. If  $\vec{a} = i + j + \hat{k}$ ,  $\vec{c} = j - \hat{k}$  are the given vectors then find a vector  $\vec{b}$  satisfying the equation.
- $$\vec{a} \times \vec{b} = \vec{c}, \quad \vec{a} \cdot \vec{b} = 3.$$
77. Let  $\overline{OA} = \vec{a}$ ,  $\overline{OB} = 10\vec{a} + 2\vec{b}$  and  $\overline{OC} = \vec{b}$  and  $O$  is the origin. Let  $S$  denotes the area of the quadrilateral  $OABC$  and  $T$  denotes the area of parallelogram with  $OA$  and  $OC$  as adjacent sides. Prove that  $S = 6T$ .
78. Find a unit vector perpendicular to plane  $ABC$  where. Position vector  $A$ ,  $B$ ,  $C$  are  $3\hat{i} - \hat{j} + 2\hat{k}$ ,  $\hat{i} - \hat{j} - 3\hat{k}$  and  $4\hat{i} - 3\hat{j} + \hat{k}$  respectively.
- \*79. Find the values of  $a$  for which the vector  $\vec{r} = (a^2 - 4)\hat{i} + 2j + (a^2 - 9)\hat{k}$  makes acute angle with coordinate axes.
- \*80. Let  $\hat{a}$ ,  $\hat{b}$ ,  $\hat{c}$  be unit vectors such that  $\hat{a} \cdot \hat{b} = \hat{a} \cdot \hat{c} = 0$  and the angle between  $\hat{b}$  and  $\hat{c}$  is  $\frac{\pi}{6}$ , then prove that  $\hat{a} = \pm 2(\hat{b} \times \hat{c})$ .
81. Prove that angle between any two diagonals of cube is  $\cos^{-1}(1/3)$ .
82. Find the image of the point  $(3, -2, 1)$  in the plane  $3x - y + 4z = 2$ .
83. The line  $\frac{x-4}{1} = \frac{2y-4}{2} = \frac{k-z}{-2}$  lies exactly in the plane  $2x - 4y + z = 7$ . Find the value of  $K$ .
84. A  $l_1$ ,  $m_1$ ,  $n_1$ , and  $l_2$ ,  $m_2$ ,  $n_2$  are direction cosines of two mutually perpendicular lines, show that the direction cosines of line perpendicular to both of them are
- $$m_1 n_2 - n_1 m_2, \quad n_1 l_2 - l_1 n_2, \quad l_1 m_2 - m_1 l_2$$
85. Find vector and cartesian equation of a line passing through a point with position vectors  $2\hat{i} - \hat{j} + \hat{k}$  and which is parallel to the line joining the points with position vectors  $-\hat{i} + 4\hat{j} + \hat{k}$  and  $\hat{i} + 2\hat{j} + 2\hat{k}$ .

- \*86. The cartesian equations of a line is  $6x - 2 = 3y + 1 = 2z - 2$ , find direction ratios of the line. Also find cartesian and vector equations of a line parallel to this line and passing through  $(2, -1, -1)$ .
87. Find image (Reflection) of the point  $(7, 4, -3)$  in the line  $\frac{x}{1} = \frac{y-1}{2} = \frac{z-2}{3}$ .
88. Find equations of a plane passing through the points  $(2, -1, 0)$  and  $(3, -4, 5)$  and parallel to the line  $2x = 3y = 4z$ .
89. Find distance of the point  $(-1, -5, -10)$  from the point of intersection of line  $\frac{x-2}{3} = \frac{y+1}{4} = \frac{z-2}{12}$  and the plane  $x - y + z = 5$ .
90. Find equation of the plane passing through the point  $(2, 3, -4)$  and  $(1, -1, 3)$  and parallel to the  $x$ -axis.
91. Find equation of the plane which bisects the line joining the points  $(-1, 2, 3)$  and  $(3, -5, 6)$  at right angle.
92. What is the equations of plane :  $\vec{r} = (i - j) + \lambda(i + j + \hat{k}) + u(i - 2j + 3\hat{k})$  in scalar product.
93. Find the distance of the point  $(1, -2, 3)$  from the plane  $x - y + z = 5$ , measured parallel to the line  $\frac{x}{2} = \frac{y}{3} = \frac{z}{-6}$ .
94. Find the equation of the plane passing through the intersection of two plane  $3x - 4y + 5z = 10$ ,  $2x + 2y - 3z = 4$  and parallel to the line  $x = 2y = 3z$ .
95. Show that the lines  $x = ay + b$ ,  $z = cy + d$  and  $x = a'y + b'$ ,  $z = c'y + d'$  are perpendicular if  $aa' + cc' + 1 = 0$ .
96. Find the equations of the planes parallel to the  $x - 2y + 2z - 3 = 0$  whose perpendicular distance from the point  $(1, 2, 3)$  is 1 unit.
97. A variable plane moves in such a way that the sum of the reciprocals of its intercepts on the three coordinate axis is constant. Show that the plane passes through a fixed point.
98. Find equation of the plane passing through the point  $(3, 4, 2)$  and  $(7, 0, 6)$  and is perpendicular to the plans  $2x - 5y = 15$ .
99. Find cartesian as well as vector equation of the plane through the intersection of the plane  $\vec{r} = (2i + 6j) + 12 = 0$  and  $\vec{r} \cdot (3i - j + 4\hat{k}) = 0$  which is at a unit distance from origin.
100. Find equation of the plane which is perpendicular to the plane  $5x + 3y + 6z + 8 = 0$  and which contain the line of intersection of the plane  $x + 2y + 3z - 4 = 0$  and  $2x + y - z + 5 = 0$ .
101. Find equation of the plane containing the points  $(0, -1, -1)$   $(-4, 4, 4)$ ,  $(4, 5, 1)$ . Also show that  $(3, 9, 4)$  lies on the required plane.

### LONG ANSWER TYPE QUESTIONS (6 Marks Each)

102. The vector equations of two lines are :

$\vec{r} = \vec{i} + 2\vec{j} + \hat{k} + \lambda(\vec{i} - \vec{j} + 2\hat{k})$  and  $\vec{r} = 2\vec{i} - \vec{j} - \hat{k}(2\vec{i} + \vec{j} + 2\hat{k})$ . Find the shortest distance between them.

103. Check the coplanarity of lines

$$\vec{r} = (-3\vec{i} + \vec{j} + 5\hat{k}) + \lambda(-3\vec{i} + \vec{j} + 5\hat{k})$$

$$\vec{r} = (-\vec{i} + 2\vec{j} + 5\hat{k}) + \mu(-\vec{i} + 2\vec{j} + 5\hat{k})$$

If they are coplanar, find equation of the plane containing the lines.

104. Find shortest distance between the lines :

$$\frac{x-8}{3} = \frac{y+19}{-16} = \frac{z-10}{7} \quad \text{and} \quad \frac{x-15}{3} = \frac{y-29}{8} = \frac{z-5}{-5}$$

105. Show that the lines  $\frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{4}$  and  $\frac{x-4}{5} = \frac{y-1}{2} = z$  intersect. Also find the point of intersection.

106. Find shortest distance between the lines whose vector equations are :

$$\vec{r} = (1-t)\vec{i} + (t-2)\vec{j} + (3-2t)\hat{k} \text{ and } \vec{r} = (s+1)\vec{i} + (2s-1)\vec{j} + (2s+1)\hat{k}$$

107. Find the equations of the two lines through the origin such that each line is intersecting the line

$$\frac{x-3}{2} = \frac{y-3}{1} = \frac{z}{1} \text{ at an angle of } \frac{\pi}{3}.$$

108. A plane passes through  $(1, -2, 1)$  and is perpendicular to the planes  $2x - 2y + 2z = 0$  and  $x - y + 2z = 4$ . Find the distance of that plane from origin.

109. Find the equation of the plane passing through the intersection of planes  $2x + 3y - z = -1$  and  $x + y - 2z + 3 = 0$  and perpendicular to the plane  $3x - y - 2z = 4$ . Also find the inclination of this plane with  $xy$ -plane.

110. Find the shortest distance and the vector equation of line of shortest distance between the lines given by

$$\vec{r} = (3\vec{i} + 8\vec{j} + 3\hat{k}) + \lambda(3\vec{i} - \vec{j} + \hat{k})$$

$$\vec{r} = (-3\vec{i} - 7\vec{j} + 6\hat{k}) + \mu(-3\vec{i} - 2\vec{j} + 4\hat{k})$$

111. Show that the lines joining the points  $(7, 0, 6)$  and  $(2, 5, 1)$  intersects the line joining the points  $(2, 2, -1)$   $(3, 4, 2)$ . Also find the point of intersection.

112. Find the equations of two planes through the points  $(4, 2, 1)$  and  $(2, 1, -1)$  and making an angle of  $\frac{\pi}{4}$  with the plane  $x - 4y + z - 9 = 0$ ,

113. A variable plane is at a constant distance  $3p$  from the origin and meet the coordinate axes in  $A, B, C$ . Show that the locus of centroid of  $\Delta ABC$  is  $x^2 + y^2 + z^2 = p^2$ .
114. A vector  $\vec{n}$  of magnitude 8 units inclined to  $x$ -axis at  $45^\circ$ ,  $y$  axis at  $60^\circ$  and an acute angle with  $z$ -axis. If a plane passes through a point  $(\sqrt{2}, -1, 1)$  and is normal to  $\vec{n}$ , find its equation in vector form.
115. Find the foot of perpendicular from the point  $2\hat{i} - \hat{j} + 5\hat{k}$  on the line  $\vec{r} = (11\hat{i} - 2\hat{j} - 8\hat{k}) + \lambda(10\hat{i} - 4\hat{j} - 11\hat{k})$ . Also find the length of the perpendicular.
116. Three vectors of magnitude  $a, 2a, 3a$  meet in a point and their directions are along the diagonals of the adjacent faces of a cube, determine their resultant.
117. A line makes angles  $\alpha, \beta, \gamma, \delta$  with the four diagonals of a cube. Prove that

$$\cos^2 \alpha + \cos^2 \beta + \cos^2 \gamma + \cos^2 \delta = \frac{4}{3}.$$

## CHAPTER 12

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# LINEAR PROGRAMMING

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### LONG ANSWER TYPE QUESTIONS (6 Marks Each)

1. A man has Rs. 1500 to purchase two types of shares of two different companies  $S_1$  and  $S_2$ . Market price of one share  $S_1$  is Rs 180 and  $S_2$  is Rs. 120. He wishes to purchase a maximum of ten shares only. If one share of type  $S_1$  gives a yield of Rs. 11 and of type  $S_2$  Rs. 8 then how much shares of each type must be purchased to get maximum profit? And what will be the maximum profit?
2. Daily wages of two tailors  $A$  and  $B$  is respectively Rs. 150 and Rs. 200. 'A' can stitch 6 shirts and 4 pairs of trousers per day, while  $B$  can stitch 10 shirts and 4 pairs of trousers per day. How many days should each of them work if it is desired to produce at least 60 shirts and 32 pairs of trousers at a minimum labour cost?
3. A dealer wishes to purchase two types of dinner sets, type I and II. He has only Rs. 5760 to invest and has space for at most 20 dinner sets. Cost of type  $A$  and  $B$  dinner sets is Rs. 360 and Rs. 240 respectively. He earns a profit of Rs. 44 and Rs. 36 respectively on type I and II type of dinner sets respectively. Assuming that he can sell all the dinner sets he buys, how should he invest the money in order to maximize the profit? Find maximum profit also.
4. A company manufactures two types of lamps say  $A$  and  $B$ . Both lamps go through a cutter and then a finisher. Lamp  $A$  requires 2 hours of the cutter's time and 1 hour of the finisher's time. Lamp  $B$  requires 1 hour of cutter's and 2 hours of finisher's time. The cutter has 100 hours and the finisher has 80 hours of time available each month. Profit on one lamp  $A$  is Rs. 7.00 and on one lamp  $B$  is Rs. 13.00. Assuming that he can sell all that he produces, how many of each type of lamps should be manufactured to obtain maximum profit?
5. A catering agency has two kitchens to prepare food for two places  $A$  and  $B$ . From these places midday meal is to be supplied to three different schools situated at  $P$ ,  $Q$  and  $R$ . The monthly requirement of the schools are respectively 40, 40 and 50 food packets. A packet contains lunch for 1000 students. Preparing capacity of kitchen  $A$  and  $B$  are 60 and 70 packets per month respectively. The transportation cost per packet for kitchens to schools is given below :

**Transportation Cost per Packet (in rupees)**

To	From	
	$A$	$B$
$P$	5	4
$Q$	4	2
$R$	3	5

How many packets from each kitchen should be transported to schools so that the cost of transportation is minimum. Also find the minimum cost. Convert the above problem to an L.P.P. and solve graphically.

6. A farmer has a supply of chemical fertilizer of type I which contains 10% nitrogen and 6% phosphoric acid and type II contains 5% nitrogen and 10% phosphoric acid. After testing the soil conditions of a field, it is found that at least 14 kg of nitrogen and 14 kg of phosphoric acid is required for a good crop. The fertilizer I costs Rs. 2 per kg and type II costs Rs. 3 per kg. How many kilograms of each fertilizer should be used to meet the requirement at the minimum cost. Solve graphically as L.P.P.
7. An airline agree to charter planes for a group. The group needs at least 160 first class seats and at least 300 tourist class seats. The airline must use at least two of its model 314 planes which have 20 first class and 30 tourist class seats. The airline will also use some of its model 535 planes which have 30 first class seats and 60 tourist class seats. Each flight of a model 314 plane costs the company Rs. 1 lakh, and each flight of a model 535 plane costs Rs. 1.5 lakh. How many of each type of planes should be used to minimise the flight cost? Solve this as a LPP.
8. A firm manufactures two type of products A and B, each of which must be processed on two machines  $M_1$  and  $M_2$ . The hourly requirements per unit for each product in each machine, the weekly capacity of each machine, selling price per unit, labour cost per unit, and raw material cost per unit are as follows :

	<i>Product A</i>	<i>Product B</i>	<i>Weekly capacity</i>
Machine $M_1$	3 hrs.	2 hrs.	130 hrs.
Machine $M_2$	4 hrs.	6 hrs.	260 hrs.
Selling price per unit	Rs. 25	Rs. 30	
Labour cost per unit	Rs. 16	Rs. 20	
Raw material cost	Rs. 4	Rs. 4	per unit.

How many units of each type should be produced to maximise profit?

9. Kellogg is a new cereal formed by a mixture of bran and rice that contains at least 88 grams of protein at least 56 milligrams of iron. Knowing that bran contains 80 grams of protein and 40 milligrams of iron per kilogram, and that rice contains 100 grams of protein and 30 milligrams of iron per kilogram, find the minimum cost of producing this new cereal if bran costs Rs. 5 per kg and rice costs Rs. 4 per kg. Solve graphically as L.P.P.
10. A dietician mixes together two kinds of foods in such a way that the mixture contains at least 6 units of vitamin A, 7 units of vitamin B, 11 units of vitamin C, and 9 units of vitamin D. The vitamin contents of 1 kg of food X and 1 kg of food Y are given below :

	<i>Vitamin A</i>	<i>Vitamin B</i>	<i>Vitamin C</i>	<i>Vitamin D</i>
Food X	1	1	1	2
Food Y	2	1	3	1

One kg of food X cost Rs. 5, whereas one kg of food Y costs Rs. 8. Find the least cost of mixture which will produce the desired diet, graphically.

11. If a young man drives his motorcycle at 25 km per hour, he has to spend Rs. 2 per kilometre on petrol. If he drives it at a faster speed of 40 km per hour, the petrol cost increases to Rs. 5 per kilometre. He has Rs. 100 to spend on petrol and wishes to find the maximum distance he can travel within one hour. Express this as linear programming problem and then solve it.

12. Mr. Jain wants to invest Rs. 1,00,000 in Public Provident Fund (PPF) and in National Bonds. He has to invest at least Rs. 40,000 in P.P.F. and at least Rs. 20,000 in bonds. If rate of interest on PPF is 9% per annum and that on bonds is 6% per annum, how should he invest the money to earn maximum annual income? Also find the maximum annual income.
13. A company has factories located at each of two places P and Q. From these locations a certain commodity is delivered to each of three depots situated at A, B and C. The weekly requirements of the depots are respectively 8, 8 and 9 units of the commodity while the weekly production capacities of the factories at P and Q are respectively 10 and 15 units. The cost of transportation from P to A, B, C is Rs. 10, Rs. 12, Rs. 15 respectively per unit and from Q to A, B, C is Rs. 15, Rs. 13, Rs. 10 respectively per unit. How many units should be transported from each factory to each depot in order that the transportation cost is minimum. Formulate the above LPP mathematically and then solve it.
14. Two godowns X and Y have a grain storage capacity of 100 quintals and 50 quintals respectively. Their supply goes to three ration shops A, B and C whose requirements are 60, 50 and 40 quintals respectively. The costs of transportation per quintal from the godowns to the shops are given in the following table :

Cost of transportation (in Rs. per quintal)

To Form	X	Y
A	6.00	4.00
B	3.00	2.00
C	2.50	3.00

How should the supplies be transported in order that the transportation cost is minimum?

15. Find maximum and minimum values of  $z = 2x + y$  subject to the constraints :

$$x \geq 0, y \geq 0$$

$$x + 3y \geq 6$$

$$x - 3y \leq 3$$

$$3x + 4y \leq 24$$

$$-3x + 2y \leq 6$$

$$5x + y \geq 5$$

16. Solve the following LPP problem graphically :

Maximize and minimize  $z = 3x + 5y$

Subject :  $3x - 4y + 12 \geq 0$

$$2x - 4y + 2 \geq 0$$

$$2x - 3y - 12 \geq 0$$

$$0 \leq x \leq 4$$

$$y \geq 2$$

17. (i) Maximize  $z = 3x_1 + 3x_2$ . If possible graphically subject to constraints :

$$\begin{aligned}x_1 - x_2 &\leq -1 \\-x_1 + x_2 &\leq 0 \\x_1 \geq 0, x_2 \geq 0\end{aligned}$$

- (ii) Maximize  $z = 3x + 3y$ , if possible graphically subject to constraints :

$$\begin{aligned}x - y &\leq 1 \\x + y &\leq 3 \\x, y \geq 0\end{aligned}$$

18. A farmer owns a field of area  $1000m^2$ . He wants to plant fruit trees in it. He has sum of Rs. 2400 to purchase young trees. He has the choice of two types of trees. Type A requires  $10m^2$  of ground per tree and cost Rs. 30 per tree and type B requires  $20m^2$  of ground per tree and costs Rs. 40 per tree. When full grown a type – A tree produces an average of 20 kg of fruit which can be sold at a profit of Rs. 12 per kg and a type – B tree produces an average of 35 kg of fruit which can be sold at a profit of Rs. 10 per kg. How many of each type should be planted to achieve maximum profit when trees are fully grown? What is the maximum profit?

19. Find the maximum and minimum values of  $5x + 2y$  subject to constraints :

$$\begin{aligned}x \geq 0, y \geq 0 \\-2x - 3y \leq -6 \\x - 2y \leq 2 \\6x + 4y \leq 24 \\-3x + 2y \leq 3\end{aligned}$$

20. A company produces two types of belts, A and B. Profits on these belts are Rs. 2 and Rs. 1.5 each belt, respectively. A belt of type A requires twice as much time as belt of type B. The company can produce at the most 1000 belts of type B per day. Material for 800 belts per day is available. At the most 400 buckles for belts of type A and 700 for those of type B are available per day. How many belts of each type should the company produce so as to maximize the profit?

# CHAPTER 13

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# PROBABILITY

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## POINTS TO REMEMBER

- **Conditional Probability :** If event  $B$  has already occurred then probability of event

$$P(A|B) = \frac{P(A \cap B)}{P(B)}$$

- **Multiplication Rule of Probability :**

$$(i) P(A \cap B) = P(B) \cdot P\left(\frac{A}{B}\right) = P(A) \cdot P\left(\frac{B}{A}\right).$$

$$(ii) P(A \cap B \cap C) = P(A) \cdot P\left(\frac{B}{A}\right) \cdot P\left(\frac{C}{AB}\right).$$

- If (i)  $A$  and  $B$  are independent events then  $P(A \cap B) = P(A) \cdot P(B)$

- (ii)  $A$ ,  $B$  and  $C$  are independent events then.

$$P(A \cap B) = P(A) \cdot P(B), P(B \cap C) = P(B) \cdot P(C \cap A) = P(C) \cdot P(A).$$

$$P(A \cap B \cap C) = P(A) \cdot P(B) \cdot P(C)$$

- If  $A$  and  $B$  are Independent the

- (i)  $A$  and  $B^c$  are independent

- (ii)  $A^c$  and  $B$  are independent

- (iii)  $A^c$  and  $B^c$  are independent.

- Baye's Theorem. If  $E_1, E_2, \dots, E_n$  are mutually exclusive and exhaustive events and  $A$  be any event on sample space  $S$ , s.t  $P(A) \neq 0$ , If  $A$  has already occurred then

$$P\left(\frac{E_i}{A}\right) = \frac{P(E_i) \cdot P\left(\frac{A}{E_i}\right)}{\sum_{i=1}^n P(E_i) \cdot P\left(\frac{A}{E_i}\right)}$$

$$i = 1, 2, \dots, n$$

- Probability distribution of a random variable. Let a random variable  $x$  assume  $x_1, x_2, \dots, x_n$  with corresponding probabilities  $p_1, p_2, \dots, p_n$ . Then different values of a random variable together with their corresponding probabilities form a probability distribution.

$$\sum_{i=1}^n p_i x_i$$

Mean of probability distribution,  $\mu = \frac{\sum_{i=1}^n p_i x_i}{\sum_{i=1}^n p_i}$

Variance  $\sigma^2 = \sum (x_i - \mu)^2 p_i$

**OR**

$$\sigma^2 = \sum p_i x_i^2 - \mu^2.$$

### **VERY SHORT ANSWER TYPE Q QUESTIONS (1 Mark Each)**

1. If  $P\left(\frac{A}{B}\right) = \frac{4}{9}$ ,  $P(B) = \frac{9}{13}$ , write value of  $P(A \cap B)$ .
2. A fair dice is tossed and if events  $E = \{2, 4, 6\}$ ,  $F = \{2, 3\}$ , then write the value of
  - (i)  $P\left(\frac{E}{F}\right)$
  - (ii)  $P\left(\frac{F}{E}\right)$ .
3. If  $A$  and  $B$  are independent events such that  $P(A) = \frac{1}{4}$ ,  $P(B) = \frac{1}{13}$ , write the value of
  - (i)  $P(A \cap B')$
  - (ii)  $P(A' \cap B)$ .
- \*4. If  $A$  and  $B$  are independent events and if  $P(A \cap B) = \frac{4}{5}$ , write the value of  $P(A' \cup B')$ .
5. If  $P(A) = \frac{1}{2}$ ,  $P(B) = 0$ , then write the value of  $P(A/B)$ . (If exist).
6. A problem in mathematics is given to two students whose chances of solving it are  $\frac{1}{2}$  and  $\frac{1}{3}$  respectively. What is the probability that both students fail to solve it?
7. The probability of student  $A$  passing an examination is  $\frac{3}{5}$  and student  $B$  passing is  $\frac{4}{5}$ . Find the probability that only  $A$  passes the examination.
- \*8. The probability distribution of a random variable  $X$  is given as :

$X$	$0$	$1$	$2$
$P(X)$	$\frac{144}{169}$	$\frac{24}{169}$	$\frac{1}{169}$

Write the value of mean of this probability distribution.

9. The probability distribution of  $X$  is :

$X$	0	1	2	3
$P(X)$	0.2	$k$	$k$	$2k$

Write the value of  $k$  and  $P(X = 3)$ .

- \*10. If  $X$  has a Binomial distribution  $B(4, \frac{1}{3})$  write :

- $$(i) \quad P(X = 3) \qquad (ii) \quad P(X = 1)$$

11. Find the mean of the binomial distribution  $B\left(2, \frac{1}{2}\right)$ .

12. Find  $P(X = 0)$  of the Binomial distribution  $B(10, \frac{1}{3})$ .

13. Find  $P(X = 1)$  of the Binomial distribution  $B(3, \frac{1}{6})$ .

14. A dice is thrown 3 times. If getting a 'six' is considered a success, find the probability of 3 successes.

15. What is the probability of the die coming up with a number less than 5?

16. In a probability distribution of  $X$ , what is the sum of all the probabilities.

17. What is the probability that a leap year will have 53 Sundays?

18. In a single throw of three dice, determine the probability of getting a total of 5.

19. A police-man fires four bullets on a dacoit. The probability that the dacoit will be killed by one bullet is 0.6. What is the probability that the dacoit is still alive?

- \*20. Find the expectation of the number of heads in 15 tosses of a coin.

## **SHORT ANSWER TYPE QUESTIONS (4 Mark Each)**

21. Assuming a family has two children :

- (i) Write sample space.
  - (ii) What is the probability that both the children are boys given that at least one of them is boy.
  - (iii) What is the probability that both the children are girls given that at least one of them is girl.
  - (iv) What is the probability that second is not a boy given that first is a boy.

22. Fifteen horses numbered 1 to 15 participated in Race. If it is known that the winner horse is odd numbered.
- What is probability that the number of winner horse is more than 10.
  - What is the probability that the number is prime.
23. A die is thrown twice and both numbers observed to be odd. Find the probability that :
- Both are same.
  - Their sum is 4.
  - Their sum is more than 10.
24. Three coins are tossed once. If :
- $E$  : Head appears on first coin.
- $A$  : Exactly two tails appear.
- $B$  : Exactly one tail appears.
- $C$  : No tail appears.
- Find :  $P\left(\frac{A}{E}\right), P\left(\frac{B}{E}\right), P\left(\frac{C}{E}\right)$ .
25. An anti aircraft gun can take a maximum of four shots at an enemy plane moving away from it. The probabilities of hitting the plane at the first, second, third and fourth shot are 0.4, 0.3, 0.2 and 0.1 respectively. What is the probability that gun strikes the plane?
26. A bag contains 4 red and 3 black balls. A second bag contains 2 red and 4 black balls. One bag is selected at random and from the selected bag one ball is drawn. Find the probability that the ball drawn is red.
27. A card from a pack of 52 cards is lost. From the remaining cards of the pack, two cards are drawn and are found to be both diamonds. Find the probability of the lost card being a diamond.
28. Suppose that reliability of a HIV test is specified as follows :
- Of people having HIV, 90% of the test detected but 10% go undetected. Of people free of HIV, 99% of the test are judged HIV negative but 1% are diagnosed as showing HIV positive. From a large population of which only 0.1% have HIV, one person is selected at random, given the HIV test, and the pathologist reports him/her as HIV negative. What is the probability that the person is actually has HIV.
29. A candidate has to reach the examination centre in time. Probability of his going by bus or scooter or by other means of transport is  $\frac{3}{10}, \frac{1}{10}, \frac{3}{5}$  respectively. The probability that he will be late will be  $\frac{1}{4}$  and  $\frac{1}{3}$  respectively, if he travels by bus or scooter. But he reaches in time if he uses any other mode of transport. He reached late at the centre. Find the probability that he travelled by bus.

30. Find the probability distribution of the number of green balls drawn when 3 balls are drawn one by one without replacement from a bag containing 3 green and 5 white balls.
31. Three cards are drawn successively with replacement from a well shuffled deck of 52 cards. A random variable  $X$  denote the number of cards of heart in three cards drawn. Determine the probability distribution of  $X$ .
- \*32. Five dice are thrown simultaneously. If the occurrence of 3, 4 or 5 in single die is considered a success, find the probability of at most three successes.
- \*33. The probability of a shooter hitting a target is  $\frac{3}{4}$ . How many minimum number of times must he/she should fire so that the probability of hitting the target at least once is more than 0.99?
34. In a game, a man wins a rupee for a six and loses a rupee for any other number when a fair die is thrown. The man decided to throw a die thrice but to quit as and when he gets a six. Find the expected value of the amount he wins/loses.
35. If a fair coin is tossed 10 times, find the probability of
- (i) at least six heads.
  - (ii) at most six heads.
36. On a multiple choice examination with three possible answers for each of the five questions. What is the probability that a candidate would get four or more correct answers just by guessing?
- \*37. Find the probability distribution of number of doublets in three throws of a pair of dice.
38. The sum and the product of the mean and variance of a binomial distribution are 24 and 128 respectively. Find the distribution.

### **LONG ANSWER TYPE QUESTIONS (6 Mark Each)**

39. In an office 50% females likes to wear suits, 20% saree and 30% jeans. If 10% likes to wear both suit and saree, 15% wear suit and jeans, 6% wear saree and jeans and only 3% who likes to wear all the three. Then find whether the following events are independent.
- |                   |                          |
|-------------------|--------------------------|
| (i) $A$ and $B$   | (ii) $B$ and $C$         |
| (iii) $A$ and $C$ | (iv) $A$ , $B$ and $C$ . |
- Where  $A$  : female wear suit  
 $B$  : female wear saree  
 $C$  : Female wear jeans
40. In a colony their are 60 persons who have cars or motorbike or scooter. 28 persons have cars, 28 has motorbike, 25 has scooter. If 8 person have cars and bike, 9 have bike and scooter, 7 have cars and scooter. 3 of them have all the three vehicles, and
- If  $C$  : Persons having car.

*M* : Persons having motorbike.

$S$  : Persons having scooter.

Find if the following events are independent.

- (i)  $C$  and  $M$       (ii)  $M$  and  $S$ ;      (iii)  $C$  and  $S$ ;      (iv)  $C, M$  and  $S$ .

41. In a competition students of a school of class VIII painted pictures using Red, Blue colour according as the data shown below :

<i>Painting</i>	<i>Only in Red</i>	<i>Only in Blue</i>	<i>Red and Blue both</i>
VIII A	12	3	15
VIII B	15	5	20
VIII C	10	2	13

If the painting that was awarded was having blue colour in it, find the probability that :



42. In attempting to solve a question, probability that the student knows the answer is  $\frac{3}{10}$ , copies is  $\frac{1}{5}$ , guesses is  $\frac{1}{10}$ , and do not attempt is  $\frac{2}{5}$ . The probability that his answer is correct given that he copied is  $\frac{1}{4}$  and the probability of giving correct answer by guess is  $\frac{1}{5}$ . If it is given that his answer is correct find the probability that was done by guessing.

43. Probability of attempting solving a problem by  $A$ ,  $B$ ,  $C$  is  $\frac{1}{2}, \frac{1}{3}, \frac{1}{6}$  respectively. And probability that  $A$ ,  $B$ ,  $C$  will solve it correctly is 50%, 60% and 80% respectively. If the problem is solved correctly, what is the probability that it was solved by (i)  $A$  (ii)  $B$  (iii)  $C$ .

44. From a well shuffled pack of playing cards, three cards are drawn without replacement.

- (i) Find the probability distribution of the number of kings.
  - (ii) Find its mean and variance.

45. From a well shuffled pack of playing cards, five cards are drawn one by one with replacement.

- (i) Find the probability distribution of the number of Aces.
  - (ii) Find its mean and variance.

46. Find the probability distribution of number of sixes while throwing a dice 5 times. Also find its mean and variance.

47. Three tailors  $A$ ,  $B$  and  $C$  stitched 500, 300 and 200 shirts respectively. The probability of stitching a defective shirt by them is 0.01%, 0.15% and 0.2% respectively. If a shirt stitched is given to be defective, find the probability that it was stitched by (i)  $A$  (ii)  $B$  (iii)  $A$  or  $C$  (iv)  $B$  or  $C$ .

48. Suppose 15% of men and 36% of women have grey hair. If probability of dying hair by men is 21% and by women is 63%. A dyed hair person is selected at random, what is the probability that this person is a (i) Male (ii) Female ?
49. A random variable  $X$  has the following probability distribution.

$X$	1	2	3	4	5	6
$P(X)$	$0$	$k$	$2k$	$k^2$	$2k^2$	$6k^2$

Determine (i)  $k$  (ii)  $P(X < 5)$  (iii)  $P(X > 3)$ .

Find also mean and variance of the distribution.

50. An unbiased coin is tossed six times. What is the probability of getting.
- (i) at most '3' heads  
(ii) at least 2 heads  
(iii) Also find mean and variance of number of heads.
51. A pair of dice is thrown 7 times. If getting a total of 7 is considered a success, what is the probability of
- (i) no success; (ii) 6 successes;  
(iii) at least 6 successes (iv) at most 6 successes.

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# CBSE QUESTIONS PAPER – 2008

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## MATHEMATICS

xf.kr

**Time allowed : 3 hours**

fu/wj r le; %3 ?kVs

**Maximum marks : 100**

vf/kdre vd %100

### **General Instructions**

1. All questions are compulsory.
2. The question paper consists of 29 questions divided into three sections A, B and C. Section A comprises of 10 questions of one mark each, Section B comprises of 12 questions of four marks each and Section C comprises of 7 questions of six marks each.
3. All questions in Section A are to be answered in one word, one sentence or as per the exact requirement of the question.
4. There is no overall choice. However, internal choice has been provided in 4 questions of four marks each and 2 questions of six marks each. You have to attempt only one of the alternatives in all such questions.
5. Use of calculators is not permitted.

### **I kewi funz%k %**

1. l Hh ižu vfuok ZgA
2. bl ižui=keas29 ižu gatkrhu [k MaefofHt r giv] c rFklA [kMv ea10 ižu gäft ueal siR s d , d vd dkga [kMc ea12 ižu gäft ueal siR s d plj vd dkga [kMl ea7 ižu gäft ueal siR s d N%vd dk ga
3. [kMv ea1 Hh ižukadsmkj , d 'kn] , d oD; vFlok ižu dh vlo'; drkvuklj fn; st k l drsgA
4. iWZižui=keafodYi ughagA fQj Hhplj valkoys4 ižuklearFk6 valkoys2 ižukeavkrfjd fodYi gA , sl Hh ižukaeal svk dks, d gh fodYi djuk gA
5. dSydyj dsizk dh vuefr ughagA

## SECTION A [k M ^v\*]

1. If  $f(x) = x + 7$  and  $g(x) = x - 7$ ,  $x \in R$ , find  $(fog)(7)$ .

; fn  $f(x) = x + 7$  rFk  $g(x) = x - 7$ ,  $x \in R$ , rks(fog)(7) Kkr dft , A

2. Evaluate :  $\sin \left[ \frac{\pi}{3} - \sin^{-1} \left( -\frac{1}{2} \right) \right]$

eku Klu dlft, %  $\sin \left[ \frac{\pi}{3} - \sin^{-1} \left( -\frac{1}{2} \right) \right]$ .

3. Find the value of  $x$  and  $y$  if :  $2 \begin{bmatrix} 1 & 3 \\ 0 & x \end{bmatrix} + \begin{bmatrix} y & 0 \\ 1 & 2 \end{bmatrix} = \begin{bmatrix} 5 & 6 \\ 1 & 8 \end{bmatrix}$ .

$x$  rEky dseku Klr dlft, ; fn %  $2 \begin{bmatrix} 1 & 3 \\ 0 & x \end{bmatrix} + \begin{bmatrix} y & 0 \\ 1 & 2 \end{bmatrix} = \begin{bmatrix} 5 & 6 \\ 1 & 8 \end{bmatrix}$ .

4. Evaluate :  $\begin{bmatrix} a+ib & c+id \\ -c+id & a-ib \end{bmatrix}$

eku Klr dlft, %  $\begin{bmatrix} a+ib & c+id \\ -c+id & a-ib \end{bmatrix}$ .

5. Find the co-factor of  $a_{12}$  in the following :

$$\begin{vmatrix} 2 & -3 & 5 \\ 6 & 0 & 4 \\ 1 & 5 & -7 \end{vmatrix}.$$

fuEu ea  $a_{12}$  dk l g [ kM Klr dlft, %

$$\begin{vmatrix} 2 & -3 & 5 \\ 6 & 0 & 4 \\ 1 & 5 & -7 \end{vmatrix}.$$

6. Evaluate :  $\int \frac{x^2}{1+x^3} dx$ .

eku Klr dlft, %  $\int \frac{x^2}{1+x^3} dx$ .

7. Evaluate :  $\int_0^1 \frac{dx}{1+x^2}$ .

eku Klr dlft, %  $\int_0^1 \frac{dx}{1+x^2}$ .

8. Find a unit vector in the direction of  $\vec{a} = 3i - 2j + 6\hat{k}$ .

l fn'k  $\vec{a} = 3i - 2j + 6\hat{k}$ . dsvufn'k, d ekld l fn'k Klr dlft, A

9. Find the angle between the vectors  $\vec{a} = i - j + \hat{k}$  and  $\vec{b} = i + j - \hat{k}$ .

$$|\vec{a}| = \sqrt{1+1+1} = \sqrt{3}, |\vec{b}| = \sqrt{1+1+1} = \sqrt{3}$$

10. For what value of  $\lambda$  are the vectors  $\vec{a} = 2i + \lambda j + \hat{k}$  and  $\vec{b} = i - 2j + 3\hat{k}$  perpendicular to each other?

$$\vec{a} \cdot \vec{b} = 2i + \lambda j + \hat{k} \cdot i - 2j + 3\hat{k} = 2 - 2\lambda + 3 = 0 \Rightarrow \lambda = 2.5$$

## SECTION B

### [k M ^c\*]

11. (i) Is the binary operation  $*$ , defined on set  $Q$ , given by  $a * b = \frac{a+b}{2}$  for all  $a, b \in Q$ , commutative?  
 (ii) Is the above binary operation  $*$  associative?  
 (i) Define  $a * b = \frac{a+b}{2}$  for all  $a, b \in Q$ , show that  $a * b = b * a$  and  $(a * b) * c = a * (b * c)$ .  
 (ii) Define  $a * b = \frac{a+b}{2}$  for all  $a, b \in Q$ , show that  $a * b = b * a$  and  $(a * b) * c = a * (b * c)$ .

12. Prove the following

$$\tan^{-1} \frac{1}{3} + \tan^{-1} \frac{1}{5} + \tan^{-1} \frac{1}{7} + \tan^{-1} \frac{1}{8} = \frac{\pi}{4}.$$

for (i) prove

$$\tan^{-1} \frac{1}{3} + \tan^{-1} \frac{1}{5} + \tan^{-1} \frac{1}{7} + \tan^{-1} \frac{1}{8} = \frac{\pi}{4}.$$

$$\begin{bmatrix} 3 & 2 & 5 \end{bmatrix}$$

13. Let  $A = \begin{bmatrix} 4 & 1 & 3 \\ 0 & 6 & 7 \end{bmatrix}$ . Express  $A$  as sum of two matrices such that one is symmetric and the other is skew symmetric.

**OR**

$$\begin{bmatrix} 1 & 2 & 2 \end{bmatrix}$$

If  $A = \begin{bmatrix} 2 & 1 & 2 \\ 2 & 2 & 1 \end{bmatrix}$ , verify that  $A^2 - 4A - 5I = 0$ .

$\begin{bmatrix} 3 & 2 & 5 \\ 4 & 1 & 3 \\ 0 & 6 & 7 \end{bmatrix}$   
 eku A = . A dks, ksnkvlQ gads; kx ds: i easyf[k ftual s, d lefer vlo grkk

nwjk fo"le lefer vlo grkk

vlok

$\begin{bmatrix} 1 & 2 & 2 \\ 2 & 1 & 2 \\ 2 & 2 & 1 \end{bmatrix}$   
 ; fn A = , gfrksl R kif dlft, fd  $A^2 - 4A - 5I = 0$ .

14. For what value of  $k$  is the following function continuous at  $x = 2$ ?

$$f(x) = \begin{cases} 2x + 1 & ; \quad x < 2 \\ k & ; \quad x = 2 \\ 3x - 1 & ; \quad x > 2 \end{cases}$$

k dsfdll eku dsfy, fuFu Qyu  $x=2$  ij lrr gS

$$f(x) = \begin{cases} 2x + 1 & ; \quad x < 2 \\ k & ; \quad x = 2 \\ 3x - 1 & ; \quad x > 2 \end{cases}$$

15. Differentiate the following with respect to  $x$ :

$$\tan^{-1} \left( \frac{\sqrt{1+x} - \sqrt{1-x}}{\sqrt{1+x} + \sqrt{1-x}} \right)$$

fuFu dk x dsli k vodyu dlft, %

$$\tan^{-1} \left( \frac{\sqrt{1+x} - \sqrt{1-x}}{\sqrt{1+x} + \sqrt{1-x}} \right)$$

16. Find the equation of tangent to the curve  $x = \sin 3t$ ,  $y = \cos 2t$ , at  $t = \pi/4$ .

oO x = sin 3t, y = cos 2t, dsfcIhq t = pi/4 ij Li 'Ej{k dk l ehdj.k Kkr dlft, A

17. Evaluate :  $\int_0^\pi \frac{x \sin x}{1 + \cos^2 x} dx$ .

eku Kkr dlft, %  $\int_0^\pi \frac{x \sin x}{1 + \cos^2 x} dx$ .

18. Solve the following differential equation :

$$(x^2 - y^2) dx + 2xy dy = 0$$

given that  $y = 1$ , when  $x = 1$ .

**OR**

Solve the following differential equation :

$$\frac{dy}{dx} = \frac{x(2y-x)}{x(2y+x)}, \text{ if } y=1, \text{ when } x=1.$$

full vody 1 elhdj.k dksgy dlft, %

$$(x^2 - y^2) dx + 2xy dy = 0$$

fn; k gSfd t c x=1 gark y=1.

vElok

full vody 1 elhdj.k dksgy dlft, %

$$\frac{dy}{dx} = \frac{x(2y-x)}{x(2y+x)}, ; \text{fn } y=1 \text{ t c } x=1.$$

19. Solve the following differential equation :

$$\cos^2 x \frac{dy}{dx} + y = \tan x.$$

full vody 1 elhdj.k dksgy dlft, %

$$\cos^2 x \frac{dy}{dx} + y = \tan x.$$

20. If  $\vec{a} = i + j + \hat{k}$  and  $\vec{b} = j - \hat{k}$ , find a vector  $\vec{c}$  such that  $\vec{a} \times \vec{c} = \vec{b}$  and  $\vec{a} \cdot \vec{c} = 3$ .

**OR**

If  $\vec{a} + \vec{b} + \vec{c} = \vec{0}$  and  $|\vec{a}| = 3$ ,  $|\vec{b}| = 5$  and  $|\vec{c}| = 7$ , show that the angle between  $\vec{a}$  and  $\vec{b}$  is  $60^\circ$ .

; fn  $\vec{a} = i + j + \hat{k}$  rElok  $\vec{b} = j - \hat{k}$ , tks l fn'k  $\vec{c}$  Kkr dlft, ; fn  $\vec{a} \times \vec{c} = \vec{b}$  rElok  $\vec{a} \cdot \vec{c} = 3$ .

vElok

; fn  $\vec{a} + \vec{b} + \vec{c} = \vec{0}$  rElok  $|\vec{a}| = 3$ ,  $|\vec{b}| = 5$  rElok  $|\vec{c}| = 7$ , rks n'kk, fd  $\vec{a}$  rElok  $\vec{b}$  ds clp dk dks 60° dk gA

21. Find the shortest distance between the following lines :

$$\frac{x-3}{1} = \frac{y-5}{-2} = \frac{z-7}{1} \text{ and } \frac{x+1}{7} = \frac{y+1}{-6} = \frac{z+1}{1}.$$

**OR**

Find the point on the line  $\frac{x+2}{3} = \frac{y+1}{2} = \frac{z-3}{2}$  at a distance from  $3\sqrt{2}$  from the point (1, 2, 3).

fuFu jskladsclp Uwre njhKkr dlft, %

$$\frac{x-3}{1} = \frac{y-5}{-2} = \frac{z-7}{1} \text{ rFk } \frac{x+1}{7} = \frac{y+1}{-6} = \frac{z+1}{1}.$$

vFlok

jslk  $\frac{x+2}{3} = \frac{y+1}{2} = \frac{z-3}{2}$  ij og fcIhqKkr dlft, tksfcIhq(1, 2, 3) ls  $3\sqrt{2}$  dh njh ij gka

22. A pair of dice is thrown 4 times. If getting a doublet is considered a success, find the probability distribution of number of successes.

iklakd , d ; kplj clj Qalk x; lA ; fn nksaikl hij , d gh lq; k vukl lQyrk eluk tk tks lQyrkvladhlq; kdk iif; drk cVu Kkr dlft, A

**SECTION C**  
[kM ^] \*

23. Using properties of determinants, prove tha following :

$$\begin{vmatrix} \alpha & \beta & \gamma \\ \alpha^2 & \beta^2 & \gamma^2 \\ \beta + \gamma & \gamma + \alpha & \alpha + \beta \end{vmatrix} = (\alpha - \beta)(\beta - \gamma)(\gamma - \alpha)(\alpha + \beta + \gamma).$$

lqif.kladsxqklesdkizlk dj fuFu fl ) dlft, %

$$\begin{vmatrix} \alpha & \beta & \gamma \\ \alpha^2 & \beta^2 & \gamma^2 \\ \beta + \gamma & \gamma + \alpha & \alpha + \beta \end{vmatrix} = (\alpha - \beta)(\beta - \gamma)(\gamma - \alpha)(\alpha + \beta + \gamma).$$

24. Show that the rectangle of maximum area that can be inscribed in a circle is a square.

**OR**

Show that the height of the cylinder of maximum volume that can be inscribed in a cone of height  $h$  is  $\frac{1}{3}h$ .

fl ) dlft, fd fdl hor dsvalxZ fufeZ vfldre {kQy dkvk kr , d oxZgkA

### vFllok

fl ) dlft , fd fdl h' kloqft l dhÅplbZh g\$ dsvlxz vf/kdre vk ru okysfufeZ cyu dhÅplbZh  $\frac{1}{3}$  h  
gkxhA

25. Using integration find the area of the region bounded by the parabola  $y^2 = 4x$  and the circle  $4x^2 + 4y^2 = 9$ .

l ekdu dk izlk djrsqq ijoy;  $y^2 = 4x$  rFk o Ùk  $4x^2 + 4y^2 = 9$  ds e/; orlZ{sk dk {kQy Kkr dlft , A

26. Evaluate : 
$$\int_{-a}^a \sqrt{\frac{a-x}{a+x}} dx$$

eku Kkr dlft , % 
$$\int_{-a}^a \sqrt{\frac{a-x}{a+x}} dx$$

27. Find the equation of the plane passing through the point  $(-1, -1, 2)$  and perpendicular to each of the following planes :

$$2x + 3y - 3z = 2 \text{ and } 5x - 4y + z = 6.$$

**OR**

Find the equation of the plane passing through the points  $(3, 4, 1)$  and  $(0, 1, 0)$  and parallel to the line  $\frac{x+3}{2} = \frac{y-3}{7} = \frac{z-2}{5}$ .

ml l ery dk l ehkj.k Kkr dlft , tksfd fcIhq(-1, -1, 2) l sgkldj tkrkgSrFk fuEufyf[ld nkaryka ij yFkor g\$% $2x + 3y - 3z = 2$  rFk  $5x - 4y + z = 16$ .

### vFllok

ml ry dk l ehkj.k Kkr dlft , tksfcIhyha(3, 4, 1) vls (0, 1, 0) l sgkldj tkrkgSrFk l jy js lk  
 $\frac{x+3}{2} = \frac{y-3}{7} = \frac{z-2}{5}$  ds l ekj gA

28. A factory owner purchases two types of machines, A and B for his factory. The requirements and the limitations for the machines are as follows :

<i>Machine</i>	<i>Area occupied</i>	<i>Labour force</i>	<i>Daily output (in units)</i>
A	1000 $m^2$	12 men	60
B	1200 $m^2$	8 men	40

He has maximum area of  $9000 m^2$  available, and 72 skilled labourers who can operate both the machines. How many machines of each type should he buy to maximise the daily output?

, d QSwelyd A vls B nksizlj dhe' huaviuhQSwdsfy, Ø; djrkgs bu e' huldhvlo'; drkj rFk l hek j fuEufor~g%

<i>e'lu</i>	<i>{slQy ft ruk Llu ?jrh gA</i>	<i>Jfedlk dh vlo'; drk</i>	<i>ifrinu mRknu bdlbz lq; k%</i>
A	1,000 oxZ eh	12 Q fDr	60
B	1,200 oxZ eh	8 Q fDr	40

QSVhelyd dsikl vf/kdre 9000 oxZeh{sk rFk 72 dQky Jfed mi yCkgat knkizlk dhe'kuu pykl drsgA ml siR s iwlj dhfdruk&fdruhe'kuu [kjmuh plfg, ft 11 sfd vf/kdre mRknu 1 Mo gks l ds

29. An insurance company insured 2,000 scooter drivers, 4,000 car drivers and 6,000 truck drivers. The probability of an accident involving a scooter, a car and a truck are 0.01, 0.03 and 0.15 respectively. One of the insured persons meets with an accident. What is the probability that he is a scooter driver.

, d ciek dEuh 2000 LDWj pkydli 4000 dlj pkydli rFk 6000 Vd pkydli dk ciek djrh gA , d LdWj dlj rFk Vd dsnqZukxLr gksdh iH; drk aOE'e'k% 0.01, 0.03, rFk 0.15 gA cekNr Q fDr; ka pkydli s, d nqZukxLr gks t rk gA ml 0 fDr dsLdWj pkyd gksdh iH; drk D; k gS

# **MARKING SCHEME**

## **SECTION A**

1. 7;      2. 1;      3.  $x = 3, y = 3$ ;      4.  $a^2 + b^2 + c^2 + d^2$ ;      5. 46;

$$6. \quad \frac{1}{3} \cdot \log |(1 + x^3)| + c; \quad 7. \quad \frac{\pi}{4}; \quad (8) \quad \frac{3}{7} \hat{i} - \frac{2}{7} \hat{j} + \frac{6}{7} \hat{k};$$

$$9. \quad \theta = \cos^{-1} \left( -\frac{1}{3} \right). \quad 10. \quad \lambda = \frac{5}{2}.$$

11. (i) If the candidate verifies that the operation is commutative but not associative, full credit may be given. 2 + 2

$$12. \quad LHS = \left( \tan^{-1} \frac{1}{3} + \tan^{-1} \frac{1}{5} \right) + \left( \tan^{-1} \frac{1}{7} + \tan^{-1} \frac{1}{8} \right) = \tan^{-1} \frac{8/15}{14/15} + \tan^{-1} \frac{15/56}{55/56} = \tan^{-1} \frac{4}{7} + \tan^{-1} \frac{3}{11} = \tan^{-1} 1 = \pi/4 = RHS.$$

$$13. \text{ For } A' = \begin{pmatrix} 3 & 4 & 0 \\ 2 & 1 & 6 \\ 5 & 3 & 7 \end{pmatrix}$$

$$\therefore \frac{A + A'}{2} = \begin{pmatrix} 3 & 3 & 5/2 \\ 3 & 1 & 9/2 \\ 5/2 & 9/2 & 7 \end{pmatrix} \text{ which is symmetric.}$$

$$\frac{A - A'}{2} = \begin{pmatrix} 0 & -1 & 5/2 \\ 1 & 0 & -3/2 \\ -5/2 & 3/2 & 0 \end{pmatrix} \text{ which is skew symmetric.}$$

$$\therefore \begin{pmatrix} 3 & 2 & 5 \\ 4 & 1 & 3 \\ 0 & 6 & 7 \end{pmatrix} = \begin{pmatrix} 3 & 3 & 5/2 \\ 3 & 1 & 9/2 \\ 5/2 & 9/2 & 7 \end{pmatrix} + \begin{pmatrix} 0 & -1 & 5/2 \\ 1 & 0 & -3/2 \\ -5/2 & 3/2 & 0 \end{pmatrix}$$

OR

$$\text{For } A^2 = \begin{pmatrix} 9 & 8 & 8 \\ 8 & 9 & 8 \end{pmatrix}$$

$$4A = \begin{pmatrix} 4 & 8 & 8 \\ 8 & 4 & 8 \\ 8 & 8 & 4 \end{pmatrix}, \quad 5I = \begin{pmatrix} 5 & 0 & 0 \\ 0 & 5 & 0 \\ 0 & 0 & 5 \end{pmatrix}$$

For verifying  $A^2 - 4A - 5I = 0$ .

1

14. Getting LHS = 5, RHL = 5

$1\frac{1}{2} \times 2 = 3$

$$\Rightarrow K = 5.$$

1

15. Let  $x = \cos 2\theta$ ,  $\sqrt{1+x} = \sqrt{2} \cos \theta$ ,  $\sqrt{1-x} = \sqrt{2} \sin \theta$ .

1

$$\therefore y = \tan^{-1} \left[ \frac{1 - \tan \theta}{1 + \tan \theta} \right] = \tan^{-1} \cdot \tan \left( \frac{\pi}{4} - \theta \right)$$

$1 + \frac{1}{2} = 1\frac{1}{2}$

$$= \frac{\pi}{4} - \theta = \frac{\pi}{4} - \frac{1}{2} \cos^{-1} x$$

$\frac{1}{2}$

$$\therefore \frac{dy}{dx} = \frac{1}{2\sqrt{1-x^2}}.$$

1

16. At  $t = \pi/4$ ,  $x = \frac{1}{\sqrt{2}}$ ,  $y = 0$ .

1

$$\frac{dx}{dt} = 3 \cos 3t, \quad \frac{dy}{dt} = -2 \sin 2t \quad \therefore \frac{dy}{dx} = \frac{-2 \sin 2t}{3 \cos 3t}$$

$1\frac{1}{2}$

$$\therefore \left. \frac{dy}{dx} \right|_{t=\pi/4} = \frac{2\sqrt{2}}{3}$$

$\frac{1}{2}$

Equation of tangent  $3y = 2\sqrt{2}x - 2$  or  $3y - 2\sqrt{2}x + 2 = 0$

1

17.  $I = \int_0^{\pi} \frac{x \sin x}{1 + \cos^2 x} dx = \int_0^{\pi} \frac{(\pi - x) \sin x}{(1 + \cos^2 x)} dx$

1

$$\therefore 2I = \pi \int_0^{\pi} \frac{\sin x}{1 + \cos^2 x} dx$$

1

$$\therefore I = -\pi \left[ \tan^{-1} (\cos x) \right]_0^{\pi/2} = -\pi(-\pi/4) = \frac{\pi^2}{4}.$$

$1 + \frac{1}{2} + \frac{1}{2} = 2$

18. Writing  $\frac{dy}{dx} = \frac{y^2 - x^2}{2xy}$ , which is homogeneous.

$\frac{1}{2}$

$$\text{Putting } y = vx \Rightarrow \frac{dy}{dx} = v + x \frac{dv}{dx}$$

$\frac{1}{2}$

$$\therefore \text{getting } \frac{2v}{1+v^2} dv = -\frac{dx}{x}$$

1

$$\therefore \log|1+v^2| = -\log|x| + \log|c| = \log\left|\frac{c}{x}\right| \quad 1$$

$$\Rightarrow x^2 + y^2 = cx \quad \Rightarrow \quad c = 2 \text{ when } x = 1, y = 1. \quad 1$$

$$\therefore x^2 + y^2 = 2x. \quad 1$$

**OR**

$$\text{Writing } \frac{dy}{dx} = \frac{2y-x}{2y+x} \quad \frac{1}{2}$$

$$y = vx \quad \Rightarrow \quad \frac{dy}{dx} = v + x \frac{dv}{dx} \quad \frac{1}{2}$$

$$\text{Getting } \frac{2v+1}{2v^2-v+1} dv = -\frac{dx}{x} \quad 1$$

$$\therefore \frac{1}{2} \frac{4v-1}{2v^2-v+1} dv + \frac{3}{4} \frac{dv}{v^2 - \frac{1}{2}v + \frac{1}{2}} = -\frac{dx}{x} \quad 1$$

$$\text{Getting } \frac{1}{2} \log \left| \frac{2y^2 - xy + x^2}{x^2} \right| + \frac{3}{\sqrt{7}} \tan^{-1} \frac{4y-x}{\sqrt{7}x} = -\log x + c \quad 1$$

$$\text{where } c = \frac{1}{2} \log 2 + \frac{3}{\sqrt{7}} \tan^{-1} \frac{3}{\sqrt{7}} \quad 1$$

$$19. \text{ Writing } \frac{dy}{dx} + \sec^2 x \cdot y = \tan x \cdot \sec^2 x \quad \frac{1}{2}$$

$$\text{I.F.} = e^{\tan x} \quad 1$$

$$\therefore \text{Solution is, } y \cdot e^{\tan x} = \int e^{\tan x} \cdot \tan x \cdot \sec^2 x \cdot dx + c \quad \frac{1}{2}$$

$$y \cdot e^{\tan x} = e^{\tan x} (\tan x - 1) + c \quad 1$$

$$\therefore \text{or } y = (\tan x - 1) + c \cdot e^{\tan x} \quad 2$$

$$20. \text{ Let } \vec{c} = xi + yj + zk \quad 2$$

$$\therefore \vec{a} \times \vec{c} = i(z-x) - j(z-x) + \hat{k}(y-x) = 0i + j - \hat{k} \quad 1$$

$$\Rightarrow y = z = x - 1 \quad 1$$

$$\vec{a} \cdot \vec{c} = 3 \quad \Rightarrow \quad x + y + z = 3 \quad \frac{1}{2}$$

$$\therefore x = 5/3, \quad y = z = \frac{2}{3} \quad \Rightarrow \quad \vec{c} = \frac{5}{3}i + \frac{2}{3}j + \frac{2}{3}\hat{k} \quad 1 + \frac{1}{2}$$

**OR**

$$\begin{aligned} \overrightarrow{a} + \overrightarrow{b} + \overrightarrow{c} = \overrightarrow{0} &\Rightarrow \overrightarrow{a} + \overrightarrow{b} = -\overrightarrow{c} & 1 \\ \therefore |\overrightarrow{a}|^2 + |\overrightarrow{b}|^2 + 2\overrightarrow{a} \cdot \overrightarrow{b} &= |\overrightarrow{c}|^2 & 1 \\ 9 + 25 + 2ab \cos \theta &= 49 & 1 \\ \therefore \cos \theta &= +\frac{1}{2} \quad \therefore \theta = \pi/3 = 60^\circ. & 1 \end{aligned}$$

21.  $\overrightarrow{a}_1 = 3i + 5j + 7\hat{k}, \quad \overrightarrow{b}_1 = i - 2j + \hat{k}$  1  
 $\overrightarrow{a}_2 = -i - j - \hat{k}, \quad \overrightarrow{b}_2 = 7i - 6j + \hat{k}$

$$5.D = \frac{|(\overrightarrow{a}_2 - \overrightarrow{a}_1) \cdot (\overrightarrow{b}_1 \times \overrightarrow{b}_2)|}{|\overrightarrow{b}_1 \times \overrightarrow{b}_2|} \quad 1$$

$$\overrightarrow{a}_2 - \overrightarrow{a}_1 = -4i - 6j - 8\hat{k}, \quad \overrightarrow{b}_1 \times \overrightarrow{b}_2 = 4i + 6j + 8\hat{k} \quad \frac{1}{2} + 1 = 1\frac{1}{2}$$

$$\therefore S.D. = \sqrt{116}. \quad \frac{1}{2}$$

**OR**

Getting  $x = 3\lambda - 2, y = 2\lambda - 1, z = 2\lambda + 3$  1

Distance  $D$  from  $(1, 2, 3) = 3\sqrt{2}$ .

$$\therefore (3\sqrt{2})^2 = (3\lambda - 2)^2 + (2\lambda - 3)^2 + (2\lambda)^2 \quad 1$$

$$\Rightarrow \lambda = 0 \text{ or } \lambda = \frac{30}{17}. \quad 1$$

$$\therefore \text{Points are } \left( \frac{56}{17}, \frac{43}{17}, \frac{111}{17} \right) \text{ or } (-2, -1, 3) \quad 1$$

22.  $p = \frac{1}{6}, q = \frac{5}{6} \quad \therefore \text{Prob. dist is } \left( \frac{1}{6} + \frac{5}{6} \right)^4$  1

$x$	0	1	2	3	4	$\frac{1}{2}$
$P(X)$	$\frac{625}{1296}$	$\frac{500}{1296}$	$\frac{150}{1296}$	$\frac{20}{1296}$	$\frac{1}{1296}$	$2\frac{1}{2}$

## SECTION C

23.  $R_3 \rightarrow R_3 + R_1 \Rightarrow \Delta = \begin{vmatrix} \alpha & \beta & \gamma \\ \alpha^2 & \beta^2 & \gamma^2 \\ \alpha + \beta + \gamma & \alpha + \beta + \gamma & \alpha + \beta + \gamma \end{vmatrix} = (\alpha + \beta + \gamma) \begin{vmatrix} \alpha & \beta & \gamma \\ \alpha^2 & \beta^2 & \gamma^2 \\ 1 & 1 & 1 \end{vmatrix}$

$1\frac{1}{2} + \frac{1}{2} = 2$

$c_1 \rightarrow c_1 - c_2$  and  $c_2 \rightarrow c_2 - c_3$

$$\Rightarrow \Delta = (\alpha + \beta + \gamma) \begin{vmatrix} \alpha - \beta & \beta - \gamma & \gamma \\ \alpha^2 - \beta^2 & \beta^2 - \gamma^2 & \gamma^2 \\ 0 & 0 & 1 \end{vmatrix}$$

$1 + 1 = 2$

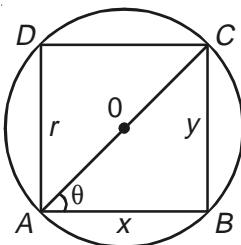
$$= (\alpha + \beta + \gamma)(\alpha - \beta)(\beta - \gamma) \begin{vmatrix} 1 & 1 & \gamma \\ \alpha + \beta & \beta + \gamma & \gamma^2 \\ 0 & 0 & 1 \end{vmatrix}$$

$1$

$$= (\alpha + \beta + \gamma)(\alpha - \beta)(\beta - \gamma)(\gamma - \alpha)$$

$1$

24.  $x = 2r \cos \theta, \quad y = 2r \sin \theta$  1

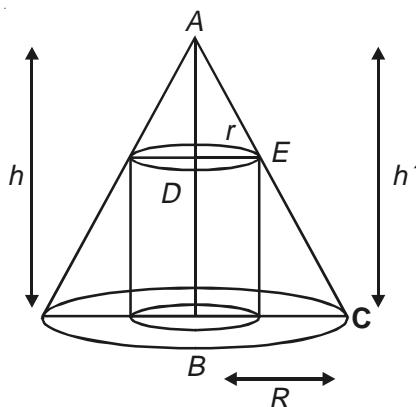


Area  $A = x \cdot y = 4r^2 \sin \theta \cos \theta = 2r^2 \sin 2\theta$  1

$\therefore \frac{dA}{d\theta} = 4r^2 \cos 2\theta; \frac{dA}{d\theta} = 0 \Rightarrow \theta = \pi/4$  1

Showing  $\frac{(d^2A)}{d\theta^2} < 0$  1

$\therefore$  Area is maximum at  $\theta = \pi/4 \Rightarrow x = y \Rightarrow$  square. 1



$$V = \pi r^2 h'$$

1

$$= \pi \frac{R^2}{h^2} [h^2 + h'^2 + 2hh'] h'$$

1

$$\frac{dv}{dh'} = 0 \Rightarrow h' = \frac{h}{3}$$

1

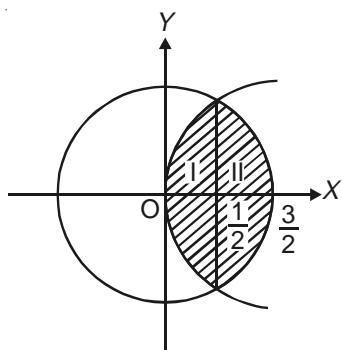
$$\text{Showing } \frac{dV^2}{dh'^2} < 0$$

1

$$\therefore V \text{ is maximum, when height of cylinder} = \frac{1}{3} h.$$

1

25.



1

$$\text{Points of intersection, } x = \frac{1}{2}$$

1

$$\begin{aligned} \text{Required area} &= 2 \int_0^{1/2} 2\sqrt{x} dx + 2 \int_{1/2}^{3/2} \sqrt{\frac{9}{4} - x^2} dx \\ &= \frac{2\sqrt{2}}{3} - \frac{\sqrt{2}}{2} + \frac{9\pi}{8} - \frac{9}{4} \sin^{-1} \frac{1}{3} \end{aligned}$$

2

2

$$\left[ \text{Note : Full credit for } A = \frac{9\pi}{8} - \frac{\sqrt{2}}{6} + \frac{9}{4} - \sin^{-1} \frac{1}{3} \right]$$

$$26. \quad I = \int_{-a}^a \sqrt{\frac{a-x}{a+x}} dx = \int_{-a}^a \frac{a dx}{\sqrt{a^2 - x^2}} - \int_{-a}^a \frac{x dx}{\sqrt{a^2 - x^2}} = I_1 + I_2$$

1 + 1 = 2

In,  $I_1$  function is even and in  $I_2$ , function is odd

1m

$$\therefore I_2 = 0$$

1m

$$\therefore I = 2a \int_0^a \frac{dx}{\sqrt{a^2 - x^2}} = 2a \cdot \pi/2 = \pi \cdot a.$$

2

27. Equation of plane through  $(-1, -1, 2)$  is

$$a(x + 1) + b(y + 1) + c(z - 2) = 0 \quad (\text{i})$$

$$\therefore 2a + 3b - 3c = 0 \text{ and } 5a - 4b + c = 0$$

$$\text{Solving to get } a : b : c = 9 : 17 : 23$$

$$\therefore \text{Equation of plane is } 9x + 17y + 23z = 20$$

**OR**

Equation of plane through  $(3, 4, 1)$  is

$$a(x - 3) + b(y - 4) + c(z - 1) = 0$$

$$\therefore \text{we get } 3a + 3b + c = 0 \text{ and } 2a + 7b + 5c = 0$$

$$\text{Solving to get } a : b : c = 8 : -13 : 15$$

$$\therefore \text{Equation of plane is } 8x - 13y + 15z + 13 = 0$$

28. Getting the constraints as

$$5x + 6y \leq 45, \quad 3x + 2y \leq 18, \quad x \geq 0, \quad y \geq 0$$

$$\text{Total output } P = 60x + 40y$$

Correct graph

Vertices of feasible region are

$$(0, 0), (6, 0), \left(\frac{9}{4}, \frac{45}{8}\right), (0, 15/2)$$

$$\therefore P \text{ at } (0, 0) = 0 \quad P \text{ at } (6, 0) = 360$$

$$P \text{ at } (0, 15/2) = 300m \quad P \text{ at } \left(\frac{9}{4}, \frac{45}{8}\right) = 360.$$

$$\therefore \text{Max. } P = 360.$$

$$29. \quad P(E_1) = \frac{1}{6}, \quad P(E_2) = \frac{1}{3}, \quad P(E_3) = \frac{1}{2}$$

$$P(A/E_1) = \frac{1}{100}, \quad P(A/E_2) = \frac{3}{100}, \quad P(A/E_3) = \frac{15}{100}$$

$$\begin{aligned} P(E_1/A) &= \frac{P(E_1) \cdot P(A/E_1)}{\sum_{i=1}^3 P(E_i) P(A/E_i)} \\ &= \frac{1}{52}. \end{aligned}$$

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# PRACTICE QUESTION PAPER-1

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Time : 3 hours

Total Marks = 100

**General Instructions**

1. Question paper has three sections, Section A, contains 10 questions of 1 mark each, Section B contains 12 questions of 4 marks each and Section C contains 7 questions of 6 marks each.
2. All questions are compulsory.
3. Internal choices are given in some questions, where one part is to be attempted out of two.
4. Calculators are not allowed.

## SECTION A

1. If  $A = \begin{pmatrix} 5 & -1 \\ 4 & 1 \end{pmatrix}$  what is adj A?
2. What is the principal value of  $\cos^{-1}\left(-\frac{\sqrt{3}}{2}\right)$  ?
3. If A is a matrix of order  $2 \times 2$  and  $|A| = -3$ , what is the value of  $|3A|$ ?
4. Let  $f : R \rightarrow R$  be defined as  $f(x) = \frac{2x - 3}{5}$ , what is  $f^{-1}$ ?
5. What is the differential equation representing the family of straight lines  $y = mx + c$ , m, c being arbitrary constants?
6. Write the general solution of the differential equation in  $\frac{dy}{dx} = xy$ .
7. If a line makes angle  $90^\circ$ ,  $150^\circ$  and  $60^\circ$  with the positive direction of x, y and z-axis respectively, what are its direction cosines?
8. Write the vector equation of the line  $\frac{x+2}{3} = \frac{y+4}{5} = \frac{6-z}{2}$ .
9. Give example of two non zero  $2 \times 2$  matrices A and B such that  $A.B. = 0$ .
10. If  $\overrightarrow{a} = i + j$ ;  $\overrightarrow{b} = j + \hat{k}$ ;  $\overrightarrow{c} = \hat{k}$  what will be the unit vector in the direction of  $\overrightarrow{a} + \overrightarrow{b} + \overrightarrow{c}$  ?
11. Let X be a nonempty set and  $P(X)$  be its powerset. Let \* be the binary operation defined in  $P(X)$  by  $A * B = A \cap B$ ,  $\forall A, B \in P(X)$ .
  - (i) show that \* is commutative.

- (ii) \* is associative  
 (iii) Find the identity element in  $P(X)$  w.r.t. \*  
 (iv) Find the invertible elements of  $P(X)$

**OR**

Show that the relation  $R$  in Set  $A = \{x : x \in \mathbb{Z}, 0 \leq x \leq 15\}$  given by  $R = \{(a, b) : (a - b)$  is a multiple of 3}, is an equivalence relation. Also find the set of all elements related to 4.

12. Find  $x$ , if  $\tan^{-1} 4x = \cot^{-1} \left( 2 \tan \cos^{-1} \frac{5}{13} \right) + \tan^{-1} \left( 2 \tan \sin^{-1} \frac{5}{13} \right)$ .

13. If  $a, b, c$  are all positive and distinct, then prove that :

$$\Delta = \begin{vmatrix} a & b & c \\ b & c & a \\ c & a & b \end{vmatrix} \text{ is negative.}$$

14. Determine the values of  $m, n, p$  for which the function :

$$f(x) = \begin{cases} \frac{\sin x + \sin(m+1)x}{n}, & \text{for } x < 0 \\ \frac{\sqrt{x+px^2} - \sqrt{x}}{px^{3/2}}, & \text{for } x > 0 \end{cases}$$

for  $x < 0$  is continuous at  $x = 0$ .

15. Find the intervals in which the function  $f(x) = (x+3)^3 \cdot (x-2)^3$  is strictly increasing or decreasing.

16. For  $a > 0$  find  $\frac{dy}{dx}$ , if  $y = a^{\frac{t-1}{t}}$  and  $x = \left( t - \frac{1}{t} \right)^a$

If  $x = \sqrt{a^{\sin^{-1} t}}, y = \sqrt{a^{\cos^{-1} t}}$ , for  $a > 0$ .

Show that  $\frac{dy}{dx} = -\frac{y}{x}$ .

17. Evaluate :  $\int \frac{1}{\sin(x-\alpha)\cos(x-\beta)} dx$

**OR**

Evaluate :  $\int \frac{1}{\sqrt{(x-a)(x-b)}} dx$

18. Evaluate  $\int_2^5 (3x^2 - 2x) dx$  by the method of limit a sum.

**OR**

Using properties of definite integrals evaluate :

$$\int_0^{\pi} \log |1 + \cos x| dx$$

19. Evaluate  $\int \frac{2x+3}{(1-x^2)(1+x^2)} dx.$
20. Using vectors show that the angle between any two diagonals of a cube is  $\cos^{-1}\left(\frac{1}{3}\right).$

**OR**

Find the angle between the lines whose direction cosines ( $l, m, n$ ) are given by the equations.  
 $3l + m + 5n = 0, 6mn - 2nl + 5lm = 0.$

21. Let  $\overrightarrow{a} = i + 4j + 2\hat{k}, \overrightarrow{b} = 3i - 2j + 7\hat{k}$  and  $\overrightarrow{c} = 2i - j + 4\hat{k}$ . Find a vector  $\overrightarrow{d}$  which is perpendicular to both  $\overrightarrow{a}$  and  $\overrightarrow{b}$ , and  $\overrightarrow{c} \cdot \overrightarrow{d} = 15$ .
22. The probability that a person will buy a shirt is 0.2, the probability that he will buy a trouser is 0.3 and the probability that he will buy a shirt given that he buys a trouser, is 0.4. Find the probability that he will buy a shirt and a trouser. Find also the probability that he will buy a trouser given that he buys a shirt.

23. Obtain the inverse of the matrix  $A = \begin{pmatrix} 3 & 1 & 1 \\ 1 & 2 & 3 \\ 0 & 1 & 2 \end{pmatrix}$  using elementary transformations and verify your result.

**OR**

The sum of three numbers is 2. If twice the second number is added to the sum of first and third, the sum is 1. By adding second and third number to five times the first number, we get 6. Find the three numbers using matrices.

24. The cost of fuel for running a bus is proportional to the square of the speed generated in km/hr. It costs Rs. 48 per hour when the bus is moving at a speed of 20 km/hr. What is the most economical speed if the fixed charges are Rs. 108 for an hour, over and above the running charges?
25. Find the area of region common to the circle  $x^2 + y^2 = 16$  and the parabola  $x^2 = 6y$ , using integration.
26. Solve the differential equation :  $(x^3 - 3xy^2)dx = (y^3 - 3x^2y) dy$

**OR**

Form the differential equation of the family of circles in the second quadrant which touch the coordinate axes.

27. Find the shortest distance between the pair of lines whose cartesian equations are :

$$\frac{x-1}{2} = \frac{y+1}{3} = z \text{ and } \frac{x+1}{3} = \frac{y-2}{1}; z = 2.$$

28. A fair coin is tossed 6 times. Find the probability of getting :

- (i) exactly 5 heads
- (ii) at least 5 heads
- (iii) at most 5 heads

Find also the mean and variance of the number of heads.

29. A diet is to contain at least 60 units of vitamin A and 45 units of minerals. Two foods  $F_1$  and  $F_2$  are available. Food  $F_1$  costs Rs. 4 per unit and food  $F_2$  costs Rs. 6 per unit. One unit of food  $F_1$  contains 3 unit of vitamin A and 4 units of minerals. One unit of food  $F_2$  contains 6 units of Vitamin A and 3 units of minerals. Formulate this as a linear programming problem to find the minimum cost for diet that consists of mixture of these two foods and also meets the minimal nutritional requirements and solve it graphically.

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# PRACTICE QUESTION PAPER–2

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Time : 3 hours

Total Marks = 100

**General Instructions**

1. Question paper has three sections, Section A, contains 10 questions of 1 mark each, Section B contains 12 questions of 4 marks each and Section C contains 7 questions of 6 marks each.
2. All questions are compulsory.
3. Internal choices are given in some questions, where one part is to be attempted out of two.
4. Calculators are not allowed.

## SECTION A

1. If  $f(x) = \sin^{-1} x$ ,  $g(x) = x^3$ .  
Then what is  $gof(x)$ , if it is defined.
2. If the points  $(2, -3)$ ,  $(\lambda, -1)$  and  $(0, 4)$  are collinear, find the value (s) of ' $\lambda$ '.
3. Write the principal value of  $\tan^{-1}\left(\frac{-1}{\sqrt{3}}\right)$ .
4. Write the no. of all possible matrices of order  $2 \times 2$  with each entry 4 to 5.
5. If  $A$  be a square matrix of order  $3 \times 3$  and  $|A| = 10$ , then write the value of  $|4A|$ .
6. Write the order and degree of the differential equation  $\left(\frac{d^2y}{dx^2}\right)^2 + 5\left(\frac{dy}{dx}\right)^3 = \sin x$ .
7. Write the differential equation representing the family of parabolas  $y^2 = 4bx$ .
8. If the position vector  $\vec{a}$  of point  $P(3, n)$  is such that  $|\vec{a}| = 5$ , then write the value of  $n$ .
9. Find the angle between the lines,  $\frac{x-1}{2} = \frac{y-1}{3} = \frac{z}{-4}$  and  $\frac{x}{-1} = \frac{2y}{3} = \frac{z}{0}$ .
10. Find the distance between the planes.  
 $3x + 4y - 7 = 0$  and  $3x + 4y + 3 = 0$ .

## SECTION B

11. If  $\cos^{-1} x + \cos^{-1} y + \cos^{-1} z = \pi$  then show that  $x^2 + y^2 + z^2 + 2xyz = 1$ .

Or

Prove that  $\tan \left[ 2 \tan^{-1} \frac{1}{5} - \frac{\pi}{4} \right] = \frac{-7}{17}$ .

12. Express  $A = \begin{bmatrix} -3 & 4 \\ 2 & 7 \end{bmatrix}$  as the sum of a symmetric and a skew-symmetric matrix.
13. Show that  $f : R \rightarrow R$  defined by  $f(x) = x^3 - 8$ , is bijective. Also find  $f^{-1}$  (19).
14. For what values of 'a' and 'b'

$$f(x) = \begin{cases} 5x^2 - ax & \text{if } x < 1 \\ 8 & \text{if } x = 1 \\ bx^3 - 3x & \text{if } x > 1 \end{cases}$$

is continuous at  $x = 1$ .

15. If  $x = a \cos^3 \theta$ ,  $y = \sin^3 \theta$ , find  $\frac{d^2y}{dx^2}$ .

**OR**

If  $y = (\sin x)^x + (\log x)^{\cos x}$ , find  $\frac{dy}{dx}$ .

16. If  $f(x) = x^2 - 3x + 1$  then using differential find the approximate value of  $f(1.09)$ .

**OR**

Find the equation of normal to the ellipse,  $3x^2 + 6y^2 = 6$  at  $P(x_1, y_1)$  where  $y_1 = 1$ .

17. Evaluate :  $\int \frac{\sin x}{\sin 4x} dx$ .

18. Evaluate :  $\int \frac{dx}{\sqrt{e^{2x} + 3e^x + 1}}$ .

19. Evaluate :  $\int_{\pi/6}^{\pi/3} \frac{\sin x + \cos x}{\sqrt{\sin 2x}} dx$ .

**OR**

Evaluate :  $\int e^{2x} \left( \frac{1 + \sin 2x}{1 + \cos 2x} \right) dx$ .

20. Prove that, for any two vectors  $\vec{a}$  and  $\vec{b}$ .

$$|\vec{a} \times \vec{b}|^2 = |\vec{a}|^2 |\vec{b}|^2 - (\vec{a} \cdot \vec{b})^2.$$

## **SECTION C**

23. For the matrix  $A = \begin{pmatrix} 3 & -2 & 1 \\ 5 & 0 & 4 \\ 1 & 6 & 3 \end{pmatrix}$ , find  $A^{-1}$  and use it to solve, system of equations.

$$3x + 5y + z = 5$$

$$-2x + 6z = 10$$

$$x + 4y + 3z = 15$$

24. Show that the semi-vertical angle of a right circular cone of given surface area and maximum volume is  $\sin^{-1}\left(\frac{1}{3}\right)$ .

25. Find the area of the region bounded by  $y^2 \geq 4x$  and  $4x^2 + 4y^2 \leq 9$ .

OR

Evaluate :  $\int_0^2 (3x^2 - 2x) dx$  as a limit of a sum.

26. Solve initial value problem :  $x \cdot e^{y/x} - y \sin\left(\frac{y}{x}\right) + x \frac{dy}{dx} \sin\left(\frac{y}{x}\right) = 0$ , given that  $y(1) = 0$ .

27. Find the shortest distance between the two skew lines :

27. Find the shortest distance between the two skew lines :

$$\frac{x-1}{1} = \frac{y+2}{2} = \frac{z}{3} \text{ and } \frac{x}{-1} = \frac{2-y}{2} = \frac{z-1}{3}$$

28. An aeroplane can carry a maximum of 200 passengers. A profit of Rs. 1000 is made on each executive class ticket and a profit of Rs. 600 is made on each economy class ticket. The Airline reserve at least 20 seats for executive class. However at least 4 times as many passengers prefer to travel by economy class, than by the executive class. Determine how many tickets of each type must be sold in order to maximise the profit for the Airline. What is the maximum profit?

29. In a test, an examine either guesses or copies or knows the answer to a multiple choice question with four choices. The probability that he makes a guess is  $\frac{2}{3}$  and the probability that he copies the answer is  $\frac{1}{8}$ . The probability that his answer is correct, given that he copied it, is  $\frac{1}{8}$ . Find the probability that he knew the answer to the question, given that he correctly answered it.

## HINTS AND ANSWERS

### CHAPTER 1

# RELATION AND FUNCTIONS

1.  $R_1$  – Universal Relation  
 $R_2$  – Empty Relation.  
 $R_3$  – Neither Empty Nor Universal.  
 $R_4$  – Neither Empty nor Universal.  
 $R_5$  – Neither Empty nor Universal
2. (i) Yes. Because every element in set A has different image in A.  
(ii) Yes, (Constant function)  
(iii) No, Because 2 have two images.  
(iv) No, Because 5 has no image.  
(v) No, Because 2 does not have a unique image.
3.  $(\text{Fog}) (7) = 7$   
 $(\text{gof}) (7) = 7$   
[Hint. : Use  $(\text{fog}) (x) = f[g(x)]$ ]
4.  $\text{fog} = \{(0, 6), (1, 3), (2, 2)\}$
5.  $(\text{fof}) (x) = \frac{x}{2x + 1}$ .
6.  $f^{-1}(x) = \frac{5x + 1}{2}$ .
7. (i) Not one-one Hint. :  $f(2) = f(-2)$   
(ii) One-one  
(iii) Not one-one  
(iv) One-one  
(v) Not one-one Hint. :  $f(1) = f(2) = f(3) = 0$   
(vi) Not one-one Hint. :  $f(1.3) = f(1.4) = 1$   
(vii) Not one-one because  $f(0) = f(\pi) = 0$ .

- (viii) One-one because  $x_1 \neq x_2$  in  $[0, \pi] \Rightarrow f(x_1) \neq f(x_2)$
- (ix) One-one.
8. (i) Onto (function) [Hint. : Range = Codomain.]
- (ii) onto (Surjective function).
- (iii) onto
- (iv) Not onto Because  $R_f \neq R$
- (v) Not onto, Because  $R_f = \{1, 8, 27, \dots\} \neq N$
- (vi) Not onto, Because  $R_f = (0, \infty) \neq R$
- (vii) Not onto, because 1 has no preimage.
- (viii) Not onto, as  $f(x)$  is constant function  $R_f = \{0\}$ .
9. (i) 0 (ii) 12
- (iii) 26/9 (iv) 5/27
10. (a) Equivalence Relation
- (b) Transitive Relation/
- (c) Reflexive and Transitive.
- (d) Reflexive and Transitive.
- (e) Symmetric and Transitive.
- (f) Reflexive and Transitive.
- (g) Neither symmetric nor reflexive nor transitive.
- (h) Equivalence Relation.
- (i) Neither reflexive nor symmetric nor transitive.
- (j) Equivalence Relation.
11. (i) Bijective (one-one and onto)
- (ii) Bijective
- (iii) Neither injective nor surjective.
- (iv) Neither injective nor surjective.
- (v) Bijective
- (vi) Neither one-one nor onto.
- (vii) Bijective

(viii) Bijective

(ix) Injective but not surjective.

(x) Bijective

(xi) Injective but not surjective

(xii) Neither injective nor surjective.

12. Commutative and associative. (1, 1) is identity element.

13. (i) Yes, '\*' is commutative

$$(ii) 2 * (3 * 4) = 2 * |3^2 - 4^2| = 2 * 7 = |4 - 49| = 45$$

$$(2 * 3) * 4 = |2^2 - 3^2| * 4 = 5 * 4 = |25 - 16| = 9.$$

$\therefore$  '\*' is not associative.

14. (i) No, '\*' is not commutative

(ii) Not associative.

15. 0 is the identity element in  $\mathbb{Q} - \{1\}$ .

16.  $f(x)$  is bijective and  $f^{-1}(x) = \frac{4x + 1}{3}$ .

17. No, it is not invertible. Because,  $f$  is not one-one function :  $f(0) = f(\pi) = 0$

18. (fog)  $(x) = x$ .

(gof)  $(x) = x$ . Hence they are equal.

19. No, They are not equal.

## CHAPTER 2

# INVERSE TRIGONOMETRIC FUNCTIONS

1. (i)  $\frac{-\pi}{3}$       (ii)  $\frac{\pi}{3}$       (iii)  $\frac{5\pi}{6}$

(iv)  $\frac{\pi}{6}$       (v)  $\frac{-\pi}{6}$       (vi)  $\frac{\pi}{6}$

(vii)  $\frac{-\pi}{6}$       (viii)  $\frac{\pi}{6}$       (ix)  $\frac{2\pi}{3}$

(x)  $\frac{\pi}{3}$       (xi)  $\frac{2\pi}{3}$       (xii)  $\frac{\pi}{3}$

(xiii)  $\frac{\pi}{6}$

2. (i) 0      (ii)  $\frac{-\pi}{3}$       (iii)  $\frac{-\pi}{2}$

(iv)  $\frac{\pi}{2}$       (v)  $\frac{2\pi}{3}$       (vi)  $\frac{\pi}{2}$

(vii)  $\pi$       (viii)  $\frac{\pi}{3}$       (ix)  $\frac{\pi}{5}$

(x)  $\frac{3\pi}{5}$       (xi)  $\frac{-\pi}{6}$       (xii)  $\frac{\pi}{4}$

7. **Hint.** : Divide Num. and Den. By  $b \cos x$ .

12.  $x = 1$       [Hint. : Other value of  $x$  does not satisfy.]

13.  $x = 1/6$ .

15. (ii)  $\frac{3\pi}{4}$ .

## CHAPTER 3

# MATRICES AND DETERMINANTS

1.  $\begin{bmatrix} 0 & 3 \\ 1 & 0 \end{bmatrix}$ .

2.  $2xm$ .

3.  $\begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix}$ .

4. [18]

5.  $10\lambda$ .

6.  $3 \times 3$ .

7. 5.

8. 2.

9.  $x = \begin{bmatrix} 5 & 1 \\ 2 & 0 \end{bmatrix}$ .

10. 64.

[Hint. :  $2^6 = 64$ ]

11.  $A = \begin{bmatrix} 1 & 0 \\ 0 & 0 \end{bmatrix}, B = \begin{bmatrix} 0 & 0 \\ 0 & 1 \end{bmatrix}$ .

12.  $\begin{bmatrix} 6 & -3 \\ -9 & 12 \\ 0 & 15 \end{bmatrix}$ .

13.  $\begin{bmatrix} 2 & 2 \\ 2 & 0 \end{bmatrix}$ .

14. 0.

15.  $a^2 + b^2 + c^2 + d^2$ .

16.  $(-3)^{1/3}$ .

17. 28.

18.  $id - fg$ .

19.  $\pm\sqrt{\frac{2}{3}}$ . [Hint. :  $-3x^2 - 5 = -7$ ].

20.  $\frac{\pi}{6}, \frac{\pi}{2}$ . [Hint. :  $2 \sin^2 x + 1 = 3 \sin x$ ].

21. 0.

22. 54. [Hint. : order 3  $\Rightarrow |-3A| = (-3)^3 |A|$ ].

23. 1 Sq. unit.

24.  $x = \text{any real number}$ .

25.  $a_{13}M_{13} - a_{23}M_{23} + a_{33}M_{33}$

26.  $\frac{\pi}{3}$ .

27.  $\lambda = -\frac{3}{8}$ .

28.  $\pm 5\sqrt{5}$ . [Hint. :  $|\text{Adj } A| = |A|^{n-1}$ ]

29.  $|A| = 0$  and  $(\text{adj } A)B = 0$

30.  $\begin{bmatrix} 5 & -3 \\ 6 & 8 \end{bmatrix}$ .

31. 40.

32.  $I_2$ .

33.  $\begin{bmatrix} -13 & 2 \\ 9 & -6 \end{bmatrix}$

34. 25.

[Hint. :  $|\text{Adj } A| = |A|^{n-1}$ ]

35.  $\begin{bmatrix} 6 & 5 \\ -5 & -6 \end{bmatrix}$

36.  $x = 2, y = 1$ .

37. 3.

38. 0;

[Hint. :  $[R_1 \rightarrow R_1 + R_2 + R_3]$ ]

39.  $x = -4$ .

40.  $\begin{bmatrix} -4 & 0 \\ 0 & -4 \end{bmatrix}$

41.  $\begin{bmatrix} 4 & -3 \\ -1 & 2 \end{bmatrix}$

42.  $pqr$ .

43. 12.

44. 0.

[Hint. :  $A^2 = 0$ ]

45. 0. [Hint. :  $A + B + C = \pi$ ]

46. 0.

47. 5.

48. 200.

49. 20.

50.  $\frac{\pi}{6}$ .

$$\begin{bmatrix} 0 & -\frac{1}{3} & -\frac{1}{2} & -\frac{3}{5} \end{bmatrix}$$

51.  $A = \begin{bmatrix} \frac{1}{3} & 0 & \frac{-1}{5} & -\frac{1}{3} \\ \frac{1}{3} & \frac{1}{5} & 0 & -\frac{1}{7} \end{bmatrix}$

52.  $x = 1, y = 2, z = 3, w = 4$ .

$$A = \begin{bmatrix} \frac{11}{7} & -\frac{9}{7} & \frac{9}{7} \\ \frac{1}{7} & \frac{18}{7} & \frac{4}{7} \end{bmatrix}, \quad B = \begin{bmatrix} -\frac{5}{7} & -\frac{2}{7} & \frac{1}{7} \\ \frac{4}{7} & -\frac{12}{7} & -\frac{5}{7} \end{bmatrix}$$

54.  $X = \begin{bmatrix} 1 & -2 \\ 2 & 0 \end{bmatrix}$

59.  $\begin{bmatrix} 1 & -3 \\ -1 & \frac{7}{2} \end{bmatrix}$

60.  $\begin{bmatrix} \frac{3}{5} & \frac{1}{5} \\ -\frac{2}{5} & \frac{1}{5} \end{bmatrix}$

61. [Hint. : Use  $\cos \theta = \frac{1 - \tan^2 \theta/2}{1 + \tan^2 \theta/2}$  and  $\sin \theta = \frac{2 \tan \theta/2}{1 + \tan^2 \theta/2}$ ]

62.  $x = -2$  or  $x = -14$ .

63.  $x = 9, y = 14$ .

64. [Hint. : Use principle of mathematical induction]

66.  $-14I_3$

67.  $A^{-1} = \frac{1}{2} \begin{bmatrix} 7 & 3 \\ 4 & 2 \end{bmatrix}$

68.  $A^{-1} = \frac{1}{7} \begin{bmatrix} 2 & 1 \\ -3 & 2 \end{bmatrix}$

70.  $A^{-1} = \frac{1}{17} \begin{bmatrix} 4 & 3 \\ -3 & 2 \end{bmatrix}$

73. [Hint. :  $x = AR^{10-1}$  where  $A$  = first term,  $R$  = common ratio]

81.  $AB = \begin{bmatrix} 1 & 2 \\ -2 & 2 \end{bmatrix}, (AB)^{-1} = \frac{1}{6} \begin{bmatrix} 2 & -2 \\ 2 & -1 \end{bmatrix}$

82. (i) 20 sq. unit.    (ii)  $x = -3, x = \frac{1}{2}$ .

86.  $x = \frac{11}{24}, y = \frac{1}{24}$ .

87.  $A^5 = \begin{bmatrix} -118 & -93 \\ 31 & -118 \end{bmatrix}$ .    [Hint. :  $A^2 - 4A + 7I = 0, A^2 = 4A - 7I, A^3 = 4(4A - 7I) - 7A$ ]

89.  $X = \begin{bmatrix} -16 & 3 \\ 24 & -5 \end{bmatrix}$ .    [Hint. : if  $A \times B = P, X = A^{-1} P B^{-1}$ ]

90.  $A^{-1} = \frac{1}{2} \begin{bmatrix} -1 & 1 & 1 \\ 1 & -1 & 1 \\ 2 & 1 & -1 \end{bmatrix}$ .

91.  $\frac{1}{5} \begin{bmatrix} -2 & 0 & 3 \\ -1 & 1 & 0 \\ 2 & 1 & -2 \end{bmatrix}$ .

92.  $\begin{bmatrix} 3 & 2 & 6 \\ 1 & 1 & 2 \\ 2 & 2 & 5 \end{bmatrix}$ .

93.  $\begin{bmatrix} -2 & 1 & 1 \\ \frac{11}{4} & \frac{-1}{2} & \frac{-3}{4} \\ -1 & 0 & 0 \end{bmatrix}$ .

96.  $x = \frac{10}{19}, y = \frac{-31}{19}, z = \frac{-8}{19}$ .

97.  $x = 2, y = -1, z = -2$ .

$$98. \quad x = 1, y = 0, z = -5.$$

$$99. \quad x = 1, y = 1, z = 1.$$

[Hint. : equations are  $A'x = B$ , so  $X = (A')^{-1}B = (A)^{-1}B$ ]

$$100. \quad A^{-1} = \frac{1}{67} \begin{bmatrix} -6 & 17 & 13 \\ 14 & 5 & -8 \\ -15 & 9 & -1 \end{bmatrix}.$$

$$x = 3, y = -2, z = 1.$$

$$101. \quad x = 4, y = -3, z = 1.$$

$$102. \quad x = 1, y = -2, z = 2.$$

[Hint. : Suppose three numbers as  $x, y, z$ ]

$$103. \quad A^{-1} = \begin{bmatrix} 2 & 0 & -1 \\ 5 & 1 & 0 \\ 0 & 1 & 3 \end{bmatrix}.$$

$$104. \quad (AB)^{-1} = \frac{1}{19} \begin{bmatrix} 16 & 12 & 1 \\ 21 & 11 & -7 \\ 10 & -2 & 3 \end{bmatrix}.$$

[Hint. :  $(AB)^{-1} = B^{-1}A^{-1}$ ]

$$105. \quad x = 3, y = -2, z = -1.$$

$$106. \quad x = 2, y = 3, z = 5.$$

[Hint. : Let  $\frac{1}{x} = u, \frac{1}{y} = v, \frac{1}{z} = w.$  ]

$$107. \quad A^{-1} = \frac{1}{11} \begin{bmatrix} -3 & 4 & 5 \\ 9 & -1 & -4 \\ 5 & -3 & -1 \end{bmatrix}.$$

# CHAPTER 5

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## DIFFERENTIATION

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1.  $x = \frac{5}{3}$ .

2.  $\frac{x}{|x|}$ .

[Hint.  $f(x) = \sqrt{x^2}$ ,  $f'(x) = \frac{1}{2\sqrt{x^2}} \times 2x = \frac{x}{|x|}$ .]

3.  $x = 3$ .

4.  $x = 2, x = 3$ .

5. All integer

6. Discontinuous at  $x = 0$ .

[Hint. : Limit discontinuous LHL = -1, RHL = 1]

7.  $(0, \infty)$ .

8.  $\lambda = \frac{-1}{2}$ .

9.  $(0, \frac{1}{3})$

[Hint. :  $\log x$  is continuous in  $(0, \infty)$ ,  $\sqrt{1 - 9x^2}$  is continuous in  $(-\frac{1}{3}, \frac{1}{3})$ , common is  $(0, \frac{1}{3})$ .

10. 1.

[Hint. : As  $\lim_{x \rightarrow 0} \frac{\sin x}{x} = 1$ , so  $k = 1$ ]

11.  $2x^3$ .

[Hint. :  $\frac{d}{dx^3} (x^3)^2 = 2x^3$ ]

12.  $\frac{1}{x \log x}$ .

[Hint. :  $f(\log x) = \log(\log x)$ ]

13.  $\log_e(e - 1)$ .

[Hint. :  $e^x = \frac{e^1 - e^0}{1 - 0}$ ,  $\Rightarrow e^x = e - 1$ ,  $\Rightarrow x = \log_e(e - 1)$ .

14. 0.

[Hint. :  $\sin^{-1} x + \cos^{-1} x = \frac{\pi}{2}$ , so  $\frac{d}{dx} \frac{\pi}{2} = 0$ ]

15. 2.

16. (a)  $\frac{-1}{2\sqrt{x}(1+x)}$

(b)  $\frac{-2}{\sqrt{1-x^2}}$

(c)  $\frac{3}{3x-5} \log_5 e$

$$(d) \frac{4}{1+16x^2} - \frac{3}{1+9x^2}$$

$$\text{Hint. : } \tan^{-1} \frac{4x-3x}{1+4x \cdot 3x}$$

$$(e) \frac{3}{1+x^2}$$

[Hint. : put  $x = \tan \theta$ ]

$$(f) e^{\tan^{-1} x^2} \cdot \frac{2x}{1+x^4}$$

$$(g) 10x^4 \sin x^5 \cos x^5 \cos x^3 - 3x^2 \sin x^3 \sin x^5$$

$$(h) \frac{e}{4\sqrt{xe^x}}$$

$$(i) \frac{3}{2} \sqrt{\frac{x}{1-x^2}}$$

$$(j) \frac{-\sin x}{2\sqrt{1-\cos x}\sqrt{\cos x}}$$

17. Discontinuous.

18. Discontinuous.

19. Discontinuous.

20. Continuous.

21. Continuous.

$$\begin{cases} -2x & \text{if } x \leq -1 \\ 2 & \text{if } -1 \leq x < 1 \\ 2x & \text{if } x \geq 1 \end{cases}$$

22. Continuous.

23. Continuous

$$\text{Hint. : } \lim_{x \rightarrow 0} \frac{[(1+x) - (1-x)]}{x \frac{\sin x}{x} (\sqrt{1+x} + \sqrt{1-x})} = \lim_{x \rightarrow 0} \frac{2x}{\sin x (\sqrt{1+x} + \sqrt{1-x})} = \frac{2}{1 \times 2} = 1$$

24. Continuous.

$$25. \frac{17}{6}.$$

26.  $a = 1, b = -1$ .

27. 0, 1.

[Hint. : As  $f(x) = \frac{1}{x}$  so discontinuity at  $x = 1$

As  $f[f(x)] = \frac{x-1}{x}$ , so discontinuity at  $x = 0$ .]

$$28. k = \frac{1}{2}.$$

30. Discontinuous  $x = \frac{5}{2}$ .

31. Not differentiable.

32.  $p \in (1, \infty)$ . Hint. :  $f(0) = \lim_{x \rightarrow 0} \frac{x^p \sin \frac{1}{x} - 0}{x} = \lim_{x \rightarrow 0} x^{p-1} \cdot \sin \frac{1}{x}$ , for which  $p-1 > 0$

33.  $a = 2, b = 1$ .

34.  $(\log x)^x \left[ \frac{1}{\log x} + \log(\log x) \right] + 2x^{\log x - 1} \log x$ . [Hint. : take log on both sides]

35. 0.

36.  $\frac{-x}{\sqrt{1-x^2}}$ .

39.  $\frac{x^x (1 + \log x) + \sec^3 x \tan x}{x^x + \sec^2 x}$ .

44.  $-\frac{1}{2}$ . Hint. :  $\sqrt{1 + \sin x} = \left| \cos \frac{x}{2} + \sin \frac{x}{2} \right|$

45.  $\frac{2a}{\sqrt{1-a^2x^2}}$ . [Hint. : put  $ax = \sin \theta$ ]

46. 1.

49.  $2 \left[ \frac{1+x-x^2}{(x^2+1)^2} \right]$ .

50.  $\frac{-[y^x \log y + y x^{y-1} + x^x (1 + \log x)]}{x(y^{x-1} + x^{y-1} \log x)}$ .

51.  $\frac{\theta^2 + 1}{\theta^2 - 1}$ .

52.  $\frac{1}{3a \cos^4 \theta \sin \theta}$ .

54.  $\frac{2t}{t^2 - 1}$ .

$$55. \frac{1}{\sqrt{1-x^2}} - \frac{1}{2\sqrt{x-x^2}}.$$

[Hint. : put  $x = \sin \theta$   $\sqrt{x} = \sin \phi$ ]

$$56. y \left[ \frac{1}{2(x-1)} + \frac{2}{(1+x^2)\tan^{-1}x} - 2 - 4 \cot 2x \right]$$

$$57. \tan t.$$

$$58. -1.$$

[Hint. : put  $\frac{3}{5} = \sin \alpha$ ,  $\frac{4}{5} = \cos \alpha$ ]

$$59. \frac{-1}{\sqrt{1-x^2}}.$$

$$60. \frac{y^2}{x(x-y\log x)} \text{ or } \frac{y^2}{x^2(1-\log y)}.$$

$$62. -\cot y \operatorname{cosec}^2 y.$$

$$66. \frac{-2}{x^2}.$$

## CHAPTER 6

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# APPLICATIONS OF DERIVATIVES

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1. 1
2.  $C = \frac{3}{2}$ . [Hint. :  $f'(x) = 2x - 3 = 0, x = 3/2$ ]
3.  $(0, \pi)$ .
4.  $(-\infty, 0)$ .
5.  $(-\infty, -\frac{1}{3})$ . [Hint. :  $f'(x) = \cos x - 3\lambda, \cos x - 3\lambda > 0, \lambda < -\frac{1}{3}$ ]
6.  $(\frac{1}{e}, \infty)$  [Hint. :  $f'(x) = x^x (\log x + 1) \Rightarrow \log x + 1 > 0, x > e^{-1}$ ]
7. Increasing
8. 2 [Hint. :  $f(x)$  is minimum at  $x = 1$ ]
9.  $\frac{1}{2}$ .
10. Maximum value of  $f(x) = 5$ , Minimum value of  $f(x) = 1$ .  
[Hint. :  $-1 \leq \sin 2x \leq 1, -2 \leq 2 \sin 2x \leq 2, 1 \leq 2 \sin 2x + 3 \leq 5$ ]
11.  $(\frac{1}{2}, \frac{3}{8})$ . [Hint. : Slope of chord  $= \frac{dy}{dx} =$  slope of tangent to the curve]
12. Not defined [Hint.:  $\frac{dy}{dx} = \tan 90^\circ = \infty$ ]
13. 0.  $\left[ \frac{-1}{\frac{dy}{dx}} = \frac{1}{0}, \frac{dy}{dx} = 0 \right]$
14. -2.
15.  $(\frac{1}{2}, 0)$ . [Hint.:  $\frac{dy}{dx} =$  slope of line  $= 1$ ]
16.  $(0, 0)$ .
17.  $\frac{1}{12}$ . [Hint. : Product of slopes of tangents at intersecting point  $= -1$ ]

18. (1, 2).

$$\lceil \text{Hint. : } \frac{dy}{dx} = \tan 45^\circ \rceil$$

19. 1. [Hint. : Slope of Normal =  $-K$ , Slope of Normal =  $\frac{1}{dy/dx}$  Find and equate]  $(3, 6)$

20. No extremum value.

$$[\text{Hint. : } f'(x) = 0]$$

21.  $x - y = 0$ .

22.  $\frac{\pi}{48}$  cm/s.

23. (1, 3) (-1, 1)

24. Maximum  $\sqrt{2}$  at  $x = \frac{3\pi}{4}$ , Minimum is -1 at  $x = \frac{7\pi}{4}$ .

25. Increasing in  $(\frac{1}{4}, \infty)$  and decreasing in  $(-\infty, \frac{1}{4})$ .

26. 2; 8. [Hint. : Let  $x = 2$ ,  $x = \Delta x = 1.9$ ,  $\Delta n = -0.1$ ,  $f(x) + \Delta x f'(x) = f(x + \Delta x)$ ].

27. (i)  $(-\infty, 0]$  (ii)  $[1, \infty)$ .

28. Decreasing at the rate of 3.6 cm/sec.

29.  $-2\sqrt{ab}$ .

$$\lceil \text{Hint. : } f'(x) = a - \frac{b}{x^2} = 0 \quad x = \pm\sqrt{b/a}, f(\sqrt{b/a}) = 2\sqrt{ab}, f(-\sqrt{b/a}) = -2\sqrt{ab} \rceil$$

30.  $(0, 0), (\frac{3}{4}, \frac{-27}{32})$ .

31. (i) 0.2495; (ii) 0.2867 (iii) 0.0707

34. Increasing in  $(0, 3\pi/4) \cup (7\pi/4, 2\pi)$  and decreasing  $(3\pi/4, 7\pi/4)$

35. 0.3444.

$$[\text{Hint. : Use } f(x + h) = f(x) + h f'(h)]$$

36.  $(0, \frac{3}{2}) \cup (3, \infty)$ .

37. Increasing in  $(-\infty, 2) \cup (3, \infty)$  and decreasing in  $(2, 3)$ .

38.  $(\frac{1}{3}, -\frac{1}{3})$ .

39.  $2x + 3y = 6$ .

41. Increasing in  $(0, \frac{\pi}{4}) \cup (\frac{5\pi}{4}, 2\pi)$  and decreasing in  $(\frac{\pi}{4}, \frac{5\pi}{4})$ .

42. Maximum value = 5.

43.  $x = 14, y = 21$ .

44.  $a = -3$ .

46. 0.19235.

47. (i) No point at which tangent is parallel to  $x$  axis.

(ii)  $(3, 0), (-3, 0)$ .

48.  $a \leq -3$ . [Hint. :  $f'(x) = 3(a+2)x^2 - 6ax + 9a < 0$ ,  $x = \frac{6a \pm \sqrt{36a^2 - 4 \times 3(a+2) \times 9a}}{6(a+2)} < 0$

49.  $a^2 \cos^2 \alpha + b^2 \sin^2 \alpha = p^2$ .

[Hint. : Find  $\left(\frac{dy}{dx}\right)_{(x_1, y_1)}$ , Then equation of tangent at  $(x_1, y_1)$ .  
The eliminate the value of  $x_1$  and  $y_1$ ]

50.  $y - 1 = 0$ .

53.  $75\sqrt{3}$  sq. unit.

56. Increasing in  $(2, 3)$ , decreasing in  $(3, \infty)$ .

57.  $3x + y - 3 = 0$

$$7x - y - 14 = 0$$

60. 5 cm.

61.  $\frac{28}{\pi+4} m, \frac{112}{\pi+4} m$ .

62.  $\sqrt{5}$  unit.

66.  $\frac{16}{6 - \sqrt{3}}$ .

68.  $\theta = \frac{\pi}{2}$  maximum Area =  $\frac{1}{2} ab$ .

## CHAPTER 7

# INTEGRATION

1. (i)  $\frac{2}{3}x^{3/2} + 2\sqrt{x} + c.$  (ii)  $\tan x + c.$   
(iii)  $-\operatorname{cosec} x + c$  (iv)  $\frac{\pi}{3}.$   
(v) 0; (vi)  $\log|\log(\log x)| + c.$   
(vii)  $-\cot x - \operatorname{cosec} x + C$  (viii)  $\frac{8^x}{\log 8} + 8x^7 + 8\log x + \frac{1}{8} + c.$   
(ix)  $\sin^{-1} x + c$  (x) 0.

**Hint.** :  $\sin(\cos^{-1} x) = \sin(\sin^{-1} \sqrt{1-x^2})$

2. (i)  $\frac{2}{5}x^{\frac{5}{2}} + \frac{2}{3}x^{\frac{3}{2}} - 2x^{\frac{1}{2}} + c.$  (ii)  $\frac{a}{2}x^2 + \frac{1}{a}\log|x| - 2x + c.$   
(iii)  $\frac{-\cos x}{3} - \frac{3}{4}e^{4x} + 2\tan\frac{x}{2} + c.$  (iv)  $-\operatorname{cosec} x + c.$   
(v)  $\frac{1}{2}\left[\frac{(2x+1)^{3/2}}{3} - (2x+1)^{1/2}\right] + c$  (vi)  $\log[\log(\tan x)] + c.$   
(vii)  $\tan x + c.$  (viii)  $\frac{x^{a+1}}{a+1} + \frac{a^x}{\log a} + c.$   
(ix)  $2\left[-\cos\frac{x}{2} - \sin\frac{x}{2}\right] + c.$  (x)  $\frac{1}{3}\log(2 + 3\log x) + c.$   
(xi)  $-2\cos\sqrt{x} + c$  (xii)  $\frac{1}{6}(\tan^{-1}x^3)^2 + c.$   
(xiii)  $2x(\log x - 1) + c.$  (xiv)  $\frac{1}{2}\log|ax^2 + 2bx + c| + c$   
(xv)  $-\frac{1}{b}\log|a + b\cos x| + c.$  (xvi)  $\frac{c^x}{\log c} + \frac{x^{c+1}}{c+1} + c_1.$

(xvii)  $\log |3 + \log x| + c.$

(xviii)  $\frac{1}{20} \tan^{-1} \frac{5}{4} x + c.$

(xix)  $\frac{1}{2} \tan^{-1}(e^{2x}) + c.$

(xx)  $\frac{1}{12} \log \left| \frac{3x - 2}{3x + 2} \right| + c.$

(xxi)  $\frac{1}{40} \log \left| \frac{4 + 5x}{4 - 5x} \right| + c.$

(xxii)  $\frac{1}{2} \log \left| 2x + \sqrt{4x^2 - 9} \right| + c.$

(xxiii)  $\frac{1}{2ab} \log \left| \frac{a + bx}{a - bx} \right| + c.$

3. (i)  $\frac{\pi}{4}.$

(ii)  $2e - 2.$  [Hint. :  $e^{|x|}$  is even function]

(iii) 0;

(iv) 0

(v)  $\frac{\pi}{4}.$

(vi)  $\frac{\pi}{4}.$

(vii)  $\frac{\pi^{3/2}}{12}.$

(viii)  $\tan^{-1} e - \frac{\pi}{4}.$

(ix)  $\frac{x^3}{3} + c.$

(x) 1

[Hint. :  $e^{a \log x} = x^a.$ ]

4. (i)  $\frac{1}{2} \log \left[ \operatorname{cosec}(\tan^{-1} x^2) - \frac{1}{x^2} \right] + c.$

(ii)  $\frac{1}{2} (x^2 - x\sqrt{x^2 - 1}) + \frac{1}{2} \log |x + \sqrt{x^2 - 1}| + c.$

[Hint. : Rationalize numerator and denominator.]

(iii)  $\frac{1}{\sin(a - b)} \log \left| \frac{\sin(x - a)}{\sin(x - b)} \right| + c$

[Hint. :  $\sin(a - b) = \sin((x - b) - (x - a)).$ ]

(iv)  $x \cos 2a - \sin 2a \log |\sec(x - a)| + c.$

[Hint. : put  $xa = t$ ]

(v)  $\frac{1}{48} [12x + 6 \sin 2x + 3 \sin 4x + 2 \sin 6x] + c.$

(vi)  $\sin x - \frac{2}{3} \sin^3 x + \frac{1}{5} \sin^5 x + c.$

(vii)  $\frac{1}{32} \left[ 2x + \frac{1}{2} \sin 2x - \frac{1}{2} \sin 4x - \frac{1}{6} \sin 6x \right] + c.$

(viii)  $-\frac{\cos^9 x}{9} + \frac{2}{7} \cos^7 x - \frac{1}{5} \cos^5 x + c.$

(ix)  $-\frac{(\cot^6 x + \cot^4 x)}{6} + c.$

(x)  $\frac{1}{(a^2 - b^2) \sqrt{a^2 \sin^2 x + b^2 \cos^2 x}} + c.$

[Hint. : put  $a^2 \sin^2 x + b^2 \cos^2 x = t$ ]

(xi)  $-2 \operatorname{cosec} a \sqrt{\cos a - \tan x \cdot \sin a} + c.$

[Hint. : Take  $\sec^2 x$  as numerator]

(xii)  $\tan x - \cot x - 3x + c.$

(xiii)  $\frac{2}{5} (1 + x^{5/2})^{3/2} \left[ \frac{2}{7} (1 + x^{5/2})^2 - \frac{4}{5} (1 + x^{5/2}) + \frac{2}{3} \right] + c.$  [Hint. : put  $1 + x^{5/2} = t$ ]

(xiv)  $\sin^{-1} (\sin x - \cos x) + c.$

(xv)  $\log|x| - \frac{1}{4} \log|x^4 + 1| + c.$

(xvi)  $\frac{1}{2} \tan^{-1}(2 \tan x) + c.$

(xvii)  $\frac{1}{2\sqrt{3}} \log \left| \frac{\sqrt{3} + \tan x}{\sqrt{3} - \tan x} \right| + c$

(xviii)  $\frac{5^{5x}}{(\log 5)^3} + c.$

[Hint. : put  $5^x = t$ ]

5. (i)  $\frac{1}{\sqrt{3}} \tan^{-1} \left( \frac{2x^2 + 1}{\sqrt{3}} \right) + c.$  [Hint : put  $x^2 = t$ ]

(ii)  $\log \left| \frac{2 \log x + 1}{3 \log x + 2} \right| + C$  [Hint : put  $\log x = t$ ]

(iii)  $\sin^{-1} \left( \frac{2x - 3}{\sqrt{13}} \right) + c.$

(iv)  $2 \log |\sqrt{x-a} + \sqrt{x-b}| + c$

(vii)  $-\cos \alpha \sin^{-1} \left( \frac{\cos x}{\cos \alpha} \right) - \sin \alpha \cdot \log \left| \sin x + \sqrt{\sin^2 x - \sin^2 \alpha} \right| + c$

Hint :  $\frac{\sin(x - \alpha)}{\sin(x + \alpha)} = \frac{\sin(x - \alpha)}{\sin^2 x - \sin^2 \alpha}$

(viii)  $\frac{5}{6} \log |3x^2 + 2x + 1| + \frac{-11}{3\sqrt{2}} \tan^{-1} \left( \frac{3x+1}{\sqrt{2}} \right) + c$

- (ix)  $x - 3 \log|x^2 + 6x + 12| + 2\sqrt{3} \tan^{-1}\left(\frac{x+3}{\sqrt{3}}\right) + c$
- (x)  $-\sqrt{4x - x^2} + 4 \sin^{-1}\left(\frac{x-2}{2}\right) + c$
- (xi)  $\frac{-1}{3}(1+x-x^2)^{\frac{3}{2}} + \frac{1}{8}(2x-1)\sqrt{1+x-x^2} + \frac{5}{16} \sin^{-1}\left(\frac{2x-1}{\sqrt{5}}\right) + c$
- (xii)  $(x^2 + x + 1)^{\frac{3}{2}} - \frac{7}{2} \left[ x + \frac{1}{2} \sqrt{x^2 + x + 1} + \frac{3}{8} \log \left| x + \frac{1}{2} + \sqrt{x^2 + x + 1} \right| \right] + c$
- (xiii)  $-\log \left| \cos x + \frac{1}{2} + \sqrt{\cos^2 x + \cos x} \right| + c$  [Hint. : multiply and divide by  $\sqrt{\sec x + 1}$ ]
- (xiv)  $2 \log|\sin^2 \theta - 4 \sin \theta + 5| + 7 \tan^{-1}(\sin \theta - 2) + c$
6. (i)  $\frac{1}{7} \log \left| \frac{x^7}{x^7 + 1} \right| + c$
- (ii)  $\frac{1}{2(a^2 - b^2)} \log \left| \frac{x^2 - b^2}{x^2 - a^2} \right| + c$  [Hint. : put  $x^2 = t$ ]
- (iii)  $\log \left| \frac{1 + \cos x}{2 + 3 \cos x} \right| + c$
- (iv)  $\frac{-1}{6} \log x + \frac{3}{10} \log|x - 2| - \frac{2}{15} \log|x + 3| + c$
- (v)  $\frac{3}{8} \log|x - 1| - \frac{1}{2(x-1)} + \frac{5}{8} \log|x + 3| + c$
- (vi)  $\frac{9}{10} \log|x + 3| + \frac{4}{15} \log|x - 2| - \frac{1}{6} |x + 1| + c$
- (vii)  $x + 4 \log \left| \frac{(x-2)^2}{x-1} \right| + c$
- (viii)  $x + \frac{2}{\sqrt{3}} \tan^{-1}\left(\frac{x}{\sqrt{3}}\right) - 3 \tan^{-1}\left(\frac{x}{2}\right) + c$  [Hint. : put  $x^2 = t$ ]
- (ix)  $x + \frac{1}{2} \log \left| \frac{x-2}{x+2} \right| - \tan^{-1}\left(\frac{x}{2}\right) + c$  [divide numerator by denominator]
- (x)  $\frac{2}{17} \log|2x + 1| - \frac{1}{17} \log|x^2 + 4| + \frac{1}{34} \tan^{-1}\frac{x}{2} + c$

$$(xi) -\frac{1}{2} \log |1 - \cos x| - \frac{1}{6} \log |1 + \cos x| + \frac{2}{3} \log |1 - 2 \cos x| + c$$

[Hint. : multiply N<sup>r</sup> and D<sup>r</sup> by sin x and put cos x = t]

$$(xii) -\frac{1}{6} \log |1 - \sin x| - \frac{1}{2} \log |1 - \sin x| + \frac{1}{3} \log |2 - \sin x| + c$$

$$[\text{Hint. : } \int \frac{1}{\cos x (2 - \sin x)} dx = \int \frac{\cos x}{\cos^2 x (2 - \sin x)} dx]$$

[Hint. : Multiply numerator and denominator by cos x and put sin x = t]

$$(xiii) \frac{-1}{8} \log \left| \frac{1 + \sin x}{1 - \sin x} \right| + \frac{1}{4\sqrt{2}} \log \left| \frac{1 + \sqrt{2} \sin x}{1 - \sqrt{2} \sin x} \right| + c$$

$$(xiv) \frac{1}{2} \log \left| \frac{x^2 - x + 1}{x^2 + x + 1} \right| + c$$

$$(xv) \frac{1}{\sqrt{2}} \tan^{-1} \left( \frac{\tan x - 1}{\sqrt{2} \tan x} \right) + \frac{1}{2\sqrt{2}} \log \left| \frac{\tan x - \sqrt{2} \tan x + 1}{\tan x + \sqrt{2} \tan x + 1} \right| + c$$

$$(xvi) \frac{1}{3\sqrt{2}} \tan^{-1} \left( \frac{x^2 - 9}{3\sqrt{2}} \right) + c$$

$$(xvii) \frac{-\log x}{\sqrt{x^2 - 1}} + \sec^{-1} x + c \quad [\text{Hint. : Take log } x \text{ as I function.}]$$

$$(xviii) (-\sqrt{2} - \sqrt{3} + 5)$$

$$[\text{Hint. : } \int_1^2 \lceil x^2 \rceil dx = \int_1^{\sqrt{2}} \lceil x^2 \rceil + \int_{\sqrt{2}}^{\sqrt{3}} \lceil x^2 \rceil dx]$$

$$75. (i) \frac{1}{3} \lceil -x^3 \cos x^3 + \sin x^3 \rceil + c$$

$$(ii) \frac{1}{2} [\sec x \tan x + \log |\sec x + \tan x|] + c$$

[Hint. : Write  $\sec^3 x = \sec x \cdot \sec^2 x$  and take sec x as first function]

$$(iii) \frac{e^{ax}}{a^2 + b^2} [a \cos(bx + c) + b \sin(bx + c)] + c_1$$

$$(iv) 2x \tan^{-1} 3x - \frac{1}{3} \log |1 + 9x^2| + c \quad [\text{Hint. : put } 3x = \tan \theta]$$

$$(v) 2[\sqrt{x} \sin \sqrt{x} + \cos \sqrt{x}] + c$$

$$(vi) x^{n+1} \lceil \frac{(\log x)^2}{n+1} - \frac{2 \log x}{(n+1)^2} + \frac{2}{(n+1)^3} \rceil + c$$

- (vii)  $\frac{\sin x - x \cos x}{x \sin x + \cos x} + c$  [Hint. :  $\frac{x^2}{(x \sin x + \cos x)} = (x \sec x) \frac{x \cos x}{(x \sin x + \cos x)^2}$ ]
- (viii)  $\sqrt{x - x^2} - (1 - 2x) \sin^{-1} \sqrt{x} \frac{-\pi}{2} x + c$  [Hint. :  $\cos^{-1} \sqrt{x} = \frac{\pi}{2} - \sin^{-1} \sqrt{x}$ ]
- (xi)  $x \tan^{-1} \sqrt{\frac{x}{a}} - \sqrt{ax} + a \tan^{-1} \sqrt{\frac{x}{a}} + c.$  [Hint. : put  $x = a \tan^2 \theta$ ]
- (x)  $\frac{(x^4 - 1)}{4} \tan^{-1} x - \frac{x^3}{12} + \frac{x}{4} + c.$
- (xi)  $-\frac{1}{3} \left[ 1 + \frac{1}{x^2} \right]^{\frac{3}{2}} \left[ \log \left( 1 + \frac{1}{x^2} \right) - \frac{2}{3} \right] + c.$
- (xii)  $\frac{1}{2} e^{2x} \tan x + c.$
- (xiii)  $\frac{e^x}{2x} + c.$
- (xiv)  $\frac{e^x}{1+x^2} + c.$
- (xv)  $e^x \left( \frac{x-1}{x+1} \right) + c.$
- (xvi)  $e^x \tan x + c.$
- (xvii)  $\frac{x}{\log x} + C.$
- (xviii)  $x \log |\log x| - \frac{x}{\log x} + c.$  [Hint. : put  $\log x = t \Rightarrow x = e^t$ ]
- (xix)  $x \sin (\log x) + c.$
8. (i)  $\frac{1}{20} \log 3.$  (ii)  $-\pi/2$
- (iii)  $\frac{\pi}{4} - \frac{1}{2}.$  [Hint. : put  $x^2 = t$ ] (iv)  $\frac{\pi}{4} - \frac{1}{2} \log 2.$
- (v)  $\frac{5}{2} \log 2 \frac{3}{2} \log 3.$  (vi)  $\frac{\pi}{2}.$

$$(vii) \quad \frac{3\pi}{8}.$$

$$(viii) \quad \frac{\pi}{2}.$$

$$(ix) \quad 5 - 10 \log \frac{15}{8} + \frac{25}{2} \log \left( \frac{6}{5} \right).$$

$$(x) \quad \pi/2.$$

**Hint. :**  $\int \frac{x}{1+\cos x} + \frac{\sin x}{1+\cos x} dx.$

$$9. \quad (i) \quad 8.$$

$$(ii) \quad 0.$$

$$(iii) \quad \pi.$$

$$(iv) \quad \frac{\pi}{8} \log 2.$$

$$(v) \quad \frac{-\pi}{2} \log 2.$$

$$(vi) \quad \frac{1}{4} \pi^2.$$

$$(vii) \quad 95/12.$$

**Hint. :**  $\int_{-2}^2 f(x) dx = \int_{-2}^{-1} f(x) dx + \int_{-1}^1 f(x) dx + \int_1^2 f(x) dx$

$$(viii) \quad \frac{\pi^2}{16}.$$

$$(ix) \quad \frac{\pi^2}{2ab}.$$

**Hint. :** Use  $\int_0^a f(x) dx = \int_0^a f(a-x) dx$

$$10. \quad (i) \quad \frac{26}{3}.$$

$$(ii) \quad e - \frac{1}{e}.$$

$$(iii) \quad \frac{1}{2}.$$

$$(iv) \quad 1 - \frac{1}{e^2}.$$

$$(v) \quad 10.$$

$$(vi) \quad -9/2.$$

$$11. \quad (i) \quad \frac{1}{6} \log |\tan^2 x - \tan x + 1| + \frac{1}{\sqrt{3}} \tan^{-1} \left( \frac{2 \tan x - 1}{\sqrt{3}} \right) - \frac{1}{3} \log |1 + \tan x| + c$$

$$(ii) \quad \frac{2}{5} \tan^5 \sqrt{x} + c.$$

$$(iii) \quad 2.$$

$$(iv) \quad \frac{\pi}{2} - \log 2.$$

$$(v) \quad 0.$$

$$(vi) \quad 0.$$

$$(vii) \quad 3.$$

$$(viii) \quad \pi/2.$$

$$(ix) \quad 3.$$

$$(x) \quad \frac{x}{2} + \log|x| - \frac{3}{4} \log|1-2x| + c \quad \left[ \text{Hint. : } \int_0^a f(x) ax = \int_0^a f(a-x). \text{ put } 1+a^x = t \right]$$

$$12. \quad (i) \quad x - 4 \log|x| + \frac{5}{4} \log|x-1| + \frac{3}{4} \log|x+1| + \log|x^2+1| - \frac{1}{2} \tan^{-1}x + c.$$

$$\left[ \text{Hint. : } \frac{x^5+4}{x^5-x} = 1 + \frac{x+4}{x(x-1)(x+1)(x^2+1)} \right]$$

$$(ii) \quad \frac{-2}{25} \log|x-1| - \frac{1}{5(x-1)} + \frac{1}{25} \log(x^2+4) \frac{-3}{50} \tan^{-1}\frac{x}{2} + c.$$

$$\left[ \text{Hint. : } \frac{1}{(x-1)^2(x^2+4)} = \frac{A}{x-1} + \frac{B}{(x-1)^2} + \frac{cx+d}{x^2+4} \right]$$

$$(iii) \quad 2x - \frac{1}{8} \log|x+1| + \frac{81}{8} \log|x-3| - \frac{27}{2(x-3)} + c.$$

$$(iv) \quad x + \frac{1}{2} \log \left| \frac{x-2}{x+2} \right| - \tan^{-1}\frac{x}{2} + c.$$

$$(v) \quad \pi/\sqrt{2}.$$

$$(vi) \quad \frac{1}{2\sqrt{2}} \tan^{-1} \frac{(x^2-1)}{\sqrt{2x}} - \frac{1}{4\sqrt{2}} \log \left| \frac{x^2-\sqrt{2x}+1}{x^2+\sqrt{2x}+1} \right| + c$$

$$(vii) \quad \pi/8.$$

$$(viii) \quad \frac{\pi}{2} - \log 2.$$

$$(ix) \quad \pi/8 \log 2.$$

$$(x) \quad -\frac{1}{2(1-\cos x)^2} + c.$$

$$(xi) \quad \frac{1}{5} \log \left| \frac{\tan x - x}{2 \tan x + 1} \right| + c. \text{ Divide Num. and Den. by } \cos^2 x.$$

$$(xii) \quad \frac{2(2x-1)}{\pi} \sin^{-1}\sqrt{x} + \frac{2\sqrt{x-x^2}}{\pi} - x + c.$$

$$(xiii) \quad -2\sqrt{1-x} + \cos^{-1}\sqrt{x} + \sqrt{x-x^2} + c.$$

$$(xiv) \quad \frac{3}{\pi} + \frac{1}{\pi^2}.$$

13. (i) 14.

$$(ii) \frac{26}{3}.$$

(iii) 26.

$$(iv) \frac{1}{2}(127 + e^8).$$

$$(v) \frac{141}{2}.$$

(vi) 93/2.

## CHAPTER 8

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# APPLICATIONS OF INTEGRALS

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1.  $\pi a^2$  sq. units.

2.  $\frac{28}{3}$  sq. units

3.  $\pi ab$  sq. units

4.  $4\pi - 8$  sq. units

5.  $\frac{\sqrt{2}}{6} + \frac{9\pi}{8} - \frac{9}{8} \sin^{-1}\left(\frac{1}{3}\right)$  sq. units

7.  $\frac{(\pi - 2)ab}{4}$  sq. units

8.  $\left(\frac{8\pi}{3} - 2\sqrt{3}\right)$  sq. units

9. (a) 4 sq. units (b) 2 sq. units

10. (a) 6 sq. unit

[Hint. Coordinate of verties are (0, 1) (2, 3) (4, -1)]

(b)  $\frac{15}{2}$  sq.

[Hint. Coordinate of verties are (-1, 1) (0, 5) (3, 2)]

11.  $\left(\frac{\pi}{4} - \frac{1}{2}\right)$  sq. units

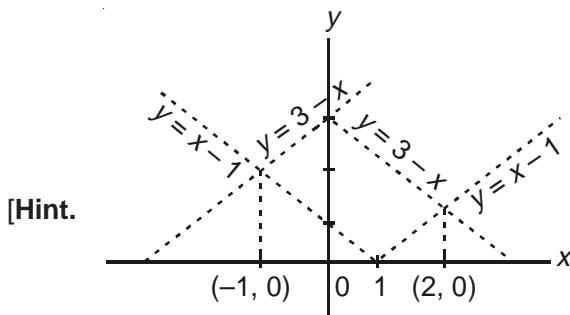
12. 1 sq. units

13.  $(2 - \sqrt{2})$  sq. units

[Hint. Required Area  $\int_0^{\pi/4} \sin dx + \int_{\pi/4}^{\pi/2} \cos dx$  ]

14. 5 sq. units

15. 4 sq. unit



16. 3 sq. units

17.  $\frac{25}{2}\pi$  sq. units

18.  $\frac{1}{3}$  sq. units

19.  $\frac{3}{2}(\pi - 2)$  sq. units

20.  $\frac{9}{8}$  sq. units

$$21. ab \left( e\sqrt{1 - e^2} + \sin^{-1} e \right) \text{ sq. unit}$$

$$22. \frac{8a^2}{m^3} \text{ sq. units}$$

$$23. \frac{1}{6} \text{ sq. unit}$$

$$24. \frac{\pi}{3} \text{ sq. unit}$$

$$25. (\pi - 2) \text{ sq. unit}$$

$$26. (1 - \pi/4) \text{ sq. units}$$

$$27. 2\pi \text{ sq. unit.}$$

## CHAPTER 9

# DIFFERENTIAL EQUATIONS

1.

- |                             |                                     |
|-----------------------------|-------------------------------------|
| (i) order = 1, degree = 1   | (ii) order = 2, degree = 1          |
| (iii) order = 4, degree = 1 | (iv) order = 5, degree not defined. |
| (v) order = 2, degree = 2   | (vi) order = 2, degree = 2          |
| (vii) order = 3, degree = 2 |                                     |

2.

- |  |   |
|--|---|
| (i) $y = \frac{x^6}{6} + \frac{x^3}{6} - 2 \log x  + c$    | (ii) $y = \log_e  e^x + e^{-x}  + c$      |
| (iii) $y = \frac{x^4}{4} + e^x + \frac{x^{e+1}}{e+1} + c.$ | (iv) $5^x + 5^{-y} = c$                   |
| (v) $2(y-x) + \sin 2y + \sin 2x = c.$                      | (vi) $2 \log  3x+1  + \log_e  1-2y  = c.$ |
| (vii) $y = x \tan x - \log  \sec x  + c.$                  | (viii) $y = c \log_e x.$                  |

3.

- |                         |                                 |
|-------------------------|---------------------------------|
| (i) $e^{\sin x}$        | (ii) $e^{\tan x}$               |
| (iii) $e^{-1/x}$        | (iv) $e^{\frac{(\log x)^2}{2}}$ |
| (v) $\frac{1}{x^3}$     | (vi) $\sec y$                   |
| (vii) $e^{\tan^{-1} y}$ | (viii) $e^{-y}.$                |

4.

- (viii) [Hint : Family of circles having centre on  $x$ -axis and radius = 2 units is of the type  $(x-h)^2 + y^2 = 4$ ]

$$\text{Ans. } y^2 \left[ 1 + \frac{dy}{dx}^2 \right] = 4.$$

(ix)  $\frac{d^2y}{dx^2} - 2 \frac{dy}{dx} + 2y = 0$

[Hint : find  $\frac{dy}{dx}$ ,  $\frac{d^2y}{dx^2}$  and eliminate A and B.]

$$(x) \quad x \left( \frac{dy}{dx} \right)^2 + xy \frac{d^2y}{dx^2} = y \frac{dy}{dx}$$

$$(xi) \quad 8a \left( \frac{dy}{dx} \right)^3 = 27y$$

$$(xii) \quad x \frac{d^2y}{dx^2} + 2 \frac{dy}{dx} - xy + x^2 - 2 = 0.$$

$$(xiii) \quad \left( \frac{dy}{dx} \right)^3 = 4y \left( x \times \frac{dy}{dx} - 2y \right)$$

[Hint : divide  $y$  by  $\frac{dy}{dx}$  and find  $c$ .]

$$(xiv) \quad 2 \frac{d^2y}{dx^2} + \left( \frac{dy}{dx} \right)^3 = 0$$

5. (a)  $x = y - 1 + ce^y$

[Hint :  $\frac{dx}{dy} - x = 2 - y$  which is (L.D.equation)]

$$(b) \quad y \sin x = \frac{2 \sin^3 x}{3} + c$$

$$(c) \quad y = \frac{x^2 (4 \log_e x - 1)}{16} + \frac{c}{x^2}$$

$$(d) \quad x = (\tan^{-1} y - 1) + c.e^{-\tan^{-1} y}$$

$$(e) \quad xe^{\tan^{-1} y} = c + \tan^{-1} y$$

$$(f) \quad y = \sin x + \frac{c}{x}, \quad x > 0$$

$$(g) \quad xe^y = e^y + y + c$$

$$(h) \quad y = \tan x - 1 + ce^{-\tan x}$$

$$(i) \quad x = -y^2 e^{-y} + cy^2$$

6.

$$(i) \quad cy = (x + 2)(1 - 2y)$$

$$(ii) \quad (e^x + 2) \sec y = c$$

$$(iii) \quad \sqrt{1 - x^2} + \sqrt{1 - y^2} = c$$

$$(iv) \quad \frac{1}{2} \log \left| \frac{\sqrt{1 - y^2} - 1}{\sqrt{1 - y^2} + 1} \right| = \sqrt{1 - x^2} - \sqrt{1 - y^2} + c$$

$$(v) \quad (x^2 + 1)(y^2 + 1) = 2$$

$$(vi) \quad \log y = -\frac{1}{3} \cos^3 x + \frac{1}{5} \cos^5 x + xe^x - e^x + c$$

$$(vii) \quad \log |\tan y| - \frac{\cos 2x}{y} = c \quad (viii) \quad 3 \sec 2y + 4 \cos 3x = c$$

$$(ix) \quad 3e^{2(y-1)} = 6e^x + 2x^3 + c$$

$$(x) \quad y = e^{-x}$$

7.

(i)  $\frac{-x^3}{3y^3} + \log|y| = c$

(ii)  $\tan^{-1}\left(\frac{y}{x}\right) = \log|x| + c$  [Hint. : Homogeneous Equation]

(iii)  $x^2 + y^2 = 2x$

(iv)  $c = x + y e^{x/y}$

[Hint. : Put  $\frac{x}{y} = v$ .]

(v)  $y = ce^{\cos(x/y)}$  [Hint. : Put  $\frac{x}{y} = v$ ] (vi)  $\sin\left(\frac{y}{x}\right) = cx$

(vii)  $c(x^2 - y^2) = y$

(viii)  $-e^{-y} = e^x + \frac{x^3}{3} + c$  [Hint. : Factorise R.H.S.]

(ix)  $\log\left(\frac{y}{x}\right) = cx$  [Hint. : Homogeneous diff. Equation]

(x)  $\log(1+y) = x - \frac{x^2}{2} + c$  [Hint. : Factorise R.H.S.]

(xi)  $y = (x-2)e^x - x \sin x - 2 \cos x + c_1 x + c_2$  where  $c_1, c_2$  are arbitrary constant  
[Hint. : Integrate Twice]

(xii)  $\sin^{-1} y = \sin^{-1} x + c$

8.

(i)  $x^2 - y^2 + 2xy \frac{dy}{dx} = 0$  [Hint. : The family of circles is,  $x^2 + y^2 + 2gx = 0$ ]

(ii)  $2y = x \frac{dy}{dx}, \quad y = 2x \frac{dy}{dx}$

(iii)  $xy \frac{d^2y}{dx^2} + x \left(\frac{dy}{dx}\right)^2 = y \frac{dy}{dx}$

(iv)  $x^2 - y^2 + 2xy \frac{dy}{dx} = 0$

(v)  $y \frac{d^3y}{dx^3} = \left(\frac{dy}{dx}\right) \left(\frac{d^2y}{dx^2}\right)$  [Hint. : Differentiate thrice and Eliminate  $a, b, c$ ]

9.  $cxy = \sec \left( \frac{x}{y} \right)$  Put  $\frac{x}{y} = v$

10.  $\log |x^2 + xy + y^2| = 2\sqrt{3} \tan^{-1} \left( \frac{x+2y}{\sqrt{3x}} \right) + c$

11.  $\frac{x^3}{x^2 + y^2} = \frac{c}{x}(x+y)$

12.

(i)  $y = \frac{3 \sin 3x}{13} - \frac{2 \cos 3x}{13} + ce^{2x}$

(ii)  $y = \frac{2}{3} \sin^2 x + \frac{1}{3} \operatorname{cosec} x$

13.

(i)  $-y = x \log \{c(x-y)\}$

(ii)  $cx^2 = y + \sqrt{x^2 + y^2}$

(iii)  $xy \cos \left( \frac{y}{x} \right) = c$

[Hint. : Put  $y = vx$ ]

(iv)  $3x^2y = y + 2x$

[Hint. : Put  $y = vx$ ]

(v)  $y = -x \log(\log|x|), x \neq 0$

(vi)  $c(x^2 + y^2) = \sqrt{x^2 - y^2}$ .

## CHAPTER 10, 11

# VECTOR AND 3-D

1.  $\frac{5\sqrt{3}}{2}, \frac{5}{2}$ .      2.  $\pm \frac{1}{3}$
3.  $\overrightarrow{x}$  and  $\overrightarrow{y}$  are collinear.      4. 126 sq. units.
5.  $60^\circ$       6. (6, 11)
7. (5, 4, -6)      8.  $4\hat{i} + 6\hat{j} + 4\sqrt{3}\hat{k}$
9.  $\frac{1}{\sqrt{3}}, \frac{1}{\sqrt{3}}, \frac{1}{\sqrt{3}}$       10.  $\cos^{-1} \frac{3}{7}, \cos^{-1} \frac{-6}{7}, \cos^{-1} \frac{2}{7}$
11.  $\frac{3}{\sqrt{26}}\hat{i} + \frac{4}{\sqrt{26}}\hat{j} - \frac{1}{\sqrt{26}}\hat{k}$       12. 0
13. 4      14.  $\lambda = -9$
15.  $|\overrightarrow{a}| = 2$       16.  $90^\circ$
17. 3 units.      18.  $\frac{3}{2}$  sq. units.
19.  $\sqrt{13}$       20.  $90^\circ$
21.  $120^\circ$       22. -1
23.  $\frac{\Pi}{4}$       24.  $\frac{\sqrt{3}}{2}\hat{i} + \frac{1}{2}\hat{j}$ .
25.  $\frac{3}{7}\hat{i} - \frac{6}{7}\hat{j} + \frac{2}{7}\hat{k}$ .      26.  $\frac{-3}{2}$ .
27.  $\sqrt{3}$       28. 0
29.  $60^\circ$       30.  $\frac{1}{\sqrt{2}}\hat{i} + \frac{1}{2}\hat{j} + \frac{1}{2}\hat{k}$ .
31. 2 : 3 internally      32. 2 : 5
33.  $\sqrt{b^2 + c^2}$       34.  $\frac{x-1}{2} = \frac{y+1}{-3} = \frac{z-2}{4}$ .
35.  $90^\circ$       36. 2

37.  $\frac{10}{\sqrt{14}}$
38. -2
39.  $\frac{-8}{5}$
40.  $O, \frac{5}{13}, \frac{-12}{13}$ .
41.  $\frac{x+2}{5} = \frac{y-4}{5} = \frac{z+5}{-6}$ .
42.  $\frac{x+1}{1} = \frac{y-2}{1} = \frac{z+3}{1}$ .
43.  $q = 5$
44.  $90^\circ$
45.  $\pm \frac{1}{\sqrt{14}}, \mp \frac{3}{\sqrt{14}}, \pm \frac{2}{\sqrt{14}}$ .
46.  $60^\circ$
47.  $60^\circ$
48.  $\frac{1}{6}$  units.
49.  $x + y + z = 1$ .
50. No
51.  $2x - y + 3z = -8$ .
52.  $\vec{r} \cdot (2i + j + 2\hat{k}) = 24$ .
53.  $2x + 3y + 5z = 29$ .
54.  $0^\circ$
55.  $(-1, 2, -2)$
56.  $\frac{10}{3\sqrt{3}}$
57. 0
58.  $\left[ \begin{array}{l} \overrightarrow{B_1} = \frac{1}{2}(3i - j) \\ \overrightarrow{B_2} = \frac{1}{2}(i + 3j - 6\hat{k}) \end{array} \right]$
59.  $\overrightarrow{PL} = \overrightarrow{PQ} + \frac{1}{2}\overrightarrow{PS}$
60.  $\overrightarrow{PM} = \frac{1}{2}\overrightarrow{PQ} + \overrightarrow{PS}$
61.  $62. \quad 2 \left| \overrightarrow{a} \right|^2$
63.  $64. \quad -6$ .
65.  $66. \quad -6$ .
67.  $68. \quad \cos^{-1} \left( \frac{11}{14} \right)$ .
69.  $70. \quad \frac{1}{4}\hat{i} + \frac{1}{4}\hat{j} + \frac{3}{4}\hat{k}$ .
71.  $x = -2$ .
72.  $\frac{1}{4}\hat{i} + \frac{1}{4}\hat{j} + \frac{3}{4}\hat{k}$ .
73.  $\frac{1}{3}\hat{i} + \frac{4}{3}\hat{j} + \frac{4}{3}\hat{k}$ .
74.  $\frac{1}{\sqrt{165}}(10\hat{i} + 7\hat{j} - 4\hat{k})$ .
75.  $a \in (-3, -2) \cup (2, 3)$ .
76.  $(0, -1, -3)$
77.  $78. \quad \overrightarrow{r} = (2i - j + 2\hat{k}) + \lambda(2i - 2j + \hat{k})$ .

86.  $\frac{x-2}{1} = \frac{y+1}{2} = \frac{z+1}{3}$ ,  $\vec{r} = (2i - j + 2\hat{k}) + \lambda(2i - 2j + \hat{k})$ .

87.  $(-9, 2, 1)$ .

88.  $29x - 27y - 22z = 85$ .

89. 13 units.

90.  $7y + 4z - 5 = 0$ .

91.  $4x - 7y + 3z - 28 = 0$ .

92.  $\vec{r} \cdot (5i - 2j - 3\hat{k}) = 7$ .

93. 1 units.

94.  $x - 20y + 27z = 14$ .

96.  $x - 2y + 2z = 0$ .

98.  $5x + 2y - 3z = 17$ .

99.  $\vec{r} \cdot (2i + j + 2\hat{k}) + 3 = 0$ ,  $2x + y + 2z + 3 = 0$ .

**Or**

$$\vec{r} \cdot (-i + 2j - 2\hat{k}) + 3 = 0, -x + 2y - 2z + 3 = 0.$$

100.  $51x + 15y - 50z + 173 = 0$ .

101.  $5x - 7y + 11z + 4 = 0$ .

102.  $\frac{3\sqrt{2}}{2}$

103.  $\vec{r} \cdot (i - 2j + \hat{k}) = 1$

104. 14 units.

105.  $(-1, -1, -1)$ .

106.  $\frac{8}{\sqrt{29}}$

107.  $\frac{x}{1} = \frac{y}{2} = \frac{z}{-1}; \frac{x}{-1} = \frac{y}{1} = \frac{z}{-2}$ .

108.  $2\sqrt{2}$

109.  $7x + 13y + 4z - 9 = 0$ ,  $\sin^{-1}\left(\frac{4}{\sqrt{234}}\right)$

110.  $S.D = 3\sqrt{30}$ ,  $\hat{r} = (3\hat{i} + 8\hat{j} + 3\hat{k}) + \mu(-6\hat{i} - 15\hat{j} + 3\hat{k})$ .

111.  $(3, 4, 2)$ .

112.  $x + 2y - 2z = 6$ ,  $2x - 2y - z = 3$ .

114.  $\vec{r} \cdot (\sqrt{2}i + j + \hat{k}) = 2$ .

115.  $\hat{i} + 2\hat{j} + 3\hat{k}, \sqrt{14}.$

116.  $\frac{\mathbf{a}}{\sqrt{2}}(4\hat{i} + 3\hat{j} + 5\hat{k})$

### HINTS FOR SELECTED QUESTIONS

1. Hz component =  $2 \cos (150^\circ)$ , Vertical component =  $5 \sin 150^\circ$ .

5.  $Q = \tan^{-1} \left( \frac{|\overrightarrow{a} \times \overrightarrow{b}|}{\overrightarrow{a} \cdot \overrightarrow{b}} \right)$ .

9.  $I = m = n$  and  $\ell + m^2 + n^2 = 1$ .

17.  $\overrightarrow{BC} = \overrightarrow{AC} - \overrightarrow{AB}$

25. Diagonal coinitial with  $\overrightarrow{a} = \overrightarrow{b}$  is  $\overrightarrow{a} + \overrightarrow{b}$

27.  $|\overrightarrow{a} + \overrightarrow{b}|^2 + |\overrightarrow{a} - \overrightarrow{b}|^2 = 2(|\overrightarrow{a}|^2 + |\overrightarrow{b}|^2).$

28.  $\overrightarrow{a} \times i$  is a vector  $\perp$  to both  $\overrightarrow{a}$  and  $i$ .

36.  $\cos^2 + \cos^2\beta + \cos^2\gamma = 1$

42. d r's are 1, 1, 1.

43. (1, 3, q) lies on the line.

57. Zero, as line is not parallel to plane.

63.  $(\overrightarrow{a} \times i)^2 = |\hat{a}|^2 \sin^2 \alpha, (\overrightarrow{a} \times j)^2 = |\hat{a}|^2 \sin^2 \beta, (\overrightarrow{a} \times \hat{k}) = |\hat{a}|^2 \sin^2 \gamma$  and  $\cos^2 \alpha + \cos^2 \beta + \cos^2 \gamma = 1$ .

71.  $\overrightarrow{c} \perp (\overrightarrow{a} \times \overrightarrow{b})$

79.  $\overrightarrow{r} \cdot i > 0, \overrightarrow{r} \cdot j > 0, \overrightarrow{r} \cdot \hat{k} > 0$ .

80.  $\overrightarrow{a}$  is parallel to  $\overrightarrow{b} \times \overrightarrow{c}$  so  $\overrightarrow{a} = \lambda(\overrightarrow{b} \times \overrightarrow{c})$ .

86. Change the line in symmetric form.

## CHAPTER 12

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# LINEAR PROGRAMMING

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1. Maximum profit = Rs. 95 with 5 shares of each type.
2. Minimum cost = Rs. 1350      { No. of days for which A work = 5 days  
    No. of days for which B work = 3 days.
3. Maximum profit = Rs. 784      { Dinner sets of type I = 8  
    Dinner sets of type II = 12
4. For minimum profits,      { Lamps of type A = 40  
    Lamps of type B = 20
5. Minimum transportation cost = Rs. 300.  
No. of packets transported from A to P = 10, A to Q = Nil, A to R = 50  
No. of packets transported from B top = 30, B to Q = 40, B → R = 10.
6. Minimum cost = Rs. 440      { Fertilizer of type I = 100 kg.  
    Fertilizer of type II = 80 kg.
7. No of flights of model 314 type = 6.  
No of flights of model 535 type = 2.
8. For maximum profit, No. of units of type A = 26  
    No. of units of type B = 26
9. Minimum cost = Rs. 7      Quantity of bran =  $\frac{14}{10}$   
    Quantity of rice = Nil
10. Minimum cost = Rs. 41 Food of type A = 5 kg.  
    Food of type B = 2kg.
11. Maximum distance = 30 km, when  
Distance covered with a speed of 25 km/hr =  $\frac{50}{3}$  km  
Distance covered with a speed of 40 km/hr =  $\frac{40}{3}$  km.
12. Maximum income = Rs. 8400, when

Investment in P.P. F = Rs. 80,000

Investment in bonds = Rs. Rs. 20,000

13. From factory P to A, B, C are 8, 2, 0 respectively  
From factory Q to A, B, C are 0, 6, 9 respectively.
14. From X to A, B, C are 50q, 40q, Nil respectively.  
From Y to A, B, C are 50q, Nil, Nil respectively.

15. Minimum value  $14\frac{1}{3}$  at  $(\frac{84}{13}, \frac{15}{13})$ .

Minimum value is  $3\frac{1}{14}$  at  $(\frac{9}{14}, \frac{25}{14})$ .

16. Minimum value of  $z = 19$  at  $x = 3, y = 2$   
Maximum value of  $z = 42$  at  $x = 4, y = 6$ .
17. (i) Maximum of this problem does not exist.  
(ii) Minimum value is infinity or solution is unbounded.
18. Maximum profit = Rs. 20,100 when 40 trees of type A and 30 trees of type B are planted.
19. Maximum value is 19 at  $(\frac{7}{2}, \frac{3}{4})$   
Minimum value is  $\frac{63}{13}$  at  $(\frac{3}{13}, \frac{24}{13})$ .
20. Maximum profit = Rs. 1300.  
No. of belts of type A = 200  
No. of belts of type B = 600.

# CHAPTER 13

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# PROBABILITY

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1.  $\frac{4}{13}$ .

2. (i)  $\frac{1}{2}$

(ii)  $\frac{1}{3}$

3. (i)  $\frac{3}{13}$

(ii)  $\frac{3}{52}$

4.  $\frac{1}{5}$  [**Hint** :  $P(A' \cup B') = P(A \cap B)$ ]

5. Not defined.

6.  $\frac{1}{3}$

7.  $\frac{3}{25}$

8.  $\frac{2}{3}$  [**Hint** :  $u = 0 \times \frac{144}{169} + 1 \times \frac{24}{169} + 2 \times \frac{1}{169}$ ].

9.  $K = 0.2$ ,  $P(x = 3) = 0.4$ .

10. (i)  $\frac{8}{81}$  [**Hint** :  $n = 4$ ,  $p = \frac{1}{3} \therefore q = \frac{2}{3}$ ]

(ii)  $\frac{32}{81} P(x = 3) = 4c_3 \left(\frac{1}{3}\right)^3 \cdot \frac{2}{3}$

11. 1 Hint.

12.  $\left(\frac{2}{3}\right)^{10}$

13.  $\frac{75}{216}$

14.  $\frac{1}{216}$

15.  $\frac{2}{3}$

16. 1

17.  $\frac{2}{7}$

18.  $\frac{1}{36}$

19. 0.0256

20. 7.5 [Hint : Expectation =  $E(x) = np$ ]

21. (i)  $S = \{bb, bg, gb, gg\}$ . (ii)  $\frac{1}{3}$

(iii)  $\frac{1}{3}$  (iv)  $\frac{1}{2}$

22. (i)  $\frac{3}{8}$  (ii)  $\frac{2}{8}$

23. (i)  $\frac{1}{3}$  (ii)  $\frac{2}{9}$   
(iii) 0

24.  $P\left(\frac{A}{E}\right) = \frac{1}{4}$

$P\left(\frac{B}{E}\right) = \frac{1}{4}$

$P\left(\frac{C}{E}\right) = \frac{1}{4}$

25. 0.6976.

26.  $\frac{19}{42}$

27.  $\frac{11}{50}$

28. 0.083

29.  $\frac{9}{13}$

30.  $P(0) = \frac{5}{28}, P(1) = \frac{15}{28}, P(2) = \frac{15}{56}, P(3) = \frac{1}{56}.$

31.  $P(0) = \frac{27}{64}, P(1) = \frac{27}{64}, P(2) = \frac{9}{64}, P(3) = \frac{1}{64}.$

32.  $\frac{13}{16}$  [Hint : Required probability =  $1 - P(X > 3)$   
 $= 1 - \{P(X = 4) + P(X = 5)\}$

33. 4 [Hint :  $P(X \geq 1) > 0.99$

$1 - P(X = 0) > 0.99$

$1 - nc_0 \cdot \frac{1}{4n} > 0.99]$

34. Expected to lose Rs.  $\frac{91}{54}.$

35. (i)  $\frac{193}{512}$  (ii)  $\frac{53}{64}$

36.  $\frac{11}{243}$

37.  $P(0) = \frac{125}{216}, P(1) = \frac{75}{216}, P(2) = \frac{15}{216}, P(3) = \frac{1}{216}.$

{Hint : Possible doublets are (1, 1), (2, 2), (3, 3) (4, 4), (5, 5) (6, 6)}

38.  $P(X = r) = 32c_r \left(\frac{1}{2}\right)^{32-r} \left(\frac{1}{2}\right)^r ; r = 0, 1, 2, \dots, 32.$

{Hint : np + npq = 24 and np × npq = 128}

39. (i) A and B are independent.

(ii) B and C are independent.

(iii) A and C are independent.

(iv) A, B and C are independent.

[Hint : Draw veen diagram.]

40. (i) C and M are not independent.

(ii) M and S not independent.

(iii) S and M are not independent.

(iv) If (i), (ii), (iii) are not independent C, M and S are also not independent.

41. (i)  $\frac{25}{58}$

(ii)  $\frac{9}{29}$

(iii)  $\frac{15}{58}$

42.  $\frac{2}{37}$

[Hint : E : doing question correctly

K : he knows

C : he copies

G : he guesses

L : he leaves the question]

$$P(K) = \frac{3}{10}, P(C) = \frac{1}{5}, P(G) = \frac{1}{10}, P(L) = \frac{2}{5}$$

$$P(E/K) = 1, P(E/C) = \frac{1}{4}, P(E/G) = \frac{1}{5}, P(E/L) = 0$$

Now use Baye's theorem.

43.  $\frac{3}{7}$

44.	X	0	1	2	3
	P(X)	$\frac{4324}{5525}$	$\frac{1128}{5525}$	$\frac{72}{5525}$	$\frac{1}{5525}$

$$\text{Mean} = \frac{3}{13}, \text{ Variance} = \frac{588}{2873}$$

Hint : Mean ( $\mu$ ) =  $\sum X_i P(X_i)$

$$\text{Variance} (\sigma^2) = \sum X_i^2 P_i - \mu^2$$

45.	X	0	1	2	3
	P(X)	$\frac{1728}{2197}$	$\frac{432}{2197}$	$\frac{36}{2197}$	$\frac{1}{2197}$

$$\text{Mean} = \frac{505}{2197}, \text{ Variance} = 0.2661$$

46.	$X$	0	1	2	3	4	5
	$P(X)$	$\frac{3125}{7776}$	$\frac{3125}{7776}$	$\frac{1250}{7776}$	$\frac{250}{7776}$	$\frac{250}{7776}$	$\frac{1}{7776}$

$$\text{Mean } (\mu) = \frac{5}{6}, \text{ Variance } (\sigma^2) = \frac{275}{36}$$

47. (i)  $\frac{1}{18}$  (ii)  $\frac{1}{2}$

(iii)  $\frac{1}{2}$  (iv)  $\frac{17}{18}$

48. (i)  $\frac{5}{41}$  (ii)  $\frac{36}{41}$

49. (i)  $K = \frac{1}{7}$  (ii)  $P(X > 3) = \frac{3}{7}$

(iii)  $P(X > 3) = \frac{1}{7}$

50. (i)  $\frac{21}{32}$  (ii)  $\frac{11}{32}$

(iii) Mean = 3, Variance = 1.5

51. (i)  $\left(\frac{5}{6}\right)^7$  (ii)  $35 \left(\frac{1}{6}\right)^7$

(iii)  $\left(\frac{1}{6}\right)^5$  (iv)  $1 - \left(\frac{1}{6}\right)^7$

Hint :  $P(X = r) = n_{C_r} p^r q^{n-r}$  Here  $P = \frac{6}{36} = \frac{1}{6}$

# ELECTROSTATICS

## KEY POINTS

- **Coulomb's Law :** The mutual electrostatic force between two point charges  $q_1$  and  $q_2$  is proportional to the product  $q_1 q_2$  and inversely proportional to the square of the distance  $r$  separating them.

$$\vec{F}_{21} = \text{Force on } q_2 \text{ due to } q_1 = k \frac{q_1 q_2}{r^2} \hat{r}_{12}$$

$\hat{r}_{12}$  is a unit vector in the direction from  $q_1$  to  $q_2$  and  $K$  is constant of proportionality.

$$k = \frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \text{ N m}^2 \text{ C}^{-2}$$

- Electric field of an electric dipole at equitorial point at a distance  $r$  from the centre :

$$\left. \begin{aligned} \vec{E} &= \frac{1}{4\pi\epsilon_0} \frac{2\vec{p} r}{(r^2 - a^2)^{3/2}} \\ &\approx + \frac{2\vec{p}}{4\pi\epsilon_0 r^3} \text{ for } r \gg a \end{aligned} \right] \text{ at axial point} \quad \left. \begin{aligned} \vec{E} &= \frac{1}{4\pi\epsilon_0} \frac{\vec{p}}{(r^2 - a^2)^{3/2}} \\ &\approx - \frac{\vec{p}}{4\pi\epsilon_0 r^3} \text{ for } r \gg a \end{aligned} \right] \text{ at equitorial point}$$

- Thus note  $\frac{1}{r^3}$  dependence of dipole electric field in contrast to  $\frac{1}{r^2}$  dependence of electric field due to point charge.
- In a uniform electric field  $\vec{E}$ , an electric dipole experiences a torque ' $\vec{\tau}$ ' given by  $\vec{\tau} = \vec{p} \times \vec{E}$ , but no net force is experienced.
- The flux  $\Delta\phi$  of electric field  $\vec{E}$  through a small area element  $\Delta\vec{S}$  is given by :

$$\Delta\phi = \vec{E} \cdot \Delta\vec{S} \quad \Delta\vec{S} = |\Delta\vec{S}| \hat{n}$$

Where  $|\Delta\vec{S}|$  is the magnitude of area element and  $\hat{n}$  is unit vector normal to the area element which can be considered plane as  $|\Delta\vec{S}|$  is small.

- The electric field  $\vec{E}$  due to thin, infinitely long straight wire of uniform linear charge density  $\lambda$  is

$$\vec{E} = \frac{\lambda}{2\pi\epsilon_0 r} \hat{n}$$

where  $r$  is the perpendicular distance of the point from the wire and  $\hat{n}$  is the radial unit vector in the plane normal to the wire passing through the point.

- The electric field due to an infinite thin plane sheet of uniform surface charge density  $\sigma$  is

$$\vec{E} = \frac{\sigma}{2\epsilon_0} \hat{n}$$

where  $\hat{n}$  is a unit vector normal to the plane, outward on either side.

- The electric field due to a thin spherical shell of uniform surface charge density  $\sigma$  is

$$\vec{E} = \frac{q}{2\pi\epsilon_0 r^2} \hat{r} \quad (r \geq R)$$

$$\vec{E} = 0 \quad (r < R)$$

where  $r$  is the distance of the point from the centre of the shell and  $R$  the radius of the shell,  $q$  is total charge of the shell.

- The dimensions of (i) Electric field are  $MLT^{-3} A^{-1}$  (ii) Electric flux are  $ML^3 T^{-3} A^{-1}$ .
- Electric potential at a point represented by position vector  $\vec{r}$  due to a point charge  $Q$  placed at the origin is given by :

$$V = \frac{Q}{4\pi\epsilon_0 r} \quad \text{where} \quad r = |\vec{r}|$$

Electric potential at a point represented by position vector  $\vec{r}$  due to a dipole of dipole moment  $\vec{p}$  at the origin is

$$\begin{aligned} V &= \frac{p \cos \theta}{2\pi\epsilon_0 (r^2 - a^2 \cos^2 \theta)} \\ &= \frac{\vec{p} \cdot \vec{r}}{4\pi\epsilon_0 r^2} \quad \text{for } r \gg a \end{aligned}$$

Here  $\theta$  = angle between  $\vec{p}$  and  $\vec{r}$ .

- Electrostatic potential energy of a pair of point charges  $q_1$  and  $q_2$  at a separation  $r$  is

$$U = \frac{q_1 q_2}{4\pi\epsilon_0 r}$$

- The potential energy of a dipole of dipole moment  $\vec{p}$  in a uniform electric field  $\vec{E}$  is

$$U = -\vec{p} \cdot \vec{E}$$

- Torque experienced by an electric dipole in a uniform electrostatic field is  $\vec{p} \times \vec{E}$ . An electric dipole must experience zero torque and its potential energy should be

(i) Minimum for stable equilibrium.

(ii) Maximum for unstable equilibrium.

- Electrostatic field is zero in the interior of a conductor due to charges on the surface of the conductor or outside the conductor.

- In the case of a charged conductor  $\vec{E} = \frac{\sigma}{\epsilon_0} \hat{n}$  where  $\hat{n}$  is a unit vector along the outward normal to the conductor and  $\sigma$  is the surface charge density.
- Any charge given to a hollow or a solid conductor will always appear on its outer surface.
- Capacitance of an air filled parallel plate capacitor is

$$C = \frac{\epsilon_0 A}{d}$$

- The capacitance of a capacitor with a dielectric medium completely filling the space between the plates is  $K$  times its capacitance without the dielectric. Here  $K$  is the dielectric constant of the medium.
- For a series combination of capacitors connected across a dc source, charge on each capacitor will be the same. From here we get

$$\frac{1}{C_s} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \dots$$

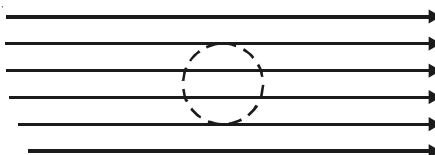
- For a parallel combination of capacitors, connected across a dc source, potential difference (or voltage) across each capacitor will be the same. From here we get

$$C_p = C_1 + C_2 + C_3 + \dots$$

- Energy stored in a charged capacitor is given by  $U = \frac{1}{2} CV^2 = \frac{Q^2}{2C} = \frac{1}{2} QV$  and energy density for a parallel plate capacitor is  $\frac{1}{2} \epsilon_0 E^2$ .

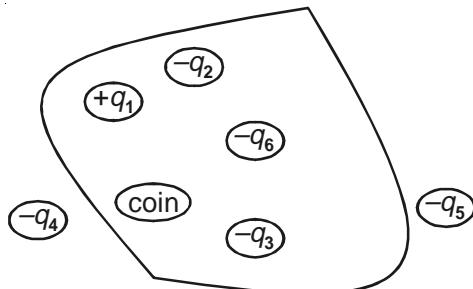
### VERY SHORT QUESTIONS (1 MARK)

- Draw schematically an equipotential surface in a uniform electrostatic field directed along Z axis.
- Shown in the figure is a uniform electrostatic field. How will the field lines modify if a metallic solid sphere is placed at the dotted place?



- Sketch electric field lines due to (i) two equal positive charges near each other (ii) a dipole.
- Name the physical quantity whose SI unit is coulomb/volt. Is it a scalar or a vector quantity?
- Two point charges repel each other with a force  $F$  when placed in a medium of dielectric constant 81. What will the force between them when placed the same distance apart in air?

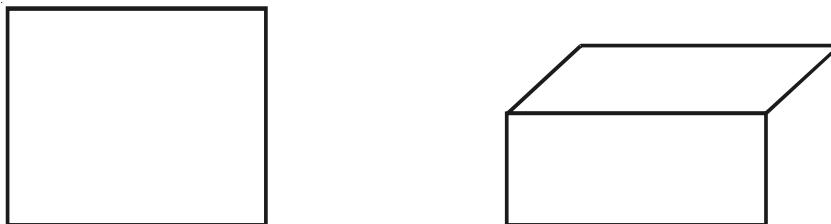
6. An uncharged insulated conductor A is brought near a charged insulated conductor B. What happens to the charge and potential of B?
7. Figure shows six charged lumps of plastic and an electrically neutral coin. The cross-section of a Gaussian surface S is indicated. What is the net electric flux through the surface?



8. A point charge Q is placed at point O shown in fig. Is the potential difference  $V_a - V_b$  between a and b positive, negative or zero, if Q is (i) positive (ii) negative charge.

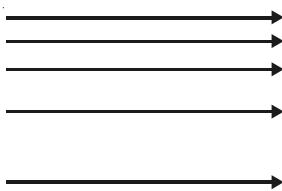


9. Electric dipole moment of  $\text{CuSO}_4$  molecule is  $3.2 \times 10^{-32}$  Cm. Find the separation between copper and sulphate ions.
10. Net capacitance of three identical capacitors connected in parallel is 12 microfarad. What will be the net capacitance when two of them are connected in (i) parallel (ii) series?
11. A thin rectangular metal sheet is charged such that it has a charge density  $\sigma$ . Will the charge density remain uniform if it is folded as shown in the figure? Justify.



12. An electron and a proton are released from rest in a uniform electrostatic field. Which of them will have larger acceleration?
13. Without referring to the formula  $C = \epsilon_0 A/d$ , explain why the capacitance of a parallel plate capacitor reduces on increasing the separation between the plates?
14. The dipole moment of a dipole is  $3.6 \times 10^{-10}$  C-m. What is the flux through a Gaussian surface of radius 10 cm enclosing the dipole?
15. Draw field lines to show the position of null point for a two point charges  $+Q_1$  and  $-Q_2$ ,  $r$  distance apart. Given that magnitude of  $Q_1 >$  magnitude of  $Q_2$ .

16. A charge  $q$  is placed at the centre of an imaginary spherical surface. What will be the flux of the electric field due to this charge through any half of the sphere.
17. What is the necessity of taking  $q_0 \rightarrow 0$ . While defining electrostatic field at a point using the formula
- $$\vec{E} = \frac{\vec{F}}{q_0}$$
18. In an uniform electrostatic field of strength  $E$ , a charged particle  $Q$  moves from point A to point B in the direction of the field and then back to A. Calculate the ratio of the work done by the electric field in taking the charge particle from A to B and from B to A.
19. In charging a capacitor of capacitance  $C$  by a source of EMF  $V$ , energy supplied by the source is  $QV$  and the energy stored in the capacitor is  $\frac{1}{2} QV$ . Justify the difference.
20. An electric dipole of dipole moment  $p$ , is held perpendicular to an electric field; (i)  $\vec{E} = E_0 \hat{i}$ ; (ii)  $\vec{E} = E_0 \times \hat{i}$ . If the dipole is released does it have (a) only rotational motion (b) only translatory motion (c) both translatory and rotatory motion in (i) and (ii).
21. Sketch the electric field vs distance graph for spherical shell of radius  $R$  and charge  $Q > 0$ .
22. Can the following set of field lines represent a uniform electrostatic field? Justify your answer.



23. Diagrammatically represent the position of a dipole in (i) stable (ii) unstable equilibrium when placed in a uniform electric field.
24. A charge  $Q$  is distributed over a metal sphere of radius  $R$ . What is the electric field and electric potential at the centre?

### **SHORT ANSWER QUESTIONS (2 MARKS)**

- The electric field intensity at any point due to a system of charges is zero? Does it mean that the net charge of the system is zero? Justify.
- An oil drop of mass  $m$  carrying charge  $-Q$  is to be held stationary in the gravitational field of the earth. What is the magnitude and direction of the electrostatic field required for this purpose?
- A point charge  $Q$  is kept at the intersection of (i) face diagonals (ii) diagonals of a cube of side  $L$ . What is the electric flux linked with the cube in (i) and (ii)?
- The electric field in a certain space is given by  $\vec{E} = 10\hat{i} + 2\hat{j} + 3\hat{k}$  N/C. Calculate the flux crossing the surface of area  $\vec{A} = 25\hat{i} + 10\hat{j} + 5\hat{k}$  cm<sup>2</sup>.
- Find the number of field lines originating from a point charge of  $q = 8.854 \mu\text{C}$ .
- What is the work done by an electric field in rotating a dipole from its unstable equilibrium to stable equilibrium? Does the energy of the dipole increase or decrease in this process?

7. The electric potential  $V$  at any point in space is given  $V = 20x^3$  volt, where  $x$  is in meter. Calculate the electric field intensity at point P (1, 0, 2).

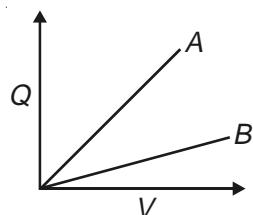
8. What is electric field between the plates with the same separation of 2cm. The electric potential of each plate is marked in Fig.

$\rule{1cm}{0.4pt}$ 150 V	$\rule{1cm}{0.4pt}$ 200 V
(i) $\rule{1cm}{0.4pt}$ -50 V	(ii) $\rule{1cm}{0.4pt}$ 20 V

9. A storage capacitor on a RAM (Random Access Memory) chip has a capacity of 55pF. If the capacitor is charged to 5.3V, how many excess electrons are on its negative plate?

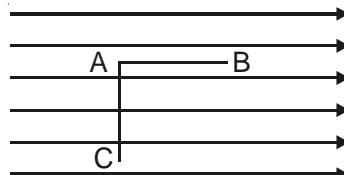
10. Derive an expression for the work done in rotating an electric dipole by an angle  $\theta$  from its equilibrium position in a uniform electrostatic field.

11. The figure shows the Q (charge) versus V (potential) graph for a combination of two capacitors. One of them is for a parallel combination. Identify the graph representing the parallel combination.



12. Show that there is always a loss of energy when two capacitors charged to different potentials share charge (when connected with each other).

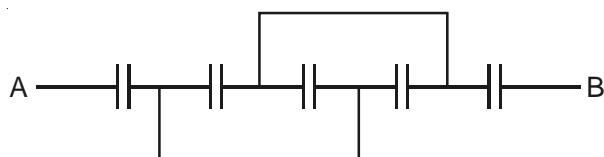
13. Calculate the work done in taking a charge of 1  $\mu\text{C}$  in a uniform electrostatic field of 10 N/C from  
 (i) A to B where AB = 5 cm along electric field (ii) from A to C where AC = 10 cm perpendicular to electric field (iii) from B to C.



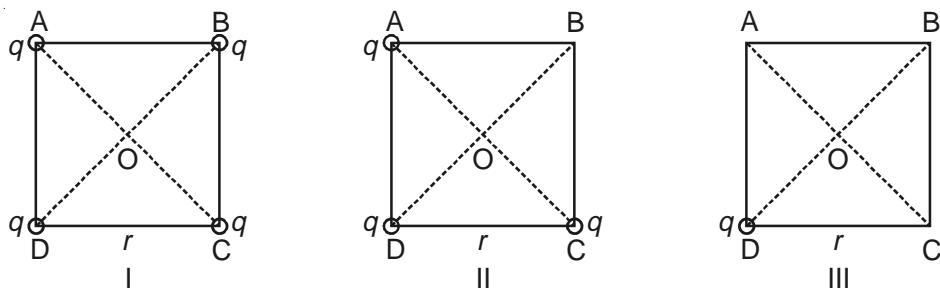
14. Ten point charges,  $q$  each are equally spaced and fixed around a circle of radius  $R$ . Relative to potential equal to zero at infinity, what is the electric field and electric potential at the centre of the circle?

15. A thin long conductor has linear charge density of 20  $\mu\text{C/m}$ . Calculate the electric field intensity at a point 5 cm from it. Draw a graph to show variation of electric field intensity with distance from the conductor.

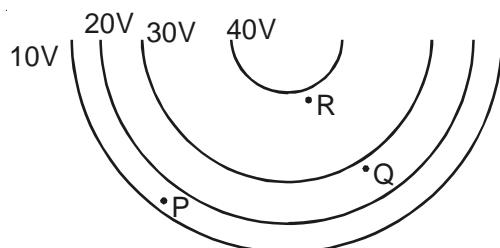
16. Find equivalent capacitance between A and B in the combination given below : each capacitor is of 2  $\mu\text{F}$ .



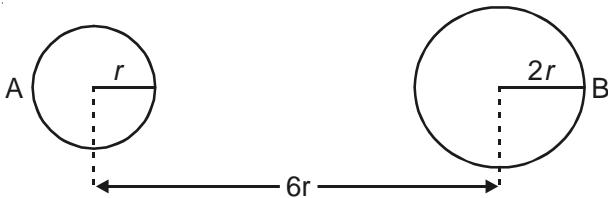
17. There is a charged glass rod in free space. A small piece of paper is to be kept near it so that it does not experience any force due to electrostatic induction. How can it be done?
18. Draw equipotential surfaces (at least three) for a point charge  $q > 0$ .
19. A short electric dipole produces electric field  $E_a$  at some point distance  $R_a$  away on the axial line and  $E_b$  at a point distance  $R_b$  away on the equatorial line. For what value of  $R_a/R_b$  is  $E_a = E_b$ ?
20. In a region, potential at a point is given by  $V = -2x^2y + 3yz$ . Find the following at point  $(a, -a, a)$ .
- Potential gradient.
  - Electric field intensity.
21. What is the electric field at O in figures (i), (ii) and (iii).



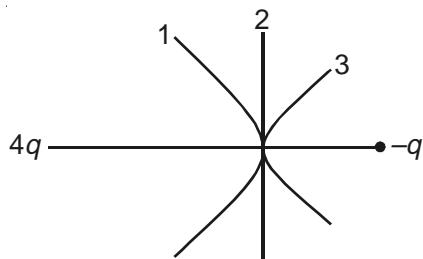
22. What should be the charge on a sphere of radius 4 cm, so that when it is brought in contact with another sphere of radius 2 cm carrying charge of  $10 \mu\text{C}$ , there is no net transfer of charge?
23. There is a uniform electric field in a region along + Y axis. What is the direction along which electric potential (i) decreases (ii) does not change?
24. For an isolated parallel plate capacitor of capacitance C and charged to potential V, what will happen to (i) charge on the plates (ii) potential difference across the plates (iii) field between the plates (iv) energy stored in the capacitor, when the distance between the plates is increased?
25. Does the maximum charge given to a metallic sphere of radius R depend on whether it is hollow or solid? Give reason for your answer.
26. There are two large parallel metallic plates  $S_1$  and  $S_2$  carrying surface charge densities  $\sigma_1$  and  $\sigma_2$  respectively ( $\sigma_1 > \sigma_2$ ) placed at a distance d apart in vacuum. Find the work done by the electric field in moving a point charge  $q$  a distance  $a$  ( $a < d$ ) from  $S_1$  towards  $S_2$  along a line making an angle  $\pi/4$  with the normal to the plates.
27. Figure shows lines of constant potential in an electric field. Out of the three given points P, Q and R, where is the electric field intensity (i) maximum (ii) minimum?



28. Two metal spheres A and B of radius  $r$  and  $2r$  whose centers are separated by a distance of  $6r$  are given charge  $Q$  each and are at potential  $V_1$  and  $V_2$ . Find the ratio of  $V_1/V_2$ . These spheres are connected to each other with the help of a conducting wire keeping the separation unchanged. What is the amount of charge that will flow through the wire?



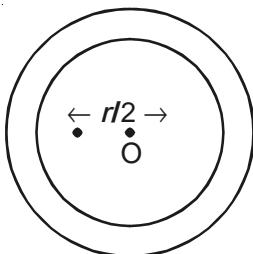
29. Obtain an expression for the field due to electric dipole at any point on the equatorial line.
30. The electric field given below shows two point charges  $4q$  and  $-q$ . Also shown in the figure are three lines in the plane of the charges. Which of them can possibly be an equipotential line? Justify.



### SHORT ANSWER QUESTIONS (3 MARKS)

- Define electrostatic potential and its unit. Obtain expression for electrostatic potential at a point P in the field due to a point charge.
- Calculate the electrostatic potential energy for a system of three point charges placed at the corners of an equilateral triangle of side 'a'.
- What is polarization of charge? With the help of a diagram show why the electric field between the plates of capacitor reduces on introducing a dielectric slab. Define dielectric constant on the basis of these fields.
- Using Gauss's theorem in electrostatics, deduce an expression for electric field intensity due to a charged spherical shell at a point (i) inside (ii) on its surface (iii) outside it. Graphically show the variation of electric field intensity with distance from the centre of shell.
- Three capacitors are connected (i) in series (ii) in parallel. Find the expression for equivalent capacitance for each type of combination.
- A charge  $Q$  is distributed over two concentric hollow spheres of radii  $r$  and  $R$  ( $R > r$ ), such that their surface density of charges are equal. Find Potential at the common centre.
- If a charge  $Q$  is given to a parallel plates capacitor and  $E$  is the electric field between the plates of the capacitor, the force on each plate is  $1/2 QE$  and if charge  $Q$  is placed between the plates it experiences a force equal to  $QE$ . Give reasons to explain the above.
- Figure shows the cross-section of a spherical metal shell of radius  $r$ . A point charge of  $-0.5$  microcoulomb is located at a distance  $r/2$  from the centre of the shell. If the shell is electrically

neutral, what are the induced charges on the inner and outer surfaces? What is the field pattern inside and outside the shell? Are the charges uniformly distributed?



9. You are given an air filled parallel plate capacitor. Two slabs of dielectric constants  $k_1$  and  $k_2$  have been filled in between the two plates of the capacitor as shown in Fig. What will be the capacitance of the capacitor (initial area of plates is A and distance between plates d)?

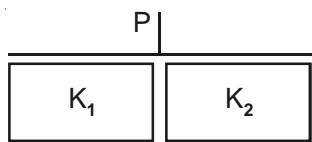


Fig. 1

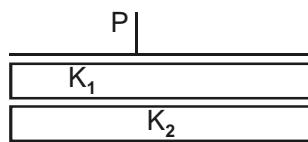
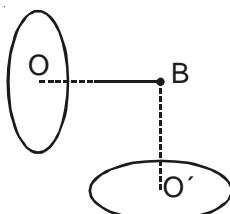


Fig. 2

### LONG ANSWER QUESTIONS (5 MARKS)

- State the principle of Van de Graaff generator. Explain its working with the help of a neat labeled diagram.
- Derive an expression for the strength of electric field intensity at a point on the axis of a uniformly charged circular coil of radius R carrying charge Q.
- In the figure given calculate the net electric field intensity at point B which is on the axis of both the loops and  $OB = O'B = 1.5$  m. The radius of each loop is 2.0m and each is carrying a charge of  $3 \mu\text{C}$ .



- Derive an expression for potential at any point distant  $r$  from the centre O of dipole making an angle  $\theta$  with the dipole.
- Suppose that three points are set at equal distance  $r = 90$  cm from the centre of a dipole, point A is on the dipole axis above the +ve charge, point B is on the axis below the negative charge and at point C which is on the perpendicular bisector of the line joining the charges. What would be the electric potential due to the dipole of dipole moment  $3.6 \times 10^{-19}$  Cm at point A, B and C?
- Derive an expression for capacitance of parallel plate capacitor with dielectric slab between the plates. How would the (i) energy (ii) charge, (iii) potential difference between the plates be

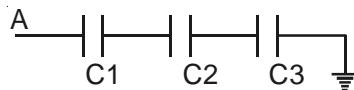
affected if dielectric slab is introduced (a) with battery disconnected, (b) after the battery is disconnected.

7. Derive an expression for torque experienced by dipole placed in uniform electric field. Hence define electric dipole moment.
8. The potential  $U_3$  energies of a dipole in different positions in a uniform electric field are  $U_1 = -3U_0$ ,  $U_2 = +5U_0$ ,  $U_3 = +3U_0$ ,  $U_4 = +7U_0$  where  $U_0$  is constant and positive. Arrange the 4 positions in increasing order of torque acting on the dipole.
9. State Gauss's theorem in electrostatics. Derive an expression for the electric field due to a charged plane sheet. Find the potential difference between the plates of a parallel plate capacitor having surface density of charge  $5 \times 10^{-8} \text{ Cm}^{-2}$  with the separation between plates being 4 mm.

## NUMERICALS

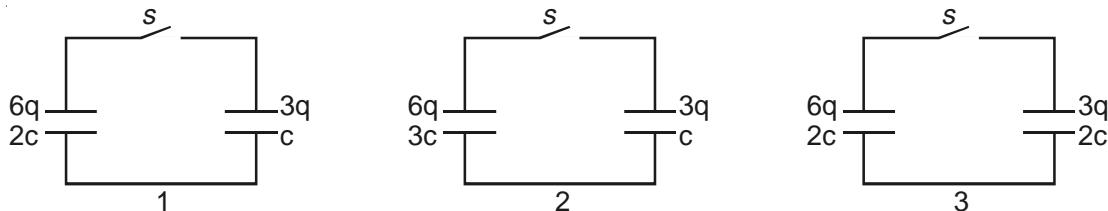
1. A pendulum bob of mass  $80 \text{ mg}$  and carrying charge of  $3 \times 10^{-8} \text{ C}$  is placed in a horizontal electric field. It comes to equilibrium position at an angle of  $37^\circ$  with the vertical. Calculate the intensity of electric field ( $g = 10 \text{ m/s}^2$ ).  $(2 \times 10^4 \text{ N/C})$
2. What should be the position of charge  $q = 5 \mu\text{C}$  for it to be in equilibrium on the line joining two charges  $q_1 = -4 \mu\text{C}$  and  $q_2 = 10 \mu\text{C}$  separated by 9 cm. Will the position change for any other value of charge  $q$ ?  $(9 \text{ cm from } -4 \mu\text{C})$
3. Two point charges  $4e$  and  $e$  each, at a separation  $r$  in air, exert force of magnitude  $F$  on each other. They are immersed in a medium of dielectric constant 16. What should be the separation between the charges so that the force between them remains unchanged.  
 $(\text{one fourth the original separation})$
4. Eight charged water droplets each of radius 1 mm and charge  $10 \times 10^{-10} \text{ C}$  join to form a single drop. Calculate the potential on the surface of the bigger drop.  $(3600 \text{ V})$
5. What potential difference must be applied to produce an electric field that can accelerate an electron to  $1/10$  of velocity of light?  $(2.6 \times 10^3 \text{ V})$
6. Two capacitors of capacitance  $10 \mu\text{F}$  and  $20 \mu\text{F}$  are connected in series with a  $6V$  battery. If  $E$  is the energy stored in  $20 \mu\text{F}$  capacitor what will be the total energy supplied by the battery in terms of  $E$ .  $(6E)$
7. A  $10 \mu\text{F}$  capacitor can withstand a maximum voltage of  $100\text{V}$  across it, whereas another  $20 \mu\text{F}$  capacitor can withstand a maximum voltage of only  $25\text{V}$ . What is the maximum voltage that can be put across their series combination?  $(75\text{V})$
8. Two point charges  $6 \mu\text{C}$  and  $2 \mu\text{C}$  are separated by 3 cm in free space. Calculate the work done in separating them to infinity.  $(3.6 \text{ joule})$
9. ABC is an equilateral triangle of side 10 cm. D is the mid point of BC. Charges  $100 \mu\text{C}$ ,  $-100 \mu\text{C}$  and  $75 \mu\text{C}$  are placed at B, C and D respectively. What is the force experienced by a  $1 \mu\text{C}$  positive charge placed at A?  
 $(9\sqrt{2} \times 10^3 \text{ N})$
10. A point charge of  $2 \mu\text{C}$  is kept fixed at the origin. Another point charge of  $4 \mu\text{C}$  is brought from a far point to a distance of 50 cm from origin. Calculate the electrostatic potential energy of the two charge system. Another charge of  $11 \mu\text{C}$  is brought to a point 100 cm from each of the two charges. What is the work done?  $(3.2 \times 10^{-3}\text{C})$

11. A 5 MeV  $\alpha$  particle is projected towards a stationary nucleus of atomic number 40. Calculate distance of closest approach.  $(1.1 \times 10^{-4} \text{ m})$
12. To what potential must an insulated sphere of radius 10 cm be charged so that the surface density of charge is equal to  $1 \mu\text{C/m}^2$ .  $(1.13 \times 10^6 \text{ V})$
13. In the following fig. calculate the potential difference across capacitor  $C_2$  Given potential at A is 90 V.  $C_1 = 20 \mu\text{F}$ ,  $C_2 = 30 \mu\text{F}$ , and  $C_3 = 15 \mu\text{F}$ .  $(20\text{V})$



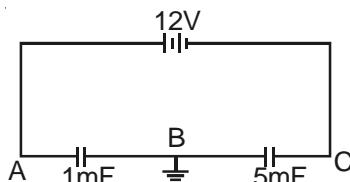
14. A point charge develops an electric field of  $40 \text{ N/C}$  and a potential difference of  $10 \text{ J/C}$  at a point. Calculate the magnitude of the charge and the distance from the point charge.  $(2.9 \times 10^{-10} \text{ C}, 25 \text{ cm})$

15. Figure shows three circuits, each consisting of a switch and two capacitors initially charged as indicated. After the switch has been closed, in which circuit (if any) will the charges on the left hand capacitor (i) increase (ii) decrease (iii) remain same?

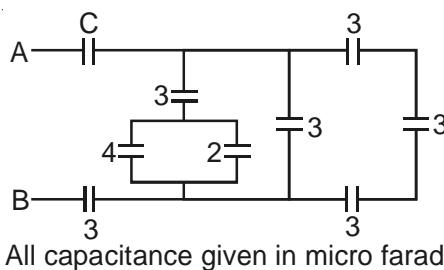


(1 remains unchanged, 2 increases, 3 decreases).

16. Find the potential at A and C in the following circuit :

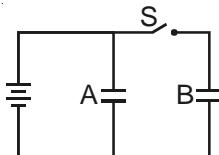


17. For what value of C does the equivalent capacitance between A and B in the figure below is  $1 \mu\text{F}$ ?



All capacitance given in micro farad

18. Two identical parallel plate capacitors connected to a battery with the switch S closed. The switch is now opened and the free space between the plates of the capacitors is filled with dielectric of dielectric constant 3. Find the ratio of the total electrostatic energy stored in both capacitors before and after the introduction of dielectric.



19. Three concentric spherical metallic shells A, B and C of radii  $a$ ,  $b$ ,  $c$  ( $a < b < c$ ) have surface densities  $\sigma$ ,  $-\sigma$  and  $\sigma$  respectively. (i) Find the potential on the surface of three shells A, B and C, (ii) If shells A and C are at the same potential obtain relation among  $a$ ,  $b$ , and  $c$ .

## ANSWERS

### VERY SHORT ANSWER TYPE QUESTIONS

6.  $\phi = \frac{(q_1 + q_3) - (q_2 + q_6)}{\epsilon_0}$
7. If  $Q$  is +ve,  $V_a - V_b$  is positive  
If  $Q$  is -ve,  $V_a - V_b$  is negative.
11. No. Surface density of charge is proportional to curvature.
13. Potential difference between plates increases on increasing distance between them, hence capacitance decreases.
16. Flux through sphere is  $\phi = \frac{q}{\epsilon_0}$ .  
Then through hemisphere is  $\phi' = \frac{\phi}{2} = \frac{q}{2\epsilon_0}$ .
18. -1.
19. Because the energy supplied by the source is at constant voltage ( $v$ ) but during charging the capacitor potential difference across it is increasing linearly from 0 to  $V$  and hence average voltage across capacitor is  $V/2$ . The rest of the energy is dissipated.
20. (i) When electric field is uniform dipole will have rotatory motion only.  
(ii) When electric field is non-uniform,  $E = E_0 \times \hat{i}$ , dipole will have rotatory and translatory motion.

### SHORT ANSWER TYPE QUESTIONS (2 MARKS)

1. No. The net charge on dipole is zero but the electric field intensity is not zero.

3. (i)  $\frac{q}{2\epsilon_0}$ ; (ii)  $\frac{q}{\epsilon_0}$ .

17. By introducing a metal plate between the glass rod and piece of paper.

21. (i)  $E = 0$

(ii)  $E = \frac{kg}{(n/\sqrt{2})^2} = \frac{2kq}{r^2}$  where  $k = \frac{1}{4\pi \epsilon_0}$ .

(iii)  $E = \frac{2kq}{r^2}$ .

26. The work done is independent of angle.

$$E = \left( \frac{\sigma_1 + \sigma_2}{\epsilon_0} \right); \quad W = F \cdot a = q E a$$

$$W = q \left( \frac{\sigma_1 + \sigma_2}{\epsilon_0} \right) a$$

27.  $E = -\frac{dv}{dr};$

Electric field at P is maximum;

Electric field at R is minimum.

28.  $V_1 = \frac{kq}{r} + \frac{kq}{6r} = \frac{7kq}{6r}$

$$V_2 = \frac{kq}{2r} + \frac{kq}{6r} = \frac{3kq + kq}{6r} = \frac{4kq}{6r}$$

$$\frac{V_1}{V_2} = \frac{7}{4}$$

$$V_{\text{common}} = \frac{2q}{4\pi\epsilon_0(r + 2r)} = \frac{2q}{12\pi\epsilon_0 r}$$

$$q_1^1 = \frac{4\pi\epsilon_0(r + 2r)}{12\pi\epsilon_0 r} = \frac{2}{3}q$$

$$q_1 - q_1^1 = q - \frac{2q}{3} = \frac{q}{3}$$

30. Potential at a point due to a point charge depends on (i) magnitude of charge (ii) distance of the point from the charge. Hence '3' will be the equipotential line.

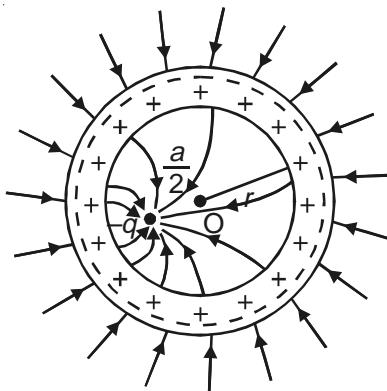
### SHORT ANSWER TYPE QUESTIONS (3 MARKS)

6.  $V = \frac{Q_1}{4\pi\epsilon_0 r} + \frac{Q_2}{4\pi\epsilon_0 R}$        $Q_1 = \sigma 4\pi r^2$

$$V = \frac{\sigma}{\epsilon_0} (r + R) \quad Q_2 = \sigma 4\pi R^2$$

7. The force experienced by point charge  $Q$  is due to both the plates, while the force on one plate is only due to the other plate.

8.



[Ans. : Positive, negative charge]

Positive charge is non uniformly distributed on inner wall of shell and an equal amount of negative charge is uniformly distributed on the outer wall.

### NUMERICALS

16.  $Q = CV$

Total charge       $Q = \text{Total capacitance in series} \times \text{voltage}$

$$= \left( \frac{5}{6} \times 10^{-3} \right) \times 12 = 10 \times 10^{-3} \text{ coulomb}$$

$$V_{AB} = \frac{Q}{C_1} = \frac{10 \times 10^{-3}}{1 \times 10^{-3}} = 10V$$

$$V_{BC} = \frac{Q}{C_2} = \frac{10 \times 10^{-3}}{5 \times 10^{-3}} = 2V.$$

When B is earthed  $V_B = 0$ ,  $V_A = 10V$  and  $V_C = -2V$ .

18. Before dielectric is introduced.

$$E_A = \frac{1}{2} CV^2; \quad E_B = \frac{1}{2} CV^2$$

$$E = E_A + E_B = CV^2$$

After disconnecting the battery and then introducing dielectric

$$E'_A = \frac{1}{2}(3C) V^2$$

$$E'_B = \frac{Q^2}{2C} = \frac{(CV)^2}{2 \times 3C} = \frac{1}{3} \left( \frac{1}{2} CV^2 \right), \quad E' = E'_A + E'_B$$

$$\frac{E'}{E} = \frac{5}{3}.$$

$$\begin{aligned}
 19. \quad V_A &= k \left[ \frac{q_1}{a} + \frac{q_2}{b} + \frac{q_3}{c} \right] \\
 &= k 4\pi a \sigma - k 4\pi b \sigma + k 4\pi c \sigma \\
 &= 4\pi a \sigma (a - b + c) \\
 &= \frac{\sigma}{\epsilon_0} (a - b + c) \\
 V_B &= k \left[ \frac{q_1}{b} + \frac{q_2}{b} + \frac{q_3}{c} \right] = k \left[ \frac{4\pi a^2 \sigma}{b} - 4\pi k b \sigma + 4\pi k c \sigma \right] \\
 &= \frac{\sigma}{\epsilon_0} \left( \frac{a^2}{b} - b^2 + c^2 \right) \\
 V_C &= \frac{\sigma}{\epsilon_0 c} (a^2 - b^2 + c^2)
 \end{aligned}$$

When  $V_A = V_C$

$$\frac{\sigma}{\epsilon_0} (a - b + c) = \frac{\sigma}{\epsilon_0 C} (a^2 - b^2 + c^2)$$

$$ac - bc + c^2 = a^2 - b^2 + c^2$$

$$c(a - b) = (a - b)(a + b)$$

$$c = a + b.$$

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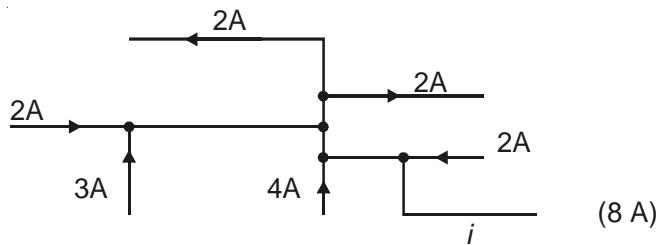
# CURRENT ELECTRICITY

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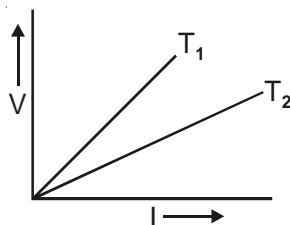
## UNIT II

### VERY SHORT ANSWER TYPE QUESTION (1 MARK EACH)

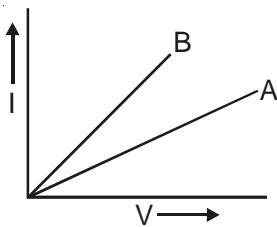
1. If the temperature of a conductor decreases, how does the relaxation time of electrons in the conductor change?
2. Sketch a graph showing variation of resistivity with temperature of (i) Copper (ii) Carbon.
3. The emf of the driver cell (Auxillary battery) in the potentiometer experiment should be greater than emf of the cell to be determined. Why?
4. You are required to select a carbon resistor of resistance  $47\text{k}\Omega \pm 10\%$  from a large collection. What should be the sequence of color bands used to code it?
5. The fig. here shows a part of a circuit. What are the magnitude and direction of the current  $i$  in the lower right-hand wire?  
(8 Amp)



6. If one wants more light at large distances, assuming the wattage of the source to be same, will one use a point source or a cylindrical tube light? Give reason.
7. Two wires one of copper and other of managing have same resistance and equal length. Which wire is thicker?
8. You are given three constantan wires P, Q and R of length and area of cross-section ( $L$ ,  $A$ ),  $\left(2L, \frac{A}{2}\right)$ ,  $\left(\frac{L}{2}, 2A\right)$  respectively. Which has highest resistance?
9. V – I graph for a metallic wire at two different temperatures  $T_1$  and  $T_2$  is as shown in the figure. Which of the two temperatures is higher and why?



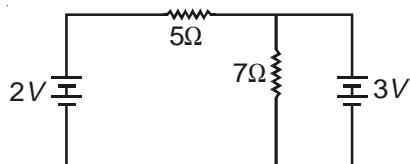
10. Out of V – I graph for parallel and series combination of two metallic resistors, which one represents parallel combination of resistors? Justify your answer.



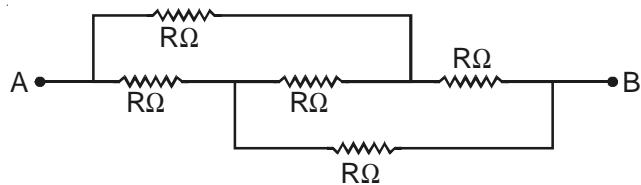
11. Why is the potentiometer preferred to a voltmeter for measuring emf of a cell?
12. How can a given 4 wires potentiometer be made more sensitive?
13. Why is copper not used for making potentiometer wires?
14. In the figure, what is the potential difference between A and B?



15. A copper wire of resistance  $R$  is uniformly stretched till its length is increased to  $n$  times its original length. What will be its new resistance?
16. Two resistances  $5\Omega$  and  $7\Omega$  are joined as shown to two batteries of emf  $2V$  and  $3V$ . If the  $3V$  battery is short circuited. What will be the current through  $5\Omega$ ?



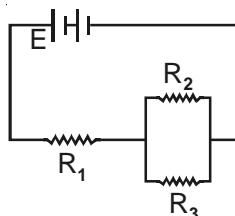
17. Calculate the equivalent resistance between points A and B in the figure given below.



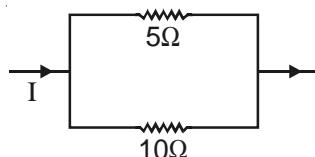
18. What is the largest voltage that can be safely put across a resistor marked  $196\Omega$ ,  $1W$ ?
19. When does the terminal voltage of a cell become (i) greater than its emf (ii) less than its emf?
20. A car battery is of  $12V$ . Eight dry cells of  $1.5 V$  connected in series also give  $12V$ , but such a combination is not used in a car. Why?
21. Two electric lamps A and B marked  $220V$ ,  $100W$  and  $220V$ ,  $60W$  respectively. Which of the two lamps has higher resistance?
22. Nichrome and copper wires of the same length and same radius are connected in series. Current  $I$  is passed through them. Which wire gets heated up more? Justify.
23. What is the effect of heating a conductor on the drift velocity of electrons?
24. What is the order of magnitude of resistivity of conductors?

## SHORT ANSWER QUESTIONS (2 MARKS)

- Define mobility of electron in a conductor. How does electron mobility change when (i) temperature of conductor is decreased (ii) Applied potential difference is doubled at constant temperature?
- On what factor does potential gradient of a potentiometer wire depend?
- What are superconductors? Give one of their applications.
- Two manganin wires whose lengths are in the ratio 1 : 2 and whose resistances are in the ratio 1 : 2 are connected in series with a battery. What will be the ratio of drift velocities of free electrons in the two wires?
- The current through a wire depends on time as  $i = i_0 + at$  where  $i_0 = 4\text{A}$  and  $a = 2\text{As}^{-1}$ . Find the charge crossing a section of wire in 10 seconds.
- Three identical resistors  $R_1$ ,  $R_2$  and  $R_3$  are connected to a battery as shown in the figure. What will be the ratio of voltages across  $R_1$  and  $R_2$ . Support your answer with calculations.



- In the arrangement of resistors shown, what fraction of current I will pass through  $5\Omega$  resistor?



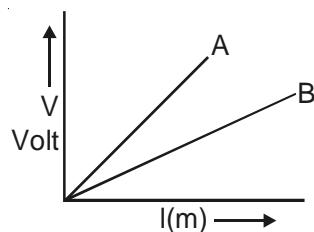
- Five identical cells, each of emf.  $E$  and internal resistance  $r$ , are connected in series to form (a) an open (b) closed circuit. If an ideal voltmeter is connected across three cells, what will be its reading?  
[Ans. : (a)  $3E$ ; (b) zero]
- A 100W and a 200 W domestic bulbs are joined in series and connected to the mains. Which bulb will glow more brightly? Justify.
- A battery has an emf of 12V and an internal resistance of  $2\Omega$ . Is the terminal to terminal potential difference greater than, less than or equal to 12V if the current in the battery is (a) from the negative to positive terminal (b) from the positive to the negative terminal? Justify the answer.
- A uniform wire of resistance  $R$  ohm is bent into a circular loop as shown in the figure. Compute effective resistance between diametrically opposite points A and B.



- In a potentiometer arrangement, a cell of emf 1.25V gives a balance point at 35 cm length of the wire. If the cell is replaced by another cell, then the balance point shifts to 63 cm. What is the emf of the second cell?

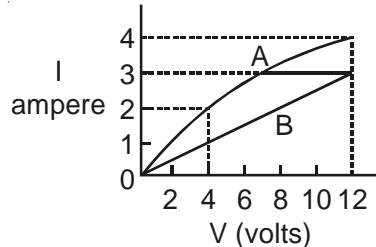
### SHORT ANSWER QUESTIONS (3 MARKS)

- Define specific resistance. Write its SI unit. Derive an expression for resistivity of a wire in terms of its material's parameters, number density of free electrons and relaxation time.
- A potential difference  $V$  is applied across a conductor of length  $L$  and diameter  $D$ . How are the electric field  $E$  and the resistance  $R$  of the conductor affected when (i)  $V$  is halved (ii)  $L$  is halved (iii)  $D$  is doubled. Justify your answer.
- Define drift velocity. A conductor of length  $L$  is connected to a dc source of EMF  $V$ . If the length of conductor is tripled by stretching it, keeping  $V$  constant, explain how do the following factors would vary in the conductor? (i) Drift speed of electrons (ii) Resistance and (iii) Resistivity.
- Define potential gradient. How can potential gradient of a potentiometer be determined experimentally. In the graph shown here, a plot of potential versus balancing length of the potentiometer is made for two potentiometers. Which is more sensitive –A or B?



- Define conductivity of a substance. Give its SI units. How does it vary with temperature for (i) Good conductors (ii) Semiconductors?
- State the principle of potentiometer. Draw a circuit diagram used to compare the emf of two primary cells. Write the formula used. How can the sensitivity of a potentiometer be increased?
- In a metre bridge, the balance point is found to be at 39.5 cm from the end A where resistor  $Y$  is of  $12.5\ \Omega$ . Determine resistance of  $X$ . Why are the connections between resistors in a metre bridge made of thick copper strips? If the galvanometer and cell are interchanged at the balance point of the bridge, will the galvanometer still show no deflection? Give reason.
- The graph shows how the current  $I$  varies with applied potential difference  $V$  across a 12 V filament lamp (A) and across one metre long nichrome wire (B). Using the graph, find the ratio of the values of the resistance of filament lamp to the nichrome wire

- (i) when potential difference across them is 12 V.



- (ii) when potential difference across them is 4V. How does the resistance of the filament lamp change as current increases? Give a physical explanation for this change.

## LONG ANSWER QUESTIONS (5 MARKS)

- State Kirchhoff's rules for electrical networks. Use them to explain the principle of wheatstone bridge for determining an unknown resistance. How is it realized in actual practice in the laboratory? State the formula used.
- Define emf and terminal potential difference of a cell. When is the terminal potential difference greater than emf? Explain how emf and terminal potential difference can be compared using a potentiometer and hence determine internal resistance of the cell.
- For three cells of emf  $E_1$ ,  $E_2$  and  $E_3$  with internal resistances  $r_1$ ,  $r_2$ ,  $r_3$  respectively connected in parallel, obtain an expression for net internal resistance and effective current. What would be the maximum current possible if the emf of each cell is  $E$  and internal resistance is  $r$  each?

## NUMERICALS

- The charge passing through a conductor is a function of time and is given as  $q = 2t^2 - 4t + 3$  milli coulomb. Calculate (i) Current through the conductor (ii) Potential difference across it at  $t = 4$  second. Given resistance of conductor is 4 ohm. **[Ans. :  $V = 48$  V,  $I = 12A$ ]**
- The resistance of a platinum wire at a point  $0^\circ\text{C}$  is 5.00 ohm and its resistance at steam point is  $5.40\Omega$ . When the wire is immersed in a hot oil bath, the resistance becomes  $5.80\Omega$ . Calculate the temperature of the oil bath and temperature coefficient of resistance of platinum. **[Ans. :  $a = 0.004^\circ\text{C}$ ;  $T = 200^\circ\text{C}$ ]**
- A copper wire of length 3m and radius  $r$  is nickel plated till its radius becomes  $2r$ . What would be the effective resistance of the wire, if specific resistance of copper and nickel are  $\rho_0$  and  $\rho_n$  respectively.

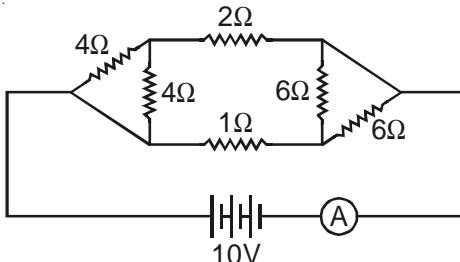
**[Hint. :**  $R_C = \rho_e \frac{l}{\pi r^2}$ ;  $R_n = \ln \frac{l}{\pi (2r)^2 - \pi r^2}$

$$R = \frac{R_C R_n}{R_C + R_n}$$

**[Ans. :**  $R = \frac{3 \rho_n \rho_c}{\pi r^2 (3\rho_c + \rho_n)}$  ]

- Three identical cells, each of emf 2V and internal resistance 0.2 ohm, are connected in series to an external resistor of 7.4 ohm. Calculate the current in the circuit and the terminal potential difference across an equivalent cell. **[Ans. :  $I = 0.75$ ;  $V = 5.55$  V]**
- Calculate the current shown by the ammeter in the circuit diagram given.

**[Ans. :  $R = 2\Omega$ ;  $I = 5A$ ]**



- A storage battery of emf 12V and internal resistance of  $1.5\Omega$  is being charged by a 12V dc supply. How much resistance is to be put in series for charging the battery safely, by maintaining a constant charging current of 6A. **[Ans. :  $R = 16.5\Omega$ ]**

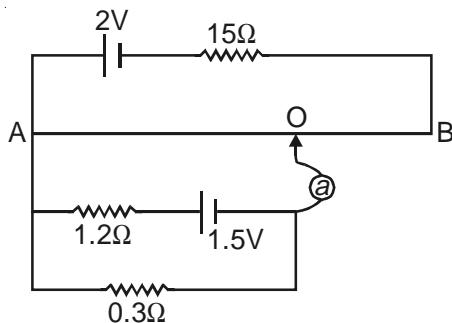
7. Three cell are connected in parallel, with their like poles connected together, with wires of negligible resistance. If the emf of the cell are 2V, 1V and 4 V and if their internal resistance are  $4\Omega$ ,  $3\Omega$  and 2 ohm respectively, find the current through each cell.

$$\text{Ans. : } I_1 = \frac{-2}{13} A, I_2 = \frac{-7}{13} A, I_3 = \frac{9}{13} A$$

8. A 16 ohm resistance wire is bent to form a square. A source of emf 9 volt is connected across one of its sides. Calculate the potential difference across any one of its diagonals. [Ans. : 1V]
9. A length of uniform ‘heating wire’ made of nichrome has a resistance  $72\Omega$ . At what rate is the energy dissipated if a potential difference of 120V is applied across (a) full length of wire (b) half the length of wire (wire is cut into two). Why is it unwise to use the half length of wire?

[Ans. : (a) 200W (b) 400W. 400W >> 200W but since current becomes large so it is not advisable to use half the length]

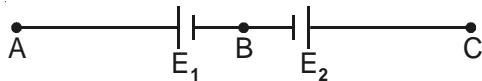
10. AB is one metre long uniform wire of  $10\Omega$  resistance. The other data are shown in the circuit diagram given below. Calculate (i) potential gradient along AB and (ii) Length AO of the wire, when the galvanometer shows no deflection. [Ans. :  $I = 37.5$  cm.]



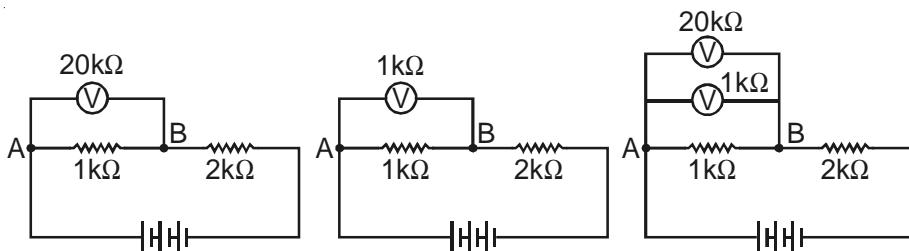
11. With a certain unknown resistance X in the left gap and a resistance of  $8\Omega$  is the right gap, null point is obtained on the metre bridge wire. On putting another  $8\Omega$  in parallel with  $8\Omega$  resistance in the right gap, the null point is found to shift by 15cm. Find the value of X from these observations. [Ans. :  $8/3\Omega$ ]

12. Two cells of emf  $E_1$  and  $E_2$  ( $E_1 > E_2$ ) are connected as shown. When a potentiometer is connected between A and B, the balancing length of the potentiometer is 300 cm. On connecting the same potentiometer between A and C, the balancing length is 100cm. Calculate the ratio of  $E_1$  and  $E_2$ .

$$\text{Ans. : } \frac{E_1}{E_2} = \frac{3}{2}$$

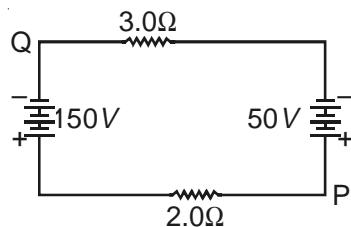


13. A battery of emf 9V and negligible internal resistance is connected to a  $3k\Omega$  resistor. The potential drop across a part of the resistor (between points A and B in the fig.) is measured by (i) a  $20 k\Omega$  voltmeter; (ii) a  $1 k\Omega$  voltmeter. In (iii) both the voltmeters are connected across AB. In which case would you get the (a) highest (b) lowest reading?



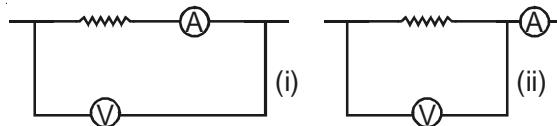
[Ans. Fig. 1 : Maximum current through AB (highest reading)  
Fig. 2 : Lowest reading (minimum current)]

14. In the figure, if the potential at point P is 100V, what is the potential at point Q?



[Ans. : - 10V]

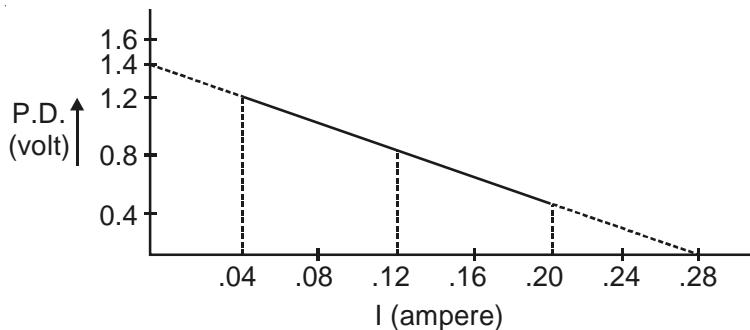
15. Given two resistors X and Y whose resistances are to be determined using an ammeter of resistance  $0.5\Omega$  and a voltmeter of resistance  $20\text{ k}\Omega$ . It is known that X is in the range of a few ohms, while Y is in the range of several thousand ohm. In each case, which of the two connection shown should be chosen for resistance measurement?



[Ans. : Small resistance : X will be preferred; large resistance : Y will be preferred]

16. Potential difference across terminals of a cell are measured (in volt) against different current (in ampere) flowing through the cell. A graph was drawn which was a straight line ABC. Using the data given in the graph, determine (i) the emf. (ii) The internal resistance of the cell.

[Ans. :  $r = 5\Omega$  emf = 1.4V]



17. Four, each of internal resistance  $0.8\Omega$  and emf  $1.4\text{V}$ , s are connected (i) in series (ii) in parallel. The terminals of the battery are joined to the lamp of resistance  $10\Omega$ . Find the current through the lamp and each cell in both the cases.

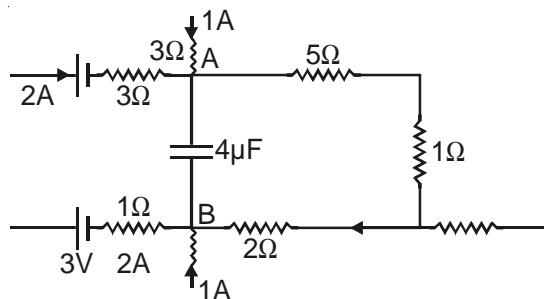
[Ans. :  $I_s = 0.424\text{A}$ ,  $I_p = 0.137\text{A}$  current through each cell is  $0.03\text{A}$ ]

18. When resistance of  $2\Omega$  is connected across the terminals of a battery, the current is  $0.5A$ . When the resistance across the terminal is  $5\Omega$ , the current is  $0.25A$ . (i) Determine the emf of the battery (ii) What will be current drawn from the cell when it is short circuited.

$$[\text{Ans.} : E = 1.5V, I = 1.5A]$$

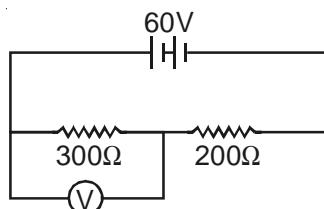
19. A part of a circuit in steady state, along with the currents flowing in the branches and the resistances, is shown in the figure. Calculate energy stored in the capacitor of  $4\mu F$  capacitance.

$$[\text{Ans.} : V_{AB} = 20V, U = 8 \times 10^{-4} J]$$



20. In the circuit shown, the reading of voltmeter is  $20V$ . Calculate resistance of voltmeter. What will be the reading of voltmeter if this is put across  $200\Omega$  resistance?

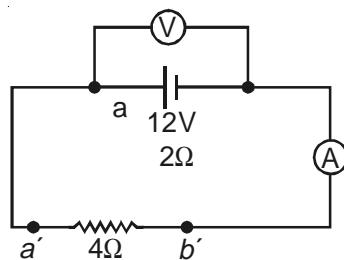
$$[\text{Ans.} : R_V = 150\Omega; V = \frac{40}{3}V]$$



21. Estimate average drift speed of conduction electrons in copper wire of cross-section  $1 \times 10^{-7} m^2$  carrying current of  $1.5A$ . Assume that each copper atom contributes one conduction electron, the density of copper is  $9 \times 10^3 \text{ kg/m}^3$  and its atomic mass is  $63.5$ . [Ans. :  $\theta_1 = 1.1 \times 10^{-3} \text{ m/s}$ ]

22. In the figure an ammeter A and a resistor of resistance  $R = 4\Omega$  have been connected to the terminals of the source to form a complete circuit. The emf of the source is  $12V$  having an internal resistance of  $2\Omega$ . Calculate voltmeter and ammeter reading.

$$[\text{Ans.} : \text{Voltmeter reading} : 8V, \text{Ammeter reading} = 2A]$$



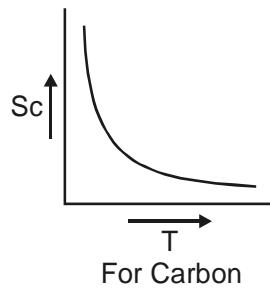
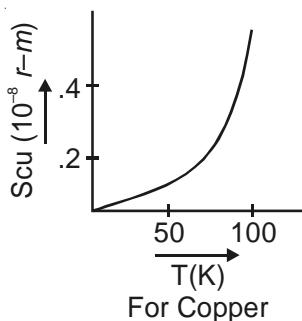
## Unit II

# ANSWERS

(VSA)

1. Relaxation time increases.

- 2.



3. If emf of driver cell is less than null point will not be obtained on the potentiometer wire.
4. Yellow, Violet, Orange, Silver.
5. 8 ampere.
6. For point source, Intensity  $\propto 1/r^2$ ; For cylindrical tube light intensity  $\propto 1/r$  so cylindrical source is better.

7.  $R = \rho_c \frac{I_c}{a_c} = \rho_m \frac{I_m}{a_m}$

$$\frac{\rho_c}{\rho_m} = \frac{a_c}{a_m} < 1$$

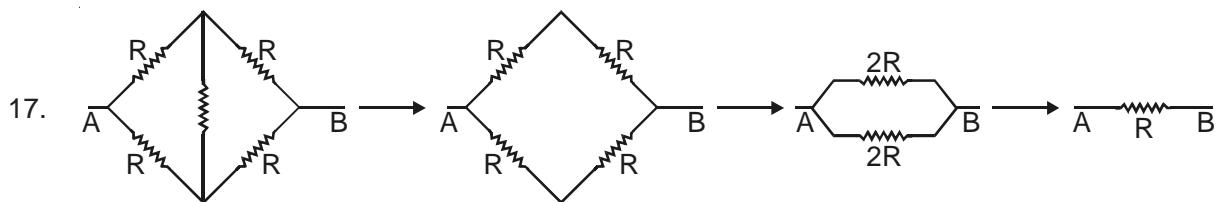
$\therefore$  managing in thicker.

8.  $R_p = \rho \frac{L}{A}, R_Q = \rho \frac{2L.2}{A} = \frac{4\rho L}{A}, R_R = \frac{\rho L}{4A}$

Q has the highest resistance.

9. Slope of  $T_1$  is large so  $T_1$  represents higher temperature as resistance increase with temperature for a conductor;  $R = \frac{V}{I} = \text{slope.}$
10. The resistance for parallel combination is less than for series combination for a given set of resistors. Hence B will represent parallel combination since  $I/V$  for it is more i.e., Resistance  $= \frac{V}{I}$  is less.

11. Emf measured by potentiometer is more accurate because the cell is in open circuit, giving no current.
12. By connecting a resistance in series with the potentiometer wire in the primary circuit, the potential drop across the wire is reduced.
13. Copper has high temperature coefficient of resistance and hence not preferred.
14.  $V_A - V_B = -8$  volt.
15.  $R' = n^2 R$
16.  $I = \frac{2}{5} A$



$$\therefore R_{\text{eq}} = R.$$

18.

$$P = \frac{V^2}{R}$$

$$V^2 = PR = 1 \times 196 = 196$$

$$V = 14 \text{ volt.}$$

19. (i) When the cell is being charged terminal potential difference becomes greater than emf;  $V = E + Ir$ .
- (ii) When the cell is discharged terminal potential is less than emf;  $V = E - Ir$ .
20. Dry cells used in series will have high resistance ( $\approx 10\Omega$ ) and hence provide low current, while a car battery has low internal resistance ( $0.1\Omega$ ) and hence gives high current for the same emf, that is needed to start the car.
21. 220V, 60W lamp has higher resistance as  $R = \frac{V^2}{P}$  and hence current reduces.
22. Nichrome wire. It has greater R as compared to copper wire.
23. Drift velocity of electrons decreases as relaxation time decreases for a conductor.
24.  $10^{-8} \Omega\text{m}$ .

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# MAGNETIC EFFECTS OF CURRENT AND MAGNETISM

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## KEY POINTS

- Force on charge moving in a magnetic field of strength  $|\vec{B}|$  is  $|\vec{F}| = q |\vec{V} \times \vec{B}| = Bqv \sin \theta$  where  $|\vec{F}|$  if measured in newton if  $B$  is measured in tesla,  $q$  in coulomb and  $\vec{V}$  in meter per second.
- 1 tesla (T) = weber meter<sup>-2</sup> = 1 newton ampere<sup>-1</sup> meter<sup>-1</sup>.
- A charge moving inside a uniform magnetic field in transverse direction follows a circular path. The force on charge due to the magnetic field provides the necessary centripetal force.
- The time period of revolution of a charged particle inside the dees of cyclotron is independent of the speed and radius of the circular path described. It depends on charge, mass and strength of field.
- Cyclotron frequency  $v_c = qB/2\pi m$ .
- A straight conductor of length  $l$  carrying current  $I$  experiences a force  $F$  in uniform external field  $B$  given as  $\vec{F} = I(\vec{l} \times \vec{B})$ .
- Biot Savart's law asserts that the magnitude of magnetic field  $d\vec{B}$  due to an element  $d\vec{l}$  carrying a current  $I$  at a point at distance ' $r$ ' from the current element is  $|d\vec{B}| = \left| \frac{\mu_0}{4\pi} \cdot \frac{d\vec{l} \times \vec{r}}{r^3} \right| = \frac{\mu_0}{4\pi} \cdot \frac{|d\vec{l}| \sin \theta}{r^2}$ , where  $\theta$  is the angle between direction of current element and the line joining the current element and point of observation. The direction of  $d\vec{B}$  is that of  $(d\vec{l} \times \vec{r})$  (found using right hand thumb rule).
- Magnetic field due to a current carrying long conductor at a point at perpendicular distance 'a' is  $B = \frac{\mu_0}{4\pi} \cdot \frac{2I}{a}$ .
- Torque on a current carrying coil having  $N$  turns of area  $A$  each placed inside a magnetic field  $\tau = NBIA \sin \theta$ .
- For a given perimeter of planar current loop placed inside the magnetic field, torque is maximum when the loop is circular in shape. It is because for a given perimeter a circle has maximum area.
- When a loop is placed in a uniform magnetic field  $\vec{B}$ , the force on it is zero but torque on it is not zero and given by  $\vec{\tau} = \vec{m} \times \vec{B}$ . In a moving coil galvanometer this torque is balanced by counter torque due to a spring yielding  $K\phi = NIAB$  where  $\phi$  is equilibrium deflection and  $K$  the torsion constant of the spring
- The three quantities needed to specify the magnetic field of the earth at any point are horizontal component, the magnetic declination and the magnetic dip which are also known as the elements of the earth's magnetic field.

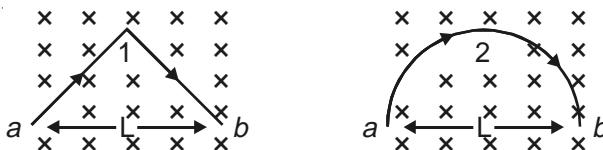
- For a linear material  $M = \chi_m H$  and  $B = \mu H$  and  $\chi_m$  is called the magnetic susceptibility of the material. The three quantities,  $\chi_m$ , the relative permeability  $\mu_r$  and the magnetic permeability  $\mu$  are related as follows :

$$\mu = \mu_r \mu_0 \quad \text{and} \quad \mu_r = 1 + \chi_m$$

- Hysteresis : The lagging of the intensity of magnetisation behind the magnetising field, when magnetic specimen is taken through a cycle of magnetisation, is hysteresis.
- The value of intensity of magnetisation of the magnetic material when magnetising field is reduced to zero, is called RETENTIVITY.
- The value of reverse magnetising field, which has to be applied to the magnetic material so as to reduce the residual magnetism to zero, is called coercivity.

### 1 MARK QUESTIONS

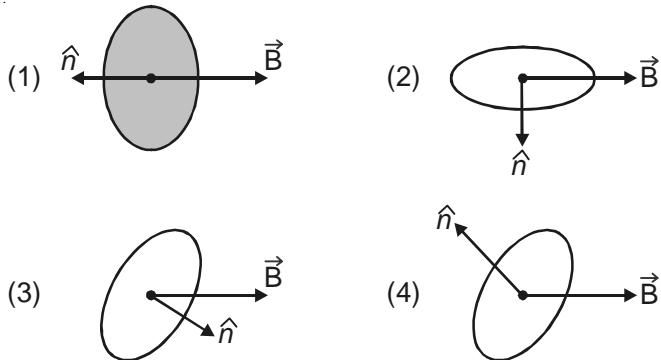
- Must every magnetic field configuration have a north pole and a south pole? What about the field due to a toroid?
- The figure shows two wires 1 and 2 both carrying the same current I from point a to point b through the same uniform magnetic field B. Determine the force acting on each wire.



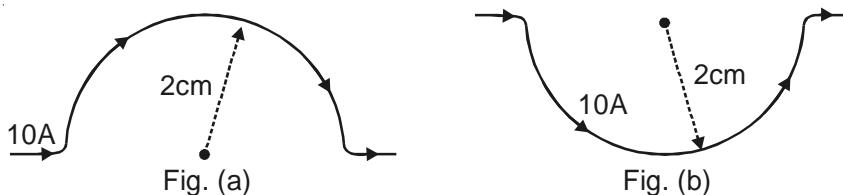
- How are the figure of merit and current sensitivity of galvanometer related with each other?
- Show graphically the variation of magnetic field due to a straight conductor of uniform cross-section of radius 'a' and carrying steady current as a function of distance  $r$  ( $a > r$ ) from the axis of the conductor.
- The force per unit length between two parallel long current carrying conductors is F. If the current in each conductor is tripled, what would be the value of the force per unit length between them?
- How does the angle of dip vary from equator to poles?
- What is the effect on the current measuring range of a galvanometer when it is shunted?
- An electric current flows in a horizontal wire from East to West. What will be the direction of magnetic field due to current at a point (i) North of wire; (ii) South of the wire; (iii) above the wire; (iv) below the wire?
- Suggest a method to shield a certain region of space from magnetic fields.
- What is the main function of soft iron core used in a moving coil galvanometer?
- Where on the earth's surface, is the vertical component of earth's magnetic field zero?
- If the current is increased by 1% in a moving coil galvanometer. What will be percentage increase in deflection?
- Write S.I. unit of (i) Pole strength and (ii) Magnetic dipole moment.

## 2 MARKS QUESTIONS

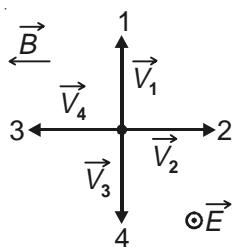
1. Write the four measures that can be taken to increase the sensitivity of a galvanometer.
2. A galvanometer of resistance  $120\Omega$  gives full scale deflection for a current of  $5\text{mA}$ . How can it be converted into an ammeter of range 0 to  $5\text{A}$ ? Also determine the net resistance of the ammeter.
3. A current loop is placed in a uniform magnetic field in four different orientations I, II, III and IV. Arrange them in the decreasing order of potential energy.



4. A current of  $10\text{A}$  flows through a semicircular wire of radius  $2\text{cm}$  as shown in figure (a). What is direction and magnitude of the magnetic field at the centre of semicircle? Would your answer change if the wire were bent as shown in figure (b)?



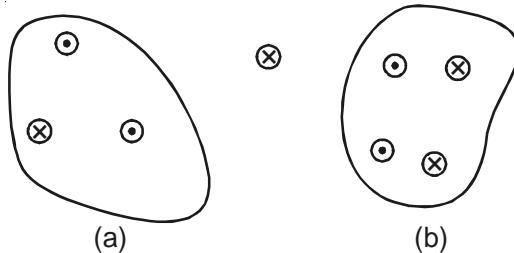
5. The figure shows four directions of motion of a positively charged particle moving through a uniform electric field  $\vec{E}$  (directed out of the page and represented with an encircled dot) and a uniform magnetic field  $\vec{B}$ . (a) Rank direction 1, 2 and 3 according to the magnitude of the net force on the particle, greatest first. (b) Of all four directions, which might result in a net force of zero?



$$|\vec{V_1}| = |\vec{V_2}| = |\vec{V_3}| = |\vec{V_4}|$$

6. A proton and an alpha particle of the same velocity enter, in turn, a region of uniform magnetic field acting perpendicular to their direction of motion. Deduce the ratio of the radii of the circular paths described by the proton and alpha particle.

7. Which one of the two an ammeter or milliammeter, has a higher resistance and why?
8. Mention two properties of soft iron due to which it is preferred for making electromagnet.
9. What is the effective resistance of ammeter if a shunt of resistance  $S$  is used across the terminals of the galvanometer of resistance  $G$ ?
10. A magnetic dipole of magnetic moment  $M$  is kept in a magnetic field  $B$ . What is the minimum and maximum potential energy? Also give the most stable position and most unstable position of magnetic dipole.
11. What will be (i) Pole strength (ii) Magnetic moment of each of new piece of bar magnet if the magnet is cut into two equal pieces :
  - (a) normal to its length?
  - (b) along its length?
12. A steady current  $I$  flows along an infinitely long straight wire with circular cross-section of radius  $R$ . What will be the magnetic field outside and inside the wire at a point  $r$  distance far from the axis of wire?
13. A coil of  $N$  turns and radius  $R$  carries a current  $I$ . It is unwound and rewound to make another coil of radius  $R/2$ , current remaining the same. Calculate the ratio of the magnetic moment of the new coil and original coil.
14. At a place horizontal component of the earth's magnetic field is  $B$  and angle of dip at the place is  $60^\circ$ . What is the value of horizontal component of the earth's magnetic field.
  - (i) at Equator; (ii) at a place where dip angle is  $30^\circ$
15. A galvanometer coil has a resistance  $G$ . 1% of the total current goes through the coil and rest through the shunt. What is the resistance of the shunt?
16. Prove that the magnetic moment of a hydrogen atom in its ground state is  $eh/4\pi m$ . Symbols have their usual meaning.
17. Each of eight conductors in figure carries  $2A$  of current into or out of page. Two path are indicated for the line integral  $\oint \vec{B} \cdot d\vec{l}$ . What is the value of the integral for the path (a) at the left and (b) at the right?



18. A proton, a deuteron and an alpha particle having equal kinetic energies enter the same uniform magnetic field  $B$  perpendicular to it. Compare the radii of their circular paths.

### **3 MARKS QUESTIONS**

1. Derive the expression for force between two infinitely long parallel straight wires carrying current in the same direction. Hence define ‘ampere’ on the basis of above derivation.
2. Define (i) Hysteresis (ii) Retentivity (iii) Coercivity
3. Distinguish between diamagnetic, paramagnetic and ferromagnetic substances in terms of susceptibility and relative permeability.
4. Define the terms horizontal component of earth’s magnetic field, magnetic dip and magnetic declination with the help of relevant diagrams.
5. Describe the path of a charged particle moving in a uniform magnetic field with initial velocity
  - (i) parallel to (or along) the field.
  - (ii) perpendicular to the field.
  - (iii) at an arbitrary angle  $\theta (0^\circ < \theta < 90^\circ)$ .
6. Obtain an expression for the magnetic moment of an electron moving with a speed ‘v’ in a circular orbit of radius ‘r’. How does this magnetic moment change when :
  - (i) the frequency of revolution is doubled?
  - (ii) the orbital radius is halved?
7. State Ampere circuital law. Use this law to obtain an expression for the magnetic field due to a toroid.
8. Obtain an expression for magnetic field due to a circular current loop of radius ‘r’ at point ‘P’ on the axis at a distance ‘x’, from the centre.
9. Derive an expression for the torque on a magnetic dipole placed in a magnetic field and hence define magnetic moment.
10. Derive an expression for magnetic field intensity due to a bar magnet (magnetic dipole) at any point (i) Along its axis (ii) Perpendicular to the axis.

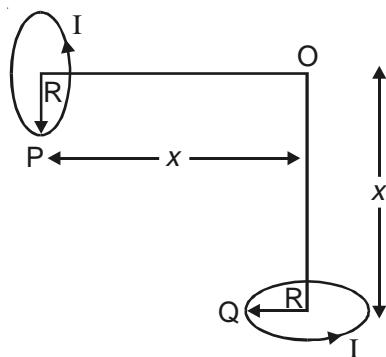
### **5 MARKS QUESTIONS**

1. How will a diamagnetic, paramagnetic and a ferromagnetic material behave when kept in a non-uniform external magnetic field? Give two examples of each of these materials. Name two main characteristics of a ferromagnetic material which help us to decide suitability for making (i) Permanent magnet (ii) Electromagnet.
2. State Biot-Savart law. Use it to obtain the magnetic field at an axial point, distance  $d$  from the centre of a circular coil of radius ‘a’ and carrying current  $I$ . Also compare the magnitudes of the magnetic field of this coil at its centre and at an axial point for which the value of  $d$  is  $\sqrt{3}a$ .
3. Write an expression for the force experienced by a charged particle moving in a uniform magnetic field  $B$ . With the help of diagram, explain the principle and working of a cyclotron. Show that cyclotron frequency does not depend on the speed of the particle.

4. Derive an expression for the torque acting on a loop of N turns, area A of each turn, carrying current I, when held in uniform magnetic field B. With the help of circuit, show how a moving coil galvanometer can be converted into an ammeter of given range. Write the necessary mathematical formula for the value of shunt required for this purpose.

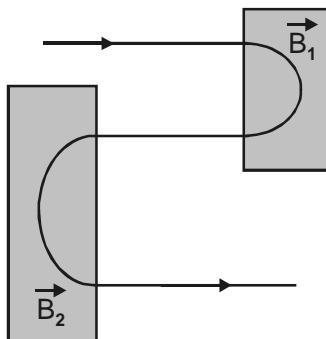
## NUMERICALS

1. If 5% of the main current is to be passed through the galvanometer of resistance 133 ohm while using it as an ammeter, calculate the value of shunt to be used. [Ans. : 7 ohm]
2. An electron travels on a circular path of radius 10m in a magnetic field of  $2 \times 10^{-3}$  T. Calculate the speed of electron. What is the potential difference through which it must be accelerated to acquire this speed? [Ans. : Speed =  $3.56 \times 10^9$  m/s; V =  $3.56 \times 10^7$  volts]
3. A ship is to reach a place  $15^\circ$  south of west. In what direction should it be steered if declination at the place is  $18^\circ$  west? [Ans. :  $87^\circ$  west of North]
4. Calculate the magnetic field due to a circular coil of 500 turns and of mean diameter 0.1m, carrying a current of 14A (i) at a point on the axis distance 0.12m from the centre of the coil (ii) at the centre of the coil. [Ans. : (i)  $5.0 \times 10^{-3}$  Tesla; (ii)  $8.8 \times 10^{-2}$  tesla]
5. An electron of kinetic energy 10 keV moves perpendicular to the direction of a uniform magnetic field of 0.8 milli tesla. Calculate the time period of rotation of the electron in the magnetic field. [Ans. :  $4.467 \times 10^{-8}$  s.]
6. If the current sensitivity of a moving coil galvanometer is increased by 20% and its resistance also increased by 1.5 times then how will the voltage sensitivity of the galvanometer be affected?
7. The true value of dip at a place is  $30^\circ$ . The vertical plane carrying the needle is turned through  $45^\circ$  from the magnetic meridian. Calculate the apparent value of dip. [Ans. :  $\delta' = 39^\circ 14'$ ]
8. A uniform wire is bent into one turn circular loop and same wire is again bent in two turn circular loop. For the same current passed in both the cases compare the magnetic field induction at their centres. [Ans. : Increased 4 times]
9. A horizontal electrical power line carries a current of 90A from east to west direction. What is the magnitude and direction of magnetic field produced by the power line at a point 1.5m below it? [Ans. :  $1.2 \times 10^{-5}$  T south ward]
10. A galvanometer with a coil of resistance 90 ohm shows full scale deflection for a current of 2.5 mA. How much should be the shunt, resistance to convert the galvanometer into an ammeter of range 0 to 7.5A? [Ans. :  $3 \times 10^{-2}\Omega$ ]
11. An electron and a proton move with the same speed in a uniform magnetic field which is directed into the page. The two move along two concentric circular paths. Which particle follows the smaller circle and does that particle travel clockwise or anticlockwise?
12. Two identical circular loops P and Q carrying equal currents are placed such that their geometrical axis are perpendicular to each other as shown in figure. And the direction of current appears anticlockwise as seen from point O which is equidistant from loop P and Q. Find the magnitude and direction of the net magnetic field produced at the point O.



$$\text{Ans. : } \frac{\mu_0 I R^2 \sqrt{2}}{2(R^2 + x^2)^{3/2}}$$

13. A cyclotron's oscillator frequency is 10 MHz. What should be the operating magnetic field for accelerating protons, if the radius of its dees is 60cm? What is the kinetic energy of the proton beam produced by the accelerator? Given  $e = 1.6 \times 10^{-19}$  C,  $m = 1.67 \times 10^{-27}$  kg. Express your answer in units of MeV 1MeV =  $1.6 \times 10^{-13}$  J. [Ans. :  $B = 0.656$ T,  $E_{\max} = 7.421$  MeV]
14. The coil of a galvanometer is  $0.02 \times 0.08$  m<sup>2</sup>. It consists of 200 turns of fine wire and is in a magnetic field of 0.2 tesla. The restoring force constant of the suspension fibre is  $10^{-6}$  Nm per degree. Assuming the magnetic field to be radial.
- (i) what is the maximum current that can be measured by the galvanometer, if the scale can accommodate  $30^\circ$  deflection?
  - (ii) what is the smallest, current that can be detected if the minimum observable deflection is  $0.1^\circ$ ? [Ans. : (i)  $4.69 \times 10^{-4}$  A; (ii)  $1.56 \times 10^{-6}$  A]
15. A voltmeter reads 8V at full scale deflection and is graded according to its resistance per volt at full scale deflection as  $5000 \Omega V^{-1}$ . How will you convert it into a voltmeter that reads 20V at full scale deflection? Will it still be graded as  $5000 \Omega V^{-1}$ ? Will you prefer this voltmeter to one that is graded as  $2000 \Omega V^{-1}$ ? [Ans. :  $7.5 \times 10^4 \Omega$ ]
16. Figure shows the path of an electron that passes through two regions containing uniform magnetic fields of magnitude  $B_1$  and  $B_2$ . Its path in each region is a half circle. (a) Which field is stronger? (b) What are the directions of two fields? (c) Is the time spent by the electron in the  $\vec{B}_1$ , region greater than, less than, or the same as the time spent in  $\vec{B}_2$  region?  
[Ans. : (a)  $B_1 > B_2$ ; (b)  $B_1$  inward;  $B_2$  outward. (c) Time spent in  $B_1 <$  Time spent in  $B_2$ ]



17. A short bar magnet placed with its axis at  $30^\circ$  with an external field 1000G experiences a torque of 0.02 Nm. (i) What is the magnetic moment of the magnet. (ii) What is the work done in turning it from its most stable to most unstable position? [Ans. : (i)  $0.4$  Am<sup>2</sup>; (ii)  $0.08$  J]

18. What is the magnitude of the equatorial and axial fields due to a bar magnet of length 4cm at a distance of 40 cm from its mid point? The magnetic moment of the bar magnet is  $0.5 \text{ Am}^2$ .  
 [Ans. :  $B_E = 7.8125 \times 10^{-7} \text{ T}$ ;  $B_A = 15.625 \times 10^{-7} \text{ T}$ ]

### HINTS / ANSWERS OF 1 MARK QUESTIONS

1. No, pole exists only when the source has some net magnetic moment. In toroid, there are no poles.
2. Same in both the cases ( $F = I LB$ ).
3. Reciprocal.
4. Fig. 1.
5. Nine Times.
6.  $0^\circ$  to  $90^\circ$
7. Increased.
8. (i) Going into the plane of the paper; (ii) Emerging out of the plane of the paper.
11. At equator.
12. 1%.
13. (i)  $\text{Am}$ ; (ii)  $\text{Am}^2$ .

### HINTS / ANSWERS OF 2 MARKS QUESTIONS

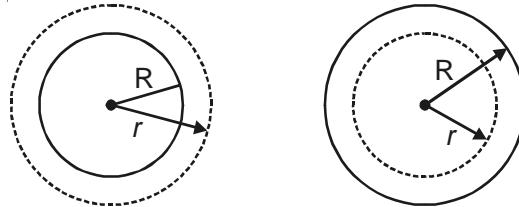
2.  $S = \frac{Ig}{(I - Ig)} G = \frac{5 \times 10^{-3}}{5 - 5 \times 10^{-3}} \cdot 120 = 0.12\Omega$ .
3.  $3 < 2 < 4 < 1$ .
4. (i)  $B = \frac{10^{-7} \times \pi \times 10}{2 \times 10^{-2}} = 5\pi \times 10^{-5} \text{ T}$  (outwards).  
 (ii)  $B = 5\pi \times 10^{-5} \text{ T}$  (inwards).
5. (a) 1.  $qE$  outward ; 2.  $qE + qVB$  outward; 3.  $qE$  outward; 4.  $qE - qVB$  (may be zero).  
 $2 > 1 = 3 > 4$ .  
 (b) 4.
6.  $r_p = \frac{mv}{qB}$  and  $r_\alpha = \frac{4mv}{(2q)B} = 2r_\alpha \Rightarrow \frac{r_p}{r_a} = \frac{1}{2}$ .
7.  $R_{mA} > R_A$ .

10. Minimum potential =  $-MB$  when  $\theta = 0$  (most stable position)

Maximum potential =  $MB$  when  $\theta = 180^\circ$  (most unstable position).

11. (a) Pole strength same; magnetic moment half.

- (b) pole strength half; magnetic moment half.



$$12. B(2\pi r) = \mu_0 \left[ \frac{I}{\pi R^2} (\pi r^2) \right]$$

$$B = \left( \frac{\mu_0 I}{2\pi R^2} \right) r \quad (R \geq r)$$

$$\oint \vec{B} \cdot d\vec{l} = \mu_0 I$$

$$\therefore B = \frac{\mu_0 I}{2\pi r} \quad (r \geq R).$$

$$13. \frac{m_{\text{new}}}{m_{\text{original}}} = \frac{2I \times \pi \left( \frac{r}{2} \right)^2}{I \times \pi R^2} = \frac{1}{2}$$

14.  $0^\circ$  and  $90^\circ$ .

15. Low resistance  $R_1$  for current and high resistance  $R_2$  for voltage.

17. (a)  $-2.0 \mu_0$ . (ii) zero.

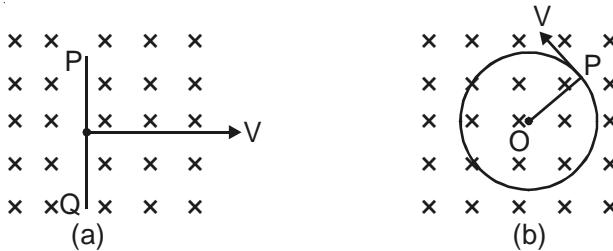
$$18. E = \frac{1}{2} mv^2 \Rightarrow v = \sqrt{\frac{2E}{m}} \Rightarrow Rp = \frac{m\sqrt{\frac{2E}{2m}}}{qB}; Rd = 2m \sqrt{\frac{2E}{2m}}; R\alpha = \frac{4m\sqrt{\frac{2E}{4m}}}{2qB}$$

$$\Rightarrow Rp : Rd : R\alpha = \sqrt{2} : 2 : \sqrt{2} \text{ or } 1 : \sqrt{2} : 1.$$

# ELECTROMAGNETIC INDUCTION

## KEY POINTS

- EMF is induced in a conductor whenever there is a change in magnetic flux linked with it.
- EMF depends on rate of change of magnetic flux linked with it  $\varepsilon = \frac{-d\phi}{dt}$ .
- Direction of induced current is determined using Fleming's right hand rule according to which if thumb, forefinger and middle finger are held mutually perpendicular to each other then.
  - Thumb → direction of motion of conductor with respect to magnetic field.
  - Forefinger → direction of magnetic field.
  - Middle finger → direction of induced current.
- Induced emf in a straight conductor QP of length l moving in magnetic field B in the way shown in Fig. (a) is  $\varepsilon = Bv/l$ ; Fig. (b) is  $\varepsilon = \frac{1}{2}Bv/l$ .



- Self inductance in general is given by :  $L = \frac{\phi}{I}$  or  $L = \left| \frac{\varepsilon}{dl/dt} \right|$

$\phi$  = Magnetic flux linked with conductor; I = current through it and  $\varepsilon$  = EMF induced and  $dl/dt$  = rate of change of current in the conductor.

- Mutual inductance between two neighbouring conductors

$$M = \phi/I \quad \dots \quad (1)$$

$$M = \left| \frac{\varepsilon}{dl/dt} \right| \quad \dots \quad (2)$$

Due to mutual induction, current in one conductor gives flux linkage with neighbouring conductor.

**OR**

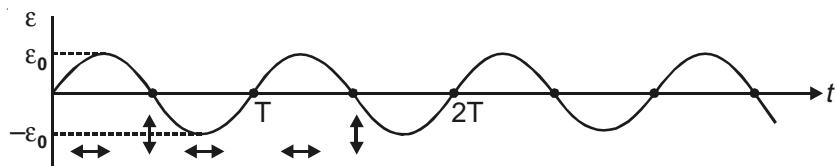
Time varying current in one conductor gives induced emf in the other conductor.

- Main parts of an a.c. generator are :
  - (i) Field magnet; (ii) armature, a conducting coil of thin insulated copper wire having several number of turns; (iii) Slip rings; (iv) carbon brushes.
- EMF induced in the generator depends on number of turns in armature, number of rotations made by it per second, its area and magnetic field applied. This is sinusoidal and given as :

$$\varepsilon = \varepsilon_0 \sin \omega t ; \varepsilon_0 = NBA\omega$$

$\varepsilon_0$  = peak value of EMF.

In the above expression choice of  $t = 0$  is that instant, when armature is perpendicular to magnetic field.



- $\leftrightarrow$  (loop) Armature is parallel to magnetic field.

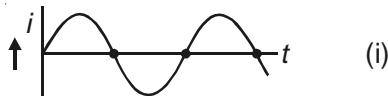
$\downarrow$  Armature is perpendicular to magnetic field.

- Average of a.c. (i) over one complete cycle  $\frac{\int_0^T i dt}{\int_0^T dt} = 0 \quad \varepsilon_{av} = 0$

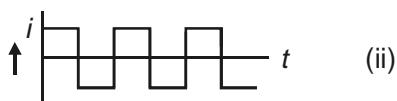
$$(ii) \text{ Over half cycle } \frac{\int_0^{T/2} i dt}{\int_0^{T/2} dt} = \frac{2\varepsilon_0}{\pi}$$

- RMS or effective or virtual value of a.c.

$$\varepsilon_{rms} = \frac{\varepsilon_0}{\sqrt{2}}$$

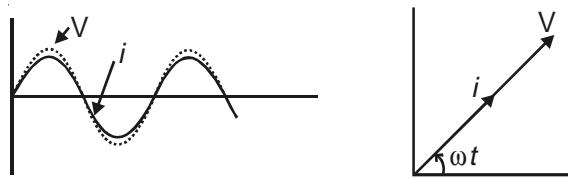


$$i_{rms} = i_0 / \sqrt{2}$$



$$\text{In fig. (ii)} \quad i_{rms} = \sqrt{\frac{i_1^2 + i_2^2 + i_3^2 + \dots + i_n^2}{n}}$$

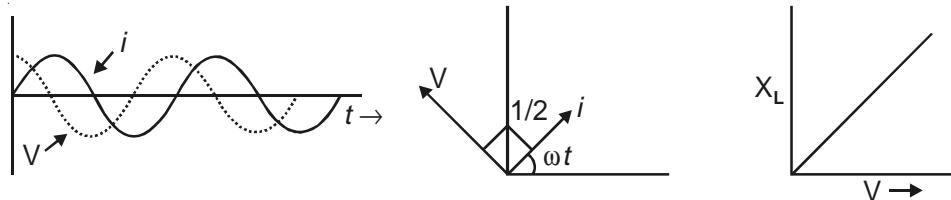
- A.C. through resistance circuit, voltage and current are in same phase



- (i)  $i = i_0 \sin \omega t$ ; (ii)  $V = V_0 \sin \omega t$ ;  $V_0 = i_0 R$ ; (iii) Average power dissipated

$$P_{av} = \frac{\int_0^T i^2 R dt}{T} = V_{rms} i_{rms} = \frac{V_{rms}^2}{R} = i_{rms}^2 \cdot R.$$

- In purely inductive circuit  $V$  leads  $i$  by  $\pi/2$ ;  $i = i_0 \sin \omega t$ ,  $V = V_0 \sin(\pi/2 + \omega t)$

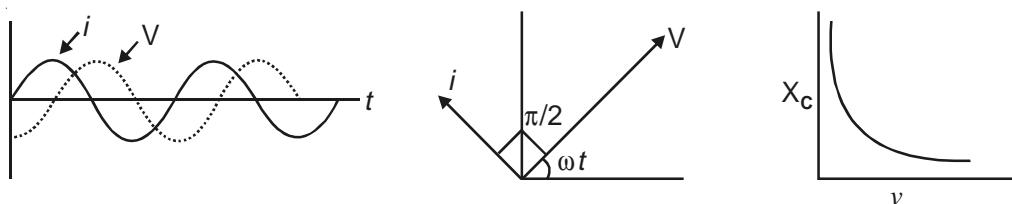


$$V_0 = i_0 X_L$$

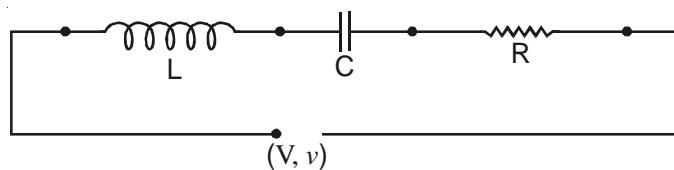
$$X_L = \omega L = 2\pi v L$$

$$X_L \rightarrow \text{inductive reactance, average power dissipated in purely inductive circuit, } P_{av} = \frac{\int_0^T P_{in} dt}{T} = 0.$$

- In capacitive circuit current leads voltages by  $\frac{\pi}{2}$ ,  $V = V_0 \sin \omega t$ ,  $i = i_0 \sin(\pi/2 + \omega t)$

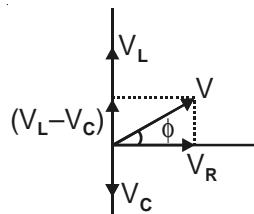


$$i_0 = \frac{V_0}{X_c}, X_c = \frac{1}{\omega C} = \frac{1}{2\pi v C}; X_c \rightarrow \text{capacitive reactance; } X_c \propto \frac{1}{v}.$$



□ Average power dissipated  $P_{av} = 0$

Series L-C-R circuit



Impedance,  $Z = \sqrt{(x_L - x_c)^2 + R^2}$

$$V = \sqrt{(V_L - V_c)^2 + V_R^2}$$

Instantaneous current through the series combination

$$i = i_0 \sin \omega t$$

Instantaneous voltage across the series combination

$$V = V_0 \sin (\omega t + \phi)$$

$\phi \rightarrow$  phase difference between  $V$  and  $i$

$$\tan \phi = \frac{V_L - V_c}{V_R} = \frac{X_L - X_c}{R}$$

Average power dissipated

$$P_{av} = \frac{\frac{1}{2} V_0 i_0 \cos \phi}{T} = \frac{1}{2} V_0 i_0 \cos \phi$$

$$\text{Power factor, } \cos \phi = \frac{P_{av}}{P_{\text{apparent}}} = \frac{R}{Z}$$

Where  $P_{\text{apparent}} = V_{\text{rms}} i_{\text{rms}}$

$$\text{natural angular frequency of circuit, } \omega_0 = \frac{1}{\sqrt{LC}}$$

If  $\omega$  be angular frequency of applied voltage then :

(i) if  $\omega > \omega_0$ , voltage leads current by  $\phi = \tan^{-1} \left( \frac{X_L - X_c}{R} \right)$

(ii) if  $\omega < \omega_0$  voltage lags current by  $\phi = \tan^{-1} \left( \frac{X_c - X_L}{R} \right)$

(iii) if  $\omega = \omega_0$  voltage and current in same phase. This state of circuit is called resonance state.

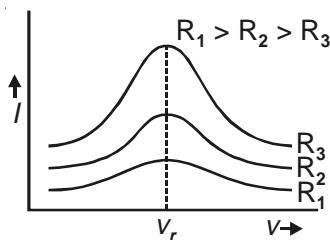
$$\text{Resonant frequency, } \omega_r = \frac{1}{2\pi\sqrt{LC}}$$

$$\text{Power factor } \cos \phi = 1$$

When  $\phi = 0, V$  and  $i$  in same phase.

$P_{av} = P_{app}$  and current is maximum.

$$I_{\max} = \frac{V}{Z_{\min}} = \frac{V}{R}$$

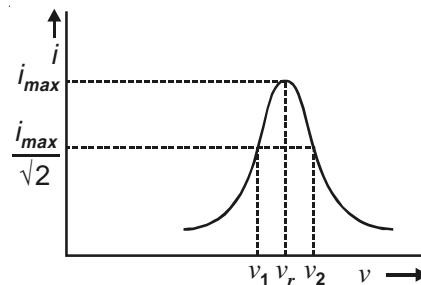


$$R_1 > R_2 > R_3$$

At resonance, voltage across inductor and capacitor are equal but have a phase difference of  $180^\circ$ .

Quality factor of circuit is the measure of selectivity of desired signal from the given band

$$Q = \frac{\nu_r}{\nu_2 - \nu_1}$$



$\Delta\nu_2 = \nu_2 - \nu_1$  is the frequency bandwidth corresponding to  $\frac{1}{\sqrt{2}}$  of  $i_{\max}$ .

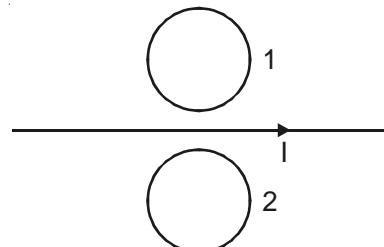
In ideal transformer  $P_{in} = P_0$

$$V_P I_P = V_S I_S$$

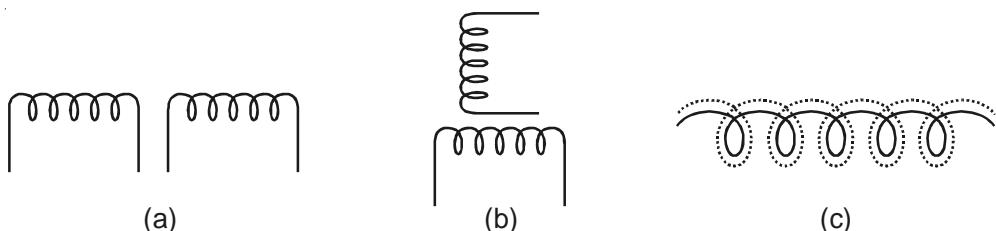
$$\text{Efficiency of the transformer} = P_0 / P_{in} = \left| \frac{\epsilon_s I_s}{V_P I_P} \right|.$$

## **VERY SHORT ANSWER QUESTIONS (1 MARK EACH)**

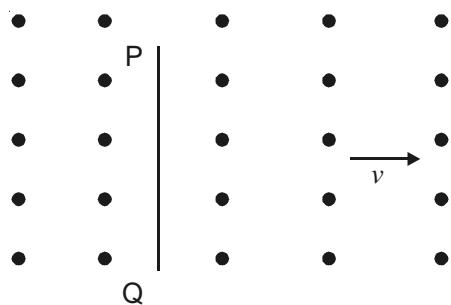
1. Why is the iron core of a transformer made laminated?
  2. What is the direction of induced currents in metal rings 1 and 2 seen from the top when current  $I$  in the wire is increasing steadily?



3. In which of the following cases will the mutual inductance be (i) minimum (ii) maximum?

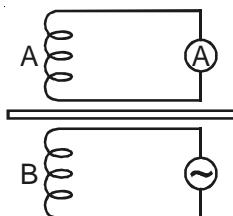


- An ac source of rms voltage  $V$  is put across a series combination of an inductor  $L_1$ , a capacitor (and a resistor  $R$ ). If  $V_L$ ,  $V_C$  and  $V_R$  are the rms voltage across  $L$ ,  $C$  and  $R$  respectively then why is  $V \neq V_L + V_C + V_R$ ?
  - In a series  $L-C-R$  circuit, voltages across inductor, capacitor, and resistor are  $V_L$ ,  $V_C$  and  $V_R$  respectively. What is the phase difference between (i)  $V_L$  and  $V_R$  (ii)  $V_L$  and  $V_C$ ?
  - Why can't transformer be used to step up or step down dc voltage?
  - A conducting rod PQ is in motion at speed  $n$  in uniform magnetic field as shown in Fig. What are the polarities at P and Q?

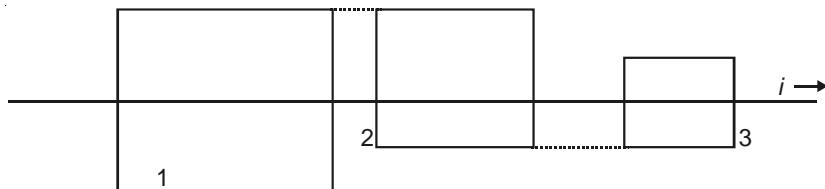


8. In an a.c. circuit, instantaneous voltage and current are  $V = 200 \sin 300 t$  volt and  $i = 8 \cos 300t$  ampere respectively. What is the average power dissipated in the circuit?
  9. Sketch a graph that shows change in reactance with frequency of a series L-C-R circuit.

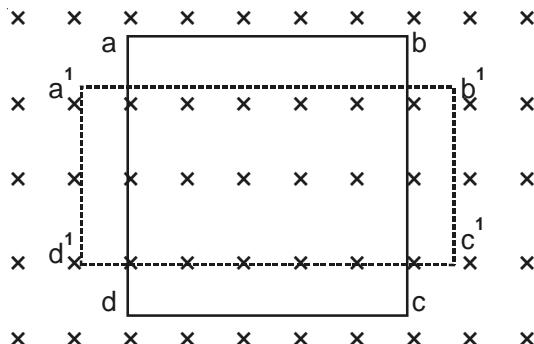
10. A coil A is connected to an A.C. ammeter and another coil B to a source of alternating e.m.f. What will be the reading in ammeter if a copper plate is introduced between the coils as shown.



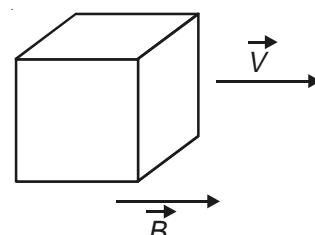
11. In a circuit instantaneous voltage and current are  $V = 150 \sin 314 t$  volt and  $i = 12 \cos 314 t$  ampere respectively. What is the nature of circuit?
12. A long straight wire with current  $i$  passes (without touching) three square wire loops with edge lengths  $2L$ ,  $1.5L$  and  $L$ . The loops are widely spaced (so as to not affect one another). Loops 1 and 3 are symmetric about the long wire. Rank the loops according to the size of the current induced in them if current  $i$  is (a) constant and (b) increasing greatest first.



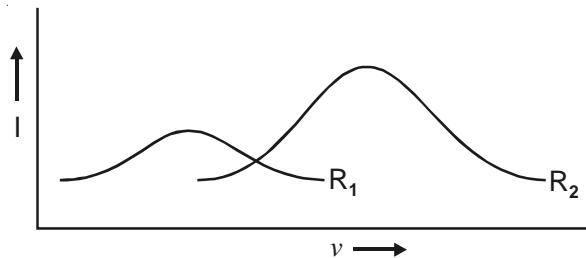
13. In a series L-C-R circuit  $V_L = V_C \neq V_R$ . What is the value of power factor?
14. In an inductor L, current passed  $I_0$  and energy stored in it is U. The current is now reduced to  $I_0/2$ . What will be the new energy stored in the inductor?
15. A square loop  $a b c d$  of a conducting wire has been changed into a rectangular loop  $a' b' c' d'$  as shown in figure. What is the direction of induced current in the loop?



16. In an L-C circuit, current is oscillating with frequency  $4 \times 10^6$  Hz. What is that frequency with which magnetic energy is oscillating?
17. Twelve wires of equal lengths are connected in the form of a skeleton cube, which is moving with a velocity  $\vec{V}$  in the direction of magnetic field  $\vec{B}$ . Find the emf in each arm of the cube.



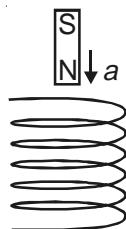
18. Current versus frequency ( $I - v$ ) graphs for two different series L-C-R circuits have been shown in adjoining diagram.  $R_1$  and  $R_2$  are resistances of the two circuits. Which one is greater— $R_1$  or  $R_2$ ?



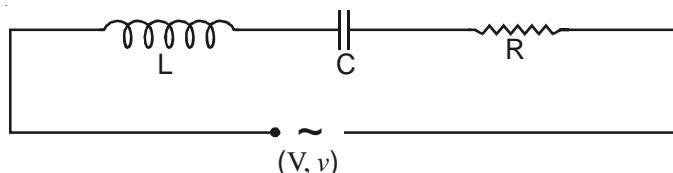
19. Why do we prefer carbon brushes than copper in an a.c. generator?

### SHORT ANSWER QUESTIONS (2 MARKS EACH)

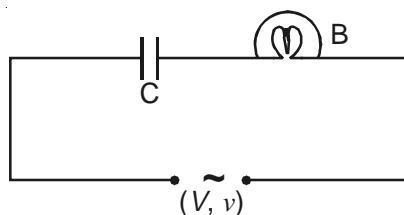
1. A bar magnet is falling with some acceleration ' $a$ ' along the vertical axis of a long cylindrical coil as shown in fig. What will be the acceleration of the magnet (whether  $a > g$  or  $a < g$  or  $a = g$ ) if (a) coil ends are not connected to each other? (b) coil ends are connected to each other?



2. The series L-C-R circuit shown in fig. is in resonance state. What is the voltage across the inductor?

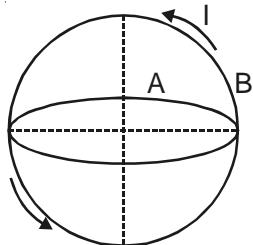


3. The divisions marked on the scale of an a.c. ammeter are not equally spaced. Why?  
4. Circuit shown here uses an airfilled parallel plate capacitor. A mica sheet is now introduced between the plates of capacitor circuit shown here uses an air-filled parallel plate capacitor. Explain with reason the effect on brightness of the bulb B.

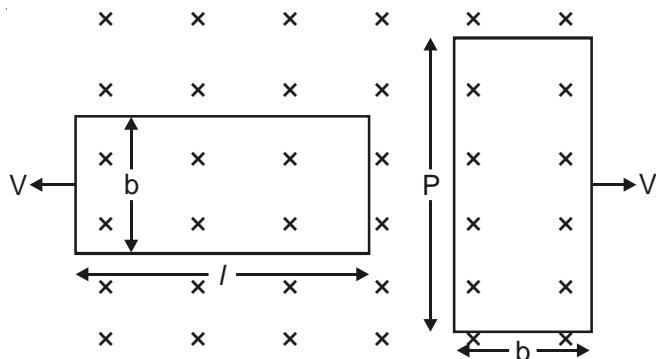


5. Explain the principle of working of a metal detector.

6. An ordinary moving coil ammeter used for d.c. cannot be used to measure an a.c. even if its frequency is low. Why?
7. Two circular conductors are perpendicular to each other as shown in figure. Will a current be induced in the conductor A, if the current is changed in conductor B?



8. In the figure shown, coils P and Q are identical and moving apart with same velocity V. Induced currents in the coils are  $I_1$  and  $I_2$ . Find  $I_1/I_2$ .

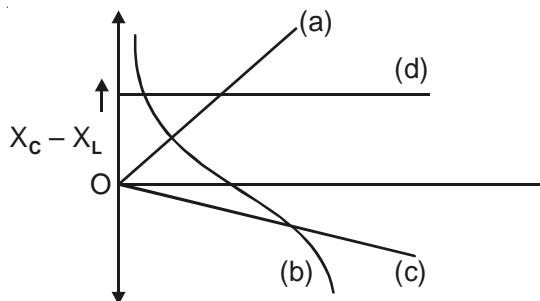


9. A  $1.5 \mu\text{F}$  capacitor is charged to  $57\text{V}$ . The charging battery is then disconnected, and a  $12 \text{ mH}$  coil is connected in series with the capacitor so that LC Oscillations occur. What is the maximum current in the coil? Assume that the circuit has no resistance.
10. The self inductance of the motor of an electric fan is  $10\text{H}$ . What should be the capacitance of the capacitor to which it should be connected in order to impart maximum power at  $50\text{Hz}$ ?

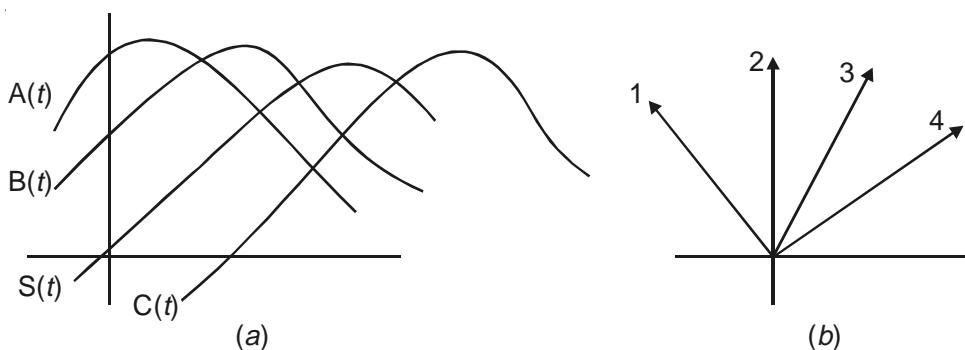
### SHORT ANSWER TYPE QUESTIONS (3 MARKS EACH)

- Obtain an expression for the self inductance of a straight solenoid of length  $l$  and radius  $r$  ( $l \gg r$ ).
- Distinguish between : (i) resistance and reactance (ii) reactance and impedance.
- In a series L-C-R circuit  $X_L$ ,  $X_C$  and  $R$  are the inductive reactance, capacitive reactance and resistance respectively at a certain frequency  $f$ . If the frequency of a.c. is doubled, what will be the values of reactances and resistance of the circuit?
- What are eddy currents? Write their any four applications.
- In a series L-R circuit,  $X_L = R$  and power factor of the circuit is  $P_1$ . When capacitor with capacitance  $C$  such that  $X_L = X_C$  is put in series, the power factor becomes  $P_2$ . Find  $P_1/P_2$ .

- Instantaneous value of a.c. through an inductor  $L$  is  $i = i_0 \cos \omega t$ . Obtain an expression for instantaneous voltage across the inductor.
- In an inductor of inductance  $L$ , current passing is  $I_0$ . Derive an expression for energy stored in it. In what forms is this energy stored?
- Which of the following curves may represent the reactance of a series, LC combination.

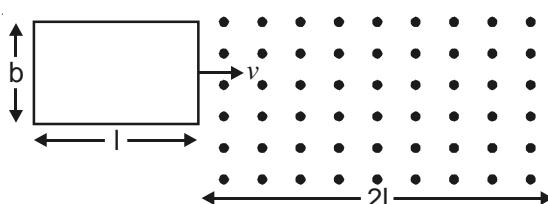


- A sinusoidal e.m.f. device operates at amplitude  $E_0$  and frequency  $\nu$  across a purely (1) resistive (2) capacitive (3) inductive circuit. If the frequency of driving source is increased. How would (a) amplitude  $E_0$  and (b) amplitude  $I_0$  increase, decrease or remain same in each case?
- The figure shows, in (a) a sine curve  $\delta(t) = \sin \omega t$  and three other sinusoidal curves  $A(t)$ ,  $B(t)$  and  $C(t)$  each of the form  $\sin(\omega t - \phi)$ . (a) Rank the three curves according to the value of  $\phi$ , most positive first and most negative last (b) Which curve corresponds to which phase as in (b) of the figure? (c) which curve leads the others?



### LONG ANSWER QUESTIONS (5 MARKS EACH)

- Draw a labelled diagram to explain the principle and working of an a.c. generator. Deduce the expression for emf generated. Why cannot the current produced by an a.c. generator be measured with a moving coil ammeter?
- Explain, with the help of a neat and labelled diagram, the principle, construction and working of a transformer.
- An L-C circuit contains inductor of inductance  $L$  and capacitor of capacitance  $C$  with an initial charge  $q_0$ . The resistance of the circuit is negligible. Let the instant the circuit is closed be  $t = 0$ .
  - What is the total energy stored initially?



The loop is moving at constant speed  $v$  and at  $t = 0$  it just enters the field  $B$ . Sketch the following graphs for the time interval  $t = 0$  to  $t = \frac{3l}{v}$ .

- (i) Magnetic flux – time
- (ii) Induced emf – time
- (iii) Power – time

Resistance of the loop is  $R$ .

9. A charged  $8\text{mF}$  capacitor having charge  $5\text{mC}$  is connected to a  $5\text{mH}$  inductor. What is :
  - (i) the frequency of current oscillations?
  - (ii) the frequency of electrical energy oscillations in the capacitor?
  - (iii) the maximum current in the inductor?
  - (iv) the magnetic energy in the inductor at the instant when charge on capacitor is  $4\text{mC}$ ?
10. A  $31.4\Omega$  resistor and  $0.1\text{H}$  inductor are connected in series to a  $200\text{V}$ ,  $50\text{Hz}$  ac source. Calculate
  - (i) the current in the circuit
  - (ii) the voltage (rms) across the inductor and the resistor.
  - (iii) Is the algebraic sum of voltages across inductor and resistor more than the source voltage? If yes, resolve the paradox.

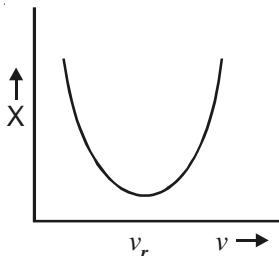
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# ANSWERS

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## 1 MARK QUESTIONS

1. To reduce loss due to eddy currents
2. Ring 1 clockwise, Ring 1, anticlockwise.
3. (i) b; (ii) c.
4. Magnetic flux.
5. (i)  $\pi/2$ ; (ii)  $\pi$ .
6. In steady current no induction phenomenon will take place :
7. P(−) Q(+).
8. Capacitor circuit,  $P_{av} = 0$ .
9. Reactance =  $X_L - X_C$   
 $v_r \rightarrow$  resonant frequency



10. Reading of ammeter will be zero.
11. As current leads voltage by  $\pi/2$  : purely capacitive circuit.
12. (a) No induced current. (b) Current will be induced only in Loop 2.
13. Resonance :  $\cos \phi = 1$ .
14. Energy  $U_L \propto I^2 \Rightarrow U' = \frac{U}{4}$ .
15. Clockwise.
16. Frequency of magnetic energy oscillators  $v_m = 2n = 8 \times 10^6$  Hz.
17. emf in each branch will be zero.
18.  $R_1 > R_2$  as current is smaller at larger resistance.
19. Corrosion free and also with small expansion on heating maintains proper contact.

## ANSWER TO 2 MARKS QUESTIONS

1. (i)  $a = g$  because the induced emf set up in the coil does not produce any current and hence no opposition to the falling bar magnet.

(ii)  $a < g$  because of the opposite effect caused by induced current.

2. Current at resonance  $I = \frac{V}{R}$ .

$$\therefore \text{voltage across inductor } V_L = I \cdot X_L = I \cdot \omega L = \frac{V}{R} (2\pi\nu) L.$$

3. A.C. ammeter works on the principle of heating effect  $H \propto I^2$ .

4. Brightness of bulb depends on current.  $P \propto I^2$  and

$$I = \frac{V}{Z} \quad \text{where} \quad Z = \sqrt{X_C^2 + R^2} \quad \text{and} \quad X_C = \frac{1}{\omega C} = \frac{1}{2\pi\nu C}$$

$X_C \propto \frac{1}{C}$ , when mica sheet is introduced capacitance  $C$  increases  $\left( C = \frac{K \epsilon_0 A}{d} \right)$ ,

$X_C$  decreases, current increases and therefore brightness increases.

5. Based on the principle of resonance. Suitably tuned coils produce resonance which produces audio visual effects.

6. Ordinary ammeter (moving coil type) measures average current which is zero for a.c.

7. No current is induced in coil A.

8. Current  $I = \epsilon/R =$

$$\text{In coil } P, I_1 = E_1/R = \frac{Bvb}{R}$$

$$\text{In coil } Q, I_2 = E_2/R = \frac{Bvl}{R} \quad I_1/I_2 = b/l.$$

9. em energy is conserved

$$\mu_E(\text{max}) = \mu_B(\text{max})$$

$$\frac{1}{2} \frac{Q^2}{C} = \frac{1}{2} LI^2$$

$$I = 637 \text{ mA}$$

10.  $10^{-6} \text{ F}$ .

## HINT / ANSWERS TO 3 MARKS QUESTIONS

8. (b)  
10. (a) C, B, A. (b) 1, A; 2, B; (c) A

## HINT / ANSWERS TO LONG ANSWERS (5 MARKS)

1. NCERT reference for a.c. generator
2. NCERT reference for transformer.
3. (i) Total energy stored initially in the capacitor  $U = U_{\max} = 1/2 \frac{q_0^2}{C}$   
$$U_{L \max} = U_{C \max}$$
(ii) Maximum current  $I_0$  is given by  $\frac{1}{2} LI_0^2 = \frac{1}{2} \frac{q_0^2}{C}$   
$$\Rightarrow I_0 = q_0 / \sqrt{LC}$$
(iii) Freq of charge oscillation  $v = \frac{1}{2\pi\sqrt{LC}}$ (iv) Energy dissipated in the resistor  $= v = \frac{1}{2} q_0^2 / C$
4. Using phasor diagram obtain expression for impedance,  $Z = \sqrt{(X_L - X_C)^2 + R^2}$

Phase angle is  $\tan \phi = \frac{X_L - X_C}{R}$

- (i) When  $\omega < \frac{1}{\sqrt{LC}}$ ,  $X_L < X_C$  circuit is capacitive therefore  $i$  leads  $V$ .
- (ii) When  $\omega = \frac{1}{\sqrt{LC}}$   $X_L = X_C$  purely resistive circuit  $V$  and  $i$  in same phase ( $\cos \phi = 1$ ,  $\phi = 0$ ).

## ANSWER OF NUMERICALS

1. (i)  $V_0 = 110$  volt  
(ii)  $V_{av \ 1/2} = \frac{2V_0}{\pi} = \frac{2 \times 110 \times 7}{22} = 70$  volt.

2. Induced emf  $\varepsilon = -N \frac{d\phi}{dt} = -25 \frac{(1-6) \times 10^{-3}}{.5} = 0.25$  volt.

3. (i) Reactance  $X_L = \omega L = 300 \times 4 \times 10^{-3} = 1.2 \Omega$ .

(ii) Peak Voltage  $V_0 = i_0 X_L = 12 \times 1.2 = 14.4$  volt.

4. In ideal transformer  $P_{in} = P_0$

$$V_P I_P = V_s I_s$$

$$\frac{V_S}{V_P} = \frac{I_P}{I_S} = \frac{N_S}{N_P} \quad N_S = \left( \frac{V_S}{V_P} \right) N_P = \frac{240}{2400} \times 4000 = 400$$

5. Induced current  $I = \varepsilon/R$

where  $\varepsilon = \frac{-d\phi}{dt} = -10t + 4$

$$\varepsilon = -10(15) + 4 = -146 \text{ mV}$$

where  $\phi = 5t^2 - 4t + 2 = 18.3 \text{ mA}$

$$\therefore I = -\frac{146}{8}$$

6. When  $V$  and  $I$  in phase

$$X_L = X_C, \quad v = \frac{1}{2\pi} \frac{1}{\sqrt{LC}}$$

$$C = \frac{1}{4\pi^2 v^2 L} = \frac{1}{4\pi^2 \times 50 \times 50 \times \frac{4}{\pi^2}}$$

$$= 2.5 \times 10^{-5} = 25 \mu\text{F.}$$

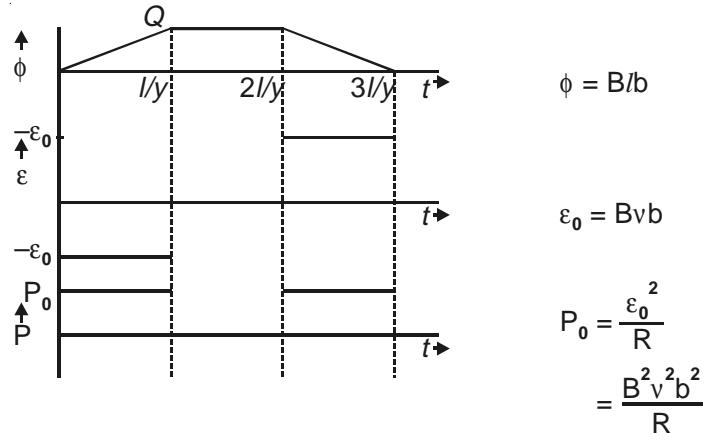
7. Current in the circuit  $I = \frac{V}{Z}$

When  $Z = \sqrt{X_c^2 + R^2}, \quad X_C = \frac{1}{\omega C} = \frac{1}{2\pi v C}$

Then total voltage across capacitor and resistor

$$V_C = i X_C, \quad V_R = IR.$$

8.



$$\phi = B/lb$$

$$\epsilon_0 = Bvb$$

$$P_0 = \frac{\epsilon_0^2}{R}$$

$$= \frac{B^2 v^2 b^2}{R}$$

9. (i) Frequency of current oscillations

$$v = \frac{1}{2\pi\sqrt{LC}}$$

(ii) Frequency of electrical energy oscillation  $v_c = 2v$

(iii) Maximum current in the circuit  $I_0 = \frac{q_0}{\sqrt{LC}}$

(iv) Magnetic energy in the inductor when charge on capacitor is 4mC.

$$U_L = U - U_C = \frac{1}{2} \frac{q_0^2}{C} - \frac{1}{2} \frac{q^2}{C} = \frac{q_0^2 - q^2}{2C}$$

Here  $q_0 = 5\text{mC}$ ;  $q = 4\text{mC}$

10. Current in the circuit :

$$(i) I = \frac{V}{Z}, \text{ where } Z = \sqrt{X_L^2 + R^2}$$

(ii) RMS voltage across  $L$  and  $R$

$$V_L = I \cdot X_L; \quad V_R = IR$$

(iii)  $(V_L + V_R) > V$  because  $V_L$  and  $V_R$  are not in same phase.

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# EM WAVES

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## KEY POINTS

- EM waves are produced by accelerated (only by the change in speed) charged particles.
- $\vec{E}$  and  $\vec{B}$  vectors oscillate with the frequency of oscillating charged particles.
- Properties of em waves :
  - (i) Transverse nature
  - (ii) Can travel though vacuum.
  - (iii)  $E_0/B_0 = E/B = v$   $v \rightarrow$  Speed of EM waves.
  - (iv) Speed =  $3 \times 10^8$  m/s in vacuum.

(v) In some medium  $v = \frac{1}{\sqrt{\mu \epsilon}}$

Where  $\mu = \mu_r \mu_0$ ,  $\epsilon = \epsilon_r \epsilon_0$

$\sqrt{\epsilon_r} = n$  refractive index of medium

Also  $v = c/n$

(vi) Wave intensity equals average of Poynting vector  $I = |\vec{S}|_{av} = \frac{B_0 E_0}{2\mu_0}$

(vii) Average electric and average magnetic energy densities are equal.

- In an em spectrum, different waves have different frequency and wavelengths.
- Penetration power of em waves depends on frequency. Higher, the frequency larger the penetration power.
- Wavelength  $\lambda$  and frequency  $v$  are related with each other  $v = \lambda v$ . Here  $v$  is the wave velocity.
- A wave travelling along  $+x$  axis is represented by

$$E_y = E_{oy} \cos(\omega t - kx)$$

$$B_z = B_{oz} \cos(\omega t - kx)$$

$$\omega = \frac{2\pi}{T} = 2\pi v \quad \frac{\omega}{k} = \lambda v = v \text{ wave speed}$$

$$k = \frac{2\pi}{T} = 2\pi v$$

$v \rightarrow$  frequency

$$\bar{v} = \frac{1}{\lambda} \text{ wave number.}$$

### VERY SHORT ANSWER TYPE QUESTIONS

1. Every *EM* wave has certain frequency. Name two parameters of an em wave that oscillate with this frequency.
2. What is the phase difference between electric and magnetic field vectors in an em wave?
3. Name em radiations used for detecting fake currency notes.
4. Give any two uses of microwaves.
5. Name the phenomenon which justifies the transverse nature of em waves.
6. Arrange the following em waves in descending order of wavelengths :  $\gamma$  ray, microwaves UV radiations.
7. Which component  $\vec{E}$  or  $\vec{B}$  of an em wave is responsible for visible effect?
8. Write expression for speed of em waves in a medium of electrical permittivity  $\epsilon$  and magnetic permeability  $\mu$ .
9. Which of the following has longest penetration power?  
UV radiation, X-ray, Microwaves.
10. Which of the following has least frequency?  
IR radiations, visible radiation radiowaves.
11. Which physical quantity is the same for microwaves of wavelength 1 mm and UV radiations of 1600  $\text{\AA}$  in vacuum?
12. Why are Microwaves better carriers for long range transmission?
13. What is ionospheric propagation?
14. Name two physical quantities which are imparted by an em wave to a surface on which it falls.
15. Name the physical quantity with unit same as that of  $\epsilon_0 \cdot \frac{d\phi_e}{dt}$ ,  $\phi_e \rightarrow$  electric flux.
16. What is the source of energy associated with propagating em waves?
17. What is the wavelength range of em waves that were produced and observed by J.C. Bose?
18. Name the device used for producing microwaves.
19. Name the em radiations which are detected using Gieger tube.

20. Relative electric permittivity of a medium is 8 and relative permeability is close to unity. What is the speed of em waves in the medium.
21. Name the physical quantity that has unit same as that of  $\frac{1}{\sqrt{\mu \epsilon}}$  where  $\mu \rightarrow$  magnetic permeability and  $\epsilon \rightarrow$  absolute electrical permitivity of medium.

### **SHORT ANSWER TYPE QUESTIONS (2 MARKS EACH)**

1. Give one use of each of the following (i) UV ray (ii)  $\gamma$ -ray
2. Represent *EM* waves propagating along the *x*-axis. In which electric and magnetic fields are along *y*-axis and *z*-axis respectively.
3. Why is it necessary to use satellite for long distance transmission?
4. State two principles of production of *EM* waves. An *EM* wave of wavelength  $\lambda$  goes from vacuum to a medium of refractive index  $n$ . What will be the frequency of wave in the medium?
5. An *EM* wave has amplitude of electric field  $E_0$  and amplitude of magnetic field is  $B_0$  the electric field at some instant become  $\frac{3}{4}E_0$ . What will be magnetic field at this instant? (Wave is travelling in vacuum).

### **SHORT ANSWER TYPE QUESTIONS (3 MARKS EACH)**

1. Name *EM* radiations used (i) in the treatment of cancer.  
 (ii) For detaching flaw in pipes carrying oil.  
 (iii) In sterilizing surgical instruments.
2. How would you experimentally show that *EM* waves are transverse in nature?
3. List any three properties of *EM* waves.

### **NUMERICALS**

1. The refractive index of medium is 1.5 A beam of light of wavelength 6000  $\text{\AA}^\circ$  enters in the medium from air. Find wavelength and frequency of light in the medium.
2. An *EM* wave is travelling in vaccum. Amplitude of the electric field vector is  $5 \times 10^4 \text{ V/m}$ . Calculate amplitude of magnetic field vector.
3. A radio can tune into any station of frequency band 7.5 MHz to 10 MHz. Find the corresponding wavelength range.
4. The amplitude of the magnetic field vector of an electromagnetic wave travelling in vacuum is 2.4mT. Frequency of the wave is 16 MHz. Find :

- (i) Amplitude of electric field vector and  
(ii) Wavelength of the wave.
5. An *EM* wave travelling through a medium has electric field vector.  
 $E_y = 4 \times 10^5 \cos (3.14 \times 10^8 t - 1.57 x)$  N/C. Here  $x$  is in  $m$  and  $t$  in  $s$ .

Then find :

- |                                |  |
|--------------------------------|--|
| (i) Wavelength                 | (ii) Frequency                           |
| (iii) Direction of propagation | (iv) Speed of wave                       |
| (v) Refractive index of medium | (vi) Amplitude of magnetic field vector. |

## ANSWERS

### 1 MARK QUESTIONS

1. Electric and magnetic field vectors.
2. Zero  $\vec{E}$  and  $\vec{B}$  are in same phase.
3. UV radiations.
4. Communications, cooking
5. Polarization.
6. Microwaves UV radiations and  $\gamma$ -radiations.
7.  $E$ -Vector produces visible effect.
8.  $v = \frac{1}{\sqrt{\mu \epsilon}}$ .
9. Penetration power depends on frequency higher frequency longer penetrations power  $x$ -rays have longest penetration power among the given radiations.
10. Least frequency-radio waves.
11. Speed ( $C = 3 \times 10^8$  m/s)
12. Small diffraction effect or large directionality.
13. Propagation of EM wave via sky after reflection from ionosphere.
14. Energy and momentum.
15. Displacement current.
16. Oscillating or accelerated charged particles. (Change in speed).
17. 5 mm to 25 mm.

18. Klystron valve or Magnetron valve.

19. X-ray.

20.  $v = \frac{c}{\sqrt{\epsilon_r}} \quad (\mu_r \approx 1)$

$$= \frac{3 \times 10^8 \text{ m/s}}{\sqrt{8}} = \frac{3\sqrt{2} \times 8^B}{4} = 1.06 \times 10^8 \text{ m/s.}$$

21. Speed of EM waves in medium.

### ANSWER TO 2 MARKS QUESTIONS

1. (i) In sterilizing surgical instruments.

(ii) treatment of cancer.

2.  $E_y = E_{0y} \cos(\omega t - kx)$

$$B_z = B_{0z} \cos(\omega t - kx)$$

$$\omega = 2\pi/T, \quad k = 2\pi/\lambda$$

3. For distance transmission carriers are high frequency waves. These can't be reflected by ionosphere therefore artificial reflectors on board of satellite are used.

4. An oscillating charged particle is the source of oscillating  $\vec{E}$  and  $\vec{B}$  vectors frequency does not change with charge of medium.  $v = c/\lambda = \frac{\nu}{\lambda} \cdot v \rightarrow$  speed of EM wave in the medium.

5. For EM waves  $E/B = E_0/B_0 = V = \text{constant}$

$$\Rightarrow B = \left( \frac{E}{E_0} \right) B_0 = \frac{3}{4} B_0$$

### ANSWER TO 3 MARKS QUESTIONS

1. (i)  $\gamma$ -radiations

(ii) x-rays

(iii) UV-radiations

2. Use two polaroids and perform experiment in the same way as for producing linearly polarized light. From observation it is concluded that light and therefore EM waves are transverse in nature.

3. Three properties :

(i) Transverse nature; (ii) Can travel in free space or vacuum; (iii)  $E/B = E_0/B_0 = v = \text{constant}$

## NUMERICALS

1. Wavelength in medium

$$\lambda m = \frac{\lambda}{n} = \frac{6000}{1.5} = 4000 \text{ Å} \quad n \rightarrow \text{refractive index of medium}$$

Frequency does not change with medium

$$\therefore v = Vm = c/\lambda = 5 \times 10^{14} \text{ Hz}$$

2.  $E_0/B_0 = c$  (in vacuum)  $\Rightarrow B_0 = 1.67 \times 10^{-4} \text{ T}$
3. Using  $\lambda = c/v$  wavelength range comes 30m – 40m
4. (i)  $E_0 = B_0 c = 2.4 \times 10^{-6} \times 3 \times 10^8 = 720 \text{ N/C}$   
 (ii) Wave length  $\lambda = V/v = 18.75 \text{ m}$
5. Given  $E_y = 4 \times 10^5 \text{ N/C} \cos(3.14 \times 10^8 t - 1.57 x)$

$$(i) k = \frac{2\pi}{\lambda} = 1.57 \Rightarrow \lambda = 4m$$

$$(ii) \omega = 2\pi\nu = 3.14 \times 10^8 \Rightarrow V = 50 \text{ MHz}$$

(iii) + x.

$$(iv) \text{ Speed } v = \frac{\omega}{k} = 2 \times 10^8 \text{ m/s}$$

(v) Refractive index of the medium of propagation

$$n = c/v$$

$$(vi) = \frac{3 \times 10^8}{2 \times 10^8} = 1.5$$

$$B_0 = E_0/v = \frac{4 \times 10^5}{2 \times 10^8} = 2 \times 10^{-3} \text{ T} = 2 \text{ mT.}$$

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# OPTICS

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- Reflection of light is the phenomenon of change of path of light without any change in medium
- Refraction of light is the phenomenon of change of speed of light when light goes from one medium to another.
- The critical angle for a pair of medium in contact is defined as the angle of incidence in the denser medium for which angle of refraction is  $90^\circ$ .
- Critical angle depends upon the colour (frequency) of light.
- Power of lens is defined as the ability of the lens to converge or diverge the beam of light falling on the lens.
- Refractive index of any medium depends upon wave length of light. This is the cause of dispersion.
- Deviation  $\delta$  for yellow colour is mean of  $\delta_v$  and  $\delta_r$ .

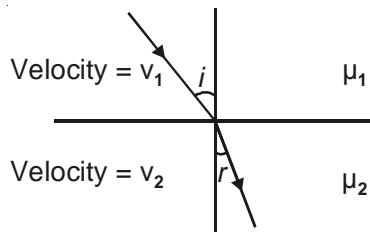
$$\text{i.e., Mean deviation } \delta = \frac{\delta_v + \delta_r}{2}.$$

- Intensity of scattered light varies inversely as fourth power of wavelength, so maximum scattering is of violet colour in visible spectrum.
- In normal adjustment, final image as seen by the eye is at infinity.
- Phase difference between two points on a wavefront is always zero.
- Two independent sources of light can never be Coherent.
- Diffraction pattern is supposed to be due to interference of secondary wavelets from the exposed portion of wavefront from the slit.
- Resolving power of an optical instrument is the ability of the instrument to resolve or separate the image of two points lying close to each other.
- Polarisation of light is the phenomenon of restricting the vibration of light (electric vector) in a particular direction by any means.
- Polarising angle depends upon the colour of light and nature of media in contact.
- A convex lens of refractive index ( $\mu_2$ ) in a medium of refractive index ( $\mu_1$ ) will behave as a convex lens only if  $\mu_1 < \mu_2$  and as a concave (diverging lens) if  $\mu_1 > \mu_2$ .

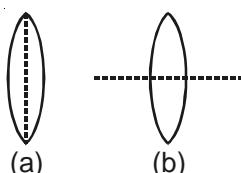
## VERY SHORT ANSWER QUESTION (1 MARK EACH)

1. Write the value of angle of reflection for a ray of light falling normally on a mirror.
2. Write the maximum angle of refraction when a light ray is refracted from glass ( $\mu = 1.5$ ) to air.
3. An air bubble is formed inside water. Does it act as converging lens or a diverging lens?

- A ray of light becomes parallel to principal axis after refraction through a concave lens. Explain the case by a ray diagram when this can happen.
- How does the dispersive power of glass prism change when it is dipped in water?
- Light falls from glass to air. Find the angle of incidence for which the angle of deviation is  $90^\circ$ .
- Name the phenomenon due to which one cannot see through fog.
- What is the ratio of  $\sin i$  and  $\sin r$  in terms of velocities in the given figure.



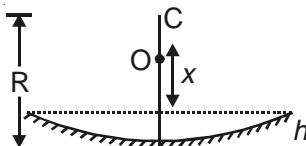
- What is the shape of fringes in young's double slit experiment?
- A equiconvex lens of focal length 15 cm is cut in to two equal halves along dotted line as shown in figure (a) and (b) What will be new focal length of each half in both cases?



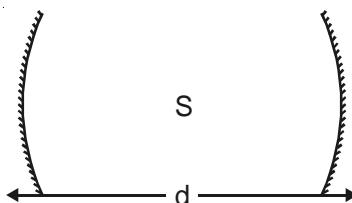
- For the same angle of the incidence the angle of refraction in three media A, B and C are  $15^\circ$ ,  $25^\circ$  and  $35^\circ$  respectively. In which medium would the velocity of light be minimum?
- Why does light usually appear to travel in a straight line inspite of its wave nature?
- What is the phase difference between two points on a cylindrical wavefront?
- What is the 'power' of plane glass plate.
- Show with the help of diagram, why a beam of white light passing through a hollow prism does not give spectrum.
- How does focal length of lens change when red light incident on it is replaced by violet light?
- A water tank is 4 meter deep. A candle flame is kept 6 meter above the level.  $\mu$  for water is  $4/3$ . Where will the image of the candle be formed?
- How can a plane wavefront be converted into a spherical wavefront?
- If eye is focussed on a distant object, will the ciliary muscles be relaxed or strained?
- The refractive indices of two media x and y are  $5/3$  and  $5/4$  respectively. Which medium is optically denser?
- Why is the image formed by totally reflected light brighter than that formed by ordinary reflected light?

### SHORT ANSWER QUESTIONS (2 MARKS EACH)

1. Water is poured into a concave mirror of radius of curvature 'R' up to a height  $h$  as shown in figure. What should be the value of  $x$  so that the image of object 'O' is formed on itself?

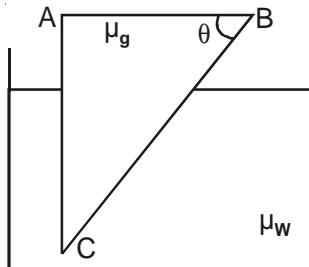


2. A near sighted person can clearly see objects up to a distance of 1.5m. Calculate power of the lens necessary for the remedy of this defect. ( $P = -0.67D$ )
3. A person can adjust the power of his eye lens between 50D and 60D. His far point is infinity. Find the distance between retina and eye lens.
4. A point source  $S$  is placed midway between two concave mirrors having equal focal length  $f$  as shown in Figure. Find the value of  $d$  for which only one image is formed.

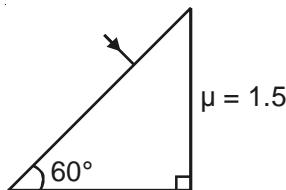


5. Calculate the value of  $\theta$ , for which light incident normally on face AB grazes along the face BC.

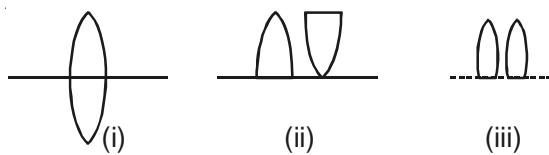
$$\mu_{\text{glass}} = 3/2 \quad \mu_{\text{water}} = 4/3$$



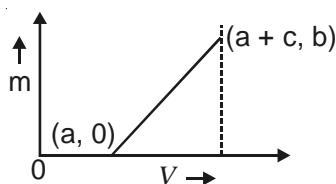
6. Name any two characteristics of light which do not change on polarisation.
7. Complete the path of light with correct value of angle of emergence.



8. A thin double convex lens of focal length  $f$  is broken into two equal halves at the axis. The two halves are combined as shown in figure. What is the focal length of combination in (ii) and (iii).



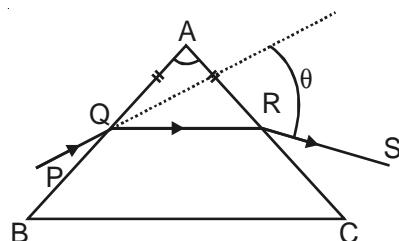
9. Define diffraction. What should be the order of the size of the aperture to observe diffraction.
10. Show that maximum intensity in interference pattern is four times the intensity due to each slit if amplitude of light emerging from slits is same.
11. Following graph shows the variation of magnification ( $m$ ) for real image produced by a convex lens with the image distance ( $V$ ). Find the focal length of lens.



12. Two poles-one 4m high and the other is 4.5 m high are situated at distance 40m and 50m respectively from an eye. Which pole will appear taller?
13.  $S_1$  and  $S_2$  are two sources of light separated by a distance  $d$ . A detector can move along  $S_2P$  perpendicular to  $S_1S_2$ . What should be the minimum and maximum path difference at the detector?

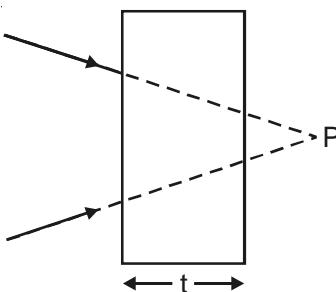


14. Draw ray diagram to show a (i) Myopic eye (ii) Corrected myopic eye.
15. A person looking at a mesh of crossed wire is able to see the vertical wire more distinctly than the horizontal wire. Why? How can this defect be corrected?
16. How much water should be filled in a container 21 cm in height, so that it appears half filled when viewed from the top of the container. ( ${}^a\mu_{\omega} = 4/3$ )?
17. A ray PQ incident on the refracting face BA is refracted in the prism BAC as shown in figure and emerges from the other refracting face AC as RS such that  $AQ = AR$ . If the angle of prism  $A = 60^\circ$  and  $\mu$  of material of prism is  $\sqrt{3}$  then find angle  $\theta$ .



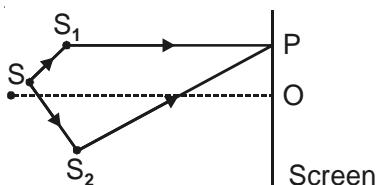
### SHORT ANSWER QUESTIONS (3 MARKS QUESTIONS)

- Using mirror formula show that virtual image produced by a convex mirror is always smaller in size and is located between the focus and the pole.
- A converging beam of light is intercepted by a slab of thickness  $t$  and refractive index  $\mu$ . By what distance will the convergence point be shifted? Illustrate the answer.



$$x = \left(1 - \frac{1}{\mu}\right) t$$

- Obtain the formula for combined focal length of two thin lenses in contact, taking one divergent and the other convergent.
- Derive snell's law on the basis of Huygen's wave theory.
- Explain with the help of lens maker formula, why does a convex lens behave as converging when immersed in water ( $\mu = 1.33$ ) and a diverging lens when immersed in  $CS_2$  solution ( $\mu = 1.6$ ).
- In double slit experiment  $SS_2$  is greater than  $SS_1$  by  $0.25\lambda$ . Calculate the path difference between two interfering beam from  $S_1$  and  $S_2$  for minima and maxima on the point P as shown in Figure.



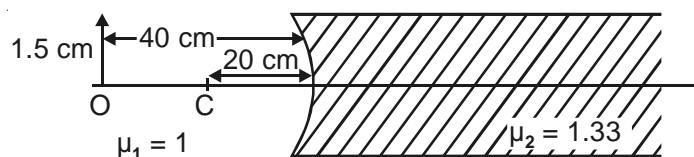
- A microscope is focussed on a dot at the bottom of the beaker. Some oil is poured into the beaker to a height of ' $b$ ' cm and it is found that microscope has to raise through vertical distance of ' $a$ ' cm to bring the dot again into focus. Express refractive index of oil in terms of  $a$  and  $b$ .
- Define total internal reflection. State its two conditions. With a ray diagram show how do optical fibres transmit light.
- A myopic person prefers to remove his spectacles while reading a book. Why?
- A plane wave front is incident on (i) a prism (ii) A convex lens (iii) A concave mirror. Draw the emergent wave front in each case.
- Derive the relation connecting the polarising angle of light and refractive index i.e.,  $\mu = \tan i_p$ .

## LONG ANSWER QUESTIONS (5 MARKS EACH)

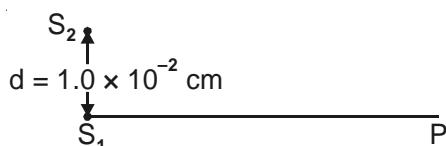
1. With the help of ray diagram explain the phenomenon of total internal reflection. Obtain the relation between critical angle and refractive indices of two media. Draw ray diagram to show how right angled isosceles prism can be used to :
  - (i) Deviate the ray through  $180^\circ$ .
  - (ii) Deviate the ray through  $90^\circ$ .
  - (iii) Invert the ray.
2. Draw a labelled ray diagram of a compound microscope and explain its working. Derive an expression for its magnifying power.
3. Diagrammatically show the phenomenon of refraction through a prism. Define angle of deviation in this case. Hence for a small angle of incidence derive the relation  $\delta = (\mu - 1) A$ .
4. Name any three optical defects of eye. Show by ray diagram :
  - (i) Myopic eye and corrected myopic eye.
  - (ii) Hypermetropic eye and corrected hypermetropic eye.
5. Define diffraction. Deduce an expression for fringe width of the central maxima of the diffraction pattern, produced by single slit illuminated with monochromatic light source.
6. What is polarisation? How can we detect polarised light? State Brewster's Law and deduce the expression for polarising angle.

## NUMERICALS

1. An object of length 2.5cm is placed at a distance of  $1.5f$  from a concave mirror where  $f$  is the focal length of the mirror. The length of object is perpendicular to principal axis. Find the size of image. Is the image erect or inverted?
2. Find the size of image formed in the situation shown in figure. (0.6 cm)

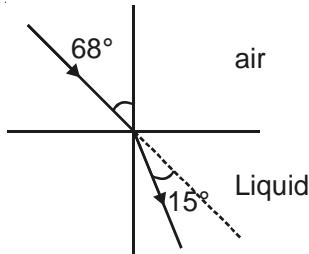


3.  $S_1$  and  $S_2$  are two sources emitting light of wavelength  $\lambda = 600 \text{ nm}$  and are  $1.0 \times 10^{-2} \text{ cm}$  apart. A detector can move along  $S_1P$  perpendicular to  $S_1S_2$ . Locate the position of detector where farthest minima is detected.

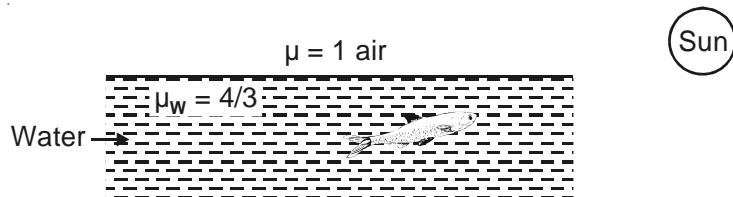


4. A ray of light passes through an equilateral prism in such a manner that the angle of incidence is equal to angle of emergence and each of these angles is equal to  $3/4$  of angle of prism. Find angle of deviation. [Ans. :  $30^\circ$ ]
5. Critical angle for a certain wavelength of light in glass is  $40^\circ$ . Calculate the polarising angle and the angle of refraction in glass corresponding to this.
6. A light ray passes from air into a liquid as shown in figure. Find refractive index of liquid.

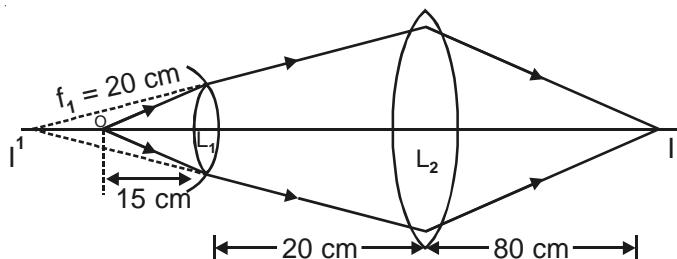
$$\Gamma_{air} \mu_{Liquid} = \sqrt{3/2}$$



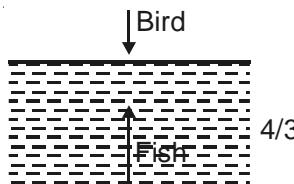
7. At what angle with the water surface does fish in figure see the setting sun?



8. In the following diagram, find the focal length of lens  $L_2$ .

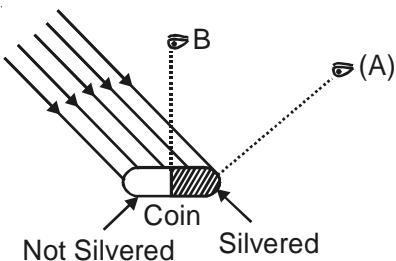


9. A fish rising vertically to the surface of water in a lake, uniformly at the rate of 3 m/s observes a bird diving vertically towards the water at a rate of 9 m/s. If refractive index of water is  $(4/3)$ , find the actual velocity of dive of the bird.



10. Which half of the coin is brighter (Refer to the diagram given below).

- (i) for observer A
- (ii) for observer B.

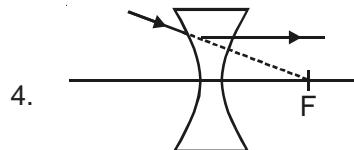


## HINTS FOR SOME QUESTIONS

### VERY SHORT ANSWER QUESTION (1 MARK EACH)

2. Maximum angle of refraction of  $90^\circ$ .

3. Diverging Lens.



5. Decreases.

6. Angle of incidence is  $45^\circ$ .

7. Scattering.

9. Hyperbolic

12. Due to its very small wavelength.

13. Zero.

14. Power of plane glass plate is zero.

16. Decreases.

17. 6m below the water level.

18. By passing through a lens or spherical mirror.

19. Relaxed.

20. In totally reflected light, there is no loss of energy.

### SHORT ANSWER QUESTIONS (2 MARKS EACH)

1. Distance of object from  $p$  should be equal to radius of curvature.

$$R = \mu x + h \Rightarrow x = \frac{R - h}{\mu}.$$

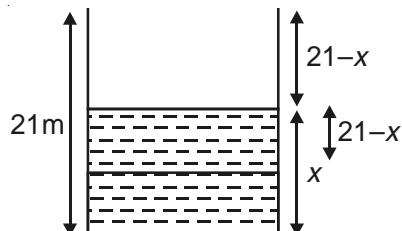
3. Far point is infinity so in this case focal length is maximum hence power is minimum.

$$\text{distance} = f = \frac{1}{50} = 2 \text{ cm.}$$

4. Distance between mirror will be  $2f$  or  $4f$ .  
 5.  $\theta = \sin^{-1} (8/9)$ .  
 6. Speed and frequency.  
 7.  $\sin^{-1} (3/4)$ .  
 8. Focal length of combination is infinite.

11. Slope of the graph =  $\frac{1}{\text{focal length}} \Rightarrow f = \frac{c}{b}$ .

12. 4m pole.  
 13. Minimum path diff = zero (when  $P$  is at infinity) Maximum path diff =  $d$ .  
 15. Astigmatism. Cylindrical lenses.  
 16.



$$\frac{\text{Real depth}}{\text{Apparent depth}} = \mu$$

$$\frac{x}{21 - x} = \frac{4}{3} \Rightarrow x = 12 \text{ cm.}$$

17. This is a case of min. deviation  $\theta = 60^\circ$ .

### ANSWERS OF 3 MARKS QUESTIONS

Path diff. :  $(SS_2 + S_2P) - (SS_1 + S_1P) = (SS_2 - SS_1) + (S_2P - S_1P) = (0.25\lambda + S_2P - S_1P)$

For maxima, path diff. =  $n\lambda$

So  $S_2P - S_1P = n\lambda - 0.25\lambda = (n - 0.25)\lambda$

For minima, path diff. =  $(2n + 1) \frac{\lambda}{2}$

So  $S_2P - S_1P = (2n + 0.5) \lambda/2$

7. Shift in the image should be equal to the change in position of microscope :

$$a = \left(1 - \frac{1}{\mu}\right) b \quad \mu = \frac{b}{b - a}$$

### NUMERICAL

3. For farthest minima path diff =  $\lambda/2$

So  $S_2P - S_1P = \lambda/2$  or  $S_2P = (S_1P + \lambda/2)$

now  $(S_2P)^2 = (S_1S_2)^2 + (S_1P)^2$  or  $(S_1O + \lambda/2)^2 = (S_1S_2)^2 + (S_1P)^2$

or  $S_1P = \frac{1}{\lambda} \left[ (S_1S_2)^2 - \frac{\lambda^2}{4} \right]$ .

4.  $i_1 = i_2 = \frac{3A}{4}$  as  $A + \delta + i_1 + i_2$

$\therefore \delta = i_1 + i_2 - A = \frac{4}{2} = 30$

6.  $\mu = \frac{\sin 60^\circ}{\sin 45^\circ} \Rightarrow \mu = \frac{\sqrt{3}}{\sqrt{2}}$ .

7. At critical angle, fish will see the sun.

8. 40 cm.

9. 4.5 m/s.

10. (i) Silvered

(ii) Not Silvered.

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# DUAL NATURE OF RADIATIONS AND MATTER

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- Light consists of individual photons whose energies are proportional to their frequencies.
- A photon is a quantum of electromagnetic energy :

Energy of photon	$E = h\nu = \frac{hc}{\lambda}$
Momentum of a photon	$= \frac{h\nu}{c} = \frac{h}{\lambda}$
Dynamic mass of photon	$= \frac{h\nu}{c^2} = \frac{h}{c\lambda}$

Rest mass of a photon is zero.

- *Photoelectric effect* : Photon of incident light energy interacts with a single electron and if energy of photon is equal to or greater than work function, the electron is emitted.
- Max. Kinetic energy of emitted electron =  $h(\nu - \nu_0)$  Here  $\nu_0$  is the frequency below which no photoelectron is emitted and is called threshold frequency.
- A moving body behaves in a certain way as though it has a wave nature having wavelength,

$$\lambda = \frac{h}{mv}.$$

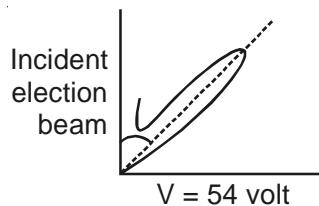
## QUESTIONS (1 MARK)

1. How does a photon differ from a material particle.
2. A good mirror reflects 80% of light incident on it. Which of the following is correct.
  - (a) Energy of each reflected photon decreases by 20%.
  - (b) Total no. of reflected photons decreases by 20%. Justify your answer.
3. Why is the surface of a photo-metal coated with alkali metals.?
4. Name the phenomenon which shows quantum nature of electromagnetic radiation.
5. Write Einstein's photoelectric equations and explain each term in it.
6. Which of the following radiations is more effective for electron emission from the surface of sodium?
  - (i) Microwave
  - (ii) Infrared
  - (iii) Ultraviolet.
7. A metal emits photoelectrons when red light falls on it. Will this metal emit photoelectrons when blue light falls on it?

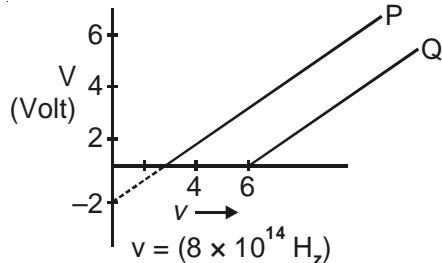
8. Name any two phenomena which show the dual nature of radiation.
9. The photoelectric cut off voltage in a certain photoelectric experiment is 1.5V. What is the max kinetic energy of photoelectrons emitted?
10. What is the de-Broglie wavelength of a 3 kg object moving with a speed of 2m/s?
11. What factors determine the maximum velocity of the photoelectrons from a surface?

## 2 MARKS QUESTIONS

1. Write one similarity and one difference between matter wave and an electromagnetic wave.
2. Does a photon have a de Broglie wavelength? Explain.
3. A photon and an electron have energy 200 eV each. Which one of these has greater de-Broglie wavelength?
4. The work function of the following metal is given Na = 2.75 eV, K = 2.3 eV, Mo = 4.17 eV, Ni = 5.15 eV which of these metal will not give a photoelectric emission for radiation of wave length 3300  $\text{\AA}$  from a laser source placed at 1 m away from the metal. What happens if the laser is brought nearer and placed 50 cm away.
5. Name the experiment for which the followings graph, showing the variation of intensity of scattered electron with the angle of scattering, was obtained. Also name the important hypothesis that was confirmed by this experiment.



6. In a photoelectric effect experiment, the graph between the stopping potential  $V$  and frequency of the incident radiation on two different metals P and Q are shown in Fig. :



- (i) Which of the two metals has greater value of work function?
- (ii) Find maximum K.E. of electron emitted by light of frequency  $v = 8 \times 10^{14} \text{ Hz}$  for metal P.
7. Do all the photons have same dynamic mass? If not, why?

### 3 MARKS QUESTIONS

1. Explain the working of a photocell? Give its two uses.
2. Find the de Broglie wavelength associated with an electron accelerated through a potential difference V.
3. What is Einstein's explanation of photo electric effect? Explain the laws of photo electric emission on the basis of quantum nature of light.
4. If kinetic energy of thermal neutron is  $\frac{3}{2}kT$  then show that de-Broglie wavelength of waves associated with a thermal neutron of mass m at temperature T kelvin is  $\frac{h}{\sqrt{3mkT}}$  where k is boltzmann constant.
5. Explain Davisson and Germer experiment to verify the wave nature of electrons.
6. Explain the effect of increase of (i) frequency (ii) intensity of the incident radiation on photo electrons emitted by a metal.
7. X-rays of wave length  $\lambda$  fall on a photo sensitive surface emitting electrons. Assuming that the work function of the surface can be neglected, prove that the de-Broglie wavelength of electrons emitted will be  $\sqrt{\frac{h\lambda}{2mc}}$ .
8. A particle of mass M at rest decays into two particles of masses  $m_1$  and  $m_2$  having velocities  $V_1$  and  $V_2$  respectively. Find the ratio of de-broglie Wavelengths of the two particles.

[Ans. : 1 : 1]

### NUMERICALS

1. Ultraviolet light of wavelength 350 nm and intensity  $1\text{W/m}^2$  is directed at a potassium surface having work function 2.2eV.
  - (i) Find the maximum kinetic energy of the photoelectron.
  - (ii) If 0.5 percent of the incident photons produce photoelectric effect, how many photoelectrons per second are emitted from the potassium surface that has an area  $1\text{cm}^2$ .
$$K_{\text{max}} = 1.3 \text{ eV}; n = 8.8 \times 10^{11} \frac{\text{photo electron}}{\text{second}}$$
2. A metal surface illuminated by  $8.5 \times 10^{14}$  Hz light emits electrons whose maximum energy is 0.52 eV the same surface is illuminated by  $12.0 \times 10^{14}$  Hz light emits electrons whose maximum energy is 1.97eV. From these data find work function of the surface and value of Planck's constant. [Work Function = 3eV]
3. An electron and photon each have a wavelength of 0.2 nm. Calculate their momentum and energy.
  - (i)  $3.3 \times 10^{-24} \text{ kgm/s}$

## **ANSWERS (1 MARK QUESTIONS)**

1. Rest mass zero.
  2. (b)
  3. Lower work function sensitive to visible light.
  4. Photoelectric effect.
  6. Ultraviolet (maximum frequency).
  8. Photoelectric effect, Compton effect.
  9.  $2.3 \times 10^{-19}$  eV
  10.  $1.1 \times 10^{-34}$  m
  11. (a) frequency of incident radiation.  
(b) Work function of surface.

## **ANSWER (2 MARKS QUESTIONS)**

7. No.

$$m = \frac{E}{c^2} = \frac{h\nu}{c^2}$$

$\Rightarrow$  *m* depends on frequency of photon.

## Unit VIII

# ATOMS AND NUCLEI

### KEY POINTS

- Gieger-Marsden  $\alpha$ -scattering experiment established the existence of nucleus in an atom.
- Bohr's atomic model
  - (i) Electrons revolve round the nucleus in certain fixed orbits called stationary orbits.
  - (ii) In stationary orbits, the angular momentum of electron is integral multiple of  $h/2\pi$ .
  - (iii) While revolving in stationary orbits, electrons do not radiate energy. The energy is emitted (or absorbed) when electrons jump from higher to lower energy orbits. (or lower to higher energy orbits). The frequency of the emitted radiation is given by  $\nu = E_f - E_i$ . An atom can absorb radiations of only those frequencies that it is capable of emitting.
- As a result of the quantisation condition of angular momentum, the electron orbits the nucleus in circular paths of specific radii. For a hydrogen atom it is given by.

$$r_n = \left( \frac{n^2}{m} \right) \left( \frac{h}{2\pi} \right)^2 \frac{4\pi\epsilon_0}{e^2} \quad r_n \propto n^2$$

The total energy is also quantised :  $E_n = \frac{-me^4}{8n^2\epsilon_0^2 h^2} = -13.6 \text{ eV}/n^2$

The  $n = 1$  state is called the ground state.

In hydrogen atom, the ground state energy is  $-13.6 \text{ eV}$ .

- de Broglie's hypothesis that electron have a wavelength  $\lambda = h/mv$  gave an explanation for the Bohr's quantised orbits.
- Neutrons and protons are bound in nucleus by short range strong nuclear force. Nuclear force does not distinguish between nucleons.
- The nuclear mass 'M' is always less than the total mass of its constituents. The difference in mass of a nucleus and its constituents is called the **mass defect**.

$$\Delta M = [Zm_p + (A - Z)m_n] - M \text{ and } \Delta E_b = (\Delta M)c^2$$

The energy  $\Delta E_b$  represents the binding energy of the nucleus.

For the mass number ranging from  $A = 30$  to  $170$  the binding energy per nucleon is nearly constant at about  $8 \text{ MeV}$  per nucleon.

- Radioactive decay law : The number of atoms of a radioactive sample disintegrating per second at any time is directly proportional to the number of atoms present at that time. Mathematically :

$$\frac{dN}{dt} = -\lambda N \text{ or } N(t) = N_0 e^{-\lambda t}$$

Where  $\lambda$  is called decay constant : It is defined as the reciprocal of the time during which the number of atoms of a radioactive substance decreases to 1/eth of their original number.

- Number of radioactive atoms  $N$  in a sample at any time  $t$  can be calculated using the formula.

$$N = N_0 \left(\frac{1}{2}\right)^{t/T}$$

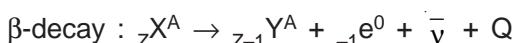
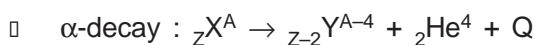
Here  $N_0$  = no. of atoms at time  $t = 0$  and  $T$  is the half-life of the substance.

**Half life :** The half life of a radio active substances is defined as the time during which the number of atoms disintegrate to one half of its initial value.

$$T_{1/2} = \frac{\ln 2}{\lambda} = \ln 2 \times \text{mean life} \text{ or } 0.693/\lambda = \frac{0.693}{\lambda}$$

Here  $\lambda$  = decay constant =  $\frac{1}{\text{mean life}}$ .

- Radius  $r$  of the nucleus of an atom is proportional to the cube root of its mass number thereby implying that the nuclear density is the same. (Almost) for all substances/nuclei.



$\gamma$ -decay : When  $\alpha$  or  $\beta$ -decay leave, the nucleus in excited state; the nucleus goes to lower energy state or ground state by the emission of  $\gamma$ -ray(s).

### VERY SHORT ANSWER QUESTIONS (1 MARK EACH)

1. Define atomic mass unit. Write its energy equivalent in MeV.
2. What was the drawback of Rutherford model of atom?
3. Name the series of hydrogen spectrum which lies in ultraviolet region.
4. What are the number of electrons and neutrons in singly ionised  ${}_{92}^{236} U$  atom?
5. Name the series of hydrogen spectrum which has least wavelength.
6. Proton and Neutron exist together in an extremely small space with in the nucleus. How is this possible when protons repel each other?
7. Define radioactive decay constant.
8. You are given reaction :  ${}_1^1 H + {}_1^1 H \rightarrow {}_2^4 He + 24 \text{ MeV}$ . What type of nuclear reaction is this?
9. After losing two electrons, to which particle does a helium atom get transformed into?

10. Write two important inferences drawn from Gieger-Marsden's  $\alpha$ -particle scattering experiment.
11. What will be the ratio of the radii of the nuclei of mass number  $A_1$  and  $A_2$ ?
12. In nuclear reaction  ${}_1^1H \rightarrow {}_0^1n + {}_Q^P X$  find P, Q and hence identify X.
13. Binding energies of neutron ( ${}_1^2H$ ) and  $\alpha$ -particle ( ${}_2^4He$ ) are 1.25 MeV/nucleon and 7.2 MeV/nucleon respectively. Which nucleus is more stable?
14.  $\alpha$ -particles are incident on a thin gold foil. For what angle of deviation will the number of deflected  $\alpha$ -particles be minimum?
15. A and B are two isotopes having mass numbers 14 and 16 respectively. If the number of electrons in A is 7, then give the number of neutrons in B.
16. If the amount of a radioactive substance is increased four times then how many times will the number of atoms disintegrating per unit time be increased?
17.  ${}^{237}U$  decays into  ${}^{234}Th$  by the emission of an  $\alpha$ -particle. There follows a chain of further radioactive decays, either by  $\alpha$ -decay or by beta decay. Eventually, a stable nuclide is reached and after that, no further radioactive decay is possible. Which of the following stable nuclide is the end product of the  ${}^{238}U$  radioactive decay chain :  ${}^{206}Pb$ ,  ${}^{207}Pb$ ,  ${}^{208}Pb$  or  ${}^{209}Pb$ ?
18. An electron jumps from fourth to first orbit in an atom. How many maximum number of spectral lines can be emitted by the atom?
19. Under what conditions of electronic transition will the emitted light be monochromatic?
20. Why does only a slow neutron cause the fission in the uranium nucleus and not the fast one?

### **SHORT ANSWER (2 MARKS QUESTIONS)**

1. Define distance of the closest approach. An  $\alpha$ -particle of kinetic energy 'K' is bombarded on a thin gold foil. The distance of the closest approach is 'r'. What will be the distance of closest approach for an  $\alpha$ -particle of double the kinetic energy?
2. Show that nuclear density is independent of the mass number.
3. Which of the following radiations  $\alpha$ ,  $\beta$  and  $\gamma$  are :
  - (i) similar to x-rays?
  - (ii) easily absorbed by matter
  - (iii) travel with greatest speed?
  - (iv) similar to the nature of cathode rays?
4. Some scientist have predicted that a global nuclear war on earth would be followed by 'Nuclear winter'. What could cause nuclear winter?
5. If the total number of neutrons and protons in a nuclear reaction is conserved how then is the energy absorbed or evolved in the reaction?

6. In the ground state of hydrogen atom orbital radius is  $5.3 \times 10^{-11}$  m. The atom is excited such that atomic radius becomes  $21.2 \times 10^{-11}$  m. What is the principal quantum number of the excited state of atom?
7. Calculate the percentage of any radioactive substance left undecayed after half of half life.
8. For a given impact parameter b, does the angle of deflection increase or decrease with the increase in energy?
9. Why is the density of the nucleus more than that of atom?
10. The atom  ${}_8\text{O}^{16}$  has 8 protons, 8 neutrons and 8 electrons while atom  ${}_4\text{Be}^8$  has 4 proton, 4 neutrons and 4 electrons, yet the ratio of their atomic masses is not exactly 2. Why?
11. What is the effect on neutron to proton ratio in a nucleus when a  $\beta$ -particle is emitted?
12. Why must heavy stable nucleus contain more neutrons than protons?
13. Does the ratio of neutrons to protons in a nucleus increase, decrease or remain same after the emission of an  $\alpha$ -particle?
14. Show that the decay rate R of a sample of radio nuclide at some instant is related to the number of radio active nuclei N at the same instant by the expression  $R = -N\lambda$ .
15. What is a nuclear fusion reaction? Why is nuclear fusion difficult to carry out for peaceful purpose?
16. Write two characteristic features of nuclear forces which distinguish them from coulomb force.
17. Half life of certain radioactive nuclei is 3 days and its activity is 8 times the ‘safe limit’. After how much time will the activity of the radioactive sample reach the ‘safe limit’?

### **3 MARKS QUESTIONS (ATOMIC NUCLEUS)**

1. In controlled thermal fission reactor, what is the function of (i) the moderator (ii) the control rods (iii) the coolant?
2. What are nuclear reactions? Give one example. Also define the Q-value of nuclear reaction.
3. Explain how radio-active nucleus can-emit  $\beta$ -particles even though nuclei do not contain these particles. Hence explain why the mass number of radioactive nuclide does not change during  $\beta$ -decay.
4. Define the term half life period and decay constant. Derive the relation between these terms.
5. State the law of radioactive decay. Deduce the relation  $N = N_0 e^{-\lambda t}$ , where symbols have their usual meaning.
6. Give the properties of  $\alpha$ -particles,  $\beta$ -particles and  $\gamma$ -rays.
7. With the help of one example, explain how the neutron to proton ratio changes during alpha decay of a nucleus.

8. Draw a labelled diagram of Gieger-Marsden experiment on the scattering of  $\alpha$ -particles. How is the size of nucleus estimated in this experiment?
9. Distinguish between nuclear fusion and fission. Give an example of each.
10. A radioactive isotope decays in the following sequence  $A \xrightarrow{\text{on}^1} A_1 \xrightarrow{\alpha} A_2$ . If the mass and atomic numbers of  $A_2$  are 171 and 76 respectively, find mass and atomic number of  $A$  and  $A_1$ . Which of the three elements are isobars?

### 5 MARKS QUESTIONS

1. State Bohr's postulates. Using these postulates, drive an expression for total energy of an electron in the  $n^{\text{th}}$  orbit of an atom. What does negative of this energy signify?
2. Define binding energy of a nucleus. Draw a curve between mass number and average binding energy/nucleon. Discuss the bindings energy curve.
3. State and explain the laws of radioactive disintegration. Hence define disintegration constant and half life period. Establish relation between them.
4. Explain the process of release of energy in a nuclear reactor. Draw a labelled diagram of a nuclear reactor and write the functions of each part.
5. What is meant by nuclear fission and nuclear chain reaction? Outline the conditions necessary for nuclear chain reaction.

### NUMERICALS

1. The radius of innermost orbit of Hydrogen atom is  $5.3 \times 10^{-1}$  m. What are the radii of  $n = 2$  and  $n = 3$  orbits.  
[Ans. :  $r_2 = 2.12 \times 10^{-10}$  m, and  $r_3 = 4.77 \times 10^{-10}$  m]
2. Calculate the radius of the third Bohr orbit of hydrogen atom and energy of electron in that orbit.  
[Ans. :  $r_3 = 4775$  Å and  $E_3 = -2.43 \times 10^{-19}$  J]
3. Calculate the longest and shortest wavelength in the Balmer series of Hydrogen atom. Rydberg constant =  $1.0987 \times 10^7$  m $^{-1}$ .  
[Ans. :  $\lambda_l = 6563$  Å,  $\lambda_s = 3646$  Å]
4. What will be the distance of closest approach of a 5 MeV proton as it approaches a gold nucleus?  
[Ans. :  $4.55 \times 10^{-14}$  m]
5. A 12.5 MeV alpha – particle approaching a gold nucleus is deflected by  $180^\circ$ . What is the closest distance to which it approaches the nucleus?  
[Ans. :  $1.82 \times 10^{-14}$  m]
6. Determine the speed of the electron in  $n = 3$  orbit of hydrogen atom.[Ans. :  $7.29 \times 10^5$  ms $^{-1}$ ]
7. There are  $4\sqrt{2} \times 10^6$  radioactive nuclei in a given radio active element. If half life is 20 seconds, how many nuclei will remain after 10 seconds?  
[Ans. :  $4 \times 10^6$ ]
8. The half life of a radioactive substance is 5 hours. In how much time will 15/16 of the material decay?  
[Ans. : 20 hours]

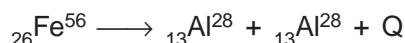
9. At a given instant, there are 25% undecayed radioactive nuclei in a sample. After 10 seconds, the number of undecayed nuclei reduces to 12.5%. Calculate the mean life of nuclei.

[Ans. : 14.43]

10. Binding energy of  ${}_2\text{He}^4$  and  ${}_3\text{Li}^7$  nuclei are 27.37 MeV and 39.4 MeV respectively. Which of the two nuclei is more stable? Why? [Ans. :  ${}_2\text{He}^4$  because its BE/nucleon is greater]

11. Find the binding energy and binding energy per nucleon of nucleus  ${}_{83}\text{B}^{209}$ . Given : mass of proton = 1.0078254 u. mass of neutron = 1.008665 u. Mass of  ${}_{83}\text{B}^{209}$  = 208.980388u. [Ans. : 1639.38 MeV and 7.84 MeV/Nucleon]

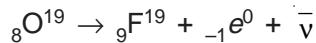
12. Is the fission of iron ( ${}_{26}\text{Fe}^{56}$ ) into ( ${}_{13}\text{Al}^{28}$ ) as given below possible?



Given mass of  ${}_{26}\text{Fe}^{56}$  = 55.934940 and  ${}_{13}\text{Al}^{28}$  = 27.98191 U

[Ans. : Since Q value comes out negative, so this fission is not possible]

13. Find the maximum energy that  $\beta$ -particle may have in the following decay :



Given

$$m({}_{8}\text{O}^{19}) = 19.003576 \text{ a.m.u.}$$

$$m({}_{9}\text{F}^{19}) = 18.998403 \text{ a.m.u.}$$

$$m({}_{-1}e^0) = 0.000549 \text{ a.m.u.}$$

[Ans. : 4.3049 MeV]

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# ANSWERS

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## ANSWER OF 1 MARK QUESTIONS

1. An a.m.u. is  $1/12$  of the mass of a carbon isotope  $^{12}\text{C}_6$ ,  $1\text{u} = 931 \text{ MeV}$ .
2. Rutherford's model of atom failed to explain the existence of sharp lines in hydrogen spectrum.
3. Lyman series.
4. The energy carried away by photon while electron jump from higher stationary state to lower stationary state is ' $h\nu$ ' and equal to the decrease in the energy of the atom.  $h\nu = E_f - E_i$
5. No. of electrons = 91, No. of neutrons =  $236 - 92 = 144$ .
6. Lyman series.
7. By strong nuclear forces which are much stronger than coulomb force but inside the nucleus only (i.e., very short range).
8. The decay constant of radioactive substance is defined as the reciprocal of that time in which the number of atoms of substance becomes  $\frac{1}{e}$  th times the atoms present initially.
9. Fusion reaction.
10.  $\alpha$ -particle.
11. (i) Positive charge is concentrated in the nucleus.  
(ii) size of nucleus is very small in comparison to size of atom.
12.  $R_1/R_2 = (A_1/A_2)^{1/3}$
13.  $P = 0$ ,  $Q = 1$ , X is a positron ( $_{+1}\text{e}^0$ ).
14. Binding energy of  ${}_2^4\text{He}$  is more than neutron ( ${}_1\text{H}^2$ ), So,  ${}_2^4\text{He}$  is more stable.
15.  $180^\circ$ .
16. 9.
17. Four times  $\therefore R = -\lambda N$ .
18.  ${}^{206}\text{Pb}$ .
19. 6.
20. Only fixed two orbits are involved and therefore single energy value.
21. Slow neutron stays in the nucleus for required optimum time and disturbs the configuration of nucleus.

## HINTS / SOLUTIONS OF 2 MARKS QUESTIONS

1. It will be halved.
2. Using the relation  $R = R_0 A^{1/3}$ .

$$\frac{R_1}{R_2} = \left( \frac{A_1}{A_2} \right)^{1/3} \quad \frac{\frac{4\pi}{3} R_1^3}{\frac{4\pi}{3} R_2^3} = \frac{A_1}{A_2} \text{ or } \frac{\frac{4}{3} \pi R_1^3}{A_1} = \frac{\frac{4}{3} \pi R_2^3}{A_2}$$

Hence nuclear density of 1st element = Nuclear density of 2nd element.

3. (i) Similar to x-rays —  $\gamma$ -rays.  
 (ii)  $\alpha$ -particle.  
 (iii)  $\gamma$ -rays.  
 (iv)  $\beta$ -particle.
4. Nuclear radioactive waste will hang like a cloud in the earth atmosphere and will absorb sun radiations.
5. The total binding energy of nuclei on two sides need not be equal. The difference in energy appears as the energy released or absorbed.
6.  $n = 2$  as  $r_n \propto n^2$
7. From relation  $\frac{N}{N_0} = \left( \frac{1}{2} \right)^{t/T}$  when  $t = T/2$   

$$\frac{N}{N_0} = \left( \frac{1}{2} \right)^{1/2} \quad \text{or} \quad \frac{N}{N_0} = \frac{1}{\sqrt{2}} = \frac{100}{\sqrt{2}} = 70.9\%.$$
8.  $\theta$  is decreased.
9. Because radius of atom is very large than radius of nucleus.
10. Due to mass defect or different binding energies.
11. Decreases as number of neutrons decreases and number of protons increases.
12. To counter repulsive coulomb forces, strong nuclear force required between neutron-neutron, neutron-proton and proton-proton.
13. Increases :  $\because \frac{N-2}{P-2} > N/P$ .
14.  $N = N_0 e^{-\lambda t}$  differentiating both sides we get  $\frac{dN}{dt} = -\lambda N_0 e^{-\lambda t} = -\lambda N$  i.e., decay rate  

$$R = \frac{dN}{dt} = -\lambda N.$$

15. For fusion, temperature required is from  $10^6$  to  $10^7$  K. So, to carry out fusion for peaceful purposes we need some system which can create and bear such a high temperature.
16. Nuclear forces are short range forces (within the nucleus) and do not obey inverse square law while coulomb forces are long range (infinite) and obey inverse square law.

17.  $\left(\frac{A}{8A}\right) = \left(\frac{1}{2}\right)^{t/T_{1/2}}$

or  $\left(\frac{1}{2}\right)^3 = \left(\frac{1}{2}\right)^{t/3}$

or  $3 = \frac{t}{3}$

$\Rightarrow t = 9$  days.

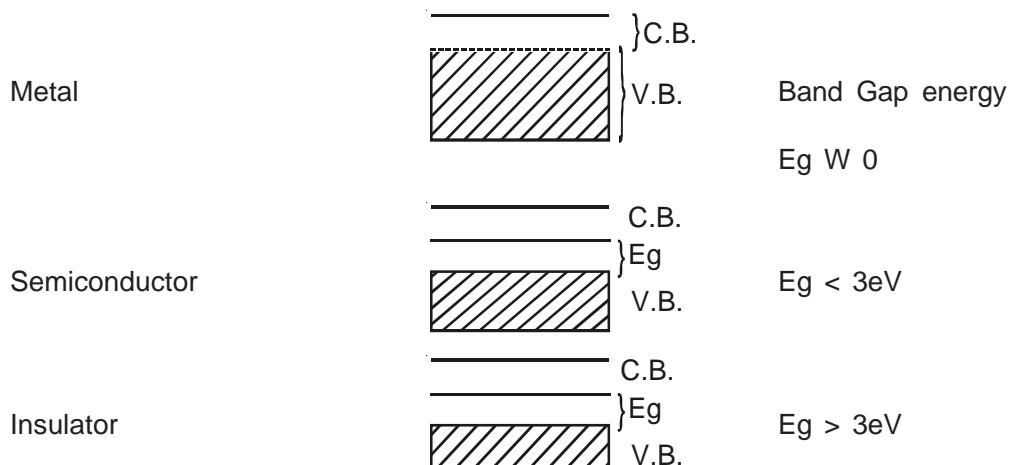
# ELECTRONIC DEVICES

## KEY POINTS

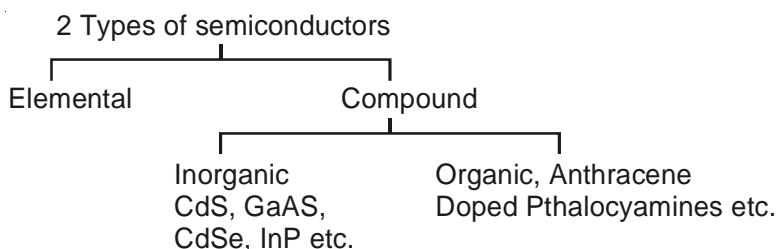
1. Solids are classified on the basic of

(i) Electrical conductivity	Resistivity	conductivity
Metals	$\rho(\Omega\text{m})$	$\sigma(\text{Sm}^{-1})$
	$10^{-2} - 10^{-8}$	$10^2 - 10^8$
Semiconductors	$10^{-5} - 10^6$	$10^{-6} - 10^5$
Insulators	$10^{11} - 10^{19}$	$10^{-19} - 10^{-11}$

(ii) Energy Bands



2. Types of Semiconductors



- In intrinsic semiconductors (Pure Si, Ge) carrier (electrons and holes) are generated by breaking of bonds within the semiconductor itself. In extrinsic semiconductors carriers (e and h) are increased in numbers by 'doping'.
- An intrinsic semiconductor at 0 K temperature behaves as an insulator.
- Pentavalent (donor) atom (As, Sb, P etc.) when doped to Si or Ge give *n*-type and trivalent (acceptor) atom (In, Ga, Al etc.) doped with Si or Ge give *p*-type semiconductor.

6. Net charge in *p*-type or *n*-type semiconductor remains zero.
7. Diffusion and drift are the two process that occur during formation of *p-n* junction.
8. Diffusion current is due to concentration gradient and direction is from *p* to *n* side drift current is due to electric field and its direction is from *n* to *p*-side.
9. In depletion region movement of electrons and holes depleted it of its free charges.
10. Because of its different behaviours in forward biasing (as conductor for  $V > V_b$ ) and reverse biasing (as insulator for  $V < V_B$ ) a *p-n* junction can be used as Rectifier, LED, photodiode, solar cell etc.
11. In half wave rectifier frequency output pulse is same as that of input and in full wave rectifier frequency of output is double of input.
12. When a zener diode is reverse biased, voltage across it remains steady for a range of currents above zener breakdown. Because of this property, the diode is used as a voltage regulator.
13. In a transistor current goes from low resistances (forward biasing) to high resistance (reverse biasing).
14. Current relationship in a transistor

$$I_e = I_b + I_c \quad (I_b \text{ is only } 2\% \text{ to } 8\% \text{ of } I_e)$$

15. In common emitter transistor characteristic we study

$I_b$  versus  $V_{BE}$  at constant  $V_{CE}$  (Input characteristic)

$I_c$  versus  $V_{CE}$  at constant  $I_B$  (output characteristic)

Input resistance  $r_i = \left( \frac{\delta V_{BE}}{\delta I_B} \right) V_{CE}$

Output resistance  $r_o = \left( \frac{\delta V_{CE}}{\delta I_C} \right) I_B$

16. Current amplifications factors

$$\beta_{ac} = \left( \frac{\delta I_c}{\delta I_b} \right) V_{CE}$$

$$\beta_{dc} = I_c/I_b.$$

$$\beta_{ac} \approx \beta_{dc}.$$

Both  $\beta_{ac}$  and  $\beta_{dc}$  vary with  $V_{CE}$  and  $I_B$  Slightly.

17. Transistor is used (i) as a switch in cut off and saturation state. (ii) as amplifier in active region.
18. In CE configuration, transistor as amplifier output differ in phase them input by  $\pi$ .
19. Transistor as an amplifier with positive feedback works as an oscillator.

20. Gates used for performing binary operations in digital electronics mainly consist of diodes and transistors.
21. NAND gates alone can be used to obtain OR gate and similarly a NOR gates alone cant be used to obtain AND gate, OR gate.

### **VERY SHORT ANSWER QUESTIONS (1 MARK EACH)**

1. Write the relation between number density of holes and number density of free electrons in an intrinsic semiconductor.
2. Write the value of resistance offered by an ideal diode when (i) forward based (ii) reverse biased.
3. Write any one use of (i) photodiode (ii) LED.
4. Write the truth table for a two input AND gate.
5. At what temperature does a semiconductor behave as an insulator?
6. Draw the circuit diagram to show use of a zener diode as voltage regulator.
7. If L and C are the inductance and capacitance of the tank circuit of an oscillator, what will be the frequency of oscillation?
8. Semiconductors do not support strong current *i.e.*, a semiconductor is damaged when strong current passes through it. Why?
9. Draw I-V characteristic of a solar cell.
10. What is the phase difference between input and output waveform in the common emitter transistor amplifier?
11. What type of feedback is required in an oscillator? Why?
12. What is the direction of diffusion current in a junction diode?
13. Draw a circuit diagram showing the biasing of a photodiode.
14. Name the semiconductor device that can be used to regulate an unregulated dc power supply.
15. Name the p.n. junction diode which emits spontaneous radiation when forward biased.
16. Name any one semiconductor used to make LED.
17. What is meant by ‘regulation’ as applied to a power supply?
18. A semiconductor device is connected in a series circuit with a battery and a resistance. A current is found to pass through the circuit. When polarity of the battery is reversed, the current drops to almost zero. Name the semiconductor device.

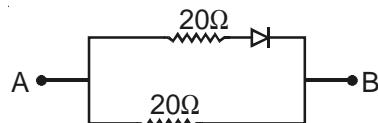
### **SHORT ANSWER QUESTION (2 MARKS EACH)**

1. If the frequency of the input signal is  $f$ . What will be the frequency of the output signal in case of:
  - (i) half wave rectifier?
  - (ii) full wave rectifier?

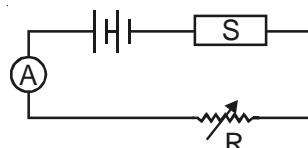
2. Find the equivalent resistance of the network shown in figure between point A and B when the p-n junction diode is ideal and :

(i) A is at higher potential

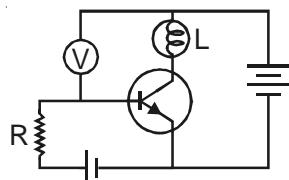
(ii) B is at higher potential



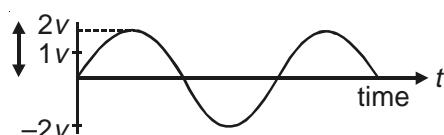
3. Potential barrier of p.n. junction cannot be measured by connecting a sensitive voltmeter across its terminals. Why?
4. Diode is a non linear device. Explain it with the help of a graph.
5. A *n*-type semiconductor has a large number of free electrons but still it is electrically neutral. Explain.
6. The diagram shows a piece of pure semiconductor S in series with a variable resistor R and a source of constant voltage V. Would you increase or decrease the value of R to keep the reading of ammeter A constant, when semiconductor S is heated? Give reason.



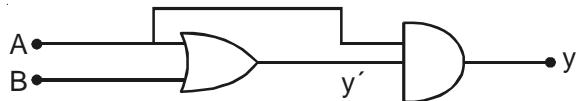
7. Transistor is termed as "transfer of resistor". How is it achieved in a transistor?
8. In the circuit shown in figure a voltmeter V is connected across lamp 'L'. What change would you observe in lamp and the voltmeter reading V, if the resistance R is reduced in value?



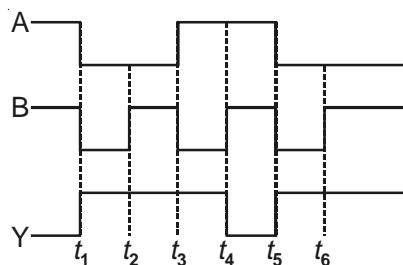
9. The gain of a transistor cannot be increased indefinitely by increasing load resistance. Why?
10. Power gain of a transistor is high. Does it mean the power is generated by the transistor itself? Explain.
11. What is the role of feedback in an oscillator circuit?
12. Why is a photo diode used in reverse bias?
13. Following voltage waveform is fed into half wave rectifier that uses a silicon diode with a threshold voltage of 0.7V. Draw the output voltage waveform.



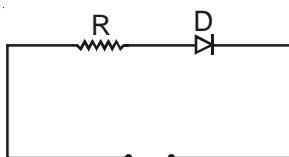
14. Explain the amplifying action of a transistor.
15. Draw a labelled circuit diagram of *n-p-n* transistor amplifier in CE-configuration.
16. The output of a 2 input AND gate is fed as input to a NOT gate. Write the truth table for the final output of the combination. Name this new logic gate formed.
17. Write the truth table for the combination of gates shown.



18. The following figure shows the input waveform 'A' and 'B' and output wave form Y of a gate. Write its truth table and identify the gate.

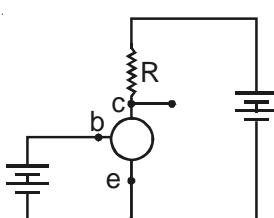


19. In the given circuit, D is an ideal diode. What is the voltage across R. When the applied voltage V makes the diode.
  - Forward bias?
  - Reverse bias?



20. A transistor is a current operated device. Explain.
21. Given here is a circuit diagram of a transistor as a NOT gate. Here the transistor has been represented by a circle with the emitter (e), base (b) and collector (c) terminals marked clearly. Carefully look at the polarity of the voltages applied and answer the following question.
  - What is the type of transistor *pnp* or *npn*?
  - Is the transistor in saturation or cutoff?

Give explanation for your answer.



### **SHORT ANSWER QUESTIONS (3 MARKS EACH)**

1. What is depletion region in *p-n* junction diode. Explain its formation with the help of a suitable diagram.
2. Explain the working of *npn* transistor as an amplifier and determine its voltage gain.
3. What is rectification? With the help of a labelled circuit diagram explain half wave rectification using a junction diode.
4. Explain the working of a transistor as a switch with the help of a suitable circuit diagram.
5. Using block diagram show the feedback in an oscillator.
6. With the help of a circuit diagram explain the V-I graph of a *p-n* junction in forward and reverse biasing.
7. With the help of a circuit diagram, explain the input and output characteristic of a transistor in common emitter configuration.
8. What is *p-n* junction? How is *p-n* junction made? How is potential barrier developed in a *p-n* junction?
9. What is a transistor? Draw symbols of *npn* and *pnp* transistor. Explain action of transistor.

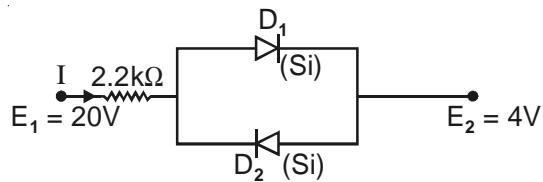
### **LONG ANSWER QUESTIONS (5 MARKS EACH)**

1. How does a transistor work as an oscillator? Explain its working with suitable circuit diagram. Write the expression for frequency of output.
2. What is the function of base region of a transistor? Why is this region made thin and lightly doped? Draw a circuit diagram to study the input and output characteristics of *npn* transistor in a common emitter configuration. Show these characteristics graphically.
3. What is *p-n* junction diode? Define the term dynamic resistance for the junction. With the help of labelled diagram, explain the working of *p-n* junction as a full wave rectifier.
4. What are logic gates? Why are they so called? Draw the logic symbol and write truth table for AND, OR and NOT gate.

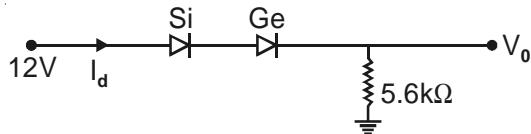
### **NUMERICALS**

1. In a *p-n* junction, width of depletion region is 300 nm and electric field of  $7 \times 10^5$  V/m exists in it.
  - (i) Find the height of potential barrier.
  - (ii) What should be the minimum kinetic energy of a conduction electron which can diffuse from the *n*-side to the *p*-side?
2. In an *npn* transistor circuit, the collector current is 10mA. If 90% of the electrons emitted reach the collector, find the base current and emitter current.
3. An LED is constructed from a *p-n* junction of a certain semiconducting material whose energy gap is 1.9eV. What is the wavelength of light emitted by this LED?

4. Determine the current  $I$  for the network. (Barrier voltage for Si diode is 0.7 volt).



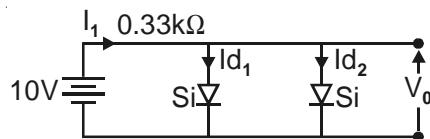
5. Determine  $V_0$  and  $I_d$  for the network.



6. A  $p-n$  junction is fabricated from a semiconductor with a band gap of 2.8 eV. Can it detect a wavelength of 600 nm? Justify your answer.

7. Determine  $V_0$ ,  $I_{d1}$  and  $I_{d2}$  for the given network. Where  $D_1$  and  $D_2$  are made of silicon.

$$(I_{d1} = I_{d2} = \frac{I_1}{2} = 14.09 \text{ mA})$$



8. Two amplifiers with voltage gain 10 and 20 are connected in series. Calculate the output voltage for an input signal of 0.01 volt. [Ans. : 2 volt]

9. A transistor has a current gain of 30. If the collector resistance is  $6\text{k}\Omega$  and input resistance  $1\text{k}\Omega$ . Calculate the voltage gain. [Ans. : 180]

10. If the current gain of a CE – Amplifier is 98 and collector current  $I_c = 4\text{mA}$ , determine the base current. [Ans. :  $I_b = 0.040\text{mA}$ ]

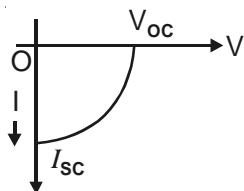
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# ANSWER3

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## VERY SHORT ANSWER TYPE QUESTIONS

1.  $n_e = n_h$ .
2. At 0 K semiconductors behave as an insulator.
7. Frequency of A.C.  $f = \frac{1}{2\pi\sqrt{LC}}$ .
8. Because bonds break up, crystal breakdown takes place and crystal becomes useless.
9. I – V characteristic of solar cell :

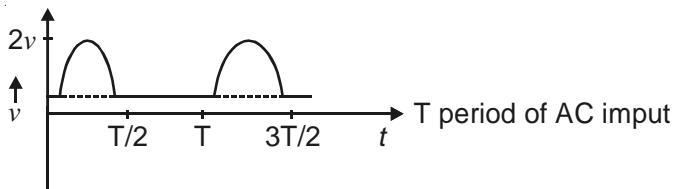


10. Phase difference between input and output waveform is  $\pi$  or  $108^\circ$ .
11. Positive feedback.
12. Direction of diffusion current is from P to N in a semiconductor junction diode.
15. Light emitting diode.
16. GaAs, GaP.
17.  $p-n$  junction diode.

## SHORT ANSWER QUESTIONS (2 MARKS EACH)

1. Frequency of output in half wave Rectifier is  $f$  and in full wave rectifier is  $2f$ .
2. Equivalent resistance is
  - (i)  $10\Omega$
  - (ii)  $20\Omega$
3. Because there is no free charge carrier in depletion region.
6. On heating S, resistance of semiconductors S is decreased so to compensate the value of resistance in the circuit R is increased.
7. By proper doping and Biasing.
12. Because in this case diode is sensitive and it gives very large amount of current in this situation.

13. Output waveform is :



18. Nand gate.

19. (a) V. (b) Zero

20. Change in  $I_c$  is related to  $I_b$  and not to the base voltage change.

21. (a) npn (ii) saturation

## NUMERICALS

1. (i)  $V = Ed = 7 \times 10^5 \times 300 \times 10^{-9} = 0.21 V$

(ii) Kinetic energy =  $eV = 0.21 \text{ eV}$

2. Emitter current  $I_e = \frac{10}{90} \times 100 = 11.11 \text{ mA}$

Base current  $I_b = I_e - I_c = 11.11 \text{ mA}$

4.  $I = \frac{E_1 - E_2 - V_d}{R} = \frac{20 - 4 - 0.7}{2.2 \times 10^3} = 6.95 \text{ mA}$

5.  $V_0 = E - V_{si} - V_{Ge} = 12 - 0.7 - 1.1 = 12 - 1.8 = 10.2 \text{ V}$

$$I_d = \frac{V_0}{R} = \frac{10.2}{5.6 \times 10^3} = 1.82 \text{ mA.}$$

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# COMMUNICATION

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## KEY POINTS

- Communication is the faithful transfer of message from one place to another.
- A communication system consists of three basic elements.



- **Transmitter** : An equipment which converts the information data into electrical signal.
- A transmitter consists of
  - (i) Transducer or Converter
  - (ii) Modulator
  - (iii) Carrier Oscillator
  - (iv) Transmitting Antenna
- **Channel** : It is the medium through which the electrical signals from the transmitter pass to reach the receiver.
- **Receiver** : An equipment which receives and retrieves information from the electrical signals.
- A Receiver section consists of
  - (i) Receiver Antenna
  - (ii) Transducer/Converter
  - (iii) Demodulator
- Two important forms of communication system are **Analog** and **Digital**. In Analog communication, the information is in analog form.
- In Digital communication, the information has only discrete or quantised values.
- Modulation is a process by which any electrical signal (called input, baseband or modulating signal) of low frequency is mounted on to another signal (carrier) of high frequency.
- Need of Modulation :
  - (i) To avoid interference between different base band signals.
  - (ii) To have a practical size of antenna.
  - (iii) To increase power radiated by antenna.
- **Demodulation** : It is a process by which a base band signal is recovered from a modulated wave.
- **Amplitude Modulation** : In this type of modulation, the amplitude of carrier wave is varied in accordance with the information signal, keeping the frequency and phase of carrier wave constant.
- **Bandwidth** : Bandwidth is the range of frequencies over which an equipment operates.
- Space communication uses free space between transmitter and receiver for transfer of data/information.

- **Ground Wave :** These are the waves radiated by antenna that travel at zero or lower angle with respect to earth surface. They are heavily absorbed by earth surface and not suitable for long range communication.
- **Space Wave :** These are the waves that travel directly through space between transmitting and receiving antennas. The space waves are within the troposphere region of atmosphere and have two **Modes of Transmission :**
  - (i) Line of sight communication
  - (ii) Satellite communication

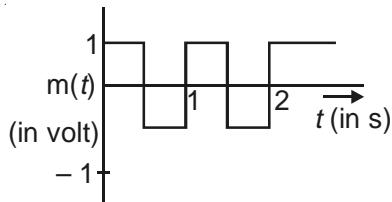
## QUESTIONS

### VERY SHORT ANSWER (1 MARK EACH)

1. What are ground waves?
2. What are the two basic modes of communication?
3. On what factors does the maximum coverage range of ground wave communication depend?
4. What is a base band signal?
5. What is the least size of an antenna required to radiate a signal of wavelength  $\lambda$ ?
6. Why do we use high frequencies for transmission?
7. Why is ionisation low near the earth and high far away from the earth?
8. What is modulation index?
9. What is ‘noise’?
10. What should be the length of dipole antenna for a carrier wave of frequency  $2 \times 10^6$  Hz?
11. Why is the transmission of signals using ground wave communication restricted to a frequency of 1500 kHz?
12. What is meant by transducer? Give one example of a transducer.
13. A T.V. transmitting antenna is 81m tall. How much service area can it cover if the receiving antenna is at ground level?
14. What is an analog signal? Give an example.
15. What is a digital signal? Give an example.

## **SHORT ANSWER QUESTIONS (2 MARKS EACH)**

1. A modulating signal is a square wave as shown in figure.



The carrier wave is given by  $C(t) = 2 \sin (8\pi) \text{ volts}$  :

- (i) Sketch the amplitude modulated waveform.
- (ii) What is the modulation index?
2. Write two differences between point to point communication and broadcast mode of communication.
3. An audio signal of amplitude one fourth of the carrier wave, is used in amplitude modulation. What is the modulation index?
4. What are the essential components of a communication system? Explain with the help of a Block diagram.
5. Explain by a diagram, how space waves are used for Television broadcast.
6. Draw amplitude modulated and frequency modulated waves to clearly bring out the difference between them.
7. Why do we need modulation (give two reasons)?
8. Give two reasons for using satellite for long distance T.V. transmission.
9. Explain the propagation of sky wave in ionospheric layers with the help of a neat, labelled diagram.

## **SHORT ANSWER (3 MARKS EACH)**

1. With the help of Block Diagram show how an amplitude modulated wave can be demodulated.
2. How an amplitude modulated wave can be produced? Give the equation of amplitude modulated wave.
3. What is amplitude modulation? Derive the equation of an amplitude modulated wave.
4. What are the different ways of propagation of radiowaves? Explain briefly.

## **NUMERICALS**

1. A sinusoidal carrier wave of frequency 1.5 MHz and amplitude 50 volt is amplitude modulated by sinusoidal wave of frequency 10 kHz producing 50% modulation. Calculate the frequency (i) amplitude; (ii) frequencies of lower and upper side bands.

Lower side band = 1490 kHz  
Upper side band = 1510 kHz  
Amplitude = 125 volt

2. An amplitude modulator consist of L-C circuit having a coil of inductance  $8\text{mH}$  and capacitance of  $5\text{pF}$ . If an audio signal of frequency  $10\text{kHz}$  is modulated by the carrier wave generated by the L-C circuit, find the frequency of upper and lower side bands.  
**[Ans.**  $f_c = 7.96 \times 10^5 \text{ Hz}$ ; Lower side band =  $786 \text{ kHz}$ ; Upper side band =  $806 \text{ kHz}$ **]**

3. A T.V. Tower has height of  $70\text{m}$ .

  - How much population is covered by the T.V. broadcast if the average population density around the tower is  $1000\text{km}^{-2}$ ? Radius of earth is  $6.4 \times 10^6 \text{ m}$ .
  - By How much should the height of the tower be increased to double the coverage area?  
**[Ans. :** Population covered =  $28.16 \text{ lacs}$ ; Change in height =  $70\text{m}$ **]**

4. A communication system is operating at wavelength  $\lambda = 750 \text{ nm}$ . If only 1% of the frequency is used as channel bandwidth for optical communication then find the number of channels that can be accommodated for transmission of

  - an Audio signal requiring a bandwidth of  $8 \text{ kHz}$ .
  - an Video T.V. signal requiring a bandwidth of  $4.5 \text{ KHz}$ .

## **ANSWERS (1 MARK QUESTIONS)**

1. Wave travelling at zero or lower angle with the earth surface.
  2. (i) Point to point (ii) Broadcast.
  3. Transmitted power and frequency.
  5. Antenna size is about wavelength.
  6. High frequency means low wavelength and hence smaller size of antenna.
  7. (i) Far away from earth few molecules are present. (ii) At lower height solar radiation intensity is low.
  9. Noise is unwanted signal which disturbs the transmission and processing of message.
  10. 150 m.
  11. Attenuation increases with frequency.
  12. Device that converts one form of energy into another form. Example – Microphone, Loudspeaker.
  13.  $A = \pi d^2$ , where  $d = \sqrt{2hR_e}$   $\Rightarrow$  service area  $A = 2\pi h R_e$
  14. Analog signals are continuous variation of voltage or current. They are single valued function of time.
  15. Digital signals are those which can take only discrete values.

## Class XII

# PHYSICS

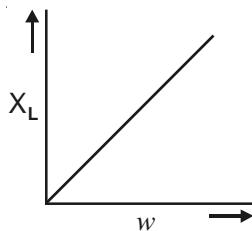
### SAMPLE PAPER – I

Time Allowed : 3 hours

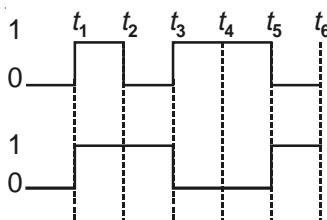
Maximum Marks : 70

Note : Attempt All questions. Marks allotted to each question are indicated against it.

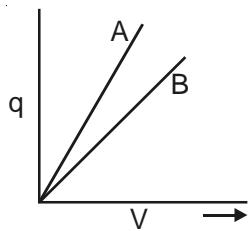
1. Name the physical quantity given by the slope of the graph shown below. What is its S.I. Unit?



2. Two point charges  $r$  distance apart in air repel each other with force  $F$ . When taken in a medium with distance  $r/2$  between them the force is still found to be  $F$ . What is the dielectric constant of the medium? 1
3. A proton and a deuteron having equal momenta enter a uniform magnetic field  $B$  perpendicular to its direction. Compare radii of their trajectories. 1
4. Name the device used for producing microwaves. 1
5. A double concave lens of refractive index  $\mu_1$  has been immersed in a liquid of refractive index  $\mu_2$  ( $\mu_2 > \mu_1$ ). What change, if any, would occur in its nature? 1
6. Kinetic energies of an  $\alpha$ -particle and of a proton are equal. Which of them has higher value of de-Broglie wavelength? 1



7. Input waveforms in an OR gate is as shown in Fig. above. What is the output waveform? 1
8. What is the direction of (i) diffusion current (ii) drift current in a  $p-n$  junction? 1
9. Charge versus potential difference graphs for two capacitors A and B are as shown : 1
- (i) Which of the them has larger capacitance and



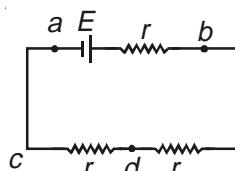
- (ii) for a given P.D. which of them would store larger amount of electrostatic potential energy? 1, 1
10. Calculate temperature at which resistance of a conductor becomes 10% more of its resistance at 27°C. The value of temperature coefficient of resistance of the conductor is  $2 \times 10^{-3} \text{ K}^{-1}$ . 2
11. A circular current loop has radius  $r$  and current flowing in it is  $I$ . Find distance of a point on its axis measured from centre where magnetic field is one eighth of its value at the centre. 2
12. A rectangular conducting loop of  $N$  turns, each of area  $A$  and total resistance  $R$  is rotated in uniform magnetic field about an axis passing through centre and parallel to longer side. If the number of rotations made per seconds is  $n$ , find maximum value of (i) induced emf. and (ii) induced current in the loop. 1, 1
13. Define EMF of a cell. When is the terminal voltage across a source (i) greater than EMF (ii) zero. 1, 1

**OR**

What will be reading in an ideal voltmeter across :

(i) ab

(ii) cd



14. Name the radiations used :

(i) to kill germs in impure water

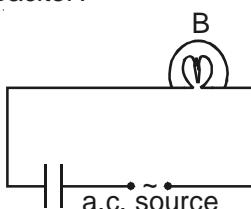
(ii) in the study of crystal structure

(iii) in T.V. communication

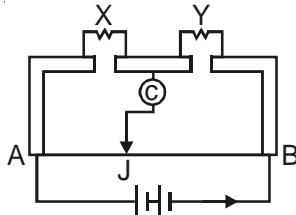
$\frac{1}{2} \times 2$

Which of these radiations has highest frequency?

15. What is an ideal diode? Frequency of a.c. input for rectification is 48 Hz. What is the frequency of output if rectifier is (i) Half wave (ii) Full wave? 2
16. A bulb B, a capacitance C and a.c. source of rms voltage  $V$  have been connected in series. How will brightness of bulb be affected if (i) frequency of a.c. is increased (ii) dielectric slab is introduced between plates of capacitor? 2



17. A message signal of frequency 10 kHz and peak voltage 10 volt is used to modulate a carrier of frequency 1 MHz and peak voltage of 20 volt. Determine (i) the modulation index (ii) the side band produced. 2
18. A parallel beam of light of wavelength 560 nm is incident on a slit of width 1mm. Find (i) angular width and (ii) linear width of principal maxima in the resulting diffraction pattern on screen kept 1.4 m away. 2
19. Define resolving power of an optical device. How will the R.P. of a telescope be changed if (i) diameter of objective is increased (ii) yellow light is replaced by green light? 3
20. Photons of certain frequency and intensity are incident on a surface of work function  $W_0$ . Kinetic energy of emitted electrons and photoelectric current are  $E_k$  and  $I$  respectively. For photons of 50% higher frequency, find (i) kinetic energy of emitted electrons (ii) photoelectric current. 3
21. State Huygen's Postulates. Draw diagrams to show the refracted wavefront from a convex lens if point source is (i) at  $2F$  (ii) at  $F$ . 3
22. When a circuit element X is connected across a.c. source, current of  $2A$  flows in phase with the a.c. voltage. For another element Y same current of  $2A$  lags in phase by  $\pi/2$  with the voltage.  
 (i) Name the element X and Y.  
 (ii) What is the current in the circuit if X and Y are in series across the same a.c. source?  
 (iii) What is the phase by which voltage V differs current I? 3
23. In the given figure balancing length AJ is 55 cm. When a resistance of  $20\Omega$  is connected in parallel to Y, balancing length shifts by 5cm towards B. If  $20\Omega$  resistance is connected in series with Y what will be the balancing length?  $AB = 100$  cm.



**OR**

State the principle of potentiometer. Two cells of EMF  $E_1$  and  $E_2$  are connected in the manner (a) and (b). Balancing points for (a) and (b) on potentiometer wire are at 356 cm, and 71.2 cm respectively. Calculate the ratio of EMF of two cells.

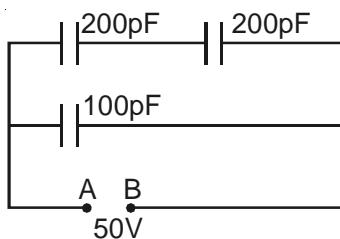


24. Define the decay constant of a radioactive substance. Half life of radioactive substance is  $T$ , initial concentration  $N_0$  and at instants  $t_1$  and  $t_2$  concentrations are  $N_1$  and  $N_2$  respectively. Find concentration at time  $(t_1 + t_2)$ . 3
25. What is meant by 'detection'? Draw the block diagram of a detector for AM signal. 3

26. State Bohr's postulates for the permitted state of electron in hydrogen atom. Energy of an electron in a hydrogen like atom is  $-\frac{54.4}{n^2}$  eV. Calculate kinetic and potential energies of electron in first excited state of the atom. 3
27. In a transistor, doping level in base is increased slightly. Then how will it affect (i) collector current? (ii) base current. In a transistor as amplifier current gain is 64. The base current is changed by  $20\mu\text{A}$ . Find change in emitter current and collector current. 3
28. Obtain an expression for electrostatic energy stored in a capacitor of capacitance C charged to a potential difference V.

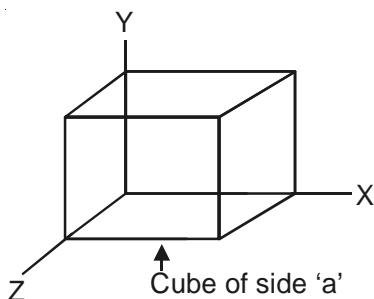
Calculate charge and energy in equivalent capacitor across AB.

5



**OR**

State Gauss' Law in electrostatics. Obtain an expression for electric field intensity E due to this charged sheet of large dimensions at a point near it. Given electric field in the region  $\vec{E} = 2x\hat{i}$ . Find (i) net electric flux through the cube (ii) charge enclosed by it. Side of the cube is 'a'.



29. Draw a diagram to depict the behaviour of magnetic field lines near a bar of (i) Aluminium (ii) Niobium lead at 90K.

At a place, horizontal component of earth's magnetic field is  $\frac{1}{\sqrt{3}}$  times the vertical component and total intensity of earth's field is 4G. Find (iii) angle of dip (iv) vertical component of earth's magnetic field. 5

**OR**

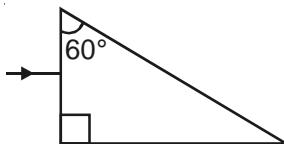
Draw a labelled diagram of moving coil galvanometer. What is the significance of radial magnetic field used in it?

A galvanometer can be converted into an ammeter to measure upto a current I by connecting resistance  $S_1$  in parallel and upto  $2I$  by connecting resistance  $S_2$  in parallel of the galvanometer.

Find resistance  $S$  in terms of  $S_1$  and  $S_2$  that should be connected in parallel of galvanometer to convert it into ammeter to read current upto  $I/2$ .

30. Complete the path of light in the adjoining figure. Give the required mathematical explanation. Given refracting index of material of prism is  $\sqrt{2}$ . In an equiangular prism, angle of incidence equals angle of emergence and are  $45^\circ$  each. Find (i) angle of deviation (ii) refractive index of material of prism.

5.



OR

With the help of a labelled diagram show image formed by a compound microscope. Derive expression for its magnifying power when final images is at near point. How is magnifying power changed on increasing (i) diameter of objective lens (ii) the focal length of the objective lens?

## Marking Scheme

# SAMPLE PAPER – I

1. Physical quantity is ‘Self Inductance’. S.I. unit Henery.
2. Force between two point charge  $q_1$  and  $q_2$ .

$$F = \frac{1}{4\pi\epsilon_0} \frac{q_1 q_2}{r^2} = \frac{1}{4\pi\epsilon_0 K} \frac{q_1 q_2}{(r/2)^2}$$

$\Rightarrow$  Dielectric constant  $K = 4$ .

3. Radius of circulator trajectory in a magnetic field  $r = \frac{mv}{Bq} r \times \frac{1}{q}$

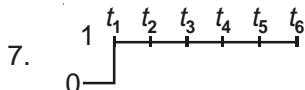
$$\therefore \boxed{\frac{r_{proton}}{r_{deuton}} = \frac{q_d}{q_p} = \frac{e}{c} = 1} \quad \text{Given } b_{proton} = b_{deuton}.$$

4. Klystron valve or magnetron valve.
5. Nature of lens in the medium will change from concave to convex. ( $\mu_2 > \mu_1$ ).

6. de-Broglie wavelength  $\lambda = \frac{h}{mv} = \frac{h}{\sqrt{2mE_x}}$

Given  $E_{k_\alpha} = E_{k_{proton}}$

$$\therefore \frac{\lambda_\alpha}{\lambda} = \sqrt{\frac{m_{proton}}{m_\alpha}} = \sqrt{\frac{m}{4m}} = \frac{1}{2}.$$



8. Diffusion current due to concentration gradient is  $p$  to  $n$  and drift current due to electric field from  $n$  to  $p$  side across the junction.
9. (i) Capacitance  $C = q/V =$  slope of  $q - v$  graph which is greater for B  
 $\therefore C_B > C_A$

- (ii) Electrostatic potential energy

$$U_E = \frac{1}{2} CV^2$$

$U_E \propto C$  for given P.D.

$\therefore C_B > C_A \quad \therefore U_B > U_A$

10. Resistance of a conductor as a function of temperature  $R_2 = R_1 (1 + \alpha \Delta t)$  (1)

where  $\Delta t = t_2 - t_1$  tem. difference.

Given  $R_2 = R_1 + 10\% R_1 = 1.1 R_1$

$$\therefore \text{From (1)} \quad 1.1 R_1 = R_1 (1 + \alpha \Delta t)$$

$$\Delta t = \frac{1}{\alpha} = \frac{.1}{2 \times 10^{-3}} = 50$$

$$t_2 - 27 = 50$$

$$t_2 = 77^\circ\text{C.}$$

$$11. \quad B_{\text{axial}} = \frac{B_0}{8}.$$

$$\frac{\mu_0 I r^2}{2(r^2 + x^2)^{3/2}} = \frac{1}{8} \frac{M_0 I}{2r}$$

$$\Rightarrow x = \sqrt{3}r.$$

12. Maximum induced emf in the loop

$$e_{\max} = NBA\omega$$

(loop is parallel to B momentarily)

$$\text{Maximum current } I_{\max} = \frac{e_{\max}}{R} = \frac{NBA\omega}{R}.$$

13. Correct definition of emf.

Terminal voltage (i)  $V > \epsilon$  during charging

(ii) Zero during short circuiting.

## OR

Current in the circuit

$$I = \frac{\epsilon}{r + r + r} = \frac{\epsilon}{3r}$$

$$\therefore \text{(i)} \quad V_{ab} = \epsilon - Ir = \epsilon - \frac{\epsilon}{3r} \cdot r = 2/3 \epsilon$$

$$\text{(ii)} \quad V_{cd} = Ir = \frac{\epsilon}{3r} \cdot r = \epsilon/3.$$

14. (i) UV radiations

(ii) X-rays.

(iii) Microwaves.

Highest frequency of X-rays.

15. Diode that has zero resistance in forward biasing and infinite resistance in reverse biasing.

(i) Frequency of output in half wave rectifier =  $v = 48$  Hz

(ii) In full wave rectifier frequency of output =  $2v = 96$  Hz.

16. Brightness of bulb depends on current ( $I$ ) in it ( $P \propto I^2$ )

$$\text{where } I = \frac{V}{Z}$$

$Z \rightarrow$  impedance of circuit

$$Z = \sqrt{X_C^2 + R_b^2} \quad R_b \rightarrow \text{resistance of bulb.}$$

$$X_C = \frac{1}{\omega C} = \frac{1}{2\pi v C}$$

17. (i) At higher frequency  $X_C$  is small  $\therefore Z$  is also small and current is large.  
 $\therefore$  brightness of bulb is more.

(ii) Also  $X_C \propto \frac{1}{C}$   $C = \frac{K\epsilon_0 A}{d}$ .

When dielectric is introduced  $X_C$  decreases,  $Z$  decreases current  $I$  increases  $\therefore$  brightness in the bulb also increases.

17. (i) Modulation index  $\mu = \frac{A_m}{A_c} = \frac{10}{20} = .5$

$A_m \rightarrow$  amplitude of modulating wave

$A_c \rightarrow$  amplitude of carrier wave.

(ii) Side band produced  $= V_c \pm V_m$   
 $= 1 \text{ MHz} \pm 10 \text{ kHz}$   
 $= 1 \text{ MHz} \pm 0.1 \text{ MHz}$   
 $= 1.01 \text{ MHz}$  and  $0.99 \text{ MHz}$ .

18. (i) Angular width of principle maxima in single slit diffraction pattern

$$B_0 = \frac{2\lambda}{a} = \frac{2 \times 560 \times 10^{-9}}{1 \times 10^{-3}}$$
$$= 1.12 \times 10^{-3} \text{ radian.}$$

$$\begin{aligned}
 \text{(ii) Linear width} &= y_1 + y_1 = 1 \\
 &= 2y_1 = \frac{2\lambda D}{a} \\
 &= .12 \times 10^{-3} \times 1.4 \\
 &= 1.568 \times 10^{-3} \text{m} \\
 &= 1.568 \text{ mm}.
 \end{aligned}$$

19. Resolving power of a device is the ability of the device to resolve two nearby objects.

R.P. of a telescope  $= \frac{1}{\theta}$ . where  $\theta \rightarrow$  angular limit of resolution.

$$\theta = \frac{1.22\lambda}{a}$$

$a \rightarrow$  diameter of objective lens

$\lambda \rightarrow$  wavelength object used.

$$\text{(i)} \Rightarrow \text{R.P.} \propto a$$

$\therefore$  R.P. increases

$$\text{(ii) Also } \text{R.P.} \propto \frac{1}{\lambda} \quad \lambda_{\text{green}} < \lambda_{\text{yellow}}$$

$\therefore$  In green light R.P. is more than that in yellow light.

20. (i) Kinetic energy of photoelectrons

$$E_K = E - W_0 = h\nu - W_0 \quad (1)$$

$$E_K + W_0 = h\nu \quad (2) \nu \rightarrow \text{frequency of incident photon.}$$

$$\begin{aligned}
 E_K' &= h\nu' - W_0 \quad (3) \text{ where } \nu' = \nu + 50\% \text{ of } \nu \\
 &= 1.5 \nu
 \end{aligned}$$

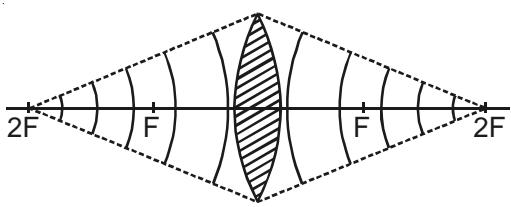
$$\begin{aligned}
 \therefore E_K &= h(1.5 \nu) - W_0 \\
 &= 1.5(E_K + W_0) - W_0 = 1.5 E_K + 0.5 W_0
 \end{aligned}$$

(ii) As Photoelectric current is independent of frequency

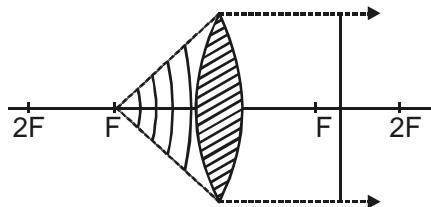
$$\therefore I' = I$$

21. Huygens Postulates – Two statements.

Refracted wave front when point source is (i) at 2F. (ii) at F.,



Refracted wavefront : Converging at  $2F$



Refracted wavefront is a plane wavefront.

- (i)  $V$  and  $I$  is phase in resistive circuit  $\therefore \times$  is resistor, and  $I$  lags by  $\pi/2$  is inductive circuit.

$\therefore y$  is inductor

$$(ii) R = \frac{V}{I} = \frac{V}{2}; \quad \text{Inductive reactance of } y;$$

$$X_L = \frac{V}{I} = \frac{V}{2}.$$

$$\text{Impedance of circuit} \quad Z = \sqrt{R^2 + X_L^2} = \frac{V}{2} \sqrt{2}$$

$$\therefore \text{Current} \quad I = \frac{V}{Z} = \frac{V}{\frac{V}{2} \sqrt{2}} = \frac{\sqrt{2}}{2} A$$

- (iii) Phase by which  $V$  differ current  $I$

$$\tan \phi = \frac{X_L}{R} = 1$$

$$\phi = \pi/4.$$

$$23. \quad \frac{X}{Y} = \frac{I}{100 - I} = \frac{55}{100 - 55} = \frac{11}{9}$$

when  $20\Omega$  resistor is connected in parallel with  $y$ .

$$\frac{X(20 + 4)}{20y} = \frac{60}{100 - 60} = 3/2 \quad (2)$$

and when  $20\Omega$  is in series with  $y$ .

$$\frac{X}{Y + 20} = \frac{I}{100 - I} \quad (3)$$

Solving (3) using (1) and (2) balancing length  $l = 18.5$  cm.

**OR**

On a uniform unit voltage drop is proportional to length of the wave.

In (a)  $(E_1 + E_2) \propto l_1 \Rightarrow \varepsilon_1 + \varepsilon_2 = kl_1$

$$\text{In (b)} \quad (\varepsilon_1 - \varepsilon_2) \propto l_2 \Rightarrow (\varepsilon_1 - \varepsilon_2) = k l_1$$

$$\Rightarrow \frac{\varepsilon_1 + \varepsilon_2}{\varepsilon_1 - \varepsilon_2} = \frac{l_1}{l_2} \Rightarrow \frac{\varepsilon_1}{\varepsilon_2} = \frac{l_1 + l_2}{l_1 - l_2} = 1.54$$

where  $l_1 = 356 \text{ cm}$ ,  $l_2 = 71.2 \text{ cm}$ .

24. Decay constant  $\lambda$  is the reciprocal of time in which concentration of a radioactive substance decreases to  $1/e$  times the initial concentration.

$$\text{Amount of radioactive substance left undecayed at time } t \text{ is } N = N_0 e^{-\lambda t} \quad (1)$$

$\therefore$  At instants  $t_1$  and  $t_2$  amounts are

$$N_1 = N_0 e^{\lambda t_1} \quad (2)$$

$$N_2 = N_0 e^{-\lambda t_2} \quad (3)$$

Amount of the substances at time  $(t_1 + t_2)$

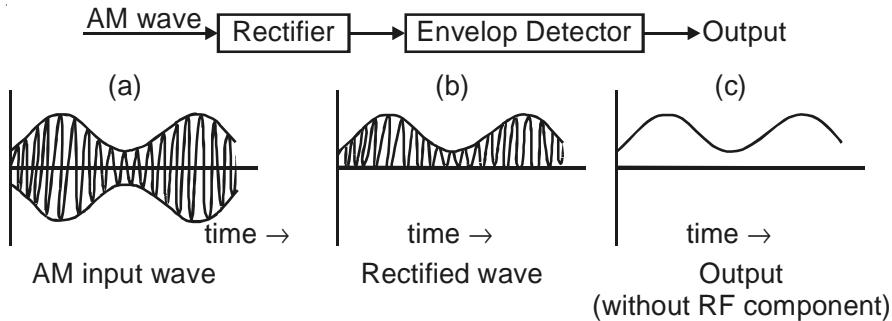
$$N = N_0 e^{\lambda(t_1+t_2)} \quad (4)$$

$$(2) \times (3) \text{ gives } N_1 N_2 = N_0^2 e^{-\lambda(t_1+t_2)}$$

$$= N_0 N$$

$$\Rightarrow \boxed{N = \frac{N_1 N_2}{N_0}}$$

25. 'Detection' is the process of recovering the modulating signal from the modulated carrier wave.



26. Bohr's Postulates – 1, 2 and 3.

$$\text{Energy of electron is H-like atom} \quad E_4 = -\frac{54.4}{n^2} \text{ eV}$$

In first excited state

$$n = 2.$$

Kinetic energy

$$E_K = -E = -\left(\frac{-54.4}{2^2}\right)$$

$$= 13.6 \text{ eV.}$$

Potential Energy

$$E_p = 2E = -2E_K = -27.2 \text{ eV.}$$

27. In a transistor current in emitter base and collector are related to each other as follows  
 $I_e = I_b + I_c$  when doping base is increased base current  $I_b$  increases and collector current decreases

Current Gain       $\beta = 64 = \frac{\delta I_c}{\delta I_b}$

Change in collector current  $\delta I_c = 64$

$$\delta I_b = 64 \times 20 \text{ mA}$$

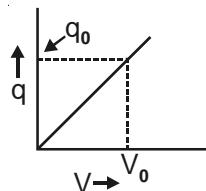
From the relation       $I_c = I_b + I_e$

change in emitter current       $\delta I_e = \delta I_b + \delta I_c$

$$= 20 \text{ mA} + 1280 \text{ mA} = 1300 \text{ mC} = 1.3 \text{ mA}$$

28. Derive expression for electrostatic potential energy in capacitor as follows

$$q \propto V \quad \text{or} \quad q = CV \quad (1)$$



Area under  $qV$  graph gives

Work done in charging the capacitor = change in electrostatic potential energy.

$$\therefore U_f - U_i = \frac{1}{2} \text{ base} \times \text{height}$$

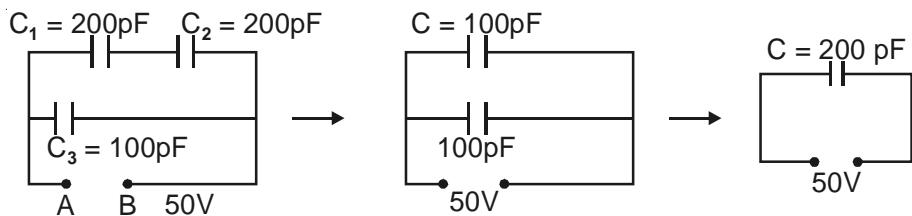
$$= \frac{1}{2} V_0 \cdot q_0 = \frac{1}{2} q_0 V_0 \quad (2)$$

From (1) in (2)  $U_f - U_i = \frac{1}{2} CV \cdot V$

$$U_i = 0 \quad U - 0 = \frac{1}{2} CV^2$$

$$U_f = U \quad \Rightarrow \quad \boxed{U = \frac{1}{2} CV^2}$$

Equivalent capacitance across AB.



$C_1$  and  $C_2$  in series which equals  $C'$ .

$C'$  is in parallel of  $C_3$ .

Charge on equivalent capacitors

$$q = C' V = 200 \times 50 = 10^{-8} \text{ coulomb}$$

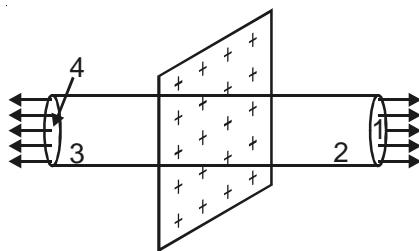
$$\begin{aligned} \text{Energy } U &= \frac{1}{2} C V^2 = \frac{1}{2} \times 200 \times 10^{-12} \times 50 \times 50 \\ &= 2.5 \times 10^{-7} \text{ J.} \end{aligned}$$

OR

Statement of Gauss Law.

Field intensity due to chain charged sheet of large dimensions

$\sigma \rightarrow$  Surface Charge Density



Charge enclosed by Gaussian surface

$$q = \sigma A. \quad (1)$$

Electric flux linked with the surface

$$\begin{aligned} \phi_E &= \phi_1 + \phi_2 + \phi_3 + \phi_4 = \int \vec{E} d\vec{A}_1 + \int \vec{E} d\vec{A}_2 + \int \vec{E} d\vec{A}_3 + \int \vec{E} d\vec{A}_4 \\ &= \int EdA_1 + 0 + 0 + \int EdA_4 = EA + EA = 2EA \end{aligned} \quad (2)$$

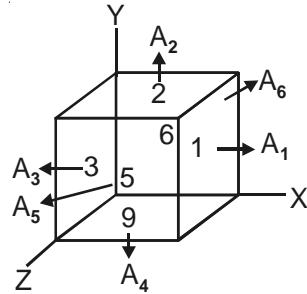
According to Gauss Law

$$\phi_e = \oint \vec{E} \cdot d\vec{A} = q/\epsilon_0$$

$$2EA = \frac{\sigma A}{\epsilon_0}$$

$$\Rightarrow \boxed{E = \frac{\sigma}{2\epsilon_0}}$$

$$\overrightarrow{E} = \frac{\sigma}{2\epsilon_0} \hat{n}$$



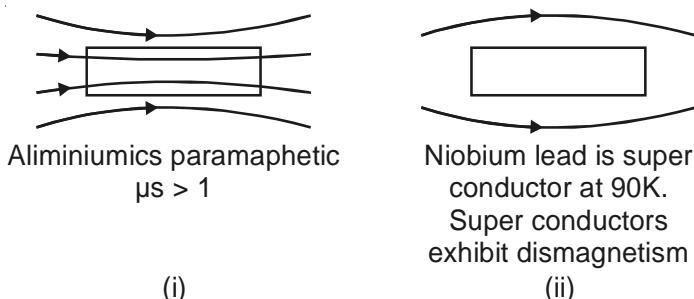
Electric flux linked with the cube

$$\begin{aligned}\phi_e &= \phi_1 + \phi_2 + \phi_3 + \phi_4 + \phi_5 + \phi_6 = \int \overrightarrow{E}_1 d\vec{A}_1 + \int \overrightarrow{E}_2 d\vec{A}_2 + \int \overrightarrow{E}_3 d\vec{A}_3 + \int \overrightarrow{E}_4 d\vec{A}_4 \\ &\quad + \int \overrightarrow{E}_5 d\vec{A}_5 + \int \overrightarrow{E}_6 d\vec{A}_6 \\ &= 2a \hat{i} \cdot a^2 \hat{i} + 0 + 0 + 0 + 0 + 0 = 2a^3\end{aligned}$$

Charge enclosed by the cube

$$q = \epsilon_0 \phi_e = \epsilon_0 2a^3.$$

29.



$$\text{Given horizontal component } B_H = \frac{1}{\sqrt{3}} B_V$$

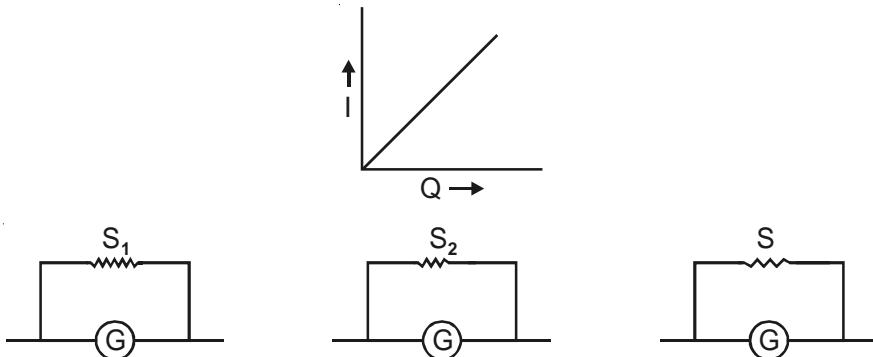
$B_V \rightarrow$  vertical component

$$\begin{aligned}\text{Angle of dip} \quad \theta &= \tan^{-1} \left( \frac{B_V}{B_H} \right) = \tan^{-1} (\sqrt{3}) = 60^\circ \\ &= .2 \times \sqrt{3} = .35 G\end{aligned}$$

**OR**

Labelled diagram of moving coil galvanometer. Then

In radial magnetic field torque on the loop remain maximum and hence the relation between current in the loop and deflection in it remains linear  $[I \propto \theta]$ .



- (i) Ammeter of range  $0 \rightarrow I$  (ii) Range  $0 \rightarrow 2I$ ; (iii) Range  $0 \rightarrow I/2$

If  $I_g$  be the current in (G) for full scale deflection then

$$S_1 = \left( \frac{I_g}{I - I_g} \right) G. \quad (1)$$

$$S_2 = \left( \frac{I_g}{2I - I_g} \right) G. \quad (2)$$

$$S = \frac{I_g}{\left( \frac{I}{2} - I_g \right)} \cdot G \quad (3)$$

$G \rightarrow$  resistances of (G)

$$\text{from (1)} \quad I_g G = S_1 (I - I_g) \quad (4)$$

Also solving (1) and (2) for  $I_g$

$$I_g = \frac{(2S_2 - S_1)}{S_2 - S_1} I \quad (5)$$

Using (4) and (3)

$$S = \frac{S_1 (I - I_g)}{I/2 - I_g}$$

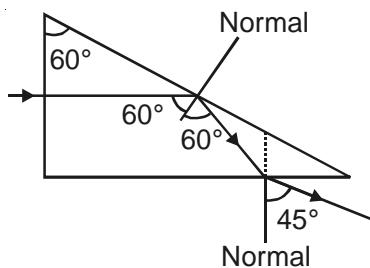
Solving

$$= \frac{2S_1 (I - I_g)}{(I - 2I_g)}$$

$$= \frac{2S_1 \left[ I - \frac{2S_2 - S_1}{(S_2 - S_1)} \right]}{I - 2I \frac{(2S_2 - S_1)}{(S_2 - S_1)}}$$

$$S = \left[ \frac{2S_2^2}{3S_2 - S_1} \right]$$

30.



Given refractive index of material of prism  $\mu = \sqrt{2}$

$$\therefore \text{Critical angle } i_c = \delta n^{-1} \left( \frac{1}{\mu} \right) = \delta n^{-1} \left( \frac{1}{\sqrt{2}} \right) = 45^\circ$$

On the face AB angle of incidence is greater than  $i_c$ .  $\therefore$  total internal reflection will occur on AB.

Whereas on the face OB angle of incidence is  $30^\circ$  ( $< i_c$ );  $\therefore$  there will be refractions on OB.

Angle of refractions  $r$  is given below

$$\frac{\sin i}{\delta n r} = 1/\mu \quad (\text{refraction is from dense to cases})$$

$$\frac{\delta n \sin 60}{\delta n i r} = \frac{1}{\sqrt{2}}$$

$$\Rightarrow r = 45^\circ$$

In equiangular prism angle of prism is  $60^\circ$

- (i) Also  $i = e = 45^\circ$  (Given)

$\therefore$  Deviation is given by

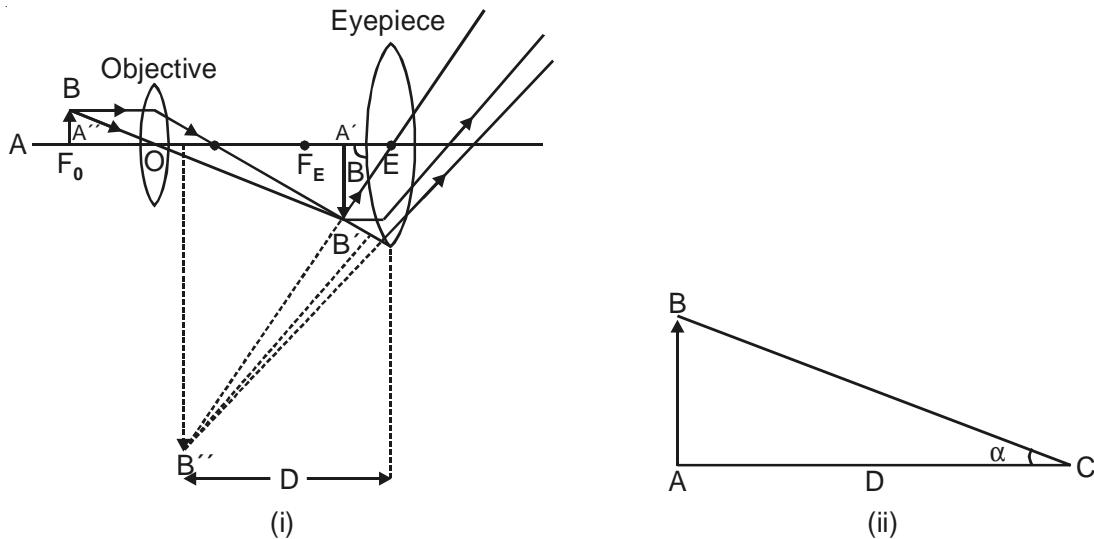
$$i + e = A + \delta$$

$$45 + 45 = 60 + \delta$$

$$\Rightarrow \delta = 30^\circ = \delta_m$$

(ii) Refractive index of material of prism

$$\mu = \frac{\sin \left( \frac{A + \delta_m}{2} \right)}{\sin \left( A/2 \right)} = \frac{\sin \left( \frac{60 + 30}{2} \right)}{\sin \left( 60/2 \right)} = \sqrt{2}.$$



$\alpha \rightarrow$  angle formed at the eye by the object AB held at distance D.

$\beta \rightarrow$  angle formed at the eye by the final image at near point.

$$\text{Magnifying power } M = \beta/\alpha \quad (1)$$

$$\beta \approx \frac{A''B''}{A''E} \quad (2)$$

$$\alpha = \frac{AB}{D} \quad (3)$$

Using (2) and (3) in (1)

$$M = \frac{\frac{A''B''}{A''E}}{\frac{AB}{D}} = \frac{A''B''}{AB} \quad (4) \quad (\because A''E = D)$$

$$= \left( \frac{A''B''}{A'B'} \right) \left( \frac{A'B'}{AB} \right)$$

$$M = m_e m_0 \quad (5)$$

$$m_0 = v_0/u_0 \quad (6)$$

$$M_e = 1 + D/f_e \quad (7)$$

(Simple Microscope)

(6) and (7) is (5) given

$$M = v_0/u_0 (1 + D/f_e) \quad (8)$$

For the maximum magnifying power  $u_0 \approx f_0$  and  $v_0 \approx L$  (length of Microscope tube)

$$\therefore M = \frac{L}{f_0} (1 + D/f_e) \quad (9)$$

- (i) No effect on magnifying power of change of diameter of objective lens.
- (ii) Magnifying power decreases with the increases in focal length of objects lens.

## Class XII

# SAMPLE PAPER – II

## PHYSICS

Time : 3 hours

Max. Marks : 70

### **General Instructions**

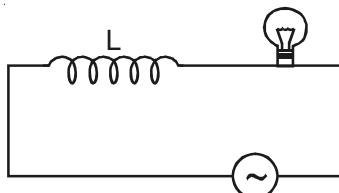
All questions are compulsory.

1. Draw the equipotential surfaces for two point charges each of magnitude  $q > 0$  placed at some finite distance? 1
2. A bar magnet of dipole moment  $M$  is cut into two equal parts along its axis. What is the new pole strength of each part. 1
3. A rod of length  $L$ , along East-West direction is dropped from a height  $H$ . if  $B$  be the magnetic field due to earth at that place and angle of dip is  $\delta$ , then what is the magnitude of induced emf across two ends of the rod when the rod reaches the earth? 1
4. Which characteristic of the following electromagnetic waves (i) increases (ii) remains same as we move along  $\gamma$ -radiation, ultraviolet rays, microwaves and radio waves? 1
5. Two polaroids are placed with their optic axis perpendicular to each other. One of them is rotated through  $45^\circ$  what is the intensity of light emerging from the second polaroid if  $I_0$  is the intensity of unpolarised light? 1
6. Sketch the graph showing the variation of applied voltage and photo electric current for (i) same frequency and two different intensities, and (ii) same intensity and two different frequencies. 1
7. A heavy nucleus splits into two lighter nuclei. Which one of the two – parent nucleus or the daughter nuclei have more binding energy per nucleon? 1
8. What happens to the width of depletion layer of a  $p-n$  junction diode when it is (i) forward biased (ii) reverse biased. 1
9. Four equal charges  $+q$ ,  $-q$  and  $+q$  are placed at the vertices  $P$ ,  $Q$  and  $R$  of an equilateral triangle of side ' $a$ '. What is the electric potential at the centre of the triangle? How will your answer change if position of charges at  $P$  and  $Q$  are interchanged? 2
10. What are ohmic and non-ohmic conductors? Give one example of each. Why can one not measure the resistance of a  $p-n$  junction is measured by using a voltmeter? 2
11. A charged particle enters a magnetic field perpendicular to it. The particle follows a zigzag path and comes out of it. What happens to its velocity and kinetic energy of the particle? Justify your answer. 2

12. Two solenoids each of length  $L$  are wound over each other.  $A_1$  and  $A_2$  are the areas of the outer and inner solenoids and  $N_1$  and  $N_2$  are the no. of turns per unit length of the two solenoids. Write the expressions for the self inductances of the two solenoids and their mutual inductance. Hence show that square of the mutual inductance of the two solenoids is less than the product of the self inductances of the two solenoids. 2
13. Why two equipotential surfaces do not intersect each other? A charge  $q_0$  is placed at the centre of a conducting sphere of radius  $R$ , what is the work done in moving a charge  $q$  from one point to other diametrically opposite along the surface of the sphere?
14. In an LCR circuit if frequency of the supply is made 4 times, how should the values of  $C$  and  $L$  be changed so that there is no change in the current in the circuit. 2

### OR

An inductor  $L$  of reactance  $X_L$  is connected in series with a bulb B to an ac source as shown in the figure. Briefly explain how does the brightness of the bulb change, when a capacitor of reactance  $X_C = X_L$  is included in series in the same circuit. Justify your answer.



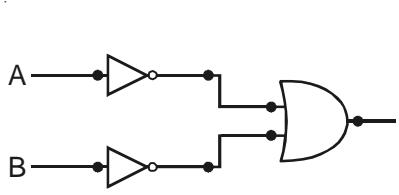
15. Arrange the following in ascending order of frequency X-rays, green light, red light, microwaves,  $\gamma$ -radiation. Which characteristic of the above waves is same for all? 2
16. A ray of light travels through an equilateral triangular prism at an angle of incidence  $i$  and emerges out at an angle of emergence  $e$  write the expression for the angle of deviation relating  $i$ ,  $e$  and  $A$  (angle of the prism). If the ray undergoes a minimum deviation of  $30^\circ$  then what is the refractive index of the material of the prism? 2
17. A radioactive material after 10 days reduces to 6.25%. If 40 g sample is taken then in how many days only 5g of the material is left? 2
18. What is ground wave communication? Why can it not be used for long distance using high frequency? 2
19. In young's double slit experiment the intensities of two interfering waves are  $I$  and  $4I$ . What are the maximum and minimum intensities in the interference pattern? 2
20. An electric dipole of moment  $p$  is placed in a uniform electric field  $E$ . Derive the expression for the potential energy of the dipole and show diagrammatically the orientation of the dipole in the field for which the potential energy is (i) maximum (ii) minimum. 3

### OR

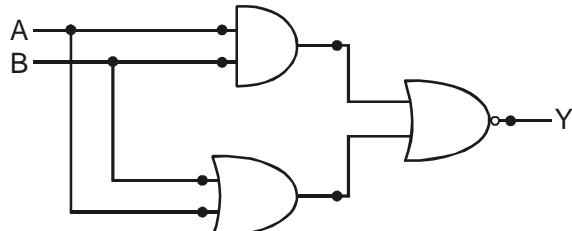
Two capacitors  $C_1$  and  $C_2$  are charged to potential  $V_1$  and  $V_2$  respectively and then connected in parallel. Calculate (i) common potential, (ii) charge on each capacitor, (iii) electrostatic energy in the system after connection.

21. Produced the truth table for the combination of gates shown in the figure.

3



(A)



(B)

22. What are the characteristics of the objectives lens of an objective lens of an astronomical telescope? Derive the expression for the magnifying power of astronomical telescope in normal adjustment.

3

23. Calculate the de-Broglie wavelength of (i) an electron accelerated by a potential difference of 100V and (ii) a particle of mass 0.03 kg moving with a speed of  $100\text{ms}^{-1}$ . Hence show that wavelength of the particle is not relevant.

3

24. Analytically show that e.m. waves are transverse in nature.

3

25. Name the series of hydrogen which does not lie in visible region?

The wavelength of first member of Lyman series is  $1216 \text{\AA}$ . Calculate the wavelength of third member of Balmer series.

3

26. The height of a transmission antenna is 600m find the area covered by the antenna in which the signal from the antenna can be received.

3

27. Draw the circuit diagram to draw the characteristics of common emitter *n-p-n* transistor. Also draw the input and output characteristics of the transistor.

3

28. Derive the formula for the equivalent emf and internal resistance of the parallel combination of the cells of emf  $E_1$  and  $E_2$  and internal resistance  $r_1$  and  $r_2$  respectively. Two cells of emf 1V and 2V and internal resistance  $2\Omega$  and  $1\Omega$  respectively connected in (i) series (ii) parallel. What should be the value of external resistance in the circuit so that the current through the resistance be the same in the two cases? In which case more heat is generated in the cells?

## OR

Two cells of emf 1.5V and 2.0V and internal resistance  $1\Omega$  and  $2\Omega$  respectively are connected in parallel so as to send current in the same direction through an external resistance of  $5\Omega$ . (a) Draw the circuit diagram. (b) Using Kirchhoff's laws, calculate current through each branch of the circuit and potential across the  $5\Omega$  resistance.

29. (i) Find an expression for the magnetic field at any point on the axis of a current carrying circular loop

5

- (ii) Two identical coils each of radius  $r$  and having number of turns  $n$  are lying in perpendicular planes, such that they have common centre. Find the magnetic field at the centre of the coils, if they carry currents equal to  $I$  and  $\sqrt{3}I$  respectively.

## OR

- (i) A beam of alpha particular and of protons, enter a uniform magnetic field at right angles to the field lines. The particles describe circular paths. Calculate the ratio of the radii two paths if they have same (a) velocity, (b) same momentum, (c) same kinetic energy.
- (ii) In hydrogen atom if in place of electron a negative particle of mass 200 times that of electron revolve around the nucleus, what would be the magnetic moment of particle in the ground state of an atom.
30. (i) Using the relation for the refraction at a single spherical refracting surface, derive lens maker's formula for a thin convex lens.
- (ii) The radius of curvature of either face of a convex lens is equal to its focal length. What is the refractive index of its material?

**OR**

- (i) Deduce the relationship between the object distance, image distance and the focal length for a mirror. What is the corresponding formula for a thin lens?
- (ii) Two lenses of powers +15D and -5D are in contact with each other forming a combination lens. (a) What is the focal length of this combination? (b) An object of size 3cm is placed at 30cm from this combination of lenses. Calculate the position and size of the image formed.

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# **PHYSICS (Theory)**

## **भौतिक विज्ञान (सैद्धान्तिक)**

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[Time Allowed : 3 hours]

½ hr 1 e; % 3 ?k V½

[Maximum Marks : 70]

½ f/k dre val % 70½

### **General Instructions**

- (i) All questions are compulsory.
- (ii) There are 30 questions in total. Questions 1 to 8 carry one mark each, questions 9 to 18 carry two marks each, questions 19 to 27 carry three marks each and questions 28 to 30 carry five marks each.
- (iii) There is no over all choice. However, an internal choice has been provided in one question of two marks, one question of three marks and all three questions of five marks each. You have to attempt only one of the given choice in such questions.
- (iv) Use of calculators is not permitted.
- (v) You may use the following physical constants wherever necessary.

$$c = 3 \times 10^8 \text{ ms}^{-1}$$

$$h = 6.626 \times 10^{-34} \text{ Js}$$

$$e = 1.602 \times 10^{-19} \text{ C}$$

$$\mu_0 = 4\pi \times 10^{-7} \text{ T mA}^{-1}$$

$$\frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \text{ Nm}^2\text{C}^{-2}$$

$$\text{Mass of neutron } m_n \approx 1.675 \times 10^{-27} \text{ kg}$$

$$\text{Boltzmann's constant } k = 1.381 \times 10^{-23} \text{ JK}^{-1}$$

$$\text{Avogadro's number } N_A = 6.022 \times 10^{23}/\text{mol}$$

### **I kekk funzkk**

- (i) I Hh ižu vfuok ZgA
- (ii) bl ižui=keady 30 ižu gA ižu 1 l s8 eaiR sl ižu , d val dkg\$ ižu 9 l s18 eaiR sl ižu nksval dk g\$ ižu 19 l s27 eaiR sl ižu rhu val dk gSrEkk ižu 28 l s30 eaiR sl ižu ilp vd dk gA
- (iii) bl ižu i=keal exzij dlbZfodYi ughagA rEkk] nksvalokys, d ižu e|rhu valokys, d ižu ea rEkkilp valokysrhu ižukeavkrfjd p; u inku fd; kx; kgA , s ižukeavki dksfn, x, p; u eal s døy , d ižu gh djuk gA
- (iv) dSydyVj dk mi; k dh vuqfr ughagA

(v) **t gk vlo'; d gkvli fu fufyf[kr Hrd fu; rkldk mi; kx dj l drsgA**

$$c = 3 \times 10^8 \text{ ms}^{-1}$$

$$h = 6.626 \times 10^{-34} \text{ Js}$$

$$e = 1.602 \times 10^{-19} \text{ C}$$

$$\mu_0 = 4\pi \times 10^{-7} \text{ T mA}^{-1}$$

$$\frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \text{ Nm}^2\text{C}^{-2}$$

**UWW dk n@ eku  $m_n \approx 1.675 \times 10^{-27} \text{ kg}$**

**ckVTeku fu; rkld  $k = 1.381 \times 10^{-23} \text{ JK}^{-1}$**

**vloklnks l q;  $k N_A = 6.022 \times 10^{23}/\text{mol}$**

1. What is the direction of the force acting on a charged particle  $q$ , moving with a velocity  $\vec{v}$  in a uniform magnetic field  $\vec{B}$ ? 1

**, dl eku pFcdh {sk  $\vec{B}$  easox  $\vec{v}$  l sxfreku fdl hvkof kd d.k q] ij yxsco dh fn'lk D; k gk h gS**

2. Name the part of the electromagnetic spectrum of wavelength  $10^{-2} \text{ m}$  and mention its one application. 1

**oS pFcdh LiDVe dsml Hk dk ule fyf[k ft l dh rjxnS; Z10<sup>-2</sup> m gA bl dk , d vuqz k H fyf[k A**

3. An electron and alpha particle have the same de-Broglie wavelength associated with them. How are their kinetic energies related to each other? 1

**fdl hbyDVW rFk , YQk d.k l sl a) n&cW h rjxnS; Zl eku gA budhxfrt AtZaijLij , d&nWjs l sfdl hizlj l ofkr gA**

4. A glass lens of refractive index 1.5 is placed in a trough of liquid. What must be the refractive index of the liquid in order to make the lens disappear? 1

**1.5 viorZld dsdkp l scukdZyA fdl hn@ l shghnk. kdk eaj [kgA bl n@ dk viorZld fdruk gkplg, rld yA vn'; gk t k\**

5. A 500  $\mu\text{C}$  charge is at the centre of a square of side 10 cm. Find the work done in moving a charge of 10  $\mu\text{C}$  between two diagonally opposite points on the square. 1

**fdl hoxZft l dhHk 10 l shgdsdkhzi j 500  $\mu\text{C}$  vloskflkr gA bl oxZdsfod. E%l EfknsfcUhyl dsclp 10  $\mu\text{C}$  vlosk dksxfr djkuseafd; k x; k dk ZKlu dlft , A**

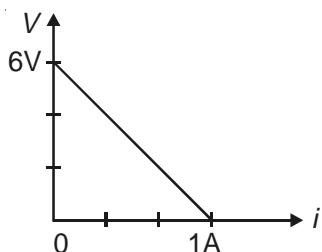
6. State the reason, why heavy water is generally used as a moderator in a nuclear reactor. 1

**ulkHdh fj, DVjkaeafoend ds: i ealHgty ds l lell r%mi; kx fd, tkusdk dk kfyf[k A**

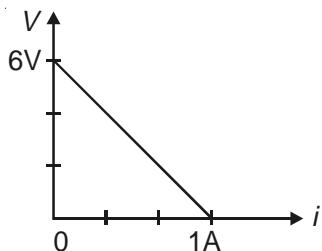
7. How does the fringe width of interference fringes change, when the whole apparatus of Young's experiment is kept in a liquid of refractive index 1.3? 1

; fn ; x dsizlk dsl eIr mi dj.k dks1.3 viorzkl dsfdl hnø ej [knarkQ frdj.k fYlt kdhfYlt plMbzad; k ifjorZ gkt k xl

8. The plot of the variation of potential difference across a combination of three identical cells in series, versus current is as shown below. What is the emf of each cell? 1



JshØe eal altr rhu l oZe l yhdsaltu dsfl jkdsclp foHokrj rEfkfo | qlik dsclp ifjorZ dks' Mzokyk xkQ fp=k ean' Mz vuqkj gA iR sl ly dk emf D; k gS



9. Derive the expression for the electric potential at any point along the axial line of an electric dipole? 2

fdl h oS q f}/h dsdkj.k f}/h&v{h jsk ds vufn' k fdl h fcuhqij fEkj oS q foHo dsfy, 0 t d Q R u dft , A

10. Define magnetic susceptibility of a material. Name two elements, one having positive susceptibility and the other having negative susceptibility. What does negative susceptibility signify? 2

fdl h inEZdh pFcdh iø flik dh ifjHk fyf[k A , s nks rRaksule fyf[k ft uea, d dh /ukRed pFcdh iø flik rEfk njsdh\_. Red pFcdh iø flik glA\_. Red pFcdh iø flik D; k l pr djrhgS

11. The oscillating magnetic field in a plane electromagnetic wave is given by

$$B_y = (8 \times 10^{-6}) \sin [2 \times 10^{11} t + 300 \text{ px}] \text{ T}$$

(i) Calculate the wavelength of the electromagnetic wave. 1

(ii) Write down the expression for the oscillating electric field. 1

fdl h l ery oS q&pFcdh rjx eank k elu pFcdh {sk

$$B_y = (8 \times 10^{-6}) \sin [2 \times 10^{11} t + 300 \text{ px}] \text{ T } \}jk Q Dr fd; k x; k gA$$

(i) oS q&pfcdh rjx dh rjxn; Z ifjdfyr dlft , A

(ii) nkyk eku oS q {lk ds fy, Q t d fyf[k A

12. Prove that an ideal capacitor, in an a.c. circuit does not dissipate power. 2

OR

Derive an expression for the impedance of an a.c. circuit consisting of an inductor and a resistor.

fl ) dlft , fd a.c. ifjiFk eavln'Zl alj=k }jk dbZ'ldr {k ughaglkA

vlok

ijd rFk ifrjksd lscusfdl h a.c. ifjiFk dh ifrckk dsfy, Q t d Q R lu dlft , A

13. A nucleus  $^{23}_{10}\text{Ne}$  undergoes  $\beta^-$  decay and becomes  $^{23}_{11}\text{Na}$ . Calculate the maximum kinetic energy of electrons emitted assuming that the daughter nucleus and anti-neutrino carry negligible kinetic energy. 2

$$\left[ \text{mass of } ^{23}_{10}\text{Ne} = 22.994466 \text{ u} \right]$$

$$\text{mass of } ^{23}_{11}\text{Na} = 22.989770 \text{ u}$$

$$1 \text{ u} = 931.5 \text{ MeV}/c^2$$

$^{23}_{10}\text{Ne}$  clvl&{k gkjg  $^{23}_{11}\text{Na}$  cu t rkgsA mR ft r by SVVlachvfkdr xfrt Åt Zifjdfyr dlft , A ; glaij ; g elku, fd l rfr dHnl rFk , Vl wlu }jk ogu dh t kusokyh xfrt Åt Zami{k lk gA

$$\left[ ^{23}_{10}\text{Ne dk nq elku} = 22.994466 \text{ u} \right]$$

$$^{23}_{11}\text{Na dk nq elku} = 22.989770 \text{ u}$$

$$1 \text{ u} = 931.5 \text{ MeV}/c^2$$

14. Distinguish between an intrinsic semiconductor and P-type semiconductor. Give reason, why, a P-type semiconductor crystal is electrically neutral, although  $n_h >> n_e$ ? 2

uf v/lkdyd rFk P&izlj dsy/lkdydneafolu dlft , A dly.k nlft , fd ; | fi  $n_h >> n_e$  g\$ fQj Hh P- izlj dk v/lkdyd fOLVy oS q mnk lu D; laglk gS

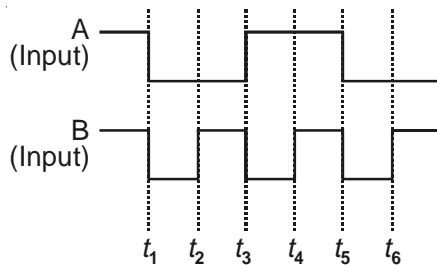
15. Draw a ray diagram of a reflecting type telescope. State two advantages of this telescope over a refracting telescope. 2

ijlorZizlk dhnjchu dkizdkkfdj.kvljsk [Hpo, A viorZnjchukadhyukeabl njchu dsnksyH fyf[k A

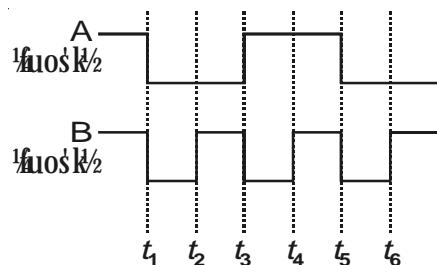
16. A ray of light passing through an equilateral triangular glass prism from air undergoes minimum deviation when angle of incidence is 3/4th of the angle of prism. Calculate the speed of light in the prism. 2

ok ql sl edlk. ld dlpo&fitTe l sxtjusokyhdllZizdkkfdj.k t c fit; ij bl izlk vkrfr gkrhgSfd  
vkru dlsk fitTe&dlsk dk 3/4 llx grk g\$ rksog U wre fopfyr grh gA fitTe eazdkk dh pky  
ifjdfyr dlft, A

17. The given inputs A, B are fed to a 2-input NAND gate. Draw the output wave from of the gate. 2



fn, x, fuosk A rEkk B dls2-fuosk NAND xV eaHj.k fd; k x; k gA bl xV dsfuxZ rjx : i dls  
vkyf[kr dlft, A



18. A transmitting antenna at the top of a tower has a height of 36 m and the height of the receiving antenna is 49 m. What is the maximum distance between them, for satisfactory communication in the LOS mode? (Radius of earth = 6400 km). 2

fdl hehujl ds' llZij LEmfir i d , lluk dh ApkZ36 eh rEkkvllkh, lluk dh ApkZ49 eh gA LOS  
folk eal rkt ud l plj dsfy, ] nksa, lluk dsclp dh vfkdre njhD; k gS ¼ Foh dh fK; k = 6400  
km<sup>1/2</sup>

19. How is a wavefront defined? Using Huygen's construction draw a figure showing the propagation of a plane wave refracting at a plane surface separating two media. Hence verify Snell's law of refraction. 3

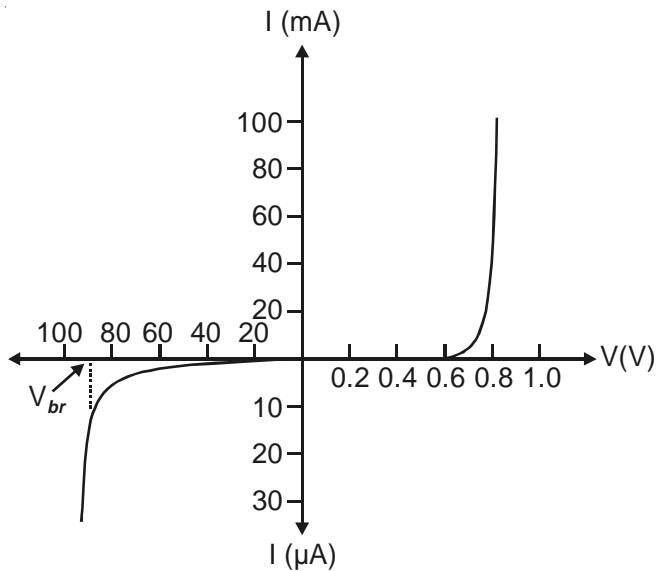
rjxkzdh ifjHkk fyf[k A gbxj jpu k dk mi ; lk djdsnsek; eldsi Eku dsl eryh i "B ij gks  
okysl ery rjx dsl pj.k dsvioru dksfp=k [kpdj n'kk, A bl izlk LuY dkvioru fu; e l R kif  
dlft, A

20. A metallic rod of length  $l$  is rotated at a constant angular speed  $\omega$ , normal to uniform magnetic field  $B$ . Derive an expression for the current induced in the rod, if the resistance of the rod is  $R$ . 3

yEkbZ/ dh dlbZ/krod NMfdl h, dl elu pcdh {lk B dsvfkyEcor~fu; r dksli pky  $\omega$  l s?kk  
dj jgh gA ; fn NMdk ifrjk R g\$ rksNM-eajjr lk dsfy, Q tu Q llu dlft, A

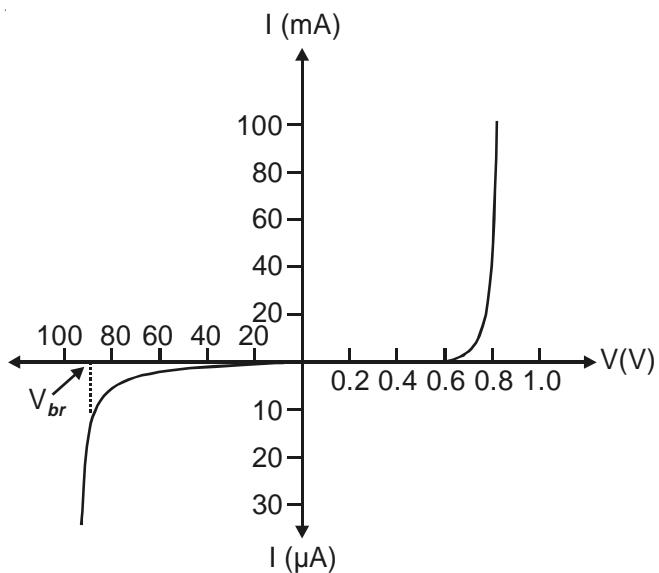
21. The figure below show the V-I characteristic of a semiconductor diode.

3



- Identify the semiconductor diode used.
- Draw the circuit diagram to obtain the given characteristic of this device.
- Briefly explain how this diode can be used as a voltage regulator.

ulpsn' kx, fp=k eafdl h v/klyd M, M dk V-I vfllyklf.kd n' kx; kgA



- mi; kx fd, x, v/klyd M, M dk igplfu, A
- bl ; fpr ds fn, x, vfllyklf.kd dk iHr djus ds fy, ifjifk vksk [kg, A
- l k ea Li 'V dlft, fd bl s oWrk fu; al d ds : i ea M, M fdl h i dk mi; kx fd; k t k l drk gA

22. An inductor  $200 \text{ mH}$ , capacitor  $500 \mu\text{F}$ , resistor  $10\Omega$  are connected in series with a  $100 \text{ V}$ , variable frequency a.c. source. Calculate the
- frequency at which the power factor of the circuit is unity.
  - current amplitude at this frequency
  - Q-factor

3

100 V ds ifjorZvlo flk ds a.c. l kr ds l lk 200 mH dk ijd] 500  $\mu\text{F}$  dk l allj=k r lk 10  $\Omega$  dk ifrjld l akr r gA fuifuf[lk dk ifjdyu dlft, %

- og vlo flk ftl ij ifjifk dk 'kdr xqkdl , d gA
- bl vlo flk ij /lk&vk le
- xqloUk xqkdl-Q.

23. Prove that the current density of a metallic conductor is directly proportional to the drift speed of electrons.

3

### OR

A number of identical cells,  $n$ , each of emf  $E$ , internal resistance  $r$  connected in series are charged by a d.c. source of emf  $E'$ , using a resistor  $R$ .

- Draw the circuit arrangement.
- Deduce the expression for (a) the charging current and (b) the potential difference across the combination of the cells.

fl ) dlft, fd fdl h/kRd pkyd dk/ljk ?kuR by DMVdh vi olg&ply ds vuQekujrh gk gA

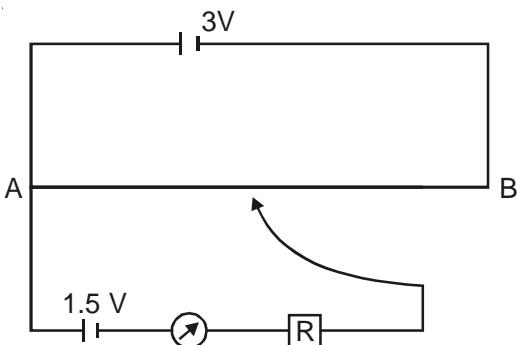
vFllok

E emf rEfk r vkrjfd ikrjlk ds n l oZ e l y] t kJshOe esal akr r gA R ikrjlk dk mi; lk djds E' emf dsfdl h d.c. l kr }ljk pkl Zfd, t krs gA

- ifjifk Q oLFk [lk, A
- (a) pkl Zdjus ds fy, /lk rEfk (b) l y] ds l akr u ds fl jk ds clp foHokrhj ds fy, Q t d Q R u dlft, A

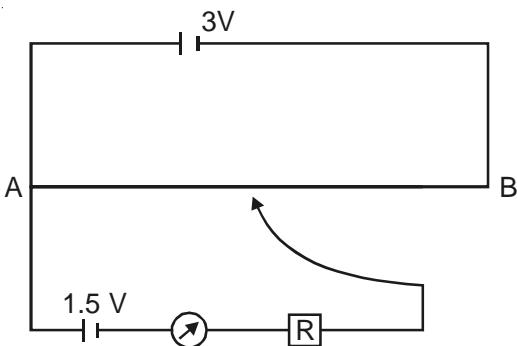
24. A potentiometer wire of length  $1 \text{ m}$  is connected to a driver cell of emf  $3 \text{ V}$  as shown in the figure. When a cell of  $1.5 \text{ V}$  emf is used in the secondary circuit, the balance point is found to be  $60 \text{ cm}$ . On replacing this cell and using a cell of unknown emf, the balance point shifts to  $80 \text{ cm}$ .

3



- (i) Calculate unknown emf of the cell.
- (ii) Explain with reason, whether the circuit works, if the driver cell is replaced with a cell of emf 1V.
- (iii) Does the high resistance  $R$ , used in the secondary circuit affect the balance point? Justify your answer.

fp=kean'lk avulj 3 V emf dk dlbZijplyd ly 1m yFcbZdsrlj okysiWUleWj lsl alfr gA  
tc f}rh d ifjiEka 1.5 V emf dsl y dkmi; lk djrsgrksl rgyu fcLhq60 lehij iMr grkgA bl  
ly dksfdl hvKkr emf dsl y lsifrLFKfir djasij l rgyu fcLhq80 lehij folFKfir gkt krk gA

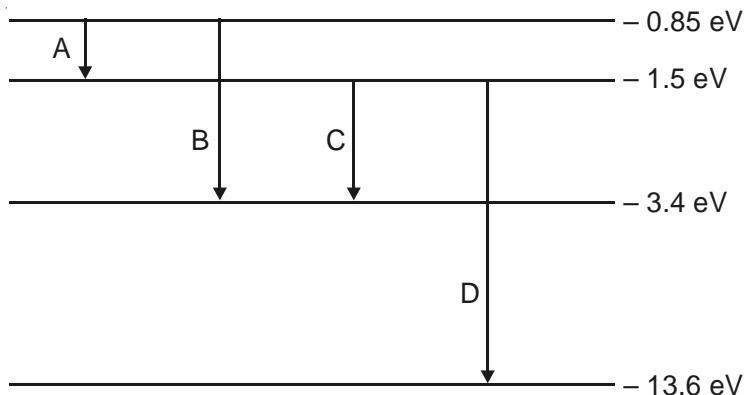


- (i) ly dk vKkr emf ifjdfyr dlft, A
- (ii) djk.k l fgr Li"V dlft, fd ; fn ifjplyd ly dks 1V emf ds ly }jk ifrLFKfir dj  
nk rks D; k ; g ifjiE k fQj Hh dk Z djxkA
- (iii) f}rh d ifjiE k ea mi; lk fd; k x; k mPpk ifrjlk R D; k l rgyu fcLhq dks iMr for djrk  
gS vius mUj dh ifjV dlft, A

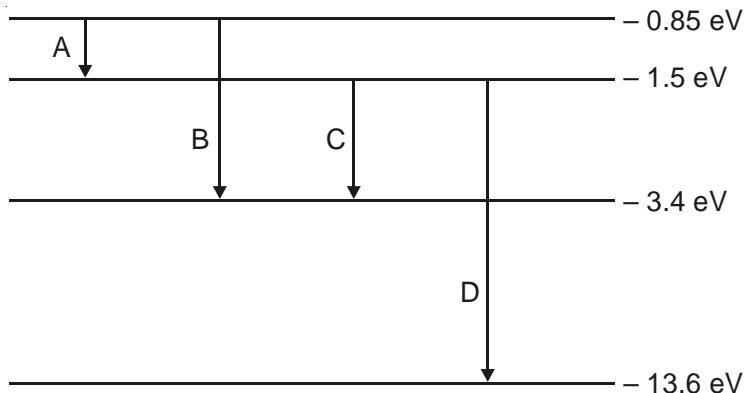
25. An electromagnetic wave of wavelength  $\lambda$  is incident on a photo-sensitive surface of negligible work function. If the photo-electrons emitted from this surface have the de-Broglie wavelength  $\lambda_1$ , prove that  $\lambda = \frac{(2mc)}{h} \lambda_1^2$ . 3

rjxnS; Zλ dh dlbZoS q&pfcdh rjx fdl hmi skll dk Qyu okysiZk k&l qgh i "B ij vki fr gA  
; fn bl i "B l smR ft r izlk ld&by DMSadhn&cW hrjxnS; Zλ, gSrksfl ) dlft,  $\lambda = \frac{(2mc)}{h} \lambda_1^2$ .

26. The energy level diagram of an element is given below. Identify, by doing necessary calculations, which transition corresponds to the emission of a spectral line of wavelength 102.7 nm.



ulpsfdll hrB dkAt ZLrj vij{kfn; kx; kgA vlo'; d ifjdyuk}ijk; g igplfu, fd dka lkl oe.k  
102.7 nm rjxns; Zdh LiDVe jsk dsmR tZ dsrnaq ih gA



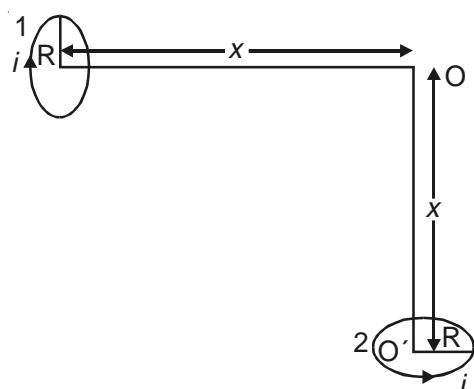
27. Draw a plot of the variation of amplitude versus  $\omega$  for an amplitude modulated wave. Define modulation index. State its importance for effective amplitude modulation. 3

fdl hvk le elMyr rjx dsfy, vk le rEkk  $\omega$  dsclp ifjorZ dksn' Zsokyk vlijk [kp, A elMyu  
l pdkd dh ifjRkk fyf[k A iHoh hvk le elMyu dsfy, bl dk egB fyf[k A

28. (a) Using Biot–Savart's law, derive an expression for the magnetic field at the centre of a circular coil of radius  $R$ , number of turns  $N$ , carrying current  $i$ .  
 (b) Two small identical circular coils marked 1, 2 carry equal currents and are placed with their geometric axes perpendicular to each other as shown in the figure. Derive an expression for the resultant magnetic field at O. 5

OR

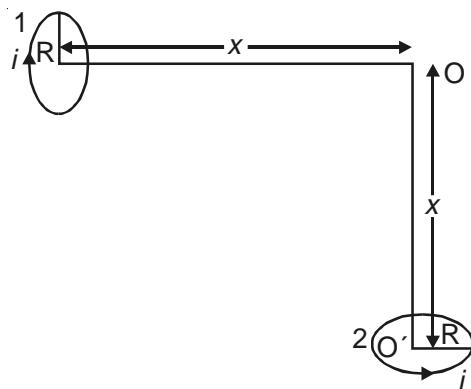
Draw a schematic diagram of a cyclotron.  
Explain its underlying principle and working,



stating clearly the function of the electric and magnetic fields applied on a charged particle.

Deduce an expression for the period of revolution and show that it does not depend on the speed of the charged particle.

- (a)  $c_k k \& l loVZfu; e dkmi ; kx djdsR f=K; krFk N Qjsholyho \bar{U}kdlj dqMyhft l l s_i / k j k i \bar{o}fgr gkjh g \bar{s} dsd \bar{U}hzij pFcdh \{ k dsfy, Q \& d Q \bar{U}l u dlft , A$
- (b)  $nksNWhl oZ e o \bar{U}kdlj dqMy; laft u ij 1, 2 vFdr g \bar{s}rFk ft ul sl elu / k j k ai \bar{o}fgr gkjh g \bar{s} fp=k ean' \bar{U} vuq \bar{j} b1 izl \bar{j} j [ k g \bar{s}fd budsT; kferh v{k, d & n \bar{U}js dsyEcor~gA fclhqO ij ifj. k eh pFcdh \{ k dsfy, Q \& d Q \bar{U}l u dlft , A$



vFlok

I lbDy \bar{U}W dk Q oLFk vki \bar{j}k [ kfp, A vlof kr d.k ij o\\$ q rFk pFcdh \{ kksdsdk kdk Li "V : i l s ok \bar{U} djrsgq bl dk dk ZrFk dk Zdjus dk ey fl ) kfr Li "V dlft , A

bl dsifj \bar{O}e. k dky dsfy, Q \& d Q \bar{U}l u dlft , rFk ; g n' \bar{U} , fd ; g vlof kr d.k dh pky ij fu \bar{U} ughadjrlA

29. (a) For a ray of light travelling from a denser medium of refractive index  $n_1$  to a rarer medium of refractive index  $n_2$ , prove that  $\frac{n_2}{n_1} = \sin i_c$ , where  $i_c$  is the critical angle of incidence for the media.
- (b) Explain with the help of a diagram, how the above principle is used for transmission of video signals using optical fibres. 5

### OR

- (a) What is plane polarised light? Two polaroids are placed at  $90^\circ$  to each other and the transmitted intensity is zero. What happens when one more polaroid is placed between these two, bisecting the angle between them? How will the intensity of transmitted light vary on further rotating the third polaroid?
- (b) If a light beam shows no intensity variation when transmitted through a polaroid which is rotated, does it mean that the light is unpolarised? Explain briefly.

- (a)  $n_1$  vior~~zkl~~ fdl h l ?ku ek; e l s  $n_2$  vior~~zkl~~ ds fdl h fojy ek; e eaxeu djrh fdl h izdkk fdj.k ds fy, fl ) dlt, fd  $\frac{n_2}{n_1} = \sin i_c$ , ; gka i<sub>c</sub> ek; ek ds fy, Ølfrd vkiu dsk g~~a~~
- (b) fp=k dh l gk rk l s ; g Li"V dlt, fd mijDr fl ) kfr dk mi; k fdl izlk i~~zlk~~ kr rlyha dk mi; k djds olM; k l arlk ds i~~zlk~~ ds fy, fd; k t lk g~~s~~

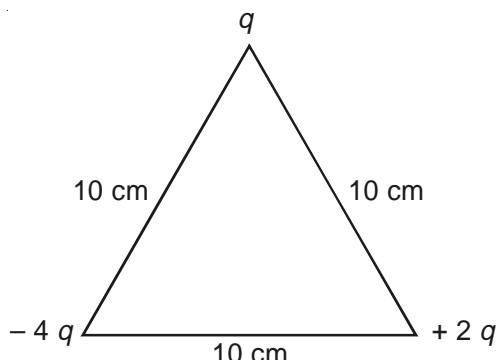
### vlok

- (a) l ery /opr izlk fdl s dgrs g~~s~~ nks i~~kyjWM~~, d&nwjs l s 90° ds dsk ij j [k gsrEkk i~~kyj~~xfer rlozk 'W g~~a~~; fn bu nksa i~~kyjWM~~ ds clp , d vU i~~kyjWM~~ bl izlk j [k na fd ; g nksa ds clp ds dsk dk l ef}Hkt u dj\$ rls D; k g~~kk~~ rhl js i~~kyjWM~~ dh vli ?lkf r djkus ij i~~kyj~~xfer izlk dh rlozk fdl izlk ifjofrr g~~kk~~
- (b) ; fn dlbZizlk&i~~lt~~ fdl h , l s i~~kyjWM~~ tks ?lkf fd; k tk jgk g~~s~~ l s i~~kyj~~xfer g~~ks~~ is i~~kyjWM~~ rlozk ea dlbZifjor~~z~~ ugha n'WZ rls D; k bl l s ; g r~~kk~~; Zg~~kk~~ g~~s~~ fd izlk v/opr g~~s~~ l~~aki~~ ea Li"V dlt, A
30. (a) Using Gauss's law, derive an expression for the electric field intensity at any point outside a uniformly charged thin spherical shell of radius R and charge density s C/m<sup>2</sup>. Draw the field lines when the charge density of the sphere is (i) positive, (ii) negative.
- (b) A uniformly charged conducting sphere of 2.5 m in diameter has a surface charge density of 100  $\mu\text{C}/\text{m}^2$ . Calculate the
- (i) charge on the sphere
  - (ii) total electric flux passing through the sphere

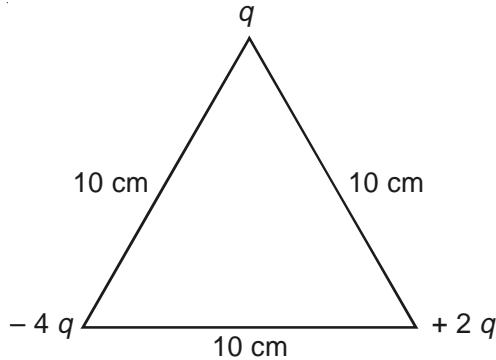
5

### OR

- (a) Derive an expression for the torque experienced by an electric dipole kept in a uniform electric field.
- (b) Calculate the work done to dissociate the system of three charges placed on the vertices of a triangle as shown. Here  $q = 1.5 \times 10^{-10}$  C.



- 2 xkml ds fu; e dk mi; kx djds fdl h R f<sub>AT</sub>; k ds , dl eku irys vlosk kr xlyh [ky] ft l dk vlosk ?kuro s c/m<sup>2</sup> g<sub>g</sub> ds clgj fdl h fcIhq ij fo | r~{sk rlzrk ds fy, 0 t d Q P U dlft , A {sk jsk a vlys[kr dlft , t cfd xlys dk vlosk ?kuR (i) /kuRed] (ii) \_ . Red gA
- (b) 2.5 eh 0 k ds fdl h , dl eku vlosk pkyd xlys dk i 'Bh vlosk /kuR 100  $\mu\text{C/m}^2$  gA fuLufyf[kr dk ifjdyu dlft , %
- (i) xlys ij vlosk
- (ii) xlys ls xtjus okyk dy o\\$ q ¶yDl A  
vElok
- (a) fdl h , dl eku fo | r~{sk ea j [ks o\\$ q f}/h }jk vuH fd, tkus okys cy&vkWZ ds fy, 0 t d Q P U dlft , A
- (b) n'WZ x, vuq j fH ds 'WZ ij fEkr rhu vlosk ds fudk dks fo; ktr djus ds fy, fd; k tkus okyk dk Z ifjdfyr dlft , A ; gla  $q = 1.6 \times 10^{-10}\text{C}$ .



## **UNIT I**

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# **SOLIDS**

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1. Solids are classified as crystalline and amorphous. In a crystalline solid the particles are arranged in a regular and repetitive three dimensional arrangement. Crystalline solids are anisotropic, that is the physical properties have different values in different directions. In an amorphous solid, the particles are arranged in an irregular and non-repetitive three dimensional arrangement. Amorphous substances are generally isotropic *i.e.*, their physical properties are the same in all directions.
2. The crystalline solids are further classified as metallic solids, covalent solids, ionic and molecular solids.
3. A regular three dimensional arrangement of points in space is called a space lattice. A unit cell is the smallest portion of the crystal lattice. There are three types of unit cells based on the cube.
  - (a) A primitive or a simple cube.
  - (b) A body-centred cube.
  - (c) A face-centred cube.
4. The number of atoms in a unit cell of a
  - (a) Primitive or simple cube = 1
  - (b) A body-centred cube = 2
  - (c) Face-centred cube = 4
5. The most economical way in which the identical spheres can be packed in the hexagonal arrangement.
6. In the cubic close packed (ccp) or face centred cubic (fcc) arrangement if the three layers are represented by A, B and C, then the resulting structure has an ABC ABC ABC - - arrangement.
7. In the body centred cubic arrangement, the second layer of atoms fits into the holes of the first layer and the third layer is identical to first layer.
8. The number of nearest neighbours of an atom or a molecule is called coordination number. The coordination number in the hcp as well as CCP structure is 12; in the BCC arrangement is 8.
9. In the hcp and ccp structures about 74% of the available space is occupied by the spheres. In BCC arrangement is about 68%.
- 10- The voids or holes between the touching spheres are also called interstices. A void is created by 4 spheres in contact with each other and coordination number of tetrahedral void thus four an void is created when six spheres are in contact with each other. Thus the coordination number of octahedral void is 6. There is one octahedral void and two tetrahedral void for every atom in close packed arrangement. Octahedral voids are larger than tetrahedral voids.

11. The density of the unit cell is given by the relation :  $f = \frac{Z \times M}{a^3 \times N_A}$
12. The defects can also be introduced in ionic solids by adding ions having different valencies than the host as e.g., Sr Cl<sub>2</sub> is added to NaCl as impurity, the divalent Sr<sup>2+</sup> occupies the Na<sup>+</sup> and produces cation vaccines.
13. Based on their electrical conductivity, solids are classified as conductors, semiconductors and insulators. Pure substances that show conducting behaviour like Si or Ge are called intrinsic semiconductors.
14. Extrinsic semiconductors are obtained by adding an impurity to a conductor. An *n*-type semiconductor is obtained by doping Si with a group 15 element. It provides an excess of electrons. A *p*-type semiconductor is obtained by doping Si with a group 13 element. The impurity provides an excess of positive charges which are termed as holes.
15. Depending on their response to magnetic field, the substances are classified as (a) Diamagnetic and (b) Paramagnetic. They are further classified as (a) ferromagnetic (b) antiferromagnetic (c) ferrimagnetic.

## QUESTIONS

### 1 MARK QUESTIONS

1. What is meant by long range order in crystals?
2. What is polymorphism?
3. What are amorphous solids?
4. Why are amorphous solids isotropic in nature?
5. Define the term 'crystal lattice'.
6. Define the term voids.
7. State the importance of voids in crystals.
8. Which of the following lattices has the highest packing efficiency : (i) Simple cubic; (ii) body centred cubic and (iii) hexagonal close-packed lattice?
9. Define the term 'dislocation' in relation to crystals.
10. What are stoichiometric defects?
11. What is schottky defect in reference to crystals?
12. What point defect is observed in a crystal when a vacancy is created by an atom or ion missing from a lattice site?
13. What is Frenkel defect?
14. Why is Frenkel defect not found in pure alkali metal halides?

15. What are F-centres?
16. What type of stoichiometric defect is shown by (i) ZnS and (ii) AgBr?
17. Define the term 'doping'.
18. Define *n*-type semiconductor.
19. What is *p*-type semiconductor?
20. Although pure silicon is an insulator then how does it behaves as a semi-conductor on heating.
21. How many spheres are in contact with each other in a single plane of a close packed structure?
22. Name two closest packed arrangements of identical spheres.
23. How much space is occupied by the spheres in a hexagonal closest packed cubic close packing?
24. What is a primitive unit cell?
25. In the formula of a compound  $A_2B$ , which site would be occupied by A ions?
26. If the formula of an ionic compound is  $A^+B^-$ , can the  $A^+$  occupy all the
  - (i) tetrahedral voids
  - (ii) octahedral voids?
27. In Zinc Sulphide; ZnS which ions.
  - (i) occupy tetrahedral voids
  - (ii) form the close packed lattice?
28. What is the coordination number of an octahedral void?
29. What is the coordination number of a tetrahedral void?
30. In NaCl crystal,  $Cl^-$  ions form the cubic close packing. What sites are occupied by  $Na^+$  ion?
31. Why is  $Fe_3O_4$  ferrimagnetic at room temperature but becomes paramagnetic at 850K?
32. What is the effect of increasing temperature on the conductivity of semiconductors?
33. Why are the solids containing F centres paramagnetic?
34. Name the crystal defect produced when NaCl crystal is doped with  $MgCl_2$ .

## 2 MARKS QUESTIONS

1. Account for the following :
  - (a) solids are rigid.
  - (b) Solids have a definite volume.

2. (a) What is meant by the term, 'crystallinity of a solid'?  
(b) Why is quartz regarded as a crystalline solid while glass an amorphous solid?
  3. "Stability of a crystal is reflected in the magnitude of its melting point" justify the statement.
  4. Explain with the help of diagrams the structural differences between various types of cubic units cells.
  5. Explain how much portion of an atom located at (a) corner (b) body centre and (c) face-centre of a cubic unit cell in part of its neighbouring unit-cell.
  6. Explain the term 'Unit Cell'. Name the parameters that characterize a unit cell.
  7. Explain :
    - (a) Ionic solids are hard and brittle
    - (b) Copper is malleable and ductile
  8. Explain the term 'crystal imperfections or crystal defects'. Name the two types of crystal imperfections.
  9. Define the term, 'Point Defect'. Name the various types of point defects.
  10. What is meant by non-stoichiometric defect? Ionic solids which have anionic vacancies due to metal-excess defect develop colour. Explain with the help of a suitable example.
  11. Explain how vacancies are introduced in a solid when a cation of higher valence is added in it.
  12. Analysis shows that nickel has formula  $\text{Ni}_{0.98}\text{O}_{1.00}$ . What fraction of the nickel exist as  $\text{Ni}^{2+}$  and  $\text{Ni}^{3+}$  ions?
  13. Explain the terms : (i) Intrinsic semiconductors and (ii) Extrinsic semiconductors.
- Hots** 14. Pure Silicon is an insulator. Silicon doped with phosphorus is a semiconductor. Silicon doped with gallium is also a semiconductor. What is the difference between the two doped silicon semiconductors?
15. How can you calculate the density of a crystal whose length of the edge of the unit cell is known?

### 3 MARKS QUESTIONS

1. Give reasons for :
  - (i) Window panes of the old buildings are thick at the bottom.
  - (ii) Glass is considered a supercooled liquid.
  - (iii) Amorphous solids are isotropic in nature.
2. (i) What is meant by co-ordination number?

- (ii) What is the (a) percentage of free space and (b) coordination number of a sphere in the following close packed structure.
- (A) Hexagonal close pack.  
(B) Body centred close pack.
3. Explain the basis of : (i) similarities and (ii) differences between metallic and cubic crystals.
4. Write and explain three differences between consequences of schottky and frenkel defects under the heads.
- (i) Effect on density  
(ii) Effect on electrical conductivity  
(iii) Effect on stability of the crystal
- Hots5.** Account for the following :
- (i) Zinc oxide on heating turns yellow.  
(ii) Schottky defect decreases the density of a crystal.  
(iii) The cation vacancies in certain crystals move them good catalysts.
- Hots6.** Give reasons for :
- (i) Non-stoichiometric sodium chloride is a yellow in colour.  
(ii) Solids with F-centres are paramagnetic.  
(iii) Doping of NaCl crystal with SrCl<sub>2</sub> changes its structure.
7. What is a semiconductor? Describe the two main types of semiconductors and contrast their conductance mechanism.
8. (i) What is the origin of magnetic moments associated with electrons in atoms?  
(ii) Distinguish between paramagnetism and diamagnetism.
9. Explain the following with simple examples :
- (i) Ferromagnetism  
(ii) Antiferromagnetism  
(iii) Ferrimagnetism

## NUMERICALS

1. A metallic element has a body central cubic lattice. Each edge of its unit cell is  $2.88 \times 10^{-8}$  cm. The density of the metal is  $7.20 \text{ g cm}^{-3}$ .

Calculate :

- (i) The volume of unit cell.
- (ii) Mass of unit cell.
- (iii) Number of atoms in 100 g of metal.

[Ans. : (i)  $2.39 \times 10^{-23} \text{ cm}^3$  (ii)  $1.72 \times 10^{-22} \text{ g}$  (iii)  $1.162 \times 10^{24} \text{ atoms}$ ]

2. A fcc element (molar mass =  $604 \text{ g mol}^{-1}$ ) has cell edge  $4.0 \times 10^{-8} \text{ cm}$ . Calculate its density ( $N_A = 6.023 \times 10^{23} \text{ mol}^{-1}$ ). [Ans. :  $6.23 \text{ g cm}^{-3}$ ]
3. An element crystallises in a structure having a fcc unit cell of an edge 200 pm. calculate its density if 200 g of this element contain  $24 \times 10^{23}$  atoms. [Ans. :  $41.6 \text{ g cm}^{-3}$ ]
4. Silver crystallises in fcc lattice. If edge length of the cell is  $4.07 \times 10^{-8} \text{ cm}$  and density is  $10.5 \text{ g cm}^{-3}$ , calculate the atomic mass of silver. ( $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$ ). [Ans. : 103u]
5. Niobium crystallises in body-centred cubic structure. Its density is  $8.55 \text{ g cm}^{-3}$ . Calculate atomic radius of niobium using its atomic mass 93u. ( $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$ ).
6. Copper crystallises into a fcc lattice with edge length  $3.61 \times 10^{-8} \text{ cm}$ . Show that the calculated density is in agreement with its measured value of  $8.92 \text{ g cm}^{-3}$ .
7. Gold (atomic radius = 0.144 nm) crystallises in a face centred unit cell. Calculate the length of a side of the cell. [Ans. :  $4.07 \times 10^{-8} \text{ cm}$ ]
8. Aluminium crystallises in a cubic close packed structure. Its metallic radius is 125 pm.
  - (i) What is the length of the side of the unit cell?
  - (ii) How many unit cell are there in  $1.00 \text{ cm}^3$  of aluminium?[Ans. : (i) 354 pm; (ii)  $2.26 \times 10^{22}$ ]
9. A metal crystallises into two cubic phases fcc and bcc, whose unit lengths are 3.5 and  $3.0 \text{ \AA}$  respectively. Calculate the ratio of the densities of fcc and bcc lattices. [Ans. : 1.26]
10. An element of atomic mass  $98.5 \text{ g mol}^{-1}$  occurs in fcc structure. If its unit edge length is 500 pm and its density is  $5.22 \text{ g cm}^{-3}$ . Calculate the value of Avogadro constant. [Ans. :  $6.03 \times 10^{23} \text{ mol}^{-1}$ ]
11. A compound formed by elements P and Q crystallises in cubic structure where P atom are at the corners of a cube and Q atoms are at the face centre. What is the formula of the compound? [Ans. :  $\text{PQ}_3$ ]

## SOLIDS

### \*HOTS

#### I. Account for the following :

- (i) Solids are rigid and have a definite volume.
- (ii) Quartz is regarded as a crystalline solid.

- (iii) Glass is regarded as an amorphous solid.
- (iv) Crystalline solids are anisotropic in nature.
- (v) Amorphous solids are isotropic in nature.
- (vi) Stability of a crystal is reflected in the magnitude of its melting point.
- (vii) Ionic solids conduct electricity in molten state but not in solid state.
- (viii) Vacancies are introduced in an ionic solid when a solid of higher valence is added as an impurity in it.
- (ix) Zinc oxide on heating becomes yellow.
- (x) The cation vacancies in certain crystals make them good catalysts.
- (xi) Non-Stoichiometric sodium chloride is a yellow solid.
- (xii) Solid with F-centres are paramagnetic.
- (xiii) In a p-type semiconductor the current is said to move through holes.
- (xiv) Conductivity of metals decreases with rise in temperature.

## 1 MARK QUESTIONS

### HOTS

- Iron changes from the body centred cubic lattice to the face-centred cubic lattice at 1199 K. How would the density of iron change during this transformation?  
**[Hint :** In closest packed face-centred cubic lattice, the coordination number is 12 whereas body centred-cubic lattice has only eight (8) nearest neighbours. The smaller the number of nearest neighbours. The less compact is the packing. Hence, BCC lattice has less density than the FCC lattice.]
- Why are Cu-Be alloys sometimes used in electric switches whose circuits are closed and opened frequently, instead of copper metal, which is much better electric conductor than Cu-Be alloy?  
**[Hint. :** Cu and Be form interstitial solid solution which is harder than copper and has more melting point.]
- Which one of the following statement is incorrect? Assign the reason of your choice.
  - The coordination number of each type of ion in CsCl crystal is 8.
  - A metal that crystallizes in bcc structure is more compact as compared to the same metal that crystallizes in cubic-close packed lattice.
  - A unit cell of an ionic crystal shares some of its ions with the other unit cells.
  - The length of unit cell in NaCl is 522 pm ( $r_{Na^+} = 95 \text{ pm}$ ,  $r_{Cl^-} = 181 \text{ pm}$ ).

[Hint : (b) because bcc lattice has a coordination number of 8 and ccp arrangement has a coordination number of 12 that makes later more compact.]

## II. Problems

1. In corundum, oxide ions form hcp and  $\text{Al}^{3+}$  occupy two third of octahedral voids. Find the formula of corundum.  
[Ans. :  $\text{Al}_2\text{O}_3$ ]
2. An ion oxide crystalizes in hcp array of oxygen with two out of three vacant octahedral voids occupied by iron. Find the formula of iron oxide.  
[Ans. :  $\text{Fe}_2\text{O}_3$ ]
3. A solid  $\text{A}^+ \text{B}^-$  has NaCl type close packed structure. If the anion has a radius of 250 pm. What should be the ideal radius for the cation? Can a catron  $\text{C}^+$  having a radius of 180 pm be stepped into the tetrahedral void of the crystal  $\text{A}^+\text{B}^-$ ? Give reason for your answer.
4.  $r(\text{Rb}^+) = 1.47 \text{ \AA}$ ,  $r(\text{Br}^-) = 1.95 \text{ \AA}$   
 $r(\text{I}) = 2.16 \text{ \AA}$ , Predict the probable geometry for Rb Br and Rbl.  
[Ans. : CsCl and NaCl type])

## 1 MARK QUESTIONS

### HOTS

1. Explain why ionic and metallic crystals have higher heat of vaporisation than do covalent molecular solids?

[Hint. : Electrostatic forces of attraction act between the ions in ionic compounds and between the lattice of metal cations and delocalised electrons in metallic crystals which are stronger than the van der Waals forces of attraction acting in covalent molecular solids.]

2. One of the best electric insulator is solid sulphur. In terms of electronic configuration, why is sulphur an insulator?

[Hint. : Sulphur consists of  $\text{S}_8$  molecules which have no free electrons unlike metals. Therefore it regarded as best electric insulator.]

3. Metallic cerium occurs both as hexagonal and Face-centred cubic close packed crystals. Would you expect the density of Face-centred cubic close-packed cerium crystals to be much different from the density of hexagonal close-packed cerium crystals why or why not?

[Hint. : Both face-centred-cubic close-packed and hexagonal close-packed crystals have the same coordination numbers and packing fraction. So they have this same densities.]

## 3 MARK QUESTIONS

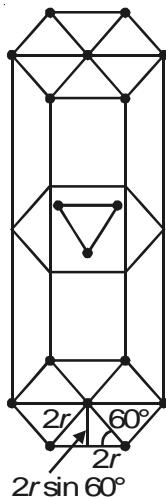
1. A metallic element crystallises into a lattice containing sequence of layers of ABABAB.... Any packing of spheres leaves out voids in the lattice. Assume the radius of every sphere to be 'r'. Calculate :
  - (a) the number of spheres in this HCP unit cell.
  - (b) volume of this HCP unit cell.

(c) percent of empty space in this unit cell.

[Hint. : (a) No of spheres in HCP unit cell =  $12 \times \frac{1}{6}$  (corners) +  $2 \times \frac{1}{2}$  (Face centres) + 3 (in middle layer).

(b) Base area =  $6 \times$  area of equilateral triangle

$$\begin{aligned} &= 6 \times (2r \times 2r \sin 60^\circ) \\ &= 6 \times \sqrt{3} r^2 \end{aligned}$$



The height of hexagonal =  $2 \times$  distance between the closest packed layers =  $2 \times [\frac{1}{3}$  of body diagonal of FCC with unit cell length 'a']

$$= 2 \times \frac{1}{3} \times \sqrt{3} a$$

Now in FCC spheres of radius 'r' touch each other along the face diagonal ( $\sqrt{2} a$ ), i.e.,

$$4r = \sqrt{2} a \text{ or } a = 2\sqrt{2} r. \text{ Hence height of hexagonal} = \frac{2}{\sqrt{3}} 2\sqrt{2} r$$

$$= 4\sqrt{\frac{2}{3}} r$$

Volume of hexagonal (V) = base area  $\times$  height of hexagon.

$$\therefore V = 6\sqrt{3} r \times \frac{4\sqrt{2}}{\sqrt{3}} r = 24\sqrt{2} r^3.$$

Volume occupied by side sphere in a HCP unit cell =  $6 \times \frac{4}{3} \pi r^3$ .

(c) ∴ Fraction of volume occupied by Re spheres.

$$= \frac{6 \times \frac{4}{3} \pi r^3}{24\sqrt{2} r^3} = \frac{\pi}{3\sqrt{2}} = 0.74$$

Fraction of empty space =  $1.00 - 0.74 = 0.26$ .

or percent of empty space = 26%.

## UNIT 2

# SOLUTIONS

### POINTS OF REMEMBER

1. The concentration of a solution is expressed in a number of ways :

(i) Molarity (M) :

$$\text{Molarity} = \frac{\text{Number of moles of solute}}{\text{Volume of solution in litres}}$$

(ii) Molarity (m) :

$$\text{Molarity (m)} = \frac{\text{Number of moles of solute}}{\text{Mass of solution in kg}}$$

(iii) Mole Fraction (x) :

$$\text{Mole fraction} = \frac{\text{Number of moles of solute}}{\text{No. of moles of solute} + \text{No. of moles of solvent}}$$

(iv) Percentage Composition :

$$\text{Mass percentage (w/w)} = \frac{\text{Mass of solute}}{\text{Mass of solution}} \times 100$$

$$\text{Volume percentage (v/v)} = \frac{\text{Volume of component}}{\text{Volume of solution}} \times 100$$

(v) Parts per million (ppm) : means mass of solute present in one million grams of the solution.

2. **Henry's Law** : States that the solubility of a gas in a liquid at a given temperature is directly proportional to the partial pressure of the gas.

$$P = K_H X.$$

3. According to **Raoult's Law** : The vapour pressure of a solution containing a non-volatile solute is directly proportional to the mole-fraction ( $X_A$ ) of the solvent  $p = p_A^\circ X_A$ .

If the solution consists of two volatile liquids  $p = pA + pB = p_A^\circ X_A + p_B^\circ X_B$ .

4. Characteristics of an ideal solution :

(i) It obeys Raoult's law at all concentrations and temperatures.

(ii)  $\Delta_{mix} V = 0$

(iii)  $\Delta_{mix} H = 0$

5. Solution which do not obey Raoult's Law are known as *non ideal solutions*. The solution shows *positive deviation* from Raoult's law if its vapour pressure is more than that predicated by Raoult's law. The solution shows *negative deviation* if its vapour pressure is lower than that predicted by Raoult's law.
6. *Azeotropes* are those liquid mixtures which boil at a constant temperature and distill over completely at the same temperature without change in composition. Azeotropes arise due to very large deviation from Raoult's Law.
7. *Colligative properties* of solutions are those properties which depend only upon the number of solute particles in the solution and not on their nature. There properties are :
  - (i) Relative lowering of vapour pressure.
  - (ii) Elevation of Boiling point.
  - (iii) Depression of freezing point.
  - (iv) Osmotic pressure.
8. Relative lowering of vapour pressure of a solution is equal to the mole fraction of the solute :

$$\frac{p^0_A - pA}{p^0_A} = \frac{nB}{nA + nB} \approx \frac{nB}{nA} \text{ (For a very dilute solution)}$$

9. For a dilute solution, the elevation in boiling point is found to be proportional to the molality of the solution.

$$\Delta T_b = K_b \cdot m = K_b \cdot \frac{n_B}{W_A} \text{ where } W_A \text{ is expressed in kg.}$$

10. The depression in freezing point is proportional to the molality of the solution.

$$\Delta T_f = K_f \cdot m = K_f \cdot \frac{n_B}{W_A} \text{ where } W_A \text{ is expressed in kg.}$$

11. *Osmotic pressure* ( $\pi$ ) is the pressure which must be applied to the solution side to prevent the passage of pure solvent into it through a semipermeable membrane.

$$\pi = \frac{n_B}{V} RT$$

where  $V$  is the volume of solution in litres.

12. *Isotonic solutions* are those solutions which have the same osmotic pressure at the same temperature.
13. In many cases the solute associates or dissociates in solutions and the numbers of effective solute particles in the solution, therefore, changes. Abnormal results are obtained when molar masses of such solutes are determined as the basis of colligative properties.

14. The inclusion of the van't Hoff factor modifies of equations for the colligative properties.

$$\begin{aligned}
 (\text{vant's Hoff factor}) &= \frac{\text{Observed colligative property}}{\text{Normal colligative property}} = \frac{\text{Total no. of particles in solution after dissociation/Association}}{\text{No. of particles in solution before dissociation/association}} \\
 &= \frac{\text{Normal molar mass}}{\text{Observed molar mass}}.
 \end{aligned}$$

15. (i)  $\frac{p_A^0 - p_{\text{soln}}}{p_A^0} = i X_B$

(ii)  $\Delta T_b = iK_b m$

(iii)  $\Delta T_f = iK_f m$

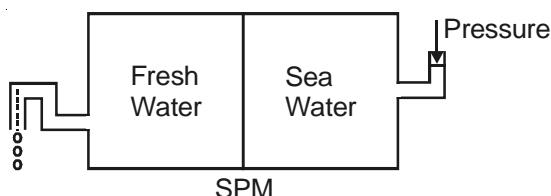
(iv)  $\pi = \frac{i n_B}{V} R T$

## QUESTIONS

### 1 MARK QUESTIONS

- Give two examples of gaseous solution.
- When would dissolving of solute in a solvent leads to liberation of heat energy?
- How is it that NaCl is soluble in water but not in benzene?
- What is the weight percent of a solution? State the units of it in which is expressed.
- Which concentration term remain unaffected for a solution when its temperature changes?
- Suppose a solid solution is formed between two substances, one of whose particles are very large and the other whose particles are very small, What kind of solid solution in this likely to be?
- Define 'mole fraction of a component' in a solution.
- Write an expression for mole fraction of a component 'A' present in a solution with another component 'B'.
- What is the sum of the mole fractions of all the components in a three component system?
- How is the molality of a solution different from its molarity?
- State the formula relating pressure of a gas with its mole fraction in a liquid solution is contract with it.
- State Raoult's law for a solution of volatile liquids.
- State Raoult's law for a solution containing non-volatile solute.

14. State the conditions which must be satisfied of an ideal solution is to be formed.
15. Define 'azeotropic mixture.'
16. What type of azeotrope is formed on mixing nitric acid and water?
17. Define an ideal solution.
18. What is the :
  - (i) enthalpy change and
  - (ii) volume change when an ideal solution is formed?
19. When a gas is dissolved in water, heat is released. Why?
20. Aquatic species feel more comfortable in cold water rather than in warm waters. Why?
21. What type of deviation from Raoult's law is expected on adding  $\text{H}_2\text{SO}_4$  to water?
22. Define cryoscopic constant.
23. If  $k_f$  for water is  $1.86 \text{ Kg mol}^{-1}$ , what is the freezing point of 0.1 molal solution?
24. Name the solid that separates first when salt solution is frozen.
25. Define 'Osmotic pressure'.
26. What are 'isotonic solutions'?
27. What is reverse osmosis?
28. What is van't Hoff factor for  $\text{Na}_2\text{SO}_4 \cdot 10 \text{ H}_2\text{O}$ ?
29. What are colligative properties?
30. Mention a large scale use of the phenomenon called 'reversible osmosis'.
31. Carefully examine the diagram and name the process involved.



32. What happens when red blood cells are placed 0.1% NaCl solution?
33. The freezing point depression of 0.1% NaCl solution is 0.372 K. What conclusion can you draw about its molecular state in solution? Assume that NaCl is completely ionised ( $K_f = 1.86 \text{ km}^{-1}$ ).

## 2 MARKS QUESTIONS

1. Write two points of difference between molarity and molality of a solution.

2. Calculate the molarity of a solution prepared by mixing 2.5 L of 0.5 M urea solution and 500 ML of 2M urea solution. [Ans. : 0.75 M]
3. Calculate the mass percentage of benzene [ $C_6H_6$ ] and carbon tetrachloride [ $CCl_4$ ], if 22 g of benzene is dissolved in 122 g of carbon tetrachloride.
4. Calculate the mass urea [ $NH_2CONH_2$ ] required in making 2.5 kg of 0.25 solution.
5. The Henry's law constant for oxygen dissolved in water is  $4.34 \times 10^4$  atm at  $25^\circ C$ . If the partial pressure of oxygen in air is 0.2 atm under ordinary atmosphere conditions, calculate the concentration in moles per litre) of dissolved oxygen in water in equilibrium with air at  $25^\circ C$ .

[Ans. :  $2.6 \times 10^{-4}$  M]

6. Give an example of solution :
- showing positive deviation
  - showing negative deviation
  - forming azeotrope with maximum boiling.
  - forming an azeotrope with minimum boiling.
7. The vapour pressure of pure benzene at  $25^\circ C$  is 639.7 mm Hg and the vapour pressure of a solutions of a non-volatile solute is benzene at the same temperature is 631.9 mm Hg. Calculate the mole fraction of solute and molality of the solution. [Ans. : 0.0122; 0.156 m]
8. Benzene and Toluene from a nearly ideal solution. At a certain temperature, calculate the vapour pressure of the solution containing equal masses of the two substances.

Given =  $P^\circ$  benzene = 150 mm

$P^\circ$  benzene = 55 mm

9. Draw vapour pressure vs composition diagram for an ideal solution.
10. Draw the total vapour pressure vs mole fraction diagram for a binary solution exhibiting non-ideal behaviour with negative deviation.
11. Show that the relative lowering of vapour pressure of a solvent is a colligative property.
12. List-four important colligative properties of solutions of non-volatile solutes.
13. Why do certain solutions show non-ideal behaviour with positive deviations?

### 3 MARKS QUESTIONS

1. Find the (i) molarity and (ii) molality of a 15% solution of  $H_2SO_4$ . The density of  $H_2SO_4$  solution is  $1.10\text{ g cm}^{-3}$  and molar mass of  $H_2SO_4$  is  $98\text{ g mol}^{-1}$ . [Ans. : 1.68 m, 1.8 m]
2. Calculate (i) molality (ii) molarity and (iii) mole fraction of KI of the density of 20% (mass/mass) aqueous KI is  $1.202\text{ g ml}^{-1}$ .

- Hots**
3. State Henry's Law for solubility of a gas in a liquid. Explain the significance of Henry's law constant ( $K_H$ ). At the same temperature and pressure, hydrogen is more soluble in water than Helium. Which of them will have a greater value of  $K_H$  and why?
  4. Why should a solution of a non-volatile solute boil at a higher temperature? Explain with the help of a diagram.
  5. Why do colligative properties of an electrolyte solution of a given concentration are found to be larger than those of a non electrolyte solution of the same concentration?
  6. Out of the two solutions having density = 1 g mL<sup>-1</sup>.
    - (i) Molar cane sugar solution.      (ii) Molar urea solution in acetone.
      - (a) Which one has Higher relative lowering of vapour pressure
      - (b) Higher osmotic pressure?
  7. An aqueous solution containing 3.12 g of Barium Chloride is 250 g of water is found to be boil at 100.0832°C. Calculate the degree of dissociation of Barium Chloride [Given : BaCl<sub>2</sub> = 208 g mol<sup>-1</sup>, Kb for water = 0.52 k/m].  
[Ans. : 83.3%]
  8. The degree of dissociation of Ca(NO<sub>3</sub>)<sub>2</sub> in a dilute aqueous solution, containing 7.0 g of salt per 100 g of water at 100°C is 70%, If the vapour pressure of water at 100°C is 760 mm, calculate the vapour pressure of the solution.  
[Ans. : 745.3 m]
  9. 2g of C<sub>6</sub>H<sub>5</sub> COOH dissolved in 25g of benzene shows depression in freezing point equal to 1.62K. Molar depression constant for benzene is 4.9K kg mol<sup>-1</sup>. What is the percentage association of acid if it forms a dimer in solution?  
[Ans. : 99.2%]

## 5 MARKS QUESTIONS

1. (i) Explain the terms (a) Mass-percentage and (b) Volume percentage of a solution.  
(ii) What volume of 95% sulphuric acid (density = 1.85 g ml<sup>-1</sup>) and what mass of water must be taken to prepare 100ml of 15% solution of H<sub>2</sub>SO<sub>4</sub> (density = 1.10 g ml<sup>-1</sup>).  
[Ans. : 9.39 ml; 90.61 g]
2. (i) Explain the terms (a) Molarity and (b) Molality of solution.  
(ii) 100 cm<sup>3</sup> of an aqueous solution of BaCl<sub>2</sub>.2HO is found to contain  $6.023 \times 10^{22}$  Cl<sup>-</sup> ions. Calculate the molarity of the solution. [ $N_A = 6.022 \times 10^{23}$  mol<sup>-1</sup>, molar mass of BaCl<sub>2</sub>.2H<sub>2</sub>O = 244.5g mol<sup>-1</sup>]  
[Ans. : 0.5M]
3. (i) Explain the term : Mole fraction.  
(ii) Which of the following is a dimensionless quantity : Molarity, Molality or Mole Fraction?  
(iii) A solution is 25% water, 25% ethanol and 50% acetic acid by mass, calculate the mole fraction of each component. [Ans. : X<sub>H<sub>2</sub>O</sub> = 0.503; X<sub>alcohol</sub> = 0.196 × acetic acid = 0.301]

4. (i) When is a molar solution of a solute in water more concentrated than a molal solution at room temperature?
- (ii) The solubility of  $\text{Ba}(\text{OH})_2 \cdot 8\text{H}_2\text{O}$  in water at 288 K is 5.6g per 100 g of water. Calculate the molality of the hydroxide ions in the saturated solution of Barium hydroxide at 288K. [Molar Mass of  $\text{Ba}(\text{OH})_2 \cdot 8\text{H}_2\text{O}$  = 315g  $\text{mol}^{-1}$ ].
5. The density of  $2\text{M}^+\text{Na}_2\text{S}_2\text{O}_3$  solution is 1.25g  $\text{ml}^{-1}$ . Calculate (i) the percentage by weight of sodium thiosulphate (ii) the mole fraction of sodium thiosulphate and (iii) molality of  $\text{Na}^+$  ions and  $\text{S}_2\text{O}_3^{2-}$  ions. [Molar mass of  $\text{Na}_2\text{S}_2\text{O}_3$  = 158 g  $\text{mol}^{-1}$ ] [Ans. : (i) 37.92%; (ii) 0.065; (iii) 7.732m]
6. (i) State one disadvantage of molarity and one advantage of molarity as the unit of concentration.
- (ii) A solution of glucose in water is labelled as 10% w/w. Calculate the molality and mole fraction of each component in the solution. If the density of the solution is 1.2g  $\text{ml}^{-1}$ , calculate the molarity of the solution. [Molar mass of glucose = 180 g  $\text{mol}^{-1}$ ]  
[Ans. : 0.62m; 0.01; 0.99; 0.67M]
7. (i) State and explain Henry's Law.
- (ii) If  $\text{O}_2$  is bubbled through water at 393K, how many millimoles of  $\text{O}_2$  gas would dissolve in 1L of water? Assume that  $\text{O}_2$  exerts a pressure of 0.95 bar.  
[Given :  $K_H$  for  $\text{H}_2\text{O}$  = 46.82 bar at 393K]
8. (i) Describe a method of determining molar mass of a non-volatile solute from vapour pressure lowering.
- (ii) A solution containing 30g of a non-volatile solute exactly in 90g water has a vapour pressure of 2.8kPa at 298K. Further 18g of water is then added to the solution, the new vapour pressure becomes 2.9 kPa at 298K. Calculate (a) Molar mass of the solute, (b) Vapour pressure of water at 298K.  
[Ans. : (i) 34 g  $\text{mol}^{-1}$ , (ii) 3.4 kPa]
9. The molar volume of liquid benzene (density = 0.877 g  $\text{ml}^{-1}$ ) increases by a factor of 2750 as it vaporises at 20°C and that of liquid toluene (density = 0.867 g  $\text{ml}^{-1}$ ) increases by a factor of 7720 at 20°C. A solution of benzene and toluene at 20°C has a vapour pressure of 46.0 for r. Calculate the mole fraction of benzene in the vapour above the solution. [Ans. : 0.74]
10. (i) Explain how molecular mass of a solute, can be determined by boiling point elevation.
- (ii) Estimate the boiling point of a solution of 25.9 g urea,  $\text{NH}_2\text{CONH}_2$  plus 25.0 g of thiourea,  $\text{NH}_2\text{CSNH}_2$  in 500 g of chloroform,  $\text{CHCl}_3$ . The boiling point of pure chloroform is 61.2°C.  $K_b$  of chloroform = 3.63K  $\text{m}^{-1}$ .  
[Ans. : 66.645°C]
11. (i) Show graphically that the freezing point of a liquid will be depressed when non-volatile solute is dissolved in it.
- (ii) A solution containing 2.56g of sulphur in 100g of carbon disulphide gave a freezing point lowering of 0.38K. Calculate the molecular formula of sulphur. [ $K_f$  for  $\text{CS}_2$  = 3.83K  $\text{kg mol}^{-1}$ , At. mass of S = 32u].  
[Ans. :  $\text{S}_8$ ]
12. (i) Why is freezing point depression considered a colligative property?

- (ii) The cryoscopic constant of water is  $1.86 \text{ K mol}^{-1}$  per kg solvent. Comment on this statement.
- (iii) Calculate the amount of ice that will separate out on cooling solution containing 50g of ethylene glycol in 200g  $\text{H}_2\text{O}$  to  $-9.3^\circ\text{C}$ . [ $K_f$  for water =  $1.86 \text{ K kg mol}^{-1}$ ][Ans. : 38.71g]

## SOLUTIONS

### HOTS

#### I. Explain the following :

1. Solubility of a solid in a liquid involves dynamic equilibrium.
2. Ionic compounds are soluble in water but are insoluble in non-polar solvents.
3. Benzene is soluble in toluene but not in water.
4. Gases tend to be less soluble in liquids as the temperature is raised.
5. Equilibrium between bond and its vapour is not established in an open vessel.
6. Vapour pressure of a liquid in a closed vessel is constant at a given temperature.
7. A non-volatile solute does not contribute to the total vapour pressure of the solution.
8. Lowering of vapour pressure is considered a colligative property.
9. A mixture of chlorobenzene and bromo benzene is nearly an ideal solution but a mixture of chloroform and acetone is not.
10. Non-ideal solution denote from Raoult's Law.
11. Some non-ideal solutions shows positive deviations while some other negative deviations.
12. A solution of chloroform and acetone shows negative deviation from ideality.
13. Boiling point elevation is considered a colligative property.
14. Freezing point is depressed when a non-volatile solute is dissolved in a liquid.
15. When fruits and vegetables that have been dried are placed in water, they slowly swell and return to original form.
16. Red blood cells swell up and finally burst when placed in 0.1 NaCl solution.
17. Measurement of depression in freezing point of a solution enables us to conclude about the nature of bonding in the solute.
18. The freezing point depression of 0.1M sodium chloride is nearly twice that of 0.1 M glucose solution.
19. A person suffering from high blood pressure is advised to take less soluble table salt.

#### II. Problems

1. KCl and  $\text{MgCl}_2$  are strong electrolytes. 1m KCl solution elevates the boiling point by 0.6 K. Calculate the boiling point of 1m  $\text{MgCl}_2$  solution. [Ans. :  $100.9^\circ\text{C}$ ]

2. Calculate the amount of NaCl which must be added to one kg of water so that the freezing point is depressed by 3K. Given  $K_f = 1.86 \text{ K kg mol}^{-1}$ , As mass : Na = 23, Cl = 35.5.  
**[Ans. : 47.2 g NaCl]**
3. Three particles of a solute, A associate in benzene to form species  $A_3$ . Calculate the freezing point of 0.25 molal solution. The degree of association of solute A is found to be 0.80. The freezing point of benzene is  $5.5^\circ\text{C}$  and its  $K_f$  value is  $5.13 \text{ Km}^{-1}$ .  
**[Ans. :  $4.9^\circ\text{C}$ ]**
4. The boiling point elevation of 0.6 g acetic acid in 100 g benzene is 0.1265K. What conclusion can you draw about the molecular state of the solute in solution? Molal boiling point constant for benzene is 2.53 degree per mole.  
**[Ans. :  $\text{Cl}_3^+$  cool+ nets as a demon]**
5. Calculate the freezing point of an aqueous solution of a non-electrolyte having an osmotic pressure of 2.0 atm at 300K. ( $K_f = 1.86 \text{ k kg mol}^{-1}$ ,  $R = 0.0821 \text{ L atm K}^{-1} \text{ mol}^{-1}$ ).  
**[Ans. : 272.849 K]**
6. A 4% solution of sucrose,  $\text{C}_{12}\text{H}_{22}\text{O}_{11}$  is isotonic with 3% solution of an unknown organic substance. Calculate the molecular mass of the unknown substance.  
**[Ans. : 256.5 g mol<sup>-1</sup>]**
7. A solution of urea in water is to be prepared so that the difference in its boiling point and freezing point is  $102^\circ\text{C}$ . How many grams of urea is to be dissolved in 100g water for obtaining such a solution?  $K_f$  for water =  $1.86 \text{ km}^{-1}$ ;  $K_b$  for water =  $0.52 \text{ km}^{-1}$ .  
**[Ans. : 5.04 g]**
8. (a) What is the composition of vapour of a 20%. Solution of heptane ( $\text{C}_7\text{H}_{16}$ ) in pure toluene?  
(b) If this vapour is condensed to a liquid, what are the composition of the condensed liquid and its vapour? The vapour pressure of pure heptane and pure toluene are 92.1 mm Hg and 59.1 mm Hg respectively.

**[Ans. : (a)  $X_{\text{C}_7\text{H}_{16}} \text{ vapour} = 0.2638$ ;  $X_{\text{C}_6\text{H}_5.\text{CH}_3} \text{ vapour} = 0.7362$   
(b)  $X_{\text{C}_7\text{H}_{16}} \text{ vapour} = 0.3584$ ;  $X_{\text{C}_6\text{H}_5.\text{CH}_3} \text{ vapour} = 0.6416$ ]**

## UNIT 3

# ELECTRO CHEMISTRY

### POINTS TO REMEMBER

1. A galvanic cell consists of two half cells. Each half cell contains an electrolytic solution and a metallic electrode. Anode is the electrode at which oxidation takes place. Cathode is the electrode at which reduction takes place. The two half-cells are separated from each other by means of a salt bridge.
2. A cell reaction is a combination of the functions of two half-cells. Thus for a cell.



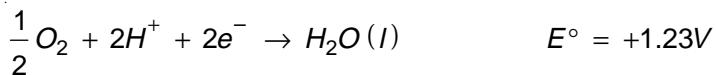
3. The decrease in Gibbs energy of the cells is related to emf of the cell by expression.

$$\Delta G^\circ = -nF E^\circ_{cell}$$

4. A standard hydrogen electrode consists of a platinised platinum foil surrounded by hydrogen gas at one bar pressure and immersed in a solution containing  $H^+$  (1M). The temperature is 298K.
5. The potential of the standard hydrogen electrode is assigned an arbitrary value of zero.
6. When the potential of an electrode is measured by coupling it with standard hydrogen electrode, it is known as standard electrode reduction potential,  $E^\circ$ .
7.  $E^\circ_{cell} = E^\circ_{cathode} - E^\circ_{Anode}$
8. For an electrochemical cell, Nernst equation at 298K,

$$E - E^\circ_{cell} = \frac{0.059}{n} \log \frac{\text{anodic concentration}}{\text{cathodic concentration}}$$

9. When an electrochemical cell contains more than one substance. Then the substance whom higher reduction potential will be reduced first at the cathode.  $Na^+$ ,  $Ca^{2+}$ , and  $Al^{3+}$  cannot be reduced in aqueous solution as their reduction potentials are much higher than that of water. In such case, water is preferentially reduced substances which have lower electrode potential than the reaction.

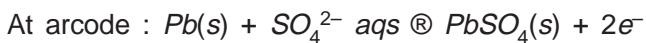


will be oxidised before the oxidation of water occurs.

10. In a mercury cell, the anode consists of Zn–Hg amalgam and a paste of HgO. Cathode is carbon. The electrolyte is a paste of ZnO and KOH. The electrode reaction are



11. Lead storage battery : The following reactions occur during its use,



12. The reciprocal of resistivity is called :

conductivity (Specific conductance)

$$K = \frac{1}{R} = \frac{1}{A} \cdot \frac{1}{\text{Resistance}} = \frac{\text{Cell constant}}{\text{Resistance}}$$

13. Molar conductivity is the conducting power of all the ions produced by one mole of an electrolyte in a given solution.

$$\Lambda_m = \frac{K}{C}.$$

## QUESTIONS

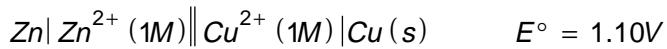
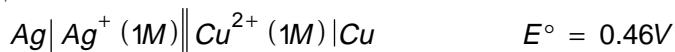
### 1 MARK QUESTIONS

- What is meant by standard electrode potential?
  - What is a galvanic cell?
  - What is the purpose of a salt-bridge placed between two half-cells of a galvanic cell?
  - How is an electrode potential different from a cell potential?
  - What is the significance of normal or standard hydrogen electrode?
  - How does an electrochemical series help us in predicting whether a redox reaction is feasible in a given direction or not?
  - When does a cell formulation represent a non-spontaneous activity of the galvanic cell?
  - Write Nernst equation for the electrode reaction.  $M^{n+}_{(aq)} + ne^- \longrightarrow M_{(s)}$ .
  - List the two factors that influence the value of cell potential of a galvanic cell.
  - Write the relation between Gibbs energy change and cell potential of a galvanic cell.
  - How is equilibrium constant of a reaction related to standard cell potential?
- Hot**s 12. Why is equilibrium constant K related to only  $E^\circ$  cell and not  $E_{cell}$ ?

13. How does specific conductance vary with temperature?
14. Define cell constant.
15. What is the SI unit of cell constant?
16. Define specific conductance.

## 2 MARKS QUESTIONS

1. A conventional method of representing a Daniel cell is  $Zn(s) | Zn^{2+}(1M) \parallel Cu^{2+}(1M) | Cu(s)$ .
  - (i) Draw a diagram of the cell and mark anode and cathode as current is drawn from the cell.
  - (ii) Write the reactions taking place at the cathode and the anode during operation of Daniel cell.
2. State two differences between electrochemical cell and electrolytic cell.
3. Describe the construction and working of standard hydrogen electrode.
4. Using standard electrode potentials, predict the reaction, if any, that occurs between  $Fe^{3+}_{(aq)}$  and  $I^-_{(aq)}$ ,  $E^\circ_{Fe^{3+}/Fe^{2+}} = 0.77V$ ,  $E^\circ_{I_2/I^-} = 0.54V$ .
5. The *emf* of the following cells are



calculate *emf* of the cell :



6. Using the standard electrode potentials, predict the reaction, if any, that occurs between the following :
  - (i)  $Fe^{3+}(aq)$  and  $Br^-(aq)$   $E^\circ_{Fe^{3+}/Fe} = 0.77V$ ,  $E^\circ_{Br_2/Br^-} = 1.07V$
  - (ii)  $Ag^+(aq)$  and  $Cu(s)$   $E^\circ_{Cu^{2+}/Cu} = 0.34V$ ,  $E^\circ_{Ag^+/Ag} = 0.80V$ .
7. Calculate the standard cell potential of galvanic cell in which reactions are as follows :



$$\text{Given } E^\circ_{Cr^{3+}/Cr} = -0.74V, E^\circ_{Cd^{2+}/Cd} = -0.40V. \quad [\text{Ans. : } + 0.40V]$$

8. For concentration cell,

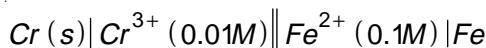


(i) Calculate the cell potential.

(ii) Will the cell generate *emf* when concentration becomes equal.

[Ans. : 0.0295V, No]

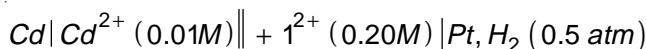
9. Calculate the *emf* of the cell at 25°C.



$$E^\circ_{Cr^{3+}/Cr} = 0.74V$$

$$E^\circ_{Fe^{2+}/Fe} = 0.44V$$

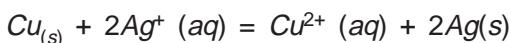
10. Calculate the *emf* of the cell



$$E^\circ_{Cd^{2+}/Cd} = -0.403V$$

[Ans. : 0.40V]

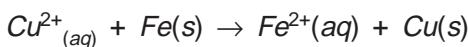
11. Calculate the equilibrium constant for the reaction at 25°C.



The standard cell potential for the reaction at 25°C is 0.46V.

[Ans. :  $4.0 \times 10^{15}$ ]

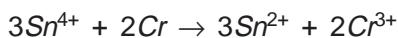
12. Calculate,  $A_rG^\circ$  for the reaction



$$E^\circ_{Cu^{2+}/Cu} = +0.34V, \quad E^\circ_{Fe^{2+}/Fe} = 0.44V.$$

[Ans. : -150, 540 kJ]

13. The *emf*. of the cell reaction



is 0.89V. Calculate  $A_rG^\circ$  for the reaction.

[Ans. : -515.310 kJ]

14. List four differences between metallic conductance and electrolytic conductance.

15. Define molar conductivity? How does it vary with temperature?

16. How does molar conductivity vary with concentration for (i) weak electrolytes and (ii) for strong electrolytes? Give reasons for these variations.

17. Explain with examples the term, weak and strong electrolytes. How can these be distinguished?

18. State and explain Kohlrausch laws of independent migration of ions with an example.

19. Write two applications of Kohlrausche Law.

20. Suggest a method to determine the  $\Lambda_m^\circ$  value of water.
21. The molar conductivity of 0.025M methanoic acid is  $46.1 \text{ S cm}^{-1}$ . Calculate its degree of dissociation and dissociation constant. Given

$$\lambda_{H^+}^- = 349.6 \text{ cm}^2 \text{ mol}^{-1} \text{ and } \lambda^-(\text{HCOO}^-) = 54.6 \text{ cm}^2 \text{ mol}^{-1}$$

22. The conductivity of 0.20M solution of KCl at 298K is  $0.248 \text{ S cm}^{-1}$ . Calculate its molar conductivity.
23. The resistance of a conductivity cell containing 0.001 M KCl solution of 298 K is 1500 ohm. What is the cell constant if conductivity of 0.001 KCl. Solution of 298K is  $0.146 \times 10^{-3} \text{ cm}^{-1}$ .
24. Explain faradays first and second law of electrolysis.

**Hots\*** 25. How many coulombs of electric charge must be passed through a solution of silver nitrate to coat a copper sheet of area  $100 \text{ cm}^2$  on both sides with thick layer, Density of silver =  $10.59 \text{ g cm}^{-3}$ .

### 3 MARKS QUESTIONS

1. A conductivity cell whose cell constant is  $3.0 \text{ cm}^{-1}$  is filled with 0.1 M acetic acid solution. Its resistance is 4000 ohms. Calculate :
- (i) Molar conductance of 0.1 M acetic acid.
  - (ii) degree of dissociation of acetic acid in solution ( $\alpha$ )
  - (iii) Acid dissociation constant, ( $K_a$ )

$$\lambda^-\text{CCl}_3 \text{ COOH} = 400 \text{ ohm}^{-1} \text{ cm}^2 \text{ mol}^{-1}. [\text{Ans. : } 7.55 \text{ cm}^2 \text{ mol}^{-1}, 0.01875, 2.56 \times 10^{-5}]$$

2. (i) Molar conductivity as infinite dilution for  $\text{NH}_4\text{Cl}$ ,  $\text{NaOH}$  and  $\text{NaCl}$  solution at 298K are respectively 129.8, 217 A and  $108.9 \text{ cm}^2 \text{ mol}^{-1}$  and  $\lambda_m$  for  $10^{-2}$  solution of  $\text{NH}_4\text{OH}$  is  $9.33 \text{ cm}^2 \text{ mol}^{-1}$ . Calculate the degree of dissociation of  $\text{NH}_4\text{OH}$ . [Ans. : 0.039]

**Hots\*** (ii) Why does molar conductivity of  $10^{-2}$  M solution of  $\text{NH}_4\text{OH}$  increase when the temperature of the solution is increased?

3. Describe a Leclanche cell with special reference to :
- (i) The electrodes used and
  - (ii) The reactions occurring at the electrodes during action.
4. Describe the composition of anode and cathode in a mercury cell. Write the electrode reactions for this cell. Why is mercury cell used in hearing aid?
5. Write the cell reaction which occur in the lead storage battery (i) When the battery is in use  
(ii) When the battery is on charging.

6. Explain :

- (i) The effect of dissolved  $\text{CO}_2$  in natural water on rusting of iron.
- (ii) The principle of cathodic protection of iron against rusting.

7. How much total charge is required for the following reductions :

- (i) 1 mol of  $\text{Al}^{3+}$  to Al.
- (ii) 1 mol of  $\text{Cu}^{2+}$  to Cu.
- (iii) 1 mol of  $\text{MnO}_4^-$  to  $\text{Mn}^{2+}$ ?

8. Three electrolytic cells, A, B, C containing solution of  $\text{ZnSO}_4$ ,  $\text{AgNO}_3$  and  $\text{CuSO}_4$  respectively are connected in series. A steady current of 1.5A was passed through the until 1.45 g of Ag deposited at the cathode of cell B. How long did the current flow? What mass of copper and zinc were deposited?

9. Standard reduction potentials are as given below :

Half Cell	$E^\circ$ Value
$\text{F}_2(\text{g})/\text{F}^-$	+ 2.9 V
$\text{Ag}^+/\text{Ag}$	+ 0.8 V
$\text{Cu}^+/\text{Cu}$	+ 0.5 V
$\text{Fe}^{2+}/\text{Fe}$	- 0.4 V
$\text{Na}^+/\text{Na}$	- 2.7 V
$\text{K}^+/\text{K}$	- 2.9 V

- (i) Arrange oxidising agents in order of increasing strength.
- (ii) Which of these oxidising agents will oxidise Cu to  $\text{Cu}^+$  under standard conditions?

10. The standard reduction potentials are as given below :

Half Cell	$E^\circ$ Value
$\text{Zn}(\text{OH})_2/\text{Zn}$	- 1.245 V
$\text{Mg}(\text{OH})_2/\text{Mg}$	- 2.690 V
$\text{Fe}(\text{OH})_2/\text{Fe}$	- 0.877 V
$\text{Fe}(\text{OH})_3/\text{Fe}$	- 2.30 V

12. Under standard conditions :

- (i) Which is the strongest reducing agent?
- (ii) Which reducing agent could reduce  $\text{Zn}(\text{OH})_2$  to Zn?
- (iii) Which reducing agent could reduce  $\text{Fe}(\text{OH})_2$  to Fe?

## 5 MARKS QUESTIONS

1. (i) Write the cell reactions which occur in Nickel Cadmium cell.
- (a) When the battery is in use and
- (b) When the battery is on charging
- (ii) Conductivity of 0.0241 M acetic acid is  $7.896 \times 10^{-5}$   $\text{scm}^{-1}$ . Calculate its molar conductivity. If  $\lambda_m^\infty$  for acetic acid is  $390.55 \text{ cm}^2 \text{ mol}^{-1}$ , calculate its dissociations constant.  
[Ans. :  $32.76 \text{ scm}^2 \text{ mol}^{-1}$ ,  $1.85 \times 10^{-5}$ ]
2. (i) How does molar conductivity vary with concentration for
- (a) Weak electrolyte and for
- (b) Strong electrolyte?  
Give reasons for these variations.
- (ii) Write the Nernst equation and calculate the *emf* of the following cell at 298K.
- $$\text{Cu(s)} | \text{Cu}^{2+}(0.130M) \| 100 \times 10^{-4} M | \text{Ag(s)}$$
- Given  $E^\circ \text{Cu}^{2+}/\text{Cu} = +0.34 \text{ V}$ ;  $E^\circ \text{Ag}^+/\text{Ag} = +0.80 \text{ V}$ .
- [Ans. : 0.25V]
3. (i) Calculate the equilibrium constant for the reaction.
- $$\text{Zn(s)} + \text{Cu}^{2+}(\text{aq}) \rightarrow \text{Zn}^{2+}(\text{aq}) + \text{Cu(s)}$$
- Given  $E^\circ \text{Zn}^{2+}/\text{Zn} = -0.763 \text{ V}$
- $$E^\circ \text{Cu}^{2+}/\text{Cu} = +0.34 \text{ V}$$
- (ii) The equilibrium constant at 25°C for the process  $\text{CO}^{3+}(\text{aq}) + 6\text{NH}_3(\text{aq}) \rightarrow [\text{CO}(\text{NH}_3)_6]^{3+}(\text{aq})$  is  $2.5 \times 10^6$ . Calculate the value of  $\Delta G^\circ$  at 25° C [R =  $8.314 \text{ J mol}^{-1} \text{ K}^{-1}$ ].  
In which direction is the reaction spontaneous under standard condition?
4. When a certain conductivity cell was filled with 0.1 MKCl, it has a resistance of 85 ohm at 25°C. When the same cell was filled with an aqueous solution of 0.052 M unknown electrolyte, the resistance was 96 ohm. Calculate the molar conductivity of the electrolyte at this concentration. [Specific conductivity of 0.1 MKCl =  $1.29 \times 10^{-2} \text{ ohm}^{-1} \text{ cm}^{-1}$ ].
5. (i) How would you explain the sharp increase in the molar conductivity of a weak electrolyte on dilution? How is the molar conductivity related to the degree of dissociation of a sparingly soluble salt?
- (ii) Silver is electrodeposited on a metallic vessel of surface area  $800 \text{ cm}^2$  by passing current of 0.2 ampere for 3 hours. Calculate the thickness of silver deposited. [Density of silver =  $10.47 \text{ g cm}^{-3}$ , Atomic mass of silver =  $107.92 \text{ u}$ ]  
[Ans. :  $2.9 \times 10^{-4} \text{ cm}$ ]

6. The  $E^\circ$  values for the two reduction electrode process are:



Formulate the galvanic cell for their combination. What will be the standard cell potential for it? Calculate  $A_f G^\circ$  for the cell reaction ( $F = 96,500 \text{ C mol}^{-1}$ ). [Ans. : 0.36V,  $- 34.7 \text{ kJ mol}^{-1}$ ]

7. (i) In the button cell, widely used in watches and other devices, the following reaction takes place :



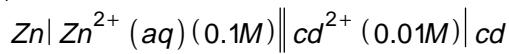
Determine  $E^\circ$  and  $A_f G^\circ$  for the reaction. [Ans. : 1.56 V,  $- 301.08 \text{ kJ mol}^{-1}$ ]

8. (i) Explain why electrolysis of aqueous solution of NaCl gives  $\text{H}_2$  at cathode and  $\text{Cl}_2$  at anode. Write the overall reaction.

Given :  $E^\circ \text{Na}^+/\text{Na} = - 2.71 \text{ V}$ ,  $E^\circ \text{H}_2\text{O}/\text{H}_2 = - 0.23 \text{ V}$

$$E^\circ \text{Cl}_2/2\text{Cl}^- = + 1.36 \text{ V}, E^\circ \text{H}^+ + \text{O}_2/\text{H}_2\text{O} = - 1.32 \text{ V}$$

(ii) Calculate the *emf* of the cell



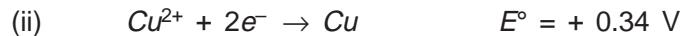
298K

[Given :  $E^\circ \text{Zn}^{2+}/\text{Zn} = - 0.76 \text{ V}$        $E^\circ \text{cd}^{2+}/\text{cd} = - 0.40 \text{ V}$ ] [Ans. : 0.3305V]

9. (i) Account for the following :

(a) Alkaline medium inhibits the rusting of iron.

(b) Iron does not rust even if the zinc coating is broken in a galvanized iron pipe.



(a) Construct a galvanic cell using the above data.

(b) For what concentration of  $\text{Ag}^+$  ions will the *emf* of the cell be zero at 25°C, if the concentration of  $\text{Cu}^{2+}$  is 0.01 M [ $\log 3.919 = 0.593$ ]. [Ans. :  $1.59 \times 10^{-9} \text{ M}$ ]

## UNIT 3

# ELECTRO CHEMISTRY

### HOTS

- \*1. What is the difference between oxidation potential and reduction potential of a metal? How are the two related?
2. What is the purpose of salt bridge placed between two half-cells?
3. How is an electrode potential different from a cell potential?
4. Why absolute value of electrode potential cannot be determined?
5. How would you determine the standard electrode potential of the system  $Mg^{2+}/Mg$ ?
6. Blue colour of copper sulphate solution is discharged slowly when iron rod is dipped into it. Why (Given  $E^\circ_{Cu^{2+}/Cu} = + 0.34V$ ,  $E^\circ_{Fe^{2+}/Fe} = -0.44V$ ).
7. Account for the fact that when chlorine is passed through a fluoride solution, no reaction takes place.

(Given  $E^\circ_{F_2/2F^-} = + 2.87V$ ,  $E^\circ_{Cl_2/2Cl^-} = -1.36V$ ).

8. Copper does not dissolve in  $HCl(aq)$  but dissolves in  $HNO_3(aq)$  producing  $Cu^{2+}$  ions. Explain the difference in behaviour.

(Given  $E^\circ_{Cu^{2+}/Cu} = + 0.34V$ ,  $E^\circ_{Cl_2/2Cl^-} = + 1.36V$

$E^\circ_{NO_3^-} + 4H^+ + 3e^- \rightarrow NO(g) + 2H_2O = + 0.97V$ ).

9. Why is equilibrium constant K related to only  $E^\circ$  cell and not E cell?
10. Conductivity of two electrolytic solution of 0.1 M concentration of the substances A and B are  $9.2 \times 10^{-3}$  and  $4.7 \times 10^{-4} \Omega^{-1} cm^{-1}$  which one of these offer less resistance for the flow of current and which one is a stronger electrolyte?
11. Give reasons for :
  - (i) For a weak electrolyte, its molar conductivity in dilute solution increases sharply as its concentration in solution is decreased.
  - (ii) Molar conductivity of a strong electrolyte like KCl decreases slightly while increasing concentration?
  - (iii) It is not easy to determine  $\lambda_m^\infty$  of a weak electrolyte by extrapolation of concentration vs  $\Lambda_m$ ?
12. What would be the effect of hydration the conductivity of electrolytic solution?

13. Account for the following observations :

- (i) In a dry cell, the build up of ammonia gas around the carbon cathode should disrupt the electric current, but in practice this does not happen.
- (ii) Ordinary dry cells are not rechargeable.
- (iii) The voltage of a mercury battery is constant during its operation.

14. How is efficiency of a fuel cell determined?

15. Give appropriate reason for :

- (i) Zinc metal is used in the cathodic protection of iron?
- (ii) An oxide film protect aluminium but an oxide film cannot protect iron.

## 2 MARKS QUESTIONS

### HOTS

1. The standard electrode potential of  $\text{Cu}^{2+}/\text{Cu}$  and  $\text{Cu}^{2+}/\text{Cu}^+$  half-cells are 0.337V and 0.153 V respectively calculate the standard electrode potential of  $\text{Cu}^+/\text{Cu}$  half-cell.

[Hint. :  $E^\circ_{\text{Cu}^{2+}/\text{Cu}} = 0.337\text{V}$  and  $E^\circ_{\text{Cu}^{2+}/\text{Cu}^+} = 0.153\text{V}$

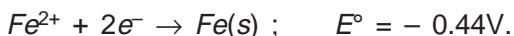
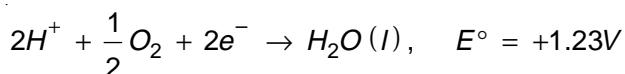
(i) .....  $\text{Cu}^{2+} + 2e^- \rightarrow \text{Cu}; E^\circ = 0.337\text{V}$  .....  $\therefore \Delta G^\circ_1 = -(+2) \times 0.337 \text{ F}$   
(ii) .....  $\text{Cu}^{2+} + e^- \rightarrow \text{Cu}^+; E^\circ = 0.153\text{V}$  .....  $\therefore \Delta G^\circ_2 = -(1) \times 0.153 \text{ F}$

Substracting equ. (ii) from equ (i) and  $\Delta G^\circ = \Delta G^\circ_1 - \Delta G^\circ_2$

$$\text{Cu}^+ + e^- \rightarrow \text{Cu}^+; \Delta G^\circ = -(1) E^\circ \text{ F} = -2 \times 0.337 \text{ F} - (-0.153 \text{ F}).$$

Therefore,  $-E^\circ \text{ F} = -0.521 \text{ F}$  or  $E^\circ = 0.521 \text{ V}$ .

2. The rusting of iron takes place as follows :



Calculate the  $\Delta G^\circ$  for the net process.

[Hint. : The net process for rusting (corrosion) of Fe is the conversion of  $\text{Fe}(s)$  to  $\text{Fe}^{2+}$  in contact with water containing dissolved oxygen and  $\text{H}^+$  ions. [Ans. : - 322.31 kJ]

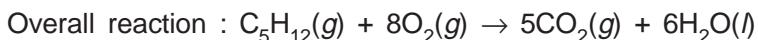
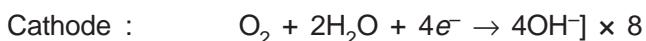
3. Calculate the value of  $E^\circ_{\text{Cell}}$  for the pentane-oxygen fuel cell at 298 K using the following data

Substance	Standard Gibbs Energy of formation $D_fG^\circ / \text{kJ mol}^{-1}$
Pentane (g)	- 8.2
$\text{CO}_2(g)$	- 394.4
$\text{H}_2\text{O}(l)$	- 237.2

and Faraday's constant = 96500 C mol<sup>-1</sup>.

[Hint. : The half-cell reactions are :

i.e.,



$$\Delta_f G^\circ = -n E^\circ_{cell} F = -32 E^\circ_{cell} \times 96500 \text{ C mol}^{-1}$$

Using  $\Delta G^\circ$  data, of the substance we can calculate  $\Delta_f G^\circ$  as below :

$$\Delta_f G^\circ = 5. \Delta_f G^\circ (\text{CO}_2, g) + 6. \Delta G^\circ_f (\text{H}_2\text{O}, l) - 1. \Delta_f G^\circ (\text{C}_5\text{H}_{12}, g)$$

$$= [5 (-394.4) + 6 (-237.2) - 1. (-8.2)] \text{ kJ mol}^{-1}$$

$$= -3387 \text{ kJ mol}^{-1}$$

$$\therefore -32 E^\circ_{cell} \times 96500 \text{ C mol}^{-1} = -3387 \times 10^3 \text{ J mol}^{-1}$$

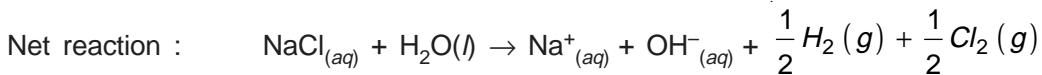
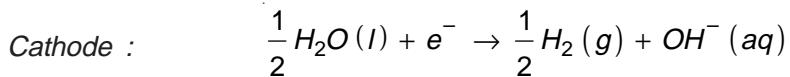
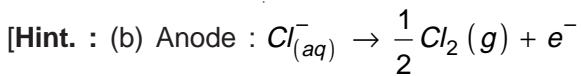
$$\text{or } E^\circ_{cell} = \frac{3387 \times 10^3 \text{ J}}{32 \times 96500 \text{ C}} = 1.097 \approx 1.10V.$$

## PROBLEMS

1. A Zinc rod is dipped in 0.1 M solution of  $\text{ZnSO}_4$ . The salt is 95% dissociated at this dilution at 298K. Calculate the electrode potential.  $E^\circ_{\text{Zn}^{2+}/\text{Zn}} = -0.76V$ . [Ans. : -0.7902V]
2. For the electrode Pt,  $\text{H}_2$  (1 atm) |  $\text{H}^{+}_{(aq)}$  (XM), the reduction electrode potential at 25°C is -0.34V. Write the electrode reaction equation and calculate the value of x. How will you deduce the pH of solution from this result? [Ans. :  $x = 1.807 \times 10^{-6}$ , pH = 5.743]
3. For what concentrations of  $\text{Ag}^{+}_{(aq)}$  will the *emf* of the given cell be zero at 25°C if concentration of  $\text{Cu}^{2+}_{(aq)}$  is 0.1M? Given :  $E^\circ_{\text{Ag}^+/\text{Ag}} = +0.80V$ ;  $E^\circ_{\text{Cu}^{2+}/\text{Cu}} = +0.34V$ . [Ans. :  $5.3 \times 10^{-9}$ ]
4. Zinc granules are added in excess to a 500 ml of 1.0 M nickel nitrate solution at 25°C until the equilibrium is reached. If the standard reduction potential of  $\text{Zn}^{2+}/\text{Zn}$  and  $\text{Ni}^{2+}/\text{Ni}$  are -0.75V and -0.24V respectively, find out the concentration of  $\text{Ni}^{2+}$  in solution at equilibrium. [Ans. :  $5.88 \times 10^{-18} \text{ M}$ ]
5. The molar conductivity of 0.1M  $\text{CH}_3\text{COOH}$  solution is 4.6 S cm<sup>2</sup> mol<sup>-1</sup>. Calculate the conductivity and resistivity of the solution. (0.00046 s cm<sup>-1</sup>, 2174 Ω cm). [Ans. : 7.396 × 10<sup>-2</sup>]
6. The molar conductivities of  $\text{NH}_4^+$  ion and  $\text{Cl}^-$  ion are 73.5 s cm<sup>2</sup> mol<sup>-1</sup> and 76.2 s cm<sup>2</sup> mol<sup>-1</sup> respectively. The specific conductivity of 0.1 M  $\text{NH}_4\text{Cl}$  is  $1.288 \times 10^{-2}$  s cm<sup>-1</sup>. Calculate the dissociation constant of  $\text{NH}_4\text{Cl}$ . [Ans. : 7.396 × 10<sup>-2</sup>]

## 2 MARKS QUESTIONS

1. Electrolysis of dil aqueous NaCl solution was carried out by passing 10 m. A current (a) calculate the time required to liberate 0.01 mol of H<sub>2</sub> gas at an electrode. [Farday constant = 96500 C mol<sup>-1</sup>. (b) the reactions occurring at anode and cathode. (c) Is the solution after electrolysis acidic or alkaline?



(c) The solution becomes alkaline due to presence of OH<sup>-</sup> ions on the products side.

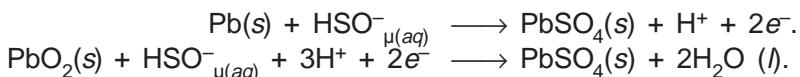
(a)  $\frac{1}{2}$  mol H<sub>2</sub> is liberated by the passage of 1 mol of electrons i.e., 1F or 96500 C.

$$\frac{\text{Charge } (q)}{\text{Time } (t)} = \text{Current } (I)$$

$$\frac{96500 \text{ C}}{t} = 10^{-3} \text{ A} \quad \text{or} \quad t = \frac{96500 \text{ C}}{10^{-3} \text{ A}}$$
$$= 9.65 \times 10^6 \text{ s.}]$$

## 3 MARKS QUESTIONS

1. The half-cell reactions for the discharging cycle of each lead storage cell in a car battery are



- (a) Write overall equation for the cell reaction during discharging.  
(b) During the discharge, at which electrode the oxidation is taking place and at which electrode is reduction occurring?  
(c) Does the concentration of sulphuric acid increase or decrease during the discharging cycle? Why it possible to use the density of sulphuric acid solution as an indication of the amount of energy that can be obtained from a car battery?  
(d) What is the composition of each electrode when the cell is completely discharged?

[Hint. : (c) Yes, as the battery is discharged, the density of H<sub>2</sub>SO<sub>4</sub> (aq) decreases.

(d) Anode : Pb(s) and PbSO<sub>4</sub>; Cathode : PbO<sub>2</sub>(s) and PbSO<sub>4</sub>.]

2. (a) What is the maximum electric potential difference between two hydrogen half cells with the following description at 298K.

Half cell A :  $\text{H}_2$  (1 atm)/ $\text{H}^+$ (1M)

Half cell B :  $\text{H}_2$  (1 atm)/ $\text{H}^+$  ( $10^{-8}$  M)

Given that  $R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1}$ ,  $F = 96500 \text{ C mol}^{-1}$ .

- (b) If the two half cells described in part (a) are connected so that charge is transferred for a long time interval, what will eventually happen to the hydrogen ion concentration in the two half-cells.

[Hint. : (a)  $\text{H}_2$  (atm)| $\text{H}^+$  ( $10^{-8}$  M) ||  $\text{H}^+$  (1M)|  $\text{H}_2$  (1 atm)]

$$E_{\text{cell}} = \frac{-0.059V}{1} \log \frac{[\text{H}^+]_{\text{LHC}}}{[\text{H}^+]_{\text{RHC}}} = -0.059 \log \frac{10^{-8}}{1} \\ = 0.472 \text{ V.}$$

(b) Equilibrium is attained and eventually the  $[\text{H}^+]$  in both the half-cell will be the same.]

3. A Daniel cell transfers 4825C of electric charge through an external circuit when the potential difference between the terminals is 1 volt. Given that  $E_{\text{Cell}}^\circ = 1.10\text{V}$  and Faraday's constant =  $96500\text{C mol}^{-1}$ .

- (a) How many moles of zinc will be changed to  $\text{Zn}^{2+}$ .

- (b) What is quantity of electrical energy in  $\text{kJ mol}^{-1}$  of zinc.

- (c) Compare the quantity of electrical energy transferred per mol of zinc in this case with maximum quantity of electrical energy that can be transferred by a Daniel cell.

[Hint. : (a)  $\text{Zn} \rightarrow \text{Zn}^{2+} + 2e^-$ .

$2 \times 96500 \text{ C} \equiv 1 \text{ mol of Zn}$

$$\therefore 4825 \text{ C} \equiv \frac{4825 \text{ C}}{2 \times 96500 \text{ C}} \text{ mol of Zn} = 0.05 \text{ mol Zn}$$

(b)  $\Delta G = - n E_{\text{cell}} F = - 2 \times 1\text{V} \times 96500 \text{ C} = - 193 \text{ kJ mol}^{-1}$  of Zn.

(c)  $\Delta G^\circ = - 2 \times 1.10 \times 96500 \text{ CV} = - 212.3 \text{ kJ mol}^{-1}$  of Zn.

## UNIT 4

# CHEMICAL KINETICS

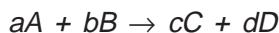
**Rate of Reaction :** It is defined as the change in concentration of reactants or products per unit time.

Instantaneous rate is the rate of reaction expressed at a particular instant of time whereas average rate is the rate of reaction expressed over a large interval of time.

### Factors Affecting the Rate of Reactions

- (i) Temperature
- (ii) Concentration of reactants
- (iii) Catalyst

**Rate Law :** It is the mathematical representation of the rate of reaction e.g., for a general reaction.



Rate may be expressed as :

$$\text{Rate} = -\frac{1}{a} \frac{d(A)}{dt} = -\frac{1}{b} \frac{d(B)}{dt} = \frac{1}{c} \frac{d(C)}{dt} = \frac{1}{d} \frac{d(D)}{dt} \quad \dots(i)$$

$$\text{or} \quad \text{Rate} = k [A]^x [B]^y \quad \dots(ii)$$

where  $x$  and  $y$  are experimentally determined powers of concentration on which rate of reaction depends these may or may not be the same as the stoichiometric coefficient of the reacting species in a balanced chemical equation.

**Order of a Reaction :** The sum of the powers of the concentration of the reactants raised in the rate law expression is called the order of that chemical reaction e.g., in equation (ii) overall order =  $x + y$ . Order of the reaction has to be determined experimentally and it cannot be predicted by merely looking at the balanced chemical equation.

**Rate Constant ( $k$ ) :** It is the proportionality factor in the rate law.

Rate constant and order of a reaction can be determined from rate law or its integrated rate equation.

**Molecularity :** It is defined as the number of reacting species (atoms, ions or molecules) taking part in an elementary reaction, which must collide simultaneously in order to bring about a chemical reaction.

**Molecularity** is defined only for elementary reactions whereas order is applicable to elementary as well as complex reactions. Values of molecularity are limited from 1 to 3 whereas order can be 0, 1, 2, 3,  $n$ th or even a fraction.

## UNITS OF RATE CONSTANT

From eqn. (ii)  $k = \frac{\text{Rate}}{[A]^x [B]^y}$

$$= \frac{\text{Concentration}}{\text{time}} \times \frac{1}{[\text{Concentration}]^n} \quad (\text{where } x + y = n, \text{ order of the reaction})$$

Taking SI units of concentration = mol L<sup>-1</sup>

and SI units of time = s

Units of rate constants are as follows :

<i>Reaction Order</i>	<i>Units of Rate Constant k.</i>
0	$\frac{\text{mol L}^{-1}}{\text{s}} \times \frac{1}{(\text{mol L}^{-1})^0} = \text{mol L}^{-1}\text{s}^{-1}$
1	$\frac{\text{mol L}^{-1}}{\text{s}} \times \frac{1}{(\text{mol L}^{-1})^1} = \text{s}^{-1}$
2	$\frac{\text{mol L}^{-1}}{\text{s}} \times \frac{1}{(\text{mol L}^{-1})^2} = \text{mol L}^{-1}\text{s}^{-1}$

□ **For Zero order reactions**

Integrated rate equation for a reaction R → P is :

$$[R] = -kt + [R]_0 \Rightarrow k = \frac{[R]_0 - [R]}{t}$$

□ **For First order reactions**

Integrated rate equation for a reaction R → P is :

$$k = \frac{2.303}{t} \log \frac{[R]_0}{[R]}$$

□ **Half life period** is the time taken when the concentration of the reactant is reduced to half for 1st order reaction

$$t_{1/2} = \frac{0.693}{k}$$

- For **every 10° rise in temperature, the rate of reaction becomes nearly double.** This is because the number of molecules with energy greater than threshold energy becomes nearly double.
- Variation of reaction rate with temperature is given by Arrhenius equation as

$$k = A \cdot e^{-E_a/RT}$$

A is Arrhenius factor which is a constant specific to a particular reaction.

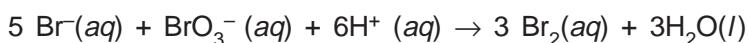
R is gas constant;  $E_a$  is activation energy in J mol<sup>-1</sup>.

$$\log \frac{k_2}{k_1} = \frac{E_a}{2.303 R} \left( \frac{1}{T_1} - \frac{1}{T_2} \right)$$

## QUESTIONS

### 1 MARK QUESTION (Very Short Answer Questions)

1. Define the term 'rate of reaction'.
2. Write the unit of first order rate constant of gaseous reaction if the partial pressure of gaseous reactant is given in atm.
3. State two factors by which the rate of reaction can be increased.
4. Express the rate of reaction in terms of Br<sup>-</sup> (aq) as reactant and Br<sub>2</sub> (aq) as product for the reaction :



5. For a reaction



the rate of reaction is denoted by

$$\frac{-\Delta[\text{R}]}{\Delta t} \quad \text{or} \quad \frac{+\Delta[\text{P}]}{\Delta t}$$

Why a positive sign (+) is placed before  $\frac{\Delta[\text{P}]}{\Delta t}$  and not before  $\frac{\Delta[\text{R}]}{\Delta t}$ ?

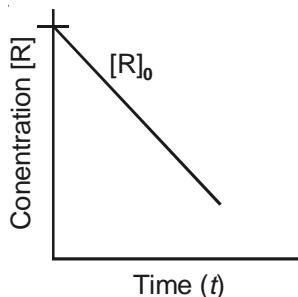
6. Define the term order of a reaction?

7. A zero-order reaction :

Reactant to product is represented by the graph.



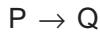
What does the slope of the graph represent?



8. Mention the order of a reaction if the rate of reaction does not depend on the concentration of any of the reactants.
9. Identify the reaction order from each of the following rate constant units.
- $R = 2.5 \times 10^{-4} \text{ mol}^{-1} \text{ LS}^{-1}$
  - $R = 4.0 \times 10^{-4} \text{ S}^{-1}$ .
10. For the elementary step of a reaction :
- $$\text{A} + \text{H}_2\text{O} \rightarrow \text{B}$$
- rate  $\propto [\text{A}]$
- What is the (i) Molecularity and (ii) Order of the reaction.
11. Differentiate between instantaneous and average rate of reaction.
12. Mention the units of rate constant for a first order reaction.
13. A first order reaction is found to have a rate constant  $k = 200 \text{ s}^{-1}$ . Find the half life period of the reaction. [Ans. :  $3.465 \times 10^{-3}\text{s}$ ]

### HOTS (1 MARK)

14. The rate constant of a chemical reaction is  $0.0693 \text{ min}^{-1}$ . Starting with 10 moles. Calculate the rate of reaction after 110 min. [Ans. :  $5 \times 0.693 \text{ mol/mm}$ ]
15. Consider an endothermic reaction



with activation energies  $E_b$  and  $E_f$  respectively for the backward and forward reactions. Express the relationship between  $E_b$  and  $E_f$

[Hint. : For endo thermic reaction,  $\Delta H = +ve$ ,  $\Delta H = E_f - E_b$  or  $E_b < E_f$ ]

16. For a reaction :



the rate of the reaction quadruples (becomes 4 times) when the concentration of A is doubled. The rate of the reaction is

$$\text{Rate} = [\text{A}]^n$$

What is the value of  $n$ ?

[Ans. :  $n = 2$ ]

17. Suggest an appropriate reason for the observation : "On increasing temperature of the reacting system by 10 degrees, the rate of reaction almost doubles"

[Ans. : The fraction of the molecules having energy equal to threshold energy or more, increase].

18. The rate constant of a reaction is given by the expression :

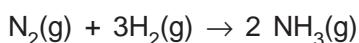
$$k = A \cdot e^{-E_a/RT}$$

Which factor in this expression should register a decrease so that the reaction proceeds rapidly?

[Ans. :  $E_a$ ]

## 2 MARKS QUESTIONS (Short Answer Questions)

1. (i) Express the reaction rate for the reaction.



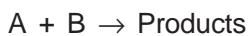
- (ii) How is the rate of formation of  $\text{NH}_3$  related to the disappearance of  $\text{H}_2(\text{g})$ ?

2. In the reaction  $R \rightarrow P$ , the concentration of R decreases from  $0.03\text{M}$  to  $0.02\text{ M}$  in 25 minutes. Calculate the average rate of reaction using unit of time both in minutes and seconds.

[Ans. :  $4 \times 10^{-4} \text{ M min}^{-1}$   $6.66 \times 10^{-6} \text{ M s}^{-1}$ ]

3. (i) Write two points of difference between order and molecularity of a reaction.

- (ii) For a reaction

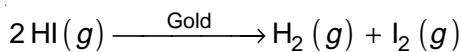


the rate law is given by

$$r = k [\text{A}]^{1/2} [\text{B}]^2$$

Determine the order of the reaction.

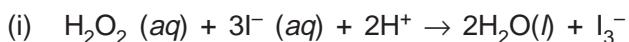
4. Thermal decomposition of  $\text{HI}$  on gold surface is a zero order reaction.



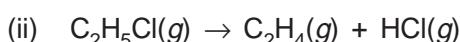
- (i) Express the relationship between the rate of production of iodine and rate of disappearance of hydrogen iodide.

$$\begin{aligned} \text{Ans. : (a)} \quad & -\frac{1}{2} \frac{d[\text{HI}]}{dt} = \frac{+d(\text{I}_2)}{dt} \\ \text{(b) Rate} & = k [\text{HI}]^\circ \end{aligned}$$

5. From the rate expression for the following reactions, determine their order and the dimensions of their rate constants :



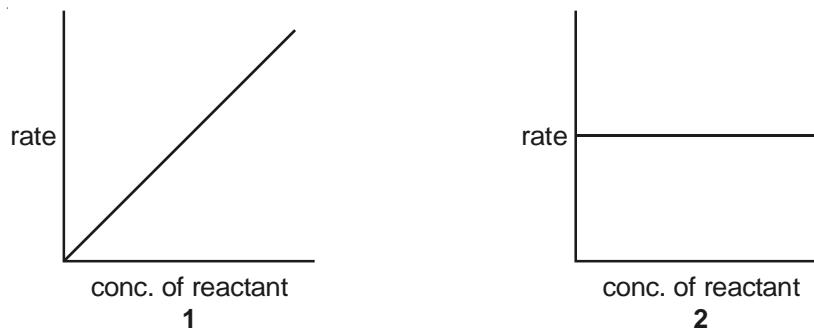
$$\text{Rate} = k [\text{H}_2\text{O}_2] [I^-]$$



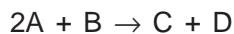
$$\text{Rate} = k [\text{C}_2\text{H}_5\text{Cl}]$$

[Ans. : (i) 2; (ii) 1. Units; (i)  $\text{mol}^{-1}\text{LS}^{-1}$ ; (ii)  $\text{S}^{-1}$ ]

6. The graphs (1 and 2) given below are plot of rate of reaction versus concentration of the reaction. Predict the order from the graphs.



7. The following results have been obtained during the kinetic studies of the reaction.



<i>Experiment</i>	<i>A/Mol L<sup>-1</sup></i>	<i>[B]/mol L<sup>-1</sup></i>	<i>Initial rate of formation of D/mol L<sup>-1</sup> min<sup>-1</sup></i>
I	0.1	0.1	$6.0 \times 10^{-3}$
II	0.3	0.2	$7.2 \times 10^{-2}$
III	0.3	0.4	$2.88 \times 10^{-1}$
IV	0.4	0.1	$2.40 \times 10^{-2}$

Determine the rate law and the rate constant for the reaction.

$$[\text{Ans. : Rate} = k [A] [B]^2; \quad k = 6.0 \text{ mol}^{-2} \text{ L}^2 \text{ min}^{-1}]$$

8. What is the pseudo first order reaction? Give one example.  
 9. A first order reaction has a rate constant  $1.15 \times 10^{-3} \text{ s}^{-1}$ . How long will 5g of this reactant take to reduce to 3g?  
 [Ans. :  $t = 444\text{s}$ ]  
 10. The following values for first order rate constant were obtained in a reaction.

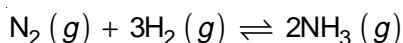
$$T_1 = 298\text{K} \quad k_1 = 3.5 \times 10^{-5} \text{ s}^{-1}$$

$$T_2 = 308\text{K} \quad k_2 = 10.0 \times 10^{-5} \text{ s}^{-1}$$

Calculate the value of energy of activation for the reaction. ( $R = 8.314\text{J K}^{-1} \text{ mol}^{-1}$ )

$$[\text{Ans. : } 105.617 \text{ J mol}^{-1}]$$

11. A first order reaction is found to have a rate constant,  $k = 7.39 \times 10^{-5} \text{ sec}^{-1}$ . Find the half life of the reaction.  
 [Ans. :  $9.38 \times 10^3 \text{ sec}$ ]  
 12. Sketch a graph between potential energy and reaction co-ordinate for the reaction.



On the graph, indicate

- (i) Activation Complex

(ii) Activation Energy

(iii) Enthalpy of reaction.

13. The rate of reaction triples when the temperature changes from 20°C to 50°C. Calculate the energy of activation. ( $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ ,  $\log 3 = 0.4771$ ) [Ans. : 28.818 kJ mol $^{-1}$ ]
14. Draw a graph between fraction of molecules and kinetic energy of the reacting species for two different temperatures :

(i) Room temperature

(ii) Temperature 10°C higher than the room temperature

(iii) Indicate the fraction of additional molecules which react at  $(t + 10)$ °C.

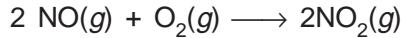
15. For a reaction, the energy of activation is zero. What is the value of rate constant at 300K if  $k_1 = 1.6 \times 10^{-6} \text{ S}^{-1}$  at 280K ( $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ ) [Ans. :  $k_2 = k_1 = 1.6 \times 10^6 \text{ S}^{-1}$ ]
16. Rate constant ( $k$ ) of a reaction varies with temperature according to the equation

$$\log k = \log A - \frac{Ea}{2.303T}$$

Where  $Ea$  is the energy of activation. On plotting a graph between  $\log k$ . vs  $\frac{1}{T}$ , a straight line with a slope  $- 6670 \text{ K}$  is obtained. Calculate  $Ea$  for the reaction ( $R = 127.71 \text{ kJ mol}^{-1}$ ).

[Hint. : Slope of the line =  $Ea/2.303 R$ ].

17. For the reaction in a close vessel :

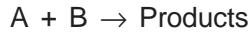


$$\text{Rate} = k [\text{NO}]^2 [\text{O}_2]$$

If the volume of the reaction vessel is doubled, how would it affect the rate of the reaction?

[Ans. : Diminish to 1/8 value of initial value]

18. The rate law for the reaction



is given by

$$\text{Rate} = k [\text{A}]^n [\text{B}]^m$$

On doubling the concentration of  $A$  and reducing the concentration of  $B$  to half of its original concentration, calculate the ratio of the new rate to the earlier rate of reaction.

**Hint. :** New rate =  $k [2\text{A}]^n \left[ \frac{\text{B}}{2} \right]^m$

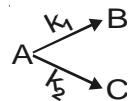
[Ans. :  $2^{(n-m)}$ ]

19. A first order reaction was started with a decimolar solution of the reactant. 8 minutes and 20 seconds later its concentration was found to be  $\frac{M}{1000}$ . Calculate the rate constant of the reaction.

**Hint.** :  $[R]_0 = \frac{M}{10} = 0.1\text{M}$ ;  $[R]_{5005} = \frac{M}{100} = 0.01\text{M}$ . Apply  $k = \frac{2.303}{t} \log \frac{[R]_0}{[R]}$

[Ans. :  $4.606 \times 10^{-3}\text{ S}^{-1}$ ]

20. A substance undergoes first order decomposition. The decomposition follows two parallel first order reactions as:



Given  $k_1 = 1.26 \times 10^{-4}\text{ S}^{-1}$ ;  $k_2 = 3.8 \times 10^{-5}\text{ S}^{-1}$ . Calculate the percentage of B and C formed.

**Hint.** : % of B =  $\frac{k_1}{k_1 + k_2} \times 100$ ; % of C =  $\frac{k_2}{k_1 + k_2} \times 100$

[Ans. : % of B = 76.83 ; % of C = 23.17]

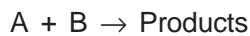
### 3 MARKS QUESTION (SHORT ANSWER QUESTIONS)

1. A reaction is first order in A and second order is B.
  - (i) Write the differential rate equation.
  - (ii) How is the rate affected on increasing the concentration of B three times?
  - (iii) How is the rate affected when the concentrations of both A and B are doubled?
2. The concentration of a reactant A at different time are given below :

$t(s)$	$[A]\text{ mol L}^{-1}$
0	$160 \times 10^{-3}$
5	$80 \times 10^{-3}$
10	$40 \times 10^{-3}$
20	$10 \times 10^{-3}$

Calculate the average rate of reaction  $A \rightarrow B$  during different interval of time.

3. (i) For a reaction



the rate law is given by

$$r = k[A]^{1/2} [B]^2$$

What is the order of the reaction?

- (ii) The conversion of molecules  $x$  to  $y$  follows second order kinetics. If concentration of  $X$  is increased to three times how will it affect the rate of formation of  $Y$ ?[Ans. : 9 times]
4. What is meant by zero order reaction? Derive an integrated rate equation for a zero order reaction.
5. The following data were obtained the first thermal decomposition of  $N_2O_5(g)$  at constant volume.

$2N_2O_5(g)$	$\longrightarrow$	$2N_2O_4(g) + O_2(g)$
Time/s		Total pressure/atm
0		0.5
100		0.152

Calculate the rate constant.

$$[Ans. : k = 4.92 \times 10^{-4} s^{-1}]$$

6. The reaction  $SO_2Cl_2(g) \xrightarrow{k} SO_2(g) + Cl_2(g)$  is a first order reaction with half life of  $3.15 \times 10^4$  s at 575K. What percentage of  $SO_2Cl_2$  would be decomposed on heating at 575K for 90 min.  
[Ans. : 11.2%]
7. A certain reaction is 50% complete in 20 min at 300 K and the same reaction is again 50% complete in 5 min at 350K. Calculate the activation energy if is a first order reaction. ( $R = 8.314 J K^{-1} mol^{-1}$ ,  $\log 4 = 0.602$ )  
[Ans. : 24.206 kJ/mol]
8. A reaction is 20% complete in 20 minutes. Calculate time for 80% completion, if the reaction follows first order kinetics.
9. During nuclear explosion one of the products is  $^{90}Sr$  with half life of 28.1 years. If 1  $\mu g$  of  $^{90}Sr$  was absorbed in the bones of a newly born baby instead of calcium, how much of it will remain after 10 years and 60 years if it is lost metabolically.

Hint. : Use  $k = \frac{0.693}{t_{1/2}}$  and then  $k = \frac{2.303}{t} \log \frac{[R]}{[R]_0}$  and find  $[R]$

$$[Ans. : \text{Amount left after 10 years} = 0.7814 \mu g, \text{Amount left after 60 years} = 0.227 \mu g]$$

10. The half-life for radioactive decay of  $^{14}C$  is 5730 years. An archaeopogical artifact containing wood had only 80% of the  $^{14}C$  found in a living tree. Estimate the age of the sample
11. Hydrolysis of methyl acetate in aqueous solution has been studied by titrating the liberated acetic acid against sodium hydroxide. The concentration of the ester at different times is given below.

$t/(min)$	0	30	60	90
$C(mol L^{-1})$	0.8500	0.8004	0.7538	0.7096

Show that it follows a Pseudo first order reaction as the concentration of water remain nearly constant ( $55 \text{ mol L}^{-1}$ ) during the course of the reaction. What is the value of 'k' in the equation?

$$\text{Rate} = k' [\text{CH}_3\text{COOCH}_3] [\text{H}_2\text{O}]$$

$$[\text{Ans. : } k' = 3.64 \times 10^{-5} \text{ mol}^{-1} \text{ L min}^{-1}]$$

**Hots\*12.** A hydrogenation reaction is carried out at  $500\text{k}$ . If the same reaction is carried out in the presence of a catalyst at the same rate. The temperature required is  $400\text{k}$  calculate the activation energy of the reaction if the catalyst lowers the activation barrier by  $20 \text{ kJ mol}^{-1}$ .

[Hint. :  $k = AE^{-Ea/RT}$ . In the absence of catalyst,  $Ea = x \text{ kJ mol}^{-1}$ . In the presence of catalyst,  $Ea = (x - 20) \text{ kJ mol}^{-1}$ ] [Ans. :  $Ea = 100 \text{ kJ mol}^{-1}$ ]

**Hots\*13.** The rate constat for the first order decomposition of  $\text{H}_2\text{O}_2$  is given by the following equation  $\log k = 14.34 - 1.25 \times 10^4 \text{ k/T}$ .

Calculate  $Ea$  for this reaction and at what Temperature will its half-period be 256 minutes.

**Hots\*14.** What percentage of the initial concentration of the reactant is left after two hours for a reaction whose rate constant is  $4.25 \times 10^{-5} \text{ s}^{-1}$ ?

[Hint. : Let  $[R]_0 = 1 \text{ mol L}^{-1}$

$$[R] = (1 - x) \text{ mol L}^{-1} \text{ (} x \text{ mol L}^{-1} \text{ have reacted in 2 hrs.)}$$

Use  $k = \frac{2.303}{t} \log \frac{[R]_0}{[R]}$  to find the value of  $x$  and then the percentage. [Ans. : 26.36%]

**Hots\*15.** Under the same conditions, initial concentration of  $1.386 \text{ mol dm}^{-3}$  of a substance become half in 40 second through first order and half in 20 seconds through zero order. Calculate  $\frac{k_1}{k_0}$

where

$k_1$  = rate constant for the first order reaction.

$k_0$  = rate constant for the zero order reaction.

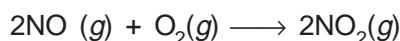
$$[\text{Hint. : } k_1 = \frac{0.693}{40} \text{ s}^{-1} \quad \text{using } t_{1/2} = \frac{0.693}{k}]$$

$$k_0 = \frac{1.386}{2 \times 20} \text{ mol dm}^{-3} \text{ s}^{-1}$$

$$[\text{Ans. : } 0.5 \text{ mol}^{-1} \text{ dm}^3]$$

## 5. Marks questions (long answer questions)

1. (i) List the factors affecting the rate of reaction.  
 (ii) What is rate law?  
 (iii) In the reaction.

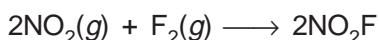


the following results are obtained.

S.No.	Initial [NO] mol L <sup>-1</sup>	Initial [O <sub>2</sub> ] / mol L <sup>-1</sup>	Initial rate of	Formation of NO <sub>2</sub> /mol L <sup>-1</sup> S <sup>-1</sup>
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	0.78

How is the rate of the reaction affected.

- (i) If the concentration of NO is doubled keeping the concentration of O<sub>2</sub> constant.
  - (ii) If the concentration NO is kept constant and concentration of O<sub>2</sub> is doubled.
  - (iii) Write the rate law expression for the reaction from the above observations.
2. Derive the integrated form of rate equation for a first order reaction. What will be the nature of the curve when log [conc] is plotted against time for such a reaction. Find out the slope of the curve.
3. (i) What is meant by 'half life period' of a chemical reaction? Show that the time required for the completion of half of the first order reaction is independent of the initial concentration of the reaction.
- (ii) Show that in a first order reaction time required for completion of 99.9% is 10 times of half-time( $t_{1/2}$ ) of the reaction.
4. (i) What is the effect of temperature on the rate constant of a reaction.
- (ii) Write Arrhenius equation showing the effect of temperature on reaction rate. What do the symbol significant.
- (iii) State the role of activated complex and its relation with the reactivation energy.
5. The following data were obtained for the reaction.



Expt.	Initial concentration [N <sub>2</sub> ]	[F <sub>2</sub> ] mol <sup>-1</sup>	Initial rate of Formation mol <sup>-1</sup> min <sup>-1</sup>
I	0.20	0.05	$6.0 \times 10^{-3}$
II	0.40	0.05	$1.2 \times 10^{-2}$
III	0.80	0.10	$4.8 \times 10^{-2}$

Determine (i) Order (ii) Rate Law

- (iii) Rate of reaction when [NO<sub>2</sub>] = 0.50 mol L<sup>-1</sup> and [F<sub>2</sub>] = 0.60 mol L<sup>-1</sup>.

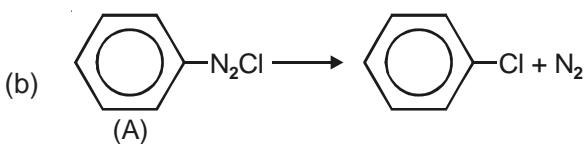
$$[\text{Ans. : (i) } 2; \text{ (ii) } r = k [\text{NO}_2] [\text{F}_2]; \text{ (iii) } 0.18 \text{ mol L}^{-1} \text{ min}^{-1}]$$

### HOTS OF 5 MARKS

6. (a) Rate constant  $k_1$  and  $k_2$  for two different reactions are  $10^{16} e^{-200/T}$  and  $10^{15} e^{-1000/T}$ , respectively. At what temperature will  $k_1$  be equal to  $k_2$ .

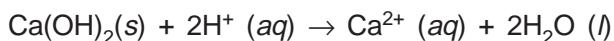
$$[\text{Hint. : Use } k = A \cdot e^{-E_a/RT}]$$

$$[\text{Ans. : } T = \frac{1000}{2.303} K]$$



Half life is independent of concentration of A. After 10 min, volume of nitrogen gas is 10 L and after complete reaction, volume nitrogen gas is 50 L. Calculate the rate constant for the reaction.

7. (a) The reaction  $\text{Ca}^{2+} (\text{aq}) + 2\text{OH}^- (\text{aq}) \rightarrow \text{Ca}(\text{OH}_2) (\text{s})$  is extremely fast while the reaction

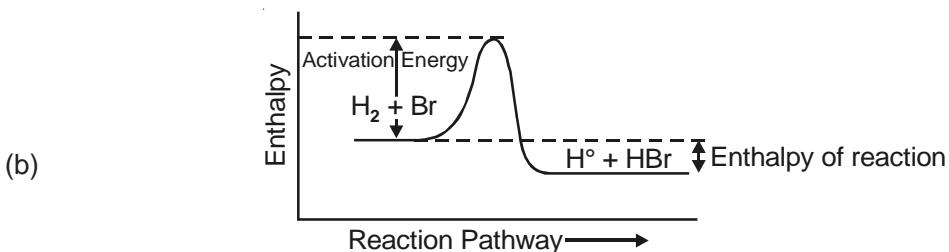


is fairly slow/ How can be difference in rates be explained?

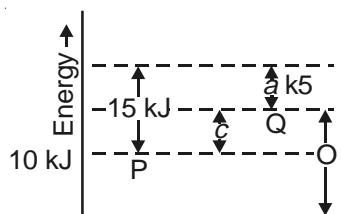
- (b) Some bromine molecules ( $\text{Br}_2$ ) are dissociated into free radicals ( $\text{Br}^\circ$ ). When ultraviolet light is absorbed by bromine gas. Propose a pathway to explain how bromine and hydrogen react in the presence of ultraviolet light to produce HBr (Enthalpy of formation of  $\text{HBr} = -363 \text{ kJ/mol}^{-1}$ ).

[Hint. : (a) 1st react is ionic reaction in aqueous form.

2nd react reactant is in solid-form.



8. The energy of activation for forward and backward reactions for a hypothetical reaction  $P \rightarrow Q$  are 15 kJ/mol and 9 kJ/mol respectively. Potential energy of P is 10 kJ/mol as shown in the graph.



### Predict

- (i) Threshold energy of the reaction.
- (ii) Potential energy of Q.
- (iii) Heat of Reaction.
- (iv) Type of reaction.

[Ans. : (i) 25 kJ; (ii) 16 kJ; (iii) 6 kJ; (iv) Endothermic]

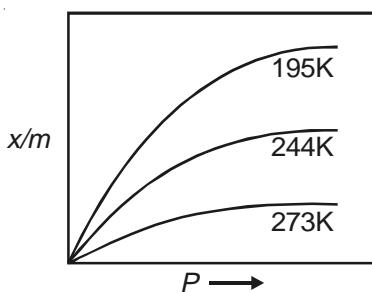
## UNIT 5

# SURFACE CHEMISTRY

### POINTS TO REMEMBER

**Adsorption :** Then phenomenon of attracting and retaining the molecules of a substance on the surface of a solid resulting into a higher concentration on the surface than in the bulk.

**Adsorption Isotherm (Freundlich Isotherm) :** The relationship between the extent of adsorption ( $x/m$ ) and pressure of the gas at constant temperature is known as adsorption isotherm.



$$\frac{x}{m} = k \cdot P^{1/n} \quad (n > 1)$$

where  $x$  is the mass of the gas adsorbed,  $m$  is the mass of the adsorbent at pressure  $P$ .

$k$  and  $n$  are the constants which depend on the nature of the adsorbent a gas at a particular temperature.

**Sorption :** A term used when both adsorption and absorption occur simultaneously.

**Desorption :** It is the process reverse of adsorption i.e., the removal of the adsorbed substance from the surface of the adsorbent.

**Occlusion :** It is the term used for adsorption of gases on a metal surface.

<i>Physical Adsorption</i>	<i>Chemisorption</i>
1. The adsorbate is held to the adsorbent by weak van der Waal's forces.	The adsorbate is held to the adsorbent by strong forces (i.e., Chemical bond).
2. Enthalpy of adsorption is low (20 – 40 kJ/mol).	Enthalpy of adsorption is high (80 – 240 kJ/mol).
3. Process is reversible and it decreases with temperature	Process is irreversible and it first increases and then decreases with temperature.
4. Non-Specific in nature	Specific in nature.
5. Forms multi-molecular layers on surface.	Forms unimolecular layer.

**Catalyst** : It is broadly divided into two groups.

- (i) Homogeneous catalysis in which the catalyst is in the same phase as are the reactants.
- (ii) Heterogeneous catalysis in which the catalyst is in the different phase from that of the reactant.

**Micelles** are associated colloids. Surface active agents like soaps and synthetic detergents belong to this class.

**CMS** (Critical Micelle Concentration) is the lowest concentration at which micelle formation appears. Micelles from the ionic surfactants can be formed only above a certain temperature called **Kraft Temperature**.

**Colloids** are heterogeneous in nature, have colligative properties, undergo Brownian motion, electrophoresed exhibit Tyndall effect.

**Emulsion** is dispersion of one liquid into another which are immiscible.

- Oil in water (O/W).
- Water in Oil (W/O).

To obtain stable emulsion, emulsifier is added, it is generally a long chain hydrocarbon derivative containing a polar end group ( $\text{SO}_3^-$ ).

## QUESTIONS

### 1 MARK QUESTIONS (VERY SHORT ANSWER QUESTIONS)

1. Write one point of difference between an adsorbate and an adsorbent.
2. Why does a finely divided substance more effective as an adsorbent than its crystalline form?
3. "Physical adsorption decreases with increase in temperature". Suggest a possible reason.
4. "Chemisorption is highly specific." Illustrate with an example.
5. State the relationship between the quantity of gas adsorbed by a solid adsorbent and the pressure of the gas.
6. When are gas masks used and how do they work?
7. Write the name of the catalyst used in the following process :
  - (i) Hydrolysis of the methyl acetate.
  - (ii) Oxidation of ammonia into nitric oxide by Ostwald process of Nitric acid.
8. Distinguish between a promoter and poison of a catalyst.
9. Indicate a chemical reaction involving homogeneous catalyst.
10. Name two industrial processes in which heterogeneous catalysts are employed.

11. Name a zeolite catalyst which directly convert alcohol into gasoline.
12. What is the importance of critical temperature in respect of adsorption of gases?
13. Why does  $\text{Fe(OH)}_3$  dispersed in water is a sol while glucose in water is considered a solution?
14. Name two naturally occurring macromolecular colloids.
15. What is meant by critical micelle concentration?
16. Identify the micelle in the following :
  - (i)  $\text{C}_{17}\text{H}_{35}\text{COO}^-\text{Na}^+$ ; (ii) Gold Sol; (iii) Solution of NaCl.
17. State the principle of dialysis.
18. Why do colloidal solutions show Tyndall effect?
19. Why does sky appears blue to us?
20. Name a silver sol used as an eye-lotion.

### HOTS (1 MARK)

21. Arrange the following gases in the decreasing order of their adsorption by the same mass of activated charcoal,  $\text{H}_2$ ,  $\text{CO}_2$ ,  $\text{CH}_4$ ,  $\text{NH}_3$ .  
[Ans. :  $\text{CO}_2 > \text{NH}_3 > \text{CH}_4 > \text{H}_2$ ]
22. How can the process of dialysis of a colloidal solution be made faster?  
[Ans. : By applying an electrical field across the Parchment bag]
23. "Medicines in colloidal form are more effective than in the solid form." Why?
24. A colloidal solution of ferrie hydroxide is mixed with  $\text{As}_2\text{O}_3$  sol what would be the observation mode?  
[Ans. : Their mutual precipitation takes place]
25. State the purpose of impregnating the filter paper with colloidion solution.  
[Ans. : The pores of filter paper get reduced in size and stop the flow of colloidal particles]
26. Using the phenomenon of physical adsorption, suggest how a mixture of noble gases can be separated?  
[Ans. : By adsorption on coconut charcoal at different temperature]
27. What form of Freunlich adsorption isotherm equation indicate that "adsorption is independent of pressure".  
[Ans. :  $\frac{x}{m} = k$ ]
28. State the sign of energy change involved when the molecules of a substance get adsorbed on a solid surface.  
[Ans. :  $\Delta H$  = negative]
29. What will be the charge on the colloidal particles in the following sols.
  - (i)  $\text{Fe(OH)}_3$  sol formed by addition of  $\text{FeCl}_3$  to excess of hot water;
  - (ii) Colloidal sol of Ag formed by addition of  $\text{AgNO}_3$  to KI.[Ans. : (i) +ve; (ii) -ve]

30. Which of the following is most effective in coagulating  $\text{Fe(OH)}_3$  sol and why?

(i)  $\text{KCl}$ ; (ii)  $\text{FeCl}_3$ ; (iii)  $\text{Na}_2\text{SO}_4$ ; (iv)  $\text{K}_3[\text{Fe}(\text{CH})_6]$

[Hint. :  $\text{Fe(OH)}_3$  sol being +vely charged; anion having highest -ve charge would be most effective]

### **2 MARKS QUESTIONS (SHORT ANSWER QUESTIONS)**

1. Distinguish between physisorption and chemisorption. Give four point of difference.

2. Justify the statement "Adsorption is an exothermic process".

3. What is an adsorption isotherm? In the relation  $\frac{x}{m} = k \cdot p^{\frac{1}{m}}$  ( $n > 1$ )

What do the symbols  $x$ ,  $m$ ,  $k$ ,  $P$  and  $n$  represent?

4. How can the validity of Freundlich isotherm be verified? What are its limitations?

5. Classify the following processes into absorption, adsorption or sorption.

(i) Anhydrous  $\text{CaCl}_2$  placed in the atmosphere saturated with water.

(ii) Aqueous solution of raw sugar passed over beds of animal charcoal.

(iii) A chalkstick dipped in ink.

(iv) Addition of animal charcoal to methylene blue.

6. How is the phenomenon of adsorption helpful in

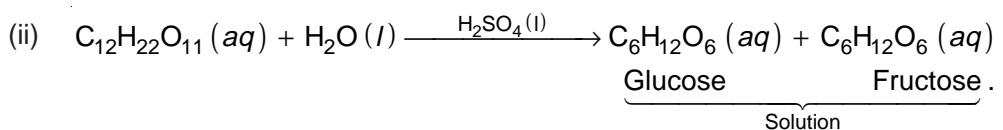
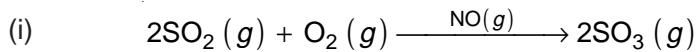
(i) Production of high vaccum.

(ii) Control of humidity.

(iii) Separation of inert gases.

(iv) Forth floatation process.

7. Identify the following processes as homogeneous or heterogeneous catalysis, giving reason :-

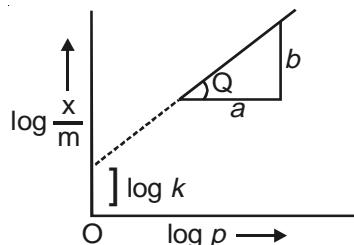


8. (i) How do enzymes differ from catalysts?

- (ii) Name the enzyme catalyse using the following reactions.
- Conversion of glucose into ethyl alcohol.
  - Decomposition of urea into ammonia and carbon dioxide.
9. Suggest a mechanisms of enzyme catalysed reaction along with the diagram.
10. What are lyophilic and lyophobic colloids? Give one example of each type.
11. (i) Why does a gas mixed with another gas not form a colloidal system?  
(ii) Give one example each of :
- A liquid dispersed into solid.
  - A gas dispersed in a liquid.
12. (i) In what way a sol is different from a gel?  
(ii) Why do lyophilic sols do not require stabilising agent.
13. "Action of soap is due to emulsification and micelle formation". Justify giving the suitable example.
14. What is colloidion? How is ultra filter paper prepared using a colloidion? Describe the ultra filtration process used in the separation of colloidal particles.
15. State "Hardy Schulze" rule with example.
16. What are emulsions? List the two types of emulsions giving one example of each type.
17. What is an emulsifying agent? What role does it play in forming an emulsion?

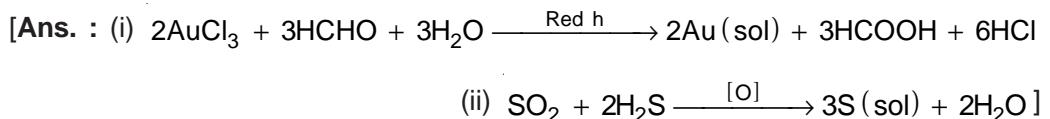
### HOTS (2 MARKS)

18. Which of the following gases be adsorbed readily on the surface of 1g of charcoal and why?  
(i)  $\text{CH}_4$  gas;    (ii)  $\text{SO}_2$  gas.
- [Ans. :  $\text{SO}_2$  has higher critical temperature than  $\text{CH}_4$ , is easily liquefiable and the van der Waal's forces are stronger near the critical temperature]
19. What will be the (i) slope and (ii) probable value of the slope for the following graph drawn between the quantity of gas adsorbed by unit mass of solid adsorbent and pressure at a particular temperature.



[Ans. : Slope =  $\frac{1}{n}$    Probable value of slope = 0  $\rightarrow 1$ ]

20. A small amount of silica gel and a small amount of anhydrous calcium chloride are placed separately in two corners of the laboratory. Name the phenomenon that takes place in both the cases. [Ans. : Silica gel – adsorption; Anhydrous  $\text{CaCl}_2$  – absorption as it forms  $\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$ ]
21. Arrange  $\text{NaCl}$ ,  $\text{MgCl}_2$  and  $\text{AlCl}_3$  in the order in which they are required to coagulate 10 ml of 0.1 M  $\text{AS}_2\text{S}_3$  solution? Suggest a suitable reason.  
 [Ans. :  $\text{AlCl}_3 < \text{MgCl}_2 < \text{NaCl}$ . As according to Hardy Schulze rule, greater the valence of the flocculating ion, greater is the precipitating power i.e.,  $\text{Al}^{3+} > \text{Mg}^{2+} > \text{Na}^+$ . Since the coagulating power of  $\text{AlCl}_3$  being higher will be required in smaller quantities.]
22. How can you distinguish between the two emulsions :
- Oil in water type;
  - Water in Oil type
- [Hint. : By dilution with water].
23. Account for the following :
- A delta is formed at the point where the river enters the sea.
  - Artificial rain can be caused by spraying electrified sand on the clouds.
24. Write the reaction involved in the
- Preparation of gold sol by reduction method.
  - Preparation of sulphur Sol by oxidation method.



### 3 MARKS QUESTIONS (SHORT ANSWER QUESTIONS)

- How are colloids classified on the basis of :
  - Physical state of the components.
  - Nature of dispersion medium.
  - Interaction between dispersed phase and the dispersion medium.
- (i) Write the important feature of the modern adsorption theory of heterogeneous catalysis.  
 (ii) What do you mean by activity and selectivity of a catalyst?
- (i) What is shape selective catalysis?  
 (ii) Give an example of a shape selective catalyst.  
 (iii) Describe two features of catalysis by zeolites.

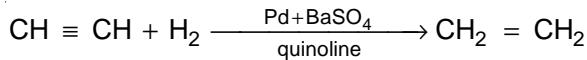
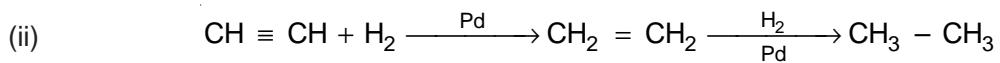
4. (i) Write the optimum temperature and optimum pressure for enzyme catalysed reactions.
- (ii) What are activators? Give two examples. How do the activators increase the catalytic activity?
5. Distinguish between multimolecular and macromolecular colloids. Give one example of each. How are associated colloids different from those of two type of colloids.
6. Describe the method of preparation of colloids by :
  - (i) Chemical method
  - (ii) Bredig's arc method
  - (iii) Peptization
7. Explain the terms with suitable example :
  - (i) Alcohol; (ii) Aerosol; (iii) Hydrosol
8. (i) Hydrated Ferric oxide is positively charged. Give reasons.  
(ii) Define Zeta-potential taking an example.  
(iii) "The presence of equal and similar charges on colloidal particles provides stability to the colloidal system". Explain.
9. Describe briefly the cleansing action of soap.
10. Explain what happens.
  - (i) When a beam of light is passed through a colloidal solution.
  - (ii) An electrolyte NaCl is added to hydrated ferric hydroxide sol.
  - (iii) Electric current is passed through a colloidal sol.
11. (i) How are emulsions useful in preparing photographic plates or films?  
(ii) Explain with diagram the process of electrical precipitation of smoke.
12. Explain the following terms :
  - (i) Dialysis
  - (ii) Coagulation
  - (iii) Tyndall Effect
  - (iv) Brownian movement.

### HOTS (3 MARKS)

13. Suggest suitable reason for the following :
  - (i) Zig Zag movement of colloidal particles.

- (ii) Use of special type of filter papers for the filtration of colloidal sole.
- (iii) Bleeding from a fresh cut can be stopped by applying alum.
14. (i) What property of colloids is responsible for the sun to look red at the time of setting?
- (ii) Acetylene on addition with hydrogen forms ethane in the presence of palladium but if barium sulphate and quinoline are added along with palladium, the product is ethene. Give reason. Support your answer by describing the reactions involved.

[Ans. : (i) At the time of setting, sun is at the horizon and blue part of the light is scattered away by the dust particles as light has to travel a long distance through the atmosphere.



15. (i) How does the size of the colloidal particles comparable to the size of the particles present in true solution.
- (ii) Calculate the ratio of the volume of the colloid particle ( $V_C$ ) and volume of the solute particles in a true solution ( $V_S$ ).

[Hint. : For true solution diameter range = 1 to  $< 10 \text{ \AA}$

For colloidal dolution diameter range = 10 to 1000  $\text{\AA}$

Taking the lower limits :

$$\frac{V_C}{V_S} = \frac{\frac{4}{3} \pi r_c^3}{\frac{4}{3} \pi r_s^3} = \frac{r_c^3}{r_s^3} = \frac{(10/2)^3}{(1/2)^3} = 10^3$$

16. 1 g of charcoal adsorbs 100 ml of 0.5 M  $\text{CH}_3\text{COOH}$  to form a monolayer and thereby molarity of  $\text{CH}_3\text{COOH}$  is reduced to 0.49 M. Calculate the surface area of the charcoal used in adsorbing one molecule of  $\text{CH}_3\text{COOH}$ . (Surface area of 1g charcoal is =  $3.01 \times 10^2 \text{ m}^2/\text{g}$ ).

[Ans. : No. of moles of  $\text{CH}_3\text{COOH}$  present initially =  $\frac{0.5}{1000} \times 1000 = 0.05 \text{ mol}$

No. of moles of  $\text{CH}_3\text{COOH}$  left after adsoption =  $\frac{0.49}{1000} \times 1000 = 0.049 \text{ mol}$

No. of moles of  $\text{CH}_3\text{COOH}$  adsorbed =  $0.05 - 0.049 = 0.001 \text{ mol} = 1 \times 10^{-3} \text{ mol}$

No. of moles of  $\text{CH}_3\text{COOH}$  adsorbed =  $1 \times 10^{-3} \times 6.022 \times 10^{23} \text{ molecule}$

$6.022 \times 10^{20} \text{ molecules get adsorbed on surface area} = 3.01 \times 10^2 \text{ m}^2$

Molecules get adsorbed on surface area =  $3.01 \times 10^2 \text{ m}^2 / 6.022 \times 10^{20} = 5.0 \times 10^{19} \text{ m}^2]$

## **UNIT 6**

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# **GENERAL PRINCIPLES AND PROCESSES OF ELEMENTS**

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### **POINTS TO REMEMBER**

1. The minerals from which metals are extracted are called ores.
2. The ores are concentrated by various methods like hydraulic washing, magnetic separation, froth floatation method and leaching.
3. Metal carbonate and hydrate metal oxide ores are converted to metal oxide by calcination.
4. Metal sulphate moves the roasted to form metal oxide.
5. Metal oxides are reduced to metal by reducing agents like C, Co and reactive metals.
6. Ellingham diagram (plot of  $\Delta G^\circ$  per mol<sup>-1</sup> of O<sub>2</sub> verses T) provides the basis for the choice of reducing agent for the reduction of metal oxide.
7. The criterion of feasibility is that the net Gibbs energy must be negative at a particular temperature.
8. In Ellingham diagram the reduction of oxide of the metal represented by upper line is feasible by metal represented by the lower line.
9. The concept of electrode potential is used in the electrometallurgy of aluminium. If the sum of electrode potentials of the two redox couples is positive, therefore Gibbs energy change would be negative.
10. The crude metals thus extracted require refining. Refining process depends upon the difference in the properties of impurities and the metal.
11. Chromatography is very useful for the purification of the elements which are available in minute quantities and impurities are not different in chemical properties from the element to be purified.

### **QUESTIONS**

#### **1 MARK QUESTIONS**

1. Write the name and formula of a mineral that contains both Iron and copper.
2. State the principle involved in the concentration of an ore by magnetic separation.
3. Name the method used in the concentration galena and copperpyrites ores.
4. What is the role of depressant in froth floatation method? Name the process used to convert. A metal sulphide ore to metal oxide.

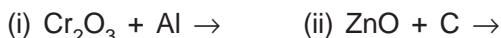
5. Name any two elements present in anode mud in the electrolytic refining of copper.

[Hint. : antimony, selenium, tellurium, silver, gold and platinum]

6. Write the two functions of cryolite in the metallurgy of aluminium.

7. What happens when roasted ore of copper is heated with silica?

8. Complete the reaction.



9. Write the importance of graphite rod in the metallurgy of aluminium.

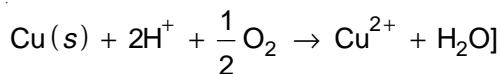
10. How is cast iron different from pig iron?

11. How is cast iron made from pig iron?

12. Write the significance of leaching in the extraction of aluminium.

13. How is leaching carried out in case of low grade copper ores?

[Hint. : Low grade copper ores are leached with dilute copper in presence of air or bacteria



14. What is meant by the term "chromatography"?

15. What criterion is followed for the selection of stationary phase in chromatography?

### HOTS (1 MARK)

16. Although aluminium is above hydrogen in the electrochemical series, it is stable in air and water.

[Hint. : Aluminium is coated with invisible  $\text{Al}_2\text{O}_3$  layer which makes aluminium resistant to the further reaction with air and water.]

17. Zinc and not copper is used for the recovery of metallic silver from the complex  $[\text{Ag}(\text{CN})_2]^-$ , although electrode potentials of both zinc and copper are less than that of Ag. Explain why?

[Hint. : Zinc reacts at faster rate as compared with copper further zinc is cheaper than copper.]

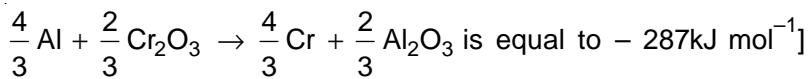
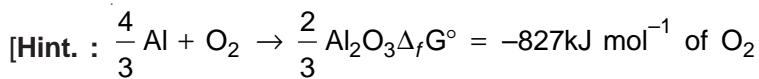
### 2 MARKS QUESTIONS

1. Write the chemical reactions taking place in different zones in the blast furnace.

2. Giving examples, write two points of difference between roasting and calcination.

3. How are impurities separated from a bauxite ore to get pure alumina?

4. The  $\Delta_f G^\circ$  values for the formation of  $\text{Cr}_2\text{O}_3$  and  $\text{Al}_2\text{O}_3$  are  $-540$  and  $-827 \text{ kJ mol}^{-1}$  of  $\text{O}_2$  respectively. Is the reduction of  $\text{Cr}_2\text{O}_3$  possible with Al. Justify your answer.



5. Write the chemical equations of the reactions involved in the extraction of zinc from zinc blade or calamine.

- Hots\*6.** At a site low grade copper ores are available. Zinc and iron scraps are also available. Which of the scraps would be more suitable for reducing the leached copper ores and why?

[Hint. : Electrode potential of zinc is more negative than that of iron. So reduction of  $\text{Cu}^{2+}$  ions will be faster with zinc scraps. But zinc is costlier metal than iron so using iron scraps will be more advantageous.]

- Hots\*7.** Why is the reduction of a metal oxide easier if metal formed is in liquid state at the temperature of reduction?

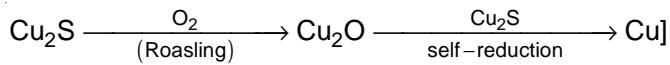
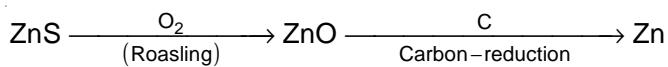
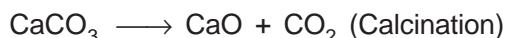
[Hint. : When metal oxide is in solid state and metal formed is in liquid state.  $T\Delta S$  will be more positive and hence  $\Delta_f G^\phi$  will be more negative].

- Hots\*8.** Copper can be extracted by hydrometallurgy but not zinc. Explain why?

[Hint. : Since  $E_{Zn^{2+}}^\phi/Zn$  is lower than that of  $E_{Cu^{2+}}^\phi/Cu$ , zinc displace Cu from  $\text{Cu}^{2+}$  in solution  $\text{Zn}^{2+}$  cannot be displaced by metals like Al, Mg, Ca etc. although electrode potentials are lower than that of Zn. Since these reactive metal have lower electrode potential than that of  $\text{H}_2\text{O}$ , these reactive metals reacts with  $\text{H}_2\text{O}$  forming their corresponding ions and liberating  $\text{H}_2$  gas].

- Hots\*9.** Match the conversions listed in column I with the type(s) of reaction (s) given in column II

	Column I	Column II
A	$\text{PbS} \rightarrow \text{PbO}$	(p) Roasting
B	$\text{CaCO}_3 \rightarrow \text{CaO}$	(q) Calcination
C	$\text{ZnS} \rightarrow \text{Zn}$	(r) Carbon reduction
D	$\text{Cu}_2\text{S} \rightarrow \text{Cu}$	(s) Self-reduction



**Hots\*10.** The active silver forms a water soluble complex with dilute aqueous solution of NaCN in presence of a gas J. The silver metal is obtained by the addition of a metal K. Write the structures of [L] and [M] and identify J and K in the following reaction sequence.



[Hint. : Metallurgy of silver : J = O<sub>2</sub>; [L] ≡ Na[Ag(CN)<sub>2</sub>]



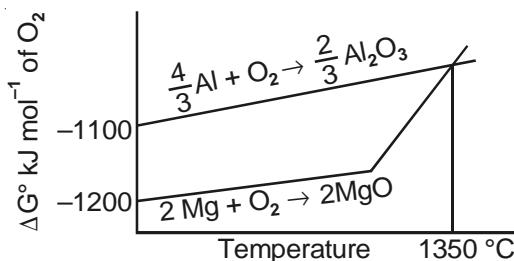
### 3 MARKS QUESTIONS

1. Name the principles ore of aluminium. How is pure aluminium extracted from alumina? Draw the labelled diagram of the electrolytic cell?
2. Name the principles ore of iron. Write the chemical reactions that take place in different zones of blast furnace.
3. How is pure copper obtained from its principle ore? Write the chemical reactions that occur in the extraction.
4. State the principles of refining of metals in the following methods:
  - (i) Zone refining
  - (ii) Electrolytic refining
  - (iii) Vapour phase refining.
5. How is copper extracted and iron low grade ores and scraps? Write chemical reactions involved in the extraction.

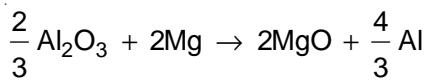
**Hots\*6.** Suggests a condition under which :

- (i) Mg could reduce alumina (Al<sub>2</sub>O<sub>3</sub>).
- (ii) Al could reduce MgO.

[Hint. : The Gibbs energy  $\Delta G^\theta/\text{kJ mol}^{-1}$  of O<sub>2</sub> and temp. (T) plots for the formation of oxides Al<sub>2</sub>O<sub>3</sub> and MgO show that reduction of oxide of the upper line is feasible by the element represented by the lower line.

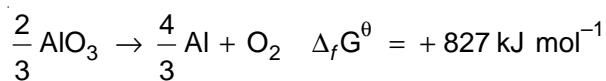
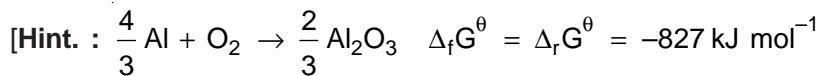


At the point of interaction of Al<sub>2</sub>O<sub>3</sub> and MgO curves, the  $\Delta G^\theta$  becomes zero for the reactions.



Below  $1350^{\circ}\text{C}$ , the oxide represented by upper line, i.e.,  $\text{Al}_2\text{O}_3$  will be reduced by the element shown by lower i.e., Mg. Above  $1350^{\circ}\text{C}$  the oxide represented by lower line would become Al. Therefore Al].

7. Calculate the minimum *emf* required to carry out the electrolysis of  $\text{Al}_2\text{O}_3$ . Given that  $\Delta G_f^\theta (\text{Al}_2\text{O}_3) = -827 \text{ kJ mol}^{-1}$  of  $\text{O}_2$  involved. Faraday's constant ( $F$ ) =  $96500 \text{ C mol}^{-1}$



No of electrons involved in this redox reaction = 4

$$\Delta G^\theta = n E_{\text{Cell}}^\circ F$$

$$E^\theta = \frac{\Delta_r G^\theta}{n F} = -\frac{+827 \times 10^3 \text{ J mol}^{-1}}{4 \times 96500 \text{ C mol}^{-1}}$$

$$= -2.14 \text{ J/c} = -2.14 \text{ V.}$$

[(–)ve sign shows that *emf.* of 2.14 V is required].

## UNIT 7

# p – BLOCK ELEMENTS

### POINTS TO REMEMBER

1. The general electronic configuration of *p*-block elements is  $ns^2 np^{1-6}$ .
2. The maximum oxidation state shown by a *p*-block element is equal to the number of valence electrons. This is called group oxidation state.
3. The group oxidation state is most stable for the lighter elements.
4. The oxidation state two units less than the group oxidation state becomes progressively more stable as we descend the group. This is due to inert pair effect.
5. *Interpair effect* : Due to poor shielding effect of intervening *d*- and or *f*-orbitals, the increased effective nuclear charge holds the  $ns^2$  electrons so tightly that the energy required to unpair these electrons cannot be compensated by the energy released during the formation of two additional bonds.
6. The first member of each group of *p*-block elements *i.e.*, N, O and F of group 15, 16 and 17 show anomalous behaviour. This is due to small size, high electronegativity and absence of *d*-orbitals in their valence shell.
7. The maximum covalence shows by N, O and F in four because they have only four orbitals (one *s* and three *p*) in their valence shell.
8. Group 15 elements exhibits two important oxidation states +3 and +5 but +3 acidification state is favoured by heavier elements due to inert pair effect.
9. Oxygen shows usually -2 oxidation state. The stability of -2 oxidation decreases down the group due to decrease in the electronegativity of the group 16 elements.
10. Stability of +6 oxidation state shown by group 16 elements decreases and that of +4 increases on descending the group 16. This is due to inert pair effect.
11. Fluorine always shows -1 oxidation state other halogen also show -1 oxidation state. They also show (+) oxidation states of +1, +3, +5 and +7.
12. Fluorine form one oxoacid but other halogens shows a series of oxoacids. This is due to the absence of *d*-orbitals in the valence shell of F.
13. Stability of hydrides of group 15, 16 and 17 elements decreases down the group due to increase in the size of the group elements.
14. The reducing nature of hydrides increases down the group.
15. P forms a number of oxoacids. Their basicity is determined by the number of P–OH bonds. Oxoacids having P–H bonds are used as reducing agent.

16. Interhalogens  $\text{XX}_n$  (where X is higher than X and  $n = 1, 3, 5, 7$ ) are more reactive than halogens  $\text{X}_2$  except  $\text{F}_2$ .
17. Group 18 elements are least reactive because they have complete octet of outer most shell-except helium (He) which has fully filled 15 orbital.
18. How to determine the hybridisation.

$$X = \frac{1}{2}(V + S + E)$$

where V = Valence electrons of the atom of which hybridisation is to be determined.

S – No. of electrons shared by attached atoms.

No. of  $\sigma$  bonds – No. of  $\pi$  bonds

E – Charge, add one for negative and subtract one for each positive charge.

<i>x</i>	Type of Hybridisation	Shape	Bond Angle
2	SP	Linear	$180^\circ$
3	$\text{SP}^2$	Trigonal Planar	$120^\circ$
4	$\text{SP}^3$	Tetrahedral	$109^\circ 28'$

## QUESTIONS

### 1 MARK QUESTIONS

1. Write the chemical formula of fluorapatite.
  2. The ionization enthalpy of group 15 elements is much higher than those of corresponding elements of group 14 why?
  3. Maximum covalence of Nitrogen is '4' but the heavier elements of Group 15 show covalence greater than '4' Why?
  4. Why does nitrogen form diatomic molecule?
- Hots\***
5. N–N single bond is weaker than P–P single bond. Why?
  6. Among group 15 elements. Why does nitrogen show anomalous behaviour?
  7. Which has lower boiling point.  $\text{PH}_3$  or  $\text{NH}_3$ ? Why?
  8. Why is  $\text{BiH}_3$  the strongest reducing agent amongst all the hydrides of group 15 elements?
  9. Why is  $\text{NH}_3$  considered a lewis base?
  10. What happens when freshly prepared precipitate of  $\text{AgCl}$  is treated with ammonia solution?
  11.  $\text{NO}_2$  dimerise to form  $\text{N}_2\text{O}_4$ . Why?
  12. Draw the structure of  $\text{P}_4$  molecule.

13. Draw the structure of  $\text{PCl}_5$  molecule.
  14. Draw the structure of solid  $\text{PCl}_5$ .
  15. Write the reaction of  $\text{PCl}_5$  with heavy water.
  16. How many P–O–P bonds are there in cyclotrimeta phosphoric acid?
- Hots\*** 17.  $\text{H}_3\text{PO}_2$  is used as reducing agent. Why?
18. Group 16 elements have lower ionization enthalpy values than the corresponding elements of group 15. Why?
  19. In group 16, the stability of +6 oxidation state decreases and that of +4 oxidation state increases down the group. Why?
  20. Why does the acidic character of hydrides of group 16 elements increase down the group?
  21. What is the covalence of nitrogen in  $\text{N}_2\text{O}_5$ ?
  22. Write the chemical equation of the reaction that occurs between conc.  $\text{HNO}_3$  and  $\text{P}_4$ .
  23. Thermal stability of hydrides of group 16 elements decreases down the group. Why?
  24. Second ionization constant of  $\text{H}_2\text{SO}_4$  (*aq*) is much lesser than its first ionization constant. Why?
  25. Explain why fluorine forms only one oxoacid (HOF).
  26. Fluorine exhibit only –1 oxidation state while other halogens exhibit +1, +3, +5 and +7 oxidation states also explain. Why?
  27. Compare the oxidising powers of  $\text{F}_2$  and  $\text{Cl}_2$  on the basis of bond dissociation enthalpy and electron gain enthalpy.

**Hots\*** 28. Why is nitrogen and phosphorus tetra atomic?

[Hint. : Due to larger size of phosphorus effective  $p\pi-p\pi$  bonding is not possible.]

**Hots\*** 29. Draw the structure of  $\text{H}_2\text{S}_2\text{O}_7$  and find out the number of S–S bond if any.

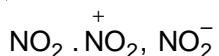
**Hots\*** 30. Draw the structure of  $\text{P}_4\text{O}_{10}$  and determine the number of P–O single and double bonds.

**Hots\*** 31. Which one of the following is not oxidised by  $\text{O}_3$ . State the reason for your choice.



[Hint. :  $\text{KMnO}_4$  since Mn is showing maximum oxidate of +7.]

**Hots\*** 32. Arrange the following triatomic species in the order of increasing bond angle.



[Hint. :  $[\ddot{\text{O}}-\ddot{\text{N}}-\ddot{\text{O}}]$ ;  $[\ddot{\text{O}}-\ddot{\text{N}}-\ddot{\text{O}}]^+$ ;  $[\ddot{\text{O}}-\ddot{\text{N}}-\ddot{\text{O}}]^-$ ]

$\text{NO}_2$  has one non-bonding electron and  $\text{NO}_2^-$  has two non-bonding electrons on Nitrogen atom and  $\text{NO}_2^+$  has no non-bonding electron on Nitrogen atom. Hence  $\text{NO}_2^-$  has minimum bond angle and  $\text{NO}_2^+$  maximum bond angle].

**Hots\*33.** Arrange following oxides in the order of increasing acid strength :  $\text{Cl}_2\text{O}_7$ ,  $\text{SO}_2$ ,  $\text{P}_4\text{O}_{10}$ .

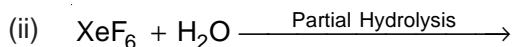
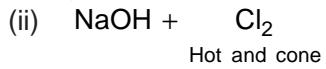
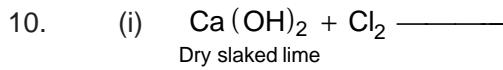
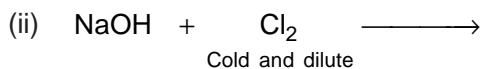
[**Hint.** : Acid strength of oxides increases along the period with the increase in the atomic number of element.]

**Hots\*34.** Why can't  $\text{NH}_3$  be dried by anhydrous  $\text{CaCl}_2$

[**Hint.** :  $\text{CaCl}_2 + 8 \text{ NH}_3 \rightarrow \text{CaCl}_2 \cdot 8\text{NH}_3$ ].

## 2 MARKS QUESTIONS

- How is nitrogen prepared in the laboratory? Write the chemical equation of the reaction involved. Explain why  $\text{N}_2$  is not reactive at room temp.
- How is ammonia manufactured industrially? Write the conditions that favour the formation of  $\text{NH}_3$ . How does  $\text{NH}_3$  act as a complexing agent?
- Complete the following reactions :
  - $\text{Na}_2\text{S}_2\text{O}_3 + \text{Cl}_2 + 5\text{H}_2\text{O} \longrightarrow$
  - $\text{FeCl}_3(\text{aq}) + \text{NH}_4\text{OH} \longrightarrow$
- $(\text{NH}_4)_2\text{Cr}_2\text{O}_7 \xrightarrow{\Delta} \dots$
  - $\text{NH}_4\text{NO}_3 \xrightarrow{\Delta} \dots$
- $\text{P}_4 + \text{NaOH} + \text{H}_2\text{O} \xrightarrow{\Delta} \dots$
  - $\text{Zn} + \text{HNO}_3 \text{ (conc.)} \xrightarrow{\Delta} \dots$
- $\text{Ca}_3\text{P}_2 + \text{H}_2\text{O} \longrightarrow \dots$
  - $\text{Cu SO}_4 + \text{PH}_3 \longrightarrow \dots$
- $\text{CH}_3\text{COOH} + \text{PCl}_3 \longrightarrow \dots$
  - $\text{PCl}_3 + \text{H}_2\text{O} \xrightarrow[\text{excess}]{} \dots$
- $\text{Cu} + \text{H}_2\text{SO}_4 \xrightarrow[\text{(conc.)}]{} \dots$
  - $\text{Na}_2\text{SO}_3 + \text{SO}_2 + \text{H}_2\text{O} \longrightarrow \dots$
- $\text{F}_2 + \text{H}_2\text{O} \longrightarrow \dots$



12. How is sulphuric acid manufactured by contact process? Write the conditions and chemical reactions involved.

13. How is hydrogen chloride gas prepared? How is it converted into hydrochloric acid? Write chemical reactions involved.

14. How are  $\text{XeO}_3$  and  $\text{XeOF}_4$  prepared? Write chemical equations of reactions involved.

15. Account for following :

(i) Pentahalides of group 15 elements are more covalent than their trihalides.

(ii) Bond angle in  $\text{PH}_4^+$  is higher than that in  $\text{PH}_3$ .

16. (i)  $\text{PCl}_3$  fumes in moist air.

(ii) Phosphinic acid (hypophosphoric acid) is monoprotic but phosphonic acid (oxiphosphorous acid) is diprotic.

17. (i) Dioxygen is a gas while sulphur is a solid.

(ii) In group 16, the stability of -2 oxidation state decreases down the group.

18. (i) The two oxygen – oxygen bonds in ozone are identical.

(ii) Sulphur in vapour state is paramagnetic in nature.

19. (i) Compare the bleaching of chlorine and sulphur dioxide.

(ii) Why do noble gases have very low boiling points.

(iii) Explain why halide of higher oxidation state are more covalent than in lower oxidation state.

What happens when : (write the chemical equations of the reaction involved).

20. (i) Copper reacts with conc.  $\text{H}_2\text{SO}_4$ .

(ii)  $\text{NaCl}$  is heated with conc.  $\text{H}_2\text{SO}_4$  in presence of  $\text{MnO}_2$ .

21. (i)  $\text{Cl}_2$  gas is passed into a solution of  $\text{NaI}$ .

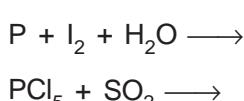
(ii)  $\text{XeF}_2$  is reacted with pentafluoride of phosphorus.

22. (i) Ammonia is treated with a solution of  $\text{Cu}^{2+}$  ions.  
(ii) Sugar is heated with conc.  $\text{H}_2\text{SO}_4$ .
23. (i) ICl is more reactive than  $\text{I}_2$ . Give reason.  
(ii) Group 18 elements are called noble gases.
24. (i) Bleaching action of  $\text{SO}_2$  is temporary while that of  $\text{Cl}_2$  is permanent.  
(ii) F<sub>2</sub> is more powerful oxidant than Cl<sub>2</sub> although electron gain enthalpy of chlorine (Cl) is more negative than that of fluorine (F).

### 2 MARKS QUESTIONS (HOTS)

25. Suggest reason why only binary compounds of noble gases are fluorides and oxides of krypton xenon and radon.  
[Hint. : F and O both are most electronegative elements and Kr, Xe and Rn have low ionisation enthalpies as compared with He, Ne and Ar].
26. Which fluorinating agents are often used instead of F<sub>2</sub>? Write two chemical equations showing their use as fluorinating agents.  
[Hint. :  $4\text{ClF}_3 + 2\text{Al}_2\text{O}_3 \longrightarrow 4\text{AlF}_3 + 2\text{Cl}_2 + 3\text{O}_2$   
 $\text{BrF}_5 + 3\text{H}_2\text{O} \longrightarrow \text{HBrO}_3 + 5\text{HF}$   
 $2\text{IF}_7 + \text{SiO}_2 \longrightarrow 2\text{IOF}_5 + \text{SiF}_4$
27. (i) Write two chemical equations which may represent the oxidising nature of Xenon fluorides.  
[Hint. :  $\text{Xe F}_4 + 2\text{H}_2 \longrightarrow \text{Xe} + 4\text{HF}$   
 $\text{Xe F}_6 + 3\text{H}_2 \longrightarrow \text{Xe} + 6\text{HF}$
- (ii) Why is hydrolysis of  $\text{XeF}_6$  not regarded as a redox reaction?

28. Why are following reactions regarded as disproportionation reactions?  
(i)  $\text{P}_4 + \text{NaOH} + \text{H}_2\text{O} \longrightarrow$   
(ii)  $\text{O}_2^- \longrightarrow \text{O}_2 + \text{O}_2^{2-}$
29. Complete the following reactions :



### 3 MARKS QUESTIONS

1. How is SO<sub>2</sub> prepared in the laboratory? Give chemical equation of the reaction involved. What happens when SO<sub>2</sub> is treated with (i) Cl<sub>2</sub> (ii) acidified KMnO<sub>4</sub> solution.
2. In the preparation of O<sub>3</sub> from O<sub>2</sub>, a silent electric discharge is used. Why? Give the Chemical equations of the reactions involved when O<sub>3</sub> is treated with (i) PbS and (ii) KI solution.

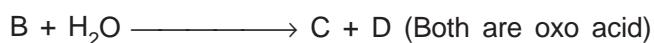
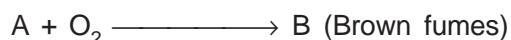
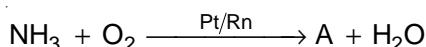
3. (i) How is  $\text{XeO}_3$  prepared from  $\text{XeF}_6$ ? Give chemical equation of reaction involved.  
(ii) Draw the structure of  $\text{XeF}_6$  and  $\text{XeF}_4$  molecules.
4. Write the reaction involved in the preparation of  $\text{XeF}_2$ ,  $\text{XeF}_4$  and  $\text{XeF}_6$ .
5. Arrange the following the order of property indicated for each set.
- (i)  $\text{F}_2$ ,  $\text{Cl}_2$ ,  $\text{Br}_2$ ,  $\text{I}_2$  – Increasing bond enthalpy  
(ii) HF, HCl, HBr, HI – Increasing acid strength.  
(iii)  $\text{NH}_3$ ,  $\text{PH}_3$ ,  $\text{ASH}_3$ ,  $\text{SbH}_3$ ,  $\text{BiH}_3$ , Increasing base strength.
6. Give the formula and describe the structure of noble gas species which is iso structural with :
- (i)  $\text{ICl}_4^-$   
(ii)  $\text{IBr}_2^-$   
(iii)  $\text{BrO}_3^-$
7. How is  $\text{Cl}_2$  prepared in the laboratory? Give the chemical equation of the reaction involved when  $\text{Cl}_2$  is treated with (i)  $\text{P}_4$  and (ii)  $\text{NH}_3$ .
8. Account for the following :
- (i) Xenon and Fluorine from compounds.  
(ii) Inspite of nearly the same electronegativity oxygen from hydrogen bonds while chlorine does not.  
(iii) Helium is used as diluent in modern diving apparatus.
9. (i) How is hydrogen chloride prepared?  
(ii) When HCl reacts with finely powdered iron, it forms ferrous chloride and not ferric chloride. Why?  
(iii) Deduce the structure of  $\text{ClF}_3$  on the basis of VSEPR theory.
10. How is phosphine prepared? How is it purified? In what way can it be proved that  $\text{PH}_3$  is basic in nature. Which reaction occurs when the solution of  $\text{PH}_3$  in water is irradiated with light.

## 5 MARKS QUESTIONS

1. (i) What inspired Neil Barlett for carrying between Xe and  $\text{PtF}_6$ ?  
(ii) Account for the following.  
(a) Noble gases have comparatively large size in their respectively periods.  
(b)  $\text{H}_2\text{O}$  is a liquid where on  $\text{H}_2\text{S}$  is gas.  
(c) BP of HF (293K) is much higher than that of HCl (189K).

2. Why does nitrogen show anomalous behaviour? Discuss the trend of chemical reactivity of group 15 elements with :
- (i) Hydrogen; (ii) Oxygen; (iii) Halogens; (iv) Metals.
3. Assign a possible reason for the following :
- (i) Stability of +5 oxidation state decreases and that of +3 oxidation state increases down the group 15 elements.
- (ii) Catenation tendency is weaker in nitrogen than Phosphorus.
- (iii)  $\text{H}_2\text{O}$  is less acidic than  $\text{H}_2\text{S}$ .
- (iv) Thermal stability of Hydrides of group 16 elements decreases down the group.
- (v) Halogens are strong oxidising agent.
4. (a) Give two examples of two anomalous behaviour of oxygen. Discuss the trend in chemical reactivity of group 16 elements with.
- (i) Hydrogen; (ii) Oxygen; (iii) Halogens
- (b) (i) Draw the structure of  $\text{SF}_4$  and  $\text{SF}_6^-$ .
- (ii) Account for the following.
- (a)  $\text{SF}_4$  is readily hydrolysed where  $\text{SF}_6^-$  is not.
- (b) HF is weaker acid than HI.
- (c)  $\text{O}_3$  act as powerful oxidising agent.
5. (i) Why Fluorine show anomalous behaviour.
- (ii) Give two examples of fluorine to show anomalous behaviour.
- (iii) What happens when :
- (a)  $\text{SO}_2$  is passed through aqueous solution of Fe(III) salts.
- (b)  $\text{SO}_2$  is passed through acidified solution of  $\text{KMnO}_4$ .
- (c) Two S–O bond in  $\text{SO}_2$  are identical.
6. How is sulphuric acid manufactured by contact process. Mention the conditions to get maximum yield of  $\text{SO}_3$ , required in the process. Give three uses of  $\text{H}_2\text{SO}_4$ .
7. (i) How is Ozone estimated quantitatively.
- (ii) Draw the structure of Ozone.
- (iii) Give one chemical reaction to show that ozone is an oxidising agent.
- (iv) Give one chemical reaction to show that  $\text{Cl}_2$  is an oxidising agent.
- (v) Write the reaction of chlorine with turpentine oil.

**Hots\*8.** Write the structure fo A, B, C, D and E in the following sequence of reactions.

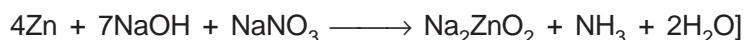


complete reactions of the above mentioned sequence.

[Hint. : A is nitric oxide].

**Hots\*9.** A solution of colourless salt J forms brown complex with  $\text{FeSO}_4$  solution acidified with  $\text{H}_2\text{SO}_4$ . The solution of salt J on boiling with NaOH, produces a non-inflammable gas. The evolution of gas ceases after sometime. Upon addition of Zn dust to the same solution the gas evolution restarts. Identify the colourless salt J and write the equations of reactions involved.

[Hint. : Salt J forms brown complex with acidic  $\text{FeSO}_4$ , therefore it is nitrate salt. Salt produces non-inflammable gas with NaOH when evolution of this gas stops and when Zn dust is added to the solution after evolution of gas stops, the evolution of same gas occurs. This shows that  $\text{NH}_3$  gas is produced by the reaction of  $\text{NO}_3^-$  ions of solution with Zn dust. The same gas is produced by the reaction of colour salt J solution. Hence salt J is  $\text{NH}_4\text{NO}_3$ .



## UNIT 8

# THE *d* – AND *f* – BLOCK ELEMENTS

### POINTS TO REMEMBER

1. General electronic configuration of *d* block element in  $(n - 1) d^{1-10} ns^{1-2}$ .  
Transition elements : those elements which has incomplete *d*-orbitals in its native state of atom or at least one of the ions e.g., – copper.
2. There are three transition series.
  - (i) First transition series : General electronic configuration  $3d^{1-10} 4s^{1-2}$ . From Sc–21 to Zn–30.
  - (ii) Second transition Series : General electronic configuration  $4d^{1-10} 5s^{1-2}$  from Yb–39 to cadmium–48.
  - (iii) Third transition series : General electronic configuration  $5d^{1-10} 6s^{1-2}$ . From La–57 to Hg–80.
3. The transition metals exhibit a variety of oxidation states because the energy of inner *d*-electron ( $n-1$ ) *d* is similar to that of the outer *s*-electrons *ns*.
4. The transition metals exhibit metallic properties and their atoms or ions are paramagnetic because of the presence of unpaired electrons.
5. The transition metals are chemically less reactive because of higher Ionisation energies and higher reduction electrode potentials.
6. Transition metal have high m. pt., Show variable oxidation states, form complexes and act as catalysts.
7. Inner transition metals have partially filled *f*-orbitals and have configuration  $(n-2) f^{1-14} (n-1) d^{0-1} ns^2$ .
8. Magnetic moment ( $\mu$ ) is given as  $\sqrt{n(n+2)}$  BM ( $n$  – no. of unpaired electrons).
9. Lanthanides and actinides have partially filled *f*-orbitals which change their physical and chemical properties. Hence they are placed separately.
10. *HOTS* questions are marked as *HOTS* or *star*.

### QUESTIONS

#### 1 MARK QUESTIONS

1. Write the electronic configuration of  $Cu^{2+}$ .
2. Identify the *d*-block elements from the following which does not exhibit variable oxidation state Cr, Co, Zn.

3. Which of the following gives a coloured solution when dissolved in water.  
 $\text{Cu}^{2+}, \text{Zn}^{2+}$ .
4. Zn, Cd and Hg have low enthalpies of vaporisation while other transition metals have high. Give a possible explanation.
5. Which of the following species is more paramagnetic –  $\text{Fe}^{2+}$ ,  $\text{Fe}^{3+}$  and why? [Fe = 26].
6. First Ionisation Enthalpies of 5d-series elements is higher than those of 3d and 4d-series elements. Why?
7. In the 3d-series [ $\text{Sc} \rightarrow \text{Zn}$ ] why is the enthalpy of atomization of zinc the lowest?
8. Arrange the following oxides in increasing order of their acidic character  $\text{MnO}$ ,  $\text{MnO}_2$ ,  $\text{Mn}_2\text{O}_7$ .
9. Out of  $\text{Cr}^{2+}$  and  $\text{Mn}^{2+}$  which one is stronger reducing agent?

$$[E^\circ_{\text{Cr}^{2+}/\text{Cr}^{2+}} = -0.40V \quad E^\circ_{\text{Mn}^{3+}/\text{Mn}^{2+}} = 1.50V]$$

10. Calculate the magnetic moment of  $\text{Ni}^{2+}$  on the basis of "Spin-Only" formula.
11. Although copper atom has completely filled  $d$ -orbitals ( $3d^{10}$ ) still it is regarded as transition elements? Give reason.
12. Find the number of unpaired electrons in the gaseous state of  $\text{Co}^{2+}$  ion [Co – 27].
13. Why is the highest oxidation state of a metal exhibited in its oxide or fluoride only.
14. Draw the structure of  $\text{Cr}_2\text{O}_7^{2-}$  ion and  $\text{CrO}_4^{2-}$  ion.
15. Write ionic equation for the reaction between  $\text{KMnO}_4$  and oxalic acid taking place in acid medium.

**Hots\*16.** In volumetric analysis of  $\text{KMnO}_4$  vs Mohr salt,  $\text{H}_2\text{SO}_4$  and not HCl is added to Mohr salt solution. Why?

17. Write the electronic configuration of Cerium. [Ce–58].
18. Which element from the lanthanoid series is well known to exhibit +4 oxidation state?
19. Lanthanoids do not have much tendency to form complexes like transition metal. Suggest a possible explanation for this observation.
20. Why is  $\text{Cu}^{2+}$  more stable than  $\text{Cu}^+$  in aqueous solution [Cu–29].

**Hots\*21.** Which one is more stable  $\text{Cu}_2\text{I}_2$  or  $\text{CuI}_2$ . Why?

[Hint. : Because  $\text{I}^-$  ion being powerful reducing agent reduces  $\text{Cu}^{2+}$  ion to  $\text{Cu}^+$  ion.



## 2 MARKS QUESTIONS

- Out of Fe and Cu which one would exhibit higher melting point. Why?
- Ni (II) compound are found to be thermodynamically more stable than Pt(II) compound while Pt(IV) compounds are relatively more stable than Ni(IV) compounds. Give a possible reason [Ni = 28, Pt = 78].
- Why are Mn<sup>2+</sup> compounds, more stable than Fe<sup>2+</sup> towards oxidation to their +3 states? [Mn = 25, Fe = 26].
- Why the  $E^\circ$  value for the Mn<sup>3+</sup>/Mn<sup>2+</sup> couple is higher than that of Cr<sup>3+</sup>/Cr<sup>2+</sup> couple.

$$[E^\circ_{Mn^{3+}/Mn^{2+}} = 1.51V \quad E^\circ_{Cr^{3+}/Cr^{2+}} = -0.41V]$$

- (a) Out of Co<sup>2+</sup> and Sc<sup>3+</sup> which one will give coloured aqueous solution, (b) How will each of them respond to magnetic field and why?
- Hots\*** 6. Anion of a chromium containing salt A, orange Crystal, react with alkali to give yellow solution [B] which on acidification gives back orange red colour. Write chemical reaction and identify A and B.
- Give reasons for the catalytic activity of finely divided iron in Haber's process?
  - The *d*-block elements exhibit a large number of oxidation states than that of *f*-block elements. Give reason for this.
- Hots\*** 9. Highest oxidation states shown by Transition metal in oxide not in fluoride. Why?

- (i) Use Hunds rule to derive the electronic configuration of Dy<sup>3+</sup> ion.  
(ii) Calculate magnetic moment by Dy on the basis of 'spin-only' formula. (Dy-66) Dysprosium.
- The relative decrease in atomic size is more in moving from Ac(89) to Lr (103) than moving from La (57) to Lu (71)? Give possible reasons.
- Give one use of ziegler Natta catalyst. Mention two compounds used in Ziegler Natta catalysts.

[Hint. : TiCl<sub>4</sub> and Al(C<sub>2</sub>H<sub>5</sub>)<sub>3</sub>]

- Hots\*** 13. Calculate the number of moles of MnO<sub>4</sub><sup>-</sup> required to oxidise one mole of ferrous oxalate completely in acidic medium.

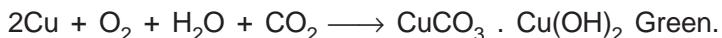


5 mole of ferrous oxalatic oxidised by = 3 mole of KMnO<sub>4</sub>

$$1 \text{ mole} = \frac{3}{5} = 0.6 \text{ mole.}$$

**Hots\*14.** In moist air, copper corrodes to produce a green layer on its surface. Explain, why?

[Hint. : In moist air, a layer of basic copper carbonate is formed on the surface



### 3 MARKS QUESTION

1. Deduce the number of  $3d$  electrons in each of the following ions.  
 $\text{Ti}^{2+}$ ,  $\text{Fe}^{3+}$  and  $\text{Cu}^{2+}$ .
2. Why do Ni and Fe shows zero, oxidation state in  $\text{Ni}(\text{CO})_4$  and  $\text{Fe}(\text{CO})_5$ .
3. List three reason for the transition metals forming a large number of complex compounds.
4. What is meant by a ‘disproportionation’ of reaction? Illustrate with an example.
5. For  $\text{M}^{2+}/\text{M}$  and  $\text{M}^{3+}/\text{M}^{2+}$  system of  $E^\circ$  value for some metals are as follows :  
 $\text{Cr}^{2+}/\text{Cr} = - 0.9\text{V}$ ,  $\text{Cr}^{3+}/\text{Cr}^{2+} = - 0.4\text{V}$   
 $\text{Mn}^{2+}/\text{Mn} = - 1.2\text{V}$ ,  $\text{Mn}^{3+}/\text{Mn}^{2+} = + 1.5\text{V}$   
 $\text{Fe}^{2+}/\text{Fe} = - 0.4\text{V}$ ,  $\text{Fe}^{3+}/\text{Fe}^{2+} = + 0.8\text{V}$

Use this data to comment upon.

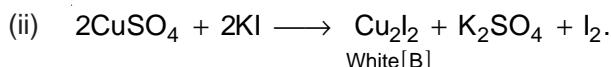
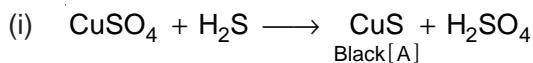
- (i) The stability of  $\text{Fe}^{3+}$  in acid solution as compared to that of  $\text{Cr}^{3+}$  or  $\text{Mn}^{3+}$ .
- (ii) The ease with which ferrous ion can be oxidised as compared to similar process for chromium and manganese metal.
6. Predict which of the following will give coloured aqueous solutions? Give reason,  $\text{V}^{4+}$ ,  $\text{Cr}^{3+}$ ,  $\text{Ti}^{4+}$ .
7. Name the ore from which  $\text{K}_2\text{Cr}_2\text{O}_7$  is manufactured. Write the steps involved in the preparation of  $\text{K}_2\text{Cr}_2\text{O}_7$  from this one.
8. (i) What is the best single use of the lanthanoids?  
(ii) What is mischmetal? Write its constitution?  
(iii) State two uses of mischmetal.
9. (i) Write the general electronic configuration for inner transition elements.  
(ii) Which of the following atomic numbers are of the inner transition series – 70, 80?  
(iii) What is common oxidation state of actinides?
10. Compare the chemistry of the lanthanoids with that of actinoid with reference to :  
(i) Electronic configuration

(ii) Oxidation state

(iii) Chemical reactivity

**Hots\*11.** An aqueous blue coloured solution of a transition metal sulphate gives with  $\text{H}_2\text{S}$  in acidic medium a black precipitate (A), which is insoluble in warm aqueous solution of KOH, first turns yellow and then produces a white precipitate (B). Identify the transition metal ion. Write equation of chemical reactions involved in the formation of (A) and (B).

[Hint. : Since the blue coloured solution of transition metal sulphate gives a black precipitate with  $\text{H}_2\text{S}$  in acidic medium. This shows it is copper sulphate.]



## 5 MARKS QUESTIONS

1. (i) What are transition metals?  
(ii) How is the electronic configuration of transition elements-differ from that of non-transition elements?  
(iii) Out of the following which are transition elements?  
 $A = [\text{Ar}] 3d^{10} 4s^2, B = [\text{Kr}] 4d^{10} 5s^1 C = [\text{Ar}] - 3d^{10} 4s^1$   
[Hint. :  $[\text{Ar}] 3d^{10} 4s^2$  is zinc - not a transition element].  
Give reason for your choice.  
(iv) Write any two characteristic properties of transition metals.
2. Explain giving reasons the following properties of transition metals.
  - (i) Shows variable oxidation state.
  - (ii) Act as catalyst.
  - (iii) Forms interstitial compounds.
  - (iv) Shows paramagnetic behaviour.
3. What is pyrolusite? Describe the preparation of potassium permanganate from it? Write chemical equation to represent the reaction of acidified  $\text{KMnO}_4$  solution with :
  - (i)  $\text{SO}_2$  gas
  - (ii)  $\text{FeSO}_4$  solution.
4. Complete the following reactions :
  - (i)  $\text{MnO}_4^- + \text{S}_2\text{O}_3^{2-} + \text{H}_2\text{O} \rightarrow$

- (ii)  $\text{MnO}_2 + \text{KOH} + \text{O}_2 \rightarrow$   
 (iii)  $\text{Cr}_2\text{O}_7^{2-} + 6\text{Fe}^{2+} + 14\text{H}^+ \rightarrow$   
 (iv)  $\text{Cr}_2\text{O}_7^{2-} + 2\bar{\text{O}}\text{H} \rightarrow$   
 (v)  $\text{Cr}_2\text{O}_7^{2-} + 3\text{Sn}^{2+} + 14\text{H}^+ \rightarrow$

5. What is Lanthanoid contraction? What are its possible causes? Write two consequences of Lanthenoid contraction.
6. (i) Describe the general trends in the following properties of the first series of the *d*-block elements. (Sc to Zn).
- (a) Stability of +2 oxidation state.
  - (b) The lower oxide is base, the highest is acidic.
- (ii) Assign reason for each of the following :
- (a) Transition metals exhibit variable oxidation states.
  - (b) Transition metal ions are usually coloured.
7. (i) Describe the steps involved in the preparation of :
- (a)  $\text{K}_2\text{Cr}_2\text{O}_7$  from  $\text{Na}_2\text{CrO}_4$ .
  - (b)  $\text{KMnO}_4$  from  $\text{K}_2\text{MnO}_4$ .
- (ii) Assign a possible chemical equations.
- (a)  $\text{La}^{3+}$  and  $\text{Lu}^{3+}$  do not show any colour.
  - (b) The third ionisation enthalpy of La is very low (La – 57).

**Hots\*8.** When a crystalline compound (A) is heated with  $\text{K}_2\text{Cr}_2\text{O}_7$  and conc.  $\text{H}_2\text{SO}_4$  a reddish brown gas (B) is evolved, which on passing in the NaOH solution gives a yellow coloured solution (C). This solution on neutralisation with acetic acid and on subsequent addition of lead acetate gives a yellow precipitate (D). When (A) is heated with NaOH solution, a colourless gas is evolved. On passing this gas in  $\text{K}_2\text{HgI}_4$  solution, a reddish brown ppt (E) is formed. Identify A, B, C, D and E. Write the sequence of the reaction involved.

[Hint. : A is  $\text{MCl} - \text{NH}_4\text{Cl}$  gives chromyl chloride test.]

- (B)  $\text{CrO}_2\text{Cl}_2$       (C)  $\text{Na}_2\text{CrO}_4$       (D)  $\text{PbCrO}_4$ .

## UNIT 9

# CO-ORDINATION COMPOUNDS

### POINTS TO REMEMBER

1. Double salt – An addition – product of two ionic compounds exist in crystalline state and loses its identity in solution.

Co-ordinate compounds – special class of compounds in which central metal atom is surrounded by ion or molecule by coordinate bond.

Transition metals form complex (Coordinate) compound because it has empty orbitals, small size and high nuclear charge.

**Ligands** : A molecule or ion that donates an electron pair to the central metal ion.

2. According to Werner's theory. A metal ion has two types of valencies.

- (i) Primary or ionizable valence.
- (ii) Secondary or non-ionizable valence.

3. Coordinate compounds are named according to the I.U.P.A.C. system as :

- (i) Number of counter cation and counter anion are not mentioned
- (ii) Number of ligands written before its name.
- (iii) If there is (-)ve charge on complex or counter cation is present in complex then in I.U.P.A.C. naming central metal atom/ion ends with – ate.

Coordinate compounds exist as isomers and exhibit various types of isomerism as

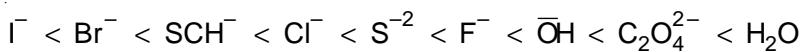
- (i) Ionisation Isomerism
- (ii) Linkage isomorphism (isomers showing linkage isomerism have at least one ambidentate ligand).
- (iii) Coordination isomerism.
- (iv) Geometrical isomerism.
- (v) Optical isomerism.
- (vi) Hydrate isomerism.

4. An inner orbital complex involves inner 3d-orbitals and its low spin. While an outer orbital complex involve outer 4d-orbitals.

5. Coordinate complex with 6 coordination number have octahedral structure.

Coordinate complexes with 4 coordination numbered are either tetrahedral or square planar.

6. Spectro chemical series is the arrangements of ligands in ascending order of orbital splitting energy. Weak field ligand.



strong field ligand.

7. Stability of complex is affected by

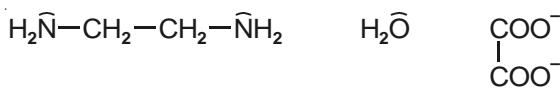
- (i) Nature of central atom or ion.
- (ii) Nature of Ligands.
- (iii) Stabilization of uncommon oxidation state.

8. HOTS questions are marked by *HOTS* or star [\*].

## QUESTIONS

### 1 MARK QUESTIONS

1. What are coordination compounds?
2. Deduce primary and secondary valency of cobalt metal in  $[\text{Co}(\text{NH}_3)_6\text{Cl}_3]$ .
3. What is meant by counter ion. Write name of counter ion in  $\text{K}_4[\text{Fe}(\text{CN})_6]$ .
4. Define ambidentate ligand with example.
5. Out of the two which are chelate ligand.



6. Calculate the oxidation number of central atom in  $[\text{CO}(\text{NH}_3)_5\text{SO}_4]\text{Cl}$ .
7. Define homoleptic complexes with an example.
8. Define heteroleptic complexes. Give an example of it.
9. Using I.U.P.A.C. norms write the systematic names of the following :

- |   |  |
|---|--|
| (i) $[\text{CO}(\text{NH}_3)_4\text{Cl}(\text{NO}_2)]\text{Cl}$ | (ii) $[\text{Mn}(\text{H}_2\text{O})_6]^{2+}$    |
| (iii) $[\text{Ni}(\text{CO})_4]$                                | (iv) $\text{K}_3[\text{Fe}(\text{CN})_6]$        |
| (v) $\text{Li}[\text{AlH}_4]$                                   | (vi) $[\text{Ni}(\text{NH}_3)_4][\text{NiCl}_4]$ |

10. Using IUPAC norms write the formula for :

  - Pentaammine nitrito – N – cobalt (III) ion.
  - Pentaammine nitrito – O – cobalt (III) ion.

11. Deduce the oxidation number of cobalt in  $K_3[Co(C_2O_4)_3]$

12.  $[CO(NH_3)_5Br_3]SO_4$  and  $[CO(NH_3)_5SO]Br$  are ionisation isomer which of them gives white precipitate with  $BaCl_2$  solution?

13. How many ions are produced from the compound  $[Ni(NH_3)_6]Cl_2$  in aqueous solution?

14. Arrange the following in the increasing Order of conductivity in solution.

$[Ni(NH_3)_6]Cl_2$ ,                             $[Co(NH_3)_6]Cl_3$ ,                             $[CoCl_2(en)_2]Cl$

15. Out of two coordination entities which one is chiral

  - Cis*– $[CrCl_2(ox)_2]^{3-}$  and
  - trans*– $[CrCl_2(ox)_2]^{3-}$

16. Arrange the following in increasing order of field strength.

Hots\*17 [Co(NH<sub>3</sub>)<sub>5</sub>(NO<sub>2</sub>)]<sup>+</sup> does not show any optical isomerism

[Hint : Due to plane of symmetry]

18. Name the central metal atom/ion present in chlorophyll. [Ans. : Mg (Magnesium)]

19. Name the central metal atom/ion present in Haemoglobin. [Ans. : Fe Iron]

20. Name the central metal atom/ion present in vitamin B<sub>12</sub>. [Ans. : Cobalt]

Hots\*21.  $[\text{Ti}(\text{H}_2\text{O})_6]\text{Cl}_2$  is coloured which on heating becomes colourless. Why?

[Hint. : H<sub>2</sub>O molecule will be removed.]

Hots\*22. Both  $[\text{Ni}(\text{Co})_4]$  and  $[\text{Ni}(\text{CN})_4]^{2-}$  are diamagnetic. Find the hybridisation of nickel in these complexes.

## **2 MARKS QUESTIONS**

1. Differentiate between a double salt and a complex with the help of an example.
  2. What are ligands? Why are they referred so as lewis base?
  3. What is meant by coordination number? Find the coordination number of CO in  $[\text{Co}(\text{en})_3]^{3+}$ .
  4. Draw the structure of facial and meridional isomers of  $[\text{Co}(\text{NH}_3)_3(\text{NO}_2)_3]$

**Hots\*** 5. Aqueous copper sulphate solution [blue is colour] gives (i) A green precipitate with aqueous potassium fluoride and (ii) A bright solution with aqueous potassium chloride.

Explain the experimental result.

6. Discuss the geometry of diamagnetic  $[\text{Ni}(\text{CN})_4]^{2-}$  on the basis of Valence-Bond Theory.
7. Determine the geometry of unpaired electron in octahedral complex  $[\text{Cr}(\text{NH}_3)_6]^{3+}$ .
8. Draw structures of geometrical isomers of  $[\text{Fe}(\text{NH}_3)_2(\text{CN})_4]^-$ .
9. Define coordination isomerism with an example.
10. Calculate the overall complex dissociation constant for the  $[\text{Cu}(\text{NH}_3)_4]^{2+}$  ion, given that overall stability constant ( $\beta_0$ ) for this complex is  $2.1 \times 10^{13}$ .

[Hint. : The overall dissociation constant is the reciprocal of overall stability i.e.,

$$\frac{1}{\beta_0} = \frac{1}{2.1 \times 10^{13}} = 4.76 \times 10^{-14}$$

11. What is meant by chelate effect? Give an example.
12. Give the oxidation state and coordination number of the central metal ion in the following :
 

(i) $\text{K}_2[\text{Co}(\text{C}_2\text{O}_4)_3]$	(ii) $[\text{Mn}(\text{H}_2\text{O})_6]\text{SO}_4$
---	---
13.  $\text{FeSO}_4$  solution mixed with  $(\text{NH}_4)_2\text{SO}_4$  solution in 1 : 1 molar ratio gives the test of  $\text{Fe}^{2+}$  ion but  $\text{CuSO}_4$  solution mixed with aqueous ammonia in 1 : 4 molar ratio does not give the test of  $\text{Cu}^{2+}$  ion. Explain why?

**Hots\*14.** One mole of aqueous solution of the complex  $\text{CoCl}_3 \cdot 5\text{H}_2\text{O}$  when treated with excess of  $\text{AgNO}_3$  solution gave one mole of white precipitate of  $\text{AgCl}$ . Suggest the formula of the complex formed giving appropriate reason.

[Hint. : As one mole of Cl react with one mole of  $\text{AgNO}_3$  solution so complex is



**Hots\*15.** Out of  $[\text{Co}(\text{CN})_6]^{3-}$ ,  $[\text{Co}(\text{NH}_3)_6]^{3+}$  and  $[\text{Co}(\text{H}_2\text{O})_6]^{3+}$  which coordination entities the magnitude of energy separation ( $\Delta_0$ ) of octahedral in crystal field splitting will have the maximum value.

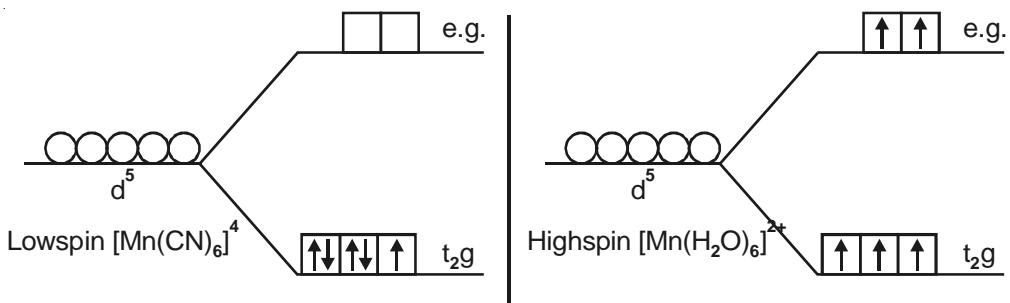
[Hint. :  $[\text{Co}(\text{CN})_6]^{3-}$        $\text{CN}^-$  ligands have strong field strength.]

### 3 MARKS QUESTIONS

1. Explain the term unidentate, didentate and ambidentate ligands by giving one example for each.
2. Write formula's for the following coordination compounds.
  - (i) Tris (ethane – 1, 2-diamine) chromium (III) chloride.
  - (ii) Iron (III) hexa cyano ferrate (II).
  - (iii) Potassium tri (oxalato) chromate (III).

3. Explain using crystal field theory – The  $[\text{Mn}(\text{H}_2\text{O})_5]^{2+}$  ion contains five unpaired electrons while  $[\text{Mn}(\text{CN})_6]^{4-}$  ion contains only one unpaired electrons?

[Hint. :  $\text{H}_2\text{O}$  is a weak field ligand so can not cause the pairing of electrons in  $3d$ -orbitals. While  $\text{CN}^-$  is a strong field ligand and cause the pairing of electrons in  $3d$ -orbitals.



4. Coordination compound having molecular formula  $[\text{CO}(\text{NH}_3)_5\text{Cl}]\text{SO}_4$  has two isomeric forms A and B. Isomer [A] gives white precipitate with  $\text{BaCl}_2$  solution while isomer [B] gives white precipitate with  $\text{AgNO}_3$  solution.
- Identify isomer A and B.
  - Write IUPAC names of these isomers.
  - Write chemical equations for reactions involved.

[Ans. : A– $[\text{CO}(\text{NH}_3)_5\text{Cl}]\text{SO}_4$ , B– $[\text{CO}(\text{NH}_3)_5\text{SO}_4]\text{Cl}$ .]

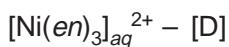
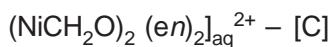
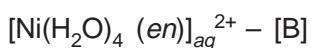
5. Draw a sketch to show the splitting of  $d$ -orbitals in an octahedral crystal field. For  $d^6$  ion write the configuration in terms of  $t_{2g}$  and  $e.g.$  How spin of the complex is decided when (i)  $\Delta_0 > P$  and (ii)  $\Delta_0 < P$ .
6. Describe the nature of bonding in  $\text{Ni}(\text{CO})_4$ .
7. (i) Write the name of coordination compound.
- Used for treatment of cancer.
  - Used to estimate the concentration by  $\text{Ca}^{2+}$  and  $\text{Mg}^{2+}$  in Hard water.

[Ans. :  $\text{Na}_2$  (EDTA)]

- (ii) Name the ligand used in the treatment of lead poisoning. [Ans. : EDTA]

- Hots\*8.** A chloride of fourth group element of quantitative analysis gives a green coloured complex [A]. The aqueous solution of which treated with ethane-1, 2-diamine (en) gives pale-blue solution (B) which on subsequent addition of ethane-1, 2-diamine turns to blue/purple and finally violet (D). Identify the element and [A], [B], [C], [D].

[Hint. : Nickel]



## UNIT 10

# ORGANIC CHEMISTRY

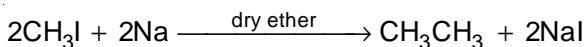
### POINTS TO REMEMBER (UNITS 10–13)

#### ASCENT OF SERIES (STEP UP SERIES)

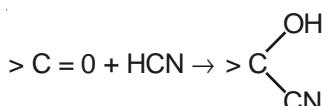
##### Aliphatic Compounds

Following are chemical reactions to add C – atom to existing compounds.

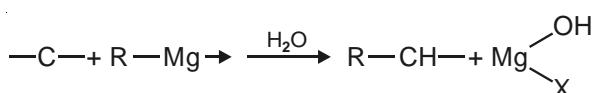
1. Wurtz Reaction :



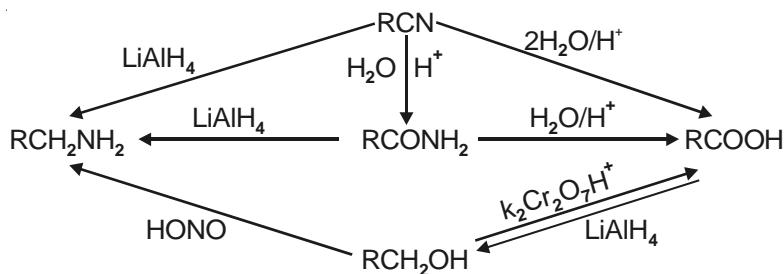
2. Addition of HCN to carbonyl group.



3. By Grignard reagent :

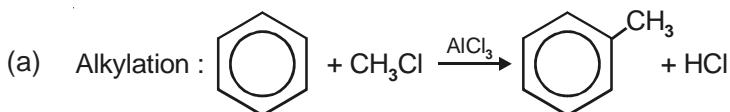


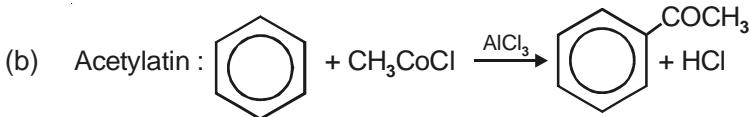
4. By the reaction of KCN on alkyl halides.  $\text{RX} + \text{KCN} \rightarrow \text{RCN} + \text{KX}$



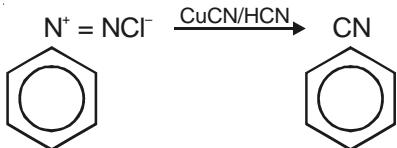
#### AROMATIC COMPOUNDS

- (i) By Friedel cract reaction :





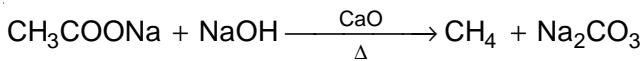
(ii) By the reaction of CuCN/HCN with benzene diazonium chloride.



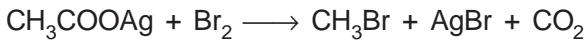
### DESCENT OF SERIES (STEP DOWN SERIES)

Following are the chemical reaction to decrease the C–atom from organic compounds.

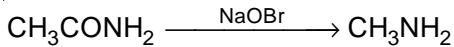
1. De carboxylation : e.g.,



2. Hunsdicker reaction :



3. Hofmann Broomamide Reaction : e.g.,



Term used in organic chemistry.

**Nucleophile** : Electron rich species e.g.,  $\bar{\text{C}}\text{N}$ ,  $\bar{\text{O}}\text{H}$  species with negative charge or lone pair of electron act as nucleophile.

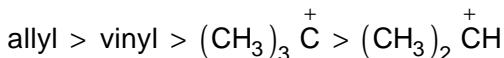
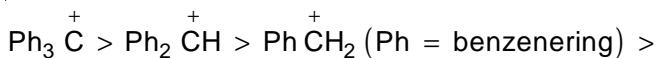
**Electrophile** : Electron deficient species e.g.,  $\overset{+}{\text{H}}$ ,  $\overset{+}{\text{NO}_2}$  positive charged species act as electrophile.

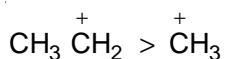
**Free radicals** : An atom or group of atoms with one unshared electron are known as free radicals e.g.,

$\text{Cl} : \text{Cl} \xrightarrow{\text{hr}} \overset{\circ}{\text{Cl}} + \overset{\circ}{\text{Cl}}$  one free radical always generate another free radical during the course of reaction e.g.,  $\overset{\circ}{\text{Cl}} + \text{H}_2 \rightarrow \text{HCl} + \overset{\circ}{\text{H}}$ .

**Carbocation** : Carbon atom carrying positive charge are known as carbocation e.g.,  $\text{H}_3\text{C}^+ — \overset{+}{\text{CH}}\text{CH}_3$ .

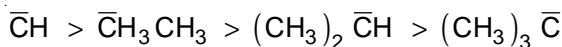
Stability of carbocations are :





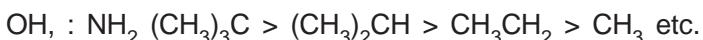
**Carbanion** : Carbon atom carrying negative charge e.g.,  $\text{H}_3\text{C} — \bar{\text{C}}\text{HCH}_3$ .

Stability of carbanions are

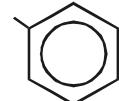


**Carbene** : Carbon atom with a lone pair of electrons is known as carbene e.g. :  $\text{CH}_2$ , :  $\text{CCl}_2$ .

**Electron releasing groups** : Groups which push the electron density away from them. e.g., :



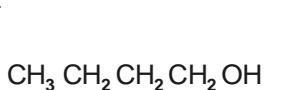
**Electron withdrawing groups** : Groups which pull the electron density towards themselves e.g.,



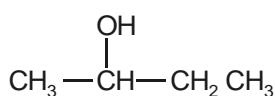
## INDUCTIVE EFFECT

Displacement of sigma electron density along the – C – C – single bond chain due to presence of electron releasing or electron with drawing groups is known as I effect. 2 types.

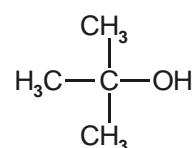
- (i) **+ I effect** : If electron density is pushed by electron releasing group e.g.,  $\text{C}_4\text{H}_9\text{OH}$  exist as three isomers.



Ore electron releasing group least reactive

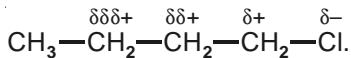


Two electron releasing group intermediate



Three electron releasing group most reactive

- (ii) **- I effect** : If the electron is pulled by electron with drawing group e.g.,

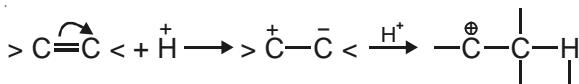


It is a permanent effect.

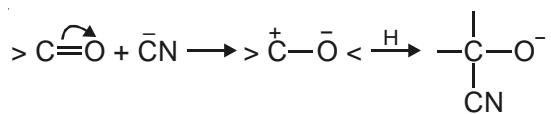
## Electromeric Effect

Transfer of  $\pi$  electron to one of the multiple bonded atom in presence of some attacking reagent is known as E effect. It is of two types.

- (i) **+ E effect** : If  $\pi$  electron in transferred to the atom to which p electron get attached. e.g.



(ii) – E effect : It  $\pi$  electron is transferred to the atom away from attacking reagent.

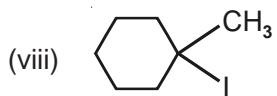
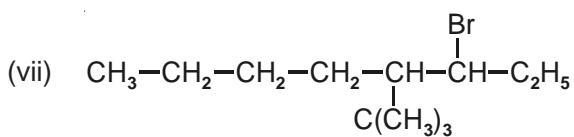
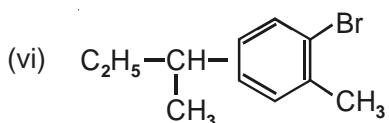
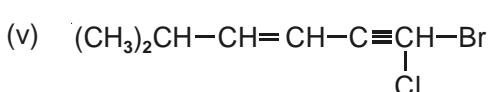
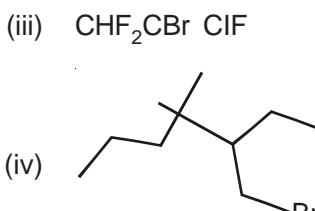
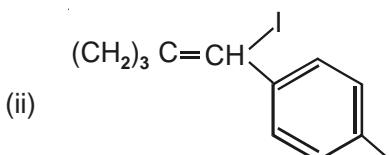
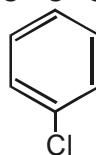
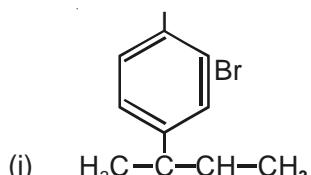


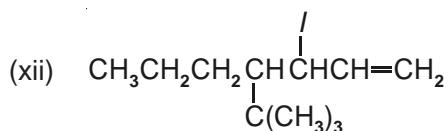
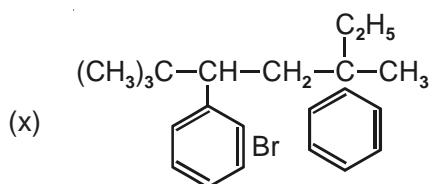
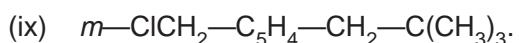
It is a temporary effect.

UNIT 10

# HALO-ALKANES AND HALOARENES

1. Write IUPAC names of the following





2. Describe the following reactions with suitable example of each :

- (i) Sandmeyer's reaction
- (ii) wurtz reaction
- (iii) wurtz – fitting reaction
- (iv) Fitting reaction
- (v) Finkelstein Reaction
- (vi) Swarts Reaction
- (vii) Hunsdicker Reaction
- (viii) Ullmann Reaction

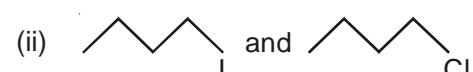
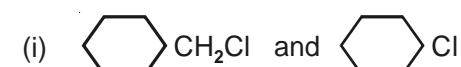
3. Explain the following statements giving a suitable example :

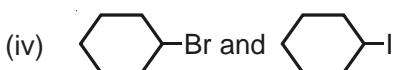
- (i) Markonikov's Rule.
- (ii) Saytzeff Rule.

4. Suggest the appropriate mechanisms for the following reactions

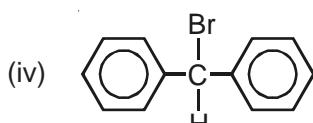
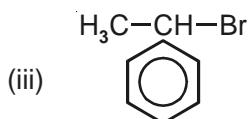
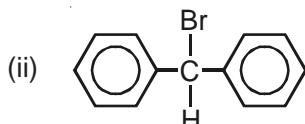
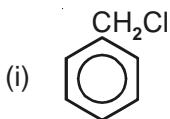
- (i)  $\text{SN}^2$  : Nucleophilic substitution biomolecular.
- (ii)  $\text{SN}^1$  : Nucleophilic substitution unimolecular.

5. In the following pairs of halogen compounds which would  $\text{SN}^2$  reactions faster and why?





6. Predict the order of reactivity of the following compounds in  $\text{S}^{\text{N}}1$  and  $\text{S}^{\text{N}}2$  reaction.



7. Account for the following :

- (i)  $\text{S}^{\text{N}}1$  reactions are favoured through solvation of halide ion with proton of protic solvent.
- (ii)  $\text{S}^{\text{N}}2$  reactions are favoured in primary halides.
- (iii) Inversion of configuration takes place in  $\text{S}^{\text{N}}2$  reactions.

8. Distinguish between following pairs :

- (i) Chiral and achiral objects.
- (ii) Enantiomers and diastereoisomers.
- (iii) Retention and Inversion.
- (iv) Electrophilic and nucleophilic substitution.

9. Arrange the following compounds of each set in the order of reactivity towards  $\text{S}^{\text{N}}2$  displacement.

- (i) 2-Bromo 2-methyl butane, 1-Bromopentane and 2-Bromopentane.
- (ii) 1-Bromo-3-methylbutone, 2-bromo 2-methyl butane 3-bromo 2-methyl butane.
- (iii) 1-Bromobutane, 1-Bromo 2, 2-dimethyl propane, 1-Bromo-2 methylbutane and 1-Bromo 3-methylbutane.

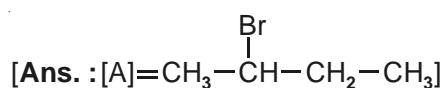
10. Suggest a chemical test to distinguish the following pairs :

- (i) Chloroethane and chlorobenzene.
- (ii) Chlorobenzene and benzyl chloride.
- (iii) Chloroethane and bromoethane.

11. Give one use each of the following specifying the property on which this use is based upon.  
Freon – 12, DDT, Carbon tetrachloride and iodoform.

12. Predict all the alkene that would be formed by dehydrohalogenation of the following halides with sodium ethoxide in ethanol.
- 1-Bromo-1-methyl cyclohexane.
  - 2-chloro-2-methyl butane.
  - 2, 3, 4-trimethyl-3-Bromopentane.
13. Write the steps involved in the conversion of :
- 2-Bromopropane into 1-Bromopropane.
  - Chlorobenzene to benzene.
  - Toluene to Benyl alcohol.
  - Aniline to chlorobenzene
  - 2-chlorobutane into 3, 4 dimethyl hexane.
  - Ethyne to propyne.
  - Propane to propan-1-ol.
  - Benzene to 4-boromonitro benzene.
  - Benzene to diphenyl.
  - Chlorobenzene to Toluene.
  - Chlorobenzene to p-nitrophenol.
  - 2-chlorobutane into 2-methyl butane nitrile.
  - Propane to propyne.
  - Benzene to Toluene.
  - Ethanol to But-I-yne.

- Hots\*14.**
- A primary alkyl halide  $C_4H_9Br$  [A] react with alcoholic KOH to give compound [B].
  - Compound [B] react with HBr to give compound [C], which is an isomer of 'A'.
  - When [A] react with sodium metal in dry ether, gives a hydrocarbon [D]  $C_8H_{18}$  which is different from the compound formed when *n*-butyl bromide react with sodium metal. Suggest the structural formula of [A] and write the chemical reactions involved.



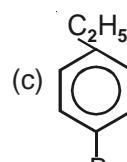
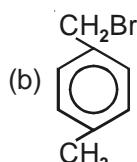
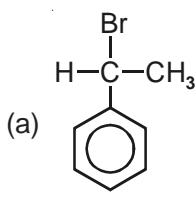
- Hots\*15.** Cyclobutylbromide on treatment with magnesium in dryether from an organometallic compound [A]. Compound [A] react with acetaldehyde to form an alcohol [B]. After mild acidification [B] is treater with HBr to give [C]. Write the structure of A and B where C is I-Bromo-I-methylcyclopentane.

16. Assign possible reason for each of the following :

- (i) Chlorobenzene is less reactive than chloroethane towards nucleophilic substitution reaction.
- (ii) Wurtz reaction is carried in dry ether.
- (iii) Grignard reagent is prepared under anhydrous conditions.
- (iv) The dipole moment of chlorobenzene is lower than that of cyclohexyl chloride.
- (v) Haloalkanes though polar but immiscible with water.
- (vi) Alkyl halides react with KCN to form nitrile as major product while AgCN forms isonitrile as chief product.
- (vii) Boiling point of haloalkanes are higher than hydrocarbons of comparable molecular masses.
- (viii) Chloroform is stored under dark coloured bottles, completely filled up to the brim.
- (ix) Melting point of para-dichloro benzene are 70–100K higher than ortho and meta isomers.
- (x)  $S_N^2$  mechanism does not take place in tertiary halides.

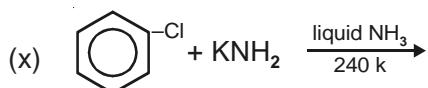
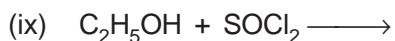
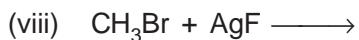
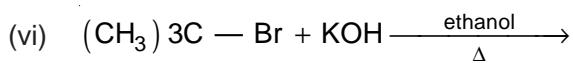
**Hots\*** 18. Three isomers [A], [B] and [C] of molecular formula  $C_8H_9Br$  gave the following compounds on oxidation.

- (i) Benzoic acid.
- (ii) Phthalic acid.
- (iii) P-bromobenzoic acid.
- (iv) [A] is optically active, both [A] and [B] gave white precipitate when warmed with  $AgNO_3$  (alcoholic) solution. Identify [A], [B] and [C].



19. Write the structure of the major organic product in each of the following reactions

- (i)  $CH_3CH_2CH = CHCH_3 + HBr \longrightarrow$
- (ii)  $CH_3CH = C(CH_3)_2 + HBr \longrightarrow$
- (iii)  $CH_3CH_2CH = CH_2 + HBr \longrightarrow$
- (iv)  $CH_3CH_2Br + AgCN \longrightarrow$
- (v)  $CH_2—CH_2—CH_2—CH_2 + NaOH(aq) \longrightarrow$



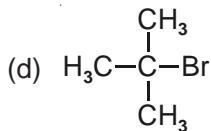
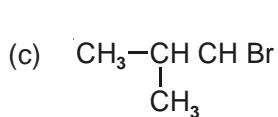
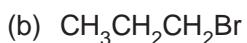
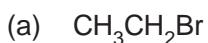
20. Write the main products formed :

- Chlorobenzene is reduced with Raney Nickel.
- Bromomethane is treated with sodium in dry ether.
- 4-Iodotoluene is treated with copper powder.
- Chlorobenzene is treated with sodium.
- Chlorobenzene is treated with 1-chloropropane in presence of Anhydrous  $\text{AlCl}_3$ .
- Chlorobenzene is treated with aq NaOH at 623K and 300 atm.
- Chloroethane is treated with KCN.
- 2-chlorobutane is treated with alcoholic KOH.
- Bromobenzene is treated with magnesium in dryether.
- Chlorobenzene is treated with chloral.
- Benzene is treated with chlorine in UV radiation.
- Carbon sulphide is treated with chlorine.

**Hots\*21.** In  $\text{S}^{\text{N}}2$  reaction of the type

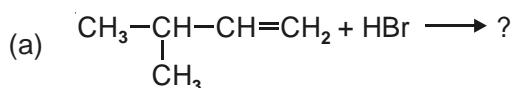


which one of the following has the highest rate of reaction and why?



[Hint. : (a)].

22. Complete the following reactions by indicating the major products.

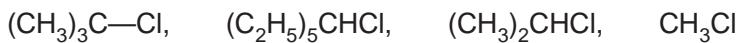


23. Predict the state of hybridisation of  $\text{C}_1$  and  $\text{C}_3$  in the compound  $\text{H}_3\text{C}-\text{CH}=\text{CH}-\overset{3}{\text{CH}}_2-\overset{1}{\text{C}}\equiv\text{CH}$ .

24. Which of the following is the most reactive compound towards electrophilic attack.

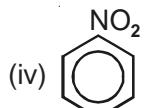
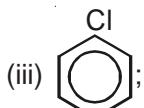
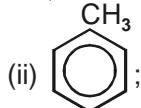
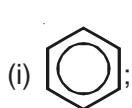


25. Identify the compound which shows complete stoichiometric inversion during  $\text{S}^{\text{N}}2$  reaction.



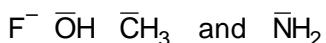
[Hint. :  $\text{CH}_3\text{Cl}$ ].

26. Arrange the following in the order of decreasing reactivity in the nucleophilic substitution.



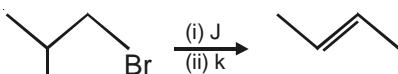
[Hint. : (iv) > (iii) > (i) > (ii).]

27. Which of the following has the highest nucleophilicity?

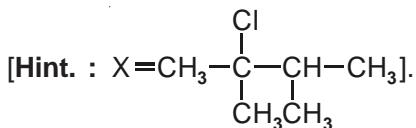


[Hint. :  $\overline{\text{C}}\text{H}_3$ ].

28. Identify the reagent J and K for the following transformations.



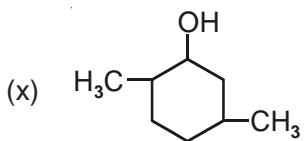
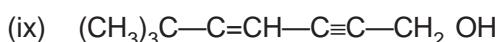
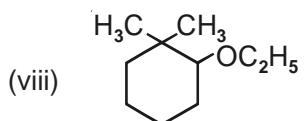
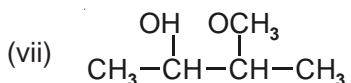
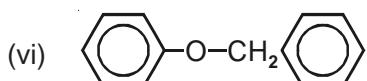
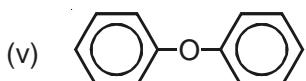
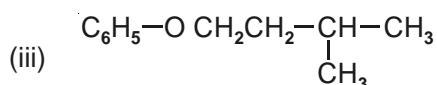
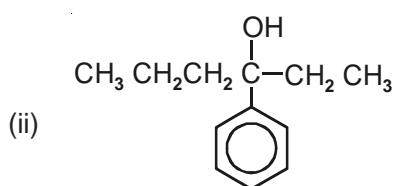
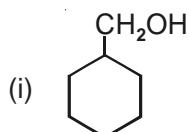
29. An alkyl halide X molecular formula  $\text{C}_6\text{H}_{13}\text{Cl}$  on treatment with potassium tertiary butoxide give two isomeric alkenes Y and Z both elkenes on hydrogenation gave 2, 3 dimethyl butane. Identify X, Y and Z.



## UNIT 11

# ALCOHOL PHENOLS AND ETHERS

1. Write IUPAC names of the following compounds :



2. Describe the following reactions giving an examples of each.

- (i) Riemer Tieman Reaction.
- (ii) Kolbe reaction.
- (iii) Williamson synthesis.
- (iv) Hydroboration oxidation of alkene.
- (v) OXO–mercuration reduction of alkene.

3. Suggest the mechanism for the following reactions.

- (i) Acid catalysed dehydration of alcohols to form alkenes.
- (ii) Acid catalysed hydration of alkenes.
- (iii) Acid catalysed dehydration of ethanol to form ethers.
- (iv) Reaction of HI with ethers.

4. Suggest Chemical test to distinguish between the following pairs.

- (i) Primary, secondary and tertiary alcohols.
- (ii) Propan–1–ol and propan–2 ol.
- (iii) Ethanol and propan–2–ol.
- (iv) Ethanol and propan–1–ol.
- (v) Propan 2–ol and 2–methyl propan–2 ol.
- (vi) Ethanol and methanol.
- (vii) Ethanol and Phenol.
- (viii) Phenol and Benzyl alcohol.
- (ix) Propan–1–ol and 2–methyl propan–2ol.
- (x) Phenol and picric acid.

5. Assign reason for the following :

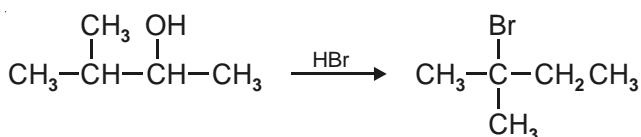
1. Phenol is acidic in nature.
2. Whether *p*-nitrophenol is more or less acidic than phenol and why?
3. Whether cresol is more or less acidic than phenol and why?
4. Ortho-nitrophenol is steam volatile while para-nitro phenol is not.
5. Boiling point of isomeric alcohols are Primary > Secondary > tertiary.
6. Alcohols are comparatively more soluble in water than hydrocarbon of comparable molecular masses.

7. Boiling point of the ethers are lower than isomeric alcohols.
  8. Symmetrical ethers have two similar alkyl groups but are still polar in nature.
  9. Phenyl methyl ether reacts with HI to form phenol and iodomethane not iodo benzene and methanol.
  10. Electrophilic substitution reactions like nitration or bromination are quicker in phenol than benzene.
  11. During the preparation of unsymmetrical ethers, substituted alkyl group (secondary tertiary is taken as alkoxide and primary halides.
  12. Ortho-nitrophenol is more acidic than ortho methoxy phenol.
  13. Acid dehydration of secondary and tertiary alcohols do not form ethers.
  14. The order of reactivity of halogen acid towards ether is HI > HBr > HCl.
6. Write the steps involved in the conversion of :
- (i) Phenol to picric acid.
  - (ii) Phenol to 4-Bromo phenol.
  - (iii) Anisole to 4-bromo anisole.
  - (iv) Phenol to benzene.
  - (v) Anisole to *p*-methoxy acetophenone.
  - (vi) Benzene to phenol.
  - (vii) Propene to propan-2ol.
  - (viii) Toluene to benzyl alcohol.
  - (ix) Ethylmagnesium chloride to propan-1ol.
  - (x) Methyl magnesium bromide to propan-2ol.
  - (xi) Phenol to anisole.
  - (xii) Ethanol to propan-2ol.
  - (xiii) Propan-2ol to 2 methylpropan-2-ol.
  - (xiv) Ethanol to ethoxy ethane.
  - (xv) Propan-2ol to propan-1-ol.
  - (xvi) Phenol to aspirin.
  - (xvii) Aspirin to Salicyclic acid.
  - (xviii) Ethanol to ethane 1, 2-diol.

(xix) Anisole to orthonitro anisole.

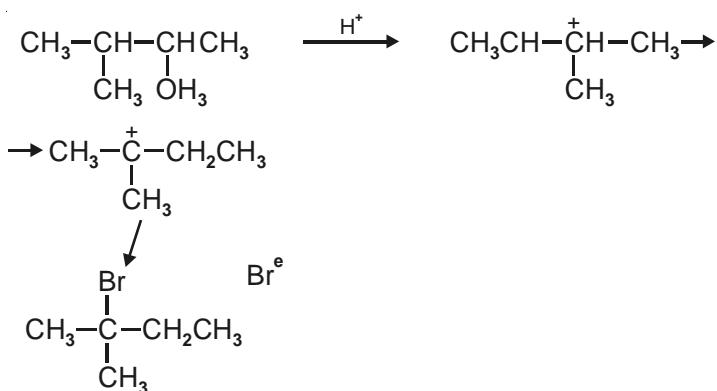
(xx) Benzene to *m*-bromophenol.

7. When 3-methylbutan-2ol is treated with H-Br the following reactions takes place.

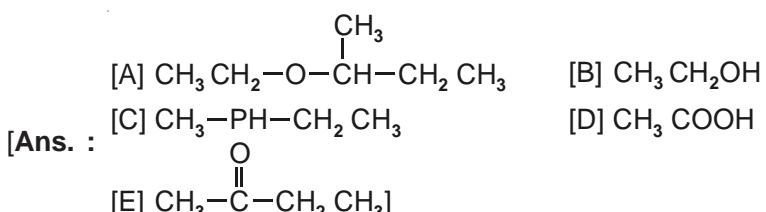


Give a mechanism for this reaction.

[Hint. : The secondary carbocation formed in step II rearranges to a more stable tertiary carbocation by a hydride ion ( $\text{H}^+$ ) shift from third carbon atom.]



**Hots\*8.** An ether [A]  $\text{C}_6\text{H}_{14}\text{O}$  when heated with excess of hot concentrated HI produced two alkyl halides, which on hydrolysis form compound [B] and [C]. Oxidation of [B] gave an acid [D] where as oxidation of [C] gave a ketone E. Deduce the structures of ketone. Deduce the structures of ABCD and E.



**Hots\*9.** An alcohol (A)  $\text{C}_4\text{H}_{10}\text{O}$  an oxidation with potassium dichromate gives a carboxylic acid (B)  $\text{C}_4\text{H}_8\text{O}_2$ . (A) is dehydrated with concentrated  $\text{H}_2\text{SO}_4$  at 453K gives a compound (C)  $\text{C}_4\text{H}_8$ . Treatment of (C) with warm aqueous  $\text{H}_2\text{SO}_4$  gives [D]  $\text{C}_4\text{H}_{10}\text{O}$ , an isomer of compound [A], compound [D] is resistant to oxidation. Identify compounds ABCD write the reactions.

[Ans. : (A) 2-methylpropan-1-ol. (B) 2-methylpropanoic acid. (C) 2-methyl propene. (D) 2-methyl propan-2-ol.

**Hots\*10.** A organic compound (A) having molecular formula  $\text{C}_6\text{H}_6\text{O}$  gives a characteristic colour with aqueous  $\text{FeCl}_3$ , solution. When A treated with carbondioxide and sodium hydroxide at 400k, under pressure, (B) is obtained. Compound (B) on acidification gives (C) which reacts with acetylchloride to from [D] which is a popular pain killer. Deduce the structure of A, B, C and D.

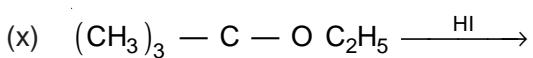
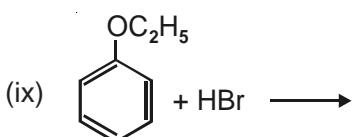
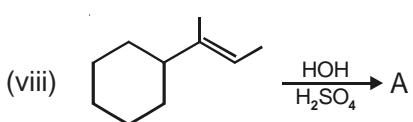
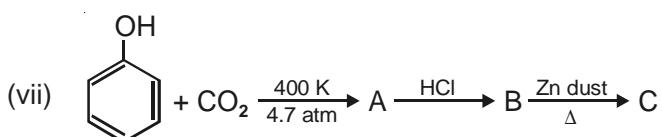
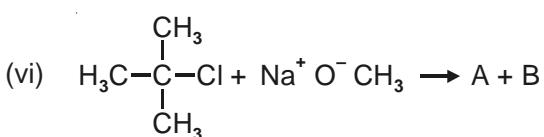
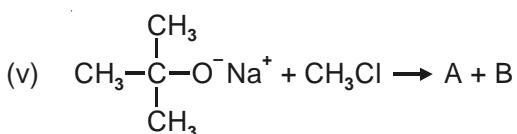
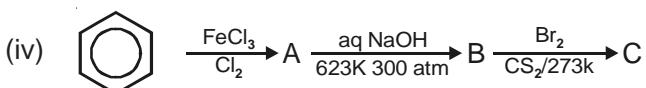
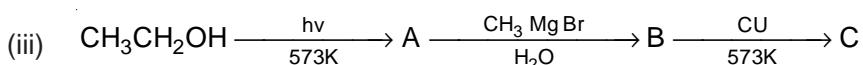
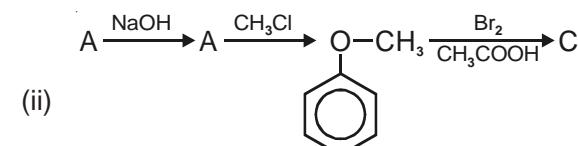
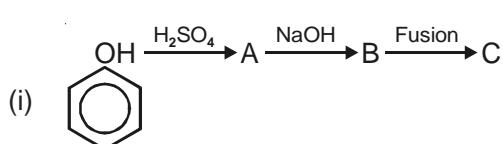
[A] = Phenol

[B] = Sodium Salicylate

[C] = Salicyclic acid

[D] = 2-acetoxy benzoic acid (aspirin)

11. Complete the following reactions :



12. Write the main products formed when :

- (i) Phenol is heated with Zn dust.
- (ii) Phenol is oxidised with alkaline potassium persulphate.
- (iii) Methanol is heated with methyl magnesium Bromide.
- (iv) Ethanol is heated with  $H_2SO_4$  at 443K.
- (v) Benzene is heated with propene in presence of  $H_3PO_4$  followed by air oxidation and distillation with  $H_2SO_4$ .
- (vi) Phenol is treated with ag  $Br_2$ .
- (vii) Anisole is heated with conc.  $HNO_3$   $H_2 SO_4$ .
- (viii) Phenatole is heated with HI.
- (ix) Propan-2 ol is passed over heated copper at 573K.
- (x) Acetic acid is reduced with iA  $1H_4$  in ether.

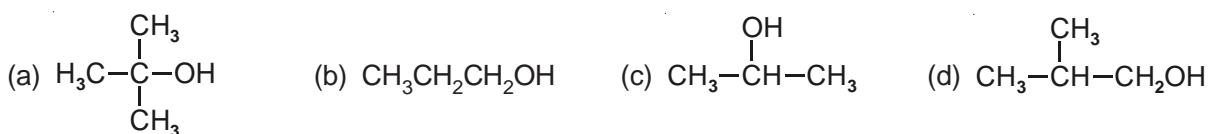
13. Name the reagent used in the following reactions.

- (i) Oxidation of ethanol to ethanoic acid.
- (ii) Oxidation of ethanol to ethanol.
- (iii) Bromination of phenol to 2, 4, 6 tri bromophenol.
- (iv) Dehydration of propan-2 ol to propene.
- (v) Penton-2 one to penton-2ol.

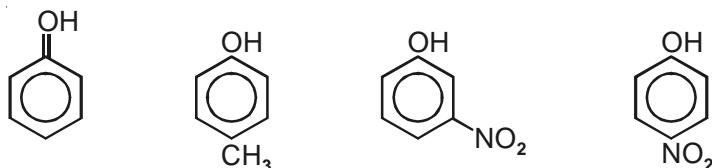
14. Write the structures of the compounds whose IUPAC names are as following.

- (i) 3-methyl Pentan-2 ol.
- (ii) 3, 5 dimethyl hexane 1, 3, 5 triol.
- (iii) 2-ethoxy-2-methyl propane.
- (iv) Cuclohexyl methanol.
- (v) Cyclo pent-3 en-1 ol.
- (vi) 1-phenyl butan-2-ol.
- (vii) 2, 3 dimethyl phenol.
- (viii) 2-ethoxy-3-methyl pentane.
- (ix) 3-cyclobutyl pentan-3ol.
- (x) 3-chloromethyl pentan-1ol.

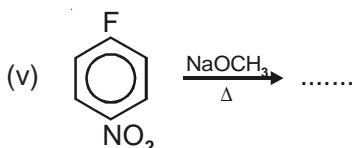
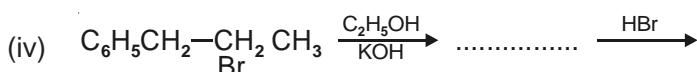
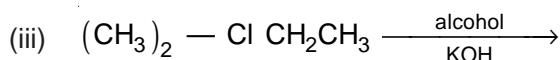
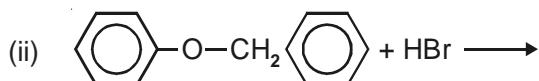
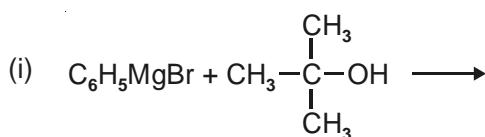
**Hots\*15.** Which of the following compound gives fastest reaction with HBr and why?



16. Arrange the following compound in the decreasing order of acidic character.



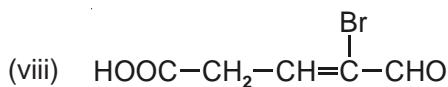
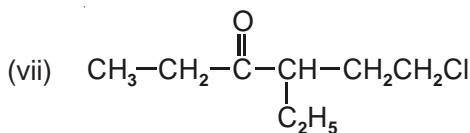
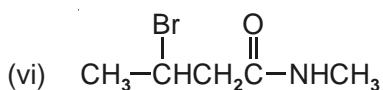
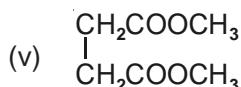
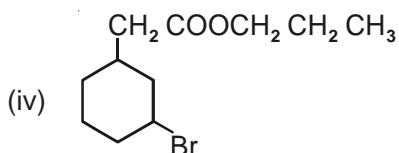
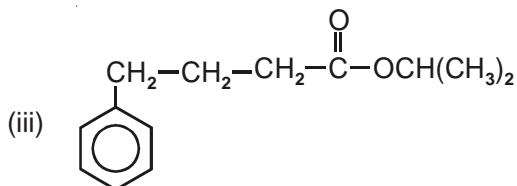
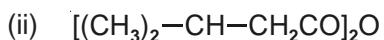
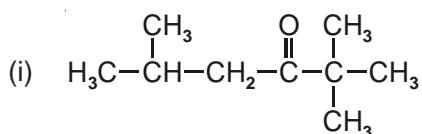
17. Complete the following Reactions.

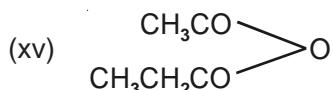
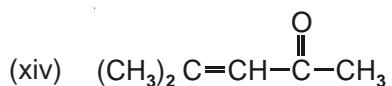
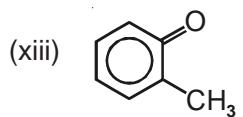
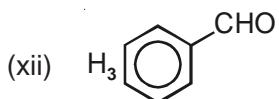
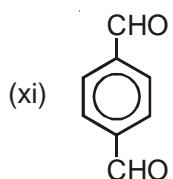
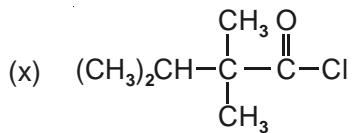
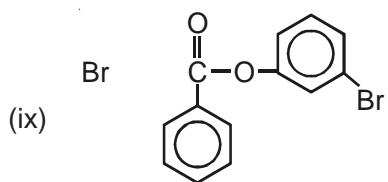


## UNIT 12

# ALDEHYDES, KETONES AND CARBOXYLIC ACIDS

1. Write IUPAC name of the following :





2. Write structure of the following compounds.

- p,p*-dihydroxybenzophenone.
- p*-nitro propiophenone.
- 4-methyl pent-2 en-2-one.
- 3-Bromo-4-Phenyl pentanoic acid.
- Hex-2-en-4-yneoic acid.
- 2, 4 dimethyl pentanoylchloride.
- Ethanoic methanoic anhydride.

- (viii) Methyl 1-methyl cyclohexyl carboxylate.
- (ix) N-ethyl N-methyl benzamide.
- (x) N, N-dimethyl propanamide.
- (xi) 2, 4-dinitrophenyl hydrazone of benzaldehyde.
- (xii) Cyclopropanoxime.
- (xiii) Acetaldehyde dimethyl acetal.
- (xiv) Semi carbozone of cyclobutanone.
- (xv) Etheylene ketal of hexan-2 one.
- (xvi) Methyl hemiacetal of methanal.

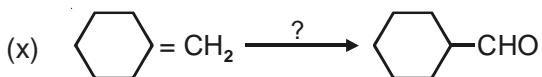
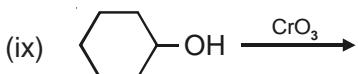
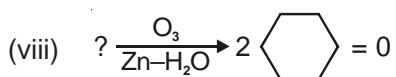
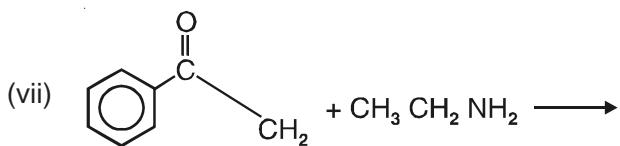
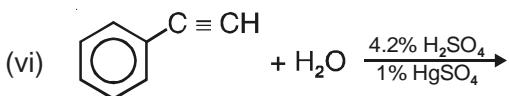
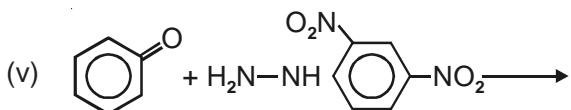
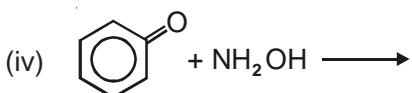
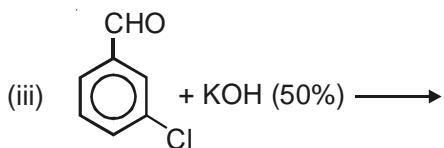
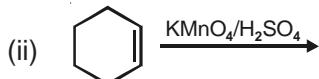
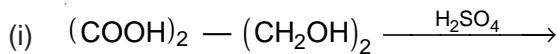
**Hots\*3.** An organic compound [A] with molecular formula  $C_8H_9O$  form an orange precipitate with 2, 4 DNP reagent and gives yellow precipitate of sodium hydroxide. It neither reduces Tollen's reagent nor felling solution, nor it decolourise bromine water or Bayer's reagent. On drastic oxidation with chromic acid it gives a carboxylic acid [B], having molecular formula  $C_7H_6O_2$ . Identify the compounds [A] and [B].

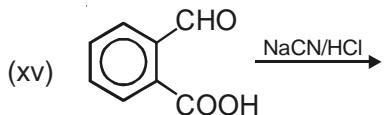
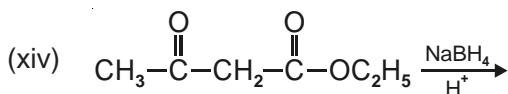
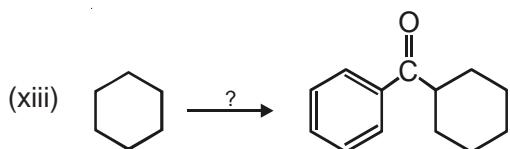
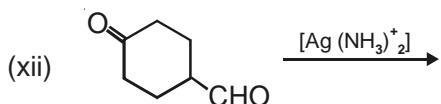
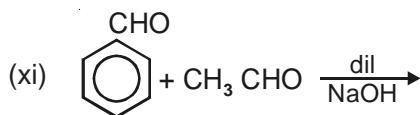
4. Convert :

- (i) Propanone to propene.
- (ii) Propanal to Butan-2-one.
- (iii) Ethanol to 2-hydroxy butanal.
- (iv) Benaldehyde to Benzophenone.
- (v) Benzaldehyde to 3-Phenyl propanal.
- (vi) Benzaldehyde to  $\alpha$ -hydroxy phenyl ethanoic acid.
- (vii) Benzaldehyde to Benzonitrile.
- (viii) Benzaldehyde to Toluene.
- (ix) Benzene to ortho-Benzaldehyde.
- (x) Benzene to ortho-Bromobenzoic acid.
- (xi) Propanoyl chloride to Diprophylamine.
- (xii) propanoic acid to propenoic acid.
- (xiii) Benzene to *m*-nitro aceto phenone.
- (xiv) Bromobezene to 1-Phenyl ethanol.
- (xv) Benzoyl chloride to Benzonitrile.
- (xvi) Benzoic acid to *m*-nitro benzyl alcohol.

- (xvii) Acetylene to propan-2 one.  
 (xviii) Acetaldehyde to 2-hydroxy but -2 enoic acid.  
 (xix) Acetone into 4-methyl pent 2 en - 2-one.  
 (xx) Acetic acid to acetone.

6. Complete the following equation :





7. Give the names of the reagent for the following transformations.

- (i) *p*-fluoro toluene to *p*-fluorobenzaldehyde.
- (ii) Allyl alcohol to propenal.
- (iii) But-2 ene to ethanol.
- (iv) Ethanenitrile to ethanol.
- (v) Benzaldehyde to Toluene.

8. Suggest appropriate mechanisms for the following :



9. Draw the structure of carbonyl group and predict

- (i) the state hybridization of carbon atom in carbonyl group and bond angle in it.
- (ii) No of sigma and Pi bond in it.
- (iii) Identify the nucleophilic and electrophilic centre in it.

10. Describe the following reactions with suitable example of each.

- (i) Resenmund Reaction.
- (ii) Cannizzaro Reaction.
- (iii) Aldol condensation.
- (iv) Clemmenson Reduction.
- (v) Wolff Kishner Reduction.
- (vi) Claisen condensation.
- (vii) ETARD reaction
- (viii) Stephen reaction.
- (ix) Gattenman kochreaction
- (x) HVZ reaction.
- (xi) Kolbe's electrolysis.

11. Give Plausible explanation for each of the following :

- (i) Aldehydes are more reactive towards nucleophile than ketones.
- (ii) Cyclohexanone forms cyanohydrin in good field but 2, 2 6-trimethyl cyclo hexanone does not.
- (iii) There are two-NH<sub>2</sub> group in semicabazide. However only one is involved in the formation of semicarbazones.
- (iv) During preparation of esters from a carboxylic acid and an alcohol in presence of an acid catalyst esters are removed as soon as it is formed.
- (v) pKa value of chloroacetic acid is less than acetic acid.
- (vi) Formic acid is stronger than acetic acid.
- (vii) Although phenoxide ion has more number of resonating structure than carboxylate ion but carboxylic acid is a stronger acid than phenol, why?

12. (i) How formaldehyde is obtained commercially.

- (ii) How formaldehyde is related to formation.

13. Molecular formula of an organic compounds is C<sub>5</sub>H<sub>10</sub>O.

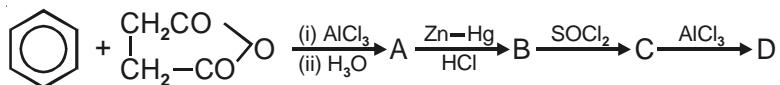
- (i) It does not reduce. Tollens, reagent.
- (ii) It give positive iodoform test.
- (iii) It forms addition product with sodium hydrogen sulphite.
- (iv) On vigorous oxidation it gives ethanoic acid and propanoic acid.

Write the structure of the compound.

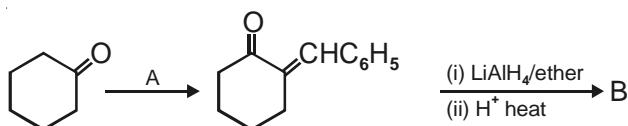
**Hots\*** 14. An organic compound with molecular formula C<sub>9</sub>H<sub>10</sub>O form DNP derivative, reduces Tollen's reagent and under go cannizzaro reaction. On vigorous oxidation it gives 1, 2-benzenedi carboxylic acid identify the compound.

15. An organic compound [A] molecular formula  $C_6H_{15}O_2$  was hydrolysed with dilute sulphuric acid to give a carboxylic acid [B] and an alcohol [C] oxidation (C) with chromic acid produce [B].[C] on dehydration gives but-lene. Write the equation for the reaction involved.

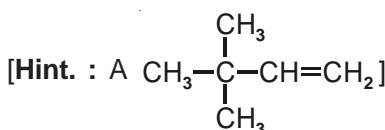
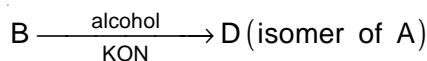
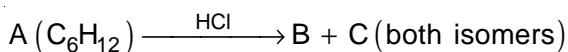
16. Predict the structures of intermediates A, B, C and D in the following sequence of reactions



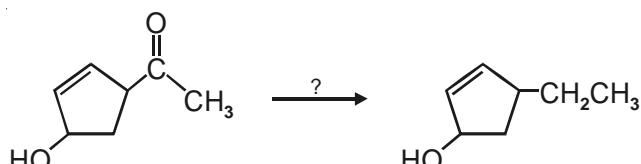
**Hots\*17.** Complete the following reactions specifying appropriate structures of products/reagents.



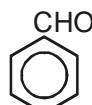
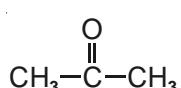
**Hots\*18.** Identify A to G in the following sequence of reactions.



**Hots\*19.** You are given  $\text{Zn-Hg}/\text{HCl}$ ,  $\text{NH}_2\text{NH}_2/\text{OH}^-$ ,  $\text{H}_2/\text{Ni}$  and  $\text{NaBH}_4$ . Select one reagent for the following transformation.

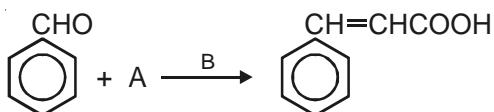


**Hots\*20.** Arrange the following in the increasing order of reactivity with  $\text{C}_6\text{H}_5\text{MgBr}$ .

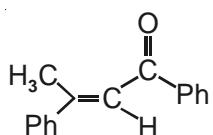


Which one of the following reagents can be used for conversion of Butan-2-one to propanoic acid.  
Tollens reagent, Fehling solution.

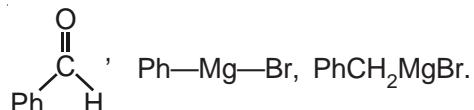
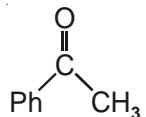
**Hots\*21.** Identify A and B in the following transformations



**Hots\*22.** A tertiary alcohol H upon acid catalysed dehydration gave a product I. Ozonolysis of I form compound J and K. Compound J on reaction with KOH gives Benzyl alcohol and compound L, whereas K on reaction with KOH gives only M whose structure is



**Hots\*23.** How will you prepare the compound  $\begin{array}{c} \text{H}_3\text{C} \\ | \\ \text{Ph}-\text{C}-\text{CH}_2-\text{Ph} \\ | \\ \text{OH} \end{array}$  from the following reagents.

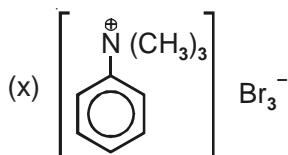
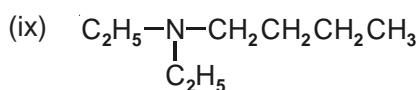
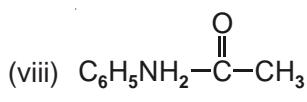
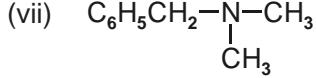
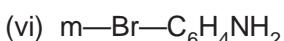
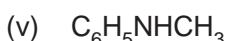
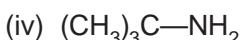


10 A hydrocarbon A of the formula  $\text{C}_8\text{H}_{10}$  on ozonolysis gives compound B ( $\text{C}_4\text{H}_6\text{O}_2$ ) only. Compound B can also be obtained from alkyl Bromide ( $\text{C}_3\text{H}_5\text{Br}$ )C. C on treatment with Mg in dry ether followed by  $\text{CO}_2$  and acidification. Identify A, B and C.

## UNIT 13

# ORGANIC COMPOUNDS CONTAINING NITROGEN

1. Write IUPAC names of the following compounds :



2. Give one chemical test to distinguish between the following pairs of compounds :

(i) Primary secondary and tertiary amines.

(ii) Methylamine and dimethyl amine.

(iii) Aniline and N-methyl aniline.

(iv) Methanamine and aniline.

(v) Aniline and Benzylamine.

3. Describe the following reaction emphasising the condition involved with one suitable example of each :

(i) Gabriel's phthalamide reaction

(ii) Hofmann Ammonolysis

(iii) Hofmann Bromamide reaction

(iv) Carbyl amine reaction

(v) Coupling reaction.

4. Account for the following :

(i) Observed  $K_b$  order of Amines in aqueous solution is :  $(C_2H_5)_2\ NH < (C_2H_5)_3\ N > C_2H_5NH_2 > NH_3$ .

(ii)  $PK_b$  value of aniline is more than methanamine.

- (iii) Methylamine in water react with Ferric chloride to precipitate hydrated Ferric oxide.
- (iv) Although  $-\text{NH}_2$  is ortho and paradirecting in aromatic electrophilic substitution but aniline on nitration gives a substantial amount of meta-nitro aniline.
- (v) Aniline does not undergo Friedal craft reaction.
- (vi) Gabriel's phthalamide synthesis is preferred for synthesis of primary amine.
- (vii) Aromatic primary Amines cannot be synthesised by Gabriel's Phthalamide synthesis.
- (ix) Amines are less acidic than alcohols of comparable molecular masses.
- (x) Diazonium salt of aliphatic amines are not known.
- (xi) Amines are higher boiling compounds than hydrocarbons of corresponding molecular masses but lower than alcohols and carboxylic acid.

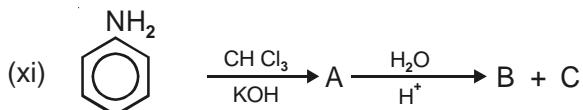
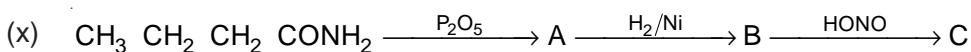
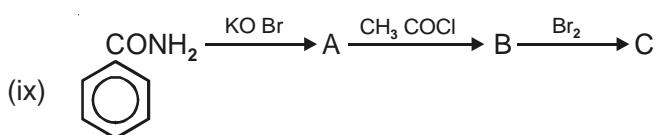
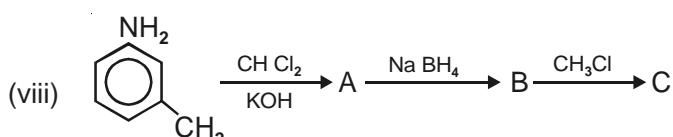
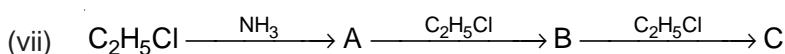
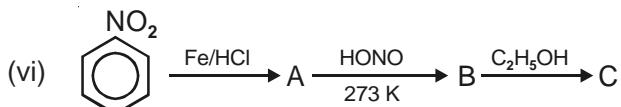
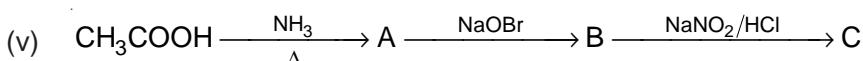
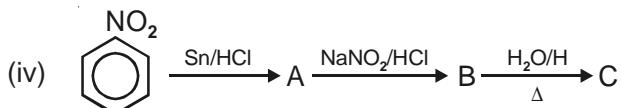
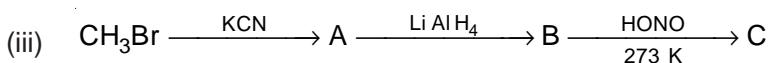
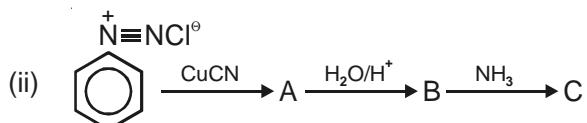
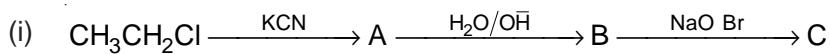
5. Write the reactions and conditions involved for the following conversions.

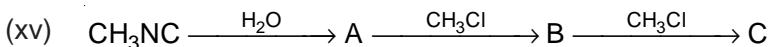
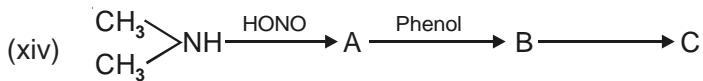
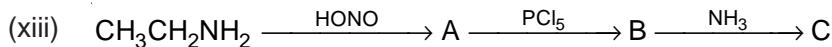
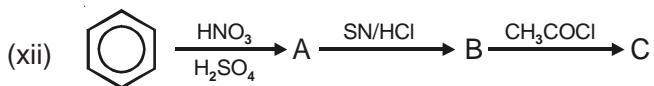
- (i) Benzene to aniline.
- (ii) Aniline to Benzene.
- (iii) Aniline to Benzoic acid.
- (iv) Aniline to 2, 4, 6 tribromofluoro benzene.
- (v) Benzyl chloride to 2-Phenylethanamine.
- (vi) Chlorobenzene to p-chloroaniline.
- (vii) Aniline to p-bromoaniline.
- (viii) Benzamide to toluene.
- (ix) Aniline to benzyl alcohol.
- (x) Ethanoic acid to methanamine.
- (xi) Hexanenitrile to 1-aminopentane.
- (xii) Methanamine to ethanamine.
- (xiii) Methanol to ethanoic acid.
- (xiv) Ethanamine to methanamine.
- (xv) Nitromethane to dimethylamine.
- (xvi) Aniline to Benzaldehyde.
- (xvii) Aniline to Benzylamine.
- (xviii) Aniline to Phenol.
- (xix) Methyl isonitrile to methanamine.

(xx) Aniline to 1, 3, 5-tribromobenzene.

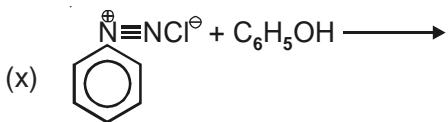
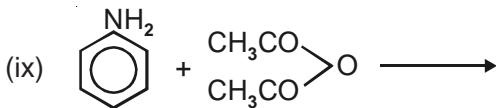
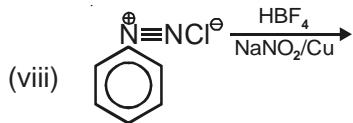
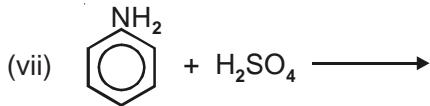
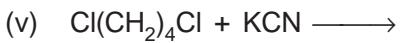
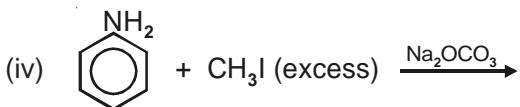
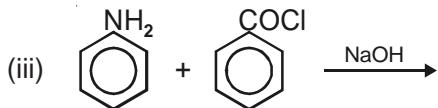
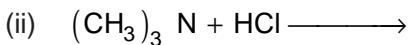
- Hots\*6.** An organic compound [A] on treatment with aqueous ammonia and on subsequent heating forms [B], which on heating with  $\text{Br}_2$  and KOH, forms a compound [C] of molecular formula  $\text{C}_6\text{H}_7\text{N}$ , suggest the structure and IUPAC names of compound A, B and C formed.

7. Write the structures of A, B and C the following reactions :

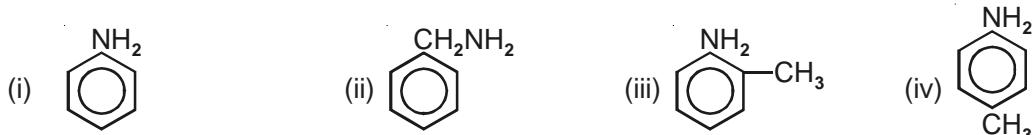




8. Write the main products of the following reactions :

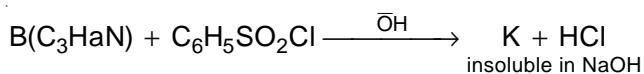
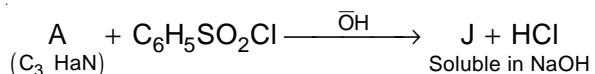


9. An organic compound [A] having molecular formula  $C_2H_3N$  on treatment with Sn/HCl gave another compound [B]. (B) on treatment with nitrous acid gave ethanol but on warming with chloroform and alcoholic KOH gave an offensive smelling substance [C]. Identify [A] [B] and [C].
10. Arrange the following as directed :
- In increasing order of the  $pK_b$  values.  $C_2H_5NH_2$ ,  $(C_2H_5)_2NH$ ,  $C_5H_5NH_2$ ,  $C_6H_5NHCH_3$ .
  - In the increasing order of basic strength  $C_6H_5NH_2$ ,  $(C_2H_5)_2NH$  and  $CH_3NH_2$ .
  - In the decreasing order of their basic strength aniline, *p*-nitroaniline, *p*-toluidine.
  - In the increasing order of solubility in water  $C_6H_5NH_2$ ,  $(C_2H_5)_2NH$ ,  $C_2H_5NH_2$ ,  $(C_2H_5)_3N$ .
  - In the increasing order of boiling points.  $C_2H_5NH_2$ ,  $(C_2H_5)_2NH$ ,  $(C_2H_5)_3N$ ,  $C_2H_2OH$ .
  - In decreasing order of basic strength in gas phase :  $C_2H_5NH_2$ ,  $(C_2H_5)_2NH$ ,  $(C_2H_5)_3N$  and  $NH_3$ .
  - In the increasing order of basic strength.  $C_6H_5NH_2$ ,  $C_6H_5NHCH_3$ ,  $C_6H_5CH_2NH_2$ .
  - In the increasing order of basic strength in aqueous solution.  
 $CH_3NH_2$ ,  $CH_3NHCH_3$ ,  $(CH_3)_3NNH_3$ .
11. Which of the following is more acidic and why
- The image shows two chemical structures side-by-side. On the left is the cation form of aniline, represented by a benzene ring with an amino group ( $-NH_3^+$ ) attached. On the right is the cation form of *p*-fluorophenyl, represented by a benzene ring with a fluorine atom ( $F$ ) at one position and an amino group ( $-NH_3^+$ ) at the para position.
- Hint. :-** I effect of F makes more acidic
12. Which of the following reagents can be used to distinguish between *p*-chloro aniline and anilium hydrochloride.
- $AgNO_3$ ,  $NaHCO_3$ , isocyanide test.
- [**Hint. :**  $AgNO_3$ ].
13. Which of the following compounds respond to carbarylamine test.
- $N$ , -N-dimethyl aniline.
  - 2, 4-dimethyl aniline.
  - N-methyl-2-methyl aniline
  - 4-methyl benzylamine.
14. Arrange the following amines in the order of increasing basic character.

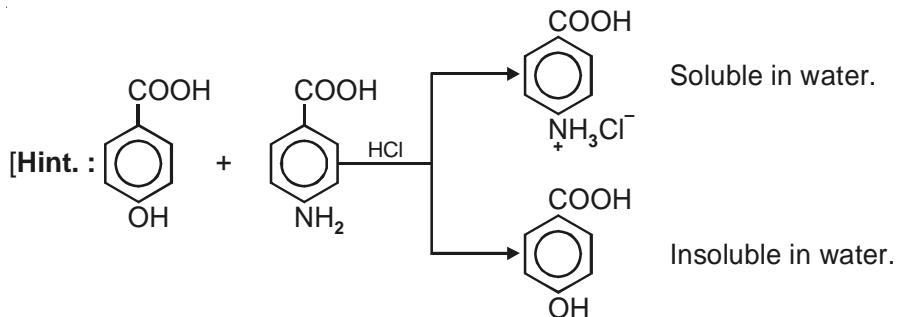


[Ans. : (iii) < (i) < (ii) < (iv)]

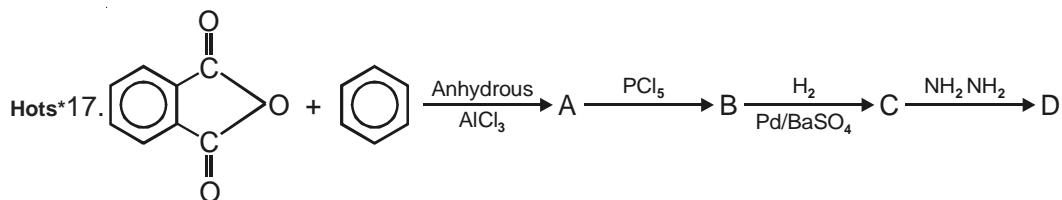
Hots\*15. Name A, B, J and K in the sequence of reactions.



Hots\*16. A mixture of 4-hydroxy benzoic acid and 4 amino benzoic acid is provided to you suggest a method to separate the two compounds from the mixture. How can they identified.



Identification gives neutral  $\text{FeCl}_3$  test.



Identify A, B, C, D in the above sequence of reaction.

## **UNIT 14**

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# **BIOMOLECULES**

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### **POINTS TO REMEMBER**

1. Carbohydrates are optically active polyhydroxy aldehydes or ketones or molecules which provide such units on hydrolysis.
2. They are broadly classified into three groups-monosaccharides, oligosaccharides and polysaccharides.
3. Glucose the most important source of energy for mammals is obtained by the digestion of starch.
4. Monosaccharides are held together by glycosidic linkages to form disaccharides or polysaccharides.
5. Proteins are the polymers of about twenty different  $\alpha$ -amino acids which are linked by peptide bonds. Ten amino acids are called essential amino acids because they can not be synthesised in our body. Hence must be provided through diet.
6. Proteins perform various structural and dynamic functions in the organisms. Proteins which contain only  $\alpha$ -amino acids are called simple proteins.
7. The secondary or tertiary structure of proteins get disturbed on change of pH or temperature and they are not able to perform their functions. This is called denaturation of proteins.
8. Enzymes are biocatalysts which speed up the reactions in biosystems. They are very specific and selective in their action and chemically all enzymes are proteins.
9. Vitamins are accessory food factors required in the diet. They are classified as fat soluble (A, D, and K) and water soluble (B group and C).
10. Nucleic acid are responsible for the transfer of characters from parents to offsprings.
12. There are two types of nucleic acids DNA and RNA. DNA contains a five carbon sugar molecule called 2-deoxy base and RNA contains ribose.
13. Both DNA and RNA contain adenine, guanine and cytosine. The fourth base is thymine in DNA and uracil in RNA. The structure of DNA is double strand while that of RNA is a single strand molecule.
14. DNA is the chemical basis of heredity and have the coded message for proteins to be synthesised.
15. There are three types of RNA i.e., m-RNA, r-RNA and t-RNA which actually carry out the protein synthesis in the molecule.

## QUESTIONS

### 1 MARK QUESTIONS

1. Rhamnose  $C_6H_{12}O_5$  is considered a carbohydrate, but it does not correspond to the general formula  $Cx(H_2O)_y$ . Explain.

[Hint : Rhamnose is a polyhydroxy alcohol containing carbonyl group.]

2. What are the two main functions of carbohydrates?

3. What structural feature is required for a carbohydrate to behave as reducing sugar?

[Hint : At least one of the reducing groups aldehyde or ketone should be free one]

4. Why is sucrose called a non reducing sugar?

5. How many asymmetric carbon atoms are present in D – (+) glucose?

[Hint : An asymmetric carbon is joined to four different groups]

6. Name the enantiomer of D-glucose.

[Hint : Enantiomers are stereoisomers which are mirror image of each other.]

7. Give the significance of prefix 'D' in the name D – (+) – glucose.

[Hint : 'D' signifies that OH groups on C – 5 is on the right hand side]

8. Give the significance of (+) – sign in the name D – (+) – glucose.

[Hint : (+) – sign indicates dextrorotatory nature of glucose].

9. Glucose is an aldose sugar but it does not react with sodium hydrogen sulphate. Give reason.

[Hint : The CHO group reacts with –OH group at C – 5 to form a cyclic hemi-acetal].

10. Write the structure of (A) formed by the reaction



11. Why is sucrose called invert sugar?

12. What are the products of hydrolysis of lactose.

13. Glucose or sucrose are soluble in water but cyclohexane or benzene are insoluble. Explain.

[Hint : Glucose or sucrose are polyhydroxy compounds capable of making H–bonds with water. Therefore they are soluble].

14. Give one basic structural difference between starch (amylose) and cellulose.

[Hint : Starch (amylose) is a linear polymer of  $\alpha$ -D-glucose while cellulose is a linear polymer of  $\beta$ -D-glucose].

15. Name two carbohydrates which act as biofuels.

16. Which polysaccharide is stored in the liver of animals?
17. Write the structure of product obtained from reaction of D-glucose with  $\text{Br}_2$  water.
18. Name the building blocks of proteins.
19. Give the structure of simplest optically active  $\alpha$ -amino acid.  
[Hint :  $\text{CH}_3 - \text{CH} - (\text{NH}_2) - \text{COOH}$ ]
20. Name and  $\alpha$ -amino acid which is not optically active.
21. Write the zwitter-ion structure of  $\alpha$ -aminoacetic acid.
22. Write the structure of dipeptide glycylalanine.
23. Name the enzyme which catalyses the hydrolysis of maltose into glucose.
24. How would you explain the amphoteric behavior of amino acids.
25. What forces are responsible for the stability of x-helix structure of proteins.
26. How are polypeptides different from proteins.

**Hots\*** 27. Why do proteins form an indispensable part of our food.

28. What is the difference between a nucleoside and a nucleotide.
29. Which nucleic acid is responsible for carrying out protein synthesis in the cell.

**Hots\*** 30. What is meant by the term DNA finger-printing.

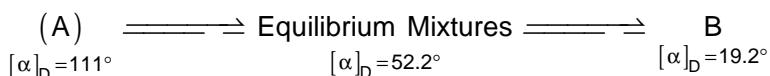
31. The two strands in DNA are not identical but complementary. Explain.
32. When RNA is hydrolysed, there is no relationship among the qualities of different bases obtained. What does this fact suggest about the structure of RNA.
33. What type of linkage holds together the monomers of DNA and RNA.
34. Name the purine and pyrimidine bases present in DNA.
35. Mention the number of hydrogen bonds between adenine and thymine.
36. Name the water soluble vitamin which can be stored in the body.

**Hots\*** 37. Name the vitamin responsible for coagulation of blood.

38. A child diagnosed with bone deformities, is diagnosed with the deficiency of which vitamin?
39. Fat soluble vitamins A, D, E and K are stored in which part of body?
40. What is meant by quaternary structure of proteins.

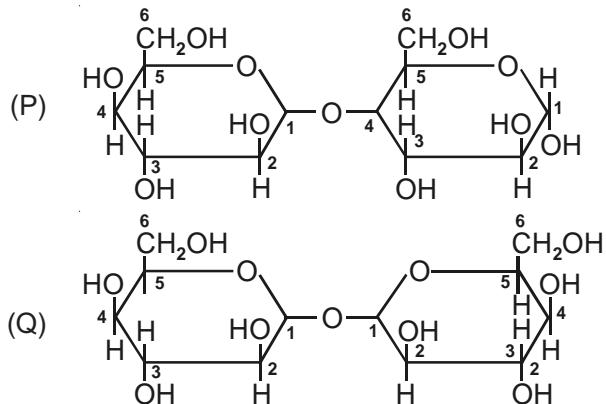
## 2 MARKS QUESTIONS

**Hots\*1.** An optically active compound having molecular formula  $C_6H_{12}O_6$  is found in two isomeric forms (A) and (B) in nature when (A) and (B) are dissolved in water, they show the following equilibrium.



- (a) What are such isomers called?
  - (b) How are they different from each other.
2. Give two examples of polysaccharides obtained from plants. Mention one use of each of them.
3. Classify carbohydrates on the basis of functional group present. Give one example of each class.
4. Give the method of preparation of glucose from :
- (i) Sucrose
  - (ii) Starch
5. (i) Acetylation of glucose with acetic anhydride gives gluco-pentacetate. Write the structure of the pentaacetate.  
 (ii) Explain the observation that glucose pentaacetate does not react with hydroxylamine.  
 [Hint : The molecule glucose pentaacetate has a cyclic structure in which – CHO react with hydroxylamine.]
6. Give two reactions of glucose which can not be explained by its open chain structure.
7. Give the names and structures of two anomers of fructose.
8. Explain the term glycosidic linkage. Give the type of glycosidic linkage present in sucrose.

**Hots\*9.** Which of the following will reduce Tollen's reagent. Explain the difference in behavior



[Hint : (P) has  $(C - 1) - (C - 4)$  glycosidic linkage. It has one free aldehyde group at  $C - 1$  of second sugar. Therefore (P) can reduce tollen's reagent. Q involves  $(C - 1) - (C - 1)$  glycosidic linkage. No – CHO group is free in Q.]

10. Name the water soluble and water insoluble polysaccharide components of starch. Give one difference in the structure of these two components.

[Hint : Amylose is a linear chain polymer of starch while amylopectin is a branched chain isomer.]

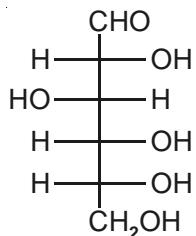
11. Classify the following as monosaccharides or oligosaccharides.

- (i) Ribose
- (ii) Maltose
- (iii) Galactose
- (iv) Lactose

12. Classify monosaccharides on the basis of functional groups. Give example of each class.

13.  $\alpha$  – D – (-) – fructose are the two anomers of fructose. Depict their structures using worth projection.

**Hots\*** 14. The Fisher projection of D-glucose is



- (a) Predict the Fischer projection of L-glucose.
- (b) Give the product of reaction of L-glucose with Tollen's reagent.

15. What is meant by the terms essential and nonessential amino acids. Give example of each?

16. Classify the following  $\alpha$ -aminoacids as neutral, acidic or basic.

- (i) HOOC – CH<sub>2</sub> – CH(NH<sub>2</sub>)COOH
- (ii) C<sub>6</sub>H<sub>5</sub> – CH<sub>2</sub> – CH(NH<sub>2</sub>)COOH
- (iii) H<sub>2</sub>N – (CH<sub>2</sub>)<sub>4</sub> – CH(NH<sub>2</sub>) – COOH
- (iv) HN=C – (CH<sub>2</sub>)<sub>3</sub> – CH(NH<sub>2</sub>)COOH  


17. Show the type of linkage are responsible for the formation of :

- (i) Primary structure of proteins.
- (ii) Secondary structure of proteins.

**Hots\*** 18. Account for the following :

- (a) On electrolysis in acidic solution, amino acids migrate towards cathode while in alkaline solution they migrate towards anode.
  - (b) The monoamino monocarboxylic acids have two pK values.
19. If you have two amino acids glycine and alanine, what are the structures of two possible dipeptides that they can form.
20. Explain the significance of secondary structure of proteins. Name the common types of secondary structure of proteins and give example of each type.
21. Name four types of intermolecular forces which stabilize 2° and 3° structure of proteins.
22. Classify the following as globular or fibrous proteins :

- (i) Keratin
- (ii) Myosin
- (iii) Insulin
- (iv) Haemoglobin

**Hots\*** 23. (i) On boiling the egg, it solidifies? Why?

- (ii) Where does the water present in the egg go after boiling.

[**Hint** : On boiling denaturation of protein occurs. As a result the soluble globular proteins of egg are converted to insoluble fibrous proteins. The water present inside is either absorbed or adsorbed in the fibrous proteins.]

24. Explain the following :

- (i) The amino acids are amphoteric in nature.

- (ii) The melting point and solubility of aminoacids in water are generally higher than of corresponding halo acids.

[**Hint** : Amino acids behave like ionic salts due to their zwiffer ion structure whereas  $\alpha$ -halo acids can't form zwither ion.]

25. (i) Name the disease caused by deficiency of vitamin C.

- (ii) Why can not vitamin C be stored in our body?

26. Define the terms hypervitaminosis and avitaminosis.

[**Hint** : Excess intake of vitamin A and D causes hypervitaminosis while multiple deficiencies caused by lack of more than one vitamin is called avitaminosis.]

27. Give the sources of vitamin A and E and name the deficiency diseases resulting from lack of vitamin A and E in the diet.

**Hots\***28. (a) DNA is exclusively responsible for maintaining the identity of different species of organisms over million of years. Why?

(b) The base sequence found in one of the strands of DNA is given below.

GATACGTC

Predict the base sequence in complementary strand.

### 3 MARKS QUESTIONS

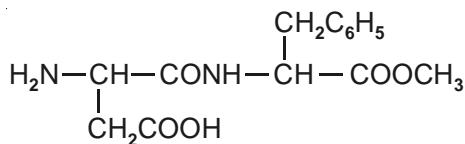
1. Write the names and structures of the products obtained when D-glucose is treated with :

- (i) HI
- (ii) HNO<sub>3</sub>
- (iii) NH<sub>2</sub>OH

**Hots\***2. An optically active amino acid (A) can exist in three forms depending on the pH of the medium if the molecular formula of (A) is C<sub>3</sub>H<sub>7</sub>NO<sub>2</sub>, write

- (a) The ionic structure of (A) in aqueous medium.
- (b) What two functional groups does this ion have?
- (c) What is the specific name for such ion.

**Hots\***3. Aspartame, an artificial sweetener, has the following structure



- (a) Write the zwiffer ion structure of the above mentioned peptide
- (b) Write the structure of two amino acids which will be formed after its hydrolysis.

4. Define the following as related to proteins :

- (i) Peptide linkage
- (ii) Primary structure
- (iii) Denaturation and renaturation.

5. Differentiate between the following :

- (i) Secondary and tertiary structure of proteins.
- (ii)  $\alpha$ -Helix and  $\beta$ -pleated sheet structure of proteins.

- (iii) Fibrous and globular proteins.
6. (i) What are enzymes?
- (ii) Why are enzymes specific in nature?
- (iii) Predict whether the enzyme-substrate complex will have activation energy higher or lower than the activated complex formed without enzyme.
7. (i) What are vitamins?
- (ii) How are they classified?
- (iii) Give one example of each. Class of vitamins

## **UNIT 15**

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# **POLYMERS**

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### **POINTS TO REMEMBER**

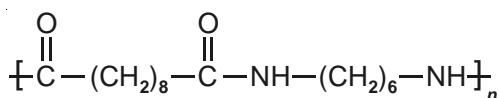
1. Polymers are defined as high molecular mass macromolecules, which consist of repeating structural units derived from the corresponding monomers. The polymers may be of natural or synthetic origin.
2. In the presence of an organic peroxide initiator, the alkenes and their derivatives undergo addition polymerisation or chain growth polymerisation through a free radical mechanism. Polythene, teflon, orlon etc. are formed by addition polymerisation of an appropriate alkene or its derivative.
3. Condensation polymerisation reactions are shown by the addition of bi- or poly functional monomers containing  $-NH_2$ ,  $-OH$  and  $-COOH$  groups. This type of polymerisation proceeds through the elimination of certain simple molecules as  $H_2O$ ,  $CH_3OH$  etc.
4. Formaldehyde reacts with phenol and melamine to form the corresponding condensation polymer products. The condensation polymerisation progresses through step by step and is called also step growth polymerisation.
5. Nylon, backelite and dacron are some of the important examples of condensation polymers.
6. A condensation of two unsaturated monomers exhibits copolymerisation. A copolymer like Buna-S contains multiple units of 1, 3-Butadiene and styrene.
7. Natural rubber is a cis 1, 4-polyisoprene. It can be made more tough by the process of vulcanization with sulphur.
8. Synthetic rubber like Buna-N are usually obtained by copolymerisation of alkene and 1, 3-Butadiene derivatives.
9. In view of potential environmental hazards of synthetic polymeric wastes certain biodegradable polymers such as PHBV and Nylon-2-Nylon-6 are developed as alternatives.

### **QUESTIONS**

#### **1 MARK QUESTIONS**

1. Define the term polymer.
2. Identify the synthetic polymer among the following starch, orlon, cellulose.
3. Give example of natural polyamide. Which is an important constituent of diet. [Hint : Proteins]
4. Classify polythene as thermosetting or thermoplastic polymer.

- Among fibres, elastomers and thermosetting polymers which one has strongest intermolecular forces of attraction?
- Give the monomers of bakelite.
- Identify the monomer in the following polymeric structure.

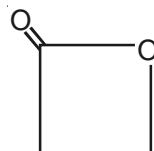


- Nylon 2 Nylon 6 is a biodegradable polymer obtained from glycine  $\text{H}_2\text{N}-\text{CH}_2-\text{COOH}$  and aminocaproic acid  $\text{H}_2\text{N}-(\text{CH}_2)-\text{COOH}$ . Write the structure of this copolymer.
- Give two uses of teflon.
- Name the monomers of the polymer used for making unbreakable crockery.
- Name the polymer used for making insulation material for coating copper wire.  
[Hint : PVC Polyvinyl chloride].
- Write the structure of monomer of the polymer which is used as synthetic wool.
- Give two uses of vulcanised rubber.
- Give example of natural addition polymers.
- Classify Buna -S as homopolymer or copolymer.
- Name the polymer used for making radio television cabinets and feeding bottles of children.

**Hots** 17. Why benzoyl peroxide is used as an initiator for chain growth polymerisation?

- What do the numbers 6 and 6, 6 represent when used in the names nylon 6 and nylon 6, 6?
- Name the polymer formed by the polymerisation of caprolactum in acid medium.
- Name the polymer which is used in orthopaedic devices and in controlled drug release capsules.
- Give the full form of PHBV. What is the difference between Buna-N and Buna-S?

**Hots** 22. Write the structure of polymer produced by the treatment of following monomer with a catalytic amount of hydroxide ion.



**Hots** 23. During the free radical polymerisation reactions, purest samples of monomers are taken why?

- Which of the following sets has all members capable of repeatedly softening on heating and hardening on cooling.
  - Glyptal, Melmac, PAN

(b) PVC, PMMA, Polystyrene

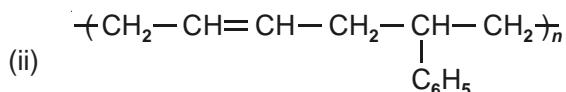
(c) Polypropylene, urea formaldehyde, teflon.

25. Which of the following is a polymide wool, Natural silk, Rayon, Nylon.

## 2 MARKS QUESTIONS

1. Classify the following as homopolymer or copolymer. Also classify them as addition or condensation polymers.

(i)  $(\text{NHCHRCO})_n$

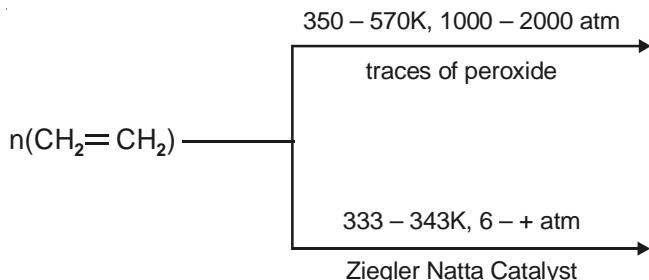


2. (i) What is the difference between step growth polymers and chain growth polymers?

(ii) Classify the following as Chain growth or step growth polymers : Terylene and Polythene.

3. Give the mechanism of polymerisation of ethene to polythene in presence of benzoyl peroxide.

4. Complete the following reactions :



5. Give the structure of monomer of the polymer neoprene. What is the advantage of neoprene over the natural rubber?

6. (i) How can we change the properties of natural rubber? Name the process involved.

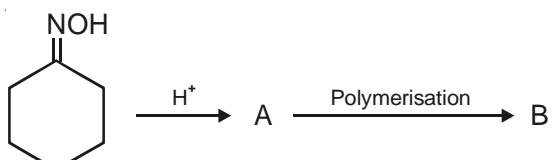
(ii) Mention the structural change introduced?

7. The monomer of natural rubber gives two moles of  $\text{CH}_2\text{O}$  and one mole of  $\text{CH}_3\text{COCHO}$  on ozonolysis.

(a) Write the structure of monomer.

(b) Write all cis configuration of polymeric chain.

8. Identify the products A and B in the following reaction



9. (a) Which synthetic rubber is resistant to the action of petrol and organic solvents.  
 (b) Name the two monomers which are used in its preparation.
10. Mention the type of intermolecular forces present in Nylon 66. What properties do they impart to nylon.
11. Identify the chain growth and step growth polymers from the following :  
 Nucleic acid, Polystyrene,
12. Identify linear polymer and branched chain polymer from the following :  
 Low density polythene, High density polythene
13. Acrilan is hard, horny and a high melting material. Write its monomers and classify it as a homopolymer or copolymer.
- Hots** 14. Give reason for the following :  
 (a) Tyres made up of natural rubber tend to crack and wither rapidly in areas around major cities where high levels of ozone and other industrial pollutants are found.  
 (b) Nylon is more easily damaged by acid or alkali as compared to chain growth polymers such as orlon and polythene.  
 [Hint : (a) Ozone attack double bonds of polymeric rubber.  
 (b) Acid hydrolyses the amide linkages of nylon.]
15. Identify the polymers whose structure are given and mention one of their important use.  
 (i)  $[\text{NH}(\text{CH}_2)_6 - \text{NH} - \text{CO} - (\text{CH}_2)_4 - \text{CO}]_n$   
 (ii)  $(\text{CH}_2 - \overset{\text{Cl}}{\underset{|}{\text{CH}}})_n$
16. Write the structure of polymers Buna-N and Buna-S. Give one use of each polymer.
17. Arrange the following polymers in the order of increasing intermolecular forces.  
 (i) Nylon 6, 6, Buna-S, Polythene  
 (ii) Nylon 6, Neoprene PVC
18. Write the expended form and give the structures of monomers for the following polymers.  
 (i) PAN  
 (ii) PTFE
19. Novolac is the linear polymer which on heating with formaldehyde forms cross linked bakelite. Write the structures of monomers and the polymer novolac.

20. Write the structures of following polymers and also give their use.
- (i) Polystyrene
  - (ii) Melamine formaldehyde resin.
21. Identify the polymer used in the manufacture of paints and lacquers. Write the structure of the polymer and its monomers.
22. Give the reaction of preparation of dacron from its monomers. Also mention two uses of dacron fibre.
23. Define biodegradable polymers, give example of a biodegradable polyester and a biodegradable polyamide.
24. A regular copolymer of ethylene and vinylchloride contains alternate monomer of each type.
  - (i) Give the structure of the copolymer formed.
  - (ii) What is the weight percentage of ethylene in this polymer.
25. Identify the monomers of the polymers whose structure is given below?
- (i)  $\text{+CO-(CH}_2)_5-\text{NH+}_n$
  - (ii)
26. Write the structure of the monomer used in the synthesis of following
- (i) Nylon 6
  - (ii) Nylon 6, 6

### 3 MARKS QUESTIONS

1. Differentiate between the following pairs
  - (i) Branched chain polymers and cross linked polymers.
  - (ii) thermoplastic and thermosetting polymers.
  - (iii) Chain growth polymerisation and step growth polymerisation.
2. Mention one structural difference between the following pairs. Also give one use of each.
  - (i) Homopolymer and copolymer.
  - (ii) Natural rubber and synthetic rubber.
  - (iii) Fibers and elastomers.

3. Write the chemical reaction involved in the preparation of following polymers.
- (i) Teflon
  - (ii) Buna-N
  - (iii) Urea formaldehyde resin.
4. Classify the polymers on the basis of structure giving example of each type.
5. List two uses each of following polymers.
- |                 |                              |
|-----------------|------------------------------|
| (i) Polypropene | (ii) Urea formaldehyde resin |
| (iii) PAN       |                              |
- Hots**6. Give the mechanism of polymerisation of propene in presence of tert-butyl peroxide.
7. (a) What is meant by biodegradable polymers.  
 (b) A biodegradable polymer is used in speciality packaging, orthopaedic devices and in controlled release of drugs. Identify the polymer and give its structure.
- Hots**8. (a) Can a copolymer be formed in both addition and condensation polymerization? Explain with two examples.  
 (b) Mention the main advantage of copolymers over homopolymers.
9. Match the chemical substances in column I with the type of bonds in column II.
- | Column I  | Column II  |
|-----------|------------|
| Protein   | Glycosidic |
| Cellulose | Ester      |
| PHBV      | Amide      |
10. Polythene finds widespread use to make carry bags and also for manufacturing buckets and pipes.
- (a) Name the different types of polythenes used for above mentioned applications.  
 (b) What is the structural difference between these two types.  
 (c) Write the method of preparation of high density polythene
- Hots**11. Draw the structures of step growth polymers you would expect to obtain from the following reactions.
- $\text{BrCH}_2\text{CH}_2\text{CH}_2\text{Br} + \text{HOCH}_2\text{CH}_2\text{CH}_2\text{OH} \xrightarrow{\text{Base}}$
  - $\text{HOCH}_2\text{CH}_2\text{OH} + \text{HOOC} - (\text{CH}_2)_6 - \text{COOH} \xrightarrow{\text{H}^+}$
  - $\text{H}_2\text{N}(\text{CH}_2)_6\text{NH}_2 + \text{ClOC} - (\text{CH}_2)_4\text{COCl} \longrightarrow$

## **UNIT 16**

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# **CHEMISTRY IN EVERY DAY LIFE**

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### **POINTS TO REMEMBER**

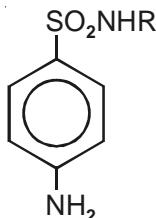
1. A drug is a chemical agent which effects human metabolism and provides cure from ailment. If taken in doses higher than recommended, these may have poisonous effect.
2. Use of chemicals for therapeutic effect is called chemotherapy.
3. Drugs usually interact with biological macromolecules such as carbohydrates, proteins, lipids and nucleic acids. These are called target molecules.
4. Drugs are designed to interact with specific targets so that these have the least chance of affecting other targets. This minimises the side effects and localises the action of the drug.
5. Drugs like analgesics, antibiotics, antiseptics, disinfectants, antacids and tranquilizers have specific pharmacological functions.
6. Antifertility drugs are used to control population. These contain a mixture of synthetic estrogen and progesterone derivatives.
7. Chemicals are added to food for their preservation, enhancing their appeal and adding nutritional value by them.
8. Artificial sweetening agents like aspartane saccharin etc. are of great value to diabetic persons and people who need to control their calories.
9. These days detergents are much in vogue and get preference over soaps because they work even in hard water.
10. Synthetic detergents are classified into three main categories namely anionic cationic and non-ionic.
11. Detergents with straight chain of hydrocarbons are preferred over branched chain as the latter are non-biodegradable and consequently cause environmental pollution.

### **QUESTIONS**

#### **1 MARK QUESTIONS**

1. Define the term chemotherapy.
2. Give two examples of the drugs classified on the basis of pharmacological effect.

3. Name the type of drugs having following structural feature.



4. What is the significance of classifying drugs on the basis of structure?
5. Name two types of macromolecules used as drug targets.
6. Why the receptors embedded in cell membranes show selectivity for one chemical messenger over the other?
7. Which forces are involved in holding the drugs to the active sites of enzyme containing functional groups like  $-\text{COOH}$ ,  $-\text{OH}$ ,  $-\text{Ph}$  etc?
8. Give one disadvantage of using sodium hydrogen carbonate as an antacid.
9. With reference to which classification has the statement 'ranitidine is an antacid' been given?

**Hots\*** 10. How is acidity cured with cimetidine?

**[Hint. :** Cimetidine prevents the interaction of histamines with the receptors present in stomach wall.]

**Hots\*** 11. While antacids and antiallergic drugs interfere with the function of histamines, why do these not interfere with the function of each other.

**[Hint. :** Antacids and antiallergic drugs bind to the different receptor sites. Therefore they do not interfere with the function of each other).

12. Name the medicine used for the treatment of syphilis.
13. Give example of narrow spectrum antibiotic.
14. Name two diseases which can be cured with chloramphenicol.
15. Give the composition of tincture of iodine.
16. How does aspirin act as analgesic?

**[Hint. :** Aspirin inhibits the synthesis of prostaglandins which stimulate inflammation in the tissues and cause pain.]

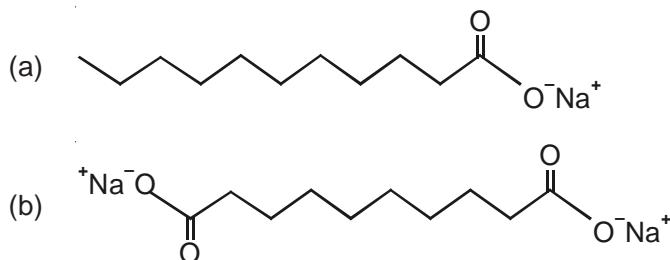
17. Name one chemical which can act both as an antiseptic and a disinfectant.
18. Name the antiseptic agents present in dettol.

**[Hint. :** Chloroxylenol and Terpineol]

## 1 MARK QUESTIONS

19. Which of the following tranquilizers is not a derivative of Barbituric acid Veronal, Equanil, Seconal, Lurninal.
20. Choose one antiseptic from the following 1% Phenol, Iodoform, Sulphur dioxide.
21. What is the name given to medicines which are used for the treatment of stress and mild or even severe mental diseases.
22. Name the medicine which can act both as analgesic and antipyretic.
23. Explain why aspirin finds use in prevention of heart attacks.
24. Mention one use of drug Meprobamate.
25. Why are cimetidine and ranitidine better antacid than sodium hydrogen carbonate or magnesium or aluminium hydroxide?
26. Name the derivative of sucrose which tastes like sugar and can be safely used by weight conscious people.
27. Which of the following is used as a preservative to protect processed food?

**Hots\*** 28. Which of the following two compounds can be used as a surface agent.



## 2 MARKS QUESTIONS

1. Explain the following terms as used in medicinal chemistry.
  - (i) Target molecules.
  - (ii) Enzyme inhibitors.
2. Explain the terms lead molecules. Write two different sources of lead molecules.

**[Hint. :** A knowledge of the physiological function of the drug target in the body helps us to choose a compound which can interact with the target and hence is expected to be therapeutically active: These compounds are called lead molecules and drugs are designed from these compounds.

Lead compounds can be obtained from natural sources such as plants, tree, bushes, venoms and metabolites of microorganisms lead compounds have also been isolated from fish, coral, sponges and marine microorganisms].

3. Mention two types of drugs having different pharmacological effect and the mode of action.
  4. Name the following :
    - (i) Drugs that can bind to the receptor site and inhibit its natural function.
    - (ii) Drugs that mimic the natural messenger by switching on the receptor.
  5. Give one function and one example of following classes of drugs.
    - (i) Antacids
    - (ii) Antihistamines
- Hots\*6.** Sulpha drugs work like antibiotics but they are not antibiotics. Explain with the help of examples.
- [Hint. : Sulpha drugs are a group of drugs which are derivatives of sulphanilamide. They have antibacterial powers like antibiotics e.g, sulphadiazine is used as a dusting power for dressing of wounds and sulphadiazine is used for disentery urinary and respiratory infection. Sulpha drugs are not antibiotics because structurally they are different from antibiotics.]
7. (i) What is an antipyretic? Give an example.
  - (ii) Name the class of medicines used for getting relief from pain. Give one example.
  8. Give one important use of each of following :
    - (i) Equanil
    - (ii) Morphine
  9. (i) What are antibiotics?
  - (ii) Where in India penicillin is manufactured?
  10. Explain the term broad spectrum antibiotic. Give two examples.
- Hots\*11.** What are barbiturates? What is the action of barbiturates on human body?
12. Which of the following drugs is used for
    - (a) treating allergic conditions,
    - (b) to get relief from pain.
- Grompheniramine, Ciprofloxacin, Heroin, Chloramphenicol.
13. Give two reasons why the drugs should not be taken without consulting a doctor.
  14. State the main difference between bacteriostatic and bacteriocidal antibiotics. Give one example of each.
  15. What are antifertility drugs? Give the names of constituents of an oral contraceptive.

**Hots\*16.** Write the structures of soaps obtained by the hydrolysis of following fats.

- (i)  $(C_{15}H_{31}COO)_3 C_3H_5$  Glyceryl palmitate.

(ii)  $(C_{17}H_{32}COO)_3C_3H_5$  Glyceryl oleate.

**Hots\*** 17. If water contains dissolved calcium hydrogencarbonate, which out of soap and detergent will you prefer to use? Why?

18. What type of detergents have germicidal properties? Write the structure of one of them.
19. What are nonionice detergents. Give one example.
20. What do you mean by monobiodegradable detergents? How can we make biodegradable detergents.

### 3 MARKS QUESTIONS

**Hots\*** 1. Pick out the odd one amongst the following on the basis of their medicinal properties. Give reason.

- (i) Luminal, Seconal, terfenadine, equanil.
- (ii) Chloroxylenol, phenol, chloramphenicol, bithional.
- (iii) Sucralose, aspartame, alitame, sodium benzoate.

2. Give the main function of following in the body of human beings?

- (i) Enzymes
- (ii) Receptor proteins
- (iii) neurotransmitter

3. Give the function of following drugs.

- (i) Phenelzine (Nardin)
- (ii) Aspirin
- (iii) Mifepristone

4. Give the pharmacological function of the following type of drugs :

- (i) Analgesics
- (ii) Tranquilizers
- (iii) Antifertility drugs.

5. Give the name of medicine used in the treatment of following diseases :

- (i) Tubercllosis
- (ii) Joint Pain (in Arthritis)
- (iii) Hypertension

6. Give the class of drugs to which these substances belong :
- Bithional
  - Amoxycillin
  - Salvarsan
7. How are antiseptics different from disinfectants? How does an antibiotic different from these two? Give one example of each of them.
8. Explain the following terms with suitable examples :
- Cationic detergents
  - Anionic detergents
  - Nonionic detergents

**Hots\*9.** Label hydrophilic and hydrophobic part in the following compounds :

- $\text{CH}_3(\text{CH}_2)_{10}\text{CH}_2\text{O SO}_3^- \text{Na}^+$
- $\text{CH}_3(\text{CH}_2)_{15}\text{N}^+(\text{CH}_3)_3 \text{Br}^-$
- $\text{CH}_3(\text{CH}_2)_{16}\text{COO} (\text{CH}_2\text{CH}_2\text{O})_n \text{CH}_2\text{CH}_2\text{OH}$

**Hots\*10.** Explain the following :

- Excess alkali is removed while making toilet soups.
- Shaving soaps contain glycerol and rosingum.
- Hair washed with hard water looks dull.

11. Classify the following structures as cationic detergents, anionic detergents or nonionic detergents:

- $\text{CH}_3(\text{CH}_2)_{10} \text{CH}_2 \text{OSO}_3^- \text{Na}^+$
- $[\text{CH}_3 - (\text{CH}_2)_{15} \text{N}(\text{CH}_3)_3]^+ \text{Br}^-$
- $\text{C}_9\text{H}_{10}-\text{C}_6\text{H}_4-\text{O}(\text{CH}_2\text{CH}_2\text{O})_X\text{CH}_2\text{CH}_2\text{OH}$   
Where ( $X = 5 - 10$ )

12. Explain the term hyperacidity discuss two types of medicines used to check hyperacidity and their mode of action.

**Hots\*13.** How do enzyme inhibitors work? Distinguish between competitive and noncompetitive enzyme inhibitors.

14. (i) Why are artificial sweetening agents harmless when taken?  
(ii) Name one such sweetening agent.

- (iii) Why is the use of aspartine as an artificial sweetener limited to cold foods.
15. (i) Give an example of anionic detergent.
- (ii) Which part of it is involved in the cleaning action.
- (iii) Where such detergents are used commonly.

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# **MODEL TEST PAPER**

## **Sr. School Certificate Examination – 2008**

### **SAMPLE PAPER**

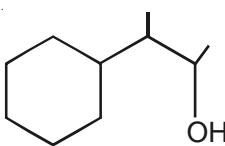
### **CHEMISTRY**

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**Time : 3 hours**

**Total Marks : 70**

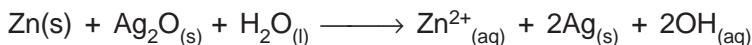
#### **General Instruction**

1. All question are compulsory.
  2. Marks for each questions are indicated against it.
  3. Question number 1 to 8 are very short answer questions, Carrying 1 mark each. Answer these in on word or about on sentence each.
  4. Question number 9 to 18 are short answer questions, Carrying 2 marks each. Answer these in about 30 words each.
  5. Question number 19 to 27 are short answer questions, Carrying 3 marks each. Answer these in about 40 words each.
  6. Question number 28 to 30 are long answer questions, Carrying 5 marks each. Answer these in about 70 words each.
  7. Use long table, if necessary.
- 
1. In the body centered cubic structure. What is the number of atoms per unit cell.
  2. One adding of an electrolyte in the colloidal sol why precipitation takes place?
  3. Why does  $\text{NH}_3$  form hydrogen bond but  $\text{PH}_3$  does not?
4. Write I.U.P.A.C. name of
- 
5. Predict the product formed. When  $(\text{CH}_3)_3\text{CCHO}$  reacts with NaOH.
  6. Why vitamin – C does not get stored in our body where as vitamin – A does?
  7. Name the monomer of Nylon – 6.
  8. Why chloroamphenicol is advised to be given orally in case of acute infection.
  9. Give simple chemical test to distinguish between the following pair of compounds.
    - (i) Phenol and ethanoic acid.

- (ii) Propan-1-ol and Propan-2-ol.
10. Write one chemical equation for each to illustrate the following reaction.
- Carbylamine reaction.
  - Coupling reaction.
- Account for the following :
- Why are aliphatic amines stronger base than aromatic amines?
  - Why is  $C_2H_5NH_2$  less soluble in water than  $C_2H_5OH$ ?
11. Are all the five bonds in  $PCl_5$  molecule equivalent. Justify your answer.
12. For a first order reaction, show that time required for a reaction to complete 99% is twice the time required for the reaction to complete 90%.
13. (i) Write chemical reaction of aniline with benzoyl chloride.  
(ii) Suggest The I.U.P.A.C. names of product formed.
14. Write full form of PHBV? State one advantage of using PHBV as a material for contain of medicine over other types of capsule material.
15. Predict the products of electrolysis of aqueous NaCl solution. Given  
 $E^0 Na^+/Na = - 2.17V$ ,  $E^0 O_2 H^+/H_2O = 1.23V = 1.23V$ .
- Explain your answer?
16. Anion of a chromium containing salt [A], an orange crystal, with alkali gives yellow solution [B], which on acidification gives back orange red colour. Write chemical equation and identify A and B.
17. Name the product formed when ethanol is heated with concentrated sulphuric acid at 443K. Suggest the mechanism of the reaction involved.
18. What are anionic detergents? Write one example and state its use.
19. (i) Which out of  $CdCl_2$  and NaCl will produce impurity defect if added to AgCl crystal?  
(ii) Calculate the packing efficiency in case of a metal crystal for face – centred cubic unit cell.
20. State the composition and functional differences between DNA and RNA. [Any three].
21. State kohlrausch's law of independent migration of ions. The specific conductivity of 0.1M acetic acid solution at 298K is  $1.65 \times 10^{-4} \text{ ohm}^{-1}$  calculate
- Molar conductance of the solution.
  - Degree of dissociation of  $CH_3COOH$ .  
( $A^\circ m$  of  $CH_3COOH$   $390.5 \text{ ohm}^{-1} \text{ mol}^{-1} \text{ cm}^2$ )

**OR**

- (i) Why iron does not rust even if Zinc coating is broken in a galvanised iron pipe?
- (ii) In a button cell widely used in watches and in other devices. The following reaction takes place :



Determine  $\Delta_rG^0$  for the reaction.

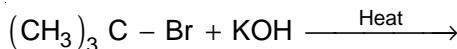
Given :  $E^\circ_{\text{zn}^{2+}/\text{zn}} = -0.76\text{V}$   $E^\circ_{\text{Ag}^+/\text{Ag}} = 0.80\text{V}$

22. (i) Bring out the following conversions :

(a) Ethyl chloride to propanoic acid.

(b) Aniline to chlorobenzene.

- (ii) Complete the following reaction :



23. (i) Hydrated ferric oxide is positively charged. Give reason.

- (ii) Define zeta – potential taking an example.

- (iii) “The presence of equal and similar charges on colloidal particles provide stability to the colloidal system.” Explain.

24. (i) Draw a graph between fraction of molecules and kinetic energy of the reacting species for the

(a) room temperature.

(b) temperature 10°C higher than the room temperature.

- (ii) Indicate the energy of activation on the graph.

- (iii) Using the above graph, explain how does a small increase in temperature speed up a reaction rate to a large extent.

25. Name the principal ore of aluminium. How is pure aluminium extracted from alumina? Draw the labelled diagram of the electrolytic cell used and the reactions occurring at electrodes.

26. (i) Describe with the steps involved in the preparation of

(a)  $\text{K}_2\text{Cr}_2\text{O}_7$  from  $\text{Na}_2\text{CrO}_4$ .

(b)  $\text{KMnO}_4$  from  $\text{K}_2\text{MnO}_4$ .

- (ii) Assign a possible reason for the observation that the third ionisation enthalpy of lanthanum is very low.

27. (i) Name the ligand used in the treatment of lead poisoning.

(ii) Describe the nature of bonding in  $\text{Ni}(\text{CO})_4$ .

28. Assign a possible reason for the following :

- (i) The stability of + 5 oxidation state decreases and that of + 3 oxidation state increases down the group 15.
- (ii) Catenation tendency is weaker in nitrogen than phosphorus.
- (iii)  $\text{H}_2\text{S}$  is more acidic than  $\text{H}_2\text{O}$ .
- (iv) Thermal stability of hydrides of groups – 17 elements decrease down the group.
- (v) Halogens are strong oxidising agents.

**Or**

(i) Draw the structures of  $\text{XeF}_2$  and  $\text{BrF}_3$ .

(ii) Accounts for the following :

- (a)  $\text{SF}_4$  is readily hydrolysed whereas  $\text{SF}_6$  is exceptionally stable.
- (b) HF is the weakest but HI is the strongest hydrohalic acid.
- (c)  $\text{O}_3$  act as a powerful oxidising agent.

29. Write structural formula and names of four possible aldol condensation products which can be obtained from propanal and ethanol?

**Or**

(i) An organic compound with the molecular formula  $\text{C}_9\text{H}_{10}\text{O}$  forms 2, 4-DNP derivative and undergo cannizzaro reaction. On vigorous oxidation it gives. 1, 2-benzene dicarbonylic acid. Write equation for the reaction involved and identify the compound.

(ii) Why cannot Tollens' reagent oxidise ketones.

30. (i) What role does the molecular interaction play in a solution of alcohol and water?

(ii) Why do gases always tend to be less soluble in liquids as the temperature is raised?

(iii) If  $\text{N}_2$  gas is bubbled through water at 293K how many millimoles of  $\text{N}_2$  gas would dissolve in 1 Litre of water. Assume that  $\text{N}_2$  exerts a partial pressure of 0.987 bar. Given that Henry's law constant for  $\text{N}_2$  at 293K is 76.48K bar.

**Or**

(i) Define the term "Abnormal molar mass."

(b) What is the effect of association of ethanoic acid in benzene on colligative properties?

(c) 2g of benzoic acid [ $\text{C}_6\text{H}_5\text{COOH}$ ] dissolved in 25g of benzene shows a depression in freezing point equal to 1.62K. Molal depression constant for benzene is  $4.9\text{ K kg mol}^{-1}$ . What is the percentage association of acid if it forms dimer in solution?

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# **MODEL TEST PAPER – II**

## **Sr. School Certificate Examination - 2008**

### **SAMPLE PAPER**

### **CHEMISTRY (Theory)**

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**Time : 3 hours**

**Maximum Marks : 70**

***General Instructions :***

1. All questions are compulsory.
  2. Marks for each questions are indicated against it.
  3. Question No.1 to 8 are very short-answer questions, carrying 1 mark each. Answer these in one word or about one sentence each.
  4. Question No. 9 to 18 are short-answer questions, carrying 2 marks each. Answer these in about 30 words each.
  5. Question No. 19 to 27 are short-answer questions, carrying 3 marks each. Answer these in about 40 words each.
  6. Question No. 28 to 30 are long-answer questions, carrying 5 marks each. Answer these in about 70 words each.
  7. Use log table, if necessary use of calculate is not permitted.
- 
1. A group 14 element is to be converted into n-type semiconductor by doping it with a suitable impurity. To which group should this impurity belong? Give one example.
  2. Name a zeolite catalyst which directly converts alcohol into gasoine.
  3. Write an equation for the preparation of  $\text{XeOF}_4$  from  $\text{XeF}_6$ .
  4. Write one structural difference between DNA and RNA.
  5. Write the name of the monomer of Nylon–6.
  6. Mention one example of cationic detergent.
  7. Which compound in the following pair will react faster in  $\text{S}^{\text{N}}2$  reaction with  $\text{OH}^-$ ?
    - (i)  $(\text{CH}_3)_3 \text{CCl}$  or
    - (ii)  $\text{CH}_3\text{Cl}$ .
  8. How is formalin related to formaldehyde?
  9. Draw a labelled diagram which represent the working of hydrogen-oxygen fuel cell. Write the anode and cathode reactions taking place in the above cell.

**Or**

Rusting of iron is an electrochemical phenomenon. Justify giving anode. Cathode and overall reactions.

10. The rate constant of a first order reaction for the decomposition of ethyliodide by the reaction :



at 600k is  $1.60 \times 10^{-5} \text{ S}^{-1}$ . Its energy of activation is  $2.9 \text{ Kjmol}^{-1}$ . Calculate the rate constant for the reaction at 700k.

$$(R = 8.314 \text{ Jk}^{-1} \text{ mol L}^{-1})$$

11. Write balanced chemical equations for the manufacture of sulphuric acid from  $\text{SO}_2\text{(g)}$  by contact process. List the two most favourable conditions for getting the maximum yield of  $\text{SO}_3\text{(g)}$ .

12. (i) Why is  $\text{Cr}^{2+}$  reducing and  $\text{Mn}^{3+}$  oxidising when both have  $d^4$  configuration?

(At No. of Cr = 24)

(At no. of Mn = 25)

- (ii) Using the ‘spin-only’ formula calculate the magnetic moment of  $\text{Ni}^{2+}$  ion in aqueous solution. (At. no. of Ni = 28).

13. Define biodegradable polymer. Give an example of a biodegradable

(i) Polyester and

(ii) Polyamide.

14. (i) How are broad spectrum antibiotics different from narrow spectrum antibiotics?

- (ii) Under which conditions phenol can be used as :

(a) an antiseptic and

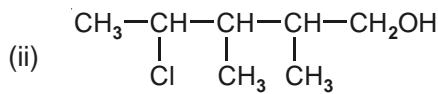
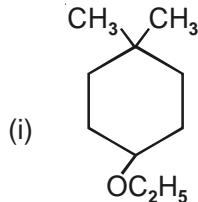
(b) a disinfectant

15. Describe the following reactions giving necessary conditions involved :

(i) Riemer Tiemann reaction.

(ii) Williamson synthesis

16. Write the IUPAC names of the following compounds :



17. An aromatic compound ‘A’ on heating with  $\text{Br}_2$  and KOH forms a compound ‘B’ of molecular formula  $\text{C}_6\text{H}_7\text{N}$ . Infer the structures of the compounds A and B and write the reactions involved.

18. Account for the following :

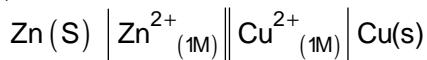
(i)  $pK_b$  of aniline is more than that of methylamine.

(ii) Diazonium salts of aromatic amines are known while those of aliphatic amines are not known.

19. (i) Silver crystallize in fcc lattice. If the edge length of the cell is  $4.07 \times 10^{-8}$  cm and density is  $10.5\text{g cm}^{-3}$ , calculate the atomic mass of silver. [ $\text{Na} = 6.023 \times 10^{23} \text{ mol}^{-1}$ ]  
(ii) Zinc oxide is white but it turns yellow on heating. Assign a reason.

20. Calculate the :

- (i) Standard cell potential, and  
(ii) Standard gibbs energy, for the reaction occurring in the cell.



$$(\text{Given } E^0_{\text{Cu}^{2+}/\text{Cu}} = 0.34\text{V} \quad E^0_{\text{Zn}^{2+}/\text{Zn}} = -0.76\text{V})$$

(iii) How is the equilibrium constant for the reaction related to Gibbs energy and  $E^0$  cell?

21. (i) Write the rate law for a first order reaction.



Justify the statement for a first order reaction half-life ( $t_{1/2}$ ) is independent of the initial concentration of the reactant  $[\text{R}]_0$ .

- (ii) A reaction is second order with respect to a reactant. How is the rate of reaction affected if the concentration of the reactant is :  
(a) doubled  
(b) reduced to half?

22. Explain what happens when :

- (i) A beam of light is passed through a colloidal solution.  
(ii) An electrolyte like NaCl is added to hydrated ferric hydroxide sol.  
(iii) Electric current is passed through a colloidal sol.

23. (i) How is bauxite different from alumina?

- (ii) The valued of  $\Delta_r G$  for formation of  $\text{Cr}_2\text{O}_3$  is  $-540 \text{ kJmol}^{-1}$  and that of  $\text{Al}_2\text{O}_3$  is  $-827\text{Kj mol}^{-1}$ . Is the reduction of  $\text{Cr}_2\text{O}_3$  possible with aluminium?  
(iii) What is the role of graphite rod in the electrometallurgy of aluminum?

**Or**

Describe the reactions taking place in different zones in the blast furnace during the extraction of iron from haematite.

24. (i) Describe the reactions taking place in different zones.

**Or**

- (ii) Describe the steps involved in the preparation of potassium dichromate from its chromite ore with the help of chemical equations.

- (iii) Write the ionic equation for the reaction between  $K_2Cr_2O_7$  and  $FeSO_4$  solutions in acidic medium.
25. (i) Using I.U.P.A.C. norms write the systematic name of  $[Co(NH_3)_4Cl(NO_2)]Cl$ .  
(ii)  $[NiCl_4]^{2-}$  is paramagnetic while  $[Ni(CO)_4]$  is diamagnetic though both are tetrahedral give reason. (At. No of Ni - 28)
26. (i) Write the structure of the product obtained when D-glucose reacts with bromine water.  
(ii) Why can't Vitamin-C be stored in our body?  
(iii) Write the zwilfer ion structure of the simplest amino acid.
27. Explain why :  
(i) The dipole moment of chlorobenzene is lower than that of cyclohexyl chloride?  
(ii) Alkyl halides, though polar are immiscible with water.  
(iii) Grignand reagents should be prepared under anhydrous conditions.
28. (i) (a) Draw a diagram to represent the vapour pressure of a two component system as a function of composition of solution showing the positive deviations.  
(b) Determine the osmotic pressure of a solution prepared by dissolving 25mg of  $K_2SO_4$  in 2 litres of water at  $25^\circ C$ , assuming that it is completely dissociated.

**Or**

- (b) Determine the osmotic pressure of solution prepared by dissolving 25mg of  $K_2SO_4$  in 2 litres of water at  $25^\circ C$ , assuming that it is completely dissociated.

**Or**

28. (i) (a) State Henry's law for the solubility of a gas in a solvent.  
(b) Why do scuba divers cope with high concentrations of dissolved gases while breathing air under deep waters?  
(ii) 0.6 mL of acetic acid ( $CH_3COOH$ ) having density  $1.06\text{ g ml}^{-1}$ , is dissolved in 1 litre of water. The depression in freezing point observed for this strength of acid was  $0.0205^\circ C$ . Calculate the van't Hoff factor for the acid. ( $K_f = 1.86\text{ k kg mol}^{-1}$ )
29. (i) Assign a reason for each of the following :  
(a)  $PCl_3$  fumes in moist air.  
(b)  $H_2S$  is less acidic than  $H_2Te$ .  
(c) Although electron gain enthalpy of fluorine is less negative as compared to chlorine, fluorine is a stronger oxidising agent than chlorine.  
(ii) Write balanced chemical equations for the following reaction :  
Chlorine is passed through a hot and concentrated solution of sodium hydroxide.  
(iii) Draw the structure of  $H_3PO_3$ .

**Or**

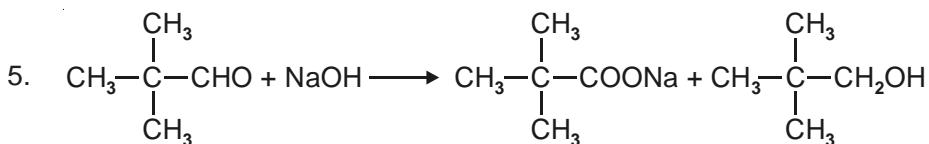
- (i) Assign a reason for each of the following :
- $\text{N}_2$  is less reactive at room temperature.
  - Fluorine exhibits only -1 oxidation state whereas other halogens exhibit + 1, + 3, + 5 and + 7 oxidation states.
  - Bond angle in  $\text{PH}_4^+$  is higher than that of in  $\text{PH}_3$ .
- (ii) Write balanced chemical equations for the following reactions :
- $\text{P}_4 + \text{NaOH} + \text{H}_2\text{O} \longrightarrow + \text{_____} + \text{_____}$ .
  - $\text{U(s)} + \text{ClF}_3 \longrightarrow + \text{_____} + \text{_____}$ .
- (iii) Draw the structure of peroxosulphuric acid.
30. (i) Write the steps and conditions involved in the following conversions :
- Propanone to Propene.
  - Benzoic acid to Benzaldehyde.
  - Ethanol to 2-Hydroxy butanol.
- (ii) Give a one chemical test in each case to distinguish between the following pairs of compounds :
- Ethanol and Propanal.
  - Phenol and Benzoic acid.

**Or**

- (i) Write the steps and conditions involved in the following conversions :
- Benzyl alcohol to phenylethanoic acid.
  - 4-Methyl acetophenone to benzene -1, 4-dicarboxylic acid.
  - Propanal to butanol.
- (ii) Give a one chemical test in each case to distinguish between the following pairs of compounds.
- Propanal and Propanone
  - Phenol and Benzoic acid

## SOLUTIONS OF MODEL TEST PAPER – 1

1. Total No. of atoms in body – centred cubic unit cell = 2 atoms.
2. It is because of neutralisation of charge of dispersed phase by electrolyte.
3. Because of high electronegativity and small atomic radii of N than that of P.
4. I.U.P.A.C. name – 4 – cyclohexyl 3–methyl butan – 2 – ol.



6. Vitamin – C is soluble in water and is readily excreted in urine and so can not be stored in our body.
7. Caprotactum.
8. Chloramphanicol is a broad – spectrum antibiotic.
9. (a) Phenol gives violet coloured solution with natural  $\text{FeCl}_3$  while acid does not give this test.

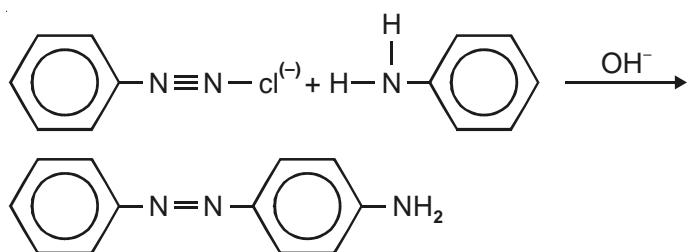
**Or**

Ethanoic acid with  $\text{NaHCO}_3$  liberate  $\text{CO}_2$  which turns lime water milky phenol does not give.

- (b) Lucas reagent (Anhy,  $\text{ZnCl}_2$  + conc. HCl) gives white turbidity with 2 – propanol white 1 – propanol gives no turbidity.
10. (a) Carbylamine Reaction



- (b) Coupling Reaction



**Or**

- (a) In  $\text{R}-\text{NH}_2$ , The alkyl group ( $-\text{R}$ ) is electron donor so increases electron density on N – atom. While in  $\text{Ar}-\text{NH}_2$ ,  $\text{Ar}-(\text{C}_6\text{H}_5-)$  is electron withdrawing group so decreases electron density on N – atom of  $\text{NH}_2$  group.

- (b) Oxygen is more electronegative than Nitrogen so in  $\text{C}_2\text{H}_5 - \text{OH}$  strong intermolecular H – bond exist.
11.  $\text{PCl}_5$  structure is trigonal bipyramidal – The three equatorial P – Cl bonds are equivalent, while two axial bonds are different and longer than equitorial bonds.
12. Let initial  $[\text{A}_0] = 100$ , So  $[\text{A}] = 100 - 99$ .  $[\text{A}]$  – conc. of reactant left after time, given

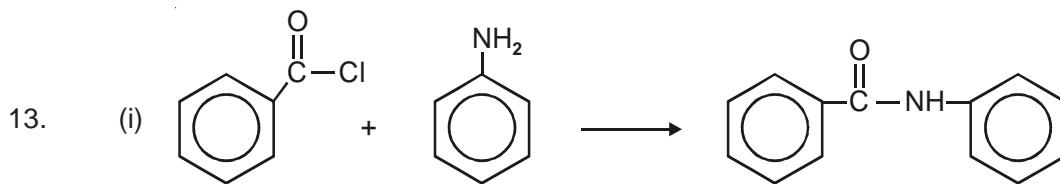
$$t = \frac{2.303}{K} \log \frac{[\text{A}_0]}{[\text{A}]}, \text{ tgg\%} = \frac{2.303}{K} \log \frac{100}{1}$$

$$t_{99\%} = \frac{2.303}{K} \log 100 \dots \dots \dots \text{(i)}$$

let 90%  $[\text{A}_0] = 100$   $[\text{A}] = 100 - 90 = 10$

$$t_{99\%} = \frac{2.303}{K} \log \frac{100}{10} \dots \dots \dots \text{(ii)}$$

Divide equation (ii) by (i)  $\frac{t_{99\%}}{t_{99\%}} = 2$



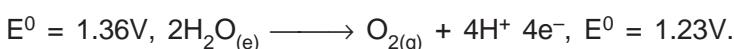
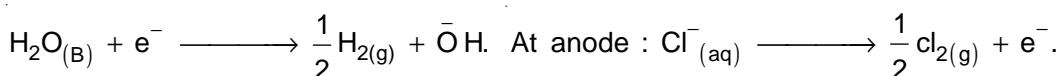
14. PHBV : Polyhydroxy butyrate – co –  $\beta$ -hydroxy valerate use

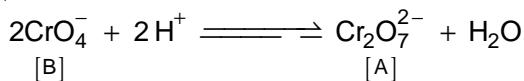
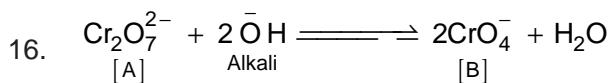
(i) In orthopaedic devices and in controlled release of drugs.

15. During the electrolysis of aqueous  $\text{NaCl}$  solution the products are  $\text{NaOH}$ ,  $\text{Cl}_2$  and  $\text{H}_2$ . In this case besides  $\text{Na}^+$  and  $\text{Cl}^-$  ions there are  $\text{H}^+$  and  $\bar{\text{O}}\text{H}$  ions alongwith solvent molecule  $\text{H}_2\text{O}$ . At the cathode there is competition between the following reduction reaction,  $\text{Na}_{(aq)}^{+} + \text{e}^- \longrightarrow \text{Na}_{(s)}$

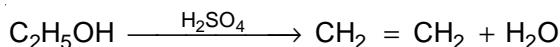


is produced by the dissociation in of  $\text{H}_2\text{O}$  so not reaction at cathode :

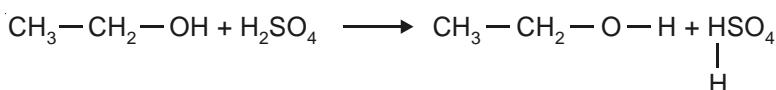




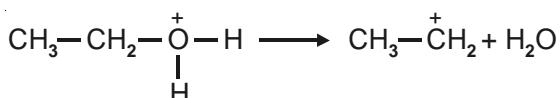
17. Ethanol is dehydrated to alkene



Mechanism – step I : Ethanol is protonated by  $\text{H}_2\text{SO}_4$ .



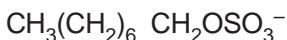
Step II : Formation of caroscation by (slow step) loss of water molecule



Step III : Fast expulsion of  $\text{H}^+$ .



18. If the large part of the molecule of a detergent is an anion it an anionic detergent. Example :



Use : Used effectively in acidic solution as they form water soluble hydrogen sulphate. Also used in tooth paste.

19. (i)  $\text{CdCl}_2$

(ii) Packing efficiency in case of F.C.C. volume of the cube =  $a^3 = (\sqrt{8r})^3 = 8\sqrt{8r^3}$ . a – edge length, r – radius of sphere. A – face centred cubic unit cell has 4 sphere per unit cell.

$$\text{Packing efficiency} = \frac{\text{Volume of sphere}}{\text{Volume of cube}} \times 100$$

$$= \frac{16 \pi^3}{3 \times 8\sqrt{8r^3}} \times 100 = 74\%$$

$$\text{Volume of free space} = 100 - 74 = 26\%.$$

20. Composition and functional difference RNA and DNA.

Sr. No.	DNA	RNA
1.	Deoxy-ribose sugar	Ribose sugar
2.	Pyrimidine base is Thymine	Pyrimidine base is uracil.
3.	One type of DNA	Three type of RNA (i) Messenger RNA (ii) Ribosomal RNA (iii) Transfer RNA
4.	Base pairing is A → T and C → G	Base pairing is A → U and C → G.
5.	Responsible for transmission of hereditary characters.	Responsible for synthesis of proteins in the cell. Single helix structure.

[Any : three]

21. Concentration (Molarity) = 0.1M

Specific conductivity  $K = 1.65 \times 10^{-4} \text{ ohm}^{-1} \text{ cm}^{-1}$ .

$$\begin{aligned}\text{Molar conductivity } (\lambda_m) &= \frac{K \times 1000}{\text{conic. (molarity)}} \\ &= \frac{1.65 \times 10^{-4} \times 10^3}{0.1} = 1.65 \text{ ohm}^{-1} \text{ mol}^{-1} \text{ cm}^2\end{aligned}$$

$\lambda^{\circ}m$  for  $\text{CH}_3\text{COOH} = 390.5 \text{ ohm}^{-1} \text{ mol}^{-1} \text{ cm}^2$

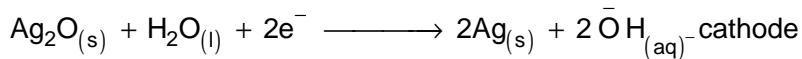
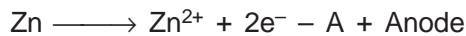
$$\lambda = \frac{\lambda^{\circ}m}{\lambda^a m} = \frac{1.65}{390.5} = 0.004$$

Kohlrausch's law of independent migration of ions :

The law state that limiting molar conductivity of an electrolyte can be determines by the sum of individual contribution of the anion and cation of the electrolyte.

Or

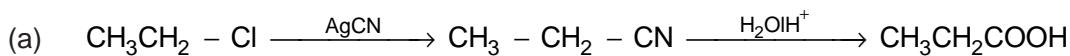
- (i) this is because zinc is more reactive than iron. This means that if a crack appears on the surface of iron contend with zinc even that zinc will take part in the redox reaction.
- (ii) In the cell zinc is oxidised while silver is reduced.



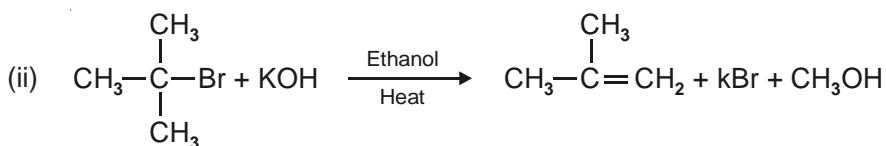
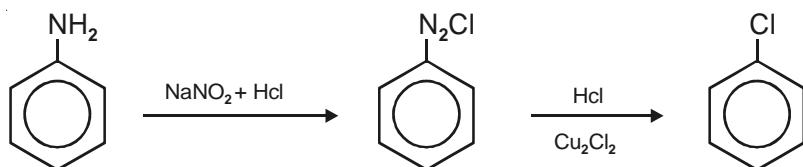
$$E^{\circ}_{\text{cell}} = 1.56\text{V}$$

$$\begin{aligned}\Delta G^{\circ} &= nFE^{\circ} = -2 \times 96500 \times 1.56 = -212300\text{CV} \\ &= -212300\text{J}\end{aligned}$$

22. (i) Conversion : Ethyl chloride to propanoic acid.



- (b) Aniline to chlorobenzene.

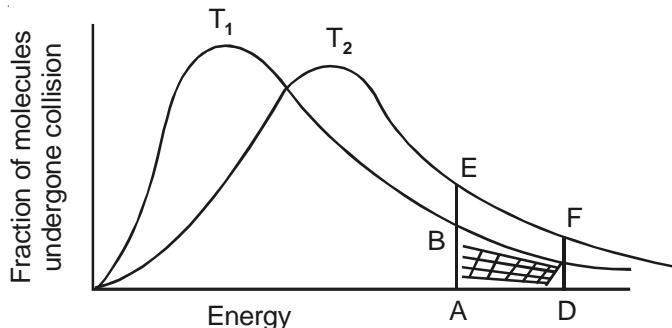


23. (i) Only  $\text{Fe}^{3+}$  ions obtained from cells solution are adsorbed.

- (ii) A potential difference developed between the fixed layer and the diffused layer having opposite charges is called zeta potential e.g.  $\text{AgI}/\text{Ag}^+\text{I}^-$ .

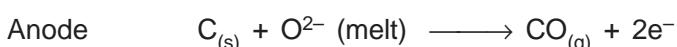
- (iii) The presence of equal and similar charges on colloidal particles is largely responsible in providing stability to the colloidal solution because the repulsive forces between charged particles having same charges prevent them from aggregating when they come closer to one another.

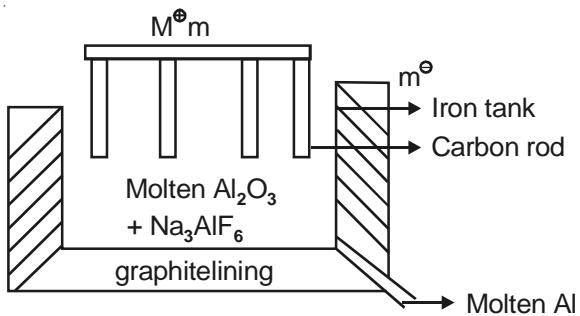
24.



- (i) It is clear from the diagram that in the curve at  $(t + 10)$  the area showing the fraction of molecules having energy equal to or greater than activation energy gets doubled leading to doubling the rate of reaction.

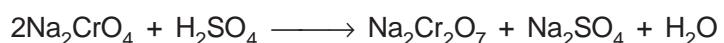
25. Ore of aluminium is bauxite  $\text{AlOx(OH)}_{3-2x}$  where  $0 < x < 1$ . Extraction of aluminium – Pure  $\text{Al}_2\text{O}_3$  is mixed with  $\text{Na}_3\text{AlF}_6$  or  $\text{CaF}_2$ . The fused matrix is electrolysed. Steel cathode and graphite anode are used.



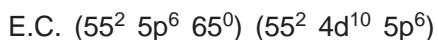


Electrolytic cell for the extraction of aluminium

26. (i)  $K_2Cr_2O_7$  from  $Na_2CrO_4$



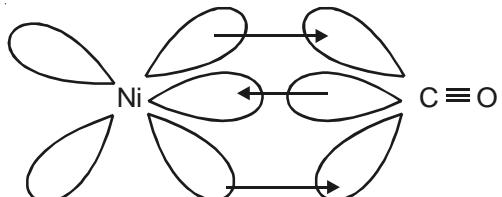
- (ii)  $La_2 + (55) \longrightarrow La^3 + (54)$  [La(57) 501<sup>1</sup> 65<sup>2</sup>]



$La^{3+}$  acquires stable electronic configuration.

27. (i) EDTA

- (ii) Ni (28) 3d<sup>8</sup> 4s<sup>2</sup> 4d<sup>0</sup>



Empty lobes show empty orbitals lobes containing two lobes containing two dots show filled orbitals. In CO there is one lone pair of electrons one and one vacant orbital ligand provides lone pair of electron to vacant orbital of Ni and also accept a lone pair of electron from Ni.

28. (i) Due to inert pair effect.

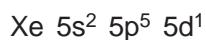
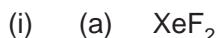
- (ii) N – N single bond is weaker than P – P single bond due to higher repulsion between lp and lp.

- (iii) Because the S – H bond is weaker than O – H bond.

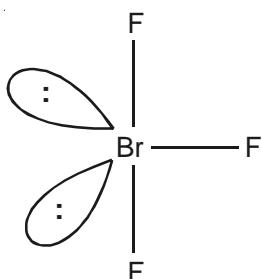
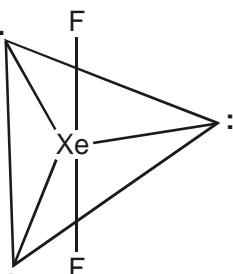
- (iv) As the size of the atoms increases down the group, the M – H bond becomes weaker.

- (v) Because halogens have higher reduction potential value.

**Or**

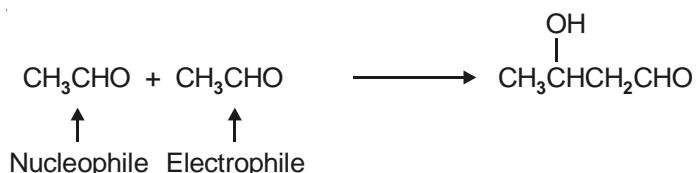
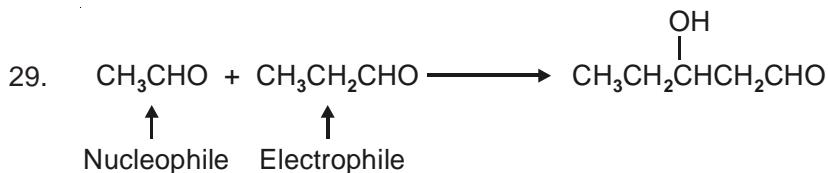
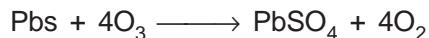


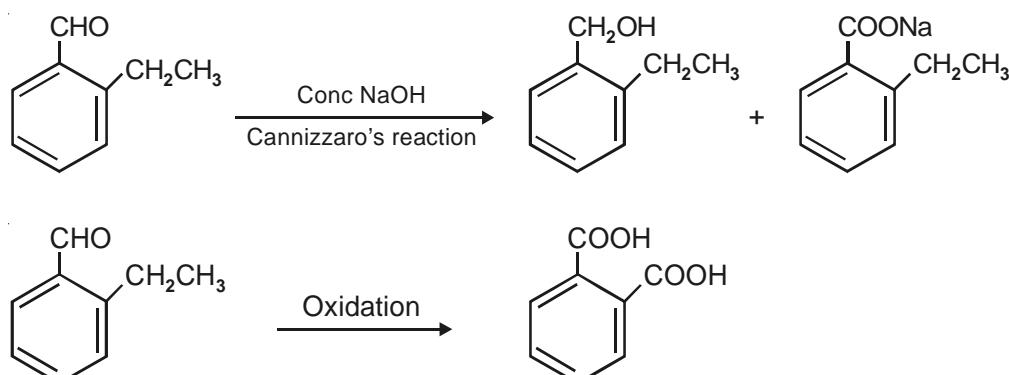
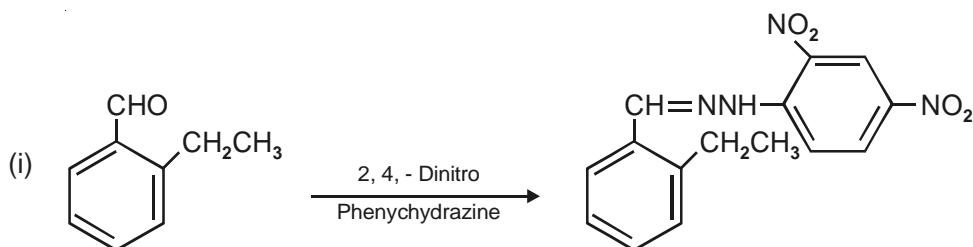
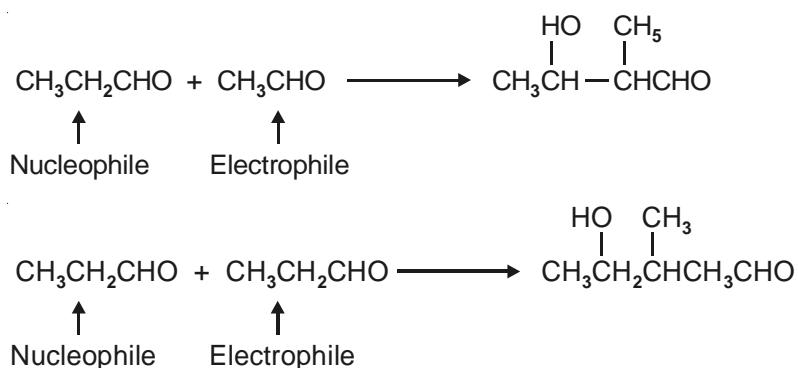
Linear shape



See saw shape

- (ii)  $\text{H}_2\text{O}$  molecules can not hydrolyse  $\text{SF}_6$  because s atom is sterically protected by six fluorine atoms.
- (iii) H – I has lower bond dissociation enthalpy than H – F, therefore it readily loses  $\text{H}^+$  in solution.
- (iv)  $\text{O}_3$  easily decomposes to give nascent O. e.g.





(ii) Tollen's reagent is a mild oxidising agent.

### 30. Ans. :

- (i) (a) Weak interaction (intermolecular H – bond) between  $\text{C}_2\text{H}_5\text{OH}$  and  $\text{H}_2\text{O}$ .
- (b) Because with increase in temperature kinetic energy of gases molecular increases.
- (ii) By apply Henry's law.

$$X_{(\text{N}_2)} = \frac{P_{(\text{N}_2)}}{K_H} = \frac{0.987 \text{ bar}}{76.480 \text{ bar}} = 1.29 \times 10^{-5}$$

As 1 litre of water contains 55.5 mol of it. Therefore if  $n$  represent no. of moles of  $\text{N}_2$  in solution.

$$x \text{ (nitrogen)} = \frac{n_{\text{mol}}}{n_{\text{mol}} + 55.5_{\text{mol}}} = \frac{n}{55.5} = 1.29 \times 10^{-5}$$

(n in denominator is neglected as it is << 55.5)

Thus  $n = 1.29 \times 10^{-5} \times 55.5 \text{ mol} = 7.16 \times 10^{-4} \text{ mol}$ .

$$= \frac{7.16 \times 10^{-4} \text{ mol} \times 1000 \text{ mol}}{1 \text{ mol}} = 0.716 \text{ mol}$$

**Or**

**Ans.**

- (i) *Abnormal Molar Mass* : Such a molar mass that is either lower or higher than the normal molar mass. Due to association of acetic acid colligative properties value decreases, or No. of molecules (particles) decreases.

(ii) Wt. of benzoic acid  $\stackrel{(W_2)}{=} 2\text{g}$ .  $\text{kJ} = 4.9\text{K kg mol}^{-1}$

Wt. of benzene  $\stackrel{(W_1)}{=} 25\text{g}$ .

$$\Delta T_f = 1.62 \text{ K}$$

$$\Delta T_f = k_f \times \frac{W_2 \times 1000}{M_2 \times W_1}$$

$$M_2 = \text{Molar Mass} = \frac{4.9 \text{ K kg mol}^{-1} \times 2\text{g} \times 1000\text{g.kg}^{-1}}{25\text{g} \times 1.62\text{K}}$$

$$= 241.98 \text{ g mol}^{-1}$$

If  $x$  represents. The degree of association of the solute then. We would have  $(1 - x)$  mol of benzoic acid left in unassociated form at equilibrium.

Therefore total number of moles of particular at equilibrium is :

$$1 - x + \frac{x}{2} = 1 - \frac{x}{2}$$

Thus total no. of moles of particles at equilibrium equal, van't Hoff factor  $i$ .

But  $i = \frac{\text{Normal Molar Mass}}{\text{Abnormal Molar Mass}}$

$$= \frac{122 \text{ g mol}^{-1}}{241.98 \text{ g mol}^{-1}} \Rightarrow \frac{x}{2} = 1 - 0.504$$

$$x = 2 \times 0.496 = 0.992$$

So degree of association of benzoic acid is 99.2%.

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# CHEMISTRY (THEORY)

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Time : 3 hours

Maximum Marks : 70

fu/ljir 1 e; % 3 ?k Vs

vf/kdre val % 70

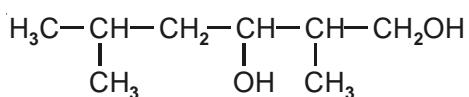
**General Instructions :**

1. All questions are compulsory.
2. Question nos. 1 to 8 are very short answer questions and carry 1 mark each.
3. Questions nos. 9 to 18 are short answer questions and carry 2 marks each.
4. Question nos. 19 to 27 are also short answer questions and carry 3 marks each.
5. Question nos. 28 to 30 are long answer questions and carry 5 marks each.
6. Use log tables if necessary, use of calculators is **not** allowed.

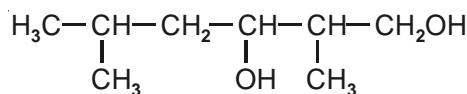
**I kekk funzkk %**

- 1- l Hh ižu vfuok ZgA
- 2- Øe 14; kls1 ls8 dsizu vfr y?qmÙjh gA ; g , d&, d val dsgA
- 3- Øe 14; k9 ls18 dsizu nk&nksvaladsy?qmÙjh ižu gA
- 4- Øe 14; k19 ls27 dsizu Hh rhu&rhu valadsy?qmÙjh ižu gA
- 5- Øe 14; k28 ls30 dsizu ilp&ilp valadsnkhZmÙjh ižu gA
- 6- vlo'; drk gksrkswW Vsy izk fd; st k l drsgA dyD; wVjadsizk dh vufr ughagA
7. What is the coordination number of each type of ions in a rock-slat type crystal structure?

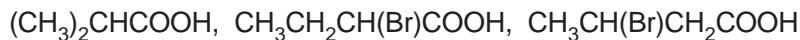
- jW&l kW izlj dh fØLVyh l jipuk eaiR sl izlj dsvk u dh l elb; 14; k D; k gkh gS
2. Define the term 'order of reaction' for chemical reactions.  
jkl k fud vfHØ; kvadsfy; s^vfHØ; k dh dW\* dh ifj Hkk fyf[k A
  3. What causes Brownian movement in a colloidal solution?  
dkylbMh foy; ulkaechmu h xfr ghs dk D; k dkj .k gkrk gS
  4. In which one of the two structure,  $\text{NO}_2^-$  and  $\text{NO}_2^-$ , the bond angle has a higher value?  
nksl jipukvlnO<sub>2</sub><sup>+</sup> vls NO<sub>2</sub><sup>-</sup> eal sfdl eavlcUu dsk vf/kd eku j [kkl
  5. Write the IUPAC name of the following compound :



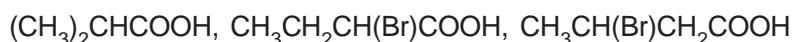
fuEufyf[kr ; kxd dk IUPAC ule fyf[k %



6. Arrange the following compounds in an increasing order of their acid strengths :



fuEufyf[kr dks mudsc<rsqgq vEyh lkeF; ZdsØe eaQ ofLkr dlft , %



7. Write a chemical reaction in which the iodide ion replaces the diazonium group in a diazonium salt.

, d jk k fud vHIO; kfjf[k ft l ea, d M t k; e yo. keal sM t k; e l eg v k MbM v k u }jik foLkr fir gk gk

8. Name a substance that can be used as an antiseptic as well as a disinfectant.

, d , s inLZdk ule nlft , ft l dk mi ; k i frjksh rFk jkk lk h nks: i k e a gk gk

9. Explain as to why haloarenes are much less reactive than haloalkanes towards nucleophilic substitution reactions.

Or

Which compound in each of the following pairs will react faster in  $S_N2$  reaction with  $-OH$ ? Why?



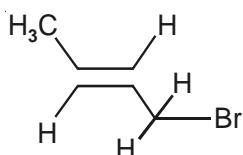
le>lb; sfd U DvvlQfyd ifrLkr vHIO; kvadsifr gyskjhuagysk Ydsadhwivsk D; hvfr de fO; khy gk gk

vEok

fuEufyf[kr iR sl t M meal sdks l k; kxd  $-OH$  dsl Eks $S_N2$  vHIO; keavf/kd rt h l svHIO; kdjxk v k D; k



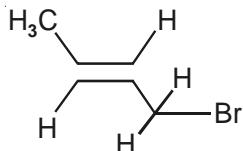
10. (a) State the IUPAC name of the following compound :



(b) Complete the following chemical equation :



1/2 fulufyf[k ; lxd dk IUPAC ule fyf[k %



1/2 fulufyf[k jk k fud 1 ehdj.k dks ijk dlft, %



11. State Henry's law correlating the pressure of a gas and its solubility in a solvent and mention two applications for the law.

bl x\$ dsnk v\$ ml dh fdl h foyk d easoys rk ds l ak eaguh dk fu; e v\$ bl fu; e dsnk vuqz k fyf[k A

12. A first order decomposition reaction takes 40 minutes for 30% decomposition. Calculate its  $t_{1/2}$  value.

, d iEe dlV dh vi?Wu vH0; k 30% vi?Wu dsfy; s40 feuV dk l e; yrhga bl dsfy,  $t_{1/2}$  dk ifjdyu dlft, A

13. What is meant by the 'rate constant,  $k$ ' of a reaction? If the concentration be expressed in mol L<sup>-1</sup> units and time in seconds, what would be the units for  $k$  (i) for a zero order reaction and (ii) for a first order reaction?

fdl h vH0; k dsnj fEjd k\* dk D; k rR; Zgk gS ; fn l mark dh ekld mol L<sup>-1</sup> v\$ 1 e; dh l d.Mgrks(i) 'W dlV dh vH0; k v\$ (ii) iEe dlV dh vH0; k dsfy; sk dkeku fdu ekldhe gkk

14. Define the following terms in relation to protein :

(i) Peptide linkage

(ii) Denaturation

iWhu ds l aHzeafufyf[k dh ifjHkk fyf[k s%

(i) iWhbM cUkrk

(ii) Mupjsku foNfrdj.kA

15. List the reactions of glucose which cannot be explained by its open chain structure.

Xydk dh mu vH0; kvaldsfyf[k sft lgabl dh [kyh J qky 1 jpuks vkk ij le>k k ugh t k l drkA

16. Assign a reason for each of the following statements :

- (i) Ammonia is a stronger base than phosphine.
- (ii) Sulphur in vapour state exhibits a paramagnetic behaviour.

fuEufyf[kr iØehæal siR s dsfy; s dlj.k fyf[k s%

- (i) QLQhu dh vi{k vely; k vf/kd iry {kj gA
- (ii) oki volFk ea l YQj vupFcdh Q ogkj infkr djrk gA

17. Draw the structure of the following molecules :

- (i) SF<sub>4</sub>
- (ii) XeF<sub>4</sub>

ulpsfy [kv.v kachl jipuk vksf[kr dlft , %

- (i) SF<sub>4</sub>
- (ii) XeF<sub>4</sub>

18. What are biodegradable and non-biodegradable detergents? Give one example of each class.

tSfuEuhdj.ki viektZl vks vtS fuEuhdj.ki viektZl D; kgfsga iR s izlj dk, d&, d mnl gj.j.k nlft , A

19. What is semiconductor? Describe the two main types of semiconductors and explain mechanisms for their conduction.

v/klyd D; kgfkgS nkiedkj izlj dsv/klydk o. k dlft , vks much pkyu fØ; kof/k dksLi' dlft , A

20. Calculate the temperature at which a solution containing 54 g of glucose,

(C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>), in 250 g of water will freeze.

(K<sub>f</sub> for water = 1.86 K mol<sup>-1</sup> kg)

ml rki dksifjdfyr dlft , ft1 ij 250 g ty e54 g Xydk ] (C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>) ?kydj cuk foy; u te t k xA (K<sub>f</sub> (ty) = 1.86 K mol<sup>-1</sup> kg).

21. What are lyophilic and lyophobic sols? Give one example of each type. Which one of these two types of sols is easily coagulated and why?

n&Lughvks n&fojkhl w (sol) D; kgfsga iR s izlj dk, d&, d mnl gj.j.k nlft , A bu nkshizlj dsl Wæal sfdl dk Ldlhu vf/kd lerk l sgsl drk gSvks D; h

22. State briefly the principles which serve as basis for the following operations in metallurgy :

- (i) Froth flotation process

- (ii) Zone refining  
 (iii) Refining by liquation

/kr&Oe easufufyf[kr iOekdsvkly fl ) Kraksl sli easyf[k s%

- (i) >lx &Qsn½ lyou iOe  
 (ii) tks &MMy½ ifj"dj.k  
 (iii) noldj.k }jk ifj"dj.k

23. Write chemical equations for the following processes :

- (i) Chlorine reacts with a hot concentrated solution of sodium hydroxide.  
 (ii) Orthophosphorous acid is heated.  
 (iii)  $\text{PtF}_6$  and xenon are mixed together.

**Or**

Complete the following chemical equations :

- (i)  $\text{Ca}_3\text{P}_2(s) + \text{H}_2\text{O}(l) \longrightarrow \dots\dots$   
 (ii)  $\text{Cu}^{2+}(\text{aq}) + \text{NH}_3(\text{aq}) \longrightarrow \dots\dots$   
 (excess)  
 (iii)  $\text{F}_2(g) + \text{H}_2\text{O}(l) \longrightarrow \dots\dots$

bu iOekdsfy; sjk k fud 1 eldj.k fyf[k s%

- (i) Dykhu l kM e gblM kM ds l kz rIr foy; u ls vflHØ; k djrh gA  
 (ii) vflHØQkij , fl M dks xeZ fd; k tkrk gA  
 (iii)  $\text{PtF}_6$  vfl t huk dks ijLij feyk k tkrk gA

vflok

fufufyf[kr jk k fud 1 eldj.k dks ijk dft , %

- (i)  $\text{Ca}_3\text{P}_2(s) + \text{H}_2\text{O}(l) \longrightarrow \dots\dots$   
 (ii)  $\text{Cu}^{2+}(\text{aq}) + \text{NH}_3(\text{aq}) \longrightarrow \dots\dots$   
 (vflHØ; )  
 (iii)  $\text{F}_2(g) + \text{H}_2\text{O}(l) \longrightarrow \dots\dots$

24. (a) What is a ligand? Give an example of a bidentate ligand.

- (b) Explain as to how the two complexes of nickel,  $[\text{Ni}(\text{CN})_4]^{2-}$  and  $\text{Ni}(\text{CO})_4$ , have different structures but do not differ in their magnetic behaviour. ( $\text{Ni} = 28$ ).

1/2 fyxIM (ligand) D; k gtrs gA f}nrah fyxIM dk , d mnl gj.k nlft , A  
1/2 Q k ; k dlft , fd dS s fudy ds nks dWysl  $[\text{Ni}(\text{CN})_4]^{2-}$  vls  $\text{Ni}(\text{CO})_4$  fHlu&fHlu l jpu k  
j [krs gq Hh leku pFcdh Q oglj infk r djrs gA ( $\text{Ni} = 28$ ).

25. Name the reagents which are used in the following conversions :

- A primary alcohol to an aldehyde.
- Butan-2-one to butan-2-ol.
- Phenol to 2, 4, 6-tribromophenol.

fufufyf[kr ifjorZkeazia glosokysvHdijdladsule fyf[k %

- , d i bejh , YdkgW dk , d , fMglbM eh
- C Wu-2-vlw dk C Wu-2-vlw eh
- Qhulw dk 2, 4, 6-VbchelQhulw ea

26. Account for the following observations :

- $\text{pK}_b$  for aniline is more than that for methylamine.
- methylamine solution in water reacts with ferric chloride solution to give a precipitate of ferric hydroxide.
- Aniline does not undergo Friedel-Crafts reaction.

fufufyf[kr voyklukadsdkj.k fyf[k s%

- , fuyhu ds fy; s  $\text{pK}_b$  dk elu effy, shu ds elu 1s vf/ld grk gA
- t y ea effy, shu dk ?ly Qfjd DylgbM ds ?ly 1s vfHfO; k dj Qfjd glbM dk vojk nrk gA
- , fuyhu YM&OHVl vfHfO; k ugha djrh gA

27. Write the names and structures of the monomers of the following polymers :

- Buna-S
- Neoprene
- Nylon-6

fufufyf[kr cgydlads, dydkadsule vls muchl jpu k afyf[k %

- cwks

(ii) fuvkhu

(iii) uk yku-6

28. Conductivity of 0.00241M acetic acid solution is  $7.896 \times 10^{-5}$  S cm $^{-1}$ . Calculate its molar conductivity in this solution. If  $\Lambda_m^0$  for acetic acid be 390.5 S cm $^2$  mol $^{-1}$ , what would be its dissociation constant?

Or

A steady current of 1.5 ampere was passed through them until 1.45 g of silver were deposited at the cathode of cell B. How long did the current flow? What mass of copper and what mass of zinc were deposited in the concerned cells? (Atomic masses of Ag = 108, Zn = 65.4, Cu = 63.5).

0.0024 , lVd vEy ?ky dhphydrk  $7.896 \times 10^{-5}$  S cm $^{-1}$  gbl ?ky eavEy dhelyj phydrk dk ifjdyu dlft , A ; fn , lVd vEy dsfy; s  $\Lambda_m^0$  390.5 S cm $^2$  mol $^{-1}$  gksrlsbl dk fo; k u fLkj D; k gkk

vlok

rhfo | q&vi?Wuhly A, B, vls C ft ueoe'kt d l RQY] fl Yoj ulbVY vls dly 1 YQY dsfoy; u j [ksx; sgJslc) t Mqgq gbl mueal s1.5 , si; j dhvifjorlzo | qAjkrc rd iokgr dht khgSrc rd fl Yoj dh 1.45 g ekly B dsdEM ij ughte t krlA dly vls t d dsfdru&fdrusnQ elu lEc) l ykheafu{kir gq gks hjeekqnQ elu] Ag = 108, Zn = 65.4, Cu = 63.5½

29. Assign reasons for the following :

- The enthalpies of atomisation of transition elements are high.
- The transition metals and many of their compounds act as good catalyst.
- From element to element the actinoid contraction is greater than the lanthanoid contraction.
- The E $^\circ$  value for the Mn $^{3+}$ /Mn $^{2+}$  couple is much more positive than that for Cr $^{3+}$ /Cr $^{2+}$ .
- Scandium (Z = 21) does not exhibit variable oxidation states and yet it is regarded as a transition element.

Or

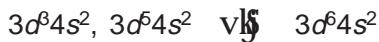
- What may be the possible oxidation states of the transition metals with the following  $d$  electronic configurations in the ground state of their atoms :  
3d $^3$ 4s $^2$ , 3d $^5$ 4s $^2$  and 3d $^6$ 4s $^2$ . Indicate relative stability of oxidation states in each case.
- Write steps involved in the preparation of (i) Na<sub>2</sub>CrO<sub>4</sub> from chromite ore and (ii) K<sub>2</sub>MnO<sub>4</sub> from pyrolusite ore.

fuEufyf[kradsdkj.k fyf[k %

- l Øe.k rRø dh i jek l o d j . k dh , IESYi ; la mPp gk h gA
- l Øe.k /krqa vls muds cgr l s ; kx d vPNs mR j d gk s gA
- f d l h rRø l s nVjs vxys rRø , d , FDVuWM l alpu viSKNr yF6WM l alpu l s vf/kd gk gA
- Mn<sup>3+</sup>/Mn<sup>2+</sup> ds fy; s E<sup>0</sup> dk eku Cr<sup>3+</sup>/Cr<sup>2+</sup> ds E<sup>0</sup> eku dh viSk vf/kd /uked gk gA
- LdSM, e (Z = 21) ifjorLzmp; u voLfk a ugha infk djrk gS fQj Hh bl s l Øe.k rRø eluk tkrk gA

vFlok

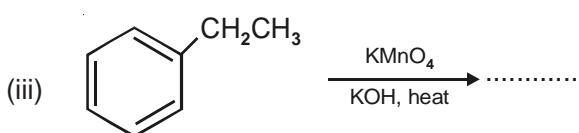
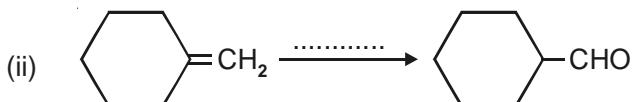
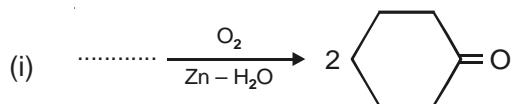
$\frac{1}{2}$  muds i jek kyladh ew voLfk ead by DVWd foU k hokys l Øe.k /kr ykadh l Mfor mp; u voLfk ad; kgk l drh gA



iR sl rRø dsfy, mp; u voLfk v kadh l ksk fLfk rk Hh fyf[k A

- ØlelkV v; Ld l s Na<sub>2</sub>CrO<sub>4</sub> vls (ii) ik jW; k lkV v; Ld l s K<sub>2</sub>MnO<sub>4</sub> ds cokus ds foHlu pj.k fyf[k A

30. (a) Complete the following reaction statements by giving the missing starting material, reagent or product as required :



- (b) Describe the following reactions :

- Cannizaro reaction
- Cross aldol condensation

Or

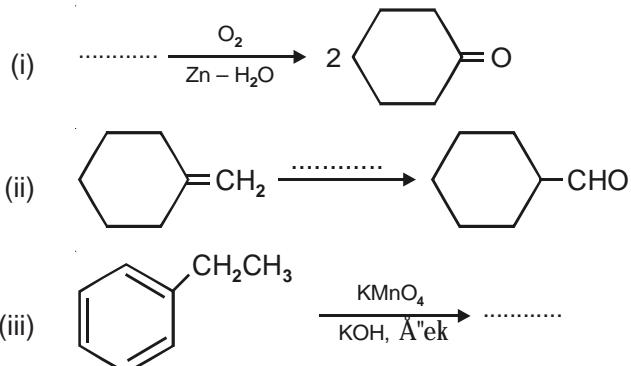
(a) How would you account for the following :

- (i) Aldehydes are more reactive than ketones towards nucleophiles.
- (ii) The boiling points of aldehydes and ketones are lower than of the corresponding acids.
- (iii) The aldehydes and ketones undergo a number of addition reactions.

(b) Give chemical tests of distinguish between :

- (i) Acetaldehyde and benzaldehyde
- (ii) Propane and propanol

1/2 इनकी विशेषताएँ क्या हैं ?



1/2 उपरोक्त विशेषताएँ क्या हैं ?

- (i) दाता के विशेषताएँ क्या हैं ?
- (ii) ऑक्सीम तथा अल्फामिनो एसिड के विशेषताएँ क्या हैं ?

विशेषताएँ

1/2 उपरोक्त विशेषताएँ क्या हैं ?

- (i) उपरोक्त विशेषताएँ क्या हैं ?
- (ii) उपरोक्त विशेषताएँ क्या हैं ?
- (iii) उपरोक्त विशेषताएँ क्या हैं ?

1/2 उपरोक्त विशेषताएँ क्या हैं ?

- (i) ऑक्सीम तथा अल्फामिनो एसिड के विशेषताएँ क्या हैं ?
- (ii) ऑक्सीम तथा अल्फामिनो एसिड के विशेषताएँ क्या हैं ?

# CHAPTER 1

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# REPRODUCTION IN ORGANISMS

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## POINTS TO REMEMBER

**Binary Fission** : Division of parental body into two equal halves.

**Clone** : Individuals that are genetically and morphologically similar to their parents and among each other.

**Diploid** : Organism with  $2n$  number chromosomes.

**Dioecious** : Unisexual condition of whole plant.

**Embryogenesis** : Process of development of embryo from zygote.

**Gamete Transfer** : Male and female gametes are brought together to facilitate fusion.

**Haploid** : Organisms with  $(n)$  number of chromosomes.

**Heterogametes** : Gametes produced are of two morphologically distinct types.

**Hermaphrodite** : Organisms possessing both male and female reproductive organs.

**Isogametes (Homogametes)** : Female and male gametes are similar in appearance.

**Juvenile Phase** : It is the period of growth before maturity when sex organs are not functional.

**Life span** : The period from birth to natural death of an organism.

**Monoeious** : The plant that bear both male and female sex organs.

**Micytes** : Specialized cells of diploid organisms which undergo meiosis.

**Menstrual Cycle** : Sexual or reproductive cycle in sexually mature primate mammals.

**Oviparous** : When female lays fertilised or unfertilised eggs and the development of embryo takes place outside the body of female.

**Oestrous Cycle** : Sexual or reproductive cycle in sexual mature non-primate mammals.

**Pericarp** : Protective covering of fruit. May be divided into epicarp, mesocarp and endocarp or wall of fruit.

**Parthenogenesis** : Development of unfertilised ovum into fully formed organism.

**Pistillate** : Unisexual flowers with female sex organs only (pistil).

**Pollination** : Transfer of pollen grains from anther to stigma.

**Staminate** : Unisexual flowers with male sex organs only (stamens).

**Syngamy** : Fusion of male and female gamete.

**Senescence :** Period between sexual maturity and death of the organism. Deterioration occurs in structure and functions of the organism.

## **QUESTIONS**

### **VSA (1 MARK)**

1. Mention the term used for the offsprings that are exactly identical to one another as well as to their parents.
2. Name the asexual reproductive structure in *Penicillium* and *Chlamydomonas*.
3. Name the aquatic plant which is called ‘terror of Bengal’.
4. Give one example of vegetative propagation by leaves.
5. Name a unicellular fungi and a multicellular invertebrate which reproduces asexually by budding.
6. Mention the medium for transport of gametes in algae, bryophyte and pteridophyte.
7. Name the phenomenon by which drone honeybees are produced.
8. What are gemmules?
- \*9. Why is there no gametic variability in the individual produced by asexual reproduction.
10. Give the scientific term used for unisexual and bisexual conditions.
11. Name the plant in which flowering occurs (1) only once in life time (2) in 12 years.

### **SA – II (2 MARKS)**

12. Name the types of proteins, which are responsible for the transaction between three phases of life span.
13. Mention the concomitant change in the body of an organism during the last phase of life span.
14. What is the sign of end of the juvenile phase/vegetative phase in higher plants?
15. Why do internodal segments of sugar cane fail to propagate vegetatively even when they are in contact with damp soil.
16. In the whiptail lizard only females are born generation after generation. There is no male. How is this possible?
17. Define the term monoecious. Give two examples of monoecious plants.
18. Define the term Dioecious. Give two examples of dioecious plants.
19. Differentiate between gametogenesis and embryogenesis.
20. Distinguish between homogamete (isogamete) and heterogamete. Give one example of each.
21. The male frog releases large number of sperms in water during copulation. Why it is so? Explain.

22. Define external fertilisation. Mention its disadvantage.
23. What are hermaphrodite animals? Give two examples.
- \*24. Why are the chances of survival of offspring is greater in viviparous animals as compared to off offspring of oviparous animal?
25. What are vegetative propagules? Give examples.

### **SA – I (3 MARKS)**

26. What are seasonal breeders and continuous breeders? Give one example of each.
27. Define the term syngamy. Write the product of this event. Where does this event occur in Amphibians and Reptiles.
28. Mention the type of fertilisation in case of fishes and birds respectively. Write differences between them. Are male gametes of mammals motile or non-motile?
- \*29. Mention the site of zygote formation in the ovule of flowering plants. What happens to sepals, petals and stamens after fertilisation? State the fate of zygote, ovule and ovary in these plants.
30. Write the four characteristic features of asexual reproduction. Out of two modes of reproduction, which one is better and why?
31. Define the term 'life span'. Mention three main phases of life span. Name an immortal organism.
- \*32. Name the blank space a, b, c and d given in the following table.

<i>Organism</i>	<i>Organ</i>	<i>Gamete</i>
a	Testis	Spermatozoa
Human female	b	Ovum
Plant (Angiosperm)	c	Pollen grain
Plant (Pteridophytes)	antheridium	d

33. Write the name of vegetative propagules found in the following angiosperms :
  - (i) ..... of water hyacinth.
  - (ii) ..... of Bryophyllum
  - (iii) ..... of Agave
  - (iv) ..... of Ginger
34. Given below are the pairs of organism and asexual reproductive structures. Which one among these is not a matching pair and why?

<i>Organisms</i>	<i>Asexual Reproductive Structures</i>
(a) <i>Chlamydomonas</i>	Zoospores
(b) <i>Penicillium</i>	Conidia
(c) Sponge	Spicules
(d) <i>Hydra</i>	Buds

### **LA (5 MARKS)**

35. Write any three differences between asexual and sexual reproduction. Why is vegetative propagation also considered as a type of asexual reproduction?
36. Describe the main events taking place in sexual reproduction.

### **ANSWERS**

#### **VSA (1 MARK)**

1. Clone
2. *Penicillium* – Conidia, *Chlamydomonas* – Zoospore
3. Water hyacinth
4. *Bryophyllum*
5. Unicellular – Yeast, Multicellular invertebrate – *Hydra*
6. Water
7. Parthenogenesis
8. Asexual reproductive structure of sponge.
9. Asexual reproduction involves only mitotic cell division.
10. Bisexual condition – Homothallic and monoecious  
Unisexual condition – Heterothallic and dioecious
11. (1) Bamboo  
(2) *Strobilanthes kanthiana* (Neela Kurangi)

#### **SA – II (2 MARKS)**

12. Hormones
13. Slowing of metabolism.
14. Plant start flowering
15. Only nodes can produce/differentiate into roots/establish new plant.

16. Through Parthenogenesis.
17. A condition when male and female reproductive structures are found in the same plant e.g. Cucurbits and coconut.
18. A condition either male or female reproductive structures are found in a plant e.g.. Date palm and papaya

<i>Gametogenesis</i>	<i>Embryogenesis</i>
1. Process of formation of gametes.	Development of embryo from zygote.
2. It produces haploid gametes.	It produces an organism.
3. Gametes are formed by meiosis.	Zygote undergoes mitosis and then cells differentiate.

20. Homogamete – gametes are similar in appearance and can not be categorized into male and female.

Heterogamete – Gametes are morphologically distinct male and female. Male gamete is called antherozoid or spore and female gamete is called egg or ovum.

21. Frog releases a large number of sperms into surrounding medium (water) in order to enhance the chance of syngamy.
22. Fusion of egg with sperm takes place outside the body of female – in external medium like water e.g., Amphibia, fishes and algae.

*Disadvantage* : The offsprings are extremely vulnerable to predators, threaten their survival.

23. An animal having both male and female reproductive organs. The same animal produces sperms as well as ova. e.g., Earthworm, sponge and leech.
24. In viviparous animals (majority of mammals), zygote develops into young one inside the body of female. After certain growth young one is developed.

Parental care helps them grow.

It protects them from predators.

In viviparous chances of fusion of male and female gamete is more than oviparous animals.

25. Unit of vegetative propagation.
- Special structures, capable of producing new offsprings.

Runner, rhizome, sucker, tuber, offset and bulb.

### **SA – I (3 MARKS)**

26. Mammals which give birth only during favourable season are seasonal breeders e.g., Dog. Mammals which give birth throughout the year irrespective of season are continuous breeders e.g., Human.

27. Fusion of male and female gamete.

Formation of zygote

(1) Amphibians – Water (outside the female body)

(2) Reptiles – Inside the female body.

28. *Fish – External fertilisation*

*Birds – Internal fertilisation*

Occurs outside the body of female.

Occurs inside the female body.

Male and female release sperm and ova respectively in water.

Spermatozoa are deposited in the body of female.

Male gametes are motile.

They get fused in reproductive tract of female.

29. Embryo sac

Sepals, petals and stamens dry and fall off. Zygote develops into embryo, ovule into seed and ovary into fruit.

30. Single parent

No gamete formation

Only mitotic cell division involved

Daughter individuals are clones.

Sexual mode of reproduction is better.

Provides more chances of variation resulting evolution.

Have more adaptive value therefore better chances of survival.

Less chances of mutational expression.

31. Period from birth to natural death of an organism.

Juvenile phase → Reproductive phase → Senescence phase

Amoeba

### LA (5 MARKS)

32. a = human male b = ovary c = anther d = antherozoid.

33. (i) offset                  (ii) Leaf

                                  (iii) Bulbil                  (iv) Rhizome

34. c – Because Asexual reproductive structure in sponge is gemmule.

35. *Sexual Reproduction*

*Asexual Reproduction*

Both male and female sex organs are involved

Sex organs are not needed.

Gametes are formed and fusion takes place.

No need of gamete formation

Offsprings are not always genetically identical

Always genetically identical.

Meiotic division takes place.

Mitotic division takes place.

Vegetative propagation involves only mitosis, gametes are not required, offsprings are produced by single parent (root, stem or leaf), offsprings are always genetically identical and sex organs are not involved in the process of vegetative propagation.

36. *Prefertilisation* – gametogenesis and gamete transfer.

*Fertilisation* – External or internal fertilisation leading to zygote formation/Parthenogenesis.

*Postfertilisation* – Zygote development, embryogenesis and germination/hatching/parturition.

## CHAPTER 2

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# SEXUAL REPRODUCTION IN FLOWERING PLANTS

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### POINTS TO REMEMBER

- Autogamy** : When pollen grains of a flower are transferred from anther to stigma of the same flower.
- Coleorhiza** : A protective sheath of radicle in monocot seed.
- Coleoptile** : A protective sheath of plumule in monocot seed.
- Endothecium** : A fibrous layer in the anther. It is layer next to epidermis.
- Epicotyl** : The portion of embryonic axis between the plumule and cotyledon.
- Geitonogamy** : Self pollination between flowers of the same plant.
- Hypocotyl** : The region of the embryonic axis between the radicle and the point of attachment of the cotyledons.
- Micropyle** : A small pore in the ovule through which the pollen tube enters.
- Nucellus** : Multicellular tissue in the centre of ovule where embryo sac is present.
- Scutellum** : Partially developed single cotyledon of monocot seed.
- Tapetum** : Nutritive layer of cells around pollen sac.
- Viability of Seed** : Ability of seed to retain the power of germination.

### QUESTIONS

#### VSA (1 MARK)

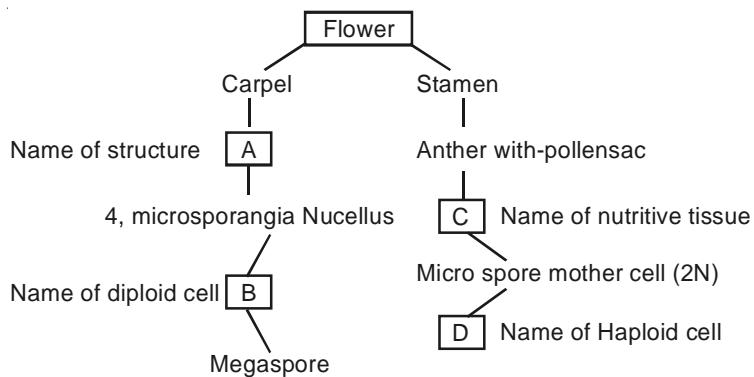
1. Name the part of an angiosperm flower in which development of male and female gametophyte takes place.
2. Name the protective substance present on the pollen envelop to tide over adverse condition.
3. Mention the technical term for fruits which are formed without fertilisation.
- \*4. If the diploid number of chromosomes in an angiospermic plant is 18. What number would you expect in the endosperm?
5. Name the aquatic plant in which pollination and fertilisation takes place on the surface of water.
6. Mention the function of endosperm.

7. How many cells are present in a completely developed female gametophyte of an angiosperm?
8. How many cells are present at the chalazal end of embryo sac? What name is given to them?
9. At what stage of development the pollen grains are liberated.
10. Write the technical term for ovule.
11. Name a plant (weed) whose seed came to India as contaminant with imported wheat.
12. Name two plants in which endosperm is completely consumed during embryonic development.
13. Name who plants where the seeds store food in endosperm.
14. What is perisperm?
15. Define apomixes.
16. Define polyembryony.

### **SA – II (2 MARKS)**

17. Why are some fruits called as false fruit? In an apple which part of the flower develop into fleshy pulp. Give another example of false fruit.
18. What are parthenocarpic fruits? Name one natural parthenocarpic fruit. Write a special characteristic features of parthenocarpic fruit.
19. Write four characteristic features of insect pollinated flower.
20. Differentiate between geitonogamy and xenogamy.
- \*21. What is meant by emasculation? When and why does a plant breeder employ this technique?
22. Compare chasmogamous flower with cleistogamous flowers.
23. Enlist four characteristics of a wind pollinated flower.
24. Draw a diagram of mature dicot, embryo and label the following parts – suspensor, radicle, cotyledon and plumule.
25. Distinguish between albuminous seed and non-albuminous seed. Give their examples also.
26. Why is the process of fertilisation in the flowering plants referred as double fertilisation?
27. What is meant by triple fusion? Where does it take place?
28. The number of chromosomes in the pollen grains of an angiospermic plant is 12. Write the number of chromosomes in the following :

(1) Embryo	(2) Integument
(3) Endosperm	(4) Antipodal cell
- \*29. Given below is an incomplete flow chart showing formation of gametes in an angiosperm plant. Observe the given flow chart carefully and fill in the blank A, B, C and D.



30. Even though each pollen grain has two male gametes. Why are least two pollen grains and not one pollen grain required to fertilize two ovules present in a particular carpel.

### **SA – I (3 MARKS)**

- \*31. What will be the fate of the following structures in the angiospermic plant : Ovary wall, zygote, ovule, outer integument, inner integument and primary endosperm nucleus.
- 32. Draw a diagram of a mature embryo sac and label the following parts : Egg cell, synergid, filiform apparatus.
- 33. Draw a diagram of longitudinal section of typical anatropous ovule and label the following parts:
  - (1) Embryo sac
  - (2) Micropyle
  - (3) Nucellus
  - (4) Funicle
- 34. Define pollination. How does the mechanism of pollination occur in the following plants?
  - (1) Vallisneria and
  - (2) Yucca
- 35. Differentiate between microsporogenesis and megasporogenesis. What type of cell division occurs during these events? Name the structure formed at the end of these two events.
- 36. Mention the three devices developed by a flowering plant to discourage self pollination.
- 37. Explain the mechanism followed by a plant breeder during emasculation and bagging.
- 38. Draw a diagram of the enlarged view of microsporangium showing different wall layers. Name the innermost layer and write its function.
- 39. Describe the structure of a pollen grain.
- 40. Differentiate between male gametophyte and female gametophyte.

### **LA (5 MARKS)**

41. Draw a longitudinal section of a pistil showing growth of pollen tube. Explain the events on embryo sac during the process of fertilisation. Which resulting stage gives rise to the embryo and endosperm respectively?
42. Briefly explain the formation of an embryo sac of an angiosperm.
43. Describe briefly the three different kinds of pollination on the basis of source of pollen grains. Name biotic and abiotic agents of pollination.
44. "Incompatibility is a natural barrier in the fusion of gametes". Justify the statement.

### **ANSWERS**

#### **VSA (1 MARK)**

1. Male gametophyte in stamen. Female gametophyte in ovule.
2. Sporopollenin
3. Parthenocarpic
4. 27 Chromosome.
5. Vallisnaria
6. Stores food
7. 7 Cells
8. 3 (three) Antipodal cells
9. Two celled stage – Vegetative cell and a generative cell.
10. Megasporangium
11. Parthenium (Carrot grass)
12. Pea and Ground nut
13. Rice and Maize.
14. In some seeds like black pepper and beet remnants of nucellus are also persistent. This residual persistant nucellus is the perisperm.
15. Special mechanism to produce seed without fertilisation.
16. Occurrence of more than one embryo in a seed.

#### **SA – II (2 MARKS)**

17. Fruits developed from any floral parts other than ovary.

Thalamus

Strawberry/Cashew

18. Fruits develop without fertilisation.

Banana

Seedless

19. Flowers are large.

Colourful petals of flower.

Presence of fragrance.

Rich in nectar

20. *Geitonogamy*

*Xenogamy*

Transfer of pollen grains from the anther to stigma of another flower of the same plant.

Transfer of pollens from the anther to stigma of different plant.

Does not provide opportunity for gametic recombination.

Provides opportunity for gametic recombination.

21. Removal of anthers from a bisexual flower before anther dehisces. It is done with the help of forceps.

A plant breeder perform this technique in order to cross different species for the combining of desirable characters for the production of superior traits

During emasculation desired pollen grains are used for pollination and stigma is protected by bagging from contamination by undesired pollen grains.

22. Refer page no. 28 NCERT book.

23. Pollen grains are light and non-sticky.

Well exposed stamens.

Stigma is feathery.

Pollen grains are produced in large number.

Unisexual male flower above the unisexual female flower.

24. Refer figure 2.13 (b) on page no. 34 NCERT book.

25. *Albuminous seed*

*Non-albuminous seed*

The seed which retain endosperm as it is

The seed which have no residual endosperm.

Not completely used up during embryo Development.

It is completely used up during embryo Development.

e.g., Wheat and maize

e.g., Pea and ground nut.

26. One of the male gamete of pollen tube fuses with the egg cell and form zygote. The other male gamete fuses with polar nuclei (2N) and develop into endosperm.

27. Fusion of one male gamete with two polar nuclei forming triploid primary endosperm nucleus.  
Takes place in central cell of embryo sac of an ovule.
28. (1) Embryo – 24 (diploid)  
(2) Integument – 24 (diploid)  
(3) Endosperm – 36 (triploid)  
(4) Antipodal cell – 12 (haploid)
29. A = Ovule/megasporangium  
B = Megaspore mother cells  
C = Tapetum  
D = Pollen grain
30. (i) Only one pollen tube enters an ovule/two pollen tubes would be required for two ovules.  
(ii) Even if a pollen grain produces more than one pollen tube only one of them carries male gamete/of the two male gametes per pollen tube, one is used in syngamy and other is in triple fusion.

### **SA – 1 (3 MARKS)**

- |                           |                                       |
|---------------------------|---------------------------------------|
| 31. Ovary wall – Pericarp | Zygote – Embryo                       |
| Ovule – Seed              | Outer integument – Testa              |
| Inner integument – Tegmen | Primary endosperm nucleus – Endosperm |
32. Refer fig. 2.8 (c) page no. 26 NCERT book.
33. Refer figure 2.7 (d) page no. 25 NCERT book.
34. Transfer of pollen grains from anther to stigma.  
Vallisneria – Refer page no. 29 NCERT book  
Yucca – Refer page no. 30.
35. Microsporogenesis – Process of formation of microspore from a pollen mother cell.  
Megasporogenesis – Process of formation of megaspore from megaspore mother cell.  
Meiotic cell division in both.  
Microsporogenesis results in the formation of megaspore.
36. Refer page no. 31 NCERT book.
37. Refer page no. 33 (Artificial hybridization) NCERT book.

38. Refer figure 2.3 (b) page no. 22 NCERT book.

Innermost layer – Tapetum

It nourishes the developing pollen grains.

39. Refer figure 2.5 page 23 of NCERT text book.

40. Male Gametophyte

Derived from pollen grain

Does not remain embedded inside the Microsporangium.

It is only 3 celled structure.

- Female Fametophyte

Derived from megasporangium

Remain permanently embedded inside the megasporangium.

It is 7 celled structure.

### **LA (5 MARKS)**

41. Refer figure 2.12 (c) page no. 32 NCERT book. Fusion of another male gamete with polar nucleus Zygote and primary endosperm cell.
42. Refer page no. 27 NCERT book.
43. Refer page no. 27 and 28 (kinds of pollination, agents of pollination) NCERT book.
44. Incompatibility is considered as the most widespread and effective device to prevent inbreeding and prevent out breeding. It acts as a natural barrier by the interaction of chemical substances produced by the male gametophyte and tissue of style. Normally the function of pollens belonging to right mating type germinate on stigma, develop pollen tube and bring about fertilisation. The pollen grains belonging to other mating type are discarded.

# CHAPTER 3

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## HUMAN REPRODUCTION

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### POINTS TO REMEMBER

**Acrosome** : A small cap like extension in the head of spermatozoa which is filled with enzymes that help in fertilisation.

**Blastula** : A stage of embryogenesis comes after morula and has a hollow fluid filled space called blastocoel.

**Embryogeny** : The development of an organism during embryonic stage.

**Endometrium** : Inner most glandular lining of uterus.

**Ejaculation** : Expulsion of semen by male.

**Foetus** : An advanced stage of embryo within the uterus.

**Gastrulation** : Movement of cells during the development of an embryo at the end of cleavage to form three germ layers.

**Gonad** : A gamete producing gland – either testis in male or an ovary in female.

**Graffian follicle** : A fluid filled vacuole containing egg, present in an ovary of mammals.

**Gestation Period** : A period between fertilisation of ovum and the birth of a baby.

**Hymen** : A thin membrane partially covering the vaginal aperture.

**Implantation** : Fixing of embryo/fertilized egg in uterus.

**Insemination** : Discharge of semen into the vagina of the female.

**Menarche** : The beginning of first menstruation in female on attaining puberty.

**Menopause** : Permanent cessation of menstrual cycle in female. It occurs between the age 45 to 50 years in human female.

**Oogenesis** : Formation and development of ova in ovary.

**Ovulation** : Process of release of mature ovum from the ovary.

**Parturition** : Process of expulsion of foetus from the uterus.

**Placenta** : Temporary connection between the foetus and uterine wall of the mother.

**Puberty** : A stage at which immature reproductive system of boy or girl becomes mature.

**Scrotum** : A muscular pouch which houses two testes.

**Spermatocyte** : Diploid cell derived from spermatogonia during meiosis in male.

**Spermatogenesis** : Formation and development of sperm in testis of male.

**Spermiation** : Process by which sperms are released from the seminiferous tubules.

**Spermiogenesis** : Process of transformation of non-motile spermatid into motile sperm.

**Trophoblast** : Outer layer of cells of blastula which absorb the nutrient secreted by uterus membrane.

**Zona Pellucida** : Non-cellular layer clearly seen around mammalian egg.

## QUESTIONS

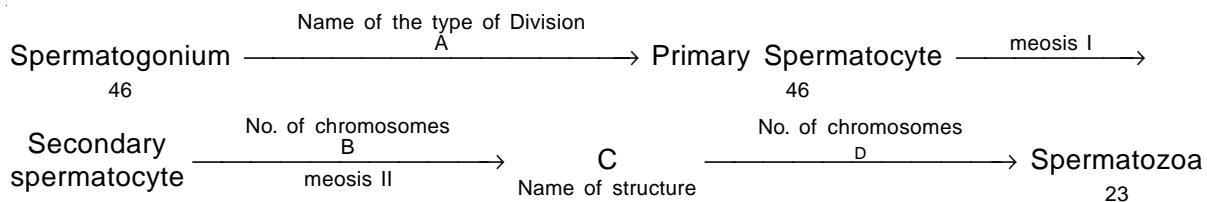
### VSA (1 MARK)

1. Name the sperm producing structures of the testis.
2. Name the innermost glandular epithelium of the uterus.
3. Name the sensitive structure of female reproductive organ/system which is homologous to penis of male.
4. What is semen?
5. Which type of cell division occurs during formation of secondary spermatocyte from primary spermatocyte?
6. Give the term for the periodic vaginal bleeding.
7. In which part of the sperm mitochondria are found?
8. Name the hormone that control ovulation.
9. What is the main cause of menstruation in human female?
10. Which two hormones control the parturition?
11. Which two hormones control implantation?
- \*12. What harm is caused if the testis in human male fail to descend into scrotal sac?
13. How many spermatozoa produced from a secondary spermatocyte?
14. The spermatogonial cell has 46 chromosomes. Give the number of chromosomes in–
  - (1) Primary spermatocyte and
  - (2) Spermatid
15. How many ova are formed from one primary oocyte?
16. What scientific name is given to cessation of menstrual cycle in human female?
17. In the fertile human female approximately on which day of menstrual cycle does ovulation take place?

18. Name the stage of implantation of the human embryo.
19. Define cleavage.
20. What is colostrum?
21. Name the pregnancy hormone.
22. What is meant by spermiation?
23. What are the special structural features of the epithelial cells that lines the fallopian tube?
24. Which structure forms the corpus luteum and name the hormone secreted by it?
- \*25. Why all copulation does not lead to fertilisation and pregnancy?
26. Name the structure which is made of foetal tissue as well as maternal tissue.

### **SA – II (2 MARKS)**

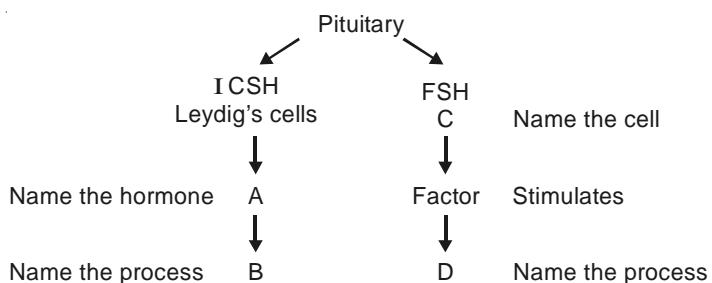
27. Which structure forms corpus luteum? What is its function?
28. Explain the significance of the condition in human in which the testes remain suspended in scrotum outside the abdominal cavity.
29. What is ovulation? Name the structure formed from the graafian follicle after ovulation.
30. Name the different parts starting after seminiferous tubule of accessory duct system in proper sequence in human male reproductive system. Mention their role.
- \*31. Explain, why the first half of the menstrual cycle is called follicular phase as well as proliferative phase?
- \*32. Explain, why the second phase of the menstrual cycle is called luteal phase as well as secretory phase?
33. Differentiate between menarche and menopause.
34. Why is there no menstrual cycle during pregnancy?
35. What is parturition? Name the hormone which is involved in induction of parturition.
36. What are the major components of seminal plasma? Name the accessory glands associated with seminal plasma.
37. What is meant by implantation? What does it represent?
38. Differentiate between spermatogenesis and spermeiogenesis.
- \*39. A woman should not be blamed for giving birth to daughter. Explain.
- \*40. Given below is a sequence of steps of spermatogenesis. Fill in the blanks (A, B, C and D).



41. Name the act expelling the full term young one from the mothers uterus at the end of gestation period. Write the missing steps of this neuro-endocrine mechanism.

- (i) Signals originates from fully developed foetus and placenta.
- (ii) \_\_\_\_\_
- (iii) \_\_\_\_\_
- (iv) Oxytocin causes strong uterine contraction.
- (v) Uterine contraction stimulates further secretion of oxytocin.
- (vi) \_\_\_\_\_

42. Given below is an incomplete flow chart showing influence of hormones on gametogenesis in male. Observe the flow chart carefully and fill in the blanks A, B, C and D.



43. List the changes that occur in morula till it is embedded in the uterine wall.
- \*44. Both gametogenesis and fertilisation are essential to maintain chromosome number constant. Why?
45. The secretion from the mother's mammary gland just after parturition is very important to infant. Name it. Give its significance for infant growth.
46. Why breast feeding during initial period of infant growth is recommended by doctors?
- \*47. What is meant by L.H. Surge? Write the role of LH.
48. Explain significance of the condition in which the testes remain suspended in scrotum outside abdomen.

### SA – I (3 MARKS)

49. Differentiate between spermatogenesis and oogenesis.

50. Describe in brief the structure of the human female external genitalia.
- \*51. "Presence and absence of hymen is not an indicator of virginity", justify the statement.
52. Draw a labeled diagram (sectional view) of the female reproductive system with the following : ovary, fimbriae, endometrium, cervix, isthmus and uterine cavity.
53. Write down the function of the following : Fimbriae, acrosome and mammary gland.
54. Draw a sketch of cross section of a part of seminiferous tubule with any six labels.
55. Draw a neat diagram of structure of sperm of human male and label the following : Acrosome, mitochondria, nucleus, neck, tail and middle piece.
56. Draw a neat diagram (sectional view) of ovary of human female with the following labels : Blood vessels, primary follicle, ovum, tertiary follicle, graffian follicle and corpus luteum.
57. Describe the structure of a human male sperm.
58. What is placenta? Write its two functions.
59. Name the cells which are located
- (1) inside the seminiferous tubules,
  - (2) outside the seminiferous tubule. Differentiate between them with reference to their functions.

### **LA (5 MARKS)**

60. What is spermatogenesis? Where does it occur? Describe the stages of this process.
61. What is oogenesis? Where does it occur? Describe the stages of this process.
62. Describe various events of menstrual cycle.
63. Describe briefly the components of human male reproductive system.
64. Describe briefly the components of human female reproductive system.
65. A woman has conceived and implantation has occurred in uterus. Discuss the sequence of changes up to parturition which takes place within her body.

### **ANSWERS**

#### **VSA (1 MARK)**

1. Seminiferous tubules.
2. Endometrium
3. Clitoris

4. Seminal fluid along with the secretion of other two accessory sex glands of male and the sperms.
5. Meiosis
6. Menstruation
7. Middle piece
8. Luteinising hormone (LH)
9. Degeneration of corpus luteum and decreased level of progesterone in the blood.
10. Oxytocin and Relaxin.
11. Estrogen and Progesterone.
12. Sterility, spermatogenesis does not occur.
13. Two
14. (a) 46 in primary spermatocyte  
(b) 23 in spermatid
15. One
16. Menopause
17. 14<sup>th</sup> day
18. Blastocyst
19. Process of rapid multiplication of the single celled zygote into blastomeres.
20. The first milk that comes out of the mother's mammary gland just after the birth of the baby.
21. Progesterone.
22. Process of releasing of sperms from the seminiferous tubules.
23. Ciliated epithelial cells.
24. Follicular cells of empty graaffian follicles, Progesterone.
25. Ovum and sperm should reach simultaneously to the ampullary – isthemic junction.
26. Placenta.

### **SA – II (2 MARKS)**

27. After ovulation, the graffian follicle is transformed into corpus luteum under the influence of hormone LH. It secretes progesterone for maintaining pregnancy.
28. To maintain the temperature 2° – 2.5°C lower than that of body. It is essential to maintain the viability of sperm.
29. Process of releasing mature ovum from ovary. Corpus luteum.

30. Rete testis → Vasa efferentia → Epididymis → Vas deferens → common ejaculatory duct → Urethra  
Store and transport sperms from testis to outside through urethra.
31. Primary follicle in the ovary grows to become fully mature graffian follicle and simultaneously the endometrium of uterus regenerates through proliferation.
32. In this phase, ruptured graffian follicle changes into corpus luteum and corpus luteum secretes large amount of progesterone which is essential for maintenance of endometrium.
33. Menarche – First menstruation in female on attaining puberty.  
Menopause – Cessation of menstruation in female around the age of 45 to 50 years.
34. After ovulation and fertilisation, the corpus luteum secretes progesterone hormone. This hormone inhibits the production of gonadotropin hormone. This prevents the sloughing off uterine lining and support to pregnancy.
35. The process of delivery of the foetus (child birth) Oxytocin.
36. Fructose, calcium and certain enzymes.  
Seminal vesicles, prostate gland and bulbo-urethral gland.
37. Attachment of blastocyst/embryo to the endometrium of uterus. After implantation a woman is said to be pregnant.
38. Spermatogenesis – The process in which haploid sperms are formed from diploid sperm mother cell (spermatogonia).  
Spermeiogenesis – The process in which spermatids are transformed into sperms.
40. (A) Mitosis (B) 23 (C) Spermatid (D) Spermeiogenesis
41. Parturition  
(i) Foetal induction reflex.  
(ii) The reflex triggers release of oxytocin.  
(iii) Expulsion of the baby out through birth canal.
42. (a) Androgen/Testosterone/male sex hormone. (b) Spermatogenesis  
(c) Sertoli cells (d) Spermiogenesis
43. Refer Page 53 NCERT book.
44. Gametogenesis results in the formation of haploid gamets while fertilisation involves fusion of gametes and restores the diploidy. If there is no meiosis during gametogenesis, the gamete will be diploid and individual produced will be tetralpoid. If gametogenesis is not followed by fertilisation then individual formed will be haploid.
45. Refer page 54 NCERT book.
46. Refer page 54 NCERT book.

47. Refer page 51 NCERT book.
48. Refer page 43 NCERT book.

### **SA – I (3 MARKS)**

- |   |  |
|---|--|
| 49. <i>Spermatogenesis</i>                | <i>Oogenesis</i>                         |
| Occurs in testis                          | Occurs in ovary                          |
| Spermatogonia change into spermatocyte.   | Oogonia change into oocyte.              |
| Primary spermatocyte divides to form two. | Primary oocyte divides to form.          |
| Secondary spermatocyte.                   | One secondary oocyte and one polar body. |
| Spermatogonium forms four spermatozoa.    | Oogonia forms only one ovum.             |
50. Mons pubis – Cushion of fatty tissue covered by skin and hairs.  
Labia majora – Fleshy fold of tissue surrounding the vaginal opening.  
Labia minora – Paired fold of tissue under labia majora.  
Clitoris – Small extension from labia minora similar to penis of male.
  51. Hymen is often torn during first coitus. However it can also be broken by a sudden fall or jolt, active participation in sport, insertion of a vaginal tampon etc. It may also persist even after coitus.
  52. Refer figure 3.3 (b) page no. 45 NCERT book.
  53. Fimbriae – Collection of egg after ovulation.  
Acrosome – Filled with enzyme that help in entry of sperm into ovum during fertilisation.  
Mammary gland – Secretion of milk after child birth by nursing mother.
  54. Refer figure 3.5 page no. 47 NCERT book.
  55. Refer figure 3.6 page no. 48 NCERT book.
  56. Refer figure 3.7 page no. 49 NCERT book.
  57. Small microscopic structure having head, neck, middle piece and a tail. Plasma membrane envelop the whole body of it.  
Contain an haploid nucleus.  
Cap like acrosome at the tip of the head containing certain enzymes.  
Middle piece containing mitochondria for energy production.  
Tail facilitates sperm motility.

58. Placenta is an intimate connection between the foetus and uterine wall of the mother.  
Facilitates the supply of oxygen and nutrients to the embryo and removal of wastes.  
Produces several hormones like HCG, hPL, estrogen, progesterone and relaxin.
59. Each seminiferous tubule is lined from inside by spermatogonia and sertoli cells. Leydig cells lie outside in cluster.  
Spermatogonia undergoes meiotic division leading to sperm formation.  
Leydig cells synthesise and secrete hormones called androgens.

### **LA (5 MARKS)**

60. Refer subtopic 3.3 (gametogenesis) page no. 47 NCERT.
61. Refer page 48 NCERT.
62. Refer 3.4 (Menstrual cycle) NCERT book.
63. Refer subtopic 3.1 (The male reproductive system) page no. 43 NCERT book.
64. Refer subtopic 3.2 (The female reproductive system) page no. 44 NCERT book.
65. Refer subtopic 3.6 (Pregnancy and embryonic development) page no. 53-54 NCERT book.

# CHAPTER 4

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# REPRODUCTIVE HEALTH

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## POINTS TO REMEMBER

**Abortion** : Termination of pregnancy

**Amniocentesis** : Diagnostic technique to detect genetic disorder of the foetus.

**Contraceptive** : Any device which prevents fertilisation of ovum.

**Coitus** : Sexual intercourse.

**Condom** : A rubber sheath used to cover penis/vagina during coitus.

**Infanticide** : Killing the infant in the womb.

**Infertility** : Inability to produce children in spite of unprotected sexual cohabitation of a couple.

**Mortality** : Death rate (number of persons removed from a population by death) at a given time.

**Sterilization** : A permanent method of birth control through surgery in male or female.

**Tubectomy** : Procedure of sterilization in human female in which fallopian tubes are cut and tied.

**Vasectomy** : Procedure of sterilization in human male in which vasa deferentia are cut and tied.

**IUCD** : Intra Uterine Contraceptive Device

**RCH** : Reproductive and Child Health care

**STD** : Sexually Transmitted Disease

**CDRI** : Central Drug Research Institute

**MMR** : Maternal Mortality Rate

**IMR** : Infant Mortality Rate

**MTP** : Medical Termination of Pregnancy

**VD** : Venereal Disease

**RTI** : Reproductive Tract Infection

**PID** : Pelvic Inflammatory Disease

**ART** : Assisted Reproductive Technologies

**IVF** : In Vitro Fertilisation

**ZIFT** : Zygote Intra Fallopian Transfer

**IUT** : Intra Uterine Transfer

**ICSI** : Intra Cytoplasmic Sperm Injection

**AI** : Artificial Insemination

**GIFT** : Gamete Intra Fallopian Transfer

## **QUESTIONS**

### **VSA (1 MARK)**

1. Name the technique used for determining the sex and condition of the foetus.
2. Name the fluid from which foetal cells are extracted for chromosomal analysis.
3. Define reproductive health.
4. What is the significance of introduction of sex education in the schools?
5. Name the technique which is used for sterilization of human female.
6. Name the technique which is used for sterilization of human male.
7. Give the term for rapid population growth.
8. Name the hormone found in birth control pills.
9. Name two sexually transmitted diseases which are curable.
10. Name two sexually transmitted diseases which are not curable.
11. What is the legally marriageable age of human male and human female in our country?

### **SA – II (2 MARKS)**

12. What are implants? How do they help in preventing fertilisation?
13. How do oral pills help in birth control? Name the common pills used.
14. Briefly explain two natural barriers of birth control.
15. Suggest various methods to assist infertile husband – wife to have children.
16. Differentiate between tubectomy and vasectomy.
17. What are venereal diseases? Write two examples of such diseases.
18. Expand the term IUD. Write down the significance of IUDs.
19. Enlist any four possible ill-effects of prolonged use of contraceptives.
- \*20. Removal of gonads can not be considered as contraceptive option. Why?
21. Enlist any four possible reasons of infertility in human beings.

22. In the table given below select and enter one correct device out of the following :  
Oral pill, Condom, CuT, Shaheli, Vasectomy, Diaphragm, Tubectomy, Cervical cap.

<i>Method of birth control</i>	<i>Device</i>
Barrier	
IUD	
Surgical Tech.	
Administering Hormones	

- \*23. Few gaps have been left in the following table showing certain terms and their meaning. Fill up the gaps.

<i>Terms</i>	<i>Meaning</i>
(i) Induced abortion/MTP	
(ii)	Absenting from coitus during fertile period.
(iii)	Sterilization in human male.
(iv) Population Explosion	

24. Reproduction health in our country has improved in last 50 years. Mention any two area of improvement which are responsible for it.  
25. Amniocentesis, the fetal sex determination list is banned in our country. Is it necessary? Comments.

### **SA (3 MARKS)**

26. Mention the various measures, one has to take to prevent from contracting STDs.  
27. Discuss three specific methods for preventing pregnancy.  
28. Explain briefly the barrier method of contraception.

### **LA (5 MARKS)**

29. Describe various ways which can be adopted for the control of human population growth.  
30. Briefly explain the various reproductive technologies to assist an infertile couple to have children.

## **ANSWERS**

### **VSA (1 MARK)**

1. Amniocentesis.
2. Amniotic fluid.
3. Total well being in all respect of reproduction i.e. physical, mental, behavioural and social.

4. It gives right information to the young ones to save them from myth and misconceptions about sex related aspects.
  5. Tubectomy
  6. Vasectomy
  7. Population explosion.
  8. Progesterone and estrogen.
  9. Syphilis and Gonorrhoea.
  10. Hepatitis B and AIDS.
  11. Male – 21 years  
Female – 18 years.

## **SA – II (2 MARKS)**



### **SA – I (3 MARKS)**

26. Avoid blood transfusion from an infected person.  
Avoid sex with an unknown partner and multiple partners.  
Always use condom.  
Avoid sharing of injection needles and syringes and surgical instruments.
27. Sterilization
- (a) Tubectomy
  - (b) Vasectomy
- Intra Uterine Device–
- Non-medicated Lippes loop
- Copper releasing – Copper-T, Cu 7 and multiloaded 375.
- Hormone releasing – Progestasert and LNG – 20.
- Oral Contraceptive Pills – Small doses of either progesterone/Progesterone–estrogen combination.
28. Condom – Made up of thin rubber latex sheath.  
Used to cover penis of male or cervix of female.  
Disposable and easy to use  
Diaphragm – Cervical caps and vaults.  
Made of rubber.  
Only for women. Reusable

### **LA (5 MARKS)**

29. Refer page 59 – 61 NCERT book.
30. Refer page no. 64 NCERT book.

## CHAPTER 5

# PRINCIPLES OF INHERITANCE AND VARIATION

### POINTS TO REMEMBER

**Allele** : Alternative forms of a gene having same locus on chromosome.

**Autosomes** : All chromosomes other than the sex chromosomes are autosomes.

**Aneuploidy** : It is the condition of addition or reduction of one or two chromosomes in a homologous pair of chromosomes.

**Co-dominance** : The alleles which do not show dominance-recessive relationship and are able to express themselves independently when present together e.g.  $I^A$  and  $I^B$  alleles of blood group AB.

**Chromosome Mapping** : The representation of relative position of genes on the chromosome. The frequency of recombination between gene pairs on the same chromosome is a measure of the distance between genes.

**Chromosome Theory** : Proposed by Sutton and Boveri. According to this theory – Genes are located on chromosomes and the inheritance and genes is similar to the inheritance of chromosomes.

**Down's Syndrome** : Genetic disorder caused due to trisomy of chromosome no. 21.

**Dominant Allele** : The allele which expresses itself in a pair of dissimilar alleles.

**Dihybrid Cross** : A cross in which two pair of contrasting characters are considered e.g. RRYY  $\times$  rryy in pea.

**Female Heterogamety** : A condition where two different types of gametes in terms of sex chromosomes are produced by females e.g.. In birds female bird produces Z and W gametes.

**Genetics** : Branch of Biology that deals with the study of reasons behind inheritance and variations.

**Gene** : Unit of inheritance of characters.

**Heterozygous** : An individual possessing two different alleles of a gene at a particular locus on homologous chromosome e.g., Tt.

**Homozygous** : An individual possessing two identical alleles of a gene at a particular locus on homologous chromosome e.g., TT or tt.

**Haemophilia** : Sex linked recessive disease which shows its transmission from unaffected carrier female to some male progeny due to lack of a blood clotting factors.

**Inheritance** : It is the process by which characters are passed from parent to progeny making them similar or dissimilar.

**Klinefelter's Syndrome** : Genetic disorder caused due to additional copy of X chromosome of sex in male resulting in a karyotype of 47 chromosomes (XXY).

**Law of Independent Assortment** : When two pairs of traits are combined in a hybrid, segregation of one pair of characters is independent of the other.

**Linkage** : It is tendency of genes present on the same chromosome to inherit together.

**Monohybrid Cross** : A cross in which a single pair of contrasting characters are considered e.g., TT x tt.

**Multiple Alleles** : Where more than two alleles give the same character in a population e.g., I<sup>A</sup>, I<sup>B</sup> and I<sup>O</sup> alleles are responsible for blood group.

**Male Heterogamety** : Condition where two different types of gametes in terms of sex chromosomes are produced by males e.g., In human, male produces X and Y gametes.

**Mutation** : Sudden, heritable discontinuous variations in organisms due to changes in genes and chromosomes.

**Mutagen** : Chemical or physical factors that induce mutation e.g., UV radiations.

**Phenylketonuria** : Inborn error of metabolism inherited as autosomal recessive trait. Affected individual lacks an enzyme that converts amino acid phenylalanine into tyrosine which comes out through urine. Mental retardation occurs as a defect.

**Punnet Square** : It is a graphical representation to calculate the probability of all possible genotypes of offspring in a genetic cross.

**Phenotype** : The observable structural and functional traits produced by the interaction of genes and environment.

**Point Mutation** : Change in a single base pair of DNA e.g.. Sickle cell anaemia.

**Pedigree Analysis** : It is the analysis of a trait in several generations of a family in humans.

**Polyplloid** : An increase in multiple of haploid set of chromosomes in an organism e.g.. 3n, 4n, 5n and 6n etc.

**Recessive Allele** : The allele which is unable to express itself in the presence of the dominant allele but expresses itself in the absence of dominant allele.

**Recombination** : It is the generation of non-parental gene combinations in the offsprings.

**Sex Chromosomes** : The chromosomes involved in the determination of sex characters. The last pair of chromosome is generally considered as sex chromosome e.g., XX and XY in humans.

**Sex Linked Inheritance** : Type of inheritance which is carried from generation to generation along the sex determining genes located on the sex chromosomes.

**Sickle Cell Anaemia** : Autosome linked recessive trait, controlled by single pair of alleles Hb<sup>A</sup> and Hb<sup>S</sup>. Due to substitution of Glutamic acid (Glu) by Valine (Val) at the 6<sup>th</sup> position of betaglobin chain of haemoglobin molecule.

**Test Cross :** A cross between an organism showing a dominant phenotype with the recessive parent to determine the genotype.

**Turner's Syndrome :** Genetic disorder caused due to absence of one sex chromosome in human female i.e. 22 Autosomes + XO (sex chromosome).

**Variation :** It is the degree by which progeny differ from their parents and among themselves.

## QUESTIONS

### VSA (1 MARK)

1. Name the unit of inheritance.
2. What are the different forms of a gene which represent contrasting traits called?
3. State the Law of Independent Assortment.
4. A pure tall pea plant is crossed with pure dwarf pea plant. The  $F_1$  progeny is self pollinated. What will be the ratio of true breeding tall plants to true breeding dwarf plants?
5. Name the antigens found on the surface of RBCs in case of AB blood group.
6. Name the process of removing stamens from flower buds during hybridization.
7. A diploid organism is heterozygous for 2 loci. How many types of gametes can be produced?
8. What is meant by trisomic condition?
9. Which is the factor that governs the frequency of recombination while constructing genetic maps?
- \*10. How many autosomes are found in a normal liver cell of a human female?
- \*11. We are considering the movement of 2 pairs of genes present on the same chromosome, one pair is tightly linked and other is loosely linked. Which gene will show high and which will show low recombination frequency?
- \*12. Letter 'A' represents a gene for dominant trait and letter 'a' for its recessive allele. If 'Aa' is crossed with 'Aa', what percentage of offsprings will exhibit dominant trait in the next generation.
13. What will be the genetic make up of an organism suffering from sickle cell anaemia?
14. Mention the chromosome mechanism by which male and female sex is determined in grasshopper.
- \*15. A modified allele is responsible for a non functional enzyme or no enzyme at all. What would be the form of allele of the gene?
16. Name the type of inheritance in which the genotypic ratio is the same as phenotypic ratio. Also give the ratio of  $F_2$  generation.

## SA – II (2 MARKS)

- \*17. Few gaps have been left in the following table showing certain terms and their meanings. Fill in the gaps shown at a, b, c, d.

<i>Terms</i>	<i>Meanings</i>
(i) a	contrasting forms of a gene
(ii) Recombination	b
(iii) Female heterogamety	c
(iv) d	analysis of traits in a number of generations of a family.

18. *Drosophila melanogaster* is a suitable material for genetic studies. Give 4 reasons.
- \*19. A woman has four daughters and is being blamed for having conceived only daughters. How will you explain to her that she is not to be blamed at all.
- \*20. How would you correlate the movement and behavior of chromosomes and genes at meiosis during (1) Segregation of an allele pair. (2) Independent assortment of two genes.
21. Distinguish between homogametic and heterogametic organisms taking *Drosophila* as an example.
22. Define point mutation. Give an example of a disease caused due to point mutation.
23. An individual has a genetic disorder with overall masculine development and gynaecomastia symptoms. Name the disorder and write its chromosomal abnormality.
24. Differentiate between co-dominance and incomplete dominance.
25. A couple believed that they have brought a wrong baby from the hospital. The wife has blood group O her husband has blood group B and the child has blood group O. Being a geneticist, justify if the child can belong to this couple and what could be the phenotypes of the siblings.
26. Differentiate between aneuploidy and polyploidy with one example of each.
27. Snapdragon shows the phenomenon of incomplete dominance. Work out the expected genotypic and phenotypic ratios of a cross between plants with pink flower colour.
28. Write the pair of contrasting traits of the following characters in *Pisum sativum*. Also specify the dominant and recessive ones.
1. Colour of pod.
  2. Position of flower.
- \*29. T and t are the two alleles of a gene. Monohybrid cross of  $\frac{1}{4} : \frac{1}{2} : \frac{1}{4}$  can be condensed in the form of  $(ax + by)^2$ . Expand the expression.

30. On the basis of mechanism of sex determination identify the organism as male and female.

<i>Organism</i>	<i>Sex chromosomes</i>	<i>Sex</i>
1. Bird	ZW	a
2. Drosophila	XY	b
3. Grasshopper	XO	c
4. Bird	ZZ	d

31. Study the following Dihybrid Cross and complete the gaps a, b, c, d.

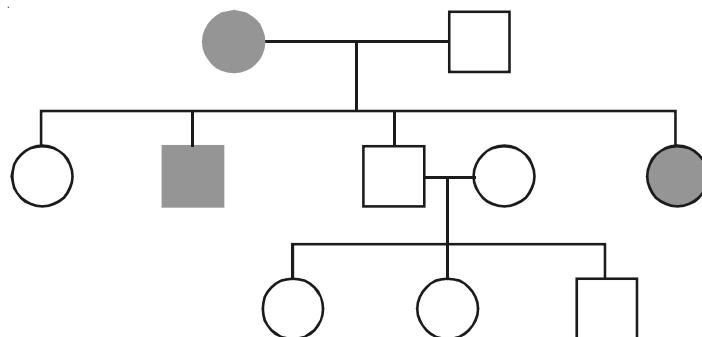
P	RRYY	X	rryy
Gametes	RY		a
F1		b	
F2	RY	c	d

32. When the red flowered Antirrhinum plant was crossed with white flowered Antirrhinum plant the F1 offspring had pink flowers Mention (a) the genotype of F1 plant and (b) the reason why it did not bear the parental red or white flowers.

33. The following table shows the genotypes for ABO blood grouping and their phenotypes. Fill in the gaps left in the table.

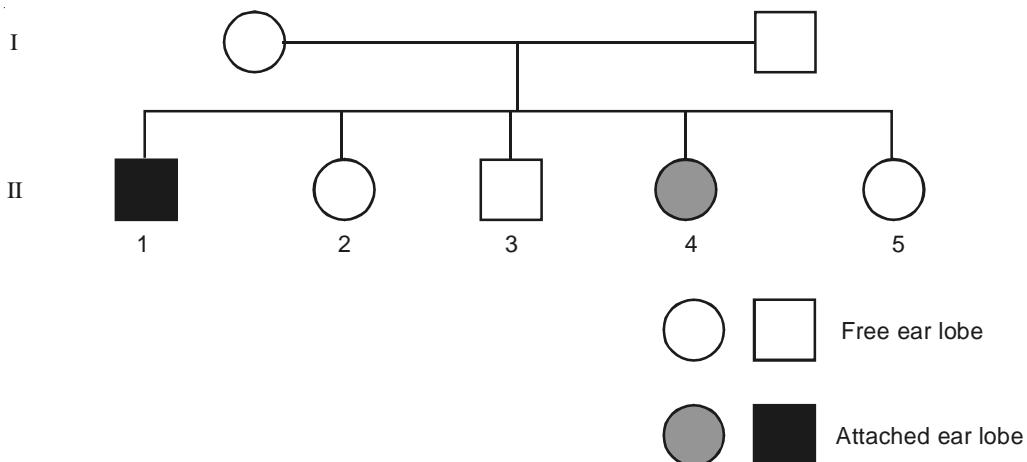
S.No.	Genotype	Blood Group
1.	I <sup>A</sup> I <sup>A</sup>	A
2.	a	A
3.	b	B
4.	I <sup>B</sup> i	B
5.	c	AB
6.	ii	d

- \*34. In the following pedigree Chart state if the trait is autosomal dominant, autosomal recessive or sex linked. Give a reason for your answer.



### SA – I (3 MARKS)

- \*35. Explain parallelism of behaviour of genes and chromosomes.
36. (i) Draw the symbols used to represent the following in human pedigree analysis :  
(a) Male    (b) Affected female  
(c) Mating line                                        (d) Mating between relatives.  
(ii) Give one significance of pedigree analysis.
37. In pea seeds, starch synthesis is controlled by the alleles B and b of a gene. Homozygous dominant produces large starch grains and seeds are round. Homozygous recessive produces small starch grains and seeds are wrinkled. This character shows the phenomenon of incomplete dominance. List the genotypes and phenotypes of F1 generation got on crossing two heterozygotes. Give another example showing this phenomenon.
38. In dogs, barking trait (B) is dominant over the silent trait (b) and erect ears (E) is dominant over drooping ears (e). What will be the expected phenotypic ratio of the offsprings of F1 when dogs heterozygous for both the traits are crossed?
39. In Mendel's breeding experiment on garden pea, the F2 generation yielded offsprings in the ratio of 25% pure yellow pods, 50% hybrid green pods and 25% pure green pods.  
(a) Which pod colour is dominant?  
(b) Write the phenotypes of the individuals of F1 generation.  
(c) Represent the cross.
- \*40. Mention the location of haemophilia gene in humans. This disease normally occurs in males and is very rare in females. Give reason.
41. What are the three possible genotypes and phenotypes observed during the transmission of gene responsible for sickle cell anaemia. Why is it that this disorder is a result of point mutation?
- \*42. Three persons with aneuploidy defects are given below :  
(i) Monosomic female of sex chromosome.  
(ii) Trisomic male of sex chromosome.  
(iii) Trisomic female of autosomal chromosome.  
Identify the disorder with two symptoms of each.
43. Given below is a pedigree chart of a family with 5 children. It shows the inheritance of attached ear lobes as opposed to free ones.



- (a) Give the genotypes of the parents.
- (b) How did you deduce the genotypes of the parents?
- (c) What may be the genotypes of child number 2?
44. A dihybrid heterozygous round yellow seeded garden pea offspring was crossed with double recessive parent.
- Work out the genotype and phenotype of the progeny.
  - Name the type of cross involved here.

### **LA (5 MARKS)**

45. (a) What is the number of alleles that control blood groups in human?
- (b) Which are the possible genotypes and phenotypes in the ABO blood group system?
- (c) Why is the inheritance of blood groups referred to as codominance?

### **ANSWERS**

#### **VSA (1 MARK)**

- Gene
- Allele
- Refer page no. 80 of NCERT book.
- 1 : 1
- Antigen A and antigen B
- Emasculation
- $2^n = 2^2 = 4$  gametes.

8. Presence of 3 copies of a chromosome.
9. Distance between genes.
10. Twenty two pairs.
11. Tightly linked – Low recombination freq.  
Loosely linked – High recombination freq.
12. 75%
13.  $Hb^s$   $Hb^s$
14. Male – XO  
Female – XX
15. Recessive allele.
16. Incomplete dominance; 1 : 2 : 1

### **SA – II (2 MARKS)**

17. (a) allele  
(b) generation of non parental gene combinations  
(c) formation of two different types of gametes in terms of sex chromosomes.  
(d) pedigree analysis.
18. Refer page no. 83 of NCERT book.
19. Females are homogametic – ovum with X chromosome only.  
Males are heterogametic – sperms with X or Y chromosome.  
Male sperms determine the sex of the child.
20. Refer page 82 of NCERT book.
  1. When homologous chromosomes separate, alleles present on them also segregate.
  2. The homologous chromosomes and so the genes present on them move independently of the other and give rise to 4 combinations.
21. Refer page no. 86 of NCERT book (Definition of each and one example of each).
22. Mutation leading to change in a single base pair e.g., Sickle Cell Anaemia.
23. Klinefelter's Syndrome                       XXY chromosome
24.                     *Co-dominance*                             *Incomplete Dominance*

(a) Both the alleles have equal strength of expression.	(a) None of the alleles is completely dominant over the other.
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- (b) Both the traits are expressed in  $F_1$   
e.g.  $I^A$  and  $I^B$  genes in human blood group.
- (b)  $F_1$  does not show either of the parental traits.  
e.g. Flower colour in Snapdragon.

25. Parent  $I^B i \times ii$

Gametes  $\textcircled{I}^B, \textcircled{i}$

	$I^B$	$i$
$i$	$I^Bi$	$ii$
$i$	$I^Bi$	$ii$

The baby belongs to the couple.

Other siblings can be of the phenotypes, B and O blood groups.

26. Refer page no. 90 – 91 of NCERT book.

27. Parents  $Rr \times Rr$

Gametes  $\textcircled{R}, \textcircled{r} \quad \textcircled{R}, \textcircled{r}$

	$R$	$r$
Progeny	$R$	$RR$ $Rr$
$F_1$	$r$	$Rr$ $rr$

Phenotypic ratio  $1 : 2 : 1$

Genotypic ratio  $1 : 2 : 1$

$RR$  = Red

$Rr$  = Pink

$rr$  = White

28. Colour of pod

Dominant – Green

Recessive – Yellow

Position of flower

Dominant – Axillary

Recessive – Terminal

29.  $(\frac{1}{2} T + \frac{1}{2} t)^2 = \frac{1}{4} TT + \frac{1}{2} Tt + \frac{1}{4} tt$

30. a – female b – male c – male d – female

31. a – ry b –  $RrYy$  c –  $Ry$  d –  $rY$

32. (a)  $Rr$ , (b) Shows in Complete dominance

33. a –  $I^A i$                           b –  $I^B I^B$

c –  $I^A I^B$

d – 0

34. Autosomal dominant. Defective trait in both male and female progeny/unaffected child did not pass down the trait.

### SA – 1 (3 MARKS)

35. Refer page no. 81 of NCERT book (Chromosome theory of Inheritance).  
 36. (i) Refer page no. 88 of NCERT book.  
 (ii) Significance – Utilized to trace the inheritance of a specific trait/abnormality.

37. Parents                  Bb                  X                  Bb

Gametes                   B                   b                   B                   b

Progeny

	B	b	
	B	BB	Bb
$F_1$	b	Bb	bb

Phenotypic                  1 : 2 : 1                  Genotypic ratio 1 : 2 : 1

BB = Round                  Bb = Intermediate                  bb = Wrinkled

38. Heterozygous barking dogs with erect ears ( $F_1$  generation Hybrid)

$F_1$  hybrids                  Bb Ee                  X                  Bb Ee

Gametes                   BE                   Be                   bE                   be                   BE                   Be                   bE                   be

Make a cross of hybrid through Punnett square

$F_2$  Phenotypic ratio 9 : 3 : 3 : 1

39. (a) Green pod colour is dominant

(b) Green pod colour

(c) Parents                  GG                  X                  gg

Gametes                   G                   g

$F_1$                   Gg

Gametes                   G                   g                  X                   G                   g

	G	g
F2	GG	Gg
	Gg	gg

Phenotypic ratio 3 : 1      Genotypic ratio 1 : 2 : 1

GG = Pure Green      Gg = Hybrid Green      gg = Pure Yellow

40. Haemophilia gene is located on X chromosome male  $X^h Y \rightarrow$  Sufferer

Females will have to have the recessive allele on both the X chromosome which will be possible only when her father is haemophilic and mother is carrier.

41. Genotypes       $Hb^A Hb^A$        $Hb^A Hb^S$        $Hb^S Hb^S$

Phenotypes      Normal      Carrier      Sufferer

This disease is caused by single base substitution at the 6<sup>th</sup> codon of the beta globin gene from GAG to GUG.

42. (i) Turner's Syndrome      XO

(ii) Klinefelter's Syndrome      XXY

(iii) Down's Syndrome Symptoms – Refer page no. 91 of NCERT book.

43. (a) Aa

(b) Since parents have free ear lobes, 2 of the offsprings have attached ear lobes therefore parents will have to be heterozygous.

(c) AA/Aa

44. Parents      RrYy      X      rryy

Gametes       $\textcircled{R}Y$        $\textcircled{R}y$        $\textcircled{r}Y$        $\textcircled{r}y$

Offsprings      RrYy      Rryy      rrYy      rryy

Phenotype      Round yellow      Round green      wrinkled yellow      Wrinkled green

Ratio      1      1      1      1

### LA - I (3 MARKS)

45. Refer page no. 77 of NCERT book.

# CHAPTER 6

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## MOLECULAR BASIS INHERITANCE

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### POINTS TO REMEMBER

**Anticodon** : A triplet in the t RNA complementary to the codon on m RNA.

**Bioinformatics** : It is a discipline in which database of biological information are created and maintained.

**BAC** : Bacterial Artificial Chromosome.

**Coding Strand** :The DNA strand with  $5' \rightarrow 3'$  polarity which does not code for RNA.

**Cistron** : Segment of DNA coding for a polypeptide.

**Continuous Synthesis of DNA** : DNA strand with polarity  $5' \rightarrow 3'$  where replication is continuous.

**Capping** : Adding of methyl guanosine triphosphate to the  $5'$  end of hn RNA.

**Codon** : A triplet nitrogenous base sequence that specifies a single amino acid present on m RNA.

**Central Dogma** : DNA  $\xrightarrow{\text{Transcription}}$  RNA  $\xrightarrow{\text{Translation}}$  Protein

**Discontinuous Synthesis of DNA** : DNA strand with polarity  $3' \rightarrow 5'$  where replication is discontinuous.

**DNA Polymorphism** : Variation at genetic level which arises due to mutation.

**DNA Ligase** : The enzyme that joins the DNA fragments of the discontinuous strand.

**Expressed Sequence Tags** : Identifying all the genes that are expressed as RNA.

**Euchromatin** : Region of chromatin which is loosely packed and transcriptionally active.

**Frameshift Mutation** : Mutation which causes a change in the reading frame from the point of insertion or deletion of base/bases.

**Histones** : Set of positively charged basic proteins found in DNA.

**Histone Octamer** : Histones organized to form a unit of eight molecules.

**Heterochromatin** : Chromatin that is more densely packed, stains dark and transcriptionally inactive.

**hn RNA** : Heterogenous nuclear RNA; is a precursor of m RNA.

**HGP** : Human Genome Project.

**Intron** : Sequences which do not appear in mature or processed RNA.

**Inducer** : Substrate which regulates switching on of an operon.

**Negative Regulation** : Regulation of operon by repressor protein.

**Nucleosome** : The structure formed by the negatively charged DNA wrapped around positively charged histone octamer.

**Non-histone Chromosomal Proteins** : Set of proteins involved in packaging of chromatin.

**Operon** : Group of genes making up a regulatory or control unit.

**Repetitive DNA** : Small stretch of DNA which is repeated many times.

**Structural Gene** : A gene in a operon that codes for a polypeptide.

**Sequence Annotation** : Sequencing of the whole set of genome that contains all the coding and non-coding sequences and later assigning different regions in the sequence with functions.

**Semiconservative DNA Replication** : After completion of replication, each DNA molecule has one parental and one newly synthesized strand.

**Splicing** : Removal of intron.

**SNPs** : Single Nucleotide Polymorphism.

**Satellite DNA** : Bulk genomic DNA.

**Transcription** : Process of copying genetic information from one strand of the DNA into RNA.

**Template Strand** : The DNA strand with polarity  $3' \rightarrow 5'$  acts as template for RNA synthesis.

**Translation** : Process of polymerization of amino acids to form a polypeptide.

**Transformation** : The phenomenon by which the DNA isolated from one type of a cell, when introduced into another type, is able to express some of the properties of the former into the latter.

**VNTR** : Variable Number Tandem Repeats.

**YAC** : Yeast Artificial Chromosome.

## QUESTIONS

### VSA (1 MARK)

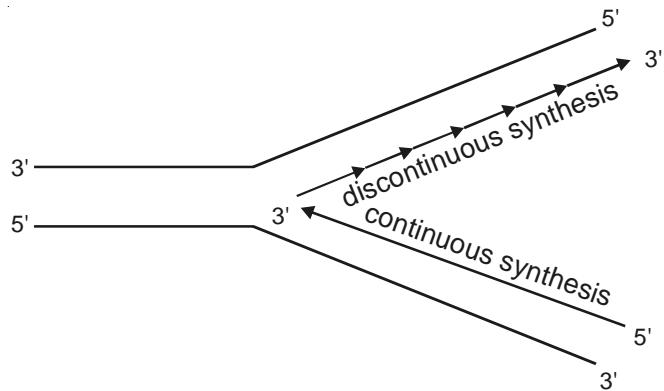
1. Mention the two roles performed by tRNA during translation.
2. Name the bond formed
  - (a) Which links a nitrogenous base to a pentose sugar to form a nucleoside.
  - (b) Which links two nucleotides to form a dinucleotide.
3. What was the name given by Fredrick Meischer to the dense structure in the center of the cell.
4. Name the two amino acid residues in which protein histone is rich.
5. Mention the function of non-histone chromosomal proteins.
6. Give the reason for terming the DNA replication as semi-conservative.

7. Name the main enzyme involved in the process of DNA replication.  
Also specify the direction in which it brings about replication.
8. What is a fully processed hn RNA called? Also expand hn RNA.
9. The codon AUG has dual functions. Specify these two functions.
10. Mention the two major approaches involved in the Human Genome Project.
11. What is the percentage of the human genome that codes for proteins.
12. Expand VNTR.
13. Name the protein found in DNA. Also mention the charge on it.
14. Name the cellular factory responsible for synthesis of proteins.
15. What is a cistron?

### **SA – II (2 MARKS)**

16. In which two aspects does the structure of an RNA nucleotide differ from a DNA nucleotide?
17. Work out the percentage of guanine in a double stranded DNA containing 15% adenine.
- \*18. If the length of E coli DNA is 1.36 mm, calculate the number of base pairs it contains?
19. The sequence of one strand of DNA is given 5' CATTGCGCAATG 3' Write down the sequence of its complimentary strand in the 3' – 5' direction.
20. Represent the central dogma.
- \*21. Give two reasons as to why both the strands of DNA do not participate in RNA synthesis?
22. A hypothetical sequence from a DNA strand is represented below :  
3' ATGCATGCATGCATGCTA 5' template strand.  
5' TACGTACGTACGTACGAT 3' coding stand.
  - (a) Which of the strands will transcribe.
  - (b) Write the sequence of RNA transcribed from the above DNA.
23. The genes in eukaryotes are split. Name the terms given to the coding sequence and to the non-coding sequence of a gene.
24. Gene expression results in the formation of a polypeptide and can be regulated at several levels. Specify the levels at which regulation can occur in eukaryotes.
25. Differentiate between euchromatin and heterochromatin.
26. List four criteria, a molecule must fulfil to act as a genetic material.

27. 'DNA' is a better genetic material as compared to "RNA". Justify the statement citing reasons for the same.
28. A replication fork is represented. Draw the newly synthesized strands specifying continuous and discontinuous strands.



29. Differentiate between codon and anticodon.
- \*30. A hypothetical codon sequence is given as CACAAGCCA.
- Now if A base a gets added between the two As, what will now be the codon sequence.
  - What is this condition referred to As?

31. Differentiate between repetitive DNA and satellite DNA.
32. Complete the blanks o the basis of Frederick Griffith's Experiment.

S strain \_\_\_\_\_ inject into mice \_\_\_\_\_ a

R strain \_\_\_\_\_ inject into mice \_\_\_\_\_ b

S strain \_\_\_\_\_ inject into mice \_\_\_\_\_ c

(heat killed)

S strain (heat killed) + \_\_\_\_\_ inject into mice \_\_\_\_\_ d

+

R strain (live)

- \*33. State two reasons to explain why RNA viruses mutate and evolve faster than other viruses.
- \*34. Draw schematically, a single polynucleotide strand (with 3 nucleotides). Prove labels and directions.
- \*35. Given below is sequence of steps of transcription in a eukaryotic cells. Fill up the blanks in the sequence.

5' methylguanosine triphosphate

Enzyme 1

RNA Splicing

DNA \_\_\_\_\_ 2

RNA \_\_\_\_\_ 3

RNA \_\_\_\_\_ 4

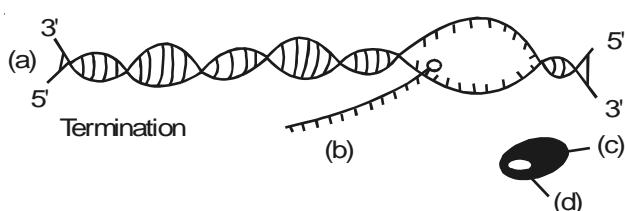
36. Draw the structure of RNA adapter molecule for codon UAC on mRNA.
37. Why is it that the distance between polynucleotide chains in DNA is almost constant?
38. Certain molecular processes are given in column (A). Provide the terms to these processes in column (B).

*Column A*

*Column B*

- (i) Activation of Amino acid and linking to their cognate rRNA
  - (ii) Removal of introns from hnRNA
  - (iii) Repressor Protein
- +
- Operator \_\_\_\_\_ No transcription
- (iv) DNA \_\_\_\_\_ DNA

- \*39. The process of Termination during Transcription in a bacterial cell is being represented here. Label the parts a, b, c, d.



### SA – I (3 MARKS)

40. The length of a DNA helix is far greater than the dimension of a typical nucleus. Explain how a DNA polymer is packaged in a cell?
41. Name the three major types of RNAs, specifying the functions each plays during translation.
42. Explain the processes of splicing, capping and tailing in terms of transcription.
43. List six important goals of Human Genome Project.
44. What are R cells and S cells with which Fredrick Griffith carried out his experiments on *Streptococcus pneumoniae*. Mention the conclusion, he arrived at from this experiment.
45. Illustrate schematically the process of initiation, elongation and termination during transcription of a gene in a bacterium.

### LA (5 MARKS)

46. Write the salient features of the double helical structure of DNA. Also represent the polynucleotide chain diagrammatically.

47. What are the components of an operon? Explain how the operator switch is turned on and off in *lac operon*.
48. Give an account of Hershey and Chase experiment proving that DNA and not the protein coat of a virus is the infecting agent.
49. Briefly describe the mechanism of DNA replication.
50. Describe the process of transcription.
51. Describe in brief the process of translation.
52. Describe the process of DNA finger printing.

## ANSWERS

### VSA (1 MARK)

1. Structural role and catalytic role (transfer of amino acid)
2. (a) N – glycosidic linkage  
(b) 3' – 5' phosphodiester linkage
3. Nuclein
4. Lysine and Arginine.
5. Packaging of chromatin.
6. After replication, each DNA molecule has one parental type and one newly synthesized strand.
7. DNA polymerase 5' – 3' direction.
8. m RNA Heterogenous Nuclear Ribose Nuclei Acid.
9. It codes for methionine Acts as initiation codon
10. Expressed Sequence Tags (ESTs) Sequence Annotation.
11. Less than 2%.
12. Variable Number Tandem Repeat.
13. Histone Positively charged.
14. Ribosome.
15. Segment of DNA coding for a polypeptide.

### SA – II (2 MARKS)

16. Has additional – OH group at 2' position in ribose sugar.  
Uracil is present in place of thymine.

17. 35%
18. Distance between two base pairs =  $0.34 \times 10^{-9}$  m.  
 Length = Total no. of base pairs  $\times$  distance between two consecutive base pairs.  
 $1.36 \times 10^{-3}$  m = No. of b p  $\times$   $0.34 \times 10^{-9}$  m  

$$\text{No. of b p} = \frac{1.36 \times 10^{-3}}{0.34 \times 10^{-9}} = \frac{136}{34} = 4 \times 10^6 \text{ b p}$$
19. 3' GTAACGCGTTAC 5'
20. Refer page no. 98 NCERT book.
21. Refer SUb topic 6.5 page no. 107 NCERT book.
22. (a) Template strand  
 (b) UACGUACGUACGUAGGAU
23. Coding – Exon      Non-coding – Intron
24. Refer page no. 115 NCERT book.
25. *Euchromatin*                          *Heterochromatin*  
 (i) Chromatin is loosely packed and stains light.      (i) Chromatin is densely packed and stains dark.  
 (ii) Transcriptionally active.                          (ii) Transcriptionally inactive.
26. Refer page no. 105 Sec. 6.8 NCERT book.
27. RNA has 2'-OH group making it labile and easily degradable (unstable) RNA is a catalyst, so reactive while DNA is less reactive and more stable. DNA mutates at a slow rate than RNA.
28. Refer page 107 Fig. 6.8 NCERT book.
29. Codon : Is a triplet of nitrogenous base which codes for an amino acid. It lies on the m RNA.  
 Anticodon : Is a triplet nitrogenous base on the t RNA complimentary to an m RNA codon. It identifies a particular codon on m RNA.
30. (a) CACAAAGCCA  
 Frame shift mutation.
31. Repetitive DNA : It is a small stretch of DNA which is repeated many times.  
 Satellite DNA : The bulk of DNA that forms a major peak and many small peaks is called S-DNA. It may be micro and macro satellite and forms large part of human genome.
32. (a) mice die  
 (b) mice live

- (c) mice live
  - (d) mice die.
33. RNA being unstable mutate faster/2 -OH group present which is a reactive group/RNA more catalytic, hence reactive (Any two).
34. Fig. 6.1 page 96 NCERT book.
35. 1 – RNA Polymerase 2 – hn 3 – m 4 – polatail.
36. Fig. 6.12 (a) page 114 NCERT.
37. Always a Purine comes opposite to a Pyrimidine base which are bonded by H – Bonds generating uniform distance between the two strands of the helix.
38. (i) Aminoacylation of tRNA                                  (ii) Splicing  
(iii) Gene regulation    (iv) Replication.
39. (a) DNA strand    (b) RNA  
(c) RNA Polymerase    (d) RHO Factor.

### **SA – I (3 MARKS)**

40. Refer sub topic packaging of DNA helix page no. 99 NCERT book.
41. Refer page no. 109 NCERT book.
42. Refer page no. 111 NCERT book.
43. Refer page no. 118 NCERT book.
44. Refer page no. 100 NCERT book.
45. Fig. 6.10 page 109 NCERT book.

### **LA (5 MARKS)**

46. Refer page no. 96 – 97, figure 6.2 NCERT book.
47. Refer page no. 116 – 117, figure 6.14 NCERT book.
48. Refer page no. 101 – 102 NCERT book.
49. Refer page no. 106 – 107 NCERT book.
50. Refer page no. 107 – 108, figure no. 6.9 NCERT book.
51. Refer page no. 114 – 115 NCERT book
52. Refer page no. 122 NCERT book.

# CHAPTER 7

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# EVOLUTION

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## POINTS TO REMEMBER

**Adaptive Radiation :** Process of evolution of different species in a given geographical area starting from common point and radiating to other areas of geography/habitats. It helps in divergent evolution.

**Analogous Organs :** The organs which have the same functions but are quite different in fundamental structure and embryonic origin e.g.. Wings of insect, bird and bat.

**Abiogenesis :** Life arising from nonliving molecules.

**Biogenesis :** Life arising from living molecules.

**Convergent Evolution :** Form of evolutionary change leading to acquiring similar adaptations for survival in similar habitats.

**Divergent Evolution :** Development of different functional structures from a common ancestral form according to their adaptive value.

**Evolutionary Biology :** It is the study of history of life forms on earth.

**Fossil :** Impression or remains of body parts of organisms of distant past. Which have escaped the process of decay and decomposition.

**Founder's Effect :** A genetic drift in human population where a population in a new settlement have different gene frequency from that of the parent population. The original drifted population becomes founder.

**Gene Pool :** Total genes and their alleles of a species in a population.

**Genetic Drift :** Chance elimination of genes of certain traits from a population due to migration or death.

**Homologous Organs :** The organs of different species of common descent which perform different functions but have similar basic structure and embryonic origin.

**Panspermia :** Units of life in the form of so called spores, which were transferred to earth from outer space.

**Natural Selection :** The selection of individuals with favorable/useful variations by nature.

**Saltation :** Single step large mutation.

## **QUESTIONS**

### **VSA (1 MARK)**

1. For a long time, it was believed that life came out of dead and rotting matter. What is this theory known as? Name the scientist who experimentally disproved this theory.
2. Out of homology and analogy, mention which one is based on convergent evolution and which one is based on divergent evolution.
3. Give two examples of evolution by anthropogenic action.
4. Mention the two key concepts of Darwinian theory of evolution.
5. Variations are required for evolution. In what aspect is the Darwinian variation different from variations reported by Hugo de Vries?
6. In what aspect are the reptilian eggs different from the amphibian eggs?
7. Evolution of early forms of life occurred in water. Name an animal which is believed to have evolved into amphibians that lived both on land and water.
8. Name the first human like creature which appeared on earth. Also write its brain capacity.
9. Thorns of *Bougainvillea* and tendrils of *Cucurbita* are homologous organs. Give one reason in support of your answer.
10. Which era is called the age of reptiles?

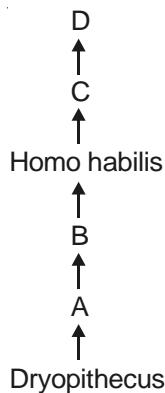
### **SA – II (2 MARKS)**

11. Given below are the names of two pairs of appendages. Categorise them into homologous and analogous organs giving reasons :
  1. Bat's wings and grasshopper's wings
  2. Human arm and forelimbs of cheetah.
12. (a) Name the most accepted theory of origin of universe.  
(b) How was water formed initially?  
(c) When did the first forms of life appear on earth?
13. Some people use the terms 'origin' and 'evolution' of life synonymously. How will you correct them?
14. (a) State the hypothesis put forward by Oparin and Haldane.  
(b) Mention the conditions present on the primitive earth.
15. Darwin used the term 'fitness of individual and population.' Fitness in what respect is he referring to and what is its implication?

16. State which of the following are homologous and which are analogous organs :
- Potato tuber and phylloclade of Opuntia.
  - Edible part of apple and mango.
  - Tail of chameleon and hand of man.
  - Fish scale and snail shell.
17. A gaint squirrel *Ratufa indica* occurs along the west coast. The population living in Gujarat (dry deciduous forests) has yellow fur, population from Maharashtra (moist deciduous forests) has light brown fur; that from Mysore (semi-evergreen forests) deep brown and form Kerala (wet evergreen forests) chocolate brown fur.  
Account for the differences in their fur colour.
18. Arrange the following in the chronological sequence of evolution;  
*Homo habilis*, *Homo sapiens*, *Homo erectus*, *Ramapithecus*.
19. Few gaps have been left in the following table showing certain terms and their meaning. Fill up the gaps.

Terms	Meaning
(i) a	Single step large mutation
(ii) Gene pool	b
(iii) c	The selection of individuals with favourable variations by nature.
(iv) Adaptive radiation	d

20. Complete the flow chart of human evolution.



21. Evolution of placental mammals and Australian marsupials are an excellent example of convergent evolution. Fill in the gaps with correct equivalents.

<i>Placental Mammals</i>	<i>Australian Mammals</i>
1. Lemur	A
2. B	Tasmanian tiger cat
3. C	Flying phalanger
4. Anteater	D

### **SA – I (3 MARKS)**

22. Diagrammatically represent SL Miller's experiment.
23. Discuss the significance of palaeontological evidence of evolution.
24. 'Industrial melanism in peppered moth is an excellent example of "natural selection." Justify the statement.
25. What is adaptive radiation? Explain taking one example.
26. Explain the presence of long neck in giraffe through natural selection. How does it differ from Lamarckian interpretation?
27. (i) State the Hardy – Weinberg Principle.  
(ii) According to this principle, what is the sum total of all allelic frequencies.  
(iii) When there is a disturbance in the Hardy – Weinberg equilibrium, what would it result in?  
(iv) List the five factors which affect Hardy – Weinberg equilibrium.
28. State in what ways Stanley Miller simulated the conditions of :  
(i) Primitive atmosphere of earth.  
(ii) Energy source at the time of origin of life.  
(iii) Formation of organic molecules of life to prove the theory of chemical evolution.
29. Rearrange the following group of plants in a ascending evolutionary scale :  
Rhynia like plants, cycads, monocotyledons, gnetales, chlorophyte ancestors, Dicotyledons.

### **LA (5 MARKS)**

30. Natural selection is an agent of evolution due to which populations adapt to their immediate environment. Explain the three types of natural selection along with their diagrammatic representation.
31. Trace the origin and evolution of man.

## **ANSWERS**

### **VSA (1 MARK)**

1. Spontaneous generation theory.  
Louis Pasteur.
2. Homology – Divergent evolution  
Analogy – Convergent evolution
3. Antibiotic resistant microbes.  
DDT resistant mosquitoes.
4. Branching descent Natural selection.
5. Darwinian variations are small and directional.  
Hugo de Vries variations are sudden and directionless caused due to large mutation.
6. Reptiles lay thick shelled eggs which don't dry up in sun like those of the amphibians.
7. Lobe finned fish (Latimaria)
8. Homo habilis 650–800 cc.
9. Both are modifications of stem (axillary bud).
10. Mesozoic era.

### **SA – II (2 MARKS)**

11. Analogous organs – same function but different origin and development plan.  
Homologous organs – same origin and development but different functions.
12. Big bang theory.  
Oxygen combined with ammonia and methane to form water. 4 billion years ago.
13. Origin of life means how the primitive forms of life came into existence. Evolution of life means how primitive forms of life evolved into complex forms.
14. Formation of life preceded by chemical evolution.  
High temperature, volcanic eruptions, reducing atmosphere with  $\text{CH}_4$ ,  $\text{NH}_3$  gases.
15. Reproductive fitness.  
Those who are better Fit in an environment leave more progeny than others.
16. Homologous – (a) only \*Analogous – (b), (c) and (d)

17. The different fur coat provide better survival capacities to the squirrels as provides camouflage; divergent evolution/adaptive radiation.
18. Ramapithecus → Homo habilis → Homo erectus → Homo sapiens.
19. (a) Saltation  
(b) Total genes and their alleles of a species in a population.  
(c) Natural selection.  
(d) The process of evolution of different species in a given geographical area starting from a point and radiating to other areas.
20. (a) Ramapithecus  
(b) Australopithecus  
(c) Homo eructus  
(d) Homo Sapeins
21. (a) Spotted cuscus  
(b) Bobcat  
(c) Flying Squirrel  
(d) Numbat

### **SA – I (3 MARKS)**

22. Refer figure 7.1 page no.128 NCERT book.
23. Fossils of lower strata are primitive where as upper strata of sedimentary rocks have complex group of organisms.  
Fossil records show that life forms varied over time and certain forms of life have arisen at different times in the history of earth.
24. Refer page no. 131 – 132 NCERT book.
25. Define – (See points to remember).  
Example – Marsupials or placental mammals in Australia or Darwin finches Refer page no. 133 NCERT book.
26. Lamarckian – use and disuse of organs (neck and legs); more use = more developed organ.  
Darwinian – Natural selection – Giraffes with longer neck had selective advantage over ones with short neck, when there was scarcity of food, short neck giraffes starved while long neck giraffes survived and propagated due to selection of useful variation by nature.
27. (i) The allelic frequencies in a population are stable and is constant from generation to generation.

(ii) One

(iii) Evolution

Gene migration; genetic drift, mutation, genetic recombination and natural selection.

28. (i) Closed flask containing  $\text{NH}_3$ ,  $\text{CH}_4$ ,  $\text{H}_2$  and water vapour to simulate primitive atmosphere on earth.  
(ii) Electric discharge  
(iii) Formation of compounds like aminoacids from simple molecules like  $\text{NH}_3$ ,  $\text{CH}_4$ ,  $\text{H}_2$ .
29. Chlorophyte ancestors .... Rhynia like plants .... Cycads... Gnetales.... Dicotyledone .... Monocotyledone.

### LA (5 MARKS)

30. Stabilising natural selection

Directional natural selection

Disruptive natural selection

Refer page no. 136 NCERT book.

31. Refer page 140-141 NECRT book.

## CHAPTER 8

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# HUMAN HEALTH AND DISEASE

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### POINTS TO REMEMBER

**AIDS :** Acquired Immuno Deficiency Syndrome. A condition when body loses immunity against pathogens due to gene mutation caused by HIV Drastic reduction in T-helper lymphocytes.

**Antigens :** A class of substance which stimulates production of antibodies. They are always non self substances. Attenuated or weak antigens are given in vaccination to produce antibodies (immunity) in an individual.

**Antibodies :** Glycoproteins (Immunoglobulins) produced by B-lymphocyte cells in blood counteract the toxins or antigen of pathogens. They are produced quickly when cells come in contact with specific antigen.

**Antibiotics :** Group of chemical substances (medicine) derived from micro-organisms and used against other pathogenic micro-organisms e.g.. Penicillin and streptomycin.

**Active Immunity :** Immunity produced by an individual after undergoing primary immune response. It is specific. It generates memory cells for future. Its generation takes longer time e.g.. against cholera, polio, small pox, chicken pox etc.

**Acquired Immunity :** Immunity specific to a pathogen is acquired by an individual after birth. It is stored in memory cells. It activates as primary immune response and continue as secondary immune response.

**Amoebiasis :** Dysentery (quick, repeated defecation) due to secretion by protozoa Entamoeba histolytica. It is an intestinal disease.

**Anamnestic (Secondary) Response :** After primary immune response, subsequent encounters show vigorous secondary immune response to the same pathogen (antigen) due to active role of memory cells. Rate of proliferation of antibodies and lymphocyte cells is very fast.

**Anaphylaxis :** Rapidly developing reverse allergic reaction that may occur in all tissues.

**Allergy :** A hypersensitive response to an antigen which shows unwanted symptoms like redness, rashes, itching, watering of eyes, regular sneezing and asthma etc. It is caused in response to an allergen. Chemical like histamine from mast cells cause it and anti-allergic chemicals control it.

**Allergen :** A non-self substance which induces allergy is called allergen. No fixed list of allergens like pollen, dust, penicillin, onion juice, smoke, cold etc.

**Auto Immunity :** A diseased condition when immunity of oneself goes off the track and damage own normal cells/tissues/organs of the body. Own immunity against self tissue e.g.. Rheumatoid arthritis.

**Biopsy :** Examination of a living tissue after being cultured to discover the cause/presence/extent of cancer.

**B-lymphocytes** : A type of agranular leucocytes (WBC) produced and matured in bone marrow and take part in humoral immunity by producing antibodies.

**Benign Tumor** : Cancerous growth in the state of non proliferation or non growing cancer.

**Constipation** : A condition of the bowels, in which faeces become dry and hardened and their evacuation is difficult. It is due to deficiency of water in the body.

**Cell mediated Immunity** : Immunity of an individual by certain WBC not producing antibodies. They provide defence in different way-phagocyte, helper T-cells and T-lymphocytes etc.

**Colostrum** : After child birth in mammals and during initial days of lactation, mother produces concentrated yellowish milk which contains abundant antibodies (passive immunity).

**Congenital Disease** : Disease which is present at birth. They are genetic and the allele is heritable.

**Contact Inhibition** : Contact between the cells inhibit (check) mitosis. When contact is lost, division becomes uncontrolled.

**Carcinogens** : Cancer causing agents. They may be physical or chemical agents like gamma rays. UV rays, cosmic radiations, soot and lead compounds.

**Cannabinoids** : An addictive drug derived from hemp plant. Its products are hashish, charas, ganja, marijuana and bhang etc.

**Eradication** : Elimination of a disease completely from that area e.g.. eradication of small pox India, polio eradication program.

**Elisa** : Enzyme Linked immunosorbent Assay' test used for detecting HIV infection and certain other infections. The test is based on antigen-antibody reaction catalysed by specific enzyme.

**HIV** : Human Immuno Deficiency Virus.

**H<sub>2</sub>L<sub>2</sub> of Antibody** : Two pairs of chains of an antibody molecule, one pair light chain and one pair heavy. Antigen binding sites are formed in them during primary immune response.

**Haplotype** : A set of linked gene on a homologue that tend to be inherited together e.g. A.B & C loci at the human HLA complex on chromosome no. 6.

**Humoral Immunity** : Immunity of an individual with the help of antibody chemical. Immunity response is given by antibodies produced by B-lymphocytes.

**HLA** : Human Leukocyte Antigen

**Immunity** : Resistance to infection or non-self substance (antigen).

**Infectious Disease** : A disease which spreads by agents like air, food, touch and articles of common use.

**Inflammation** : Response of body tissue to injury or infection characterized by six main symptoms-heat, swelling, redness, pain, vasodilation and increased capillary permeability.

**Insecticide** : Chemicals which kill or restrict growth of insects especially pests, parasites etc.

**Innate Immunity** : Immunity present at the time of birth. Provided by the parent to the child and is heritable. It acts like barrier to the pathogens.

**Interferon** : Small proteins produced by viral infected cell of vertebrates and carry message to non-infected neighbouring cells to prepare themselves for inhibiting viral multiplication. A type of innate immunity.

**Immuno-Suppressant** : A chemical (medicine) which suppresses the immunity response to antigen partially or completely.

**Lysozyme** : Enzyme that destroy the cell walls of many bacteria.

**Lymphoid Organs** : Organs of the body where white blood cells (WBC) are produced, mature, store and perform work. They are of two types (1) Primary-bone marrow and thymus gland (2) Secondary-spleen, tonsils, lymph nodes, peyer's patches and MALT lining.

**Malignant Tumor** : Type of cancer in which tumor is active and enlarge and can spread to other parts of the body through blood

**Metastasis** : A condition when malignant tumor cells spread to distant part of the body through blood.

**Mucosal Associated lymphoid Tissue (MALT)** : Lymphoid tissue lining the respiratory, digestive and urino-genital tracts which produce immunity. It is about 50% of the whole immunity.

**Oncogenes** : Viral genome which causes cancer. After viral infection, host genome goes off the track and cells become cancerous.

**Opioids** : An addictive drug resembling cocaine and morphine in its addictive physiological effects e.g., Heroin or smack. Taken by snorting or injection.

**Organ Transplant** : Organ of a suitable donor is grafted into the body of receiver it elicits immune response but the immunity is suppressed for a long time (life long) for the success of organ transplant e.g.. Eye, heart and liver transplant.

**Passive Immunity** : Immunity (antibody) produced by organism but used by another organism after inoculation. Its effect is quick bit remain for short period e.g., From mother to foetus through colostrum and milk.

**Pathogen** : An agent which causes a disease. They are microorganisms like virus, bacteria, fungi, protozoa or helminth.

**Primary Immune Response** : Defensive response of the body to an antigen when body encounters the antigen for the first time. It is always a weak response.

**Retrovirus** : A virus having RNA as genetic material. After entering into host cell, it forms DNA by reverse transcription and then replicate e.g., HIV.

**Reverse Transcriptase** : Enzyme which forms DNA from RNA (template) in retrovirus (RNA virus).

**SCID** : Severe combined Immunodeficiency

**Sporozoites** : The infective stage of protozoa *Plasmodium* which is injected into human blood through saliva of female *Anopheles* mosquito while biting.

**Syndrome** : Collection of disease symptoms responsible for genetic disorder.

**T-Lymphocytes** : A type of agranular leucocytes (WBC) which are matured in thymus gland and take part in cell mediated immunity.

**Tissue Typing** : The procedure carried out to match HLA proteins of donor and recipient.

**Vaccine** : Inactivated/weakened. Dead pathogens used for vaccination.

**Vaccination** : Inoculation of a vaccine to stimulate production of antibodies and provide immunity for one or more disease.

**Withdrawal Symptoms** : If a drug is abruptly discontinued to an addict, he/she undergoes unpleasant reaction symptoms e.g., Anxiety, shakiness, nausea and sweating etc.

## QUESTIONS

### VSA (1 MARK)

1. A body is physically fit and without any mental tension but a psychologist calls him sick. What type of illness does the boy have?
2. At what stage of malignant cancer, the cells proliferate and move to other parts of the body.
3. A protist pathogen enters the alimentary canal along with food. Write the preventive barriers, it has to resist in the stomach.
4. Which test is administered to test the presence of typhoid bacteria?
5. A patient is suffering from bouts of shivering and high fever. The pathogen of the disease depends on haemoglobin for growth. Name the disease, patient is suffering from and the pathogen.
6. Write one morphological symptom you anticipate in a person suffering from filaria. Name the vector of its pathogen.
7. Colostrum is said to be very useful for new born infant. Write its importance.
8. Which type of antibodies are related with (a) Allergy (b) colostrum
9. Name the type of immunity of vertebrates when it attaches self body tissue and damage them  
Write one example of such disease.
10. Write the role and example of one physical carcinogen.
11. A plant provides many drugs of addiction. One of the products is smack. Name the plant and mode of effect of this drug.
12. Which organ is principally affected by almost all drugs and alcohol?
13. Why do we call morphine as drug of medicine as well as drug of abuse?
14. Which group of virus does AIDS causing HIV belong to?
15. By what method coke (drug of abuse) or crack is taken in by a drug addict?
16. Expand CMIS, AMIS.
17. How is immunity and lymph system linked with each other?
18. Expand MALT. Give its role.

### **S.A. – II (2 MARKS)**

19. Modern lifestyle leads us towards lethargic, unhealthy body. Suggest four ways to attain good physical and mental health.
20. Name two organs where defence cells are matured and two organs where they perform action.
21. Distinguish between benign tumor and malignant tumor.
22. To prevent spread of infectious diseases, public hygiene, measures are also necessary. What are these public hygiene measures?
23. Innate immunity has four type of barriers. Name the physiological barrier components which prevent microbial growth.
24. Write the principle of vaccination, on which active immunity works.
25. Early detection of cancer is helpful for its cure. Write various detection techniques.
26. Which plant parts are used for extracting cannabinoids? Write the modes by which they are taken in.
27. If a drug is not made available to an addict, he shows withdrawal symptoms. Write two such symptoms.
28. Write four major methods of taking drugs by an addict.
29. Fill in the blanks in the different columns of the table below :

Disease	Causal Organism	Mode of transmission/carrier	Symptoms
1. Typhoid	.....	.....	Sustained high fever, fatigue, Headache, stomach perforations
2. .....	Streptococcus pneumoniae	.....	Alveoli filled with water, reduced breathing, fever, chills, cough
3. .....	.....	bite of female mosquito	Show chronic inflammation of organs, lymph inflammation of organs, lymph vessels of lower limbs swell.
4. Ringworm	.....	.....	Dry Scaly lesions on various body parts, intense itching, redness.

30. Define the term addiction and drug dependence.
31. How does HIV results in reduced immunity.

### **SA – I (3 MARKS)**

33. AID is transmitted from mother to the foetus through placenta in the womb then why do we call it non-congenital or acquired disease.

34. A man lives with his wife happily who is an AIDS patient. What precautions are they possibly taking so the husband is safe from the dreaded disease. Mention other ways by which this female can transmit HIV to other members.
35. Draw labeled diagram of an antibody molecule.
36. One uncle of yours is alcoholic. Some harmful effects can be seen. Write the symptoms you look at and suggest ways to overcome this addiction.
37. The lymphocytes are of two types *i.e.*, B and T. Give the reason of this nomenclature. Which type of immunity they belong to? What is their role when organ transplant is done on a person?
38. Distinguish between active and passive immunity.
39. Distinguish between primary immune response and secondary immune response.
40. Make a labelled flow chart to show of malarial parasite in human and female Anopheles mosquito.
41. A person shows strong unwelcome immunogenic reactions while exposed to certain substance. Name this condition and common term for such substance. Give two such substances and two symptoms. Name the lymphocytes responsible for such reactions.
42. What are the three main factors which affect health of a person?

### **LA (5 MARKS)**

43. Mention 5 reasons why adolescents tend towards drug addiction and alcoholism. Suggest 5 methods to overcome this menace.
44. Write causes, methods of detection and treatment of cancer.
45. Write five major groups of pathogens responsible for common human diseases. Taking one example from each group, describe the causal organism, one symptom and one control measure or treatment.
46. How HIV infects human body.

### **ANSWERS**

#### **VAS (1 MARK)**

1. Behavioural or social misadjustment
2. Metastasis
3. Low pH or HCl effect  
Effect of digestive enzymes
4. Widal test                                  *Plasmodium vivax*
5. Malaria

6. Elephant like swollen leg  
Female Culex mosquito
7. Mother provides passive immunity (antibody IgA) to infant through colostrum.
8. (a) Ig E                    (b) Ig A
9. Autoimmunity  
Rheumatoid arthritis
10. Role-Acts as agent for causing cancer.  
Example-X-ray/, UV ray/cosmic radiations/gamma rays.
11. Poppy or Opium – *Papaver somniferum*  
Depressant
12. Brain
13. Drug of medicine- If prescribed by physician and for a limited time as sedative (pain killer)  
Drug of abuse-If taken for non-medical use and in high amount and at regular frequency.
14. Retrovirus of RNA virus.
15. By snorting
16. Cell mediated Immune System, Antibody mediated Immune system.
17. Immunity occurred due to maturity of WBCs and differentiation and transported through lymph system.
18. MALT – Mucosal Associated Lymphoid Tissue provide immunity along major tracts.

### **SA – II (2 MARKS)**

19. (1) Balanced diet                    (2) Personal hygiene  
(3) Regular exercise                    (4) Yoga
20. Bone marrow and thymus gland  
Tonsils and lymph nodes
- 21.

<i>Benign tumor</i>	<i>Malignant tumor</i>
1. Confined to original location and not spread	Spread to neighbouring as well as far off place
2. No proliferation of cells.	Cancerous cells proliferate fast.
3. Cause little damage.	Can be fatal.

22. Proper disposal of wastes and excreta.

Periodic cleaning and disinfection of water reservoir.

Standard practice of hygiene in public catering.

Control and elimination of vectors and breeding places.

23. Saliva in mouth

Enzyme in tear and sweat

24. Weakened/inactivated pathogens or antigens are inoculated in the body.

Body develops immunity (humoral/cell mediated) against antigen.

Antigens are destroyed by primary response and memory cells remain there for secondary response to counteract.

Memory cells give quick and massive response of producing antibodies.

25. Tissue biopsy.

Radiography (x-Ray or CT-scan)

MRI (magnetic resonance imaging)

WBC count for leukemia (blood cancer)

26. Inflorescence, flower top, leaves and resin of the plant hemp, Cannabis.

27. Symptoms.

Anxiety, shakiness, nausea and sweating

Deaddiction is the reduction in the dependence of drug slowly and regularly.

28. Intravenous injection

Snorting

Oral consumption

Smoking

29. 1. *Salmonella typhi* (bacteria) contaminated food/water/house fly

2. Pneumonia Droplet infection via coughing, sneezing.

3. Filariasis, elephantiasis, *Wuchereria bancrofti*

4. *Microsporum trichophyton*, *Epidermophyton*, contaminated, soil, clothes, comb.

30. Addiction-psychological attachment.

Drug dependence-manifestation of unpleasant withdrawal symptoms when the drug is abruptly discontinued.

31. HIV destroys CD-4 (helper T-lymphocytes) so CMIS is not able to activate.

### **SA – I (3 MARKS)**

33. Biological birth starts at zygote formation.

Infections acquired after zygote formation do not belong to the category of congenital disease.

Its defective gene is not inherited from parent as that happens to be in congenital disease.

34. Use of condom

Her blood donated to a needy person.

Pregnant mother to her foetus.

Use of injection needle or syringe used by her.

35. Refer fig. No. 4 page no. 151 of NECRT book.

36. Loss of judgement and emotional control, visual problems, antisocial behaviour, incoherent speech.

Peptic ulcer and gastritis-excess secretion of HCl.

Cirrhosis of liver (hard and dry liver)

Increased deposition of fat on walls of blood vessels and high blood pressure

deaddiction-Identify reasons of addiction and then take remedial measures

provide counseling by professional person.

Medical help.

37. B-lymphocytes mature in bone marrow.

T-lymphocytes mature in thymus gland

B-lymphocytes belong to humoral immunity.

Their role is to reject graft working against non-self component of the organ.

- 38.

<i>Active Immunity</i>	<i>Passive Immunity</i>
1. One cells produce it.	Produced in another organism's body
2. Slow in production and action.	Fast in action (immediate relief)
3. Remain active for long.	Short lived.
4. No side effects	It may cause side effects.
5. e.g., Pox and Polio	e.g., Rabies and Snake venom

39.

<i>Primary Immune Response</i>	<i>Secondary Immune Response</i>
1. Generated at first encounter	Generated on 2 <sup>nd</sup> and afterward encounters.
2. Slow therefore takes more time.	Faster therefore takes less time
3. Weak response.	Strong response.
4. Absence of memory cells.	Memory cells present.
5. Lasts for short duration	Lasts for longer duration.
6. Antigen through vaccination or antigen.	Always natural pathogen as natural pathogen.

40. Refer figure no. 8.1 Page no. 148 of NCERT book.

41. Allergy

Allergen

Continuous sneezing/ eye watering

Mast cells

42. Genetic disorders

Infections

Life style of the person

### LA (5 MARKS)

43.

<i>Tend towards drug</i>	<i>Preventive measures</i>
1. Peer pressure	Avoid undue peer pressure.
2. Curiosity	Seeking professional and medical help.
3. Escape from frustration and failure.	Identify the reason and remedial measures.
4. Family history.	Proper education and counseling.
5. False belief of enhanced performance.	Helpful support from parents, teachers and trusted friends.

44. **Causes** Physical carcinogens like radiations

Chemical Carcinogens like nicotine etc.

Biological Carcinogens like viral oncogenes.

**Detection** Microscopic biopsy after culture of sucogenes.

Blood test for leuxemia (WBC count)

Radiography (x ray and CT scan)

**Treatment** Radiotherapy-focussed radiation

Chemotherapy-use of drugs

Immunotherapy (Antibodies)

45.

1. Virus	HIV	AIDS
2. Bacteria	Streptococcus pneumoniae	Pneumonia
3. Protista	Microsporum vivax	Malaria
4. Fungi	Microsporum	Ringworm
5. Helminths	Wucheraria	Elephant Leg

Refer page 146 (8.1) of NECRT book

46. As under :

1. HIV (Human Immune Deficiency Virus-retrovirus) attacks a macrophage, its genomic RNA enters the host cell.
2. Genomic RNA forms its complimentary DNA in the presence of enzyme reverse transcriptase and host machinery.
3. Complimentary DNA incorporates with the host DNA.
4. Viral DNA forms Viral proteins and genomic viral RNA.
5. Viral RNA and protein integrates to from process.
6. These enters helper T cells and repeat the process.
7. Helper T cells get reduced and lead to AIDS symptoms.
8. Patients get susceptible to mycobacterium infections. Antibody Mediated Immune System (AMIS).

## CHAPTER 9

# STRATEGIES FOR ENHANCEMENT IN FOOD PRODUCTION

### POINTS TO REMEMBER

**Animal Husbandry** : Science of rearing, feeding, caring and breeding of livestocks. It also includes poultry, farming and fishery.

**Apiary** : An apiary is a place where beehives are kept in wooden chambers (artificial) to get honey and other products of bee.

**Apiculture** : Rearing of honey bees for increased production of honey, bee's wax, propolis, royal jelly and bee venom. *Apis mellifera* is commonly used for production of honey on commercial basis.

**Artificial Insemination** : Introduction of semen of good quality of male into the vagina of another female.

**Aquaculture** : It pertains to the production of useful aquatic plants and animals such as fishes, prawns, crayfish, mussels, oysters and seaweeds by proper utilization of available water.

**Allele** : It refers to one of the alternative forms of a gene. In most organisms there are two alleles- Dominant and Recessive.

**Blue Revolution** : Increased production of fisheries based on scientific management.

**Callus** : Unorganised mass of cells produced after growth of explant.

**Concentrate** : Mineral rich food components e.g., Cereal grains, bran, maize and oil cake etc.

**Culture Fishery** : Rearing of fishes in artificial fresh water bodies such as pond, lake reservoir using scientific methods of feeding, breeding etc. as to enhance the output production of fish is called water agriculture of farming.

**Colchicine** : An alkaloid used to prevent the formation of spindle apparatus during mitosis. It helps in production of polyploids.

**Domestication** : Process of bringing a species under human management.

**Emasculation** : Removal of anthers from a bisexual flower which may be considered as female in a cross.

**Exotic Breeds** : Good quality breeds introduced in an area from an outside country.

**Explant** : A part of plant excised from its original location and used for tissue culture.

**Fry** : Young ones of fishes about 3-14 days old.

**Genetic Engineering** : The technique involved in altering the characters of an organism by inserting genes from another organism into its DNA.

**Germplasm Collection** : The entire collection (of plants/ seeds) having all the diverse alleles for all the genes in a given crop.

**Green Revolution** : Increased production of food due to scientific management.

**Horticulture** : It is a branch of agriculture and deals with act of growing vegetables, fruits and ornamental plants.

**Hybridization** : Method of producing new individuals by crossing parents with different genetic constitution. It brings about variation.

**Heterosis or Hybrid Vigour** : The superiority of F1 hybrids over either of the parents in terms of yield, growth or any other function.

**IARI** : Indian Agricultural Research Institute, New Delhi.

**IVRI** : Indian Veterinary Research Institute.

**Inbreeding** : Breeding by self pollination or selfing or between the members of same population, variety or species.

**Inbreeding Depression** : Continued close inbreeding decreases the fertility and productivity.

**Livestock** : Domesticated animals like cattle, sheep, goat, camel, horse and pigs etc.

**Line/ Breed** : Group of individuals related by decent.

**MOET** : Multiple Ovulation Embryo Transfer Technique.

**Out Breeding** : Crosses between different breeds.

**Plant Breeding** : An applied branch of Botany which deals with improvement of economically important plants.

**Pisciculture** : Rearing of fishes to increase meat yield.

**Poultry** : Rearing of birds to increase meat yield and egg.

**Pureline** : It is a progeny of single self fertilized homozygous individuals.

**Quarantine** : All biological introduction are carefully examined for the presence of weeds, pests and pathogens. It reduces the risk of entry of a pathogen in country.

**Super Ovulation** : Stimulation of good female animal to release more eggs.

**Swarms** : Group of bees.

**Swarming** : Leaving off old queen with some workers and drones to start a new colony at a new place.

**Sac Fry** : Newly hatched larva with yolk sac.

**SCP** : Single Cell Protein.

**Trait** : Morphological, anatomical, biochemical or behavioural features of an organism.

## **QUESTIONS**

### **VAS (1 MARK)**

1. What do you understand by Live Stock?
2. Define fishery.
3. What do you understand by the term “breed”?
4. Give names of some common breeds of cattle and poultry.
5. Give the scientific name of honey bee.
6. What are swarms?
7. Name four plants which are pollinated by bees.
8. Who developed semi-dwarf wheat variety and where?
9. Jaya and Ratna are high yielding varieties of which crop?
10. Write two qualities of *Saccharum officinarum* (sugarcane) grown in South India.
11. Name two fungal diseases of plants.
12. Name two viral diseases of plants.
13. What is black rot of crucifers?
14. Name the two diseases of mung bean for which resistance mutation is induced.
15. Name yellow mosaic virus resistant variety of bhindi.
16. Name the compounds present in the crop products that have adverse affects on animal growth.
17. What do you mean by Bio-fortification?
- \*18. Why prawn fisheries are named so? Whereas prawn is an arthropod.

### **SA – II (2 MARKS)**

19. Define inbreeding and outbreeding.
20. What do you mean by super female and super male in cattle?
21. How inbreeding depression problem can be solved?
22. Name the new breed of sheep developed in Punjab. How this breed has been developed?
23. Name fresh water and marine fishes.
24. Find out the differences between Pisciculture and Aquaculture.
25. Which revolution is responsible for our country to not merely meet the national requirements in food production but also helped even to export it? How it so happened?

26. Name the high yielding varieties of wheat.
- \*27. What is I R-8? Where it has been developed?
28. Name the high yielding variety of sugarcane.
29. Name some mutant varieties of crops and which disease these crop are resistant to?
30. What are the morphological, biochemical or physiological characteristics possessed by different plants for resistance to insect pests?
31. Name some insect pests
32. What is alternate source of proteins of animal and human nutrition? Give example.
33. Give the composition of nutrient medium and how virus free plants can be obtained *in-vitro*.
34. Write any two disadvantages for inbreeding.
35. Study the table given below and fill the blanks at A, B, C, & D.

S.No.	Crop	Variety	Resistant to disease
1.	Wheat	A	Leaf and stripe rust, hill bunt
2.	Brassica	Pusa swarnim	B
3.	Cow pea	C	Bacterial blight
4.	Chilli	Pusa sadabahar	D

### **SA – I (3 MARKS)**

36. Inbreeding increases “homozygosity”. Comment on the statement.
37. How can inbreeding increase productivity?
38. What happens when continued inbreeding (close breeding) occurs for more than 4-6 generations?
39. How controlled breeding experiment can be carried out?
40. How chances of successful production of hybrids can be improved?
41. Name three traits or characters which have been incorporated into crop plants by plant breeders to increase crop yield and quality.
42. Give sequential steps of breeding programme.
43. What is meant by biofortification? Give examples.
44. Define tissue culture, explants and cellular totipotency.
45. What are culture and somaclonal variation?
46. What are protoplast or somatic hybrids?
47. Explain the following statement in the light of your knowledge of food chain. ‘shifting from grain diet to meat diet create more demand for cereals’.

48. Fill in the blanks in the table given below from a to f

**Alternate source of protein for animal and human nutrition is single cell protein.**

**It is rich in a..... and b.....**

**Can be grown on c ..... and d .....**

**Common and known example is e.....**

**Besides rich in nutrition, SCP also reduces f .....**

49. Two of the steps involved in breeding a new genetic variety of a crop are given below write the missing steps in its proper sequence

a .....

**Collection of variability .....**

b .....

c .....

**Selection and testing of  
Superior incombinents .....**

e .....

### **LA (5 MARKS)**

50. Define out breeding. What are three types of out breeding methods? Explain them with examples.
51. What is plant breeding? Give 5 steps of breeding experiment.
52. How genetic variation is created? What is its result? Can it be artificially induced. What type of breeding it will be known as? Give examples.

### **ANSWERS**

#### **VSA (1 MARK)**

1. Livestock are the animals useful to human like buffaloes, pigs horses, cattle, sheep camel, goat etc.
2. Fishery is industry devoted to the catching, processing and selling of fish molluscs (shell-fish) and crustaceans (Prawn, crabs etc.)
3. A group of animals related by descent and similar in most characters like general appearance, features, size and configuration etc.

4. *Common breeds of cattle*

Buffaloes-Murrah, mehsana, Surti.

*Common breeds of poultry*

Aseel, Kadaknath, Chhatisgarh and Bursa.

5. *Apis indica*

6. Group of bees.

7. Sunflower, Brassica, Apple and Pear

8. Norman E borlaug (Nobel Laureate) at International Centre for wheat and maize improvement in Mexico.

9. Rice

10. Thicker stem and higher sugar content.

11. Brown rust of wheat, Red rot of sugarcane, Late blight of potato

12. Tobacco Mosaic, Turnip Mosaic

13. Bacterial disease.

14. Yellow Mosaic Virus and Powder Mildew.

15. Abelmoschus esculentus (Parbhani Kranti)

16. Glucosinolates in rap seed & mustered, Neurotoxin in Khesari Dal.

17. Breeding Crop with more than one normal composition of nutrients.

18.\* As prawns are cultured like fish and can be sold like fish to grow economy of the country.

**SA – II (2 MARKS)**

19. Inbreeding-When breeding is between animals of the same breed.

Outbreeding-When breeding is between animals of different breeds.

20. Superior female-(cow/buffalo) Produces more milk per lactation.

Superior male-(bull) Gives rise to superior progeny.

21. Selected animals of the breeding population should be mated with unrelated superior or animals of the same breed. It restores fertility and yield.

22. Hisardale and a new breed by crossing bikaneri ewes and Marino rams.

23. Fresh water fish-Catla, Rohu and Carp etc.

Marine water fish-Hilsa, Sardine, Mackarel and Pomfret etc.

24. Pisciculture-Rearing of fishes to increase meat yield and eggs.  
Aquaculture-Production of useful aquatic plants and animals.
25. Green Revolution-It has brought about by plant breeding techniques by producing yielding and disease resistance varieties in wheat, rice and maize.
26. Sonalika, Kalyan Sona.
27. Rice-IR-8 developed at IRRI (International Rice Research Institute) Philippines and Tai Chung Native-1 (from Taiwan)
28. Cross between *Saccharum barbieri* (North Indian variety) and *Saccharum officinarum* (South Indian variety)
29. Refer Table 9.1 Page no. 175 of NCERT book
30. (1) Hairy leaves  
Solid stem  
Smooth leaves  
Nectarless varieties  
High aspartic acid  
Low nitrogen and sugar content.
31. Refer table 9.2 Page no. 175 NCERT book
32. Single cell protein (SCP) e.g.. *methylophilus* and Mushrooms
33. Nutrient medium contains sugar, amino acids, vitamins, inorganic salts and growth regulators-auxins and cytokinins  
Virus free plants can be grown by taking MERISTEM (Apical and axillary)
34. (1) Inbreeding depression (ii) deleterious genes will expose.
35. A = Himgiri                      B = white rust  
C = Pusa komal                      D = Chili Mossiac Virus. Tobacco Mossiac Virus and leaf curl.

### **SA – I (3 MARKS)**

36. “Homozygosity” means homozygous pure fine are developed by crossing superior males and superior females of same breed. The progeny so obtained from such matings are evaluated or selected for further matings.
37. Inbreeding increases productivity because-
1. It exposes harmful recessive genes in F<sub>2</sub> that are eliminated by selection
  2. Selection helps in accumulation of superior genes and elimination of less desirable genes.

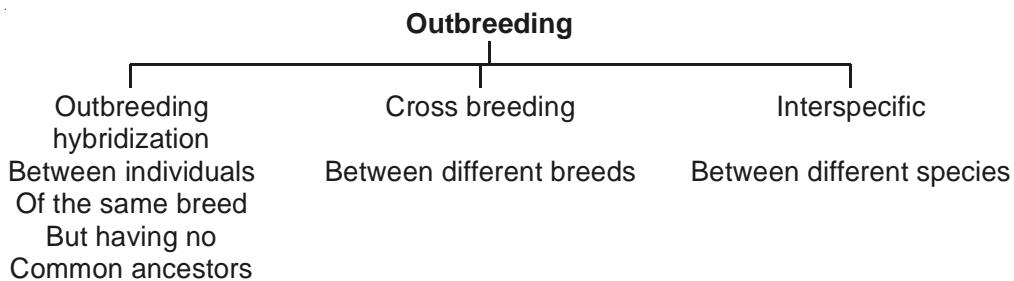
38. Continued inbreeding, especially close inbreeding reduces fertility and productivity, thus bringing "inbreeding depression".
39. Controlled breeding experiment can be carried out by using artificial insemination semen is collected from the male and injected into the reproductive tract of the selected female.
40. Multiple ovulation embryo transfer technology :  
Cow is administered hormone FSH which induce follicular maturation and super ovulation (6 to 8 eggs) instead of one egg.  
Female is mated with an elite bull or artificially inseminated.  
Fertilized eggs at 8-32 cells stages are recovered non surgically and transferred to surrogate mother  
The genetic mother may be again used for super-ovulation.
41. Increased tolerance to environment stresses (salinity, extreme temperature drought)  
Resistance to pathogens (Viruses, fungi and bacteria etc.)  
Increased tolerance to insect pests.
42. Screening germplasm for resistance sources.  
Hybridisation of selected parents.  
Selection and evaluation of the hybrids.  
Testing and release of new varieties.
43. Plant breeding programme designed to increase vitamins, minerals, higher proteins and healthier fat content in crop yield.  
*e.g.,* Maize hybrids have twice the amount of amino acid Lysine and Tryptophan.  
Wheat variety Atlas 66 have high protein content.
44. Tissue Culture—A technique of maintaining and growing plant cells, tissues or organs on artificial medium in suitable containers under controlled environmental conditions.  
Explant—The plant part which is cultured is called explant.  
Cellular totipotency—Capacity to generate a whole plant from a cell /, explant is called cellular totipotency.
45. Somaculture—Plants developed from micropropagation are genetically identical to the original plant from which they are grown.  
Somaclonal variation—The variations observed among plants generated from tissue culture are called somaclonal variation.
46. Protoplast—Plant cells are surrounded by plasma membrane. Their cell walls are digested with the help of enzymes.

Isolated protoplasts from different varieties of plant are fused to get hybrid protoplasts which can be further grown to new plants. These hybrids are called somatic hybrids and process is called somatic hybridization e.g.. Protoplast of tomato and potato fused together to form hybrids.

47. Producers are plants and meat eaters generally eat those animals which depend on plants and meat eaters generally eat those animals which depend on plants e.g Poultry mainly depend on cereals.
- 48.
- (a) Protein/Carbohydrates
  - (b) Vitamins/fats
  - (c) Straw/molasses
  - (d) Sewage
  - (e) Spirulina
  - (f) Environmental Pollution
49. (b) evolution and selection of parents (c) cross hybridization among the selected parents (e) testing, release and commercialization of new cultivators.

### LA (5 MARKS)

50. Outbreeding- the breeding of unrelated animals.



*Significance :*

It helps to overcome Inbreeding depression	Hybrid animals are better	Have economic value e.g.. Mule
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Refer page no. 168 NCERT book

51. Plant breeding is the purposeful manipulation of plant species in order to create desired plant types that are better suited for cultivation, give better yields and disease resistant varieties.

Collection of variability.

Evaluation and selection of parents.

Cross hybridization among the selected parents.

Selection and testing of superior recombination.

Testing, release and commercialization of new cultivation. Refer page no. 170 to 172 NCERT book.

52. Genetic variation is created through changes in the base sequence within genes called mutation.

It results in the creation of a new character or trait not found in parental type.

Mutation can be induced artificially through the use of chemicals or radiations (gamma)

Mutation breeding is selecting and using the plants that have desirable characters.

e.g., Mung bean-resistance to yellow mosaic virus and powdery mildew.

# CHAPTER 10

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## MICROBES IN HUMAN WELFARE

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### POINTS TO REMEMBER

**Activated Sludge Process :** Aerobic sewage treatment process using aerobic micro-organisms present in sewage sludge to break down organic matter in sewage.

**Antibiotics :** The chemicals derived from micro-organisms and used against harmful pathogens. They kill or retard the growth of pathogens. e.g., Penicillin.

**Anaerobic Sludge Digesters :** Large tanks where remaining part of flocs is pumped back for digestion of some bacteria and fungi by anaerobic bacteria producing biogas.

**Biofertilisers :** Microorganisms which produce fertilisers and enrich the soil e.g., Bacteria, cyanobacteria and fungi.

**Biogas :** Useful end product of biological treatment of sewage. It consists of mixture of methane,  $H_2S$  and  $CO_2$ .

**Bioactive Molecules :** Molecules produced for commercial use from microbes and used for various purposes e.g., *Trichoderma polysporum* (fungus) is used to obtain immunosuppressive agent cyclosporin A.

**B O D :** (Biochemical Oxygen Demand) : Total amount of oxygen consumed by bacteria for oxidation of organic matter present in one litre of water.

**Baculovirus :** Pathogens that attack insects and other arthropods. They are used to kill harmful pests and arthropods e.g., Nucleopolyhedrovirus.

**Biocontrol Agents :** Use of biological methods for controlling plant diseases and pests

**Effluent :** The product of primary treatment of sewage which is passed into large aeration tanks for secondary treatment.

**Fermentation :** The process by which microorganisms turn organic materials such as glucose into products like alcohol.

**Fermenters :** A very large vessel used in industry where microbes are grown on an industrial scale.

**Flocs :** During secondary treatment of effluent, excessive growth of aerobic bacteria and fungi form a mass of mesh like structure called flocs.

**Fermented beverages :** The beverage chemicals produced by the process of fermentation e.g., Wine, beer and whisky etc.

**Immuno Suppressive Agent :** Chemical substances which suppress the immunity against organ transplant.

**Insecticide** : The chemical by which harmful insects (pests) are killed.

**Lactic Acid Bacteria (LAB)** : Bacteria growing in milk and convert it into curd e.g., Lactobacillus.

**Mycorrhiza** : Symbiotic association of fungi with roots of higher plants to absorb water and minerals from the soil.

**Methanogens** : Bacteria which grow anaerobically on cellulosic material and produce methane along with  $\text{CO}_2$  and hydrogen.

**Primary Sludge** : The raw form of sewage which comes for primary treatment.

**Primary Treatment** : The treatment steps involve removal of small and large particles through filtration and sedimentation. The supernatant forms the effluent.

**Organic Farming** : Technique of farming, in which biofertilisers are used to enrich the soil.

**Sewage** : The organic waste matter containing water. It includes municipal waste water and large amount of organic matter and microbes which may be pathogenic.

**Secondary (Biological) Treatment** : Treatment on the primary effluent in a large aeration tank with the help of aerobic and anaerobic microbes to reduce BOD. Finally biogas is isolated and effluent is released into natural water body.

**Toddy** : A traditional alcohol drink derived from palm tree by fermentation and used in Southern India.

## QUESTIONS

### VSA (1 MARK)

1. Define 'Prion'.
- \*2. Name the bacteria that turn milk into curd.
3. Give one example of a microorganism producing bio-insecticide.
4. Expand BOD.
5. Write the components of biogas.
- \*6. Antibiotic penicillin was discovered by Alexander Fleming, but its full potential as an effective antibiotic was established by other two scientists. Name them.
7. The sap of which plant is used in making Toddy. Also mention the process involved in it.
- \*8. You have observed that bottles fruit juices bought from the market are clearer as compared to those made at home. Give reason.
9. Define biological oxygen demand.
10. Which microbe is used for commercial production of ethanol?
11. Which one of the following beverages is produced without distillation of the fermented broth?  
Whisky, brandy, beer and rum.

- \*12. Antibiotic penicillin was discovered by Alexander Fleming. Name the bacteria on which he was working.
13. Which microbe is used to kill insect larvae by a toxin.
14. In which crop fields, cyanobacteria are used as biofertilisers?
15. Name any one species of fungus which is used in the production of antibiotics.
16. Name the bacterium which is used for the production of Swiss cheese.
- \*17. In Paddy fields, cyanobacteria serve as important biofertilisers. Name any two such micro.
18. The generation time of microbial cells present in activated sludge is 40 minutes. If cells are allowed to grow for 8 hours, how many generations would have taken place?
- \*19. Which micro-organism is called baker's yeast? Also give its one other commercial application.
20. Which antibiotic was extensively used to treat American soldiers wounded in world war II and who discovered it?

### **SA – II (2 MARKS)**

21. Name the gas when released in dough, causes its increase in size. Name the metabolic pathway taking place resulting in the formation of this gas.
22. Define antibiotics. Name two antibiotics.
- \*23. Why do scientists suggest farmers to use biofertilisers instead of chemical fertilisers?
24. Explain how the microbes are helpful in the production of fuel.
- \*25. A farmer adds culture of Azotobacter to the soil before sowing a crop. How does it increase the yield of the crop?
26. Legume crops fertilize the soil but cereals do not. Give reasons.
27. Define mycorrhiza. How does mycorrhiza act as biofertiliser?
- \*28. What is green manure? Name any two crop plants which are used as green manure.
29. What is sewage? Why it should not be discharged into natural water bodies directly?
30. Which Ministry of Govt. of India has initiated Ganga Action Plan and Yamuna Action Plan? What proposal was made under these plans?
- \*31. Write the application of
- (a) *Streptococcus* with respect to myocardial infarction.
  - (b) *Methanobacterium* with respect to sewage treatment.
32. Define 'flocs' write their role in sewage treatment.
33. Select the false statement (s) and correct it.

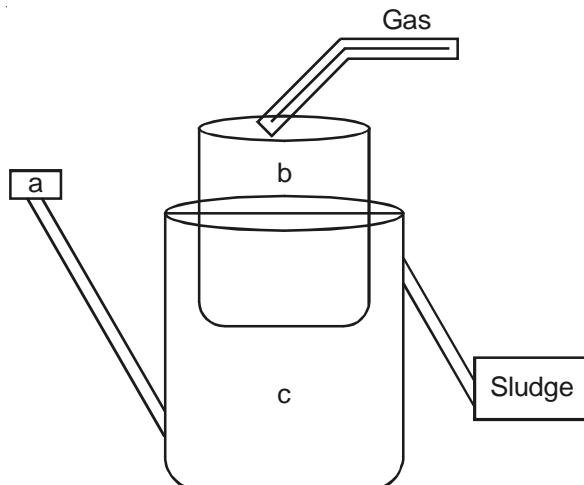
- (a) *Trichoderma* is effective biocontrol agent of several plant pathogens.
  - (b) *Aspergillus niger*, a fungus, used commercially for the production of butyric acid.
  - (c) *Saccharomyces cerevisiae* is commonly baker's yeast as well as brewer's yeast.
  - (d) Toddy is made by fermenting sap from rice.
- \*34. What is full form of LAB? How is it convert milk into curd and increases nutritional quality?
- \*35. Viruses are excellent candidates for insecticidal applications. Explain.

### **SA – I (3 MARKS)**

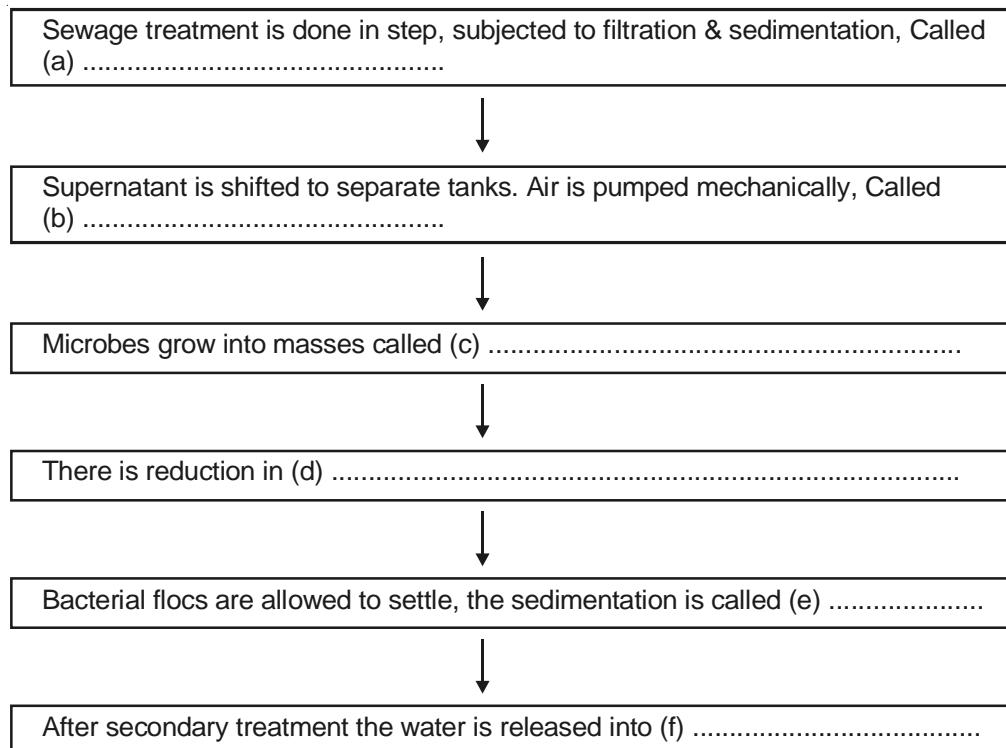
- 36. What are biofertilisers? Give two examples of biofertilisers. Name two nutrients which are made available by them.
- 37. In which food would you find acid bacteria. Write only two useful applications of this bacteria.
- \*38. Organic farming has been proved as a boon for both to the farmers and the environment. Justify this statement with examples.
- 39. Why the use of the microbes important in the control of pests and diseases in agriculture. Explain with examples.
- \*40. State the functions and the name of microorganisms which produce the following bioactive molecules.  
Streptokinase, Cyclosporin – A, Statins.
- 41. Name three organic acids and their producer microbes.
- \*42. What is measured in BOD test? BOD level of three samples of water labeled as A, B and C are 30 mg/l, 10 mg/l and 500 mg/l respectively. Which sample of water is most polluted?
- 43. Expand the term IPM. Describe main objectives of IPM concept.
- \*44. A farmer is advised to sow leguminous seeds inoculated with a bacterial culture which help in increasing crop yield. Name the bacteria in the culture. How is this bacteria useful to the crop?
- 45. Draw a labeled diagram of a typical biogas plant. Write two uses of biogas.
- \*46. Fill the blank spaces *a*, *b*, *c*, *d*, *e* and *f* given in the following table.

Name of Organisms	Commercial Product	Application
<i>Penicillium notatum</i>	Penicillin	<i>a</i>
<i>b</i>	Lactic Acid	Making curd
<i>Streptococcus</i>	clot buster enzyme	<i>c</i>
<i>Trichoderma polysporum</i>	<i>d</i>	immuno suppressive agent
<i>Saccharomyces cerevisiae</i>	<i>f</i>	wine, beer, whisky.

47. Biofertiliser are more advantageous over chemical fertilisers. Justify this statement with reference to *Rhizobium* as biofertiliser.
48. In the given figure of biogas plant, label the part *a*, *b* and *c*. Write the function of these parts.



- \*49. Define fermentation. Name two alcoholic beverages produced by fermentation with the process of distillation and two without distillation.
- \*50. Fill in the blanks at space from (a) to (f) provided in the sewage treatment as shown below.



## **LA (5 MARKS)**

51. Explain any five useful activities of microbes in producing industrial products.
- \*52. Before disposal, sewage is treated in sewage treatment plant. Explain the procedure to make it less polluting.
- \*53. Describe the biological control of pest and diseases with suitable examples.

## **ANSWERS**

### **VSA (1 MARK)**

1. Prions are proteinaceous infectious agents.
2. *Lactobacillus*.
3. *Baillus thuringiensis*.
4. Biochemical Oxygen Demand.
5. Methane, carbon dioxide and hydrogen sulphide.
6. Ernest Chain and Howard Florey.
7. Palm Fermentation.
8. Bottled juices are clarified by the use of pectinase and proteases.
9. The amount of oxygen that would be consumed if all the organic matter in one litre of water is oxidized by bacteria.
10. Yeast (*Saccharomyces cerevisiae*).
11. Beer.
12. *Staphylococci*.
13. *Bacillus thuringiensis*.
14. Paddy fields.
15. *Penicillium notatum*.
16. *Propionibacterium sharmanii*
17. *Anabaena, Nostoc, Oscillatoria* (any two).
- 18.
19. *Saccharomyces cervisiae*, Ethanol production.
20. Penicillin, Alexander Fleming.

## **SA – II (2 MARKS)**

21. Carbon dioxide Bacteria or yeast undergoes anaerobic pathway and produce CO<sub>2</sub> gas (fermentation).
22. Antibiotic is a chemical substance produced by some microbes and can kill or retard the growth of other harmful microbes. Penicillin and Tetracycline.
23. Biofertilisers are biodegradable. Low cost.  
Do not pollute the environment.  
Do not change the chemical nature of the soil.
24. Organic matter.  
Physical conditions like water and suitable temperature.  
Fermentation/degradation of organic matter by microbes.  
Production of methane gas.
25. *Azotobacter* is a free living nitrogen-fixing bacteria.  
It fixes nitrogen of the atmosphere in the soil.  
It increases the fertility of soil.  
Fertile soil increases the yield of the crop.
26. Symbiotic bacteria *Rhizobium* are present in root nodules of leguminous plants.  
*Rhizobium* fixes atmospheric nitrogen.  
This fixed nitrogen fertilize the soil.  
Cereals do not posses nitrogen fixing bacteria, hence do not fertilize the soil.
27. Mycorrhiza is a symbiotic association of certain fungi with roots of higher plants. Mycorrhiza absorbs phosphorus from soil and passes it on to the plant.
28. Green manure is a quick growing crop which is cultivated and ploughed under the soil to provide organic matter and additional nitrogen.  
*Lens esculanta* (lentil)  
*Vigna sinensis* (cow pea)
29. Waste water containing human excreta generated in large amount in urban areas, water becomes polluted.
30. The Ministry of Environment and Forests.  
It was proposed to build a large number of sewage treatment plants, so that only treated sewage may be discharged into the rivers to save these major rivers from pollution.

31. (a) remove clot from the blood vessels  
(b) produce bioges (Fuel).
32. Flocs are masses of bacteria associated with fungal *filaments* to form mesh like structure.  
Role of flocs : they consume major part of organic matter present in the sewage.
33. (b) *Aspergillus niger*, a fungus, used commercial of the production of citric acid.  
(d) Toddy is made by fermenting sap from palm.
34. LAB – Lactic acid bacteria.  
LAB – produce acid that coagulate and partially digest milk proteins and convert milk to curd.  
It also increases nutritional quality by increasing vitamin  $B_{12}$ .
35. Viruses like *Nucleopolyhedrovirus* are pathogens that attack insect and other arthropods.  
Baculoviruses have been shown species – specific, narrow spectrum insecticidal applications.

### **SA – I (3 MARKS)**

36. They are microorganisms which enrich the nutrient quality of the soil.  
Fungi, Cyanobacteria (*Nostoc, Anabaena*) Bacteria (*Rhizobium, Azotobacter*).
37. In milk (LAB or Lactic acid bacteria – *Lactobacillus*).  
Milk is changed into curd.  
In our stomach the LAB play an important role in checking disease causing microbes.
38. Organic farming – use of biofertilisers.  
Chemical fertilisers pollute the soil and water.  
Biofertilisers do not pollute the environment.  
Low cost more crop yield.
39. Chemical pesticides pollute the environment.  
Chemicals may kill both useful and harmful life forms.  
Bt Cotton – Introduction of *B. thuringiensis* toxin gene in plants.  
*Trichoderma* (fungus – biocontrol agent of several plant pathogens).  
Baculoviruses are used as biocontrol.
40. Streptokinase – *Streptococcus* (Bacteria) It is used as a ‘clot buster’ for removing clots from the blood vessels of patients.  
Cyclosporin – A *Trichoderma polysporum* (fungus) – used as an immunosuppressive agent in organ-transplant patients.

Statins – *Monascus purpureus* (yeast) – used as blood cholesterol lowering agent.

41. Citric acid – *Aspergillus niger* (Fungus).

Acetic acid – *Acetobacter aceti* (Bacteria).

Lactic acid – *Lactobacillus* (Bacteria).

42. BOD test measures rate of uptake of oxygen by microorganisms in a sample of water.

Greater the BOD of water, more is pollution.

Sample ‘C’ is most polluted because it has highest BOD level among the three samples of water.

43. Integrated Pest Management.

Involves various types of control measures to ensure continued production from the soil without excessive use of synthetic pesticides.

Biological control, crop rotation, use of disease resistant variety of seeds.

44. Leguminous plants have nitrogen fixing bacteria in their root nodules.

Bacteria culture has *Rhizobium* or *Nitrobacter*.

Bacteria supply nitrogen to the plant by fixing atmospheric nitrogen.

45. Refer 10.8 on page no. 186 of NCERT book.

Uses of biogas – Cooking and lighting.

46. (a) to kill disease causing bacteria.

(b) *Lactobacillus*

(c) Remove clots from blood vessels.

(d) cyclosporine – A

(e) Ethanol.

47. (i) Biofertilisers are economical than chemical fertilisers.

(ii) Biofertilisers are biodegradable.

(iii) Eco-friendly nature of biofertilisers.

Role of *Rhizobium* : It fixes atmospheric nitrogen in leguminous plants and increases the yield.

48. (a) Mixing Tank – Dung and water are mixed to form slurry

(b) Gas Holder – to store biogas.

(c) Digester – Anaerobic fermentation of slurry to produce biogas.

49. Fermentation : The process by which micro organisms turn raw materials such as glucose into products such as alcohol. Whisky, brandy, rum (by distillation), wine, beer (without distillation).
- 50 (a) Primary treatment (b) Aeration  
(c) Flocs (d) BOD/Biochemical Oxygen Demand  
(e) Activated sludge (f) Water bodies like river stream.

### LA (5 MARKS)

51. Beverages production.

Bakery products

Antibiotics

Enzyme production

Bioactive molecules

52. Primary treatment – Filtration and sedimentation to remove large and small particles.

Secondary treatment or biological treatment – Growth of useful aerobic microbes into flocs to consume organic matter present in effluent.

Effluent after secondary treatment is released into water bodies like river.

53. Biological control of pests and diseases

Bt cotton – Plants are resistant to attack by insect pests.

*Trichoderma* – They are effective biocontrol agent of severed plant pathogens.

Baculoviruses – They attack insects and other arthropods.

Refer page no. 186 – 187 NCERT textbook.

## CHAPTER 11

# BIOTECHNOLOGY : PRINCIPLES AND PROCESSES

### POINTS TO REMEMBER

**Biotechnology** : It deals with techniques of using live organisms or enzymes from organisms to produce products and processes useful to humans.

**Biolistics or Gene Gun** : The technique of bombarding micro projectiles *i.e.*, gold/tungsten particle coated with foreign gene with great velocity into the target cells.

**Bioreactor** : Bioreactor is a large capacity vessel with stirring arrangement in which organic raw materials are biologically converted into specific products by recombinant microorganisms under optimal conditions.

**Cloning** : It is the process of producing many identical copies of organisms and cells.

**Cloning Vectors** : The DNA used as a carrier for transferring a fragment of foreign DNA into a suitable host is called cloning vector or gene carrier *e.g.*, Plasmid, bacteriophage.

**Definition of Biotechnology (By EFB)** : The integration of natural science and organisms, cells, parts thereof and molecular analogues for products and services.

**Genetic Engineering** : Techniques to alter the chemistry of genetic material to introduce these into host organisms and thus change the phenotype of the host organisms.

**Gel Electrophoresis** : It is a technique to isolate VNTR DNA fragments with the help of gel agarose, nylon membrane and probe sequence.

**Insertional Inactivation** : The presence of recombinant can be detected by a procedure that is based on the principle that cloned DNA fragments disrupt the coding sequence of a gene.

**Origin of Replication (ori)** : It is a sequence from which replication starts and any piece of DNA when linked to this sequence can be made to replicate within the host cell.

**Plasmid** : Self replicating circular DNA molecules found in some bacteria. It is used as a vector in recombinant DNA technology.

**Palindromic Nucleotide Sequence** : The palindrome in DNA is a sequence of base pairs that reads same on the two complementary strands when orientation of reading is kept the same (5' – 3').

**Polymerase Chain Reaction (PCR)** : In PCR (Polymerase Chain Reaction), multiple copies of the genes or DNA of interest are synthesized *in vitro* using two sets of primers and the enzyme DNA polymerase.

**Restriction Nuclease Enzyme** : The enzyme that cuts out a piece of DNA at a specific location (recognition site). It is used in recombinant DNA technology.

**Recognition Sequence :** Restriction enzyme cut DNA molecule at a particular point by recognizing a specific sequence of six base pairs. This specific base sequence is known as recognition sequence for that enzyme.

**Recombinant Protein :** The protein encoding gene which is expressed in a heterologous host.

**Selectable Marker :** It is a gene (antibiotic resistance gene) which helps in identifying and eliminating non-transformants and selectively permitting the growth of the transformants.

**Transformation :** Transformation is the phenomenon by which the DNA isolated from one type of cell, when introduced into another type, is able to bestow some of the properties of the former to the latter e.g., Antibiotic resistance gene in *E.coli*.

## QUESTIONS

### VSA (1 MARK)

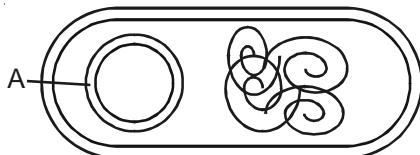
1. Define biotechnology.
2. Give any two examples of microbe mediated processes in production of food materials.
3. Plasmid is used in recombinant DNA technology. State its function in this technology.
4. Name the enzymes which are used to cut DNA and join DNA fragments respectively.
5. Expand PCR.
- \*6. In which microorganism, tumor inducing plasmid has now been modified into non-pathogenic bacteria and is used as cloning vector.
7. Name the enzyme which is used to break the plant cells open to release DNA along with other macromolecules.
8. Which technique is used to separate DNA fragments?
9. Identify the recognition sites in the given sequences at which *E coli* will be cut and make sticky ends.

5'-GAATTC-3'

3'-CTTAAG-5'

10. In a chromosome what is responsible for initiating DNA replication.
11. Name any genetically engineered microbe and write its one function.
12. Write the property of palindromes in DNA.
- \*13. In genetic engineering, there are several methods of introducing DNA into the cell. One of them is particle bombardment into host cell. Name this technique of DNA introduction.
14. Name the device in which substances are treated to stimulate biochemical transformation by living cells.

- \*15. Why restriction enzymes are known as molecular scissors?
16. Arrange the steps of the process of rDNA technology in a proper sequence.  
Cutting of DNA at specific sites, insertion of rDNA into host cell, isolation of genetic material, amplification of gene of interest.
17. A bacterial cell is shown in the given figure. Label the part A. and mention its Use in rDNA technology.



- \*18. A linear DNA fragment and a plasmid has three restriction sites for *Eco*RI. If both are completely digested with *Eco*RI, how many fragments will be produced from linear DNA and plasmid respectively.
19. State the significance of *Taq* polymerase in PCR.
20. Write conventional nomenclature of *Eco*RI.

### **SA – II (2 MARKS)**

21. Which two core techniques/inventions enabled the birth of modern biotechnology?
22. Name any two selectable markers for *E.coli* and write their uses.
23. Suggest the manner in which plasmid DNA differs from chromosomal DNA.
24. Define vector in biotechnology. Name any two vectors which are used in biotechnology.
25. Name the two steps which are collectively referred to as downstream processing. Mention why this process is significant.
26. Mention two classes of restriction enzymes/nucleases. Suggest their respective role.
27. Name two enzymes essential for recombinant DNA technology and mention their role.
28. What were two main discoveries that led to the birth of genetic engineering?
29. Make a diagrammatic representation of recombinant DNA technology showing a restriction enzyme, the substrate DNA on which it acts, the site at which it cuts DNA and the product it produces.
30. Which characteristic of *Agrobacterium* is manipulated for use in rDNA technology. Give other example which is utilized for similar purpose in animal cells.
31. In the given process of separation and isolation of DNA fragments, some of the steps are missing. Complete these missing steps.

A. Restriction Digestion of DNA fragments

B. ....

C. Staining with Ethidium bromide.

D. Visualization in U.V. light.

E. ....

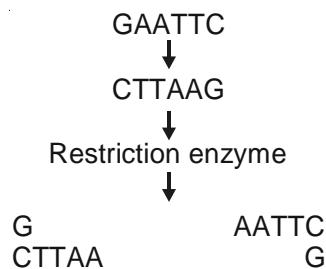
F. Purification of DNA fragments.

32. State the principle of technique – agarose gel electrophoresis. Write any one application of this technique in biotechnology.

\*33. Which out of these is not a matching pair and Why?

- (a) Plasmid : autonomously replicating circular extra chromosomal DNA
- (b) Restriction enzyme : molecular scissor
- (c) Ligases : enzyme used to break foreign DNA from plasmid
- (d) Biolistics : Gene Gun.

34.



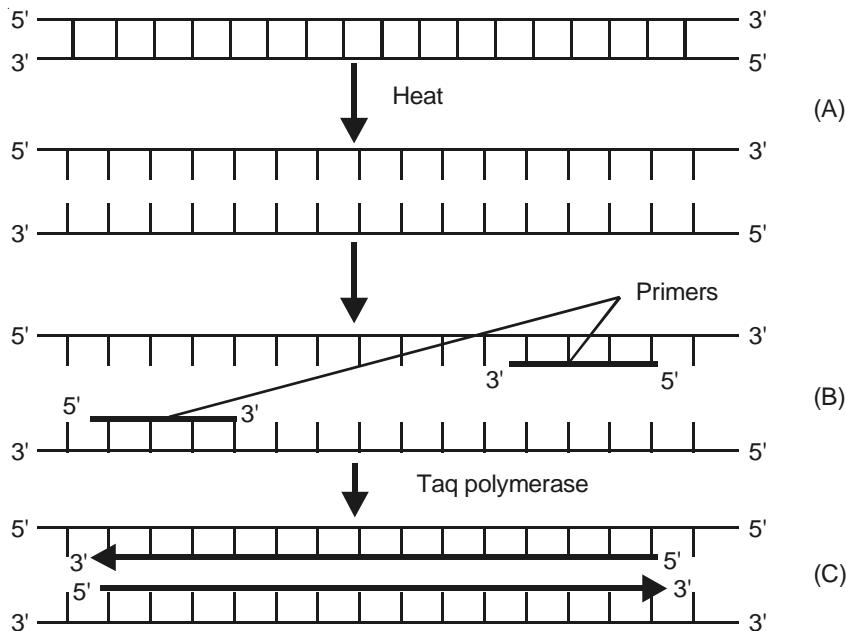
Observe the given figure and write the answers to the following :

- (i) Name the restriction enzyme used in the process and what type of ends are generated by this enzyme.
- (ii) Name nucleotide sequence which is recognized by such restriction enzyme.

\*35. A bioreactor of working volume 50 litre produces a recombinant protein in batch culture under given operating conditions from its substrate. The final concentration of recombinant proteins at the end of each run was 2.0 Kg/l. The bioreactor was operated to complete 50 runs in each year. What will be the annual output of recombinant protein in Kg per year.

### SA – I (3 MARKS)

36. Find the difficulty in passing DNA into the host cells. How is it forced into the cell? Mention any three ways.
37. Given any three applications of recombinant DNA technology.
38. How is gene or DNA of interest amplified using polymerase chain reaction?
39. Mention three basic steps in genetically modifying an organism.
40. *Agrobacterium tumifaciens* is considered as natural genetic engineer of plants. Why is it so called?
41. What is selectable marker? Why is ampicillin resistance gene called a selectable marker?
42. Define cloning. Give a reason why animal cloning is difficult than plant cloning.
43. The presence of more than one recognition sites with the vector complicate the gene cloning. Suggest the method that helps in the selection of recombinants.
44. Write any three essential features of a vector.
45. In the given figure one cycle of polymerase chain reaction is shown. Name the steps A, B and C. Give the purpose of each these steps.



46. Draw a neat diagram of simple stirred tank bioreactor and label the following parts in it, pH control, motor, sterile air, foam beaker, impeller, culture broth.
47. A selectable marker is used in the section of recombinants on the basis of their ability to produce colour in presence of chromogenic substrate.
  - (a) Mention the name of mechanism involved.

- (b) Name the enzyme involved in production of colour.
- (c) How is it advantageous over using antibiotic resistant gene as a selectable marker.
48. You are required a purified DNA fragment for genetic engineering. How do you obtain purified fragments of DNA from the cells?
49.  $^{5'}\text{CAGAATTCTTA}^{3'}$   
 $^{3'}\text{GTCTTAAGAAT}^{5'}$
- (a) Name the restriction enzyme which recognized this DNA sequence.
- (b) Write the sequence after digestion by enzyme.
- (c) Why are the ends generated after digestion called sticky ends?
50. Describe different methods of producing competent host cells of bacteria, plant and animal for transformation with recombinant DNA.

### LA (5 MARKS)

51. A biotechnologist wants to improve the quality of crop through recombinant DNA technology. Describe the processes involved in this technology.
52. What is bioreactor? Draw a labelled diagram of simple stirrer-tank bioreactor. Name any four optimum growth conditions to obtain desired product.

### ANSWERS

#### VSA (1 MARK)

- It deals with techniques of using live organisms or enzymes from organism to produce products and processes useful to humans.
- Curd, bread, wine.
- Plasmid DNA acts as vector to transfer the piece of DNA of other organism attached to it.
- Restriction endonuclease and ligase.
- Polymerase Chain Reaction.
- Agrobacterium tumefaciens*.
- Cellulase
- Gel electrophoresis



10. In a chromosome there is a specific DNA sequence called the origin of replication (ori) which is responsible for initiating replication.
11. *Escherichia coli* (*E. coli*).
12. It is a sequence of base pairs in DNA that reads same on the two complimentary strands when orientation of reading is kept same i.e., 5'-3'.
13. Biolistics/Gene gun.
14. Bioreactor.
15. Restriction enzyme cut the strand of DNA at specific sites.
16. Isolation of the genetic material, cutting of DNA at specific sites, amplification of gene of interest, insertion of rDNA into host cell.
17. A. Plasmid  
Plasmid is used as a vector to transfer the gene of interest in host cell.
18. Number of fragments of linear DNA = 4  
Number of fragments of plasmid = 3.
19. *Taq* polymerase is a thermostable DNA polymerase, isolated from *Thermos aquaticus* remain active during the high temperature induced denaturation of double stranded DNA.
20. *EcoRI* comes from *Escherichia Coli*, strain R, I indicates the order in which the enzyme was isolated.

### **SA – II (2 MARKS)**

21. Genetic Engineering  
Cloning – Growth of desired microbes or eukaryotic cells in large quantities.
22. The genes encoding resistance to antibiotics such as ampicillin, chloramphenicol, tetracycline, kanamycin.  
Selectable markers help in identifying and eliminating non-transformants and selectively permitting the growth of the transformants.
- 23.

<i>Plasmid DNA</i>	<i>Chloromosomal DNA</i>
<b>DNA</b>	
Circular DNA and extrachromosomal DNA	Linear DNA
Used as vector	It is not used as vector
Occurs in bacterial cells	Occurs in nucleus of eukaryotic cells.

24. The DNA used as carrier for transferring a fragment of foreign DNA into a suitable host and can replicate in the host is called vector.

Two vectors – Plasmid, bacteriophage, plant or animal virus.

25. Separation and Purification.

This process is significant because before reaching into market, the product has to be subjected for clinical trial and quality control.

26. Exonuclease, Endonuclease

Exonuclease removes nucleotides from the ends of the DNA.

Endonuclease makes cut at specific locations within the DNA.

27. Restriction endonuclease and Ligase

Restriction endonuclease is used to cut the strand of DNA at specific sites.

Ligases join foreign DNA to plasmid.

28. Discovery of restriction enzymes that cut DNA at specific sites.

Development of techniques in order to get new DNA fragments using cloning vectors like plasmids and phages.

29. Refer Figure 11.2 on page 197 NCERT book.

30. *Agrobacterium* is able to deliver a piece of DNA known as T-DNA to transform normal plant cells. Other example is retrovirus.

31. B Agarose gel Electrophoresis.

E elution.

32. The DNA fragments are separated according to their size through sieving effect provided by the agarose gel (charge/mass ratio). This technique is used to separate DNA fragments.

33. (c) is not a matching pair, ligases are those enzymes which are used to join foreign DNA to plasmid.

34. (i) *EcoRI*, Sticky ends.

(ii) palindromic nucleotide sequence.

35. Annual output of recombinant protein =  $50 \text{ l} \times 2 \text{ kg/l} \times 50 \text{ runs/year} = 5000 \text{ kg/year}$ .

### **SA – I (3 MARKS)**

36. DNA is a hydrophilic molecule so difficult to pass through phospholipid membrane.

(i) Chemical method – Host cells be made competent to take up DNA.

(ii) *Micro-injection* method.

(iii) Biolistics or gene gun method.

Refer page no. 200 – 201 NCERT book.

37. Production of new characters in plant and animal.
- Synthesis of vitamins, antibiotics and hormones.
- Cure of genetic disorders.
- Transfer of nitrogen fixing gene in non-leguminous plant roots.
38. In polymerase chain reaction (PCR) multiple copies of the gene or DNA are amplified *in vitro* using two sets of primers and the enzyme DNA polymerase. The PCR has three steps :
- (i) Denaturation
  - (ii) Primer annealing.
  - (iii) Extension of primers (long chain of DNA).
39. (a) Identification of DNA with desired gene.
- (b) Introduction of the identified DNA into the host.
- (c) Maintenance of introduced DNA in the host and transfer of the DNA.
40. *Agrobacterium tumifaciens* is a pathogen of many dicot plants. It is able to deliver a piece of DNA known as T-DNA to transform normal plant cells into a tumor and direct these tumor cells to produce the chemicals required by the pathogen.
41. Selectable marker is a gene which helps in identifying and eliminating non-transformants and selectively permitting the growth of the transformants.
- Ampicillin resistance gene is a selectable *marker*. If ampicillin resistance gene is transferred into *E coli* cells, the host cells become transformed into ampicillin resistant cells. If we spread the transformed cells on agar plates containing ampicillin, only transformants will grow and untransformed recipient cells will die. Only the ampicillin resistance gene, one is able to select a transformed cell in the presence of ampicillin.
42. Cloning is the ability of producing many identical copies of genes or organisms.
- Plant cells are more totipotent than animal cells.
43. Selectable marker/insertional inactivation. The presence of recombinants can be detected by a procedure that is based on the principle that cloned DNA fragments disrupts the coding sequence of a gene. It is called insertional inactivation.
- Refer procedure page no. 199 – 200 NCERT book.
44. It must be smaller in size.
- It must contain ori (origin of replication).
- It must incorporate a selectable marker or a gene.
- It must have at least one restriction site (cutting site) for restriction endonuclease.
45. (A) Denaturation – Heat denatured DNA to separate complimentary strands.

- (B) Annealing – primers hybridizes to the denatured DNA strands.
- (C) Extension – *Taq* polymerase extend the primers resulting in synthesis of copies of target DNA sequence.
46. Refer figure 11.7 (a) page No. 204 of NCERT text book.
47. (a) Insertional inactivation.  
(b)  $\beta$  – galactosidase  
(c) Selection of recombinants due to inactivation of antibiotics is a cumbersome procedure because it requires simultaneous plating on two plates having different antibiotics.
48.  to break the cell open to release DNA by treating host cells with enzymes.  
 protein along with DNA is removed by treatment with protease, RNA by treatment with RNase. Other molecules can be removed by appropriate treatments.  
 purified DNA precipitate out after the addition of chilled ethanol.
49. (a) *EcoRI*      (b) 5' CAG 3'      and      5' AATTCTTA 3'  
                          3' GTCTTAA 5'                            3' GAAT 5'
- (c) They are named so because they form hydrogen bonds with their complementary cut counterparts.
50. Bacteria – treating with a specific concentration of a divalent cation such as calcium  
Plant – biolistics or Gene Gun.  
Animal – micro-injection.

### LA (5 MARKS)

51.  Isolation of the genetic material (DNA) of desired character.  
 Cutting of DNA at specific location.  
 Amplification of gene using PCR.  
 Insertion of recombinant DNA into the host cell/organism.  
 Obtaining foreign gene product.
- For detail refer page no. 201 – 203 NCERT book.
52. Bioreactor is a big vessel in which raw materials are biologically converted into specific products by using microbial plant, animal or human cells.
- Refer diagram 11.7 page no. 204 NCERT book.
- Optimal conditions – Temperature, pH, substrates, salt, vitamins and oxygen.

## CHAPTER 12

# BIOTECHNOLOGY AND ITS APPLICATIONS

### POINTS TO REMEMBER

**Adenine Deaminase (ADA) Deficiency :** ADA enzyme is crucial for the immune system to function. This disorder is caused due to the deletion of gene for adenosine deaminase enzyme.

**Bt Cotton :** It is transgenic plant. Bt toxin genes were isolated from *Bacillus thuringiensis* and were incorporated into cotton plant.

**Biopiracy :** Unauthorised use of biological resources and traditional knowledge related to bioresources for commercial benefits without proper compensatory payments.

**Biopatents :** These are patents granted for biological entities and processes. The Indian basmati rice has recently cleared the second amendment of the Indian Patent Bill.

**Biopesticides :** Biological agents that are used to control weeds, insects and other pests.

**Cry Protein :** The Bt toxins are coded by a gene named cry. It is insecticidal protein. Some proteins encoded by the genes are *Cry IAc*, *Cry IAb* and *Cry II Ab*. This protein is produced by soil bacterium named *Bacillus thuringiensis*.

**ELISA :** Enzyme Linked Immuno-Sorbent Assay is one of the diagnostic technique which is used to detect HIV/AIDS and other diseases.

**Genetically Engineered Insulin :** The human insulin was prepared by recombinant DNA technology. This insulin has two short polypeptide chains A and B which are linked by disulphide bridges.

**Green Revolution :** Crop yield has increased tremendously to feed the growing human population.

**Genetically Modified Organisms (GMO) :** The organisms whose genes have been altered by manipulation are called Genetically Modified Organisms.

**Gene Therapy :** Gene therapy is a collection of methods that allow correction of a gene defect that has been diagnosed in a child or embryo.

**Insecticidal Protein :** A toxin in the protein crystal that is secreted by *Bacillus thuringiensis*. It can kill certain insects such as tobacco budworm, armyworm and beetles.

**Molecular Diagnosis :** Molecular diagnosis is the early detection of diseases which is not possible by traditional diagnostic techniques. These are – Recombinant DNA technology, Polymerase Chain Reaction (PCR) and Enzyme Linked Immuno-Sorbent Assay (ELISA).

**RNA Interference :** RNA interference is a process which is used to develop pest resistant plants.

**Sustainable Agriculture :** It should use renewable resources, should not cause pollution and maintain optimum yield.

**Transgenic Animals** : Animals that have had their DNA manipulated by the process and express an extra gene are known as transgenic animals.

**Transgenic Crops** : Transgenic crops are the crops that contain and express transgene. These crops are also called genetically modified crops or G M Crops. These crops are resistant to insects and capable of producing medical proteins with challenged qualities.

## QUESTIONS

### VSA (1 MARK)

1. Define Genetically Modified Organisms.
2. Expand GEAC.
3. State the main function of RNA interference. (RNAi).
4. From which microorganism, the human insulin is being commercially produced.
5. Name any two plants in which *cry* gene is introduced to make them insect resistant.
6. Name the nematode that infects the roots of tobacco plant and cause a great reduction in yield.
7. Insulin consists of two short polypeptide chains. How are these chains linked together.
8. Which bacterium plasmid is used to prepare genetically engineered insulin?
9. Name two pathogenic diseases which can be detected by amplification of their nucleic acids by PCR.
10. State the function of Genetic Engineering Approval Committee.
11. Why would biopiracy affect India most?
12. Which two patents on India's biological resources have been revoked?
- \*13. Which company has got patent rights on Basmati rice?
14. Name the protein produced by soil bacterium *Bacillus thuringiensis*.
- \*15. Insulin can not be administered orally to diabetic patients. Why?
16. What is the basic principle of ELISA?
- \*17. Name any two biotechnological techniques that serve the purpose of early diagnosis of pathogenic diseases.
18. Which Indian variety of rice was patented by an American company through the US patent and Trademark office?
19. Expand Bt.
20. Name the human protein which was present in the milk of transgenic cow, Roise.

### **SA – II (2 MARKS)**

21. *Bacillus thuringiensis* produce proteins that kill certain insects. Why does this toxin not kill the *Bacillus* bacteria?
  22. Some crop plants are genetically modified by manipulating their genes. In which way these plants are useful to us?
  23. Find three options that can be thought for increasing food production. Suggest best option with reason.
  24. Enlist four areas which are responsible for the recent advances in biotechnology.
- \*25. Write expanded form of ELISA. On which principle ELISA test is based?
26. Write two uses of Polymerase Chain Reaction.
  27. Write two objectives of Genetic Engineering Approval Committee (GEAC) set up by the Government of India.
  28. Define Biopiracy. Suggest any two points to prevent biopiracy.
- \*29. “Industrialised nations exploiting the bioresources of under industrialised nations”. Justify the statement with suitable example.
30. Give two ethical concerns regarding biotechnology.
- \*31. At which level RNAi silence the gene :  
Transcriptional or translational level. How?
- \*32. In the following pairs, diagnostic technique and their applications are given which one of these is mismatched and why?
- (a) *PCR* : Detect presence of a pathogen only when it produces a disease symptom.
  - (b) *ELISA* : Identification of HIV infected patients using serum samples.
  - (c) DNA Microarray Analysis of differential gene expression in cancer and normal cells.
  - (d) *Autoradiography* : Allowed to detect mutated genes in a clone of cells.

### **SA – I (3 MARKS)**

33. Biotechnology is being used to improve the quality of human life. Suggest three critical areas of biotechnology in which more research is needed.
- \*34. Name the toxin which is coded by a gene named *cry*. Which organism produces it? How has mass exploitation of this protein possible?
- \*35. Which strategy you suggest to prevent the crop plants from infestation by several nematodes. Describe the mechanism. Which bacterium is used as a vector to transfer the gene in this process.

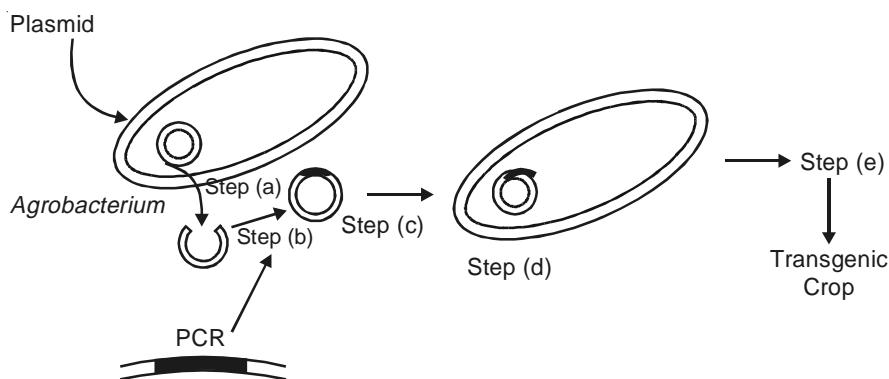
36. Write chemical nature of insulin. How does mature insulin differ from proinsulin. Explain preparation of genetically engineered insulin.
- \*37. Define gene therapy. If a person is born with adenosin deaminase (ADA) deficiency, a hereditary disease, how do you correct this defect using gene therapy?
38. What are transgenic crops? Write any two point of difference between transgenic crop technique and normal breeding technique.
39. Why is the use of microbes important in the control of pest and insect diseases in agriculture? Explain with two suitable examples.
- \*40. Some diseases cannot be easily detected in early stages because the symptoms are not visible. Name any three techniques which help in early diagnosis and explain and explain their principle.
41. In which way, the genetically modified food differ from the food produced from traditional varieties?
42. Write any three problems that may arise due to use of genetically modified food.
- \*43. Few gaps have been left in the following table, showing certain organisms and their applications. Fill up the gaps.

S.No.	Organisms	Applications
(i)	<i>Bacillus thuringiensis</i>	.....
(ii)	.....	Production of human insulin, human growth factors, interferons.
(iii)	Transgenic cow	.....
(iv)	.....	Production of pest resistant dicot plants
(v)	Transgenic mice	.....
(vi)	.....	Vitamin 'A' enriched rice.

44. If a person is born with a hereditary disease, can gene therapy be taken for such a disease? Explain with example.

### LA (5 MARKS)

45. Why are transgenic animals being produced? How can man be benefited from such modifications?
- \*46. 'The biotechnology can greatly promote human welfare, but it can also be misused to increase human sufferings'. Justify the statement.
47. In the given figure the *Agrobacterium* is utilized for the production of a transgenic crop. Explain the steps a, b, c, d and e shown in the figure.



## **ANSWERS**

### **VSA (1 MARK)**

1. Plants, bacteria, fungi and animals whose genes have been altered by manipulation are called Genetically Modified Organisms (GMO).
2. Genetic Engineering Approval Committee.
3. RNA interference prevents infestation and translation of mRNA.
4. *Escherichia coli*.
5. Bt cotton, Bt corn, Soyabean, rice, tomato, potato.
6. *Meloidegyne incognitiae*.
7. By disulphide bridges.
8. Plasmids of *E. Coli*.
9. AIDS, Cancer.
10. It makes decision regarding the validity of G M research and the safety of introducing G M organisms for public services.
11. India is richest country in bio-diversity in the world.
12. Healing properties of turmeric.  
Pesticides from Neem plant.
13. An American company got patent rights on Basmati rice through the U S Patent and Trade mark Office.
14. Crystal protein (*cry* protein).
15. Due to presence of peptide chain which can be digested by protease enzymes and becomes ineffective.
16. ELISA is based on the principle of antigen and antibody interaction.
17. Recombinant DNA technology, polymerase chain reaction (PCR) Enzyme linked immuno - sorbent Assay (ELISA).
18. Basmati.
19. Bt - *Bacillus thuringiensis*.
20. Human alpha - lactalbumin.

### **SA – II (2 MARKS)**

21. Bt toxin protein is produced as inactive protoxin.

It is converted into active form in the presence of alkaline pH of the gut of insects.

The activated toxins binds to the epithelial cells of midgut.

Toxins create pores in the gut that cause cell swelling and lysis, and finally cause death of the insect.

22. G M crops are more tolerant to abiotic stresses.

Pest resistant crops.

Helped to reduce post harvest losses.

Increased efficiency of mineral usage by plants.

Enhanced nutritional value of food.

23. Agro-chemical based agriculture.

Organic agriculture.

Genetically engineered crop – based agriculture.

Genetically engineered crop – based agriculture is the best option because it minimizes the use of fertiliser chemicals.

24. Agriculture Food Industry

Medicine Environmental Engineering.

25. Enzyme Linked Immuno Sorbent Assay

ELISA is based on the principle of antigen – antibody interaction.

Infection can be detected by the presence of antigen or by detecting the antibodies synthesized against the antigens of pathogen.

26. (i) PCR is used to detect HIV infection in suspected AIDS patients at an early stage.

(ii) It is used to detect mutation in genes in suspected cancer patients.

27. Make decisions regarding the validity of G M research.

The safety of introducing G M organisms for public services.

28. Unauthorised use of bioresources and traditional knowledge related to bioresources for commercial benefits are called biopiracy.

Benefits of bioresources should be shared between developed and developing nations.

Laws should be developed to prevent unauthorized exploitation of their bioresources.

29. Industrialised nations are collecting and patenting the genetic resources themselves e.g., an American company got patent rights on Basmati rice.

Valuable biomolecules obtained from bioresources are patented and used for commercial purposes.

Useful genes are isolated from bioresources and patented.

The traditional knowledge related to bioresources is utilized by other nations.

30. Genetic modifications of organisms can have unpredictable results when such organisms are introduced into the ecosystem.

Use of animals in biotechnology causes great suffering to the animals.

31. RNAi silence the gene at translation level. This method involves silencing of a specific mRNA due to complementary dsRNA molecule that binds to and prevent translation of the mRNA (silencing).

32. (a) is mismatched.

PCR can detect very low concentration of pathogen (bacteria, virus) even when the symptoms of disease are not yet visible.

### **SA – I (3 MARKS)**

33. Providing the best catalyst in the form of improved organism usually a microbe or pure enzyme.

Creating optimal conditions through engineering for a catalyst to act.

Down stream processing technologies to purify the organic compounds.

34. Bt toxin.

*Bacillus thuringiensis*.

Man has developed transgenic crops by introducing this gene from bacteria to crop plants such as Bt cotton and Bt corn etc.

35. Strategy based on the process of RNA interference (RNAi)

Mechanism Refer page no. 209 NCERT book.

Nematode – specific genes are introduced into plant using *Agrobacterium* vectors.

36. Insulin consists of two short polypeptide chains : chain A and chain B that are linked together by disulphide bridges.

Proinsulin has an extra stretch of C peptide chain.

Introducing two DNA sequences corresponding A and B chains of human insulin in plasmid of *E. coli*.

37. Reference page no. 211. NCERT book.

38. A crop that contain and express a transgene is called transgenic crop.

<i>Transgenic crop</i>	<i>Normal Breeding technique</i>
1. Any gene can be used for transfer.	Only those genes can be used that are present in such species that can be hybridized with them.
2. Change in genotype can be controlled.	Changes cannot be controlled.

39. Bt toxin is produced by *Bacillus thuringiensis*. Bt toxin gene has been cloned from the bacteria and been expressed in plants to provide resistance to insects.
- Using *Agrobacterium* vectors, nematode specific genes are introduced into the host plant.
- For detail refer page no. 208 and 209 NCERT book.
40. Recombinant DNA technology.
- Polymerase Chain Reaction (PCR)
- Enzyme Linked Immuno Sorbent Assay (ELISA)
- For principle refer page no. 212 NCERT book.
41. Genetically modified crops contain the protein formed by transgene.
- It has antibiotic resistance gene
- It contains the enzyme produced by the antibiotic resistance gene that was used in the gene transfer.
42. A genetically modified food may produce toxicity.
- Enzymes produced by antibiotic resistant gene may produce allergy.
- The bacteria in the alimentary canal could take up antibiotic resistance gene and they may transfer into resistant to the related antibiotics.
43. (i) production of BT toxin, used as biodegradable insecticide for crop protection.  
(ii) *Escherichia coli*.  
(iii) production of human protein – alpha lactalbumin enriched milk.  
(iv) *Agrobacterium*  
(v) Used to test the safety of the polio vaccine.  
(vi) Golden rice.
44. Yes, hereditary disease like ADA deficiency can be cured by gene therapy.
- Refer page – 211 NCERT textbook.

### LA (5 MARKS)

45. To study normal physiology and development of animals.
- Study of diseases.
- Biological products.
- Vaccine safety.
- Chemical safety testing.

46. Biotechnology provides useful products and services by using microorganisms, such as manufacture of baking powder, alcoholic beverages etc.

Used in preparing medicines.

It contributes to sustainable agriculture.

Transgenic plants and animals.

Biotechnology can also be misused in the following ways :

- Biotechnological developments favour rich industrialized nations.
- Biopiracy through biotechnology.
- Can cause biowar.

47. *Step (a)* – Plasmid is removed and cut open with restriction endonuclease

*Step (b)* – Gene of interest is isolated from another organism and amplified using PCR.

*Step (c)* – New gene is inserted into plasmid.

*Step (d)* – Plasmid is put back into Agrobacterium.

*Step (e)* – *Agrobacterium* based transformation.

# CHAPTER 13

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## ORGANISMS AND POPULATIONS

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### POINTS TO REMEMBER

**Adaptation :** Morphological/Physiological/Behavioural change that enables the organism to live successfully and reproduce in its habitat.

**Aestivation :** Summer sleep. Metabolic activities are suspended, like done during hibernation.

**Allen's Rule :** Animals that inhabit in very cold climates have shorter extremities like ear, tail etc. to minimize the heat loss.

**Ammensalism :** Relationship in which one species member is harmed where as other is un-affected.

**Biome :** Ecosystems of large type.

**Commensalism :** Relationship in which one species member is benefited but the other member is neither benefited nor harmed.

**Carrying Capacity :** The maximum population size that an environment can sustain. At this point the population size levels off in the logistic growth model.

**Competition :** Relationship in which both species members are at loss.

**Eurythermals :** Organisms that can survive in the wide range of temperature.

**Euryhaline :** Organisms tolerant of wide range of saline conditions.

**Ecology :** Study of relationship of interaction between organism and abiotic environment.

**Environment :** The aggregate of conditions in the surroundings, affecting the existence or development of someone.

**Emigration :** Permanent departure of individuals from the area under consideration, to somewhere else.

**Homeostasis :** Organisms try to maintain the constancy of the internal environment.

**Hibernation :** Winter sleep. The animal goes into hiding during winter and suspend the body activities to the minimum during that period and conserve the energy e.g., All poikilothermal animals like frog, lizard etc.

**Immigration :** Permanent arrival of individuals to an area after taking birth elsewhere.

**Migration :** Temporary moving away from the stressful habitat to more hospitable area and return to previous area (by the time stressful period is over).

**Mortality :** Number of individuals die in a given time.

**Mutualism :** Relationship in which both species members are benefited.

**Natality** : Number of births/hatching/germination during a given period and added to initial population.

**Osmoconformers** : The organisms that do not control the osmotic concentration of their body fluids, but change the osmolarity of the body fluids according to the medium in which they live e.g., Hagfish, stingray etc.

**Osmoregulators** : The organisms that maintain the internal osmolarity, which is different from the surrounding medium, in which they live e.g., Mammals.

**Population** : Collection of individuals of a species present in a particular geographical condition.

**Population Density** : Number of individuals present in per unit area or volume.

**Parasite** : Organisms getting benefit of space (for living) and nourishment from the host.

**Predation** : Relationship in which one species member devour the member of other species for food.

**Stenothermals** : Organisms that can survive in the narrow range of temperature.

**Stenohaline** : Organisms tolerant of narrow range of saline conditions.

**Species** : Related individuals which have common ancestry, share similar genetic material, freely interbreed in nature and produce fertile offsprings.

## QUESTIONS

### VSA (1 MARK)

1. Suggest two common causes for the seasons to happen.
2. Name two physical factors of the atmosphere which determine a biome such as desert, rain forest and tundra.
- \*3. Why the maintenance of body temperature is significant for the organism?
4. For an aquatic organism, merely being present in the water is not sufficient. Name two qualities of water which should be significant for such organisms.
5. Some organisms migrate temporarily to other places and return back after some time. Why do they do so?
6. When two species interact, what happens in a competition?
- \*7. A fish of fresh water was shifted to the sea, and died after sometime. Suggest the scientific reason of its death.
8. Name two parameters which tend to increase the population density.
9. Name two parameters which tend to decrease the population density.
10. Birds of Siberia leave their place during extreme winters and return afterwards. Where and why do they usually go?
11. Suggest how does a desert lizard show behavioural adaptation during low and high temperature condition.

12. Define Darwin's fitness.
- \*13. Mention one ecological significance of predation.
14. State competitive exclusion principle/Gause's principle.

### **SA – II (2 MARKS)**

- \*15. Which component of the spectrum is harmful to the organisms? Support your view with reasons.
16. Name two physiological changes in the people living in mountain areas, which are helpful to adapt in the atmospheric condition of low oxygen.
17. Name the key abiotic factors which lead to the variations in physical and chemical composition of different habitats.
18. Sometimes the outside temperature goes much lower or much higher than the body temperature. Suggest ways adopted by mammals to achieve homeostasis in both these conditions.
19. Mammals living in very cold places need to conserve their body heat. Name any two anatomical changes in these animals which are helpful in reducing the loss of body heat.
- \*20. Enlist some attributes that a population does have and as an individual and the organism does not.
21. Refer pre-reproductive and post reproductive age groups in declining and expanding populations. Compare for any one aspect.
22. Enlist any four adaptations in desert plants which are helpful in their survival in water deficient (xeric) condition.
- \*23. Mention any two physiological adaptations in kangaroo rat, to meet out the condition of less water availability/xeric condition.
24. Mention two strategies adopted by some of the organisms to overcome the stressful conditions existing for a limited period of time.
25. Explain in brief any two models/patterns of population growth.
26. Enlist any four needs which make the interaction to happen between members of different populations.
27. Enlist any four features in parasite animals which are helpful in making their lifestyle successful.
28. By taking an example, define commensalism.
- \*29. Natality and immigration both tend to increase the population size. How do both these differ in their respective characteristics? Suggest.
- \*30. Mortality and emigration both tend to decrease the population size. How do these differ in their respective characteristics? Suggest.

- \*31. Study the table given below and suggest the name of biome in blank space at A, name of biome in blank space at B, mean annual Rainfall in blank space at C and temperature range in blank space at D.

<i>S.No.</i>	<i>Mean annual temperature</i>	<i>Mean annual rainfall</i>	<i>Name of Biome</i>
1.	30°C	400 cm	A
2.	-10°C	100 cm	B
3.	30°C	C	Hot Desert
4.	D	20 cm	Coniferous Forest

### **SA – I (3 MARKS)**

- \*32. Suggest the way in which the population density is expressed in the following cases.
- Single huge banyan tree with large canopy.
  - Fish in a lake.
  - Tiger census in a national park/tiger reserve.
- \*33. Describe the term hibernation, aestivation and diapause by taking suitable example for each.
34. Define amensalism taking suitable example. Write the way in which it is different from commensalism.
- \*35. Mention at least one example from plants and at least one from animals showing their defence mechanism to escape from becoming victim of predation.

### **LA (5 MARKS)**

- \*36. Establish the relationship between the surface area and body volume. Suggest the reason that we do not find small sized animals in the polar region.
- \*37. Predator and herbivores are not different in broad ecological context. Submit your view in this regard. Mention any three ecological services rendered through predation. Why in nature the predators are said to be prudent?

## **ANSWERS**

### **VSA (1 MARK)**

- (i) Revolution of the earth around the sun.  
(ii) Tilt of the earth on its axis.
- Temperature and rainfall/snowfall.
- Temperature affects the kinetics of enzymes through basal metabolism.
- Salinity and pH.

5. They move from stressful habitat to comparatively comfortable and hospitable area.
6. They strive for the same resource.
7. Fish could not adjust with the changed osmotic conditions.
8. Natality and Immigration.
9. Mortality and emigration.
10. Keoladeo National Park/Ghana Bird Sanctuary in Bharatpur, Rajasthan. They lay their eggs in comparatively warmer and food rich situation.
11. They warm their body by basking in the sun. Escape into shade under high temperature condition.
12. Populations evolve to maximize their reproductive fitness, in the habitat in which they live. Most efficient reproductive strategy is adopted.
13. It is the nature's way of transfer of energy fixed by the green plants, to the higher trophic level.
14. Two closely related species sharing common resource can not co-exist indefinitely. The comparatively inferior in the competition is ultimately eliminated.

Hint – Gause worked on two species of *Paramecium aurelia* and *Paramecium caudatum*. When these two species were cultured separately on a fixed amount of diet, both multiplied and reached finally at constant level, where both species were grown together with a limited amount of food, only *Paramecium aurelia* was left. Importantly *Paramecium aurelia* had not attacked the other species nor secreted any harmful substance.

### **SA – II (2 MARKS)**

15. Ultra violet radiation.  
Shorter wavelength has more energy/penetration capacity in the skin.  
May cause damage to cells, and skin cancer.
16. (i) Increase red blood corpuscles production.  
(ii) Increased breathing rate.
17. Temperature, water, light and soil.
18. When hotter outside, the body releases sweat.  
Evaporation of sweat cause cooling. By movement of muscles (shivering or exercise) heat is generated.
19. (i) Presence of fat layer under the skin acts as insulation.  
(ii) Short size of ear, tail, nose and limbs (hint refer Allen's rule).
20. Birth rate, Death rate, sex ration, age groups.
21. Refer Figure 13.4 page no. 227 of NCERT book.
22. Refer page 225, para adaptations of text book of NCERT.

23. (i) Urine produced is in concentrated form, so water is conserved.  
(ii) Water produced as by product during internal fat oxidation.
24. (i) Migration  
(ii) Suspension of active life through hibernation/aestivation/spore formation.
25. (i) Exponential growth – Population growth in geometric ratio.  
(ii) Logistic growth – Population growth up to carrying capacity with enough resources.
26. Food, pollination, space, digestion of complex organic material.
27. Loss of unnecessary sense organs. Presence of suckers/adhesive organs loss of digestive system, high reproductive capacity.
28. Interaction between two organisms in which one species gets benefit but the other is neither harmed nor benefited. e.g.. Orchid plant growing as an epiphyte on some other tree.
29. Natality pertains to taking birth at the place in study. Immigration pertains to arrival of members to the place of study after taking birth at other place.
30. Mortality pertains to death of individuals at the place of study. Emigration pertains to departure of members to other place.
31. (a) tropical forest,  
(b) Arctic and alpine,  
(c) Less than 25 Cm,  
(d) 0 to 15°C

### **SA – I (3 MARKS)**

32. (a) Percent cover in biomass.  
(b) Nature of fish caught per trap.  
(c) Number per unit area.
33. Hibernation – Water sleep to overcome unfavourable condition.  
Aestivation – Summer sleep to overcome unfavourable condition (desiccation).  
Diapause – Zooplankton suspend their development process under unfavourable conditions.
34. Relationship in which one species is harmed and other is unaffected e.g.. A species produces antibiotic chemical (allochemicals) which prevent growth of other species.
35. (a) Camouflage – to avoid easy detection by predator e.g.. Chameleon.  
Monarch butterfly is distasteful because it acquires a chemical by feeding on poisonous weeds.

(b) *Acacia* develops thorns and escape from browsing animals.

### **LA (5 MARKS)**

36. Small sized animals have a larger surface area. When it is cold outside they tend to lose body heat at faster rate.

To generate more heat, they should have high rate of metabolism and spend energy resource, e.g., in polar regions large sized animals are present, so heat loss is reduced.

37. Predator and herbivores are not different in broad ecological context, it is the way of nature to transfer the energy to next higher trophic level.

Predation keeps population size under control.

Predators should be “provident” meaning that these act with care and have thought for future. If predators overexploit the prey, they themselves will become extinct for lack of food.

Refer page no. 233 NCERT book.

# CHAPTER 14

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# ECOSYSTEM

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## POINTS TO REMEMBER

**Climax Community :** The stable and final biotic community that develops at the end of ecological succession and is in the perfect harmony with its physical environment.

**Detritus :** Dead leaves, twigs, algae, animal remains etc. constitute detritus.

**Detritivore :** Organisms feeding on organic wastes.

**Ecological Succession :** The successive and orderly replacement of one community by the other community in an area, over a period of time.

**Ecological Pyramids :** The sequential graphic representation of an ecological parameter (number/biomass/energy) depicting different trophic levels in a food chain.

**Ecosystem :** Relationship between living organisms and their abiotic surrounding.

**Food Chain :** The unidirectional representation of transfer of food energy through connected organisms with repeated stages of eating and being eaten.

**Food Web :** Intermingled food chains in a community constitute food web.

**Gross Primary Productivity :** Rate of production of organic matter during photosynthesis.

**Net Primary Productivity :** Gross primary productivity minus the respiratory losses.

**Primary Productivity :** Amount of biomass or organic matter produced by producers per unit area over a period of time.

**Standing Crop :** Amount of biomass present in various trophic levels in a population at a given time. (The term applies equally well to plants and animals).

**Standing State :** The amount of minerals/nutrients present in the soil at a given time.

## QUESTIONS

### VSA (1 MARK)

1. Suggest one word for different levels occupied by different species during their distribution in a community.
2. Expand the term PAR.
3. What do you mean by trophic level?
- \*4. Name the situation in which an ecological pyramid is inverted in shape.

5. Name one detritivore.
- \*6. Name the ecological pyramid which is always upright and never inverted.
7. Nutrients are taken up by the organisms from the ecosystem, but are never lost. Suggest how it become possible?
8. Name two climatic factors that regulate decomposition process through their activities of soil microbes.
9. Study the representation of ecological pyramid given below. Identify and name the ecological pyramid. Also mention the position of small standing crop.

**Primary Consumer**

**Primary Producer**

**SA – II (2 MARKS)**

10. Mention the two types of primary productivity in brief.
11. Name different functional components of ecosystem which function as a unit.
12. Establish relation between gross primary productivity and net primary productivity.
- \*13. Mohan said that “animal diet provides more energy”. Sonu did not agree with this statement of Mohan. Suggest your view by taking scientific basis in this regard.
14. What is standing crop and standing state?
- \*15. A plant species is replaced by the other species over a period of time during ecological succession. Suggest two reasons for this type of happening.
16. What is a pioneer species and climax community in aspect of ecological succession?
- \*17. Make a comparison for two points between primary succession and secondary succession.
- \*18. Compare the grazing food chain and detritus food chain in the aspect of their (a) origin and (b) energy status.
19. What are saprotrophs? Mention their ecological significance.
20. Make comparison for two points between hydrarch succession and xerarch succession.

**SA – I (3 MARKS)**

21. Enlist the different stages involved in the primary succession in an aquatic situation.
22. With the help of simple ray diagram, show the cycling of phosphorus in a terrestrial ecosystem.
23. Enlist any six services provided by ecosystem.

24. Study the table given below and fill the blanks from A to F

S.No	Component of the Ecosystem	Position of the trophic level	Organism present in the Food chain
1.	E	Fourth tropic level	F
2.	Secondary consumer	D	Bird, fish, wolf.
3.	B	Second tropic level	C
4.	Primary producer	A	Phytoplankton, grass, tree.

\*25. Fill in the blank from a to f in the following questions :

(a)..... involves breakdown of detritus into small pieces by detritivores

Water soluble inorganic nutrients go down with soil layers. The process is called (b) .....

Enzymes of (c) ..... and (d) ..... degrade organic material. The process is called (e) ....

(f) ..... involves breakdown of detritus into small pieces by detritivores

### LA (5 MARKS)

26. Describe the different steps involved in the process of decomposition of dead remains of plants and animals.

## ANSWERS

### VSA (1 MARK)

1. Stratification.
2. Photosynthetically Active Radiation.
3. Organisms having a feeding relationship with the other organisms called trophic level/food level.
4. Pyramid of biomass in an aquatic system is inverted. (*Hint* : Small standing crop of phytoplankton support large standing crop of zooplankton).
5. Earthworm (Eats dead and decaying matter).
6. Pyramid of energy. (When energy flows from a particular trophic level to the next trophic level. Some energy is always lost as heat at each step).
7. Nutrients are recycled time and again indefinitely. (*Hint* : Though the nutrients are taken up from the environment. These may be retained till the organism lives. These are returned back to the environment by bacteria and fungi, after the death of the organism, by the process of decay).
8. Temperature, Soil moisture.

9. Pyramid of biomass in aquatic system. Primary producers represents small standing crop.

### **SA – II (2 MARKS)**

10. (i) Gross Primary Productivity – The amount of biomass present in different trophic levels in an ecosystem.  
(ii) Net Primary Productivity – The amount of biomass left after eliminating the loss in respiration from gross primary productivity.
11. Productivity, Decomposition, Energy flow, Nutrient supply.
12. The rate of production of organic matter/biomass in an ecosystem is the GPP. A considerable amount of this organic matter is utilized in respiration. After loss in respiration, the remaining biomass is referred as NPP.
13. Animal diet does not provide more energy. On contrary, the vegetable diet provides more energy. The trophic level which is more close to producer provide more energy.  
(Hint use 10% law for transfer of energy at each trophic level)
14. The amount of living material present in different trophic levels at a given time is standing crop.  
The amount of nutrients/minerals present in soil at a given time is standing state.
15. Each set of organism changes the physical conditions/microclimate thereby making conditions unfavourable.  
The community that is more complex and more specific in requirements of new situation, establishes itself.
16. The species which invades first in the barren area.  
The community which is present at the end of ecological succession and is present in harmony with the environment.
17. *Primary Succession*                                   *Secondary Succession*
- |  |  |
|--|--|
| (i) Starts from barren area where no soil was present.     | (i) Starts in area where soil is present but biotic communities have been destroyed by fire etc. |
| (ii) Competition between species is tough.                 | (ii) Competition between species is not so tough.  |
| (iii) Introduction of new species is not easy.             | (iii) Introduction of new species is easier.   |
| (iv) Takes longer time to reach at climax, say 1000 years. | (iii) Takes lesser time to reach climax say 100 years.   |
18. (a) Grazing food chain starts from producers. Detritus food chain starts from organic matter.  
(b) Grazing food chain is the major conduit of energy flow in an aquatic system.

19. Saprotrophs are the organisms which fulfill their energy and nutrient requirement by degrading the organic matter.

Saprotrophs are significant ecologically in the sense that they convert the complex food material into simpler form thus returning the minerals back into nature.

20. *Hydrarch Succession*                                   *Xerarch Succession*

- |   |  |
|---|--|
| (i) Succession stages proceed from hydric (water) to mesic (neither dry nor wet). | (i) Succession stages proceed from xeric (dry) |
| (ii) It starts in water.  | (ii) It starts on barren rock.                 |

### **SA – I (3 MARKS)**

21. Phytoplankton,

Submerged plant stage,

Submerged free floating plant stage,

Reed – swamp stage,

Marsh – meadow stage,

Scrub stage and then climax forest.

22. Refer fig. 14.7 page no. 255 NCERT text book.

23. Forest ecosystems purify air and water,

Mitigate droughts and floods,

Cycling of nutrients,

Generate fertile soil,

Provide wildlife habitat,

Maintain biodiversity,

Pollinate crops,

Storage site for carbon and its products,

Provide aesthetic, cultural and spiritual values.

24. (a) First trophic level

- (b) Primary consumer

- (c) Zooplankton, grasshopper, cow.

- (d) Third trophic level.

- (e) Tertiary consumer
  - (f) Man, lion.
25. (a) fragmentation
- (b) leaching
  - (c) bacteria
  - (d) fungus
  - (e) catabolism
  - (f) decomposition.

### **LA (5 MARKS)**

26. The dead remains of plants and animals called detritus undergo decomposition and converted into simple substances. The steps of this process are :

Fragmentation, Leaching, Catabolism, Humification, Mineralisation.

Refer Subtopic 14.3 page no. 243 NCERT book.

# CHAPTER 15

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## BIODIVERSITY AND CONSERVATION

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### POINTS TO REMEMBER

**Biodiversity** : The totality of genes, species and ecosystem of a region.

**Biosphere Reserve** : The area with objective to conserve biological diversity along with their natural ecosystem, ecological and environmental research, both within and adjacent to these reserves, and to provide facilities for education and training.

**CITES** : Convention on international trade in Endangered species, under auspices of IUCN with aim of regulating trade in endangered species of animals and plants.

**Cryopreservation** : Preservation in liquid nitrogen at  $-196^{\circ}\text{C}$ .

**Endangered** : Plant or animal species whose number is so few that it is at risk of becoming extinct.

**Extinct** : No reasonable doubt that the last individual has died.

**Endemism** : species confined to that region and not found elsewhere.

**Ex Situ** : Off the site.

**IUCN** : International Union for Conservation of Nature and Natural Resources.

**In Situ** : On the actual site.

**MAB** : Man and Biosphere Program started by UNESCO in 1986.

**National Park** : Area for wild life where forestry, grazing and cultivation is permitted. Private ownership is not allowed.

**Protected Area** : An ecological and biographical area in which wild life is conserved, poaching is prevented, natural resources are protected.

**Sanctuary** : Protected area for wild life where harvesting of timber, collection of minor forest products and private ownership rights are permitted so long as wild life remains in perfect harmony with nature.

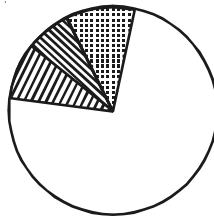
**Species** : Individuals or members of populations capable of reproducing themselves within the group and produce fertile offspring that morphogenetically resemble their parents.

### QUESTIONS

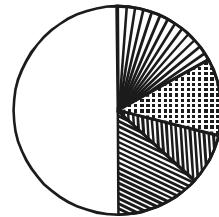
#### VSA (1 MARKS)

1. Name the person who popularized the term biodiversity.

2. What are endemic species?
3. Name the group among animals which is most species rich. Mention the approximate percentage shared by this group among animals.
4. Name the part of the earth having greatest biodiversity.
5. Who proposed the “Rivet popper hypothesis”?
- \*6. Mention any two examples of the species, along with their place from where these became extinct in the last 500 years.
7. Name the ecosystem which faces loss of species most, due to habitat loss and fragmentation.
- \*8. Write two criteria for the identification of “Biodiversity hot spots.”
- \*9. Name the group among animals having highest number of species from
  - (a) Invertebrates and
  - (b) Vertebrates as shown in the diagram given below.



(a) Invertebrates



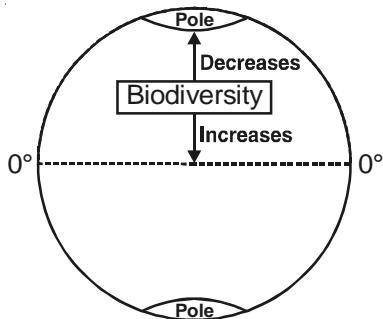
(b) Vertebrates

### **SA – II (2 MARKS)**

- \*10. How is the in-situ conservation strategy different from ex-situ conservation strategy?
11. Suggest any two strategies involved in the in-situ conservation.
12. Enlist any four strategies involved in the ex-situ conservation.

### **SA – I (3 MARKS)**

- \*13. Explain the three types of biodiversity existing at different levels of biological organization.
- \*14. “The richness or wide variety in a community is related to the functioning of the ecosystem.” Support three view points in this regard.
15. Suggest any three possible consequences followed by loss of biodiversity in a region.
16. Describe three needs felt to conserve biodiversity.
- \*17. Study the diagram of the earth given below. Give the name of the pattern of biodiversity shown therein. Suggest any two reasons for this type of happening.



### **LA – (5 MARKS)**

18. Define latitudinal gradients. Suggest this with example. Mention any three reason/hypotheses that might account for greater biological diversity in tropical areas.
- \*19. Explain reasons for loss of biodiversity, commonly known as “The Evil Quartet.” Why do we grieve for the genes when a species is lost?

### **ANSWERS**

#### **VSA (1 MARK)**

1. Edward Wilson
2. The species restricted to a particular area and not found elsewhere in nature, so called endemic species.
3. Insecta is the most species rich group among animals. It is about 70% of all the animals.
4. Amazon tropical rain forest in South America.
5. Paul Ehrlich proposed the Rivet popper hypothesis.
6. Refer para Loss of Biodiversity on page no. 263 NCERT book.
7. Tropical Rain Forest.
8. High level of species richness.  
High degree of endemism.
9. (a) Insects (b) Fishes

#### **SA – II (2 MARKS)**

10. In-situ conservation is done on the site. Ex-situ conservation is done off the site.
11. Creation of protected areas like biosphere reserves, national parks and sanctuaries. Sacred groves where plants and animals are treated with great respect.
12. Creation of zoological parks, botanical gardens and wildlife safari parks.

Cryopreservation of gametes.

In vitro fertilisation.

Propagation through tissue culture.

Creation of seed banks.

### **SA – I (3 MARKS)**

13. Biodiversity exists at the following levels :

1. *Genetic Diversity* : It exists in number, type of genes (alleles) as well as chromosomes present in a species. India has about 50000 types of rice and about 1000 types of mango.
2. *Species Diversity* : Exists in the richness of different species e.g.. Amphibian species are rich in number in western ghats than in eastern ghats.
3. *Ecological Diversity* : Exists in the variety of ecosystems that occur over a total landscape or geographical area e.g.. India has variety of ecosystems like deserts, rain forests, mangroves, wetlands, estuaries and alpine etc.

14. The richness or wide variety in a community is related to the functioning of ecosystem. It can be exemplified by the following view points :

The communities having more number of species are more stable than those with lesser number of species.

Communities with greater number show greater resistance to invasions by alien species and pathogens.

Increased biodiversity contributes to higher productivity.

15. Loss of biodiversity in a region may lead to :

Decline in plant production.

Less resistance to environmental imbalances like drought and floods.

Increased variations in the process of ecosystem viz. plant productivity, water use, pest and disease cycles etc.

16. *Narrow Utilization Aspect* : Humans derive direct benefit from nature in the form of food, fibre, medicine, firewood, industrial products etc. The nations which have rich biodiversity can be more beneficial to reap the benefits.

*Broad Utilization Aspect* : Biodiversity plays a major role in the ecosystem services that nature provides. Oxygen availability, pollination, aesthetic pleasure etc. and many other unaccounted benefits we get.

*Ethical Aspect* : Every species has its own intrinsic value. We have the moral duty to care for the well being of the other animal and plant species, we share with, on this planet. We must conserve the present for the future of our children.

17. Latitudinal gradients

- (i) More solar energy available in tropics, contribute to higher productivity, and greater biodiversity.
- (ii) Tropical environments are less seasonal, so more practicable.

**LA (5 MARKS)**

18. It is generally observed that the diversity of species decreases as we move from equator towards the poles e.g.. Columbia which is situated near the equator has about 1,400 species of birds while Greenland which is near the pole has about 56 species of birds.

A few hypotheses have been put forward by the ecologists which explain the greater biodiversity near the equator :

- (i) For millions of years, tropical latitudes remained undisturbed, but temperate regions faced frequent glaciations (ice ages) in the past. There was a scope for evolution at large scale near equator.
- (ii) Environment of tropics is relatively more constant than others. The constancy in the environment promotes niche specialization and greater species diversity.
- (iii) Comparatively more solar energy is available in tropics. Higher productivity leads to greater diversity.

19. "The Evil Quartet" saying states reasons for loss of biodiversity :

*Habitat loss and fragmentation* : When large habitats are broken up into smaller fragments due to various human activities, the animals requiring large territories (elephants, birds etc.) are badly affected and their populations decline.

*Over Exploitation* : When need for a resource becomes greed. Over exploitation of passenger pigeon resulted in its extinction. Similarly marine fish is at brink of being endangered due to over exploitation.

*Alien Species Invasion* : Intentional or non-intentional introduction of a species to a nearby area may disturb the harmony of existing species. *Eichhornia* (water hyacinth) after introduction, posed threat to native species.

*Co-extinction* : Extinction of one species invariably lead to extinction of the other. When host species is extinct, the parasites dependent on it also die.

We grieve for the lost genes, because the wild forms are hardy and more resistant to pathogen attack.

# CHAPTER 16

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## ENVIRONMENTAL ISSUES

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### POINTS TO REMEMBER

**CPCB** : Central Pollution Control Board.

**Effluents** : Something flowing over a large body of water (may be sewage or industrial effluents).

**Eutrophication** : Nutrient enrichment of water, supports growth of plant and animal life forms, and consequent loss of species diversity.

**Pollution** : Undesirable physical/chemical/biological characteristics of air/water/land which cause damage to the animals/plants/humans and architectural structures.

**Pollutants** : Agents which cause pollution.

**Planktons** : Free floating, passively drifting organisms in a water body (may be phytoplankton/zooplankton).

**Stratosphere** : Part of atmosphere between vertical height of 10 to 60 km, lacks dust and moisture, having ozone, oxygen-ozone inter conversion occurs at expanse of UV radiations.

**Troposphere** : Part of atmosphere between 10 km of vertical height, life supporting region, temperature falls with rise in height, warm air cools as it rises and causes rain etc.

### QUESTIONS

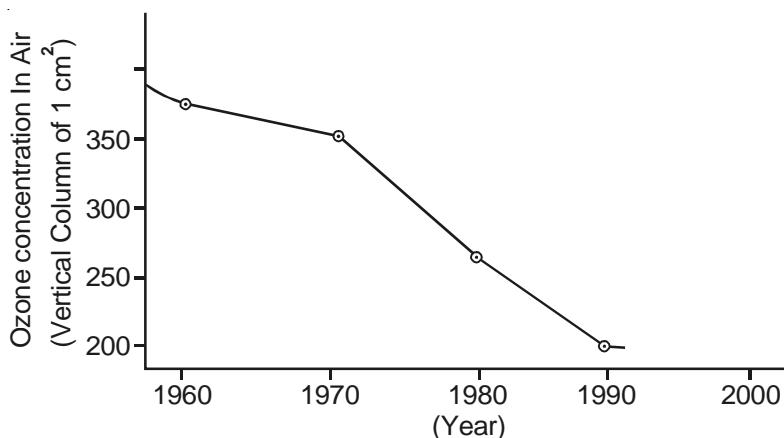
#### **VSA (1 MARK)**

1. Expand the term BOD.
2. What is Dobson unit?
3. What is ozone hole?
4. Expand the term FOAM.
5. Name the agency which monitors the level of pollution and decide the parameters.
6. Name two types of pollutants which are primarily responsible for pollution of Ganga river and Dal lake.

#### **SA – II (2 MARKS)**

7. Enlist four harmful effects caused to the humans by living in polluted air.
8. Suggest two ways to remove pollutants present in the air.

9. Enlist any four disorders caused by noise pollution.
10. Suggest any four way to reduce the noise pollution.
11. What is the cause of algal bloom? Mention any two harmful effects of it.
- \*12. Establish the relation between eutrophication and cultural/accelerated eutrophication.
13. Suggest the main steps involved in the integrated waste water treatment.
14. What is e-waste? How it is treated?
15. What is Montreal Protocol? What is the significant aspect of it?
16. Study the graph given below and suggest the name for the happening shown there in. Suggest control measures to reduce this effect.



### **SA – I (3 MARKS)**

17. Enlist any six benefits of integrated organic farming.
18. Enlist any six effects caused to humans due to widening of ozone hole.
19. Suggest any three ways to spread the awareness by people's participation regarding conservation of forests.
20. Enlist the consequences of deforestation.
- \*21. Complete the missing links in the following continuous events :

**Lake is young, water is cold, supports life**

**With time streams draining into lakes and add nutrients**

**Encourages growth of (a) ..... organisms.**

**Fertility increases, plant and animal life (b) .....**

<b>Organic remains begin to deposit at (c) .....</b>
<b>Over centuries (d) ..... and organic debris pile up</b>
<b>Lake grows shallower and (e).....</b>
<b>Marsh plants take root, begin to fill in original lake base</b>
<b>Ultimately lake gives way to masses of floating plants</b>
<b>Finally converts into (f).....</b>

### **LA (5 MARKS)**

- \*22. What is ozone hole? Describe in detail the steps leading to ozone depletion in the stratosphere. What should be done to minimize the damage to the ozone layer?

### **ANSWERS**

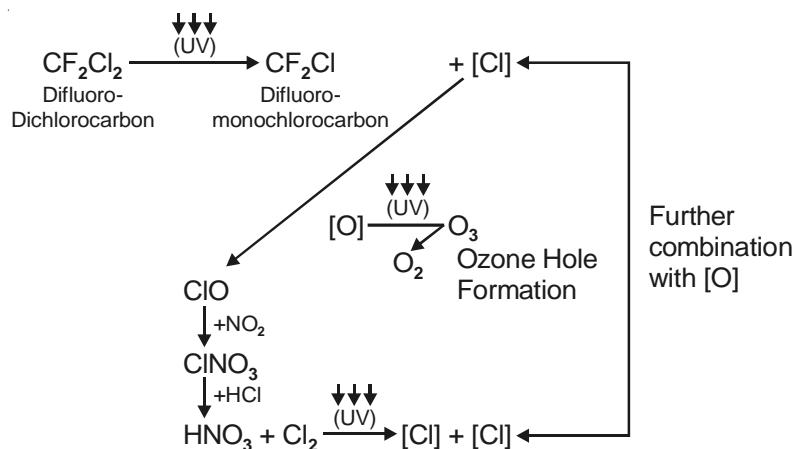
#### **VSA (1 MARK)**

1. Biochemical Oxygen Demand.
2. It is a measure of thickness of ozone in the column of air from the ground to the top of atmosphere.
3. The part of atmosphere having thinned ozone layer called ozone hole.
4. Friends of Arcata Marsh.
5. Central Pollution Control Board (CPCB).
6. (i) Sewage from municipal cities.  
(ii) Release from industries.

#### **SA – II (2 MARKS)**

7. Breathing problem                                  Irritation and inflammation  
    Damage to lungs    Premature death
8. *Electrostatic Precipitators* : The electrically charged particles are neutralized and separated from polluted air.  
*Scrubbers* : Polluted air is passed through a spray of water or lime and gases present in air are removed.
9. Sleeplessness, increased heart beat, altered breathing pattern, impaired hearing leading to the permanent loss of hearing.

10. Noise mufflers sound absorbing materials  
 Horn free zones regulated timing to play loudspeakers.
11. Large amount of nutrients present in water body causes excessive growth of algae. This is called algal bloom. It may pose following harms :  
 Fish mortality Deterioration in fish quality  
 Toxic to animals and humans.
12. Eutrophication is the process of natural ageing of the lake. Addition of sewage or industrial pollutants into the lake accelerate the ageing of the lake. It is called cultural or accelerated eutrophication.
13. Sedimentation, filtering and chlorination of waste water.  
 Absorption and assimilation of pollutants by algae, fungi and bacteria.
14. The ir-repairable computers, mobiles and other their electronic items constitute e-waste. It is (1) either buried or incinerated. (2) Recovery of useful metal and its recycling.
15. Montreal Protocol is an international treaty signed at Montreal (Canada) in 1987 (effective from 1989).  
 Releasing the deleterious effects of ozone depletion, separate directives have been formulated for developed and developing countries to reduce chlorofluorocarbon and other ozone depleting substances.
16. Ozone hole formation. Minimise the use of Chlorofluorocarbons. [Hint – Schematic representation of the ozone hole formation.]



### SA – I (3 MARKS)

17. Zero water procedure Maximum utilization of resources.  
 Nutrients are recycled Increased production efficiency.  
 Cyclical process Less dependence on chemical fertilizers.  
 Sustainable venture Extremely economical.

18. DNA mutation due to UV rays                    Skin cancer  
Inflammation of cornea                            Cataract  
Skin ageing    Permanent corneal damage.
19. People's involvement in the conservation of forests is the prime need of the time. Various movements and awards have been initiated.  
*Amrita Devi Bishnoi Wildlife Protection Award* : It is given to individuals or communities from rural areas that have shown extra ordinary courage and dedication in protecting wildlife.  
*Chipko Movement* : People of Garhwal protected trees from the axe of contractors by hugging the trees.  
*Joint Forest Management* : Govt. agencies work closely with local people in managing and protecting the forests. Forest produce is shared with people and forests are conserved in sustainable manner.
20. Enhanced CO<sub>2</sub> concentration in atmosphere. Habitat destruction.  
Loss of biodiversity                                    Soil erosion  
Desertification                                        Disturbed hydrological cycles.
21. (a) Aquatic    (b) Begins to grow rapidly  
    (d) Silt  
(c) Bottom of lake                                      (f) Land  
(e) Warmer

### LA (5 MARKS)

22. The part of the atmosphere where ozone is present in lesser concentration is called ozone hole. (It is largely observed above Antarctica).  
Chlorofluorocarbon (CFC) released in lower parts of atmosphere (due to leakage from refrigeration work).  
UV rays split CFC and release atomic [Cl].  
[Cl] traps [O] and ozone is not formed again from oxygen.  
UV rays also split ozone into oxygen. O<sub>3</sub>  $\rightleftharpoons$  O<sub>2</sub> + [O]  
[Cl] traps [O] and ozone is not formed again from oxygen.  
Depletion of ozone in the stratosphere.  
Under Montreal protocol (1987, 1989), an international treaty have framed separate guidelines for developed and under developed countries to minimize the release of CFC and other ozone depleting chemicals.

## CLASS XII

# DESIGN OF THE QUESTION PAPER : BIOLOGY

Time : 3 Hrs.

Max Marks : 70

The weightage of the distribution of marks over different dimensions of the question paper shall be as follows :

### A. Weightage to Content/Subject Units

<b>Unit</b>	<b>Content</b>	<b>Marks</b>
1.	Sexual reproduction	12
2.	Genetics and evolution	20
3.	Biology and human welfare	12
4.	Biotechnology and its applications	12
5.	Ecology and environment	14
<b>Total</b>		<b>70</b>

### 3. Weightage to Different from of Questions

<b>S. No.</b>	<b>Form of Questions</b>	<b>Marks for each</b>	<b>No. of Questions</b>	<b>Total Marks Questions</b>
1.	Very Short Answer (VSA)	1	8	08
2.	Short Answer (SA II)	2	10	20
3.	Short Answer (SA I)	3	09	27
4.	Long Answer Type (LA)	—	3	15
<b>Total</b>		<b>—</b>	<b>30</b>	<b>70</b>

### 4. Scheme of Options

2. There will be no overall option.
3. Internal choices (either/or type) on a very selective basis has been provided. This choice has been given in any one questions of 2 marks any one question of 3 marks and all the three questions of 5 marks weightage.

### **3. Weightage to Difficulty Levels of Questions**

<b>S. No.</b>	<b>Estimated Difficulty Level</b>	<b>Percentage</b>
1.	Easy	15
2.	Average	70
3.	Difficult	15

A question may vary in difficulty level from individual to individual. As such, the approximation in respect of each question will be made by the paper setter on the basis of general expectation from the group as a whole. The provision is only to make the paper balanced in nature rather than to determine the pattern of making at any stage.

## CLASS XII

# MODEL PAPER – 1 (SOLVED) : BIOLOGY

Time : 3 hours

Maximum Marks : 70

### **General Instructions :**

1. This question paper consists of four sections A, B, C and D. Section A contains 8 questions of 1 mark each. Section B is also of 10 questions of 2 marks each. Section C is of 9 questions of 3 marks each and Section D is of 3 questions of 5 marks each.
2. All questions are compulsory.
3. There is no overall choice. However an internal choice has been provided in one question of 2 marks, one question of 3 marks and all questions of 5 marks weightage. Attempt only one of the choices in such questions.
4. Question number 1 to 8 are to be answered in one word or one sentence each.
5. Question number 9 to 18 are to be answered in approximately 20 to 30 words each.
6. Question number 19 to 27 are to be answered in approximately 30 to 50 words each.
7. Question number 28 to 30 are to be answered in approximately 60 to 80 words each.

### **SECTION A**

1. What is parthenogenesis?

*Development of an egg (ovum) into a complete individual without fertilisation.*

2. From the scene of crime, some blood stains or a person suspected to be involved in the crime is taken. By what technique will the involvement of suspect A and B be detected and what is its genetic basis?

*DNA fingerprinting.*

*DNA polymorphism.*

3. Name the Nobel laureate of Mexico who was pioneer in the Green Revolution of India.

*Norman E Borlaug*

4. The gene encoding "cry" protein is inserted in a crop plants. Why crop plant with gene encoding for "Cry" protein becomes resistant to a group of insects for which this protein is toxic?

*The toxin produced by cry gene is insect group specific.*

5. Which mould did not allow bacteria *Staphylococci* to grow in the plate which Alexander Fleming was culturing the name the chemical derived from that mould.

*Penicillium notatum*

*Penicillin*

6. Give one use and one disuse of chlorofluorocarbons.

*Use – It is used as refrigerant.*

*Disuse – Causes ozone hole in upper layer of atmosphere.*

7. Visualise the effect of global warming on (a) photosynthesis (b) growth of bacteria and pathogens.

(a) *Photosynthesis will be increased.*

(b) *Bacterial and pathogens will be on rise.*

8. Endonuclease is unable to read the palindromic nucleotide sequence. Point the location at which it will cut the DNA strand.

*It will not cut the DNA segment (because of inability to read specific site for cut).*

## **SECTION B**

*Extraction of chain A and chain B separately.*

*Combining the separate chains by disulphide bonds.*

14. Visualise the impact of the rising temperature of the earth on :

(a) Life forms in alpine areas.

(b) Migration of animals

(a) *Reptiles and other poikilothermous will move toward alpine areas.*

(b) *Migration of other animals will halt.*

15. What are euryhaline and stenohaline organisms?

*Euryhaline organisms work in a wide range of saline conditions.*

*Stenohaline organisms work in a narrow range of saline conditions.*

16. Enlist four consequences caused by improper resource utilization practice.

*Soil erosion*

*Desertification*

*Water logging*

*Soil salinity*

17. Explain the procedure/method to develop a selectable marker using  $\beta$ -galactosidase which is used to differentiate recombinants from non-recombinants.

## OR

Explain the function of restriction endonuclease in recombinant DNA technology by giving an example of enzyme Eco RI.

*Insertional inactivation method.*

*A recombinant DNA inserted within the coding sequence of an enzyme  $\beta$ -galactosidase to make the enzyme inactive.*

*If the plasmid of bacteria does not have an insert, the chromogenic substrate gives blue coloured colonies.*

*Presence of insert results into insertional inactivation of the  $\beta$ -galactosidase and the bacterial colonies do not produce any colour.*

## OR

*Each restriction endonuclease find the specific recognition sequence by instructing the length of DNA sequence.*

*It binds to the DNA and cut each of the two strands of the double helix at specific point in their sugar phosphate backbone.*

18. Our farming changed with time from organic inorganic biofertilizers as far as minerals are concerned. Explain this change and the reasons thereof.

*Organic farming – Minerals to be provided through manure (old technique)*

*Inorganic farming – Minerals are supplied through chemical fertilizers (now discarded).*

*Minerals are made available by microorganisms called biofertilizers like bacteria (new).*

## SECTION C

19. Distinguish between in breeding and outbreeding. Which do you consider better and why?

*Inbreeding is mating between animals of the same breed and it increases homozygosity which may result in inbreeding depression.*

*Outbreeding is mating between animals of different breeds. It increases heterozygosity which may result hybrid vigour or heterosis.*

*Outbreeding is better because it provides more variations which give better chances of selection in new environment.*

20. Suggest any three practices that a couple should adopt to delay pregnancy or space between children.

*Use of condom. Use of diaphragm, cervical cap and vaults by female only to cover cervix during coitus.*

*Use of intra uterine devices like Lippes loop (non-medicated), Copper releasing IUD (Copper – T) and hormone release IUD.*

21. Name the intimate connection between foetus and uterine wall of mother. How does this structure also act as an endocrine tissue?

### OR

Name the structure formed just after morula. Write the name of outer envelop of this structure. Mention the fate of inner cell mass of this structure. How does stem cell differ from other cells of the inner cell mass.

*Placenta*

*It produced placental hormones like hCG, hPL, estrogen, progesterone and relaxin etc.*

*These hormones are essential for foetal growth.*

### OR

*Blastocyst*

*Trophoblast*

*Three layers from inner cell mass – Ectoderm, Mesoderm and Endoderm.*

*Stem cell has capability to form a complete organ/organism (Totipotency).*

22. Explain the drug resistance observed in bacteria in the light of Darwinian Selection theory.

*Natural selection is a process in which heritable variations enabling better survival are enabled to reproduce and leave greater number of progeny.*

*Bacteria with gene for drug resistance survive as having selective advantage and leave greater number of progeny.*

*The number of bacteria with resistance will increase in the population, making the drug ineffective.*

23. Early diagnosis of pathogen is not possible by conventional methods. Name any two techniques that serve the purpose of early diagnosis. Explain any of the technique.

*Recombinant DNA technology.*

*Polymerase Chain Reaction (PCR)*

*Enzyme Linked Immunosorbent Assay (ELIZA)*

*ELIZA – It is used to detect HIV/AIDS.*

*It is based on the principle of antigen – antibody interaction.*

*Infection by pathogen can be detected by the presence of antigens or by detecting the antibodies synthesized against the pathogen.*

24. Draw a labeled diagram of simple stirred – tank bioreactor and label any six parts.

*Figure 11.7(a) Page no. 204 NCERT book.*

25. Mention two major incidents of radioactive leakage. What harm does the radiations cause to the organisms? What ways do you suggest for safe disposal of nuclear wastes?

*Case of accidental radioactive leakage – (a) Three Mile Island (b) Chernobyl incident.*

*Harm – (a) Lethal in high doses (b) Cancer in low doses. Damage to DNA*

*Disposal – (a) Radioactive waste to be kept in shielded containers. (b) Bury deep in the earth.*

26. Give three examples in which organisms suspend their active metabolism to survive during unfavourable conditions.

*Bacteria, fungi and lower plants develop their walled spores which help them to survive during unfavourable condition. They become active when favourable conditions come back.*

*Seeds have a feature called ‘seed dormancy’. In this condition, they suspend active phase of life. Under favourable moisture condition, the seeds germinate.*

*Animals like reptiles, amphibians may go into hiding called hibernation (winter sleep) or aestivation (summer sleep). When favourable conditions are there, animals become active again.*

27. In pea plant, smooth seed coat is dominant over wrinkled seed coat. What will be the expected ratio of phenotype and genotype of the progeny of F1 in a cross of :

(a) Heterozygous smooth X Homozygous smooth

(b) Heterozygous smooth X Heterozygous smooth

(a) :				(b) :				
Parent	Ss	X	ss	Ss	X	Ss	Ss	s
Gamete	(S)		(S)	(S) .... (S)		(S)	(S)	(S)
Phenotype	Smooth	Wrinkled		Smooth	Smooth	Smooth	Smooth	Wrinkled
Phenotypic ratio	1	:	1	3	:			1
Genotypic ratio	Ss	:	ss	SS	:	Ss	:	ss
	1	:	1	1	:	2	:	1

## SECTION D

28. Describe in brief the events from pollination to fertilisation in angiosperms. What changes occur in ovule and ovary after fertilisation?

OR

How does a female gametophyte develop in angiosperm. Explain.

*The pollen grain reaches at the stigma by any agency. If pollen is compatible, stigma accepts.*

*Pollen tube grows. Content of pollen grain shifts into pollen tube (vegetative nucleus move followed by male gametes).*

*Pollen tube enters into style and finally reach into ovule.*

*One male gamete fuses with egg cell (syngamy).*

*Another male gamete fuses with secondary nucleus (two polar nuclei) (Triple fusion).*

*The phenomenon is called double fertilisation.*

*Ovule converts into seed.*

*Ovary develops into fruit.*

OR

*Megasporangium undergoes meiotic division which results formation of four megasporangia.*

*One of the megasporangia is functional while other three degenerate.*

*Functional megasporangium divides mitotically thrice to form eight nuclei with seven cells at maturity and called embryo sac.*

*Six nuclei are surrounded by cell wall and organized into cell. Three cells grouped together at micropylar end constitute egg apparatus (1 egg cell + 2 synergids). Three cells grouped at chalazal end, called antipodal cells.*

*Remaining two nuclei called polar nuclei are situated in the center (central cell).*

*Thus a typical angiosperm embryo sac at maturity, though 8 nucleate is 7 celled.*

29. Name the geneticists who were the first to elucidate a transcriptionally regulated system. Explain the mechanism involved in the regulation of catabolism or lactose.

**OR**

Explain the process of translation which takes place during protein synthesis.

*Francois Jacob and Jaques Monod explained Lac Operon.*

*Constituents – Structural gene, promoter gene, regulator gene and operator gene.*

*Function of each gene.*

*Concept of repressor protein.*

*Role of lactose as inducer.*

*Feedback mechanism to stop operon.*

**OR**

*Translation is polymerization of amino acids with the help of tRNA, mRNA and ribosomes to form polypeptide or protein.*

*mRNA carries information from DNA (nucleus) to ribosome in genetic triplet codes.*

*Specific tRNAs get charged and bring related amino acids to the ribosome.*

*Amino acid chain is initiated, elongated and finally terminated based on codon information.*

*Bond making between amino acids make the polypeptide chain longer.*

*Same mRNA, tRNA and ribosomes are used again and again during translation.*

30. How is innate immunity different from acquired immunity? Describe four main types of innate immunity. Why do we say that colostrum contains passive immunity?

**OR**

Explain cancer in terms of definition, benign and malignant tumor, metastasis, carcinogens, detection and treatment of cancer.

*Innate immunity – Non specific, present at the time of birth, genetically inherited.*

*Acquired immunity – Specific to pathogen, acquired after birth in response to antigen, persist in the individual through memory cells.*

*Physical barriers – Skin and Mucous coating*

*Physiological barriers – Acid in stomach, Saliva in mouth and tears and sweat.*

*Cellular barriers – WBC cells like neutrophil, monocyte, macrophage and lymphocyte*

*Cytokine barriers – Interferon proteins secreted by virus infected cells.*

*Colostrum milk is secreted by mother but immunity contained in it is used by the body of her infant child.*

**OR**

*Uncontrolled cell division is called cancer.*

*If cancerous cells are localized and not growing or spreading, called benign tumor.*

*If cancerous cells are proliferating, growing rapidly, damaging other tissues and spreading to other areas, called malignant cancer.*

*When cells of malignant cancer spread to other locations through blood and cause new tumors, the condition is called metastasis.*

*Carcinogens – Agents which cause cancer. They can be physical (radiations), chemical (smoke, soot) and biological (virus oncogenes)*

*Detection – Through biopsy of suspected tissue, x-rays, CT, MRI, antigen-antibody interaction.*

*Treatment – Radiotherapy, Chemotherapy, Surgery and immunotherapy.*

## **CLASS XII**

# **MODEL PAPER – II (UNSOLVED) : BIOLOGY**

**Time : 3 Hrs.**

**Max. Marks 70**

***General Instruction :***

1. This question paper consists of four sections A, B, C and D. Section A contains 8 questions of 1 mark each. Section B is also of 10 questions of 2 marks each section C is of 9 questions of 3 marks each and section D is of 3 questions of 5 marks each.
2. All questions are compulsory.
3. There is no overall choice. However an internal choice has been provided in one question of 2 marks, one question of 3 marks and all questions of 5 marks weightage. Attempt only one of the choices in such questions.
4. Question number 1 to 8 are to be answered in one word or one sentence each.
5. Question number 9 to 18 are to be answered in approximately 20 to 30 words each.
6. Question number 19 to 27 are to be answered in approximately 30 to 50 words each.
7. Question number 28 to 30 are to be answered in approximately 60 to 80 words each.

### **SECTION A**

1. Define the term clone.
2. How many types of gametes are formed by a double recessive parent?
3. Rat is removed from the forest food chain. Visualise two possible alternatives for snake.
4. Name the enzyme that is used to cut a piece of DNA.
5. Why does Bt cotton toxin not kill *Bacillus thuringiensis* while this toxin is produced by this bacterium?
6. Define linkage.
7. Name the two places where WBCs are differentiated and matured and named accordingly.
8. Name the condition created by HIV in human so that infected person feels difficult to survive.

### **SECTION B**

9. Define polypolidy. Give one example of a polyploid.
10. S.L. Miller created conditions similar to the primitive earth in the laboratory.
  - (a) Name the energy source he used.

- (b) Name the gases he used.
11. Red flowered (RR) plant is crossed with white flowered (rr) plant. The heterozygous F1 resulted in pink flowers. Name the phenomenon involved here and represent the cross.
12. In a lab., bacteria are infected by virus and cultured in two set ups A and B. Set up A medium contains radioactive phosphorus and set up B contains radioactive sulphur. Name the set up which have radioactive DNA and which will have radioactive protein. Cite reasons for the same.
13. Differentiate between exons and introns.
14. Give reasons for
- Upright ecological pyramid
  - Inverted ecological pyramid.
15. A person has adenosine deaminase (ADA) deficiency. Explain the method of gene therapy to cure the disease.
16. How *Agrobacterium tumefaciens* plasmid is preferred for transfer of genes.
17. Differentiate the common drugs Opioids, Cannabinoids and Cocaine in terms of their source, method of consumption and one name each of their processed drug.

**Or**

A drug addict did not get required drug therefore he reacts aggressively. What this reaction is known as? Suggest four measures so that the person can be saved and return to be normal.

18. Now a days we are shifting towards organic farming. What does it mean? Write role of mycorrhiza in organic farming.

## **SECTION C**

19. Suggest various areas of sex education in which the fertile couple should be guided to enjoy happy healthy reproductive life.
20. Draw a diagram of longitudinal section of a pistil showing growth of pollen tube and label the following parts – Pollen tube, antipodal cells, egg cell, stigma, polar nuclei and synergid.
21. Plant breeding program for an improved variety involve many steps. Mention these steps with one advantage each.

**Or**

What are the main reasons for which plant breeding programs are undertaken? Write the role of Single Cell Protein (SCP) with the example of *Spirulina*.

22. Define the terms : Competition, predation and parasitism.
23. What is a domestic sewage? How is it treated by nature in the water bodies? In what manner the amount of sewage in the water body is related with the biological oxygen demand?

24. Draw a labeled cartoon diagram of an antibody molecule showing its structure.
25. Why transgenic animals are being produced? How transgenic animals are helpful in the study of human diseases?
26. Define homologous organs and analogous organs. How do they support the theory of organic evolution.
27. Explain the process of amplification of gene or DNA using polymerase chain reaction.

## SECTION D

28. Describe briefly the reproductive system of human male.

**Or**

Describe briefly the reproductive system of human female.

29. In pea plant, tallness (T) is dominant over dwarfness (t) and round seed (R) is dominant over wrinkled (r) seed. If a pure tall round plant is crossed with a pure dwarf wrinkled plant, calculate the genotypic and phenotypic ratios of offsprings of F1 and F2 generations. Represent the cross by Punnett square.

**Or**

- (i) Gene 'A' is dominant over gene 'a'. What will be the genotypic ratio in offspring of F1 generation obtained from the following matings :
  - (a) Aa × aa
  - (b) AA × aa
  - (c) As × Aa
- (ii) A man has type 'A' blood group and his wife has type 'B' blood group. A physician tests the blood group of their four children. The man was amazed to find that all of them have different blood groups. What explanation could be given that all children belong to the couple and how this had happened?
30. Describe and three reasons for the depletion of biodiversity in an area. Suggest any two conservation strategies to minimize such loss.

**Or**

These days we prefer practicing integrated organic farming over traditional use of pesticide and fertilizers. Write two reasons in its favour. Suggest any six steps involved in integrated organic farming.

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# PRACTICE TEST PAPER : BIOLOGY (THEORY)

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## **General Instructions :**

- (i) All questions are compulsory
- (ii) This question paper consists of four sections A, B, C, and D. Section A contains 8 questions of **one** mark each. Section B is of **10** question of **two** marks each. Section C is of **9** question of **three** marks each and **two** D is of **3** questions and all three questions of **5 Marks** weightage. A student has to answer all three questions of **5 Mark** weightage. A student has to attempt only one of the alternatives in such questions.
- (iv) Wherever necessary, the diagrams drawn should be neat and properly labeled.

## **SECTION A**

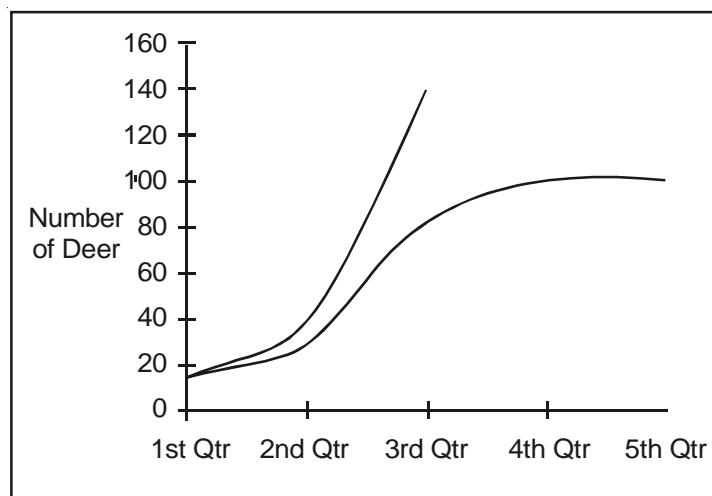
1. Give common name of slash and burn form of agro-forestry. Where is it practiced in India?
2. Leaf cell of a plant has 42 chromosomes. How many chromosomes will be there in endosperm tissue cell and synergid cell of ovule?
3. Name the phenomenon by which male honeybees and some lizards are produced without fertilization of eggs.
4. A man shows certain symptoms like enlargement of breast, reproductively sterile, sparse beard and long legs. Which disorder the person is suffering from and what is the genetic reason for it?
5. Mention the common term used for series of terminal processes like separation, purification and preservation etc. to produce a biotechnological product.
6. Why do we provide oxygen through delivery system in a bioreactor?
7. What are biofertilizers? Write an example belonging to its symbiotic type.
8. If naked protoplasts of two different plants are fused together, what will be the resultant plant known as? Give an example of this process.

## **SECTION B**

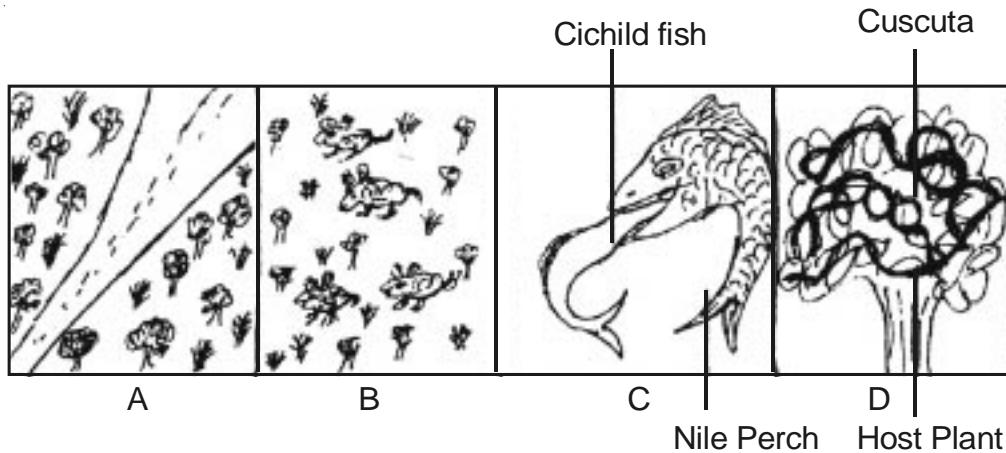
9. Growth of deer populations in two forests are explained through graph.

Observe the graph and answer the following questions

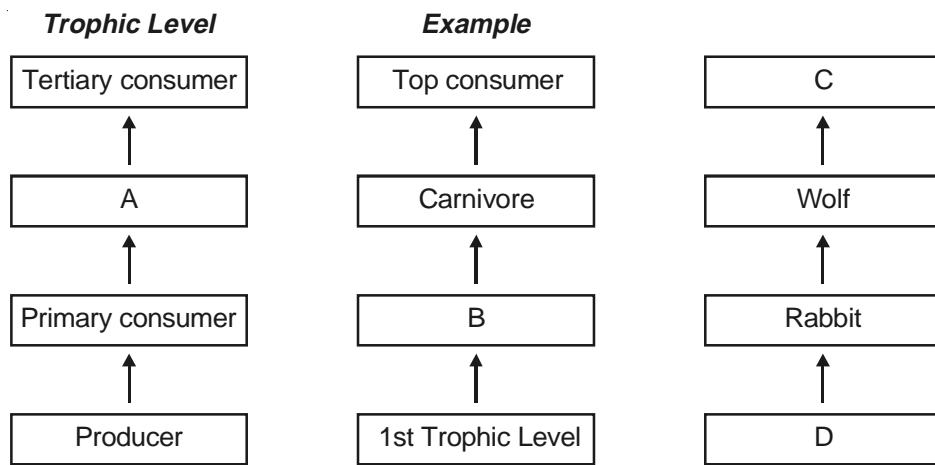
- (i) Which plot of graph shows exponential growth?
- (ii) What is K?
- (iii) Why at population density 100, plot (b) becomes stationary (logistic)?
- (iv) What type of growth pattern is being shown by the plot (b)?



10. Each of the following activities either belong to spermatogenesis or oogenesis. Identify each activity according to its affinity high specific gametogenesis and correlate.
- (i) Polar body separation
  - (ii) Formation of 4 mature gametes
  - (iii) motile gametes
  - (iv) Start of gametogenesis during foetal stage of development
11. The figure shows four different methods of biodiversity loss. Identify and write a reason for each of them.



12. A four member forest food chain is depicted in the figure in three ways having A, B, C, D blank boxes fill these boxes.

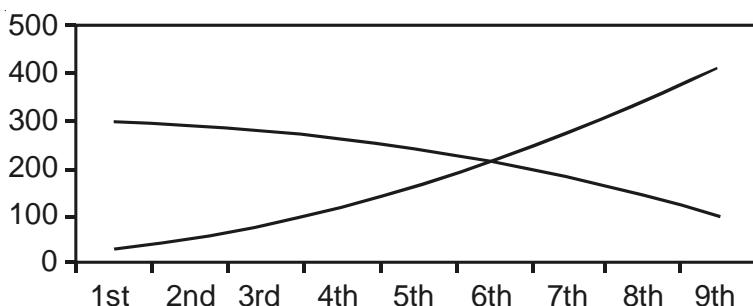


13. Amphetamine and LSD are chemicals called drugs but thought of in two different uses. Name these uses and give the reason for your answer.
14. Write various serial stages in a xerarch environment starting on a bare rock. How is primary succession different from secondary succession?
15. After primary treatment, secondary treatment involves biological agents. Write the role biological agents and product of the treatment.

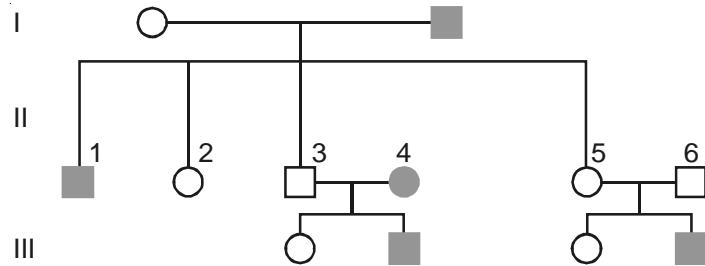
### OR

The graph below shows crop growth patterns of two farmers A and B. Look at graph and answer the following questions-

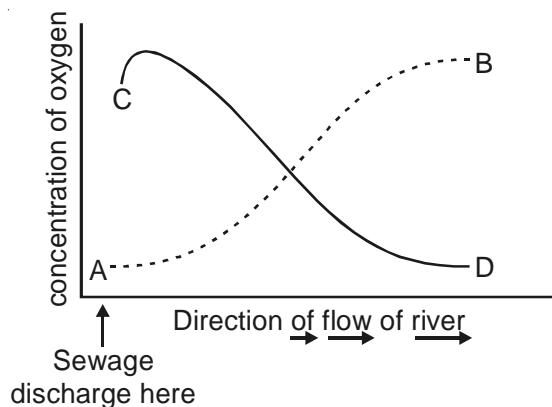
- (i) Which farmer is using biofertilizers and who is using only one type of fertilizer extensively.
- (ii) What are the three major categories of biofertilizers?



16. Although Green Revolution has increased agricultural production tremendously, but modern agriculture has to depend on G M O. In this light, mention the demerits or shortcomings of traditional agriculture.
17. The inheritance of a trait is depicted through the following pedigree chart. Identify whether the trait is dominant/recessive or sex linked. Suggest the genotype of individual no. 2 and 4. What does solid symbol indicate?



18. The graph below shows natural treatment effect in a river after sewage discharge. Study the graph and answer the questions given below :

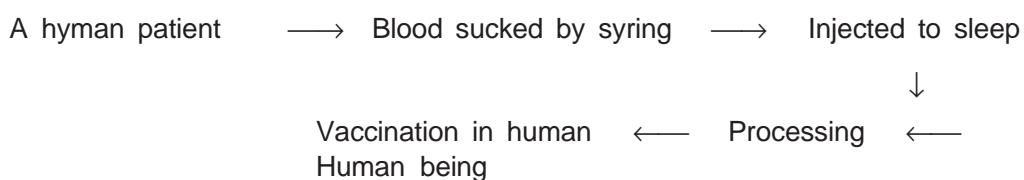


- (i) Name the area which has higher B.O.D.
- (ii) Name the area having highest dissolved oxygen

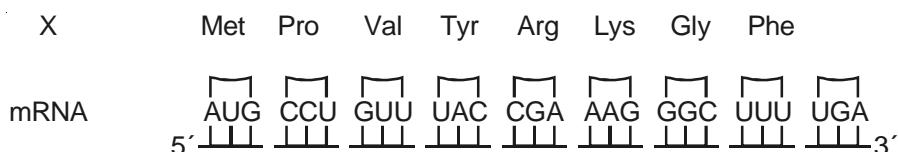
Establish the relation between plots A-B and C-D.

## SECTION C

19. A pure red flower plant is crossed with a pure white flower plant and produced 100% plants with same flower colour in F<sub>1</sub> generation. Two plants of F<sub>1</sub> selfed and produced plants of three different flower colours with same phenotypic and genotypic ratios in F<sub>2</sub> generation. What type of inheritance is this? Write the ratios of plants found in F<sub>2</sub> generation. Which flower colour will be there in F<sub>1</sub> generation?
20. An immunity development process is shown in the flow chart. Observe it carefully and answer the following questions :



- (i) Name the type of immunity shown in flow chart.
- (ii) Define this type of immunity.
- (iii) Write the opposite type of immunity.
- (iv) Give one example of disease which is resisted by this type of immunity.
21. Explain the process of evolution through natural selection taking example of black and white moth of England.
22. What differences do bioconservationists find in '*in situ*' and '*ex situ*' conservation strategies? Write various forms of '*in situ*' conservation strategy.
23. Explain five main steps in breeding a genetic variety of crop? Name a hybrid variety of wheat developed during Green Revolution.
24. Read the sequence of nucleotides in the given segment of mRNA and the respective amino acid sequence in the polypeptide chain and then answer the questions that follow-



- (i) Write the nucleotide sequence of DNA which has transcribed this mRNA.
- (ii) What will happen if 3<sup>rd</sup> base of tyrosine amino acid changes to G
- (iii) Write the anticodon of tRNA which brings phenyl alanine amino acid to the ribosomal unit.
25. Biotechnology has improved life of human but there are some issues of common concern. What these issues are and suggest measures to solve them.
26. Draw a diagram of human sperm and label any six parts.

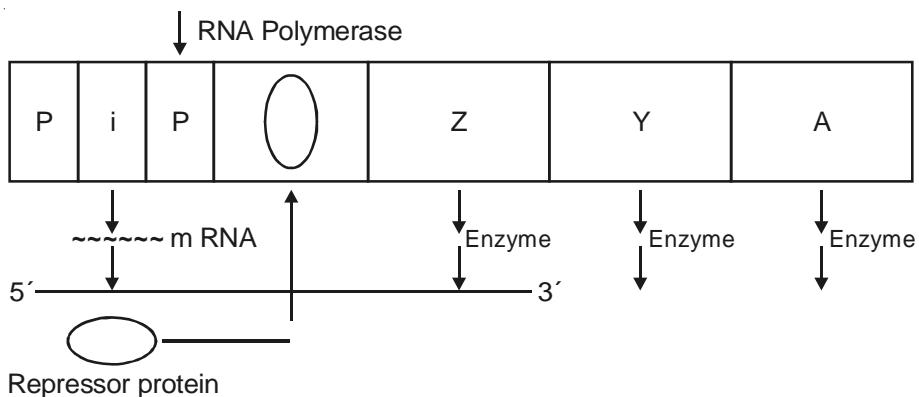
### OR

Write the development and structure of female gametophyte in an ovule.

27. Compare three pairs of given specimens in terms of evolutionary relationship-
- (i) Thorn of bougainvillea and tendril of cucurbita.
- (ii) Wings of butterfly and bird
- (iii) Flipper of whale and forelimb of human

## SECTION D

28. Observe the figure of **lac operon** and answer the following question-



- (i) Which gene category of operon do genes Z, Y and A belong to?
- (ii) Name the enzymes produced by gene Z and Y.
- (iii) What is the function of repressor protein?
- (iv) When does *lac operon* start working?
- (v) Name the structure represented by 5'-3' in the figure.

**OR**

- (a) Describe the experiment conducted by Fredrick Griffith.
- (b) Which principle did he conclude?
- (c) Who finally proved that DNA is genetic material and not protein?

29. Use of molecular scissors and PCR are very important tools in biotechnology applications. Write their advantages and mechanism of action.

**OR**

What are Genetically Modified organisms? Explain their advantages by selecting any three organisms as examples.

30. Explain physical, chemical and surgical methods of contraception. Write their various types and give any two qualities of an ideal contraceptive.

**OR**

Explain various reproductive activities that occur in female genital tract after insemination up to parturition stage.

## CLASS XII

# MARKING SCHEME : BIOLOGY

1.	(a) Jhum system	(b) North Eastern region of India	$\frac{1}{2} \times 2$
2.	(i) 63	(ii) 21	$\frac{1}{2} \times 2$
3.	Parthenogenesis		1
4.	Klinefelter syndrome	Six chromosomes in male XXY	$\frac{1}{2} \times 2$
5.	Downstream processing		1
6.	Aerobic bacteria and cells can work optimally in the presence of oxygen.		1
7.	(i) Organisms that enrich the nutrient quality of the soil (ii) <i>Rhizobium/ Glomus/ Anabaena</i> (any one)		$\frac{1}{2} \times 2$
8.	Somatic hybridisation	Hybrid of tomato and potato	$\frac{1}{2} \times 2$
9.	(i) (a) (ii) Carrying capacity—maximum number of members of a species which the habitat can support. (iii) Limiting factor effect (food/ predator) (iv) S-shaped or sigmoid curve graph/ logistic		$\frac{1}{2} \times 4$
10.	(i) and (iv) Oogenesis (ii) and (ii) Spermatogenesis		$\frac{1}{2} \times 4$
11.	(A) Fragmentation (B) Overexploitation/ overgrazing (C) Alien species invasion (D) Co-extinction		$\frac{1}{2} \times 4$
12.	Secondary	Herbivore	Lion/ Grass/small green
	A	B	C D
13.	Drug of medicine and drug of abuse		$\frac{1}{2} \times 2$
	If taken for purpose other than medicinal, in amounts/ frequency that impairs one's physical or psychological function , it is drug of abuse otherwise medicine if taken under doctor's proper advice.		$\frac{1}{2} \times 2$

14.	Lichens... Mosses ..... herbaceous plants ..... scrubs.... trees	$\frac{1}{2} \times 2$
	Primary succession takes longer time than secondary succession	$\frac{1}{2}$
	Pr. succ. starts life for first time at that place/sec. Succession starts life for second time/	
	Environmental conditions for sec. Succession are easy but difficult for first succession	$\frac{1}{2}$
15.	(i) Primary effluent is passed into aerated secondary treatment tank having flocs of aerobic bacteria and fungi which digest major part of organic matter and reduce BOD. After sedimentation it forms sludge	$\frac{1}{2}$
	(ii) Aerobic bacteria of sludge are digested by anaerobic bacteria in large tank and biogas is produced. Treated water can be released into water body	$\frac{1}{2} \times 2$
	<b>OR</b>	
	(i) 'A' farmer using biofertilizers, 'B' farmer using only one type of fertilizer extensively	$\frac{1}{2} \times 2$
	(ii) Bacteria, cyanobacteria and mycorrhiza	1
16.	Create soil, water and air pollution	
	Use of improved varieties by breeding through hybridisation	
	Dependence on agrochemicals	
	Better management practices	
	Costly	
	Difficult to store (any four)	$\frac{1}{2} \times 4$
17.	(i) Recessive	$\frac{1}{2}$
	(ii) 2-Heterozygous dominant and 4-homozygous recessive	$\frac{1}{2} \times 2$
	(iii) Trait to be investigated	$\frac{1}{2}$
18.	(i) A	
	(ii) C	
	(iii) BOD is reducing	
	(iv) D	$\frac{1}{2} \times 4$
19.	(i) Incomplete	1
	(ii) 1 : 2 :1	1
	(iii) Pink (intermediate between red and white)	1
20.	(i) Passive immunity	$\frac{1}{2}$
	(ii) Immunity produced in the body of other animal but used in human body.	$\frac{1}{2}$

	(iii) One correct example of disease	½
	(iv) Active immunity	1
21.	Before industrialization	White winged moth selected on lichen based tree trucks Black winged moth eaten by birds (predated)
	During industrialization no lichens	Dark background due to smoke and soot and no lichens Black winged moth selected. White winged moth predated
	Background helps selection/rejection of moth from predator birds	
	Nature selects the adapted character-white/black winged moth	½ × 6
22.	(i) Conservation in natural ecosystem (ii) Conservation in man made ecosystem (iii) National parks/Wildlife sanctuaries/Biosphere reserves/Sacred forests/Sacred lakes	
23.	(i) Collection of variability (ii) Evaluation and selection of desired parents (iii) Cross hybridization between selected parents (iv) Testing of superiority of recombinants (v) Evaluation and release of variety Sonalika/Kalyan Sona	
24.	(i) TAC GGA CAA ATG GCT TTC CCG AAA ACT (ii) Stop protein synthesis (iii) AAA	
25.	(i) Biopiracy (ii) Privacy or integrity of species (iii) Grant of biopatent (iv) Safety of public life from GMO (a) Control of GM research work by regulation committee like GEAC (b) International control on biopatenting (c) Frame laws to prevent biopiracy	
26.	Any six correct labels	

**OR**

One cell of nucellus enlarges and form megasporangium. Undergoes meiosis I and meiosis II forming 4 cells (3 cells degenerate). ½

	Remaining single cell undergoes three successive mitotic division (8 nuclei)	$\frac{1}{2}$
	8 nucleated (7 celled) embryo sac or gametophyte formed 1 egg cell/2 synergids/3 antipodal cells/2 polar nuclei in single central cell.	$\frac{1}{2} \times 2$
27.	(i) Homologous organs (ii) Analogous organs (iii) Homologous organs	
28.	(i) Structural genes (ii) Z – $\beta$ -galactosidase, Y – Permease (iii) Attach with operator site and stop transcription by ZYA genes (iv) Entry of lactose into the cell induces operon to start. It removes repressor protein from operator site and make the operator on. (v) m – RNA	1 $\frac{1}{2} \times 2$ 1 1 1
	<b>OR</b>	
	(a) Culture of <i>Streptococcus pneumoniae</i> with smooth type (virulent) and rough type (non virulent)  Injecting living S – type to mice – death of mice  Injecting living R – type to mice – no death of mice  Injecting DNA of heat killed S – type – no death of mice  Injecting heat killed S – type DNA <sup>+</sup> living R – type – death of mice  Transformation of non-virulent R – type to S – type virulent  Transfer of genetic material (DNA) from S – type to R – type	$\frac{1}{2}$
	(b) Transformation of genetic material (c) Avery, MacLeod and McCarty	
29.	Molecular scissors – called Restriction enzymes (endonuclease/exonuclease)  Cut DNA sequence at a particular point (specific sequence of base pairs).  Specific DNA sequence is called – Palindromic nucleotide sequence Endonuclease cuts within the DNA/Exonuclease cuts near the end of DNA  Used in gene recombination, DNA fingerprinting  PCR – called Polymerase Chain Reaction  Synthesis of DNA segments in large number (Amplification)  Process occurs in artificial lab condition ( <i>in vitro</i> )	

Use of DNA polymerase and to primers.

Steps include – denaturation, annealing and extension

Billions of DNA segment copies produced from single fragment (any 10 points)  $\frac{1}{2} \times 10$

**OR**

Organisms whose genes are manipulated GMO.

**Advantages :** More tolerant to abiotic stresses, reduced reliance on agrochemicals, reduced post harvest loss, enhanced nutritional value of food, mineral usage efficiency increased (any two).

**Examples :** Bt cotton (pest resistant plant)/role of *cry gene* and its toxic protein

Human insulin production by *E coli* bacteria

Gene therapy to ADA deficiency by ADA cADA from retroviral vector.

Transgenic animals like rat/rabbit/pigs/sheep/cows and fish etc.

Any other such examples (any three examples)  $1 \times 3$

30. Physical methods – Barriers like condom (male/female), diaphragms, cervical caps and vaults.  $\frac{1}{2} \times 4$

Chemical methods – Intra Uterine Devices (IUDs) like copper – T and Lippes loop, oral pills (Saheli), hormone releasing implants – progestogens, estrogen  $\frac{1}{2} \times 4$

Surgical methods – Sterilisation through vasectomy in male and tubectomy in female.  $\frac{1}{2} \times 2$

**OR**

After coitus – sperm motility in genital tract, fallopian tube, ampulla isthmus junction, fertilization (fusion), uterus, cleavage division, morula formation, blastula development, implantation into uterine wall, development of placenta, embryo development in uterus, delivery or parturition (any ten points)  $\frac{1}{2} \times 10$