



# CBSE

## ADDITIONAL PRACTICE QUESTIONS

### Biology (044)

### Class XII | 2023–24

Max Marks: 80

Time: 3 hours

#### General Instructions:

- (i) All questions are compulsory.
- (ii) The question paper has five sections and 33 questions. All questions are compulsory.
- (iii) Section–A has 16 questions of 1 mark each; Section–B has 5 questions of 2 marks each; Section– C has 7 questions of 3 marks each; Section– D has 2 case-based questions of 4 marks each; and Section–E has 3 questions of 5 marks each.
- (iv) There is no overall choice. However, internal choices have been provided in some questions. A student has to attempt only one of the alternatives in such questions.
- (v) Wherever necessary, neat and properly labeled diagrams should be drawn.

#### Section A

Q.Nos.	Questions	Marks
1	<p>During the pollen grain formation, the generative cell divides to give rise to the two male gametes.</p> <p>What is the ploidy of the generative cell?</p> <p>(a) <math>n</math> (b) <math>2n</math> (c) <math>3n</math> (d) <math>4n</math></p>	1
2	<p>Kiwi is a dioecious species. Which of the following methods can be definitely RULED OUT as a possible mode of pollination in its case?</p> <p>P) cleistogamous autogamy Q) chasmogamous autogamy R) geitonogamy S) xenogamy</p> <p>(a) only P and R</p>	1



	(b) only P and Q (c) only Q and S (d) only P, Q and R	
3	<p>Arun thinks that identifying the exact mRNA sequence from the protein sequence is difficult.</p> <p>Is he correct and why?</p> <p>(a) No, as the genetic code is universal. (b) Yes, as the genetic code is degenerate. (c) No, as the mRNA is translated into a protein sequence. (d) Yes, as the mRNA contains introns which are non-coding sequences.</p>	1
4	<p>Crickets are insects that follow the XO type of sex determination. Which of the following statements is ALWAYS TRUE about this type of sex determination?</p> <p>(a) Eggs that have an O chromosome will give rise to a male cricket. (b) Eggs that have an X chromosome will give rise to a female cricket. (c) Sperms that have an X chromosome will give rise to a male cricket. (d) Sperms that have an O chromosome will give rise to a male cricket.</p>	1
5	<p>Oysters are generally either dark or light in colour. Dark oysters excel in dark environments, while light oysters thrive in bright environments. Intermediate-coloured oysters are disadvantaged, lacking effective camouflage in either setting.</p> <p>Which type of natural selection does this phenomenon exemplify?</p> <p>(a) directional (b) stabilising (c) disruptive (d) (The phenomenon described does not exemplify natural selection.)</p>	1
6	<p>A team of archaeologists found a fossilized skeleton of a human-like creature with a brain capacity of more than 700cc. The structure and its associated findings also show evidence that this creature could use tools for hunting.</p> <p>Which stage of human evolution is this creature NOT from?</p> <p>(a) <i>Homo erectus</i></p>	1

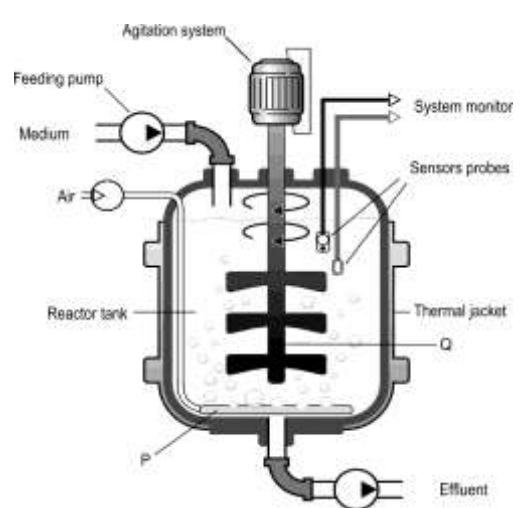


	(b) <i>Homo habilis</i> (c) Neanderthal Man (d) <i>Australopithecines</i>																
7	<p>Which of the following is CORRECT about the movement of DNA on an agarose gel and the reason for it?</p> <table border="1"> <thead> <tr> <th>Option</th> <th>Movement across terminals</th> <th>Reason</th> </tr> </thead> <tbody> <tr> <td>P</td> <td>positive to negative</td> <td>charge on histones</td> </tr> <tr> <td>Q</td> <td>negative to positive</td> <td>charge on histones</td> </tr> <tr> <td>R</td> <td>positive to negative</td> <td>charge on DNA</td> </tr> <tr> <td>S</td> <td>negative to positive</td> <td>charge on DNA</td> </tr> </tbody> </table> <p>(a) P (b) Q (c) R (d) S</p>	Option	Movement across terminals	Reason	P	positive to negative	charge on histones	Q	negative to positive	charge on histones	R	positive to negative	charge on DNA	S	negative to positive	charge on DNA	1
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S	negative to positive	charge on DNA															
8	<p>What is the MINIMUM possibility of a dominant trait being expressed in the offspring after a test cross?</p> <p>(a) 25% (b) 50% (c) 75% (d) 100%</p>	1															
9	<p>Which process is responsible for increasing the percentage of alcohol in whisky after fermentation?</p> <p>(a) malting (b) dilution (c) distillation (d) maturation</p>	1															
10	<p>What does I in the restriction enzyme named 'Hin S2 I' indicate?</p> <p>(a) It cuts after the first nucleotide in the restriction site. (b) It is the first enzyme isolated from strain S2 of the bacterium. (c) There is definitely more than one enzyme isolated from the same bacterium. (d) There is only one enzyme that can be used to digest a plasmid from strain S2 for the bacterium.</p>	1															
11	<p>Sumi and Nisha said the following about somatic hybridization in plants.</p> <p>Sumi: Gametes are not required for hybridization.</p>	1															



	<p>Nisha: The resultant plant that grows after the fusion of the cells is genetically identical to the parent plants.</p> <p>Who among them is/are CORRECT?</p> <p>(a) only Sumi (b) only Nisha (c) both Sumi and Nisha (d) neither Sumi nor Nisha</p>	
12	<p>Rupal says that in marine food chains where the pyramid of biomass is inverted, the 10% rule of energy transfer is not applicable.</p> <p>Is she CORRECT and why?</p> <p>(a) No, because every level still gets 10% of the energy from the lower level. (b) Yes, because there are more consumers and so more energy is transferred. (c) No, because the pyramid of biomass can never be inverted for any food chain. (d) Yes, because there is lower biomass of producers in these food chains so less energy is transferred.</p>	1
<p>Question No. 13 to 16 consist of two statements – Assertion (A) and Reason (R). Answer these questions selecting the appropriate option given below:</p> <p>a) Both A and R are true and R is the correct explanation of A. b) Both A and R are true and R is not the correct explanation of A. c) A is true but R is false. d) A is false but R is true.</p>		
13	<p>Assertion (A): The coconut endosperm is multinucleate throughout its development. Reason (R): Some endosperms undergo free nuclear division without the formation of distinct cell boundaries.</p>	1
14	<p>Assertion (A): DNA ligase is not used in PCR. Reason (R): Discontinuous fragments are not formed in the amplification of DNA by PCR.</p>	1
15	<p>Assertion (A): To promote sustainability while minimizing waste, it is recommended to reuse needles up to two times for the same person. Reason (R): Sterilisation of needles eliminates all pathogens and ensures safety.</p>	1
16	<p>Assertion (A): Nuclear DNA extracted from a cell is visible to the naked eye but unstained plasmid DNA running in an agarose gel is not. Reason (R): Plasmid DNA is transparent but nuclear DNA is not.</p>	1

## Section B

17	<p>Kavya says that the placenta produces relaxin which plays a crucial role during pregnancy.</p> <p>(a) Is she correct? Justify.</p> <p>(b) Name TWO other hormones secreted by the placenta during pregnancy</p>	2
18	<p>Thalassemia is an autosomal recessive disorder that causes anaemic conditions in an individual. A blood smear from a heterozygous individual shows blood cells that are small, pale and irregularly shaped along with normal RBCs.</p> <p>(a) State the genotypic and phenotypic ratios of offspring born to a carrier mother and a thalassaemic father.</p> <p>(b) Does the allele for thalassemia exhibit codominance? Justify.</p>	2
19	<p>Explain any TWO reasons why the treatment of AIDS is only partially effective.</p>	2
20	<p>Rati wants to grow a variant of the <i>lactobacillus spp.</i> in a bioreactor. Lactobacillus is an anaerobic bacterium commonly used as a starter culture for dairy products. Shown below is a bioreactor she had in her laboratory.</p> <div style="text-align: center;">  </div> <p>(a) Identify ONE component that should definitely NOT be present in the reactor to grow the <i>lactobacillus spp.</i> Justify.</p> <p>(b) Explain TWO quantities that the sensors in the bioreactor should monitor.</p>	2



21	<p>Shown below is a food chain.</p> <p style="text-align: center;">Fallen leaf <math>\longrightarrow</math> Millipedes <math>\longrightarrow</math> Fungi <math>\longrightarrow</math> Earthworm <math>\longrightarrow</math> Soil</p> <p style="text-align: center;">(A) (B) (C) (D)</p> <p>(a) Millipedes have a hard exoskeleton whose composition is different from that of the leaves. Considering all other conditions to remain the same, which step is likely to be slower between A to B and B to C and why?</p> <p>(b) What would be the direction of the flow of energy in this food chain?</p> <p><b>OR</b></p> <p>(a) A coral reef can be regarded as an ecosystem. Mention any TWO reasons why.</p> <p>(b) The net primary productivity (NPP) of a coral reef is approximately 2000 g C/m<sup>2</sup>/year and the gross primary productivity (GPP) is 4000 g C/m<sup>2</sup>/year.</p> <p>Calculate the respiration losses (R) of this ecosystem.</p>	2
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### Section C

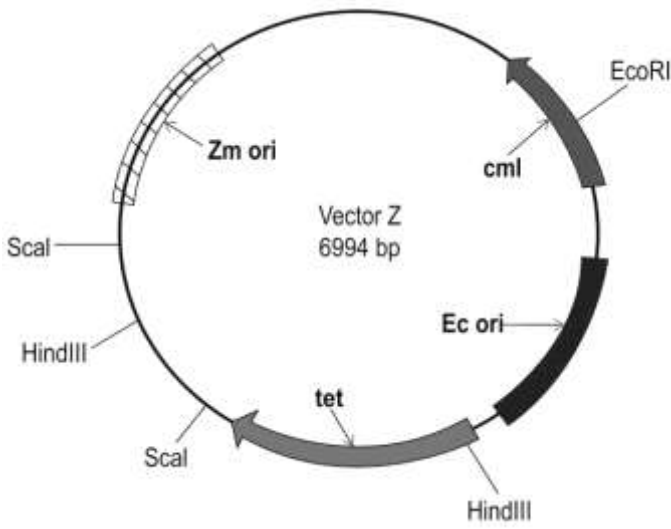
22	<p>A biologist sees the following cells in a cross-section of the seminiferous tubule and its surrounding tissues and counts the number of various kinds of cells.</p> <p>Spermatozoa, Spermatid, Primary spermatocyte, Secondary spermatocyte, Leydig cells, Sertoli cells, Spermatogonium.</p> <p>From these cells, identify the cells:</p> <p>(a) that are diploid.</p> <p>(b) that can produce hormones and their names.</p>	3
23	<p>A couple is trying to conceive and start a family.</p> <p>(a) If the woman's period, which is regular, is scheduled to start on July 19, what was the estimated date of ovulation for the previous cycle?</p> <p>(b) Name the four important reproductive hormones and state whether their levels will be high or low on the date identified in (a).</p>	3
24	<p>As part of assisted reproductive technologies (ART),</p> <p>(a) What is the destination for blastomeres with a count of less than 8 cells and more than 8 cells?</p> <p>(b) What could be the reason behind transferring to the destinations identified in (a)?</p> <p>(c) What techniques are used to transfer the blastomeres to the destinations identified in (a)?</p>	3



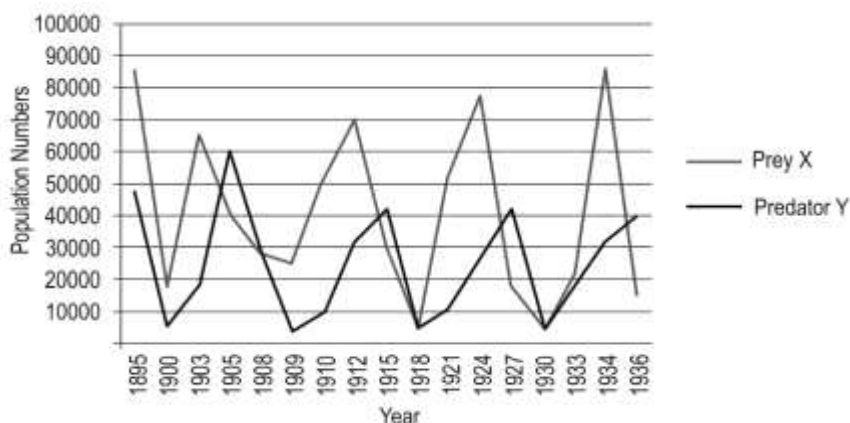
25	<p>(a) State any FOUR phenomena in which the Hardy-Weinberg theorem may not hold true.</p> <p>(b) A population of 100 individuals has a frequency of allele A of 0.3 and a frequency of allele a of 0.7. The frequency of the heterozygous genotype (Aa) is 0.49. Is this population in Hardy-Weinberg equilibrium? Justify.</p>	3												
26	<p>State whether each of these statements given below is/are true or false. Justify your answer.</p> <p>(a) Flocs reduce the pollution in water by increasing its BOD.</p> <p>(b) Mycorrhiza is a type of parasitic relationship in which only the plants benefit from fungi.</p>	3												
27	<p>Erythropoietin is a glycoprotein hormone that is otherwise naturally produced in the kidney when the body becomes anaemic. However, this does not happen in the case of chronic renal diseases where kidney function is lost. Epoetin alfa is a human erythropoietin produced in cell culture using recombinant DNA technology. The cell culture used is called Namalwa cells, a human cell culture. There are eight exons and seven introns in a single gene that encodes the hormone, whose sequence is known.</p> <p>Explain the step-by-step process that should be followed for producing human erythropoietin in culture.</p> <p><b>OR</b></p> <p>Today, many genetic disorders can be detected using a single cell from an embryo. This helps in planning the child's health care in advance, and in some cases even treating the disorder while the baby is still in the womb.</p> <p>(a) Identify a biotechnological technique that can be used for this purpose. Give a reason to support your answer.</p> <p>(b) Can the technique identified in (a) be used to detect the presence of RNA viruses? Justify.</p>	3												
28	<p>In a study comparing two continents - Antarctica and Asia, the species-area relationship was investigated using the following data:</p> <table border="1"><thead><tr><th>Parameter</th><th>Antarctica</th><th>Asia</th></tr></thead><tbody><tr><td>Area</td><td><math>14 \times 10^6 \text{ km}^2</math></td><td><math>44 \times 10^6 \text{ km}^2</math></td></tr><tr><td>Regression coefficient</td><td>1</td><td>1</td></tr><tr><td>Y-intercept</td><td>5</td><td>10</td></tr></tbody></table>	Parameter	Antarctica	Asia	Area	$14 \times 10^6 \text{ km}^2$	$44 \times 10^6 \text{ km}^2$	Regression coefficient	1	1	Y-intercept	5	10	3
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Y-intercept	5	10												

	<p>(a) Calculate the species richness value for each region.          (b) Based on (a), which continent will have greater biodiversity and why?</p>	
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### Section D

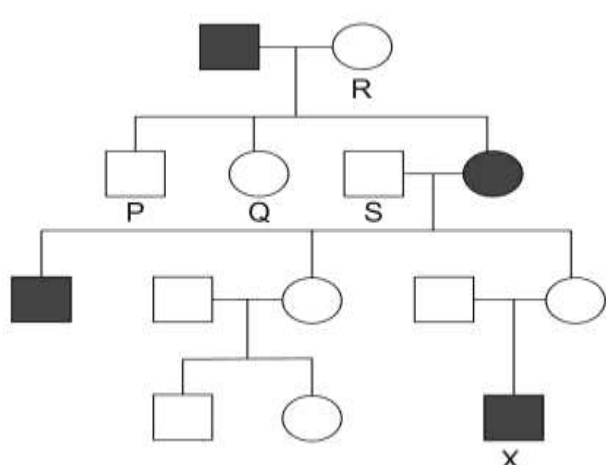
29	<p>Shown below is a cloning vector 'Z' that Kamla wants to use to create a recombinant vector with her gene of interest.</p> <div style="text-align: center;">  </div> <p>The vector consists of sites for three restriction enzymes - ScaI, HindIII and EcoRI. Restriction sites for the same enzymes are also present in the gene of interest. There are two 'ori' sequences - one allows it to replicate in <i>Escherichia coli</i> and another allows replication in <i>Zymomonas mobilis</i>. Apart from this, the vector consists of two antibiotic resistance genes - one against tetracycline (tet) and another against chloramphenicol (cml).</p> <p>(a) What is the advantage of having two 'ori' sequences in the same vector? Give a situation in which this would be particularly useful.</p> <p><b>OR</b></p> <p>If the vector was cut using HindIII, what would colonies growing on a medium containing tetracycline DEFINITELY contain?</p> <p>(b) Suggest which of the three restriction enzymes would be suitable for insertion of the gene of interest. Give TWO advantages of using the enzyme chosen by you.</p> <p>(c) State ONE disadvantage of using the other two restriction enzymes not chosen in (b).</p>	4
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30	<p>Predator Y shown in the image below is a type of wild cat that inhabits the</p>  <p>forests and preys primarily on prey X which are herbivores. Shown below is data on their respective populations over time.</p> <p>(a) What is the likely cause for the pattern seen in the prey and predator populations through the years?</p> <p>(b) Hypothetically, if all the predators of the forests become extinct, what will happen to the vegetation of the forest?</p> <p>(c) Consider a situation where another similar species of predator immigrates to the forest. What is likely to happen over time and why?</p> <p><b>OR</b></p> <p>Juglone is a chemical produced naturally in most parts of the black walnut plant. This chemical leaches into the soil when the plant falls. This leads to the death of many plants that grow around the black walnut plant.</p> <p>Identify the type of ecological interaction between the black walnut and other plants growing around it. Justify.</p>	4

### Section E

31	<p>A Non-Government Organisation (NGO) aims to increase awareness against STDs.</p> <p>(a) What could be the ideal target age group for the NGO?</p> <p>(b) Mention any TWO potential long-term health-related complications of untreated STDs that the NGO should educate the target age group about.</p> <p>(c) Mention ONE contraceptive method that provides protection against the STD. Justify.</p> <p>(d) State TWO contraceptive methods that do not protect against STDs that they can educate the group about.</p>	5
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	<p><b>OR</b></p> <p>Amey and Lalita are expecting their first child, with Lalita being in her second month of pregnancy with no known complications. Amey's family has a history of cystic fibrosis while Lalita's family has a history of Down's syndrome, leading to a concern that the baby may have one of these conditions.</p> <p>(a) Suggest and explain a way of testing if their baby is at risk for any genetic disorders.</p> <p>(b) In case of the presence of one or both of the abnormalities and posing a risk to the mother's health, mention one possible option for them to consider.</p> <p>(c) Is the process mentioned in (b) safe for Lalita at the current gestational age? Justify.</p> <p>(d) Under what conditions is the process mentioned in (b) illegal?</p>	
32	<p>Shown below is a pedigree of an individual X who is suffering from ocular albinism which results in permanent vision loss. Use the pedigree to answer the questions that follow:</p>  <p>(a) Complete the following statement about this disease: The trait for the disease is linked to _____ (X-chromosome/Y-chromosome/autosomal) and is _____ (dominant/recessive).</p> <p>(b) Give a reason to support your answer to (a).</p> <p>(c) Identify the genotypes of individuals P, Q, R and S marked in the pedigree.</p> <p><b>OR</b></p>	5

Shown below is a nucleotide sequence and the genetic code.

5' - ATGCGTAGACTCGTA - 3'

		2nd base in codon				
		U	C	A	G	
1st base in codon	U	Phe Phe Leu	Ser Ser Ser	Tyr Tyr STOP	Cys Cys STOP	U C A G
	C	Leu Leu Leu	Pro Pro Pro	His His Gin	Arg Arg Arg	U C A G
	A	Ile Ile Ile Met	Thr Thr Thr	Asn Asn Lys	Ser Ser Arg Arg	U C A G
	G	Val Val Val	Ala Ala Ala	Asp Asp Glu Glu	Gly Gly Gly Gly	U C A G

- (a) Identify the protein sequence formed by this sequence.  
 (b) Draw the tRNA molecule for the third codon with its polarity labelled. Give a reason to support the polarity identified.  
 (b) The first guanine base in the nucleotide sequence changes to cytosine. Identify the type of mutation caused by this change.  
 (c) Will the mutated sequence form an mRNA and protein? Justify.

- 33 (a) Classify the following scenarios as active/passive immunity and justify your answer.  
 (i) A fetus receives antibodies from its mother through the placenta.  
 (ii) A person accidentally gets cut by a blade and later receives a tetanus shot.  
 (iii) A person receives a blood transfusion from a donor who has been vaccinated against a disease.

(b) Zoya is bitten by an infected Anopheles mosquito in the morning. In the evening, another non-infected Anopheles mosquito bites Zoya and then bites Zaheer immediately. How likely is Zaheer to get malaria? Justify your answer.

**OR**

A patient is suffering from fatigue, high fever, and weight loss, and has been observing an increasing number and size of lumps in various regions of her body over a very short time.

5



<p>(a) What could she be suffering from? (b) Mention FOUR ways in which the disease identified in (a) is caused and FOUR techniques that can be used to diagnose it.</p>	
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# CBSE

## Additional Practice Questions Subject: Chemistry Theory (043) Class: XII 2023-24

Max. marks: 70

Time: 3 hours

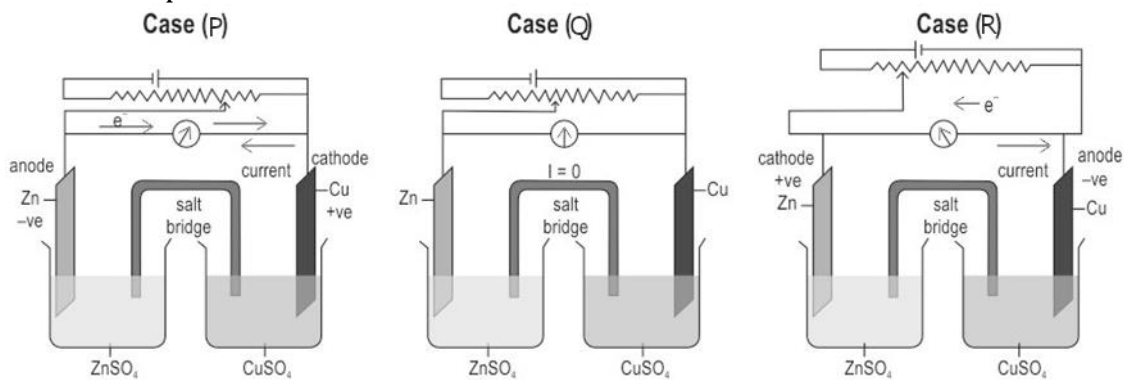
### General Instructions:

- There are 33 questions in this question paper with internal choice.
- SECTION A** comprises **16** multiple -choice questions carrying 1 mark each.
- SECTION B** comprises **5** short answer questions carrying 2 marks each.
- SECTION C** comprises **7** short answer questions carrying 3 marks each.
- SECTION D** comprises **2** case - based questions carrying 4 marks each.
- SECTION E** comprises **3** long answer questions carrying 5 marks each.
- All questions are compulsory.
- Use of log tables and calculators is not allowed.

### Section A

The following questions are multiple -choice questions with one correct answer. Each question carries 1 mark. There is no internal choice in this section.

1 Sunita set up three cells as shown below:



She applied external potential in all the three cells. The potential is increased slowly, till the opposing voltage reaches the value of 1.1 V.



	<p>Which of the following statements is INCORRECT?</p> <p>(a) Electrons flow from Zn rod to Cu rod hence current flows from Cu to Zn in case (P). (b) The chemical reaction takes place in case (Q) till the opposing voltage reaches 1.1 V. (c) Zinc is deposited at the zinc electrode and copper dissolves at copper electrode in case (P). (d) Electrons flow from Cu to Zn and current flows from Zn to Cu in case (R).</p>															
2	<p>Two compounds M and N have the general formula <math>C_nH_{2n}O</math> but different structural formulae.</p> <p>i) Compound N belongs to that homologous series where the first member contains 3 carbon atoms. ii) Compound M reacts with one equivalent of monohydric alcohol in the presence of dry hydrogen chloride to yield a hemiacetal.</p> <p>Identify the homologous series to which compounds M and N belong to?</p> <p>(a) Both the compounds are aldehydes. (b) Compound M is an aldehyde and compound N is a ketone. (c) Both the compounds are ketones. (d) Compound N is an aldehyde and compound M is a ketone.</p>															
3	<p>During a quiz competition, team A and team B have to answer a tie question on the characteristics of RNA.</p> <p>Their responses are as follows:</p> <table border="1"><thead><tr><th>Name</th><th>Team</th><th>Response</th></tr></thead><tbody><tr><td>Adrika</td><td>A</td><td>Different RNA molecules of a cell are involved in the synthesis of proteins.</td></tr><tr><td>Shaakho</td><td>A</td><td>The single-stranded helix of RNA folds upon itself to form the secondary structure.</td></tr><tr><td>Rounak</td><td>B</td><td>The C-2 atom of the pentose sugar for a ribose nucleotide contains an -OH group.</td></tr><tr><td>Ritama</td><td>B</td><td>The message for the synthesis of a particular protein is present only in the RNA.</td></tr></tbody></table> <p>What is the expected result of the quiz and why?</p> <p>(a) Team A wins the quiz as both the responses are correct. (b) Team B wins the quiz as both the responses are correct. (c) Team A loses the quiz as Adrika's response is incorrect. (d) Team B loses the quiz as Rounak's response is incorrect.</p>	Name	Team	Response	Adrika	A	Different RNA molecules of a cell are involved in the synthesis of proteins.	Shaakho	A	The single-stranded helix of RNA folds upon itself to form the secondary structure.	Rounak	B	The C-2 atom of the pentose sugar for a ribose nucleotide contains an -OH group.	Ritama	B	The message for the synthesis of a particular protein is present only in the RNA.
Name	Team	Response														
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Ritama	B	The message for the synthesis of a particular protein is present only in the RNA.														

4 What will be the change in the hybridisation of C when a nucleophile attacks the electrophilic centre of the carbonyl group?

- (a)  $sp^2$  to  $sp$
- (b)  $sp^3$  to  $sp^2$
- (c)  $sp^3$  to  $sp$
- (d)  $sp^2$  to  $sp^3$

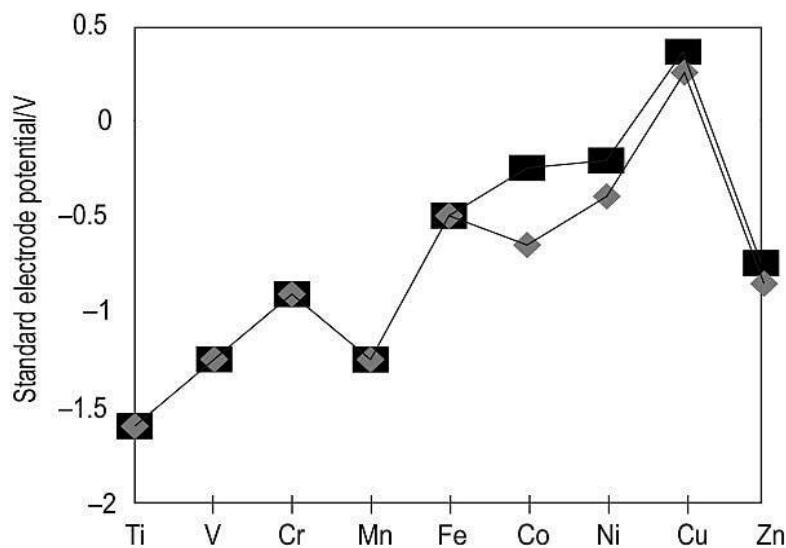
5 Four compounds,  $CH_3Cl$ ,  $CH_3Br$ ,  $C_2H_5Br$  and  $C_3H_7I$  are represented by the letters M, N, O and P in the table below (*in random order*). The boiling points are also given on the table.

Boiling points(BP)	$-24.2^\circ C$	$38^\circ C$	$3.56^\circ$	$101.6^\circ C$
			C	
Compound	M	N	O	P

Which of the four compounds does 'N' most likely represent?

- (a)  $CH_3Cl$
- (b)  $CH_3Br$
- (c)  $C_2H_5Br$
- (d)  $C_3H_7I$

6 Study the graph given below.



■ Observed values      ◆ Calculated values

Observed and calculated values for the standard electrode potentials

( $M^{2+} \rightarrow M^0$ ) of the elements Ti to Zn

Based on the graph given, which element will MOST LIKELY be involved in the



	<p>following reaction?</p> <p>Metal + conc. sulphuric acid <math>\rightarrow</math> Metal sulphate + sulphur dioxide + water</p> <p>(a) Cu (b) Co (c) Ti (d) Zn</p>																
7	<p>The table given below shows the results of three experiments on the rate of the reaction between compounds P and Q at a constant temperature.</p> <table border="1"><thead><tr><th>Experiment</th><th>The initial concentration of P (mol dm<sup>-3</sup>)</th><th>The initial concentration of Q (mol dm<sup>-3</sup>)</th><th>Initial rate (mol dm<sup>-3</sup> s<sup>-1</sup>)</th></tr></thead><tbody><tr><td>1</td><td>0.1</td><td>0.2</td><td>1.10 x 10<sup>-4</sup></td></tr><tr><td>2</td><td>0.3</td><td>0.2</td><td>9.91 x 10<sup>-4</sup></td></tr><tr><td>3</td><td>0.3</td><td>0.1</td><td>4.96 x 10<sup>-4</sup></td></tr></tbody></table> <p>Based on the data, what will be the rate equation for the reaction between P and Q?</p> <p>(a) <math>k[P]^2[Q]</math> (b) <math>k[P][Q]^2</math> (c) <math>k[P][Q]</math> (d) <math>k[P]</math></p>	Experiment	The initial concentration of P (mol dm <sup>-3</sup> )	The initial concentration of Q (mol dm <sup>-3</sup> )	Initial rate (mol dm <sup>-3</sup> s <sup>-1</sup> )	1	0.1	0.2	1.10 x 10 <sup>-4</sup>	2	0.3	0.2	9.91 x 10 <sup>-4</sup>	3	0.3	0.1	4.96 x 10 <sup>-4</sup>
Experiment	The initial concentration of P (mol dm <sup>-3</sup> )	The initial concentration of Q (mol dm <sup>-3</sup> )	Initial rate (mol dm <sup>-3</sup> s <sup>-1</sup> )														
1	0.1	0.2	1.10 x 10 <sup>-4</sup>														
2	0.3	0.2	9.91 x 10 <sup>-4</sup>														
3	0.3	0.1	4.96 x 10 <sup>-4</sup>														
8	<p>The table below shows the <math>K_H</math> values for some gasses at 293 K and at the same pressure.</p> <table border="1"><tbody><tr><td><math>K_H</math> values (kbar)</td><td>144.97</td><td>69.16</td><td>76.48</td><td>34.86</td></tr><tr><td>Gas</td><td>Helium</td><td>Hydrogen</td><td>Nitrogen</td><td>Oxygen</td></tr></tbody></table> <p>In which of the following are the gases arranged in their decreasing order of solubility (from left to right)?</p> <p>(a) Helium &gt; Nitrogen &gt; Hydrogen &gt; Oxygen (b) Hydrogen &gt; Helium &gt; Nitrogen &gt; Oxygen (c) Nitrogen &gt; Hydrogen &gt; Oxygen &gt; Helium (d) Oxygen &gt; Hydrogen &gt; Nitrogen &gt; Helium</p>	$K_H$ values (kbar)	144.97	69.16	76.48	34.86	Gas	Helium	Hydrogen	Nitrogen	Oxygen						
$K_H$ values (kbar)	144.97	69.16	76.48	34.86													
Gas	Helium	Hydrogen	Nitrogen	Oxygen													
9	<p>Sampriti took 4 acids. Help her to arrange the acids from left to right, in the increasing order of their acidity: 2, 4, 6 - Trinitrophenol, acetic acid, phenol, and benzoic acid.</p>																





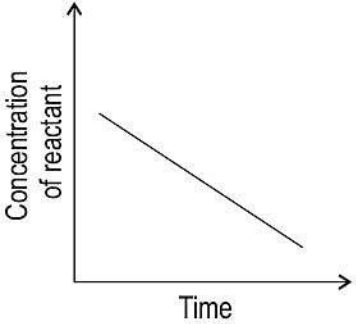
	<p>(a) 2, 4, 6 - Trinitrophenol, acetic acid, benzoic acid, phenol (b) phenol, acetic acid, benzoic acid, 2, 4, 6 - Trinitrophenol (c) 2, 4, 6 - Trinitrophenol, benzoic acid, acetic acid, phenol (d) phenol, benzoic acid, acetic acid, 2, 4, 6 - Trinitrophenol</p>
10	<p>An archeologist found that the percentage of carbon-14 in a wooden artifact was 20% of what carbon-14 would have been in the wood when it was cut from the tree.</p> <p>What would be the approximate age of this wooden artifact? (Given the half-life of carbon-14= 5730 years)</p> <p>(a) 5,790 years (b) 12,060 years (c) 13,300 years (d) 38,000 years</p>
11	<p>Sourima was having a severe headache. She took a medicine to relieve her pain. The medicine is industrially prepared by:</p> <p>(a) mononitration of phenyl methanoate (b) acetylation of salicylic acid in presence of an acid (c) hydrogenation of anisole with Br<sub>2</sub> in ethanoic acid (d) nitration of anisole with a mixture of concentrated sulphuric and nitric acids</p>
12	<p>Which of the following options give the correct arrangement of the atomic radii of the 3d, 4d, and 5d transition series of elements?</p> <p>(a) atomic radii of 3d &lt; atomic radii of 4d &lt; atomic radii of 5d (b) atomic radii of 3d &lt; atomic radii of 4d ≈ atomic radii of 5d (c) atomic radii of 3d ≈ atomic radii of 4d &gt; atomic radii of 5d (d) atomic radii of 3d &gt; atomic radii of 4d &gt; atomic radii of 5d</p>
13	<p>Two statements are given below - one labelled Assertion (A) and the other labelled Reason (R). Assertion (A): 2-Methoxy-2-methyl propane reacts with hydrogen iodide to form methyl alcohol and 2-Iodo-2-methylpropane. Reason (R): The reaction given in (A) follows S<sub>N</sub>2 mechanism. Which of the following is correct?</p> <p>(a) Both A and R are true, and R is a correct explanation of A. (b) Both A and R are true, but R is not the correct explanation of A. (c) A is true, but R is false. (d) A is false, but R is true.</p>
14	<p>Two statements are given below - one labeled Assertion (A) and the other labeled Reason (R). Assertion (A): In acetaldehyde, the carbonyl carbon acts as a Lewis acid and the carbonyl oxygen acts as a Lewis base.</p>



	<p>Reason (R): Carbonyl compounds have substantial dipole moments. Which of the following is correct?</p> <p>(a) Both A and R are true, and R is a correct explanation of A. (b) Both A and R are true, but R is not the correct explanation of A. (c) A is true, but R is false. (d) A is false, but R is true.</p>
15	<p>Two statements are given below - one labelled Assertion (A) and the other labelled Reason (R). Assertion (A): Denaturation of protein does not change the primary structure of proteins. Reason (R): The bonding between the carbon and hydrogen atoms during denaturation of proteins remains intact. Which of the following is correct?</p> <p>(a) Both A and R are true, and R is the correct explanation of A. (b) Both A and R are true, but R is not the correct explanation of A. (c) A is true, but R is false. (d) A is false, but R is true.</p>
16	<p>Two statements are given below - one labelled Assertion (A) and the other labelled Reason (R). Assertion (A): Copper does not form copper (II) sulphate on reaction with dil. sulphuric acid. Reason (R): The standard potential for <math>\text{Cu}^{+2} \text{Cu}</math> electrode is negative. Which of the following is correct?</p> <p>(a) Both A and R are true, and R is a correct explanation of A. (b) Both A and R are true, but R is not the correct explanation of A. (c) A is true, but R is false. (d) A is false, but R is true.</p>

### Section B

*This section contains 5 questions with internal choice in one question. The following questions are very short answer type and carry 2 marks each.*

17	<p>Given below is a graph of concentration of reactant vs time for a reaction.</p>  <p>(a) Based on the graph above draw a rate of reaction vs concentration of reactant graph for the same reaction. (b) What will be the order of this reaction? Justify.</p>										
18	<p>'Colligative properties help in determining the molar masses of the solutes.' The method based on which colligative property is preferred over others for determining molar masses of biomolecules and why?</p>										
19	<p>In which of the two compounds <math>\text{CH}_3\text{CH}_2\text{CH}_2\text{Cl}</math> or <math>\text{C}_6\text{H}_5\text{Cl}</math> will the C-Cl bond be longer? Why?</p>										
20	<p>Correctly match the items in the 'Reactants' column with those in the 'Product' column.</p> <table border="1" data-bbox="272 1060 1446 1402"> <thead> <tr> <th>Reactants</th> <th>Products</th> </tr> </thead> <tbody> <tr> <td>(a) Cyclohexene heated in the presence of <math>\text{KMnO}_4</math> and <math>\text{H}_2\text{SO}_4</math></td> <td>(i) Butanal</td> </tr> <tr> <td>(b) Propanenitrile hydrolysed after reduction in the presence of stannous chloride and hydrochloric acid</td> <td>(ii) 2-Chloro-2-phenylacetic acid</td> </tr> <tr> <td></td> <td>(iii) Adipic acid</td> </tr> <tr> <td></td> <td>(iv) Propiophenone</td> </tr> </tbody> </table> <p><b>OR</b></p> <p>Aqueous hydrogen cyanide is allowed to react separately with propanone and ethanal. In which case will the rate of reaction be faster and why?</p>	Reactants	Products	(a) Cyclohexene heated in the presence of $\text{KMnO}_4$ and $\text{H}_2\text{SO}_4$	(i) Butanal	(b) Propanenitrile hydrolysed after reduction in the presence of stannous chloride and hydrochloric acid	(ii) 2-Chloro-2-phenylacetic acid		(iii) Adipic acid		(iv) Propiophenone
Reactants	Products										
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	(iii) Adipic acid										
	(iv) Propiophenone										
21	<p>Glucose does not give a positive result with the Schiff's reagent in the Schiff's test. Based on the above information (a) Give a reason for the observation. (b) What type of carbonyl group is present in a glucose molecule?</p>										

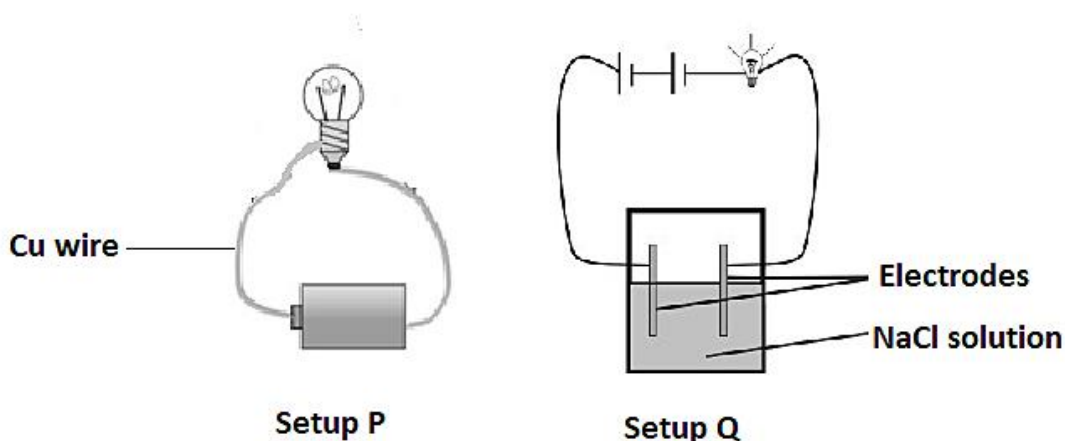
### Section C

This section contains 7 questions with internal choice in one question. The following questions are short answer type and carry 3 marks each

- 22 A metal (M) forms two different compounds O and P with two different ligands. Ligand present in compound O is  $\text{Cl}^-$  and that in compound P is  $\text{CN}^-$ . The metal M has 4 electrons in the d orbital. Complete the table given below based on the above information:

	Compound O	Compound P
Field strength of the ligands		
Electronic configuration for metal M in the complex		
Type of complex that will be formed (High spin/low spin)		

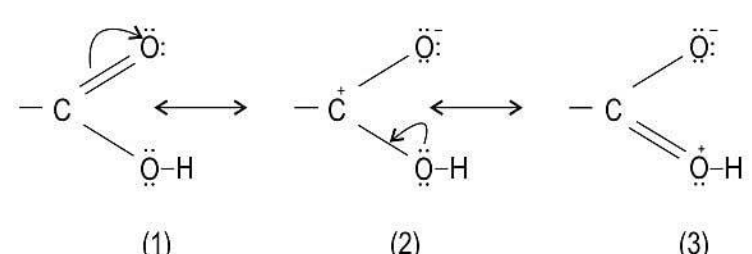
- 23 Abhisrija arranged two setups P and Q as shown below.



Both experiments are carried out at  $25^\circ\text{C}$ .

- Name the current carriers in setup P and Q.
- What is the effect of an increase in temperature on the conductivity of NaCl solution and Cu wire?
- What happens to the chemical composition of NaCl and Cu wire when current is passed through both setups for a prolonged period of time?

- 24 Draw the structure of:

	<p>(a) 3-Methylphenol</p> <p>(b) 2,4,6-Trinitrophenol</p> <p>(c) Benzene-1,3-diol</p>
25	<p>(a) If acetaldehyde, propane, propanone, acetic acid, and ethyl alcohol are arranged in the increasing order of their boiling points, which two compounds are expected to be at the third and the fourth position?</p> <p>(b) The resonance structures of the carboxylic acid group are shown below, which of them is the most stable and why?</p> <div style="text-align: center;">  <p>(1)                      (2)                      (3)</p> </div>
26	<p>(a) Write a balanced equation for the reaction between glucose and hydrogen cyanide. What inference can we draw from it?</p> <p>(b) Samta reacted glucose with acetic anhydride. Will the reaction help her to determine the number of secondary alcoholic groups and the number of primary alcoholic groups that are present in a glucose molecule? Justify your answer.</p>
27	<p>Three sets of pairs (i) and (ii) of <math>S_N1</math> reactions are given below. For each set of reactions state which reaction (i) or (ii) is expected to be slower? Justify your answer.</p> <p>(a) (i) <math>(CH_3)_3CCl + CH_3CH_2O^- \rightarrow (CH_3)_3COCH_2CH_3 + Cl^-</math> [In presence of ethanol]</p> <p>(ii) <math>(CH_3)_3CCl + 2 CH_3CH_2O^- \rightarrow (CH_3)_3COCH_2CH_3 + Cl^-</math> [In presence of ethanol]</p> <p>(b) (i) <math>(CH_3)_3CCl + H_2O \rightarrow (CH_3)_3COH + HCl</math></p> <p>(ii) <math>(CH_3)_3CBr + H_2O \rightarrow (CH_3)_3COH + HBr</math></p> <p>(c) (i) <math>(CH_3)_3CCl + H_2O \rightarrow (CH_3)_3COH + HCl</math></p> <p>(ii) <math>C_6H_5Cl + H_2O \rightarrow C_6H_5OH + HCl</math></p>
28	<p>(a) Write any four methods to increase the rate of a reversible reaction in the forward direction.</p> <p>(b) What is the unit for rate of reaction in SI units?</p>



### Section D

The following questions are case -based questions. Each question has an internal choice and carries 4 marks.

- 29 One of the most distinctive properties of transition metal complexes is their wide range of colours. This means that some of the visible spectrum is being removed from white light as it passes through the sample, so the light that emerges is no longer white. The colour of the complex is complementary to that which is absorbed. The complementary colour is the colour generated from the wavelength left over; for example, if green light is absorbed by the complex, the complex appears red.

The colour of a co-ordination compound depends on two factors:

- presence of ligands: For example, anhydrous  $\text{CuSO}_4$  is white, but  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$  is blue in colour.

- influence of ligands: If ligands like 'en' are added to  $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$  in the molar ratios en: Ni, 1:1, 2:1, 3:1 a series of reactions and their associated colour changes occur.

(a) Give an example of another complex that shows properties similar to those shown in the compound of Cu mentioned above.

What is the geometry of the central metal atom of this complex?

(b) What is the type of ligand added above to  $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$  to demonstrate the influence of ligand on colours of complex compounds?

(c) Complete the table given below:

en:N	Colour absorbed
i	
2:1	
3:1	

**OR**

en:N	Formula of the ion formed
i	
1:1	
3:1	

- 30 Conductivity measurements are used routinely in many industrial and environmental applications as a fast, inexpensive and reliable way of measuring the ionic content in a solution.



<p>For example, the measurement of conductivity is a typical way to monitor and continuously trend the performance of water purification systems.</p> <p>In many cases, conductivity is linked directly to the total dissolved solids (TDS). High quality deionized water has a conductivity of about <math>5 \times 10^{-6}</math> S/m at STP, typical drinking water is in the range of 0.02–0.08 S/m, while sea water is about 5 S/m.</p> <p>According to research, the TDS in a sample of fresh water can be calculated as <math>\text{TDS (mg/L)} = 10^4 \times 0.65 \times \text{conductivity (S/m)}</math>.</p> <p>The conductivity of a sample of water taken from a borewell is given as 0.13 S/m at STP.</p> <p>A conductivity cell is created using the water above. The resistance of the cell is found to be 10 ohms.</p> <p>(a) What is the cell constant of the cell given above?</p> <p>(b) What is the amount of TDS in the sample of water taken?</p> <p>(c) According to some studies TDS of 250 mg/L represents a good source of drinking water. What would the conductivity of such a sample of water be? If such water was made by diluting the sample of water given above, what would be the resistance of a conductivity cell made using that?</p> <p><b>OR</b></p> <p>If the resistance of a cell made from diluting the sample of water taken above was found to be 79 ohms, calculate the TDS of the new sample.</p>
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### Section E

<p><i>The following questions are long answer type and carry 5 marks each. All questions have an internal choice.</i></p>	
31	<p>Answer any <b>five</b> questions with respect to the series of ions given below: <math>\text{Sc}^{+3}, \text{Ti}^{+4}, \text{V}^{+4}, \text{V}^{+2}, \text{Cr}^{+2}, \text{Fe}^{+3}, \text{Ni}^{+2}, \text{Cu}^{+2}, \text{Zn}^{+2}</math></p> <p>(a) Which of these ions are isoelectronic?</p> <p>(b) Why do <math>\text{Sc}^{+3}, \text{Ti}^{+4}</math>, and <math>\text{Zn}^{+2}</math> form colourless aqueous solution?</p> <p>(c) Which ion(s) from the list is/are not transition element(s) and why?</p> <p>(d) Cr forms two types of oxides - <math>\text{Cr}^{+2}</math> and <math>\text{Cr}^{+3}</math>. Which of them is expected to turn red litmus blue?</p> <p>(e) Arrange the following ions in the increasing order of their magnetic moments: <math>\text{Sc}^{+3}, \text{V}^{+2}, \text{V}^{+4}, \text{Ni}^{+2}</math>.</p> <p>(f) Why are alloys mostly prepared from transition metals?</p> <p>(g) Which ion can also has a +1 oxidation state?</p>



	[Atomic number of: Sc =21, Ti =22, V =23, Cr=24, Fe=26, Ni=28, Cu=29, Zn=30]												
32	<p>The following table contains osmotic pressure data for three compounds dissolved in various solvents.</p> <table border="1"><thead><tr><th>Compound</th><th>Concentration, C (g/L)</th><th>Osmotic pressure (atm)</th></tr></thead><tbody><tr><td>Cellulose</td><td>12.5</td><td>0.0021</td></tr><tr><td>Protein</td><td>28.5</td><td>0.0026</td></tr><tr><td>Haemoglobin</td><td>5</td><td>0.0018</td></tr></tbody></table> <p>(R = 0.083 L bar mol<sup>-1</sup> K<sup>-1</sup>)</p> <p>(a) If the concentration of protein is doubled keeping all other variables constant, what will be the osmotic pressure of the new solution?</p> <p>(b) When one litre of cellulose solution was heated to 315 K, its osmotic pressure changed to 0.00248 atm. What is the molecular mass of the cellulose in the solution?</p> <p>(c) A solution of 10 g of protein in a litre of solvent was found to be isotonic to the haemoglobin solution given above in the table, at the same temperature. If the molecular weight of the protein is 130,000 g/mol, what is the molecular weight of haemoglobin.</p> <p><b>OR</b></p> <p>The relation between the osmotic pressure of three solutions A, B, and C is:</p> <p><math>\pi_B &lt; \pi_C</math> <math>\pi_C &gt; \pi_A</math> <math>\pi_A &gt; \pi_B</math></p> <p>The three solutions have the same molarity and are at the same temperature.</p> <p>(a) For which of the solutions is the value of 'i' expected to be the greatest? Give a reason.</p> <p>(b) Which of the solutions is MOST LIKELY to be glucose, potassium sulphate, and sodium chloride?</p> <p>(c) Which of the solutions is expected to give a vapour pressure-mole fraction graph similar to that of an acetone-chloroform mixture? Give reason.</p>	Compound	Concentration, C (g/L)	Osmotic pressure (atm)	Cellulose	12.5	0.0021	Protein	28.5	0.0026	Haemoglobin	5	0.0018
Compound	Concentration, C (g/L)	Osmotic pressure (atm)											
Cellulose	12.5	0.0021											
Protein	28.5	0.0026											
Haemoglobin	5	0.0018											
33	<p>The compound C<sub>6</sub>H<sub>5</sub>NHCOCH<sub>3</sub> is obtained when compound A reacts with acetic anhydride in presence of pyridine. This compound A does not undergo Friedel-Crafts reaction.</p> <p>(a) Write the reaction showing the formation of C<sub>6</sub>H<sub>5</sub>NHCOCH<sub>3</sub> from compound A.</p> <p>(b) The pH of the aq. solution of A is less than 7. Is this statement true? Give reason.</p> <p>(c) State what type of functional group can be introduced into compound A, that will:</p> <p>(i) increase the pH of the aqueous solution</p>												





(ii) decrease the pH of the aqueous solution  
(d) What do you observe when compound A reacts with bromine water at room temperature?

**OR**

Parul was given two test tubes. One of the test tubes contained ethyl amine and the other contained aniline. To distinguish between the two compounds, she adds a reagent X to both the test tubes. She observes that in only one of the test tubes a yellow dye is formed.

- (a) Identify the reagent X.
- (b) Describe how this reagent is prepared and give a reason why it is not readily available in a laboratory.
- (c) Which of the two compounds forms the yellow dye?
- (d) Draw the structure of the yellow dye formed.



# CBSE

## Additional Practice Questions Subject: Mathematics (041) Class: XII 2023-24

**Time Allowed: 3 Hours**

**Maximum Marks: 80**

### General Instructions:

1. This Question paper contains - five sections **A, B, C, D and E**. Each section is compulsory. However, there are internal choices in some questions.
2. **Section A** has 18 MCQs and 02 Assertion-Reason based questions of 1 mark each.
3. **Section B** has 5 Very Short Answer (VSA)-type questions of 2 marks each.
4. **Section C** has 6 Short Answer (SA)-type questions of 3 marks each.
5. **Section D** has 4 Long Answer (LA)-type questions of 5 marks each.
6. **Section E** has 3 source based/case based/passage based/integrated units of assessment (4 marks each) with sub parts.

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### SECTION A

**(This section comprises of Multiple-choice questions (MCQ) of 1 mark each.)**

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Serial No.	Question	Marks
1	For any $2 \times 2$ matrix $P$ , which of the following matrices can be $Q$ such that $PQ = QP$ ?	1
(a)	$\begin{bmatrix} 1 \\ 1 \end{bmatrix}$	
(b)	$\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$	
(c)	$\begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}$	
(d)	(No such matrix exists as matrix multiplication is not commutative.)	

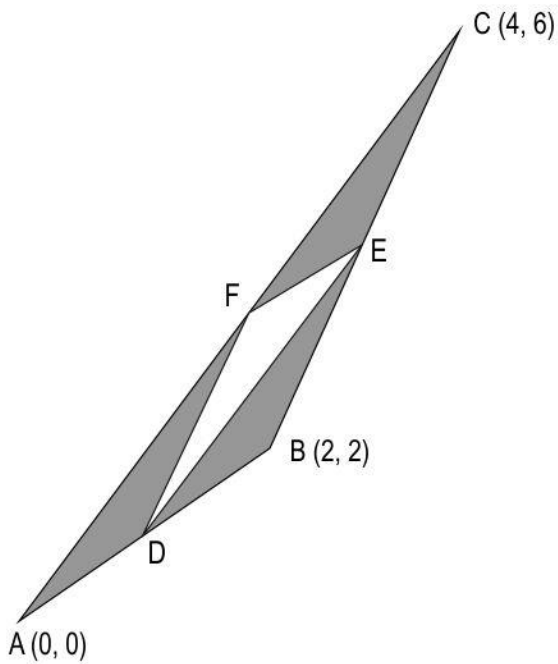


- 2  $V$  is a matrix of order 3 such that  $|\text{adj } V| = 7$ . 1

Which of these could be  $|V|$ ?

- (a)  $7^2$
- (b) 7
- (c)  $\sqrt{7}$
- (d)  $\sqrt[3]{7}$

- 3 The points  $D$ ,  $E$  and  $F$  are the mid-points of  $AB$ ,  $BC$  and  $CA$  respectively. 1



(Note: The figure is not to scale.)

What is the area of the shaded region?

- (a) 2 sq units
  - (b)  $\frac{3}{2}$  sq units
  - (c)  $\frac{1}{2}$  sq units
  - (d)  $(2\sqrt{26} - 1)$  sq units
- 4 If  $f(x) = \cos^{-1}\sqrt{x}$ ,  $0 < x < 1$ , which of the following is equal to  $f'(x)$ ? 1

- (a)  $\frac{-1}{\sqrt{1-x}}$



(b)  $\frac{1}{\sqrt{1-x}}$

(c)  $\frac{1}{2\sqrt{x(1-x)}}$

(d)  $\frac{-1}{2\sqrt{x(1-x)}}$

5 A function  $f: \mathbb{R} \rightarrow \mathbb{R}$  is defined by:

1

$$f(x) = \begin{cases} e^{-2x}, & x < \ln \frac{1}{2} \\ 4, & \ln \frac{1}{2} \leq x \leq 0 \\ e^{-2x}, & x > 0 \end{cases}$$

Which of the following statements is true about the function at the point  $x = \ln \frac{1}{2}$ ?

- (a)  $f(x)$  is not continuous but differentiable.
- (b)  $f(x)$  is continuous but not differentiable.
- (c)  $f(x)$  is neither continuous nor differentiable.
- (d)  $f(x)$  is both continuous as well as differentiable.

6 In which of these intervals is the function  $f(x) = 3x^2 - 4x$  strictly decreasing?

1

- (a)  $(-\infty, 0)$
- (b)  $(0, 2)$
- (c)  $(\frac{2}{3}, \infty)$
- (d)  $(-\infty, \infty)$

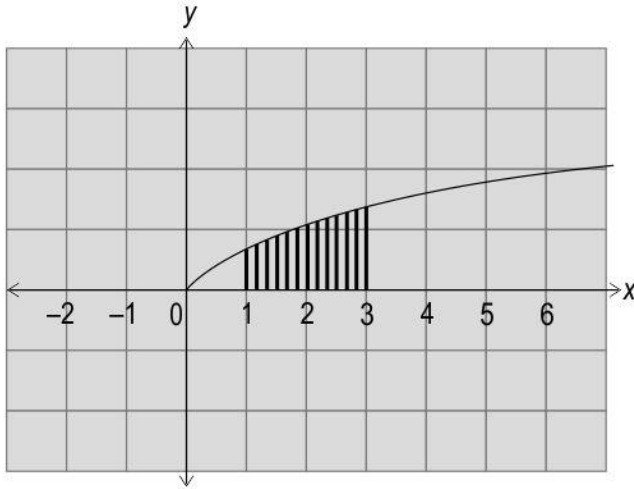
7 Which of these is equal to  $\int e^{(x \log 5)} e^x dx$ , where  $C$  is the constant of integration?

1

- (a)  $\frac{(5e)^x}{\log 5e} + C$
- (b)  $\log 5^x + x + C$
- (c)  $5^x e^x + C$
- (d)  $(5e)^x \log x + C$



- 8 Shown below is the curve defined by the equation  $y = \log(x + 1)$  for  $x \geq 0$ . 1



Which of these is the area of the shaded region?

- (a)  $6\log(2) - 2$   
(b)  $6\log(2) - 6$   
(c)  $6\log(2)$   
(d)  $5\log(2)$
- 9 In which of the following differential equations is the degree equal to its order? 1

(a)  $x^3 \left(\frac{dy}{dx}\right) - \frac{d^3y}{dx^3} = 0$

(b)  $\left(\frac{d^3y}{dx^3}\right)^3 + \sin\left(\frac{dy}{dx}\right) = 0$

(c)  $x^2 \left(\frac{dy}{dx}\right)^4 + \sin y - \left(\frac{d^2y}{dx^2}\right)^2 = 0$

(d)  $\left(\frac{dy}{dx}\right)^3 + x \left(\frac{d^2y}{dx^2}\right) - y^3 \left(\frac{d^3y}{dx^3}\right) + y = 0$



10 Kapila is trying to find the general solution of the following differential equations. 1

(i)  $xe^{\frac{x}{y}} dx - ye^{\frac{3x}{y}} dy = 0$

(ii)  $(2x + 1) \frac{dy}{dx} = 3 - 2y$

(iii)  $\frac{dy}{dx} = \sin x - \cos y$

Which of the above become variable separable by substituting  $y = b.x$ , where  $b$  is a variable?

- (a) only (i)
- (b) only (i) and (ii)
- (c) all - (i), (ii) and (iii)
- (d) None of the above

11 For which of these vectors is the projection on the y-axis zero? 1

(i)  $2\hat{j}$

(ii)  $-5\hat{k}$

(iii)  $\hat{i} - 4\hat{k}$

- (a) only (i)
- (b) only (ii)
- (c) only (i) and (ii)
- (d) only (ii) and (iii)

12 If  $(\hat{i} + \lambda\hat{j}) \times (5\hat{i} + 3\hat{j} + \sigma\hat{k}) = 0$ , what are the values of  $\lambda$  and  $\sigma$ ? 1

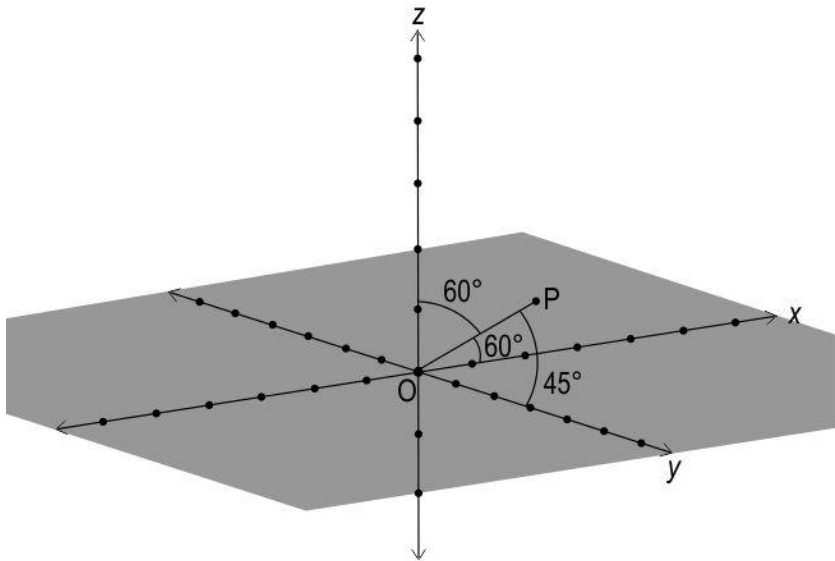
(a)  $\lambda = \frac{3}{5}, \sigma = 0$

(b)  $\lambda = \frac{5}{3}, \sigma = 5$

(c)  $\lambda = 3, \sigma = 0$

(d) (cannot be found as there are two unknowns and only one equation)

- 13 A line  $\vec{OP}$  in space, represented by the figure below, has a magnitude of  $2\sqrt{2}$  units. 1



Which of these are the direction ratios of  $\vec{OP}$ ?

- (a)  $(2, \sqrt{2}, 2)$   
 (b)  $(\sqrt{2}, 2, \sqrt{2})$   
 (c)  $(\frac{1}{2}, \frac{1}{\sqrt{2}}, \frac{1}{2})$   
 (d)  $(2\sqrt{2}, 2\sqrt{2}, 2\sqrt{2})$
- 14 A line  $m$  passes through the point  $(-4, 2, -3)$  and is parallel to line  $n$ , given by: 1

$$\frac{-x-2}{4} = \frac{y+3}{-2} = \frac{2z-6}{3}$$

The vector equation of line  $m$  is given by:

$$\vec{r} = (-4\hat{i} + 2\hat{j} - 3\hat{k}) + \lambda(p\hat{i} + q\hat{j} + r\hat{k}), \text{ where } \lambda \in \mathbf{R}$$

Which of the following could be the possible values for  $p, q$  and  $r$ ?

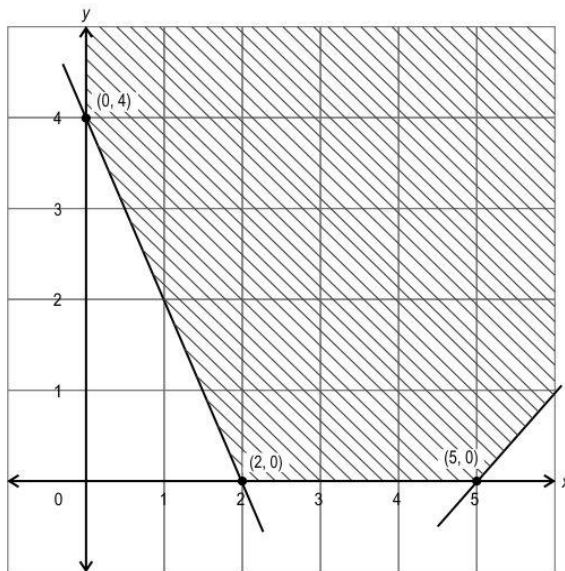
- (a)  $p = 4, q = (-2), r = 3$   
 (b)  $p = (-4), q = (-2), r = 3$   
 (c)  $p = (-2), q = 3, r = (-6)$   
 (d)  $p = 8, q = 4, r = (-3)$
- 15  $L_1$  and  $L_2$  are two skew lines. 1



How many lines joining  $L_1$  and  $L_2$  can be drawn such that the line is perpendicular to both  $L_1$  and  $L_2$  ?

- (a) exactly one
- (b) exactly two
- (c) infinitely many
- (d) (there cannot be a line joining two skew lines such that it is perpendicular to both)

- 16 A linear programming problem (LPP) along with the graph of its constraints is shown below. The corresponding objective function is Minimize:  $Z = 3x + 2y$ . The minimum value of the objective function is obtained at the corner point (2, 0).



The optimal solution of the above linear programming problem \_\_\_\_\_.

- (a) does not exist as the feasible region is unbounded.
- (b) does not exist as the inequality  $3x + 2y < 6$  does not have any point in common with the feasible region.
- (c) exists as the inequality  $3x + 2y > 6$  has infinitely many points in common with the feasible region.
- (d) exists as the inequality  $3x + 2y < 6$  does not have any point in common with the feasible region.

- 17 The feasible region of a linear programming problem is bounded. The corresponding objective function is  $Z = 6x - 7y$ .





The objective function attains \_\_\_\_\_ in the feasible region.

- (a) only minimum
- (b) only maximum
- (c) both maximum and minimum
- (d) either maximum or minimum but not both

18 M and N are two events such that  $P(M \cap N) = 0$ . 1

Which of the following is equal to  $P(M|(M \cup N))$ ?

- (a)  $\frac{P(M)}{P(N)}$
- (b)  $\frac{P(M \cup N)}{P(M \cap N)}$
- (c)  $\frac{P(M)}{P(M) + P(N)}$
- (d)  $\frac{P(M)}{P(M) \times P(N)}$

19  $X = \{0, 2, 4, 6, 8\}$ . 1  
P is a relation on X defined by  $P = \{(0, 2), (4, 2), (4, 6), (8, 6), (2, 4), (0, 4)\}$ .

Based on the above information, two statements are given below - one labelled Assertion (A) and the other labelled Reason (R). Read the statements carefully and choose the option that correctly describes statements (A) and (R).

*Assertion (A):* The relation P on set X is a transitive relation.

*Reason (R):* The relation P has a subset of the form  $\{(a, b), (b, c), (a, c)\}$ , where  $a, b, c \in X$ .

- (a) Both (A) and (R) are true and (R) is the correct explanation for (A).
- (b) Both (A) and (R) are true but (R) is not the correct explanation for (A).
- (c) (A) is true but (R) is false.
- (d) (A) is false but (R) is true.

20 Two statements are given below - one labelled Assertion (A) and the other labelled Reason (R). Read the statements carefully and choose the option that correctly describes statements (A) and (R). 1



*Assertion (A):* The maximum value of the function  $f(x) = x^5$ ,  $x \in [-1, 1]$ , is attained at its critical point,  $x = 0$ .

*Reason (R):* The maximum of a function can only occur at points where derivative is zero.

- (a) Both (A) and (R) are true and (R) is the correct explanation for (A).  
(b) Both (A) and (R) are true but (R) is not the correct explanation for (A).  
(c) (A) is false but (R) is true.  
(d) Both (A) and (R) are false.

---

### SECTION B

**(This section comprises of very short answer type-questions (VSA) of 2 marks each.)**

---

Serial No.	Question	Marks
21	Find the domain of the function $y = \cos^{-1}( x - 1 )$ . Show your steps.	2

OR

Draw the graph of the following function: 2

$$y = 2\sin^{-1}(x), -\pi \leq y \leq \pi$$

22	The sum of a matrix and its transpose is $\begin{bmatrix} 6 & -1 \\ -1 & 4 \end{bmatrix}$ .	2
----	---	---

Find one such matrix for which this holds true.  
Show your work.

23	If $x = \cot t$ and $y = \operatorname{cosec}^2 t$ , find: <span style="float: right;">2</span>
----	---

i)  $\frac{dy}{dx}$

ii)  $\frac{d^2y}{dx^2}$



Show your steps.

- 24 Iqbal, a data analyst in a social media platform is tracking the number of active users on their site between 5 pm and 6 pm on a particular day. 2

The user growth function is modelled by  $N(t) = 1000e^{0.1t}$ , where  $N(t)$  represents the number of active users at time  $t$  minutes during that period.

Find how fast the number of active users are increasing or decreasing at 10 minutes past 5 pm. Show your steps.

OR

- The population of rabbits in a forest is modelled by the function below: 2

$$P(t) = \frac{2000}{1 + e^{-0.5t}}, \text{ where } P \text{ represents the population of rabbits in } t \text{ years}$$

Determine whether the rabbit population is increasing or not, and justify your answer.

- 25 Solve the integral: 2

$$I = \int x(k - x)^{23} dx, \text{ where } k \text{ is a constant}$$

Show your steps.

---

### SECTION C

(This section comprises of short answer type questions (SA) of 3 marks each)

---

Serial No.	Question	Marks
26		3



Solve the integral:

$$I = \int \frac{3x+5}{x^2+4x+7} dx$$

Show your work.

27

Evaluate the integral:

3

$$\int_0^{\frac{\pi}{2}} \frac{\sin \theta d\theta}{(25+\cos \theta)(26+\cos \theta)}$$

Show your steps.

OR

Using the properties of definite integrals, prove the following:

3

$$\int_0^{\pi} h(\sin x) dx = 2 \int_0^{\frac{\pi}{2}} h(\sin x) dx, \text{ where } h(\sin x) \text{ is a function of } \sin x.$$

State the property used.

28

When an object is thrown vertically upward, it is under the effect of gravity and air resistance. For small objects, the force due to air resistance is numerically equal to some constant  $k$  times  $v$ , where  $v$  is the velocity of the object (in m/s) at time  $t$  (s).

3

This situation can be modelled as the differential equation shown below.

$$m \frac{dv}{dt} = -F_R - mg$$

where,

$m$  is the mass of the object in kg.

$\frac{dv}{dt}$  is the acceleration of the object in  $m/s^2$ .

$F_R$  is the force due to air resistance.

$g$  is the acceleration due to gravity ( $10 m/s^2$ ).

A tennis ball of mass 0.050 kg is hit upwards with a velocity of 10 m/s. An air resistance numerically equal to  $0.4v$  acts on the ball.

(i) Model the above situation using a differential equation.

(ii) Write an expression for the velocity of the ball in terms of the time.

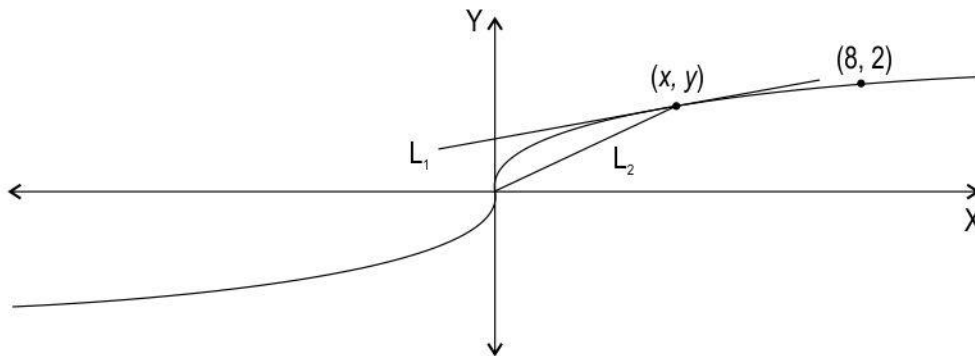
Show your work.



29

Shown below is a curve.

3



$L_1$  is the tangent to any point  $(x, y)$  on the curve.

$L_2$  is the line that connects the point  $(x, y)$  to the origin.

The slope of  $L_1$  is one third of the slope of  $L_2$ .

Find the equation of the curve. Show your work.

OR

Given  $x + (y + 1) \frac{dy}{dx} = 2$ .

3

(i) Solve the differential equation and show that the solution represents a family of circles.

(ii) Find the radius of a circle belonging to the above family that passes through the origin.

Show your work.

30

Each unit of Product A that a company produces, is sold for Rs 100 with a production cost of Rs 60 and each unit of Product B is sold for Rs 150 with production cost of Rs 90. On a given day, the company has a budget of Rs 8000 to spend on production. The production process makes it such that they can only produce a maximum of 100 units each day. Also, the number of product B produced cannot be more than twice as many of Product A.

3

Frame a linear programming problem to determine how many units of Product A and B should the company produce in a day in order to maximize their profit?

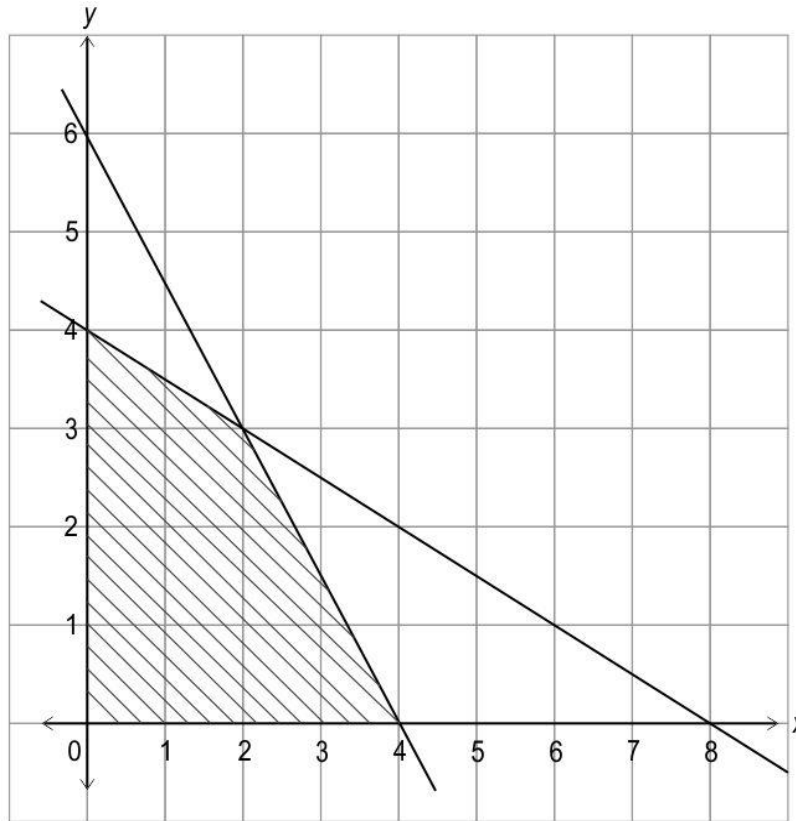


(Note: No need to find the feasible region and optimal solution.)

OR

Shown below is the feasible region of a maximisation problem whose objective function is given by  $Z = 5x + 3y$ .

3



- i) List all the constraints the problem is subjected to.
- ii) Find the optimal solution of the problem.

Show your work.

31

A company follows a model of bifurcating the tasks into the categories shown below. 3



	URGENT	NOT URGENT
IMPORTANT	urgent and important	not urgent but important
NOT IMPORTANT	urgent but not important	not urgent and not important

At the beginning of a financial year, it was noticed that:

- ◆ 40% of the total tasks were urgent and the rest were not.
- ◆ half of the urgent tasks were important, and
- ◆ 30% of the tasks that were not urgent, were not important

What is the probability that a randomly selected task that is not important is urgent? Use Bayes' theorem and show your steps.

---

## SECTION D

**(This section comprises of long answer-type questions (LA) of 5 marks each)**

---

Serial No.	Question	Marks
32	The Earth has 24 time zones, defined by dividing the Earth into 24 equal longitudinal segments. These are the regions on Earth that have the same standard time. For example, USA and India fall in different time zones, but Sri Lanka and India are in the same time zone.	5

A relation  $R$  is defined on the set  $U = \{\text{All people on the Earth}\}$  such that  $R = \{(x, y) \mid \text{the time difference between the time zones } x \text{ and } y \text{ reside in is } 6 \text{ hours}\}$ .

- Check whether the relation  $R$  is reflexive, symmetric and transitive.
- Is relation  $R$  an equivalence relation?

Show your work.

OR

A function  $f: \mathbb{R} - \{-1, 1\} \rightarrow \mathbb{R}$  is defined by:

5

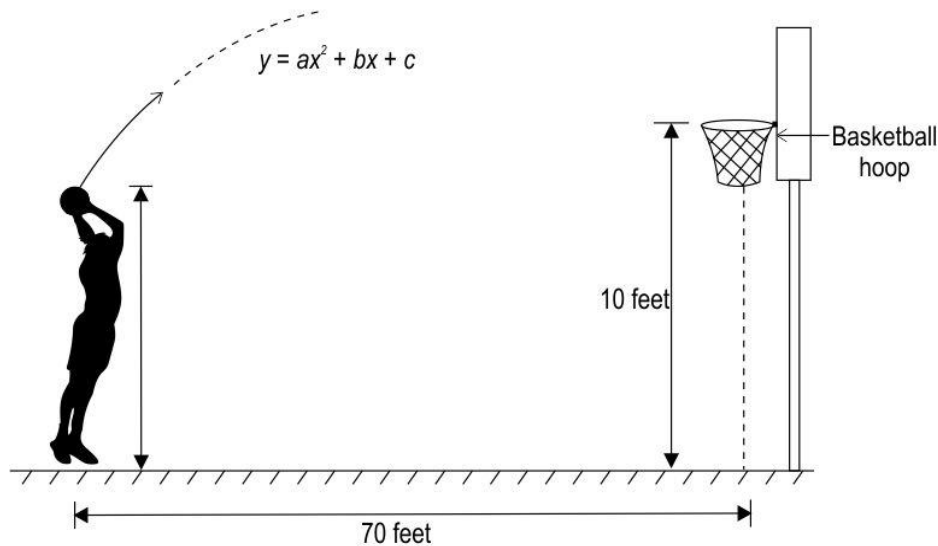
$$f(x) = \frac{x}{x^2 - 1}$$

- i) Check if  $f$  is one-one.
- ii) Check if  $f$  is onto.

Show your work.

- 33 Abdul threw a basketball in the direction of the basketball hoop which traversed a parabolic path in a vertical plane as shown below.

5



(Note: The image is for representation purpose only.)

The equation of the path traversed by the ball is  $y = ax^2 + bx + c$  with respect to a  $xy$ -coordinate system in the vertical plane. The ball traversed through the points  $(10, 16)$ ,  $(20, 22)$  and  $(30, 25)$ . The basketball hoop is at a horizontal distance of 70 feet from Abdul. The height of the basketball hoop is 10 feet from the floor to the top edge of the rim.

Did the ball successfully go through the hoop? Justify your answer.

(Hint: Consider the point where Abdul is standing as the origin of the  $xy$ -coordinate system.)

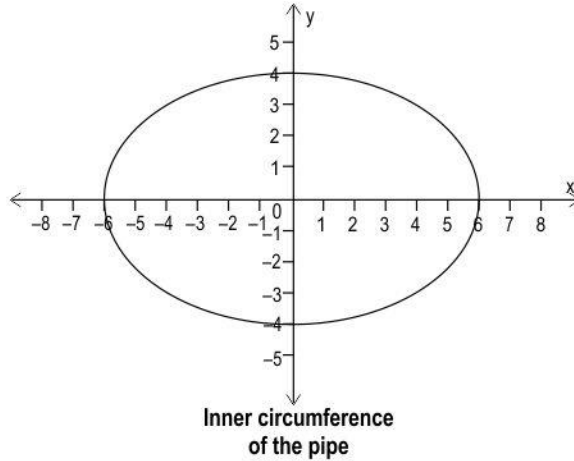
- 34 Shown below are concrete elliptical water pipes, each 10 feet in length.

5





Concrete elliptical pipes



The graph given above represents the inner circumference of the elliptical pipe, where  $x$  and  $y$  are in feet. Assume that the water flows uniformly and fully covers the inner cross-sectional area of the pipe.

Find the volume of water in the pipe at a given instant of time, in terms of  $\pi$ . Use the integration method and show your steps.

(Note:  $Volume = Area \text{ of the base} \times Height$ )

- 35 i) Find the vector and cartesian equations of the straight line passing through the point  $(-5, 7, -4)$  and in the direction of  $(3, -2, 1)$ . 5
- ii) Find the point where this straight line crosses the  $xy$ -plane.

Show your work.

OR

Given below are two lines  $L_1$  and  $L_2$ : 5

$$L_1: 2x = 3y = -z$$

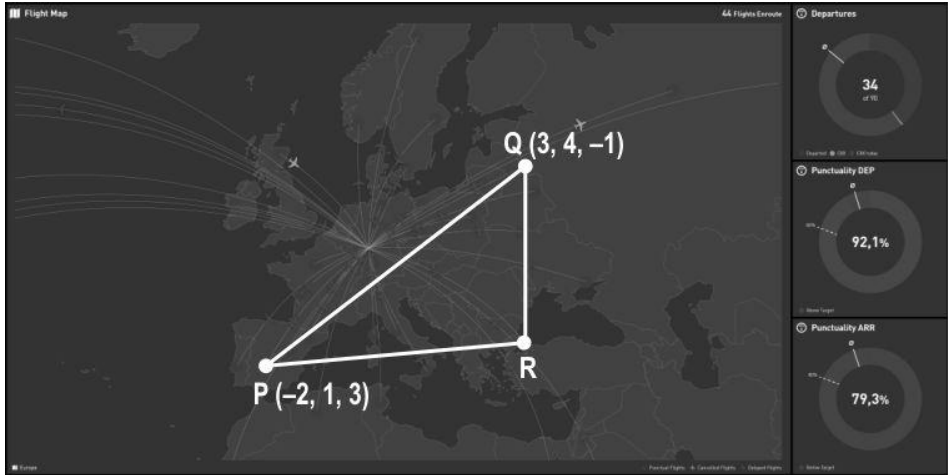
$$L_2: 6x = -y = -4z$$

- i) Find the angle between the two lines.  
ii) Find the shortest distance between the two lines.

Show your work.

## SECTION E

(This section comprises of 3 case-study/passage-based questions of 4 marks each with two sub-questions. First two case study questions have three sub questions of marks 1, 1, 2 respectively. The third case study question has two sub questions of 2 marks each.)

Serial No.	Question	Marks
36	<p><b>Answer the questions based on the given information.</b></p> <p>The flight path of two airplanes in a flight simulator game are shown below. The coordinates of the airports P and Q are given.</p>  <p>Airplane 1 flies directly from P to Q.</p> <p>Airplane 2 has a layover at R and then flies to Q.</p> <p>The path of Airplane 2 from P to R can be represented by the vector <math>5\hat{i} + \hat{j} - 2\hat{k}</math>.</p> <p><i>(Note: Assume that the flight path is straight and fuel is consumed uniformly throughout the flight.)</i></p>	1
	<p>i) Find the vector that represents the flight path of Airplane 1. Show your steps.</p>	1
	<p>ii) Write the vector representing the path of Airplane 2 from R to Q. Show your steps.</p>	1

iii) What is the angle between the flight paths of Airplane 1 and Airplane 2 just after takeoff? Show your work. 2

OR

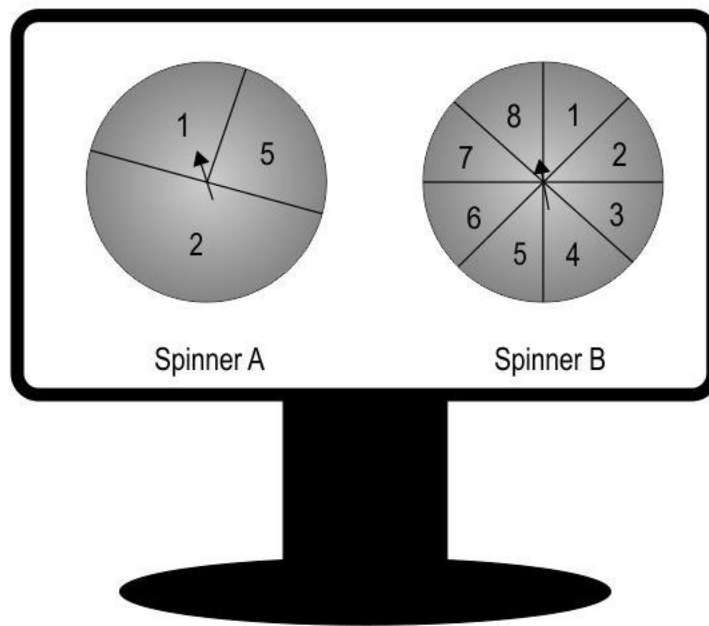
iii) Consider that Airplane 1 started the flight with a full fuel tank. 2

Find the position vector of the point where a third of the fuel runs out if the entire fuel is required for the flight. Show your work.

---

37 **Answer the questions based on the given information.**

Rubiya, Thaksh, Shanteri, and Lilly entered a spinning zone for a fun game, but there is a twist: they don't know which spinner will appear on their screens until it is their turn to play. They may encounter one of the following spinners, or perhaps even both:



Different combinations of numbers will lead to exciting prizes. Below are some of the rewards they can win:

- ◆ Get the number '5', from Spinner A and '8' from Spinner B, and you'll win a music player!
- ◆ You win a photo frame if Spinner A lands on a value greater than that of Spinner B!



i) Thaksh spun both the spinners, A and B in one of his turns. 1

What is the probability that Thaksh wins a music player in that turn? Show your steps.

ii) Lilly spun spinner B in one of her turns. 1

What is the probability that the number she got is even given that it is a multiple of 3? Show your steps.

iii) Rubiya spun both the spinners. 2

What is the probability that she wins a photo frame? Show your work.

OR

iii) As Shanteri steps up to the screen, the game administrator reveals that for her turn, the probability of seeing Spinner A on the screen is 65%, while that of Spinner B is 35%. 2

What is the probability that Shanteri gets the number '2'? Show your steps.

---

38 **Answer the questions based on the given information.**

Two metal rods,  $R_1$  and  $R_2$ , of lengths 16 m and 12 m respectively, are insulated at both the ends. Rod  $R_1$  is being heated from a specific point while rod  $R_2$  is being cooled from a specific point.

The temperature ( $T$ ) in Celsius within both rods fluctuates based on the distance ( $x$ ) measured from either end. The temperature at a particular point along the rod is determined by the equations  $T = (16 - x)x$  and  $T = (x - 12)x$  for rods  $R_1$  and  $R_2$  respectively, where the distance  $x$  is measured in meters from one of the ends.

i) Find the rate of change of temperature at the mid point of the rod that is being heated. Show your steps. 2

ii) Find the minimum temperature attained by the rod that is being cooled. Show your work. 2

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# CBSE

## ADDITIONAL PRACTICE QUESTIONS

Physics-Theory  
Class XII | 2023–24

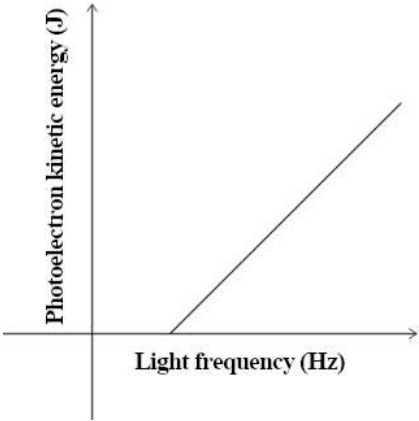
Maximum marks: 70

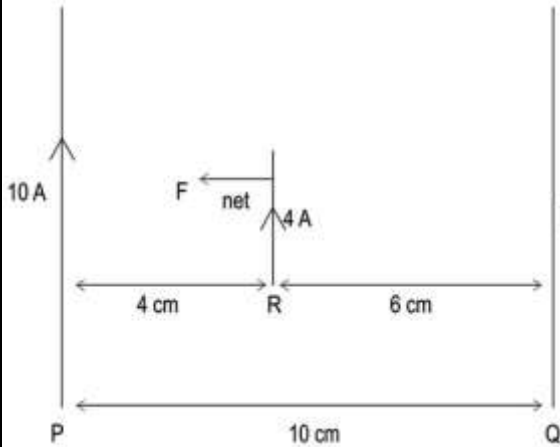
Time Allowed: 3 hours

### General instructions:

1. There are 33 questions in all. All questions are compulsory.
2. This question paper has five sections: Section A, Section B, Section C, Section D, and Section E.
3. All the sections are compulsory.
4. **Section A** contains sixteen questions, twelve MCQ and four Assertion Reasoning based of 1 mark each, **Section B** contains five questions of two marks each, **Section C** contains seven questions of three marks each, **Section D** contains two case study based questions of four marks each and **Section E** contains three long answer questions of five marks each.
5. There is no overall choice. However, an internal choice has been provided in one question in Section B, one question in Section C, one question in each CBQ in Section D and all three questions in Section E. You have to attempt only one of the choices in such questions.
6. Use of calculators is not allowed.

Q.No	Questions	Marks
<b>SECTION A</b>		
1	An electric dipole having a dipole moment of $4 \times 10^{-9}$ C m is placed in a uniform electric field such that the dipole is in stable equilibrium. If the magnitude of the electric field is $3 \times 10^3$ N/C, what is the work done in rotating the dipole to a position of unstable equilibrium?  A. zero B. $1.2 \times 10^{-5}$ J C. $2.4 \times 10^{-5}$ J D. $-1.2 \times 10^{-5}$ J	1
2	An infinite line of charge has a linear charge density of $10^{-7}$ C/m. What will be the magnitude of the force acting on an alpha particle placed at a distance of 4 cm from the line of charge?  A. $14.4 \times 10^{-15}$ N B. $7.2 \times 10^{-15}$ N C. $4.5 \times 10^4$ N D. $9 \times 10^4$ N	1

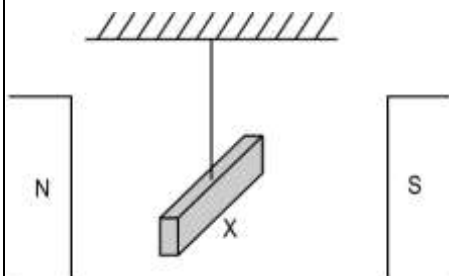
3	<p>The graph below shows the variation of the maximum kinetic energy of the emitted photoelectron with the frequency of the incident radiation for a given metal.</p>  <p>Which of the following gives the work function of the metal?</p> <p>A. x-intercept B. y-intercept C. the slope of the graph D. the area under the graph</p>	1															
4	<p>When an electron in an atom moves from the ground state to a higher energy level what happens to its kinetic and potential energies?</p> <table border="1" data-bbox="288 1146 751 1417"> <thead> <tr> <th></th> <th>kinetic energy</th> <th>potential energy</th> </tr> </thead> <tbody> <tr> <td>A</td> <td>increases</td> <td>Increases</td> </tr> <tr> <td>B</td> <td>increases</td> <td>Decreases</td> </tr> <tr> <td>C</td> <td>decreases</td> <td>Increases</td> </tr> <tr> <td>D</td> <td>decreases</td> <td>Decreases</td> </tr> </tbody> </table>		kinetic energy	potential energy	A	increases	Increases	B	increases	Decreases	C	decreases	Increases	D	decreases	Decreases	1
	kinetic energy	potential energy															
A	increases	Increases															
B	increases	Decreases															
C	decreases	Increases															
D	decreases	Decreases															
5	<p>Two long and straight current-carrying wires, P and Q are placed parallel to each other separated by a distance of 10 cm. A wire 'R' of length 8 cm and carrying a current of 4 A is placed between the two wires P and Q as shown below.</p>	1															



If the wire R, experiences a net force towards wire P, then which of the following is definitely TRUE about the current 'I' in wire Q?

- A. Current I cannot be in the upward direction.
- B. Current I can have any magnitude greater than 0 A in the upward direction.
- C. Current I cannot have a magnitude of more than 15 A in the upward direction.
- D. Current I cannot have a magnitude of more than 10 A in the upward direction.

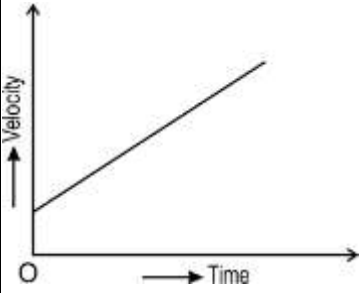
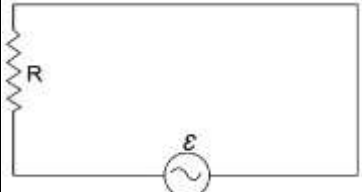
6 A rod when suspended in a uniform magnetic field aligns itself perpendicular to the magnetic field as shown below.



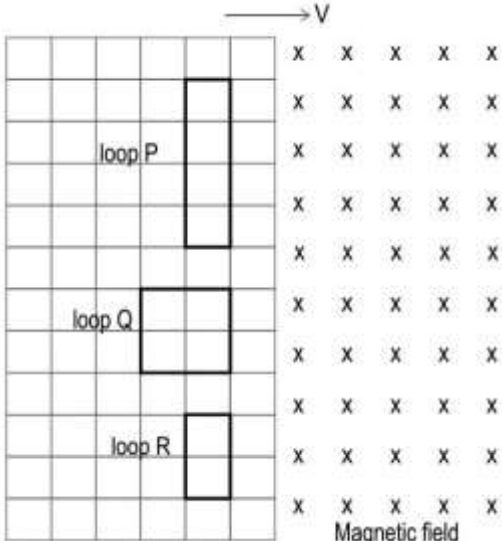
Which of the following statements is/are true for the rod?

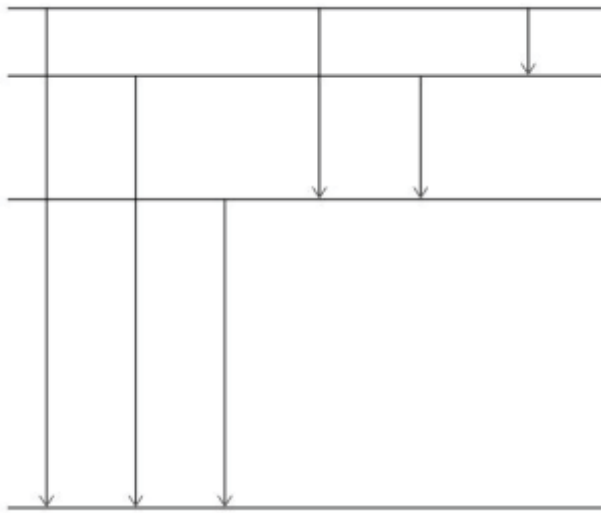
- P) Every atom in the rod, has a zero magnetic moment.
- Q) The rod is attracted when taken near the poles of a strong magnet.
- R) The relative permeability of the material of the rod is slightly less than 1.
- S) The susceptibility of the material of the rod is directly proportional to temperature.

- A. only Q
- B. only P and R
- C. only Q and S
- D. only R and S

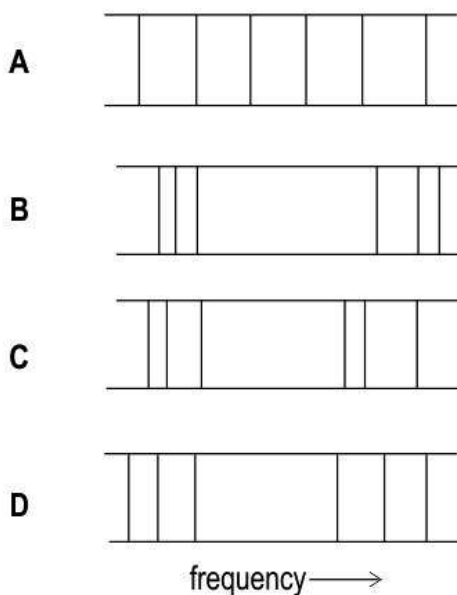
7	<p>Three students construct a solenoid of length 35 cm. They are each given insulated copper wire of the same length. The table below lists some details about the solenoids made by them.</p> <table border="1" data-bbox="288 439 1299 629"> <thead> <tr> <th></th> <th>Magnetic field produced</th> <th>Radius of solenoid</th> <th>Core of solenoid</th> </tr> </thead> <tbody> <tr> <td>Student 1</td> <td><math>B_1</math></td> <td>3 cm</td> <td>air</td> </tr> <tr> <td>Student 2</td> <td><math>B_2</math></td> <td>3 cm</td> <td>iron</td> </tr> <tr> <td>Student 3</td> <td><math>B_3</math></td> <td>6 cm</td> <td>air</td> </tr> </tbody> </table> <p>Compare the magnetic field produced by the solenoids made by the three students.</p> <p>A. <math>B_1=B_3&lt;B_2</math>            B. <math>B_3&lt;B_1&lt;B_2</math>            C. <math>B_1&lt;B_2&lt;B_3</math>            D. <math>B_1=B_2&gt;B_3</math></p>		Magnetic field produced	Radius of solenoid	Core of solenoid	Student 1	$B_1$	3 cm	air	Student 2	$B_2$	3 cm	iron	Student 3	$B_3$	6 cm	air	1
	Magnetic field produced	Radius of solenoid	Core of solenoid															
Student 1	$B_1$	3 cm	air															
Student 2	$B_2$	3 cm	iron															
Student 3	$B_3$	6 cm	air															
8	<p>A charged particle '+q' having a mass 'm' moves in a uniform electric and magnetic field. In which of the following scenarios will the path of the charged particle be linear and described by the velocity time graph shown below?</p>  <p>A. <math>E \perp B \perp</math> velocity of the particle            B. <math>E \parallel B</math> and the particle is initially at rest            C. <math>E \parallel B</math> and the particle has an initial velocity along the electric field            D. <math>E \perp B</math> and the particle has an initial velocity along the electric field</p>	1																
9	<p>A pure resistor is connected to an AC power source as shown below.</p>  <p>Which of the following statement(s) is/are TRUE?            I: The average current flowing through the circuit during one full cycle is zero.</p>	1																



	<p>II: The current in the resistor leads the voltage by <math>\pi/2</math>.</p> <p>III: The average power dissipated by the resistor is zero.</p> <p>A. only I B. only I and II C. only II and III D. all - I, II and III</p>	
10	<p>At what rate does the electric field change between the plates of a square capacitor of side 5 cm, if the plates are spaced 1.2 mm apart and the voltage across them is changing at a rate of 60 V/s?</p> <p>A. <math>7.2 \times 10^{-2} \text{ Vm}^{-1}\text{s}^{-1}</math> B. <math>30 \times 10^{-1} \text{ Vm}^{-1}\text{s}^{-1}</math> C. <math>12 \times 10^2 \text{ Vm}^{-1}\text{s}^{-1}</math> D. <math>5 \times 10^4 \text{ Vm}^{-1}\text{s}^{-1}</math></p>	1
11	<p>Three loops as shown below move into the magnetic field with a velocity <math>v</math>.</p>  <p>In which loop(s) will the induced emf be the <b>largest</b> at the instant when the loops enter the magnetic field?</p> <p>A. only P B. only Q C. only P and Q D. only Q and R</p>	1
12	<p>The emission spectrum of an element is the spectrum of frequencies of em radiations emitted due to electrons making a transition from a higher energy state to a lower energy state.</p> <p>The diagram below shows electrons transitioning from higher energy states to lower energy states.</p>	1



Which of the following spectrums most closely corresponds to the above transitions?

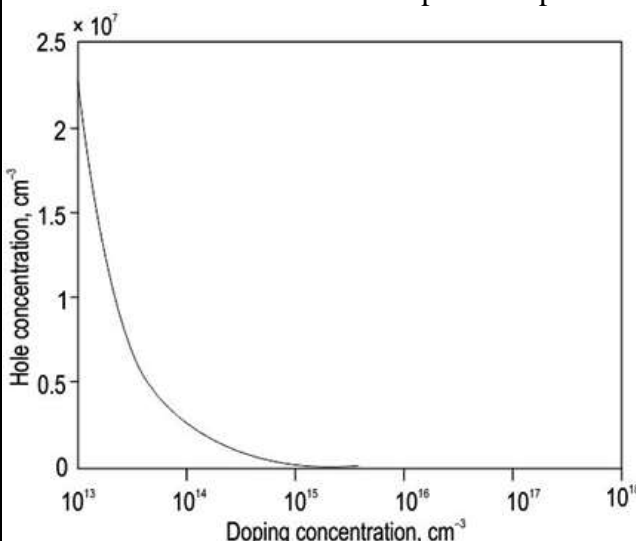


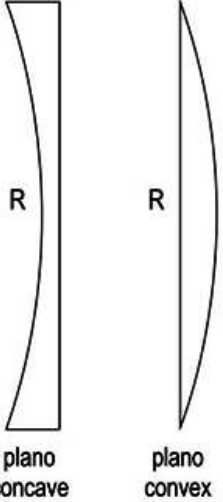
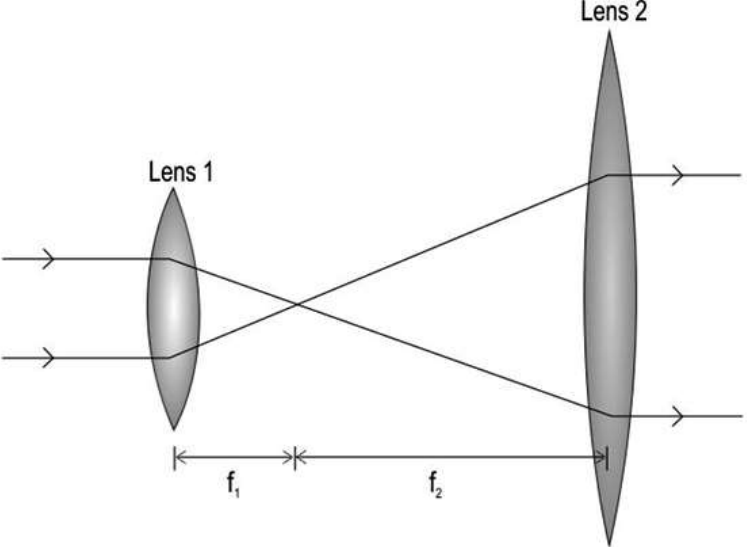
For Questions 13 to 16, two statements are given –one labelled Assertion (A) and other labelled Reason (R). Select the correct answer to these questions from the options as given below.

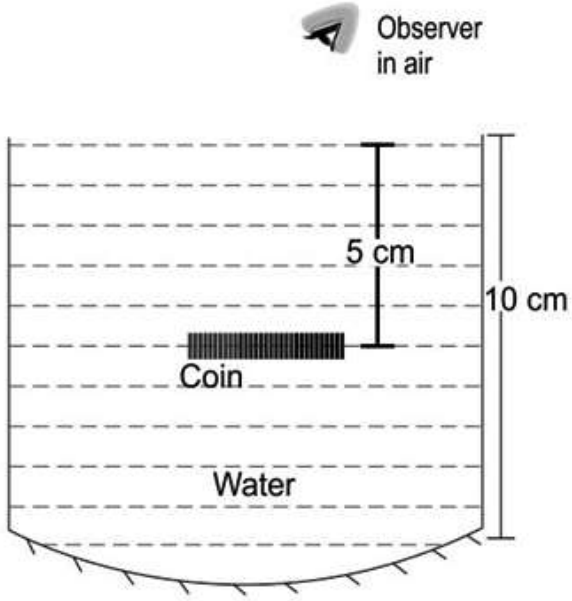
- A. Assertion and Reason are true and Reason is the correct explanation of Assertion.
- B. Assertion and Reason are true but Reason is NOT the correct explanation of Assertion.
- C. Assertion is true but Reason is false.
- D. Both Assertion and Reason are false.

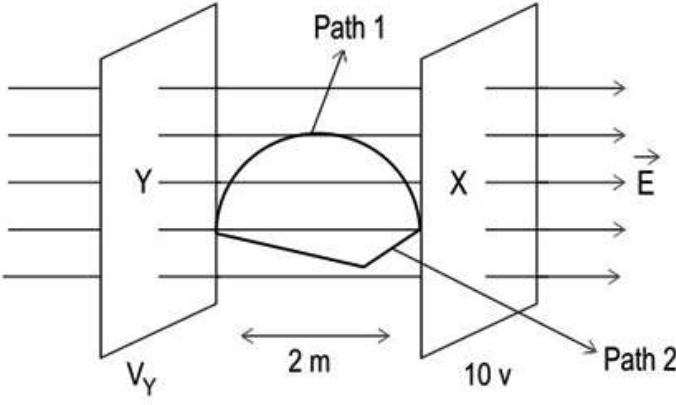
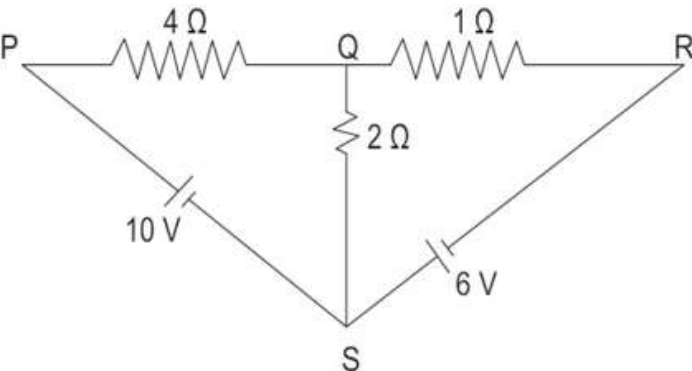
**13** Assertion (A): The work function of a given material increases with an increase in the frequency of the incident radiation.

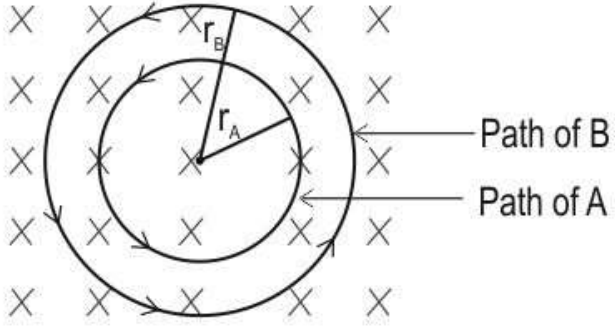
1

	Reason (R): As per Einstein's photoelectric equation $h\nu = \phi + KE$ , work function $\phi$ is directly proportional to the frequency $\nu$ of the incident radiation.	
14	Assertion (A): The conductivity of intrinsic semiconductors increases with an increase in temperature. Reason (R): Increase in temperature decreases the average time between collisions of electrons.	1
15	Assertion (A): The direction of the electric field is always perpendicular to the equipotential surface. Reason (R): Work is done by the electric force in moving a charge between any two points on an equipotential surface is zero.	1
16	Assertion (A): If the focal length of two convex lenses is the same, the lens with the larger diameter will produce brighter images. Reason (R): Convex lenses with larger diameters are able to focus light better.	1
<b>SECTION B</b>		
17	The graph shows the variation in hole concentration with doping concentration in an extrinsic semiconductor doped with pentavalent impurities.  Why does the hole concentration reduce when pentavalent doping is increased?	2
18	$\lambda_\alpha$ and $\lambda_p$ are the wavelengths associated with a moving alpha particle and a proton respectively. Obtain the relation between velocities of the two particles for which, (a) $\lambda_\alpha > \lambda_p$ (b) $\lambda_\alpha = \lambda_p$	2

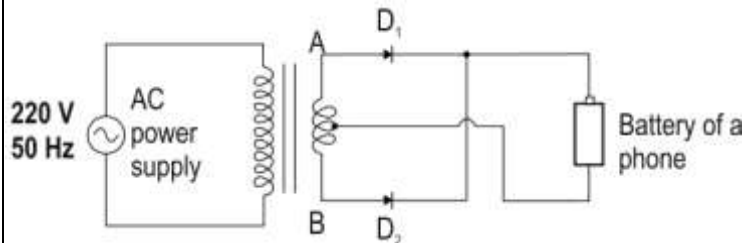
<p><b>19</b></p>	<p>Compare the focal lengths of the two lenses shown below if the radius of curvature of the curved surface is the same in both lenses.</p>  <p>plano concave      plano convex</p>	<p>2</p>
<p><b>20</b></p>	<p>(a) Two copper wires, P and Q of the same area of cross-section are joined in parallel. The combination of wires is connected across a battery of potential difference <math>V</math>. If the length of the wires, P and Q are in the ratio 1:2, find the ratio of drift velocities of electrons in wires P and Q.</p>	<p>2</p>
<p><b>21</b></p>	<p>The image below shows a setup of a device that is used to increase the diameter of a light beam from a laser.</p>  <p>Show how a combination of a convex and a concave lens can also be arranged to increase the diameter of a light beam. Your answer should include how the two lenses should be arranged and the distance between the two lenses. (<i>Note that the rays in both the incident and emergent beam are parallel.</i>)</p> <p><b>OR</b></p> <p>A glass beaker of height 10 cm, completely filled with water (refractive index = <math>4/3</math>), has a curved bottom which is silvered as shown below.</p>	<p>2</p>

	<div style="text-align: center;">  </div> <p>A plastic coin remains submerged in water at a depth of 5 cm from the top of the beaker. An observer sees the coin in the water and its image in the mirror. If the image formed by the curved mirror is seen by the observer at a distance of 15 cm from the surface of the water, what is the focal length of the curved surface? (Assume the silvered curved surface acts as a spherical mirror.)</p>	
<b>SECTION C</b>		
<p><b>22</b></p>	<p>Identify if the two nuclear reactions mentioned below are endothermic or exothermic. Show your calculations.</p> ${}^1_1\text{p} + {}^7_3\text{Li} \rightarrow 2({}^4_2\text{He})$ ${}^7_3\text{Li} + {}^4_2\text{He} \rightarrow {}^1_0\text{n} + {}^{10}_5\text{B}$ <p>Use the information below to answer the question:</p> ${}^1_1\text{p} = 1.00728 \text{ amu}$ ${}^7_3\text{Li} = 7.0160 \text{ amu}$ ${}^4_2\text{He} = 4.0026 \text{ amu}$ ${}^1_0\text{n} = 1.0087 \text{ amu}$ ${}^{10}_5\text{B} = 10.01294 \text{ amu}$	3
<p><b>23</b></p>	<p>X and Y are two equipotential surfaces separated by a distance of 2 m in a uniform electric field of 10 V/m. Surface X has a potential of 10 V</p> <p>(a) Calculate the potential of surface Y.</p> <p>(b) What is the work done in moving a +2 C charge from surface Y to surface X along path 1? How will this work change when the charge is moved along Path 2? Give a reason for your answer.</p>	3

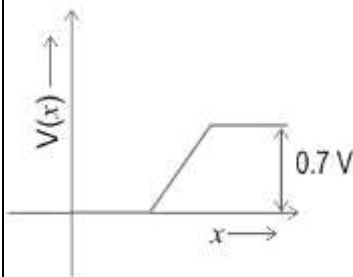
		
<p><b>24</b></p>	<p>(a) Compare the de Broglie wavelength associated with the electron in the third orbit to the circumference of the orbit.</p> <p>(b) In which of the following will the electrons have the same de Broglie wavelength?</p> <p>(i) Third orbit of He atom (ii) Fourth orbit of He atom (iii) Third orbit of Li atom (iv) Sixth orbit of Be atom</p> <p>Show your calculations.</p>	<p>3</p>
<p><b>25</b></p>	<p>Using Kirchoff's laws, calculate the current flowing through <math>4 \Omega</math>, <math>1 \Omega</math>, and <math>2 \Omega</math> resistors in the circuit shown below.</p> 	<p>3</p>
<p><b>26</b></p>	<p>Two charges A and B, each having a velocity of <math>v</math>, traverse circular paths in a uniform magnetic field as shown below.</p>	<p>3</p>

	 <p>(a) Compare the charge-to-mass ratio of the two particles A and B. Show the necessary mathematical calculations.          (b) Which of the two particles is likely to be a proton if the other is an alpha particle? Give reason.</p>																			
<p>27</p>	<p>(a) A radio wave and an infrasonic wave have the same wavelength when travelling through air. Are their frequencies the same or different? Give a reason for your answer.</p> <p>(b) An electromagnetic wave traveling east has a magnetic field that oscillates vertically and has a frequency of 60 kHz and an rms strength of <math>8 \times 10^{-9} \text{T}</math>. Determine the frequency and the rms strength of the electric field. What is the direction of the electric field?</p>	<p>3</p>																		
<p>28</p>	<p>A circular ring of diameter 0.2 m is placed in a uniform magnetic field of 0.4 T. The ring is rotated about its diameter at a frequency of 60 Hz.</p> <p>(a) If the ring has 50 turns, then what is the maximum induced emf in the ring?          (b) State one condition under which the induced emf in the circular ring will be zero?</p> <p><b>OR</b></p> <p>Given below are a few characteristics of solenoids p and q.</p> <table border="1" data-bbox="288 1467 1177 1796"> <thead> <tr> <th></th> <th>solenoid p</th> <th>solenoid q</th> </tr> </thead> <tbody> <tr> <td>length of the solenoid</td> <td>l (m)</td> <td>l (m)</td> </tr> <tr> <td>number of turns (N)</td> <td>200</td> <td>50</td> </tr> <tr> <td>cross-sectional area of the wire</td> <td>A (m<sup>2</sup>)</td> <td>A (m<sup>2</sup>)</td> </tr> <tr> <td>relative permeability of the core material</td> <td>1</td> <td>500</td> </tr> <tr> <td>self-inductance</td> <td>2 (mH)</td> <td>?</td> </tr> </tbody> </table> <p>What is the self-inductance of the solenoid q?</p>		solenoid p	solenoid q	length of the solenoid	l (m)	l (m)	number of turns (N)	200	50	cross-sectional area of the wire	A (m <sup>2</sup> )	A (m <sup>2</sup> )	relative permeability of the core material	1	500	self-inductance	2 (mH)	?	<p>3</p>
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<b>SECTION D</b>																				
<p>29</p>	<p>Read the following paragraph and answer the questions that follow.</p>	<p>4</p>																		

For most mobile devices, the voltage to recharge the battery is typically 5 volts of direct current. In India, the current supplied to our homes is alternating current at 220V and at a frequency of 50 Hz. Fatima designed a simplified version of a mobile phone charger. She made a circuit using a centre tap transformer and two similar silicon diodes  $D_1$  and  $D_2$  as shown below. Study the diagram below and answer the questions that follow.



- (a) Can Fatima also charge the battery of a phone by connecting the battery directly to the ac power supply? Give reason.  
 (b) The graph of the potential barrier ( $V$ ) vs width of the depletion region ( $x$ ), when  $D_1$  is unbiased at room temperature, is shown below.



Plot a comparative graph of the potential barrier ( $V$ ) vs width of the depletion region ( $x$ ) of  $D_1$  at room temperature when the voltage at A is negative with respect to voltage at centre tap. Give reason.

**OR**

If the battery of the phone is directly connected to the output terminals of the secondary coil of the transformer, will it get charged? Justify your answer.

- (c) What will be the output frequency across the phone's battery when the orientation of  $D_2$  is reversed in fig. 1 and the centre-tapped three-output transformer is replaced by a two-output step-down transformer? Justify your answer.

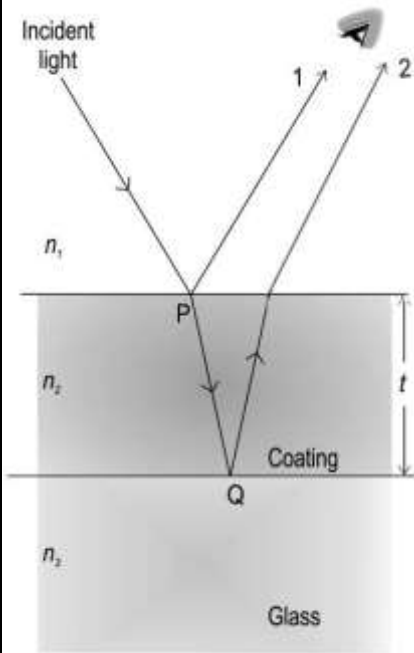
**30** Read the following paragraph and answer the questions that follow.

4

When light rays fall on glass, about 4% of the light gets reflected. To eliminate this reflection, the glass display cases in museums usually have an anti-reflective coating.

This works on the principle of interference. When light falls on the coated glass, the light gets reflected from the top and bottom surfaces of the coating and these two reflected light rays can interfere. To reduce reflection, the thickness and refractive index of the coating are adjusted such that the light rays undergo destructive interference.





Reflected light undergoes a  $180^\circ$  phase shift when it falls on a denser medium from a rarer medium and no phase shift when it falls on a rarer medium from a denser medium. (Note: The thickness of coating is much less than the glass.)

To answer the questions below, consider a monochromatic light of wavelength  $\lambda$  incident on the coating of thickness  $t$  at a small angle of incidence and  $n_1 < n_2 < n_3$ . Also Consider  $PQ \approx t$ .

(i) Which of the following occurs, if there is no coating on the glass?

- A. The object behind the case looks distorted.
- B. The colours of the object behind the glass case appear dull.
- C. A reflection of the objects in front of the glass case is seen on the case.
- D. Multiple reflections of the object behind the glass case are seen on the case

(ii) What is the path difference between rays 1 and 2? (Consider  $PQ \approx t$ .)

- A.  $t$
- B.  $2t$
- C.  $\lambda$
- D.  $2\lambda$

(iii) For what minimum thickness of the coating, do the two rays 1 and 2 undergo destructive interference? (Remember the wavelength of the light ray changes as it moves from one media to another.)

- A.  $n_2 \lambda/2$
- B.  $n_2 \lambda/4$
- C.  $\lambda/(2n_2)$
- D.  $\lambda/(4n_2)$

**OR**

For what minimum thickness of the coating, do the two rays 1 and 2 undergo constructive interference? (*Remember the wavelength of the light ray changes as it moves from one media to another.*)

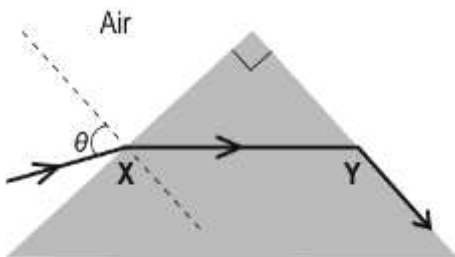
- A.  $n_2 \lambda$
- B.  $n_2 \lambda/2$
- C.  $\lambda/(n_2)$
- D.  $\lambda/(2n_2)$

(iv) If the material of the coating is changed such that  $n_2 > n_3$ , what will be the additional path difference compared to the path difference identified in question (b)?

- A.  $t$
- B.  $\pi$
- C.  $\lambda/2$
- D. (There will be NO additional path difference.)

**SECTION E**

- 31** (a) A ray of light is incident at angle  $\theta$  on a right-angled prism at point X. At point Y, it emerges along the prism surface. Calculate the refractive index of the prism in terms of the incident angle. 5



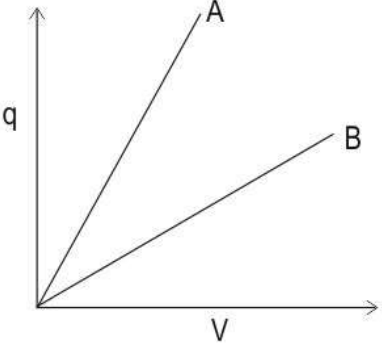
(b) Show that for an equilateral prism kept in air, minimum deviation occurs when the angle of incidence  $i = \sin^{-1}(n/2)$ , where  $n$  is the refractive index of the material of the prism.

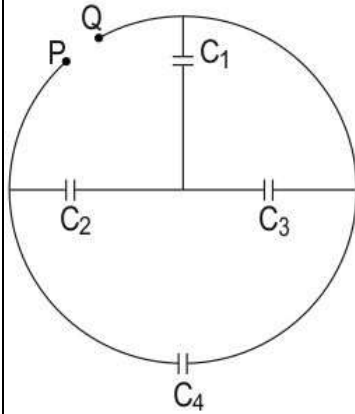
**OR**

(a) A Young's double slit setup is illuminated with monochromatic light. If the intensity of light passing through one of the slits is reduced, explain the changes that can be seen in the appearance of the bright and dark fringes?

(b) (i) A single slit diffraction setup is illuminated with green light of wavelength 500 nm. If the width of the slit is 1 mm and the screen is 2 m away from the slits, calculate the width of the central maximum.

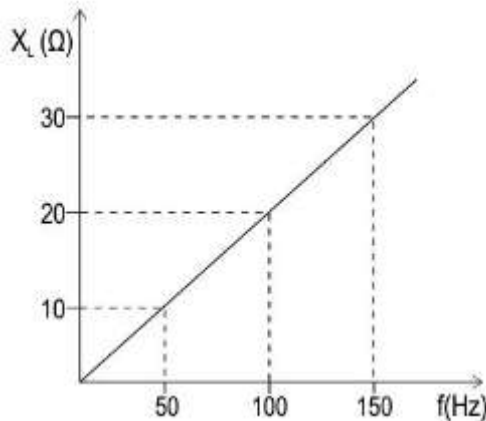
(ii) What will happen to the width of the central maximum, if the green light is replaced with the red light? Give a reason for your answer.

	<p>(c) A student wishes to study the diffraction of sound using the single slit setup. He replaces the light source with a sound source. What other change should he do to study the diffraction pattern?</p>	
<p><b>32</b></p>	<p>(a) A camera usually operates at 1.5 V and this potential difference is not sufficient to emit light energy using flash. For this purpose, the flash circuit of the camera has a capacitor that is charged to 300 V-330 V using various electrical components. If the voltage generated across the plates of the capacitor is 300 V and the capacitance of the parallel plate capacitor used is 100 <math>\mu\text{F}</math>, then find the energy released when the trigger button on the camera is pressed.</p> <p>(a) How much charge does the 100 <math>\mu\text{F}</math> capacitor charged to 300 V hold?</p> <p>(b) If the distance between the parallel plate capacitor of capacitance 100 <math>\mu\text{F}</math> is increased two times, then calculate the capacitance of the capacitor.</p> <p>(c) The graph below shows the variation of charge 'q' with potential difference 'V' for a parallel plate capacitor 'C' for scenarios P and Q. Scenario P - the space between the capacitor 'C' is filled with air. Scenario Q - the space between the capacitor 'C' is filled with a substance of dielectric constant K. Which of the two lines A or B corresponds to scenario Q? Give a reason for your answer.</p>  <p><b>OR</b></p> <p>(a) Find the effective capacitance between points P and Q, if each capacitor has a capacitance of 6<math>\mu\text{F}</math>.</p>	<p>5</p>



(b) Find the ratio of charges on capacitors  $C_1$  and  $C_4$ , if the potential difference between points P and Q is 10 V.

- 33** An inductor of inductance 'L' is connected to an AC source,  $V = 100 \sin \omega t$ . The graph below represents the variation of inductive reactance ( $X_L$ ) of the inductor with the frequency of an alternating source.



- (a) What is the self-inductance of the inductor?  
 (b) If the ac source is replaced by a battery such that  $V = 100$  V, then what is the inductive reactance of the inductor? Give reason.  
 (c) When the frequency is 50 Hz, what is the average power dissipated by the inductor over a complete cycle in the circuit? Justify your answer.  
 (d) This inductor is connected in series with a resistance of  $15 \Omega$  and a capacitor of  $5 \mu\text{F}$ . The frequency of the alternating source is varied such that the power dissipated in the circuit becomes maximum. Calculate the frequency and the phase difference between alternating voltage and current when the power dissipated is the maximum.

**OR**

An ideal transformer having a ferromagnetic core consists of two coils having 500 turns (primary) and 50 turns (secondary) respectively.

- (a) What is the voltage across the secondary coil, if the rms voltage across the primary coil is 240 V?  
 (b) What will be the individual currents in the two coils (primary and secondary), if the secondary has a resistive load of 20 ohms?

