

SEMESTER 2 EXAMINATION
ENGLISH PAPER 1
(LANGUAGE)

Maximum Marks: 40

Time Allowed: One and a half hours

*(Candidates are allowed additional 10 minutes for only reading the paper.
They must NOT start writing during this time.)*

All questions are compulsory.

The intended marks or parts of questions are given in brackets [].

Question 1

[20]

Write a composition in approximately 350 – 400 words on any *one* of the following subjects:

(You are reminded that you will be rewarded for orderly and coherent presentation of matter, use of appropriate style and general accuracy of spelling, punctuation, and grammar.)

- (i) Write about a day when you were returning home from school and the weather suddenly changed for the better. Describe the sights, sounds and smells that captivated your senses. How did the change in weather affect your state of mind?
- (ii) Narrate an incident from your life when you experienced an unexpected act of kindness and what it made you realize.
- (iii) Technology has adversely affected human creativity.
Argue **FOR** or **AGAINST** this statement.
- (iv) Mystery
- (v) Life has no limitations except the ones we create. Give your views on this statement.
- (vi) Write an original short story titled '**An Interesting Interview**'.

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Question 2

- (i) Your school organised an adult literacy camp recently. Write a report for your school magazine in 200-250 words, using the following points: [12]
- Location of the camp – people who participated – timing and duration – volunteers from your school – lessons taught – materials used – feedback from the participants – experience of the volunteers.
- (ii) As the Head of the Science Club of your school, you intend to conduct an interclass competition, in which students will present creative experiments. Write a proposal in not more than 150 words, stating the steps you will take to make this competition a success. [8]

**SEMESTER 2 EXAMINATION
PHYSICS PAPER 1 (THEORY)**

Maximum Marks: 35

Time allowed: One and a half hours

Candidates are allowed an additional 10 minutes for only reading the paper.

They must NOT start writing during this time.

All questions are compulsory.

This question paper is divided in 3 Sections A, B and C.

The intended marks for questions are given in brackets [].

All working, including rough work, should be done on the same sheet as and adjacent to the rest of the answer.

Answers to sub parts of the same question must be given in one place only.

A list of useful physical constants is given at the end of this paper.

A simple scientific calculator without a programmable memory may be used for calculations.

SECTION A – 7 MARKS

Question 1

- | | |
|--|-----|
| (i) Define coherent sources of light. | [1] |
| (ii) State de Broglie hypothesis. | [1] |
| (iii) What is an n- type semiconductor? | [1] |
| (iv) Dispersive power of a prism depends upon | [1] |
| <div style="margin-left: 40px;">(a) Shape of the prism.</div> | |
| <div style="margin-left: 40px;">(b) Height of the prism.</div> | |
| <div style="margin-left: 40px;">(c) Material of the prism.</div> | |
| <div style="margin-left: 40px;">(d) Angle of the prism.</div> | |
-

[1]

(v) If in **Young's double slit interference experiment**, the distance between the two slits is **made three times**, keeping all other conditions same, then the **fringe width** becomes

- (a) one third.
- (b) one ninth.
- (c) nine times.
- (d) three times.

[1]

(vi) **Angular momentum** of an electron orbiting in the **3rd Bohr orbit** of a hydrogen atom is:

- (a) $h/2\pi$
- (b) $2h/2\pi$
- (c) $3h/2\pi$
- (d) $4h/2\pi$

[1]

(vii) In **photoelectric effect**, the graph of **Stopping potential 'V_s'** versus **frequency 'f'** of the incident radiation is a straight line. Then, **Slope 'm'** of this line, **Planck's constant 'h'** and **elementary charge 'e'** are related as follows:

- (a) $h = e m$
- (b) $m = e h$
- (c) $e = m h$
- (d) $e = m \pi h$

SECTION B – 10 MARKS

Question 2

[2]

- (i) What is meant by “**diffraction of light**”?
- (ii) State any **one** difference between **diffraction of light** and **interference of light**.

Question 3

[2]

- (i) State any **one advantage** of a reflecting telescope over a refracting telescope.
- (ii) Where should an object be kept in front of a convex lens in order to get an image of the **same size as the object**?

Question 4

[2]

- (i) A **biconvex** lens made of glass (refractive index 1.5) has two spherical surfaces having radii 10cm and 20cm. Calculate its **focal length**.

OR

- (ii) Calculate refractive index of the material of an **equilateral** prism if its angle of minimum deviation is 30° .

Question 5

[2]

With reference to **semiconductor physics**, define the following terms:

- (i) Doping.
- (ii) Depletion region.

[2]

Question 6

- (i) Threshold wavelength for a certain metal for photoelectric effect is 600nm. Calculate its:

- (a) threshold frequency.
(b) work function.

OR

- (ii) Calculate the minimum amount of energy released when an electron annihilates a positron.

SECTION C – 18 MARKS

[3]

Question 7

- (i) When two thin lenses are kept in contact, show that their effective focal length or equivalent focal length 'F' is given by:

$$\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2}$$

where the terms have their usual meaning.

OR

- (ii) Using Huygen's wave theory, prove the law of reflection of light.

Question 8

[3]

Draw a neat labelled ray diagram of a simple microscope when the image is formed at the least distance of distinct vision D. Write the expression for its angular magnification (magnifying power) in this setup.
[Derivation of formula is not required.]

Question 9

[3]

Monochromatic light of wavelength 620nm is incident on a pair of slits which are separated by 1.5mm. If the screen is kept 60cm away from the plane of the two slits, calculate:

- (i) Fringe separation i.e. fringe width.
- (ii) Distance of the 10th bright fringe from the centre of the interference pattern.

Question 10

[3]

Draw an energy level diagram for hydrogen atom showing four lowest energy levels. On it, show transitions responsible for the emission of lines of

- (i) Balmer series by a continuous line.
- (ii) Lyman series by a dotted line.

Question 11

[3]

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

India built its first nuclear reactor, Apsara, at Trombay, Maharashtra, in the year 1956. It was used mainly to generate electric power. Nuclear reactors are also used to produce radio-isotopes which are used in the fields of research, medicine, agriculture etc. Unlike thermal power stations, nuclear power stations don't cause atmospheric pollution. Still, there is opposition to installing them as there is an apprehension that there may be a radiation leakage which can be harmful to the people living nearby.

- (i) In a nuclear reactor, what is the function of cadmium rods?
- (ii) In a nuclear reactor, which material is used as a moderator?
- (iii) Give any one balanced equation representing the nuclear fission reaction taking place in a nuclear reactor.

Question 12

[3]

(i) Answer the following questions.

- (a) Draw a labelled circuit diagram of a half wave rectifier.
- (b) Show graphically how output voltage varies with time in case of a half wave rectifier when an ac voltage is fed to it from the mains.

OR

(ii) With reference to Semiconductor Physics, answer the following questions:

- (a) Show how a junction diode can be forward biased.
- (b) Draw a labelled V-I characteristic curve of a junction diode during forward bias.

Constants & Useful Relations:

1	Speed of light in vacuum	c	3×10^8 m/s
2	Planck's constant	h	6.6×10^{-34} Js
3	Mass of an electron / positron	m	9.1×10^{-31} kg
4	1nm	=	1×10^{-9} m

MATHEMATICS

Maximum Marks: 80

Time Allowed: Three hours

*(Candidates are allowed additional 15 minutes for only reading the paper.
They must NOT start writing during this time.)*

This Question Paper consists of three sections A, B and C.

Candidates are required to attempt all questions from Section A and all questions

EITHER from Section B OR Section C.

Section A: Internal choice has been provided in two questions of two marks each, two questions of four marks each and two questions of six marks each.

Section B: Internal choice has been provided in one question of two marks and one question of four marks.

Section C: Internal choice has been provided in one question of two marks and one question of four marks.

All working, including rough work, should be done on the same sheet as, and adjacent to the rest of the answer.

The intended marks for questions or parts of questions are given in brackets [].

Mathematical tables and graph papers are provided.

SECTION A - 65 MARKS

Question 1

In subparts (i) to (x) choose the correct options and in subparts (xi) to (xv), answer the questions as instructed.

- (i) A relation R on $\{1, 2, 3\}$ is given by $R = \{(1, 1), (2, 2), (1, 2), (3, 3), (2, 3)\}$. [1]

Then the relation R is:

- (a) Reflexive.
- (b) Symmetric.
- (c) Transitive.
- (d) Symmetric and Transitive.

(ii) If A is a square matrix of order 3, then $|2A|$ is equal to:

[1]

- (a) $2|A|$
- (b) $4|A|$
- (c) $8|A|$
- (d) $6|A|$

(iii) If the following function is continuous at $x = 2$ then the value of k will be:

[1]

$$f(x) = \begin{cases} 2x + 1, & \text{if } x < 2 \\ k, & \text{if } x = 2 \\ 3x - 1, & \text{if } x > 2 \end{cases}$$

- (a) 2
- (b) 3
- (c) 5
- (d) -1

(iv) An edge of a variable cube is increasing at the rate of 10 cm/sec. How fast will the volume of the cube increase if the edge is 5 cm long?

[1]

- (a) $75 \text{ cm}^3/\text{sec}$
- (b) $750 \text{ cm}^3/\text{sec}$
- (c) $7500 \text{ cm}^3/\text{sec}$
- (d) $1250 \text{ cm}^3/\text{sec}$

(v) Let $f(x) = x^3$ be a function with domain $\{0, 1, 2, 3\}$. Then domain of f^{-1} is:

[1]

- (a) $\{3, 2, 1, 0\}$
- (b) $\{0, -1, -2, -3\}$
- (c) $\{0, 1, 8, 27\}$
- (d) $\{0, -1, -8, -27\}$

(vi) For the curve $y^2 = 2x^3 - 7$, the slope of the normal at $(2, 3)$ is:

[1]

- (a) 4
- (b) $\frac{1}{4}$
- (c) -4
- (d) $-\frac{1}{4}$

(vii) Evaluate: $\int \frac{x}{x^2+1} dx$ [1]

(a) $2 \log(x^2 + 1) + c$

(b) $\frac{1}{2} \log(x^2 + 1) + c$

(c) $e^{x^2+1} + c$

(d) $\log x + \frac{x^2}{2} + c$

(viii) The derivative of $\log x$ with respect to $\frac{1}{x}$ is: [1]

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

(b) $\frac{-1}{x^3}$

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

(d) $-x$

(ix) The interval in which the function $f(x) = 5 + 36x - 3x^2$ increases will be: [1]

(a) $(-\infty, 6)$

(b) $(6, \infty)$

(c) $(-6, 6)$

(d) $(0, -6)$

(x) Evaluate: $\int_{-1}^1 x^{17} \cos^4 x dx$ [1]

(a) ∞

(b) 1

(c) -1

(d) 0

(xi) Solve the differential equation: $\frac{dy}{dx} = \operatorname{cosec} y$ [1]

(xii) For what value of k the matrix $\begin{bmatrix} 0 & k \\ -6 & 0 \end{bmatrix}$ is a skew symmetric matrix? [1]

(xiii) Evaluate: $\int_0^1 |2x + 1| dx$

[1]

(xiv) Evaluate: $\int \frac{1+\cos x}{\sin^2 x} dx$

[1]

(xv) A bag contains 19 tickets, numbered from 1 to 19. Two tickets are drawn randomly in succession with replacement. Find the probability that both the tickets drawn are even numbers.

[1]

Question 2

[2]

(i) If $f(x) = [4 - (x - 7)^3]^{\frac{1}{5}}$ is a real invertible function, then find $f^{-1}(x)$

OR

(ii) Let $A = \mathbb{R} - \{2\}$ and $B = \mathbb{R} - \{1\}$. If $f: A \rightarrow B$ is a function defined by $f(x) = \frac{x-1}{x-2}$ then show that f is a one - one and an onto function.

Question 3

[2]

Evaluate the following determinant without expanding.

$$\begin{vmatrix} 5 & 5 & 5 \\ a & b & c \\ b+c & c+a & a+b \end{vmatrix}$$

Question 4

[2]

The probability of the event A occurring is $\frac{1}{3}$ and of the event B occurring is $\frac{1}{2}$. If A and B are independent events, then find the probability of neither A nor B occurring.

Question 5

[2]

Solve for x :

$$5\tan^{-1} x + 3\cot^{-1} x = 2\pi$$

Question 6

[2]

(i) Evaluate: $\int \cos^{-1}(\sin x) dx$

OR

(ii) If $\int x^5 \cos(x^6) dx = k \sin(x^6) + C$, find the value of k .

[4]

Question 7

If $\tan^{-1}\left(\frac{x-1}{x+1}\right) + \tan^{-1}\left(\frac{2x-1}{2x+1}\right) = \tan^{-1}\left(\frac{23}{36}\right)$ then prove that $24x^2 - 23x - 12 = 0$

[4]

Question 8

If $y = e^{ax} \cos bx$, then prove that $\frac{d^2y}{dx^2} - 2a \frac{dy}{dx} + (a^2 + b^2)y = 0$

[4]

Question 9

- (i) In a company, 15% of the employees are graduates and 85% of the employees are non-graduates. As per the annual report of the company, 80% of the graduate employees and 10% of the non-graduate employees are in the Administrative positions. Find the probability that an employee selected at random from those working in administrative positions will be a graduate.

OR

- (ii) A problem in Mathematics is given to three students A, B and C. Their chances of solving the problem are $\frac{1}{2}$, $\frac{1}{3}$ and $\frac{1}{4}$ respectively. Find the probability that
- (a) exactly two students will solve the problem.
- (b) at least two of them will solve the problem.

[4]

Question 10

- (i) Solve the differential equation:

$$(1 + y^2) dx = (\tan^{-1}y - x) dy$$

OR

- (ii) Solve the differential equation:

$$(x^2 - y^2) dx + 2xy dy = 0$$

Question 11

[6]

Use matrix method to solve the following system of equations.

$$\frac{2}{x} + \frac{3}{y} + \frac{10}{z} = 4$$

$$\frac{4}{x} - \frac{6}{y} + \frac{5}{z} = 1$$

$$\frac{6}{x} + \frac{9}{y} - \frac{20}{z} = 2$$

Question 12

[6]

- (i) Prove that the semi-vertical angle of the right circular cone of given volume and least curved area is $\cot^{-1} \sqrt{2}$

OR

- (ii) A running track of 440m is to be laid out enclosing a football field. The football field is in the shape of a rectangle with a semi-circle at each end. If the area of the rectangular portion is to be maximum, then find the length of its sides. Also calculate the area of the football field.

Question 13

[6]

- (i) Evaluate: $\int \frac{3e^{2x} - 2e^x}{e^{2x} + 2e^x - 8} dx$

OR

- (ii) Evaluate: $\int \frac{2}{(1-x)(1+x^2)} dx$

Question 14

[6]

A box contains 30 fruits, out of which 10 are rotten. Two fruits are selected at random one by one without replacement from the box. Find the probability distribution of the number of unspoiled fruits. Also find the mean of the probability distribution.

SECTION B - 15 MARKS

Question 15

[5]

In subparts (i) and (ii) choose the correct options and in subparts (iii) to (v), answer the questions as instructed.

- (i) If $|\vec{a}| = 3$, $|\vec{b}| = \frac{\sqrt{2}}{3}$ and $\vec{a} \times \vec{b}$ is a unit vector then the angle between $\vec{a}$ and $\vec{b}$ will be:
- $\frac{\pi}{6}$
 - $\frac{\pi}{4}$
 - $\frac{\pi}{3}$
 - $\frac{\pi}{2}$
- (ii) The distance of the point $2\hat{i} + \hat{j} - \hat{k}$ from the plane $\vec{r} \cdot (\hat{i} - 2\hat{j} + 4\hat{k}) = 9$ will be:
- 13
 - $\frac{13}{\sqrt{21}}$
 - 21
 - $\frac{21}{\sqrt{13}}$
- (iii) Find the area of the parallelogram whose diagonals are $\hat{i} - 3\hat{j} + \hat{k}$ and $\hat{i} + \hat{j} + \hat{k}$.
- (iv) Write the equation of the plane passing through the point (2, 4, 6) and making equal intercepts on the coordinate axes.
- (v) If the two vectors $3\hat{i} + \alpha\hat{j} + \hat{k}$ and $2\hat{i} - \hat{j} + 8\hat{k}$ are perpendicular to each other, then find the value of α .

Question 16

[2]

- (i) If A (1, 2, -3) and B (-1, -2, 1) are the end points of a vector $\overrightarrow{AB}$ then find the unit vector in the direction of $\overrightarrow{AB}$.

OR

- (ii) If $\hat{a}$ is unit vector and $(2\vec{x} - 3\hat{a}) \cdot (2\vec{x} + 3\hat{a}) = 91$, find the value of $|\vec{x}|$

Question 17**[4]**

- (i) Find the equation of the plane passing through the point $(1, 1, -1)$ and perpendicular to the planes $x + 2y + 3z = 7$ and $2x - 3y + 4z = 0$

OR

- (ii) A line passes through the point $(2, -1, 3)$ and is perpendicular to the lines $\vec{r} = (\hat{i} + \hat{j} - \hat{k}) + \lambda(2\hat{i} - 2\hat{j} + \hat{k})$ and $\vec{r} = (2\hat{i} - \hat{j} - 3\hat{k}) + \mu(\hat{i} + 2\hat{j} + 2\hat{k})$. Obtain its equation.

Question 18**[4]**

Find the area of the region bounded by the curve $x^2 = 4y$ and the line $x = 4y - 2$

SECTION C - 15 MARKS**Question 19****[5]**

In subparts (i) and (ii) choose the correct options and in subparts (iii) to (v), answer the questions as instructed.

- (i) If the demand function is given by $p = 1500 - 2x - x^2$ then find the marginal revenue when $x = 10$
- (a) 1160
- (b) 1600
- (c) 1100
- (d) 1200
- (ii) If the two regression coefficients are 0.8 and 0.2, then the value of coefficient of correlation r will be:
- (a) ± 0.4
- (b) ± 0.16
- (c) 0.4
- (d) 0.16
- (iii) Out of the two regression lines $x + 2y - 5 = 0$ and $2x + 3y = 8$, find the line of regression of y on x .
- (iv) The cost function $C(x) = 3x^2 - 6x + 5$. Find the average cost when $x = 2$

- (v) The fixed cost of a product is ₹30,000 and its variable cost per unit is ₹800. If the demand function is $p(x) = 4500 - 100x$, find the break-even values.

Question 20

[2]

- (i) The total cost function for x units is given by $C(x) = \sqrt{6x + 5} + 2500$. Show that the marginal cost decreases as the output x increases.

OR

- (ii) The average revenue function is given by $AR = 25 - \frac{x}{4}$

Find total revenue function and marginal revenue function.

Question 21

[4]

Solve the following Linear Programming Problem graphically.

Maximise $Z = 5x + 2y$ subject to:

$$x - 2y \leq 2,$$

$$3x + 2y \leq 12,$$

$$-3x + 2y \leq 3,$$

$$x \geq 0, y \geq 0$$

Question 22

[4]

- (i) The following table shows the Mean, the Standard Deviation and the coefficient of correlation of two variables x and y .

Series	x	y
Mean	8	6
Standard deviation	12	4
Coefficient of correlation	0.6	

Calculate:

- (a) the regression coefficient b_{xy} and b_{yx}
 (b) the probable value of y when $x = 20$

OR

- Write a p
- (ii) An analyst analysed 102 trips of a travel company. He studied the relation between travel expenses (y) and the duration (x) of these trips. He found that the relation between x and y was linear. Given the following data, find the regression equation of y on x .
- $\Sigma x = 510$, $\Sigma y = 7140$, $\Sigma x^2 = 4150$, $\Sigma y^2 = 740200$, $\Sigma xy = 54900$

BIOLOGY PAPER 1

(THEORY)

Maximum Marks: 70

Time Allowed: Three hours

Candidates are allowed additional 15 minutes for only reading the paper.

They must NOT start writing during this time.

This paper is divided into four sections – A, B, C and D.

Answer all questions.

Section – A consists of one question having sub-parts of one mark / two marks each.

Section – B consists of seven questions of two marks each.

Section – C consists of seven questions of three marks each, and

Section – D consists of three questions of five marks each.

*Internal choices have been provided in one question each in Section B,
Section C and Section D.*

The intended marks for questions or parts of questions are given in brackets [].

SECTION A – 20 MARKS

Question 1

Answer the following questions briefly.

- (i) Name the source of thermostable DNA polymerase. [1]
- (ii) Mention the scientific name of protozoan parasite that causes Amoebiasis. [1]
- (iii) What is cryopreservation? [1]
- (iv) The maternal grandfather of a boy is colourblind, but his maternal grandmother is normal. The father of the boy is also normal. What is the probability of this boy being colourblind? [1]
- (v) Name the type of antibody that can be transferred through the placenta. [1]

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- (vi) During which phase of the cell cycle, does DNA replication take place? [1]
- (vii) How many sets of primers are required in each cycle of PCR? [1]
- (viii) Define *perisperm*. [1]
- (ix) Which one of the following enzymes is used to join DNA fragments? [1]
- (a) DNA polymerase
 - (b) Ligase
 - (c) Primase
 - (d) Endonuclease
- (x) What type of ecological pyramid would be obtained from the following data? [1]
- Secondary consumer: 120 gm
Primary consumer: 60 gm
Primary producer: 10 gm
- (a) Inverted pyramid of biomass
 - (b) Pyramid of energy
 - (c) Upright pyramid of numbers
 - (d) Upright pyramid of biomass
- (xi) **Assertion:** A person who has received a cut from a sharp object and is bleeding, needs to be given an anti-tetanus injection. [1]
- Reason:** Anti-tetanus injection stimulates the production of antibodies for tetanus.
- (a) Both Assertion and Reason are true, and Reason is the correct explanation of Assertion.
 - (b) Both 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.

- (xii) Which one of the following factors is responsible for activation of protoxin into active Bt toxin of *Bacillus thuringiensis*? [1]
- (a) Body temperature
 - (b) Moist surface of midgut
 - (c) Alkaline pH of gut
 - (d) Acidic pH of stomach
- (xiii) Give *one* significant contribution of each of the following scientists: [2]
- (a) T.R. Malthus
 - (b) R. Mishra
- (xiv) Give a term for the following: [2]
- (a) An ART in which eggs are removed from the ovary of the female, fertilised and then placed in her fallopian tube.
 - (b) Fusion of male gamete and secondary nucleus in angiosperms.
- (xv) Expand the following abbreviations: [2]
- (a) NACO
 - (b) PID
- (xvi) Give a reason for each of the following: [2]
- (a) Cattle avoid browsing on *Calotropis* plant.
 - (b) DNA cannot enter directly into the host cell.

SECTION B – 14 MARKS

[2]

Question 2

Give *one* difference between the following pairs:

- (i) Sites of maturation of B – Lymphocytes and T – Lymphocytes
- (ii) Sources of Opioids and Cannabinoids

[2]

Question 3

Briefly discuss *any two* methods by which plants avoid self – pollination.

[2]

Question 4

Mention the location and the function of Leydig cells.

[2]

Question 5

- (i) What are *vestigial organs*? Give *any one* example of a vestigial organ in human body.

OR

- (ii) State Hardy Weinberg's principle. Give a mathematical expression for this principle.

[2]

Question 6

Riya went to the hospital to meet her sister who was undergoing some treatment. The hospital was crowded with patients suffering from various types of allergies, pneumonia and Ascariasis.

Name the disease that Riya is most likely to get infected with. Give *one* reason for your answer.

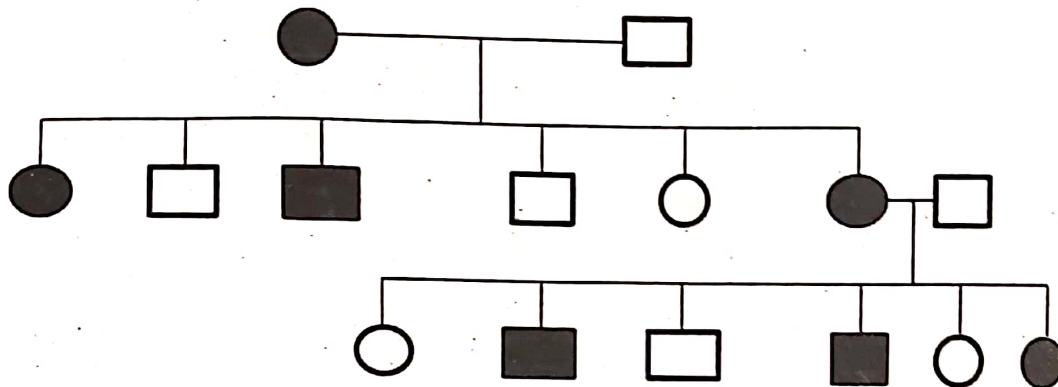
[2]

Question 7

State the steps involved in the process of gene therapy for the treatment of ADA – deficiency.

Question 8**[2]**

The pedigree chart given below represents the pattern of inheritance of sickle cell anaemia in a family. Study it carefully and answer the questions that follow.



- (i) What is the genotype of the father?
- (ii) What is the phenotype of the mother?

SECTION C – 21 MARKS**Question 9****[3]**

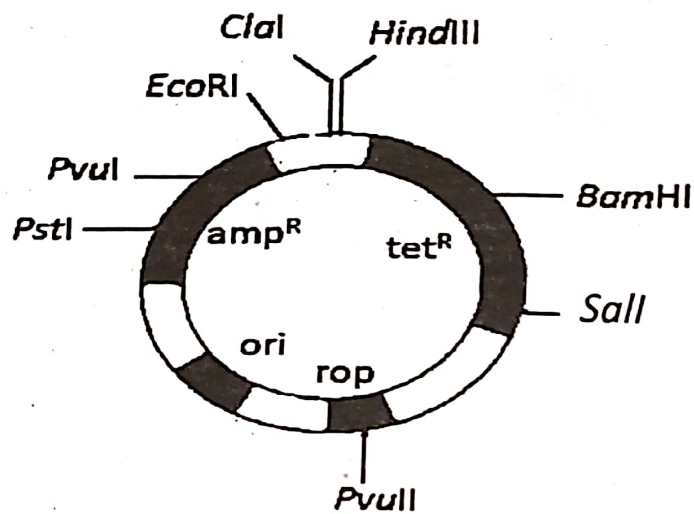
Discuss *any three* major causes of loss of biodiversity.

Question 10**[3]**

- (i) Name and describe the technique that helps in the separation and isolation of DNA fragments.

OR

- (ii) Study the diagram given below and answer the questions that follow.



- (a) Name the cloning vector shown above. In which organism is this cloning vector inserted?
- (b) Mention *any two* restriction sites shown in the diagram.
- (c) Name *any two* selectable markers shown in the diagram.

Question 11

[3]

Draw a neat and well labelled diagram of L.S of an anatropous ovule.

Question 12

[3]

- (i) Explain the process of sex - determination in grasshopper.
- (ii) What is the genotype of Turner's Syndrome? Mention *any one* symptom of this syndrome.

Question 13

[3]

With the help of neatly labelled diagrams, explain the different types of age pyramids of human population.

Question 14

[3]

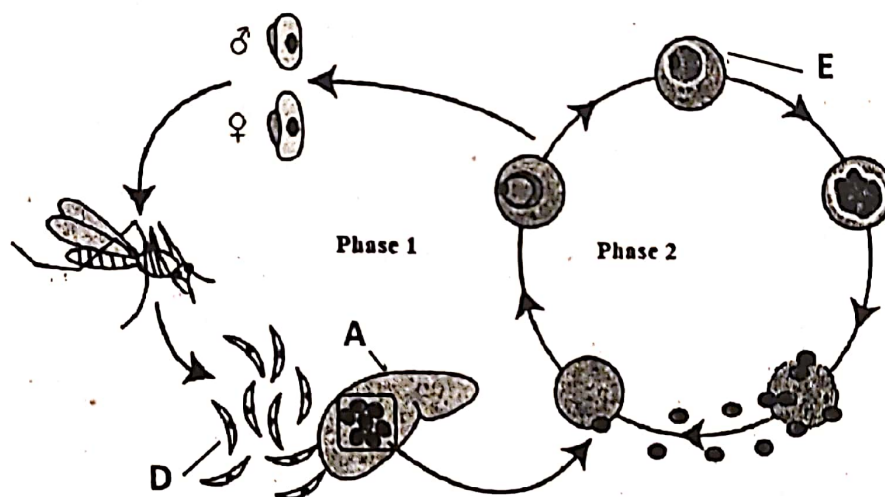
The scientists from a research institute collected samples of water from sewage pipes of two different cities, A and B. On analysis, the BOD value of the sample from city A was found to be 500 mg / L. The BOD value of the sample from city B was 200 mg / L.

- Which one of the two cities needs a sewage treatment plant?
- Briefly discuss the steps involved in the treatment of sewage.
- What will be the effect of sewage treatment on the value of BOD?

Question 15

[3]

The diagram given below shows the life cycle of a malarial parasite. Study it carefully and answer the questions that follow:



- Name the hosts in which the asexual phase and sexual phase of the life cycle take place.
- Identify the infective stage labelled 'D'.
- Name the structures labelled 'A' and 'E'.
- Give *any one* symptom of malaria.

SECTION D – 15 MARKS

Question 16

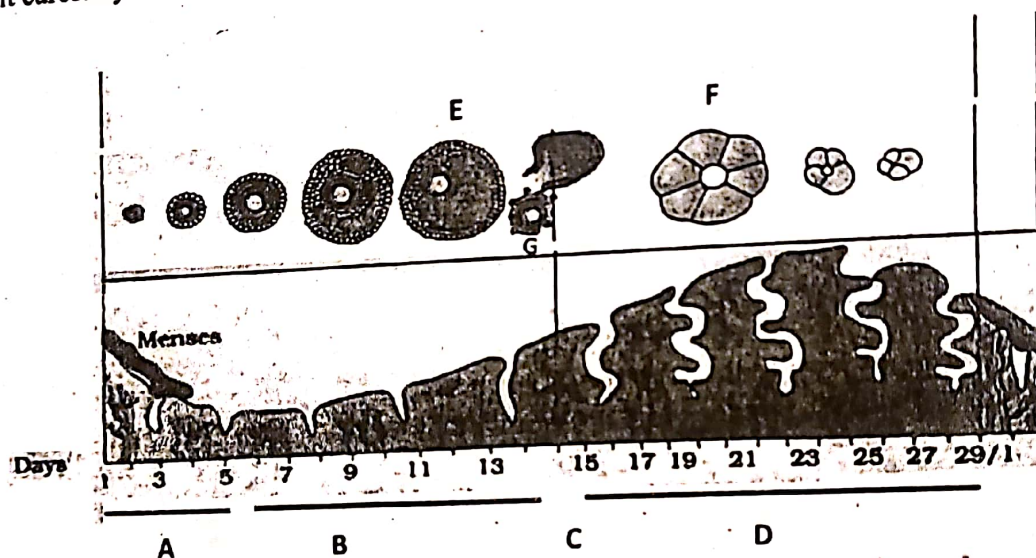
Explain the components of the structural genes in the *Lac operon* system in *E. coli*.
How does the operon function in the presence of lactose?

[5]

Question 17

- (i) Given below is the diagram depicting the menstrual cycle in human beings. Study it carefully and answer the questions that follow.

[5]



- Which phases are indicated by 'C' and 'D'?
- Name the structure labelled 'F'? What is its role?
- Explain the changes in the level of progesterone during phases 'C' and 'D'.
- Which hormone present in the urine confirms pregnancy in human beings?
- Identify the structure labelled 'E'. Name the hormone released by it.

OR

- (ii) According to a survey conducted by the Government of India in the year 1950, the population of the country was 350 million. In the next survey conducted in the year 2010, the population had reached above 1000 million.
- (a) List *any two* reasons for this rise in the population.
 - (b) Suggest *any two* steps which should be taken by the Government to control this rise.
 - (c) How does the population explosion affect the growth of a country?
 - (d) What is the difference between the *natural* and *artificial contraceptive methods*? Give *one* example of each method.

Question 18

[5]

Describe the mechanism of decomposition by explaining the various processes involved in it.

ENGLISH PAPER 2
(LITERATURE IN ENGLISH)
(Prescribed Textbooks)

Maximum Marks: 80

Time Allowed: Three hours

Candidates are allowed additional 15 minutes for only reading the paper.

They must NOT start writing during this time.

Answer all questions in Section A and Section B.

The intended marks for questions or parts of questions are given in brackets [].

SECTION A – 20 MARKS

Question 1

Choose the correct options for the following questions:

[10]

- (i) In the Masque in Act IV of the play *The Tempest*, how does Ceres know that Juno is coming?
- (a) By Juno's gait.
 - (b) Through Prospero's words.
 - (c) By Venus' disappearance.
 - (d) By the nymphs.
- (ii) What does Ceres say to bless the young couple?
- (a) That their barns will never be empty.
 - (b) That they will rule as King and Queen.
 - (c) That they will overcome all obstacles.
 - (d) That they will travel around the world.

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Turn over



- (iii) In Act V, Scene I of the play *The Tempest*, Alonso says, "Irreparable is the loss." What is the irreparable loss being referred to here?
- (a) Loss of his kingdom.
 - (b) Loss of his crew members.
 - (c) Loss of his ship.
 - (d) Loss of his son.
- (iv) What does Prospero intend to do with his book before his interaction with Alonso in Act V of the play, *The Tempest*?
- (a) Burn it to ashes.
 - (b) Pass it to Caliban.
 - (c) Drown it deeper than plummet's sound.
 - (d) Gift it to Miranda.
- (v) Where did B. Wordsworth live in the short story, *B. Wordsworth*?
- (a) Miguel Street.
 - (b) Alberto Street.
 - (c) St. Clair Avenue.
 - (d) Savannah.
- (vi) In the short story, *To Build a Fire*, which "wild idea" came into the Man's head when all seemed lost?
- (a) To identify the hidden pools.
 - (b) Not to share his lunch with the dog.
 - (c) To set the dog free.
 - (d) To kill the dog and crawl into its carcass for warmth.
- (vii) In the short story, *The Story of an Hour*, what according to the doctor did Mrs. Mallard die of?
- (a) Her ill health.
 - (b) The torture by her husband.
 - (c) Joy that kills.
 - (d) Falling down the stairs.

(viii) In the poem, *Dover Beach*, where is the "eternal note of sadness" heard?

- (a) The French coast where the light gleams and goes.
- (b) The cliffs of England.
- (c) The sound of the wind.
- (d) The grating roar of the pebbles flung by the waves.

(ix) In the poem, *Birches*, how are the crystal shells shed?

- (a) By the sun's warmth.
- (b) By the gentle breeze.
- (c) By the footsteps of people.
- (d) By the boy swinging on the birches.

(x) In the poem, *We are the Music Makers*, what are the 'sea-breakers'?

- (a) Explorers.
- (b) Sea-pirates.
- (c) Large ships.
- (d) Large waves.

Question 2

Complete the following sentences by providing a reason for each:

[10]

- (i) In Act III, Scene II of the play *The Tempest*, Stephano and Trinculo are angry with Caliban as they struggle out of the filthy pool because _____.
- (ii) In Act V of the play *The Tempest*, Prospero greets Gonzalo first because _____.
- (iii) At the end of Act III, Scene III of the play *The Tempest*, Gonzalo urges the other Lords to follow the "three men of sin" because _____.

- (iv) In Act III, Scene II of the play, *The Tempest*, Stephano threatens to tie Trinculo to the next tree because _____.
- (v) In the short story, *The Sound Machine*, Dr. Scott thought Klausner was ill when Klausner rang up the doctor because _____.
- (vi) Towards the end of the story *B. Wordsworth*, the poet told the boy to never visit him because _____.
- (vii) In the short story, *To Build a Fire*, the fire built by the Man under the tree was extinguished because _____.
- (viii) In the poem, *The Darkling Thrush*, the poet thinks the bird had some awareness which the poet did not because _____.
- (ix) In the poem, *Dover Beach*, the poet wants his beloved to be "true" to him because _____.
- (x) Towards the end of the poem *Birches*, the poet expresses a wish to return to Earth because _____.

SECTION B – 60 MARKS

The Tempest: William Shakespeare

Question 3

- (i) Referring closely to Act III Scene III, relate the stern warning of Ariel to the "three men of sin". What impact does his warning have on the three sinners? [5]
- (ii) With close reference to Act V, describe how Prospero has used the spirits of "hills, brooks, groves" to give shape to his magical acts. What does he finally decide to do with his magical powers? [5]
- (iii) (a) With close reference to Act V, examine how Shakespeare presents the idea of forgiveness and reconciliation at the end of the play. [10]

OR

- (b) Magic is used to manipulate, intimidate and amaze the various characters in the play. Give your views on this statement by referring to any two examples from the Acts studied. [10]

ECHOES: PROSE

Question 4

- (i) Referring closely to the short story, *The Singing Lesson*, show how the Headmistress' summons to Miss Meadows eventually brings the latter out from cold despair to a realm of hope, love and joy. [5]
- (ii) Referring closely to the short story, *The Sound Machine*, give specific instances to show how Klausner was obsessed with sound. [5]
- (iii) (a) With close reference to the short story, *To Build a Fire*, discuss how the Man's lack of imagination led to his paralysing death while the dog's primitive instincts helped him to survive. [10]

OR

- (b) Do you think that friendship is not a matter of age but of emotional connect? Give your views with close reference to V.S. Naipaul's short story *B. Wordsworth*. [10]

REVERIE: POETRY

Question 5

- (i) Referring closely to the poem, *Dover Beach*, show how the poet correlates the gradual receding of the "Sea of Faith" with the gradual loss of human faith in religion. [5]
- (ii) Referring closely to the poem, *The Darkling Thrush*, examine the poet's encounter with the aged thrush as a passage from amazement to introspection. [5]
- (iii) (a) Referring closely to the poem, *Birches*, discuss what differentiates the swinging of birches in the poet's adulthood from that in his childhood. [10]

OR

- (b) How does the poem, *Crossing the Bar*, portray the poet's deep affirmation and faith in God? [10]

**SEMESTER 2 EXAMINATION
COMPUTER SCIENCE PAPER 1
(THEORY)**

Maximum Marks: 35

Time allowed: One and a half hours

*Candidates are allowed an additional 10 minutes for only reading the paper.
They must NOT start writing during this time.*

Answer all questions in Section A, Section B and Section C.

While answering questions in Section A and B, working and reasoning may be indicated briefly, wherever required.

The intended marks for questions or parts of questions are given in brackets. []

All working, including rough work, should be done on the same sheet as the rest of the answer.

SECTION A - 7 MARKS

Question 1

- (i) The concept in Java to perform method overloading and method overriding is called: [1]
- (a) inheritance
 - (b) polymorphism
 - (c) data abstraction
 - (d) encapsulation
- (ii) The interface in Java is a mechanism to achieve: [1]
- (a) encapsulation
 - (b) overriding
 - (c) polymorphism
 - (d) abstraction

(iii) `System.out.println("Computer Science".lastIndexOf('E'));` [1]
The output of the statement given above will be:

- (a) 8
- (b) 7
- (c) -1
- (d) 15

(iv) Write a statement in Java to extract the last four characters from the word "SIMPLICITY". [1]

(v) Name a data structure that follows LIFO principle and one that follows FIFO principle. [1]

(vi) What is the output of the program code given below, when the value of $x = 294$? [1]

```
int simple(int x)
{ return (x <= 0)? 0: x + simple(x/10); }
```

(vii) State *any one* drawback of using recursive technique in a Java program. [1]

SECTION B - 8 MARKS

Question 2

Differentiate between *finite recursion* and *infinite recursion*. [2]

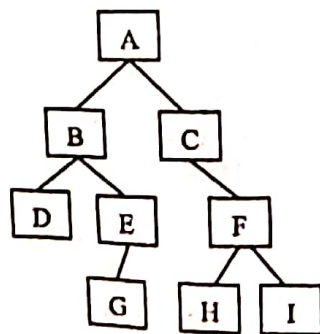
Question 3

Convert the following infix notation to prefix notation:

$P * (Q - R) + S$

Question 4

Answer the following questions from the diagram of a Binary Tree given below:



- (i) State the siblings of the nodes C and E. Also, state the *predecessor node(s)* [2]
and *successor node(s)* of node B.
- (ii) Write the *in-order* traversal of the left sub tree and the *pre-order* traversal [2]
of the right sub tree.

SECTION C - 20 MARKS

*Each program should be written in such a way that it clearly depicts the logic of the problem.
This can be achieved by using mnemonic names and comments in the program.*

(Flowcharts and Algorithms are not required.)

The programs must be written in Java.

Question 5

[6]

- (i) Design a class **Unique**, which checks whether a word begins and ends with a vowel.

Example: APPLE, ARORA etc.

The details of the members of the class are given below:

Class name : **Unique**

Data members/instance variables:

word : stores a word
len : to store the length of the word

Methods/Member functions:

Unique() : default constructor
void acceptword() : to accept the word in UPPER CASE
boolean checkUnique() : checks and returns 'true' if the word starts and ends with a vowel otherwise returns 'false'
void display() : displays the word along with an appropriate message

Specify the class **Unique**, giving details of the constructor, **void acceptword()**, **boolean checkUnique()** and **void display()**. Define the **main()** function to create an object and call the functions accordingly to enable the task.

OR

- (ii) Design a class **NoRepeat** which checks whether a word has no repeated alphabets in it.

Example: COMPUTER has no repeated alphabets but SCIENCE has repeated alphabets.

The details of the class are given below:

Class name : **NoRepeat**

Data members/instance variables:

word : to store a word

len : to store the length of the word

Methods/ Member functions:

NoRepeat(String wd) : parameterized constructor to initialize word=wd

boolean check() : checks whether a word has no repeated alphabets and returns *true* else returns *false*

void prn() : displays the word along with an appropriate message

Specify the class **NoRepeat**, giving details of the **constructor(String)**, **boolean check()** and **void prn()**. Define the **main()** function to create an object and call the functions accordingly to enable the task.

- (i) A class **CalSeries** has been defined to calculate the sum of the series:

$$\text{sum} = 1 + x + x^2 + x^3 + \dots + x^n$$

Some of the members of the class are given below:

Class name : **CalSeries**

Data members/instance variables:

x : integer to store the value of x
n : integer to store the value of n
sum : integer to store the sum of the series

Member functions/methods:

CalSeries() : default constructor
void input() : to accept the values of x and n
int power(int p,int q) : return the power of p raised to q (p^q) using recursive technique
void cal() : calculates the sum of the series by invoking the method *power()* and displays the result with an appropriate message

Specify the class **CalSeries**, giving details of the constructor, **void input()**, **int power(int,int)** and **void cal()**. Define the **main()** function to create an object and call the member function accordingly to enable the task.

OR

(ii) Design a class **Revno** which reverses an integer number.

Example: 94765 becomes 56749 on reversing the digits of the number.

Some of the members of the class are given below:

Class name : **Revno**

Data member/instance variable:

num : to store the integer number

Member functions/methods:

Revno() : default constructor

void inputnum() : to accept the number

int reverse(int nn) : returns the reverse of a number by using **recursive technique**

void display() : displays the original number along with its reverse by invoking the method *reverse()*

Specify the class **Revno**, giving details of the **constructor**, **void inputnum()**, **int reverse(int)** and **void display()**. Define the **main()** function to create an object and call the functions accordingly to enable the task.

Question 7

[4]

A super class **Item** has been defined to store the details of an item sold by a wholesaler to a retailer. Define a subclass **Taxable** to compute the total amount paid by the retailer along with *service tax*.

Some of the members of both the classes are given below:

Class name : **Item**

Data members/instance variables:

name : to store the name of the item
code : integer to store the item code
amount : stores the total sale amount of the item (in decimals)

Member functions/methods:

Item(...) : parameterized constructor to assign value to the data members
void show() : to display the item details

Class name : **Taxable**

Data members/instance variables:

tax : to store the service tax (in decimals)
totamt : to store the total amount (in decimals)

Member functions/methods

Taxable(...) : parameterized constructor to assign values to the data members of both classes
void cal_tax() : calculates the service tax @ 10.2% of the total sale amount
calculates the total amount paid by the retailer as (total sale amount + service tax)
void show() : to display the item details along with the total amount

Assume that the super class **Item** has been defined. Using the concept of inheritance, specify the class **Taxable**, giving details of the constructor, void cal_tax() and void show().

The super class, main function and algorithm need NOT be written.

Question 8

[4]

A Stack is a kind of data structure which can store elements with the restriction that an element can be added or removed from the top end only.

The details of the class **Stack** is given below:

Class name : **Stack**

Data members/instance variables:

cha[] : array to hold the characters
size : stores the maximum capacity of the stack
top : to point the index of the topmost element of the stack

Member functions/methods:

Stack(int mm) : constructor to initialize the data member size = mm, top = -1 and create the character array
void push_char(char v) : to add characters from the top end if possible else display the message("Stack full")
char pop_char() : to remove and return characters from the top end, if any, else returns '\$'
void display() : to display elements of the stack

Specify the class **Stack**, giving the details of void **push_char(char)** and **char pop_char()**. Assume that the other functions have been defined.

The **main()** function and algorithm need NOT be written.

SEMESTER 2 EXAMINATION
MATHEMATICS

Maximum Marks: 40

Time allowed: One and a half hours

Candidates are allowed an additional 10 minutes for only reading the paper.

They must NOT start writing during this time.

The Question Paper consists of three sections A, B and C.

Candidates are required to attempt all questions from Section A and all questions EITHER from Section B OR Section C.

All working, including rough work, should be done on the same sheet as, and adjacent to the rest of the answer.

The intended marks for questions or parts of questions are given in brackets [].

Mathematical tables and graph papers are provided.

SECTION A - 32 MARKS

Question 1

Choose the correct option to answer the following questions.

(i) $\int \frac{\sin 2x}{\cos x} dx$ is equal to:

[1]

(a) $-2 \cos x + c$

(b) $2 \cos x + c$

(c) $\frac{-\cos x}{2} + c$

(d) $\frac{\cos x}{2} + c$

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- (ii) If A and B are two events such that $P(A) = \frac{4}{5}$ and $P(B/A) = \frac{7}{8}$ then $P(A \cap B)$ is equal to: [1]
- (a) $\frac{7}{40}$
- (b) $\frac{21}{40}$
- (c) $\frac{32}{35}$
- (d) $\frac{7}{10}$
- (iii) $\int e^{\sin x} \cos x \, dx$ is equal to: [1]
- (a) $e^{\cos x} + c$
- (b) $e^{\sin x} + c$
- (c) $\frac{\sin^2 x}{2} + c$
- (d) $e^{\sin^2 x} + c$
- (iv) The order and degree of the differential equation $\frac{d^3 y}{dx^3} + \frac{d^2 y}{dx^2} + \left(\frac{dy}{dx}\right)^2 = 3$ is: [1]
- (a) order 3 and degree 1
- (b) order 1 and degree 3
- (c) order 2 and degree 1
- (d) order 2 and degree 2
- (v) A bag contains 9 red, 7 white and 4 black balls. If two balls are drawn at random without replacement, the probability that both balls are red will be: [1]
- (a) $\frac{11}{95}$
- (b) $\frac{18}{95}$
- (c) $\frac{18}{85}$
- (d) $\frac{18}{23}$

- (vi) $\int a^{1/x+2} dx$ is equal to: [1]
- (a) $\left(\frac{a^{1/x}}{1 \log_e a}\right) + c$
- (b) $a^2 x + \left(\frac{a^{1/x}}{1 \log_e a}\right) + c$
- (c) $a^2 \left(\frac{a^{1/x}}{1 \log_e a}\right) + c$
- (d) $a^2 \left(\frac{a^{1/x}}{\log_e a}\right) + c$

Question 2

(a) Evaluate: $\int \frac{1}{\sin^2 x \cos^2 x} dx$

OR

(b) Evaluate: $\int \left(\sqrt{x} + \frac{1}{\sqrt{x}}\right)^2 dx$

Question 3

(a) Solve: $\frac{dy}{dx} = \sin x - x$

OR

(b) Solve: $\frac{dy}{dx} + 2x = e^{3x}$

Question 4

Evaluate: $\int_1^4 |x - 2| dx$



Question 5

Two horses are considered for race. The probability of selection of first horse is $\frac{1}{5}$ and that of second is $\frac{2}{3}$. Find the probability that:

- both will be selected.
- only one of them will be selected.
- none of them will be selected.
- at least one of them will be selected.

[4]

Question 6

(a) Evaluate: $\int \frac{dx}{x[(\log x)^2 + 5 \log x + 6]}$

OR

(b) Evaluate: $\int x \tan^{-1} x \, dx$

[4]

Question 7

An insurance company insured 1000 scooter drivers, 2000 car drivers and 4000 truck drivers. The probability of accidents by scooter, car and truck drivers are 0.02, 0.05 and 0.03 respectively. If one of the insured persons meets with an accident, find the probability that he is a truck driver.

[6]

Question 8

(a) Write a particular solution of the differential equation, $\frac{dy}{dx} = \frac{y^2}{xy - x^2}$, when $x = 1$ and $y = 1$

OR

(b) Write a particular solution of the differential equation, $(1 + x^2) \frac{dy}{dx} + 2xy = \frac{1}{1+x^2}$ when $y = 0$, $x = 0$

[6]

SECTION B - 8 MARKS

Question 9

[2]

Choose the correct option to answer the following questions.

(i) If the intercept form of the equation of the plane $2x - 3y + 4z = 12$ is $\frac{x}{a} + \frac{y}{b} + \frac{z}{c} = 1$, then the values of a, b, c are respectively,

- $a = 6, b = -4, c = 3$
- $a = -6, b = -4, c = 3$
- $a = 6, b = 4, c = 3$
- $a = 6, b = 4, c = -3$

(ii) The distance of the plane whose equation is given by $3x - 4y + 12z = 3$, from the origin will be:

- $\frac{3}{13}$
- $\frac{-2}{13}$
- -3
- $\frac{13}{19}$

Question 10

[2]

Find the equation of the plane passing through the points $(-2, 6, 6)$, $(1, -1, 0)$ and $(1, 2, -1)$

Question 11

[4]

Find the area of the region bounded by the curves $y = x^2 + 2$, $y = x$, $x = 0$ and $x = 3$.



SECTION C - 8 MARKS

Question 12

[2]

Choose the correct option to answer the following questions.

- (i) If the two regression coefficients b_{xy} and b_{yx} are -0.8 and -0.2 respectively, then the correlation coefficient(ρ) will be,
- (a) 0.16
 - (b) -0.16
 - (c) 0.4
 - (d) -0.4
- (ii) The line of regression of y on x is, $4x - 5y + 33 = 0$ and the line of regression of x on y is, $20x - 9y - 107 = 0$, then the value of x when $y = 7$ is,
- (a) 8.5
 - (b) -8.5
 - (c) 0.5
 - (d) -0.5

Question 13

[2]

The mean and standard deviation of the two variables x and y are given as $\bar{x} = 6$, $\bar{y} = 8$, $\sigma_x = 4$, $\sigma_y = 12$. The correlation coefficient is given as $r = \frac{2}{3}$. Find the regression line of x on y .

Question 14

[4]

A manufacturer has two machines X and Y that may run at the most 360 minutes in a day to produce two types of toys A and B.

To produce each Toy A, machines X and Y need to run at the most 12 minutes and 6 minutes respectively.

To produce each Toy B, machines X and Y need to run at the most 6 minutes and 9 minutes respectively.

By selling the toys A and B, the manufacturer makes the profits of ₹ 30/- and ₹ 20/- respectively.

Formulate a Linear Programming Problem and find the number of toys A and B that should be manufactured in a day to get maximum profit.

**SEMESTER 2 EXAMINATION
BIOLOGY PAPER 1 (THEORY)**

Maximum Marks: 35

Time allowed: One and a half hours

Candidates are allowed an additional 10 minutes for only reading the paper.

They must NOT start writing during this time.

*Internal choices have been provided in one question in Section B
and one question in Section C.*

The intended marks for questions or parts of questions are given in brackets.[]

SECTION A – 7 MARKS

Question 1

(i) Give the biological name of the causative agent of typhoid. [1]

(ii) Hybrids are usually superior to their parents. This phenomenon is called: [1]

- (a) Hybrid depression
- (b) Inbreeding depression
- (c) Heterosis
- (d) Transgenesis

(iii) **Assertion:** Motor vehicles equipped with catalytic converter should use unleaded petrol. [1]

Reason: The catalyst used in the catalytic converter gets inactivated by the lead in the petrol.

- (a) Both assertion and reason are true, and reason is the correct explanation of assertion.
 - (b) Both 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.
-

- (iv) Give one significant contribution of S. Cohen. [1]
- (v) Expand the term CNG. [1]
- (vi) Cancer causing agents are called _____. [1]
- (vii) Why is the pyramid of energy never inverted? [1]

SECTION B – 16 MARKS

Question 2 [2]

A person in good health visits a garden where flowers are in bloom. While returning from the garden, he suddenly starts sneezing and wheezing.

- (i) Name and define the response of the person's immune system in the above case.
- (ii) State the type of antibody which is produced against such a response.

Question 3 [2]

Write the role of 'ori site' and 'restriction sites' in the cloning vector pBR322.

Question 4 [2]

Define:

- (i) Allen's rule
- (ii) Standing crop

Question 5 [2]

- (i) The *Net Primary Productivity* of a terrestrial ecosystem is 1500 Kg per meter square per year and the *respiratory loss* of the ecosystem is 1200 Kg per meter square per year. Calculate the gross primary productivity of the given ecosystem.

OR

- (ii) In an ecosystem, a food chain follows the following pattern:
Grass → Insects → Snake → Peacock.
If 2000 J of energy is available at the level of producers in this food chain, how much energy would be available to the peacock?

SECTION A – 14 MARKS

Question 1

(A) In *maize*:

Question 6

[2]

Explain the significance of *bagging* and *emasculation* in the process of artificial hybridisation of plants.

Question 7

[2]

What is PCR? Explain the steps involved in PCR technique.

Question 8

[2]

What is a Ti plasmid? Name the organism in which it is found.

Question 9

[2]

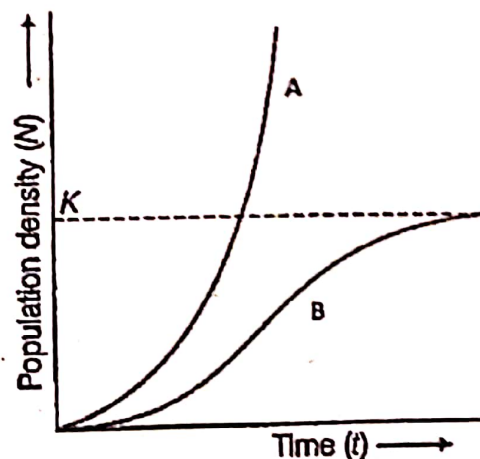
In an ecosystem, is the climax stage achieved more quickly during the primary succession or during the secondary succession? Give a reason to justify your answer.

SECTION C – 12 MARKS

Question 10

[3]

The following diagram represents the population growth curves of two different species A and B, living together in an area. Answer the following questions based on it.



- What type of growth-patterns are exhibited by the species A and B?
- Give mathematical equations to represent the growth curves of species A and species B, separately.
- In the diagram, what does the horizontal line K represent?

Question 11

[3]

With reference to inbreeding of cattle, answer the following questions:

- (i) Define *inbreeding*.
- (ii) Suggest *one* advantage and *one* disadvantage of this process.

Question 12

[3]

Draw a well-labelled diagram of a stirred-tank bioreactor.

Question 13

[3]

- (i) (a) What is *eutrophication*?
- (b) Explain the consequences of eutrophication on the life of plants and animals in an aquatic ecosystem.

OR

- (ii) (a) Define *biogeochemical cycle*.
- (b) Give a graphic outline of phosphorus cycle in an ecosystem.

CHEMISTRY PAPER 1

PHYSICS PAPER 1 (THEORY)

Maximum Marks: 70

Time Allowed: Three hours

*(Candidates are allowed additional 15 minutes for only reading the paper.
They must NOT start writing during this time.)*

This paper is divided into four sections – A, B, C and D.

Answer all questions.

Section A consists of one question having sub-parts of one mark each.

Section B consists of seven questions of two marks each.

Section C consists of nine questions of three marks each, and

Section D consists of three questions of five marks each.

*Internal choices have been provided in two questions each in Section B,
Section C and Section D.*

The intended marks for questions are given in brackets [].

*All working, including rough work, should be done on the same sheet as and
adjacent to the rest of the answer.*

Answers to sub parts of the same question must be given in one place only.

A list of useful physical constants is given at the end of this paper.

A simple scientific calculator without a programmable memory may be used for calculations.

SECTION A – 14 MARKS

Question 1

(A) In questions (i) to (vii) given below, choose the correct alternative (a), (b), (c) or (d) for each of the questions.

(i) A hollow sphere of radius R has a point charge Q at its centre. Electric flux emanating from it is ϕ . If both the charge and the radius of the sphere be doubled, electric flux emanating from the sphere will: [1]

- (a) remain the same.
- (b) become 2ϕ
- (c) become 4ϕ
- (d) become 8ϕ

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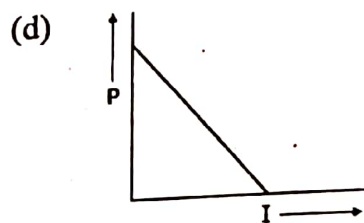
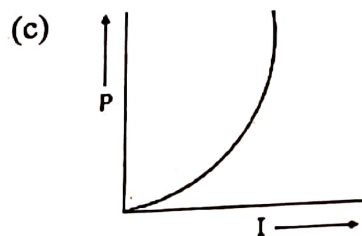
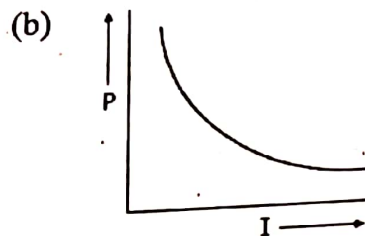
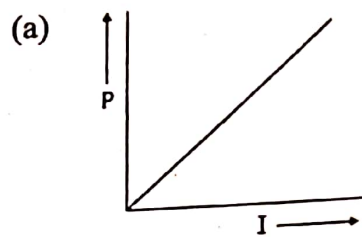
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- (ii) An electric current (I) flowing through a metallic wire is gradually increased. The graph of heating power (P) developed in it versus the current (I) is: [1]



- (iii) A circular coil has radius ' r ', number of turns ' N ' and carries a current ' I '. Magnetic flux density ' B ' at its centre is: [1]

- (a) $B = \mu_0 NI$
 (b) $B = \mu_0 NI/2r$
 (c) $B = \mu_0 NI/4\pi r$
 (d) $B = \mu_0 NI/4r$

- (iv) If an object is placed at a distance of 10cm in front of a concave mirror of focal length 20cm, the image formed will be: [1]

- (a) real and 20cm in front of the mirror.
 (b) real and 6.67cm in front of the mirror.
 (c) virtual and 20cm behind the mirror.
 (d) virtual and 6.67cm behind the mirror.

SECTION B – 14 MARKS

Question 2

[2]

- (i) Calculate **equivalent capacitance** of the circuit shown in *Figure 1* given below:

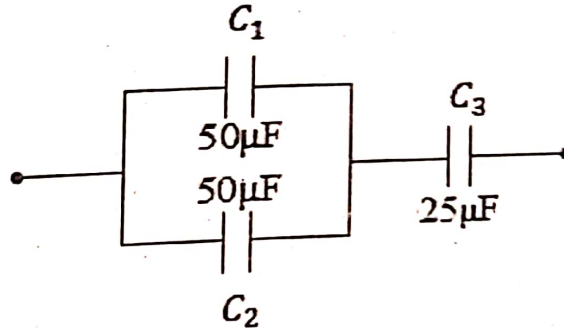


Figure 1

OR

- (ii) Calculate **electric potential** at a point P which is at a distance of 9cm from a point charge of $50\mu\text{C}$.

[2]

Question 3

- (i) Write **balancing condition** of a Wheatstone bridge.
- (ii) Current 'I' flowing through a metallic wire is related to drift speed v_d of free electrons as follows:

$$I = nAev_d$$

State what the symbol 'n' stands for.

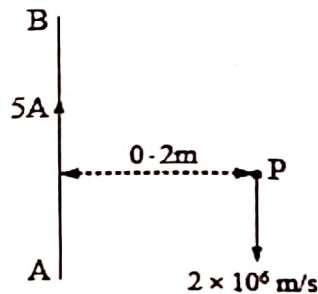
[2]

Question 4

When an **electric current** is passed through a wire or a coil, a **magnetic field** is produced. Is the reverse phenomenon possible i.e., can a **magnetic field** produce an **electric current**? Explain with the help of an **appropriate example**.

Question 5**[2]**

- (i) A long straight wire **AB** carries a current of **5A**. **P** is a proton travelling with a velocity of $2 \times 10^6 \text{ m/s}$, parallel to the wire, **0.2m** from it and in a direction opposite to the current, as shown in **Figure 2** below. Calculate the force which magnetic field of the current carrying conductor **AB** exerts on the proton.

**Figure 2****OR**

- (ii) A moving coil galvanometer of resistance 55Ω produces a full scale deflection for a current of **250 mA**. How will you convert it into an ammeter having a range of **0 – 3A**?

Question 6**[2]**

- (i) State how vectors $\vec{E}$, $\vec{B}$ and $\vec{c}$ are oriented in an electromagnetic wave.
- (ii) Name the electromagnetic wave / radiation which is used to study crystal structure.

Question 7**[2]**

Name *any two* phenomena which take place in the formation of a rainbow.

Question 8**[2]**

With reference to semiconductor physics, answer the following questions.

- (i) What is meant by “Forbidden band” of energy levels?
- (ii) In which material “Forbidden band” is absent?

SECTION C - 27 MARKS

[3]

Question 9

Q1

(i)

Show that intensity of electric field at a point in broadside position of an electric dipole is given by:

$$E = \left(\frac{1}{4\pi\epsilon_0} \right) \frac{p}{(r^2 + l^2)^{3/2}}$$

where the terms have their usual meaning.

Question 10

[3]

- (i) Eight identical cells, each of emf 2V and internal resistance 3Ω , are connected in series to form a row. Six such rows are connected in parallel to form a battery. This battery is now connected to an external resistor R of resistance 6Ω . Calculate:

- emf of the battery.
- internal resistance of the battery.
- current flowing through R .

OR

- (ii) In the circuit shown in *Figure 3* below, E_1 and E_2 are batteries having emfs of 25V and 26V. They have an internal resistance of 1Ω and 5Ω respectively. Applying Kirchhoff's laws of electrical networks, calculate the currents I_1 and I_2 .

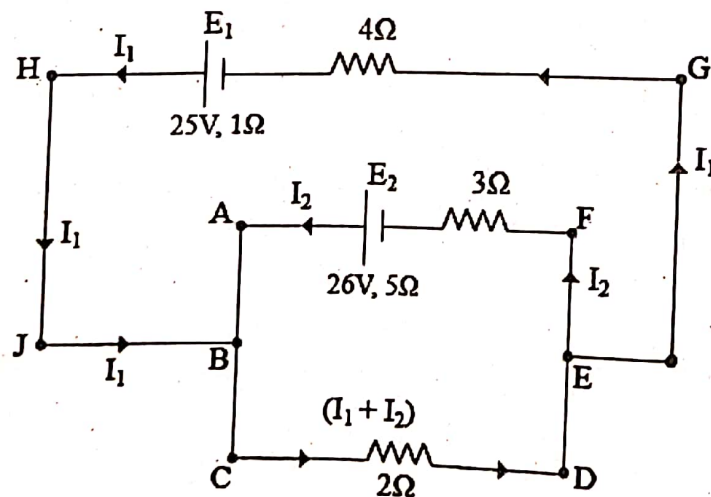


Figure 3

Question 11

[3]

Using Ampere's circuital law, obtain an expression for magnetic flux density 'B' at a point near an infinitely long and straight conductor, carrying a current I.

Question 12

[3]

Using Huygen's wave theory of light, show that the angle of incidence is equal to the angle of reflection. Draw a neat and labelled diagram.

Question 13

[3]

- (i) For any prism, obtain a relation between angle of the prism (A), angle of minimum deviation (δ_m) and refractive index of its material (μ or n).

OR

- (ii) Obtain an expression for refraction at a single convex spherical surface i.e., the relation between μ_1 (rarer medium), μ_2 (denser medium), object distance u , image distance v and the radius of curvature R .

Question 14

[3]

- (i) What is the essential condition for obtaining a sustained interference?
- (ii) In Young's double slit experiment, the distance of the 4th bright fringe from the centre of the interference pattern is 1.5mm. The distance between the slits and the screen is 1.5m and the wavelength of light used is 500nm. Calculate the distance between the two slits.

Question 15

[3]

Monochromatic light of wavelength 396nm is incident on the surface of a metal whose work function is 1.25eV. Calculate:

- (i) the energy of an incident photon in eV.
- (ii) the maximum kinetic energy of photoelectrons in eV.

Question 16

[3]

Name *any two* essential parts of a nuclear reactor. State the function of *any one* of them.

Draw a well-labelled diagram of a stirred-tank bioreactor.

Question 13

[3]

Question 17

[3]

Draw a labelled circuit diagram of a **full wave rectifier**. Show graphically how the **output voltage** varies with **time**.

SECTION D – 15 MARKS

Question 18

[5]

- (i) A 60Ω resistor, a 1.0 H inductor and a $4\mu\text{F}$ capacitor are connected in series to an ac supply generating an emf $e = 300 \sin(500t)\text{ V}$. Calculate:
- impedance of the circuit.
 - peak value of the current flowing through the circuit.
 - phase difference between the current and the supply voltage.

OR

- (ii) (a) An ac generator generates an emf which is given by $e = 311 \sin(240\pi t)\text{ V}$. Calculate:
- frequency of the emf.
 - r.m.s. value of the emf.
- (b) The primary coil of a transformer has 60 turns whereas its secondary coil has 3000 turns.
- If a 220 V ac voltage is applied to the primary coil, how much emf is induced in the secondary coil?
 - If a current of 5 A flows in the primary coil, how much current will flow in a load in the secondary coil? State the assumption you have made regarding the transformer, in this calculation.

[5]

Question 19

- (i) (a) Name the series of lines of hydrogen spectrum which lies in the
- ultraviolet region.
 - visible region.
- (b) How much is the angular momentum of an electron when it is orbiting in the second Bohr orbit of hydrogen atom?
- (c) With reference to Nuclear Physics, answer the following questions.
- What is meant by "Isotopes"?
 - Define 1 u (where u stands for unified atomic mass unit).

OR

- (ii) (a) Using **Bohr's Theory** of hydrogen atom, obtain an expression for the **velocity** of an electron in n^{th} orbit of an atom.
- (b) What is meant by "**binding energy per nucleon**" of a nucleus? State its physical significance.

Question 20

[5]

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

There are two types of lenses: Converging lenses and Diverging lenses, depending on whether they converge or diverge an incident beam of light. They are also called convex or concave lenses. Lenses are usually made of glass. Convex lenses are more popular as they form a real image of an object. They are widely used in our daily life, for instance, in microscopes, telescopes, projectors, cameras, spectacles etc. Microscopes are used to view small and nearby objects whereas telescopes are used to see distant objects.

- State **any one** factor on which focal length of a lens depends.
- Give an example where a convex lens behaves like a diverging lens.
- What type of lens is used in a camera?
- Write an expression for **magnifying power** of a **compound microscope** when its final image lies at the least distance of distinct vision (D).
- State **any one** difference between a **reflecting telescope** and a **refracting telescope**.

Useful Constants & Relations:

1	Constant for Coulomb's law	$(1/4\pi\epsilon_0)$	$9 \times 10^9 \text{ m/F}$
2	Permeability of vacuum	(μ_0)	$4\pi \times 10^{-7} \text{ H/m}$
3	Speed of light in vacuum	c	$3 \times 10^8 \text{ m/s}$
4	Planck's Constant	h	$6.6 \times 10^{-34} \text{ Js}$
5	Charge of a proton	e	$1.6 \times 10^{-19} \text{ C}$
6		1 eV	$1.6 \times 10^{-19} \text{ J}$
7		1 nm	$1 \times 10^{-9} \text{ m}$

CHEMISTRY PAPER 1

(THEORY)

Maximum Marks: 70

Time Allowed: Three hours

Candidates are allowed additional 15 minutes for only reading the paper.
They must NOT start writing during this time.

This paper is divided into four sections – A, B, C and D.

Answer all questions.

Section A consists of one question having sub-parts of one mark each.

Section B consists of ten questions of two marks each.

Section C consists of seven questions of three marks each, and

Section D consists of three questions of five marks each.

Internal choices have been provided in one question each in Section B,
Section C and Section D.

All working, including rough work, should be done on the same sheet as, and adjacent to the rest
of the answer.

The intended marks for questions or parts of questions are given in brackets [].

Balanced equations must be given wherever possible and diagrams where they are helpful.

When solving numerical problems, all essential working must be shown.

In working out problems, use the following data:

$$\begin{aligned}\text{Gas constant } R &= 1.987 \text{ cal deg}^{-1} \text{ mol}^{-1} = 8.314 \text{ JK}^{-1} \text{ mol}^{-1} \\ &= 0.0821 \text{ dm}^3 \text{ atm K}^{-1} \text{ mol}^{-1}\end{aligned}$$

$$1 \text{ l atm} = 1 \text{ dm}^3 \text{ atm} = 101.3 \text{ J. } 1 \text{ Faraday} = 96500 \text{ coulombs.}$$

$$\text{Avogadro's number} = 6.023 \times 10^{23}.$$

SECTION A – 14 MARKS

Question 1

- (A) Fill in the blanks by choosing the appropriate word(s) from those given in the [4×1] brackets:

[stable, low, aldehyde, unstable, 6, 4, ethane, Clemmensen's, 2, 3, carboxylic acid, high, propane, Rosenmund's]

- (i) The primary alcohols are easily oxidised first into _____ and then into _____.
- (ii) The intermediate activated complex in a chemical reaction is highly _____ due to _____ energy.
- (iii) The coordination number and oxidation state of the complex $\text{K}_4[\text{Fe}(\text{CN})_6]$ are _____ and _____ respectively.
- (iv) Propanone on reaction with zinc-amalgam in presence of conc. HCl gives _____ and the reaction is known as _____ reduction.

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(B) Select and write the correct alternative from the choices given below:

- (i) The reaction of a primary amine with chloroform and ethanolic KOH is called:
- Carbylamine reaction
 - Kolbe's reaction
 - Reimer-Tiemann reaction
 - Wurtz-Fittig reaction
- (ii) Which one of the following statements is **TRUE** for the Galvanic cell?
- Electrons flow from copper electrode to zinc electrode.
 - Current flows from zinc electrode to copper electrode.
 - Cations move towards copper electrode.
 - Cations move towards zinc electrode.
- (iii) Which one of the following compounds is diamagnetic and colourless?
- $K_2Cr_2O_7$
 - $ZnSO_4$
 - $KMnO_4$
 - $Cr_2(SO_4)_3$
- (iv) For a first order reaction, the half-life period ($t_{1/2}$) is:
- proportional to the initial concentration.
 - inversely proportional to the initial concentration.
 - proportional to the square root of the initial concentration.
 - independent of the initial concentration.

(C) Match the following:

[4×1]

- | | |
|----------------------|------------------------|
| (i) Phenol | (a) Hexane + heptane |
| (ii) EDTA | (b) Globular protein |
| (iii) Ideal solution | (c) Azo dye |
| (iv) Insulin | (d) Hexadentate ligand |

(D)

[2×1]

- (i) **Assertion** : If a solution contains both H^+ and Na^+ ions, the H^+ ions are reduced first at cathode.

Reason : Cations with higher E° value are reduced first at cathode.

- (a) Both Assertion and Reason are true, and Reason is the correct explanation for Assertion.
 - (b) Both Assertion and Reason are true, but Reason is not the correct explanation for Assertion.
 - (c) Assertion is true but Reason is false.
 - (d) Assertion is false but Reason is true.
- (ii) **Assertion** : Addition of bromine water to 1-butene gives two optical isomers.

Reason : The product formed contains two asymmetric carbon atoms.

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

SECTION B – 20 MARKS

Question 2

[2]

Calculate the mass of ascorbic acid (molecular mass = 176 g/mol) that should be dissolved in 155g of acetic acid to cause a depression of freezing point by 1.15K. Assume that ascorbic acid does not dissociate or associate in the solution.

(K_f for acetic acid = 3.9 K kg/mol)

Question 3

[2]

Give a reason for the following:

- (i) Cu^{+2} salts are paramagnetic while Cu^+ salts are diamagnetic.
- (ii) Mn^{+2} compounds are more stable than Fe^{+2} compounds.

Question 4**[2]**

Give chemical equations for each of the following:

- (i) Ethyl chloride is treated with aqueous KOH solution.
- (ii) Chlorobenzene is treated with ammonia at 573K and high pressure.

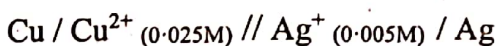
Question 5**[2]**

State one reason for each of the following:

- (i) Alkylamine is soluble in water whereas arylamine is insoluble in water.
- (ii) Methylamine is a stronger base than methyl alcohol.

Question 6**[2]**

Calculate the emf of the following cell at 298K.



Given $E^\circ_{\text{Cu}^{2+}/\text{Cu}} = 0.34\text{V}$, $E^\circ_{\text{Ag}^+/\text{Ag}} = 0.80\text{V}$,

1 Faraday = 96500 C mol^{-1}

Question 7**[2]**

Complete and balance the following chemical equations:

- (i) $\text{KMnO}_4 + \text{H}_2\text{SO}_4 + \text{KI} \longrightarrow \underline{\hspace{1cm}} + \underline{\hspace{1cm}} + \underline{\hspace{1cm}} + \underline{\hspace{1cm}}$
- (ii) $\text{K}_2\text{Cr}_2\text{O}_7 + \text{H}_2\text{SO}_4 + \text{H}_2\text{S} \longrightarrow \underline{\hspace{1cm}} + \underline{\hspace{1cm}} + \underline{\hspace{1cm}} + \underline{\hspace{1cm}}$

Question 8**[2]**

- (i) How will the following be obtained? (Give chemical equation)

- (a) Ethanol from Grignard's reagent.
- (b) Diethyl ether from sodium ethoxide.

OR

- (ii) An organic compound [A] $\text{C}_2\text{H}_6\text{O}$, on heating with conc. H_2SO_4 at 413K gives a neutral compound [B] $\text{C}_4\text{H}_{10}\text{O}$. Compound [B] on treatment with PCl_5 gives a product, which on subsequent treatment with KCN yields compound [C] $\text{C}_3\text{H}_5\text{N}$. Compound [C] on hydrolysis gives an acid [D] $\text{C}_3\text{H}_6\text{O}_2$. Identify the compounds [A], [B], [C] and [D].

Question 9**[2]**

The osmotic pressure of blood at 37°C is 8.21 atm. How much glucose in grams should be used per litre of aqueous solution for an intravenous injection so that it is isotonic with blood? (Molecular wt of glucose = 180g/mol)

Question 10**[2]**

An aromatic carboxylic acid [A] which readily sublimes on heating, produces compound [B] on treatment with PCl_5 . Compound [B], when reduced in the presence of Pd catalyst over BaSO_4 poisoned by sulphur in xylene solution gives compound [C]. When compound [C] is condensed in the presence of alcoholic KCN, it gives compound [D]. (Molecular formula of compound [D] is $\text{C}_{14}\text{H}_{12}\text{O}_2$)

Identify the compounds [A], [B], [C] and [D].

Question 11**[2]**

State a reason for each of the following:

- (i) $\text{La}(\text{OH})_3$ is more basic than $\text{Lu}(\text{OH})_3$.
- (ii) Transition elements and their compounds act as catalyst.

SECTION C – 21 MARKS**Question 12****[3]**

20% of a first order reaction is completed in five minutes. How much time will the 60% reaction take to complete? Calculate the half-life period ($t_{1/2}$) for the above reaction.

Question 13**[3]**

Write the balanced chemical equations for the following name reactions:

- (i) Sandmeyer's reaction
- (ii) Wurtz reaction
- (iii) Finkelstein reaction

[3]

Question 14

- (i) Give an example each of reducing sugar and non-reducing sugar.
- (ii) What is *denaturation of proteins*?
- (iii) Give an example each of water soluble vitamin and fat soluble vitamin.

[3]

Question 15

When 2g of benzoic acid is dissolved in 25g of benzene, it shows a depression in freezing point equal to 1.62K. Molal depression constant (K_f) of benzene is 4.9 K kg mol⁻¹ and molecular weight of benzoic acid = 122g/mol. What will be the percentage association of the benzoic acid?

(Benzoic acid forms dimer when dissolved in benzene.)

[3]

Question 16

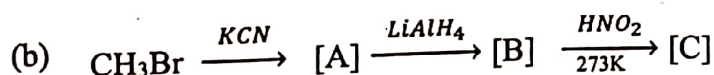
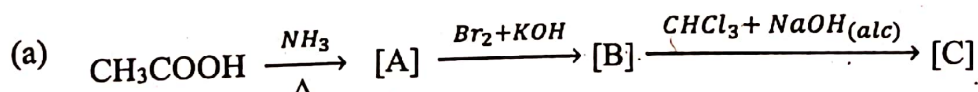
Account for the following:

- (i) Phenol is a stronger acid than aliphatic alcohols.
- (ii) Ethanol gives iodoform reaction whereas methanol does not give iodoform reaction.
- (iii) Ethers should not be distilled to dryness.

[3]

Question 17

- (i) Identify the compounds [A], [B] and [C] in the following reactions:



OR

- (ii) How will the following be converted? (Give chemical equation)

- (a) Ethyl bromide to ethyl isocyanide.
- (b) Aniline to benzene diazonium chloride.
- (c) Benzene diazonium chloride to phenol.

Question 18**[3]**

A first order reaction is 50% completed in 40 minutes at 300K and in 20 minutes at 320K. Calculate the activation energy of the reaction.

SECTION D – 15 MARKS**Question 19****[5]**

(i) Write the chemical equations to illustrate the following name reactions:

- (a) Cannizzaro's reaction
- (b) HVZ reaction
- (c) Aldol condensation

(ii) How will the following be converted? (Give chemical equation)

- (a) Acetaldehyde to acetone
- (b) Formaldehyde to urotropine

Question 20**[5]**

(i) Name the type of isomerism exhibited by the following pairs of compounds.

- (a) $[\text{Co}(\text{NH}_3)_5(\text{ONO})]\text{Cl}_2$ and $[\text{Co}(\text{NH}_3)_5(\text{NO}_2)]\text{Cl}_2$
- (b) $[\text{Cr}(\text{H}_2\text{O})_5\text{Cl}]\text{Cl}_2 \cdot \text{H}_2\text{O}$ and $[\text{Cr}(\text{H}_2\text{O})_4\text{Cl}_2]\text{Cl} \cdot 2\text{H}_2\text{O}$
- (c) $[\text{Pt}(\text{NH}_3)_4\text{Cl}_2]\text{Br}_2$ and $[\text{Pt}(\text{NH}_3)_4\text{Br}_2]\text{Cl}_2$

(ii) Write the IUPAC names of the following complexes:

- (a) $[\text{Co}(\text{NH}_3)_4(\text{H}_2\text{O})_2]\text{Cl}_3$
- (b) $\text{K}_2[\text{Ni}(\text{CN})_4]$

Question 21**[5]**

(i) The specific conductance of 2.5×10^{-4} M formic acid is $5.25 \times 10^{-5} \text{ ohm}^{-1}\text{cm}^{-1}$. Calculate its molar conductivity and degree of dissociation.

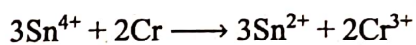
Given $\lambda^\circ_{(\text{H}^+)} = 349.5 \text{ ohm}^{-1}\text{cm}^2\text{mol}^{-1}$ and

$$\lambda^\circ_{(\text{HCOO}^-)} = 50.5 \text{ ohm}^{-1}\text{cm}^2\text{mol}^{-1}$$

- (ii) Calculate the time taken to deposit 1.27g of copper at cathode when a current of 2 amp. is passed through the solution of CuSO_4 .
(Atomic weight of Cu = 63.5 gmol^{-1})

OR

- (i) The resistance of a conductivity cell with 0.1M KCl solution is 200 ohm. When the same cell is filled with 0.02M NaCl solution, the resistance is 1100 ohm. If the conductivity of 0.1M KCl solution is $0.0129 \text{ ohm}^{-1}\text{cm}^{-1}$, calculate the cell constant and molar conductivity of 0.02M NaCl solution.
- (ii) The emf (E°_{cell}) of the following reaction is 0.89V:



Calculate the value of ΔG° for the reaction. Predict whether the above reaction will be spontaneous or not.