

SAMPLE PAPER-2

PAPER-1

Time : 3 Hours

Maximum Marks : 186

READ THE INSTRUCTIONS CAREFULLY

GENERAL :

1. This sealed booklet is your Question Paper. Do not break the seal till you are told to do so.
2. Use the Optical Response sheet (ORS) provided separately for answering the questions.
3. Blank spaces are provided within this booklet for rough work.
4. Write your name, form number and sign in the space provided on the back cover of this booklet.
5. After breaking the seal of the booklet, verify that the booklet contains **32** pages and that all the **18** questions in each subject and along with the options are legible. If not, contact the invigilator for replacement of the booklet.
6. You are allowed to take away the Question Paper at the end of the examination.

OPTICAL RESPONSE SHEET :

7. The ORS will be collected by the invigilator at the end of the examination.
8. Do not tamper with or mutilate the ORS. **Do not use the ORS for rough work.**
9. Write your name, form number and sign with pen in the space provided for this purpose on the ORS. **Do not write any of these details anywhere else on the ORS.** Darken the appropriate bubble under each digit of your form number.

DARKENING THE BUBBLES ON THE ORS :

10. Use a **BLACK BALL POINT PEN** to darken the bubbles on the ORS.
11. Darken the bubble **COMPLETELY.**
12. The correct way of darkening a bubble is as :
13. The ORS is machine-gradable. Ensure that the bubbles are darkened in the correct way.
14. Darken the bubbles **ONLY IF** you are sure of the answer. There is **NO WAY** to erase or "un-darken" a darkened bubble.
15. Take **$g = 10 \text{ m/s}^2$** unless otherwise stated.

DO NOT BREAK THE SEALS WITHOUT BEING INSTRUCTED TO DO SO BY THE INVIGILATOR

SOME USEFUL CONSTANTS

Atomic No. : H = 1, B = 5, C = 6, N = 7, O = 8, F = 9, Al = 13, P = 15, S = 16,
Cl = 17, Br = 35, Xe = 54, Ce = 58

Atomic masses : H = 1, Li = 7, B = 11, C = 12, N = 14, O = 16, F = 19, Na = 23, Mg = 24,
Al = 27, P = 31, S = 32, Cl = 35.5, Ca = 40, Fe = 56, Br = 80, I = 127,
Xe = 131, Ba = 137, Ce = 140,

- | | |
|------------------------------------|--|
| • Boltzmann constant | $k = 1.38 \times 10^{-23} \text{ JK}^{-1}$ |
| • Coulomb's law constant | $\frac{1}{4\pi\epsilon_0} = 9 \times 10^9$ |
| • Universal gravitational constant | $G = 6.67259 \times 10^{-11} \text{ N-m}^2 \text{ kg}^{-2}$ |
| • Speed of light in vacuum | $c = 3 \times 10^8 \text{ ms}^{-1}$ |
| • Stefan-Boltzmann constant | $\sigma = 5.67 \times 10^{-8} \text{ Wm}^{-2}\text{-K}^{-4}$ |
| • Wien's displacement law constant | $b = 2.89 \times 10^{-3} \text{ m-K}$ |
| • Permeability of vacuum | $\mu_0 = 4\pi \times 10^{-7} \text{ NA}^{-2}$ |
| • Permittivity of vacuum | $\epsilon_0 = \frac{1}{\mu_0 c^2}$ |
| • Planck constant | $h = 6.63 \times 10^{-34} \text{ J-s}$ |

Space for Rough Work

HAVE CONTROL → HAVE PATIENCE → HAVE CONFIDENCE ⇒ 100% SUCCESS

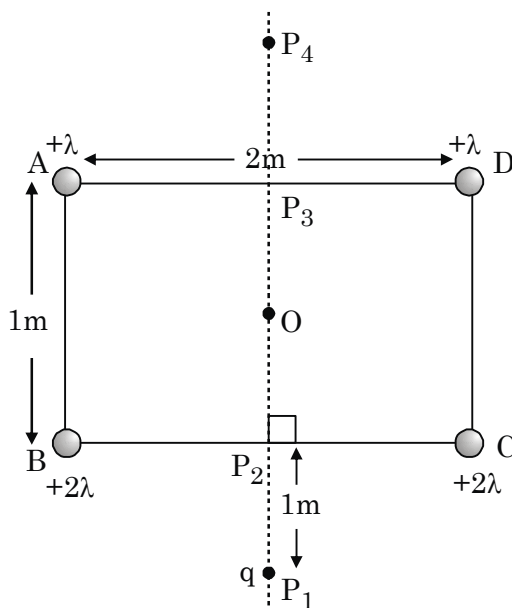
BEWARE OF NEGATIVE MARKING

PART-1 : PHYSICS

SECTION-I(i) : (Maximum Marks : 12)

- This section contains **FOUR** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is correct.
- For each question, darken the bubble corresponding to the correct option in the ORS.
- For each question, marks will be awarded in one of the following categories :
Full Marks : +3 If only the bubble corresponding to the correct option is darkened.
Zero Marks : 0 If none of the bubbles is darkened.
Negative Marks : -1 In all other cases

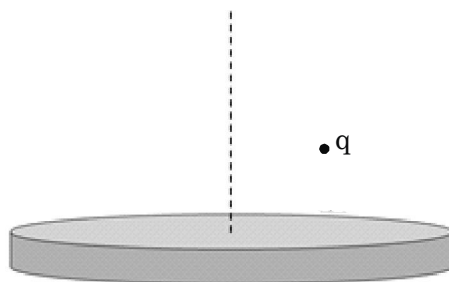
1. There is a system of 4 infinite length uniformly charged wire passing through corners of a rectangle ABCD and perpendicular to the plane of rectangle as shown in figure. Charge density of wires passing through A, D is λ and B & C is 2λ . P_1, P_2, P_3 and P_4 are points on the perpendicular bisector of AD and BC.



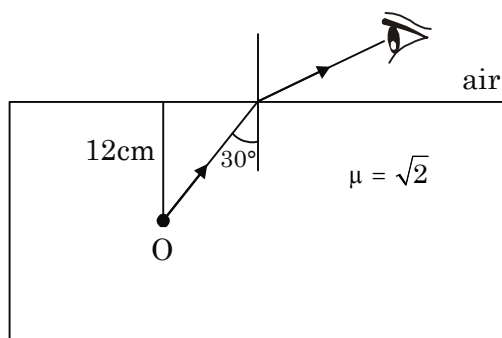
- (A) Potential energy of system is increasing continuously if a charge particle 'q' is moved from P_1 to O along perpendicular bisectors.
- (B) Potential energy of system 1st increase then decrease if a charge particle 'q' is moved from O to P_3
- (C) Potential energy of system decrease continuously if a charge particle 'q' is moved from P_2 to O.
- (D) Potential energy of system 1st increase and then decrease if particle is moved from P_2 to O along perpendicular bisector line.

Space for Rough Work

2. A light disc made of aluminium (a nonmagnetic material) is kept horizontally and is free to rotate about its axis as shown in the figure. A point charge particle is revolving about the axis of disc, then the disc will



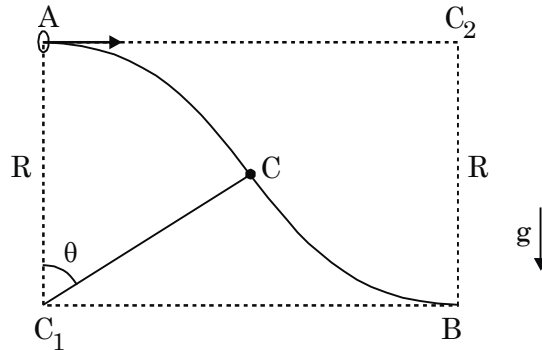
- (A) Rotate in the direction opposite to the direction of charge's motion.
 - (B) Rotate in same direction as the direction of charge's motion.
 - (C) Not rotate but temperature will increase.
 - (D) Not rotate but its temperature will remain unchanged
3. An object is placed at distance 12 cm from top face of glass slab ($\mu = \sqrt{2}$). If the object is viewed from the position of observer as shown, then the apparent distance from the top surface of glass slab will be :



- (A) $\frac{4}{\sqrt{3}}$
- (B) $4\sqrt{3}$
- (C) $2\sqrt{2}$
- (D) $\frac{8}{\sqrt{3}}$

Space for Rough Work

4. Smooth wire shaped as circular arc AC and CB are of same radius but centre of curvature are on opposite sides as shown. A small bead is projected horizontally from A with speed such that normal force become zero at point C. Speed of the particle when it reach to B will be [Take $\theta = \cos^{-1} (5/6)$]:



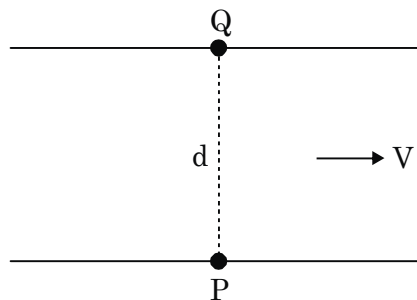
- (A) $\sqrt{2gR}$ (B) $\sqrt{3gR}$ (C) $\sqrt{\frac{5}{2}gR}$ (D) $\sqrt{\frac{3}{2}gR}$

Space for Rough Work

SECTION-I(ii) : (Maximum Marks: 32)

- This section contains **EIGHT** questions.
- Each question has **FOUR** options for correct answer(s). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct option(s).
- For each question, choose the correct option(s) to answer the question.
- Answer to each question will be evaluated according to the following marking scheme:
Full Marks : +4 If only (all) the correct option(s) is (are) chosen.
Partial Marks : +3 If all the four options are correct but **ONLY** three options are chosen.
Partial Marks : +2 If three or more options are correct but **ONLY** two options are chosen, both of which are correct options.
Partial Marks : +1 If two or more options are correct but **ONLY** one option is chosen and it is a correct option.
Zero Marks : 0 If none of the options is chosen (i.e. the question is unanswered).
Negative Marks : -1 In all other cases.
- **For Example** : If first, third and fourth are the **ONLY** three correct options for a question with second option being an incorrect option; selecting only all the three correct options will result in +4 marks. Selecting only two of the three correct options (e.g. the first and fourth options), without selecting any incorrect option (second option in this case), will result in +2 marks. Selecting only one of the three correct options (either first or third or fourth option), without selecting any incorrect option (second option in this case), will result in +1 marks. Selecting any incorrect option(s) (second option in this case), with or without selection of any correct option(s) will result in -1 marks.

5. A boat start from point 'P' from one bank of river with a sound siren of frequency f move in the river in such a way that it crosses the river in minimum time. A detector is fixed at some height from the ground on the other bank just opposite to point P. If velocity of river flow is V , velocity of boat is $2V$ w.r.t. water flow and velocity of sound in air = V_0 . Consider only sound pulse reach to detector only through air. Then [width of river = d and $V \ll V_0$]

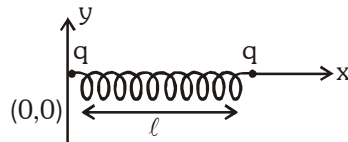


- (A) Maximum frequency observed by detector = $\left[\frac{V_0}{V_0 - 2V} \right] f$
- (B) Maximum frequency observed by detector = $\left[\frac{V_0}{V_0 - \sqrt{3}V} \right] f$
- (C) Detector will observed frequency f when boat cross half of river.
- (D) Minimum frequency observed by detector = $\left[\frac{V_0}{V_0 + 3V} \right] f$

Space for Rough Work

ALLEN

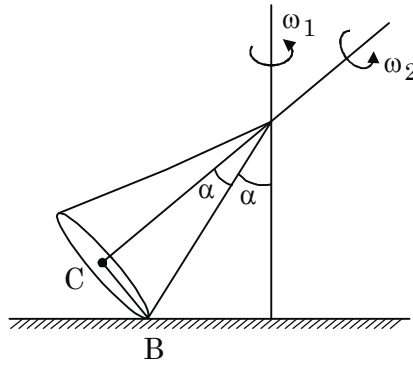
6. One end of a spring of negligible unstretched length and spring constant k is fixed at the origin $(0,0)$. A point particles of mass m carrying a positive charge q is attached at its other end. The entire system is kept on a smooth horizontal surface. When some positive point charge ' q ' is fixed at the origin, the spring get stretched to a length ℓ and attains a new equilibrium position and at rest. If the spring is elongated slightly from equilibrium and released, it is found that



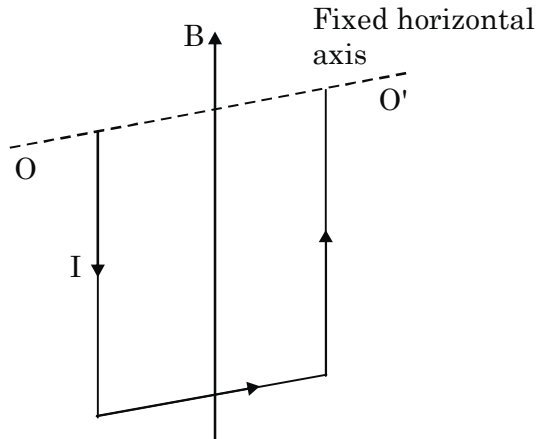
- (A) Particle oscillate with time period $T = 2\pi\sqrt{\frac{m}{3k}}$
- (B) Particle oscillate with time period $T = \pi\sqrt{\frac{m}{3k}}$
- (C) When particle move from mean position to extreme position then modulus of change in potential energy of spring is equal to modulus of change in electrostatic potential energy (for very small amplitude)
- (D) When particle move from mean position to extreme position then modulus of change in potential energy of spring is half modulus of change in electrostatic potential energy (for very small amplitude)

Space for Rough Work

7. A uniform solid cone (height h , semi-vertex angle α) is inclined against a vertical axis as shown in the figure. The cone rotates about its own axis as well as rotates about the vertical axis with angular speeds marked in the diagram. If the cone does not slip at point B , then



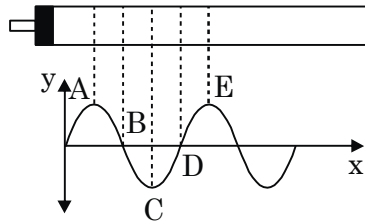
- (A) $\frac{\omega_1}{\omega_2} = 1$ (B) $\frac{\omega_1}{\omega_2} = \sqrt{3}$
 (C) Velocity of $C = h \sin 2\alpha \omega_1$ (D) Velocity of $C = h\omega_1$
8. A copper wire of density ρ with cross-sectional area S bent to make three sides of a square can turn about a horizontal axis OO' . The wire is located in uniform vertical magnetic field. If on passing a current I through the wire the latter deflects by an angle θ and remain in equilibrium. Then



- (A) Magnetic field $B = \frac{2\rho Sg}{I} \tan \theta$
 (B) Magnetic field $B = \frac{2\rho Sg}{I} \sin \theta$
 (C) Net magnetic force on the copper wire is along horizontal.
 (D) Net magnetic force on the copper wire is zero.

Space for Rough Work

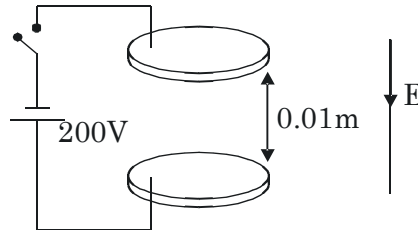
9. Displacement (y) of air column of position x from its mean position at any instant is given by graph shown in the figure. We can conclude from graph that



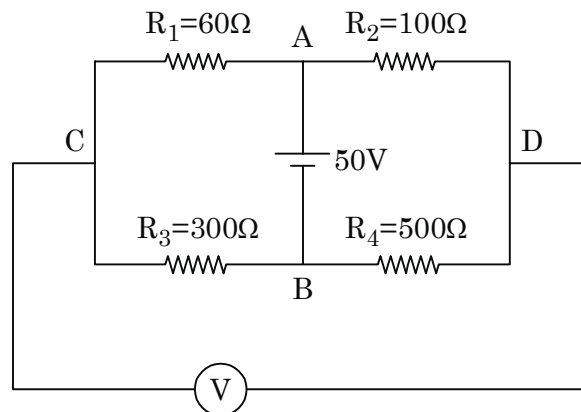
- (A) Average density in pipe is equal to density at point A at given instant
 - (B) Average density in pipe is equal to density at point C at given instant
 - (C) Density of air is maximum at B
 - (D) Density of air is minimum at D
10. A proton collides with a stationary deuteron and a ${}^3\text{He}$ nucleus is formed. For this reaction to take place, the proton must have minimum kinetic energy 1.4 MeV. If instead, a deuteron collides with a stationary proton to make a ${}^3\text{He}$ nucleus. Then
- (A) minimum kinetic energy deuteron must possess = 2.8 MeV
 - (B) minimum kinetic energy deuteron must possess = 0.7 MeV
 - (C) Energy needed for the reaction is approx 0.93 MeV
 - (D) Energy needed for the reaction is approx 2.8 MeV

Space for Rough Work

11. Two large circular disc separated by a distance of 0.01 m are connected to a battery via switch as shown in the figure. Charged oil drops of density 900 kg/m^3 are released through a tiny hole at the centre of the top disc. Once some oil drops achieve terminal velocity, the switch is closed to apply a voltage of 200 V across the disc and also an external electric field $E = 4 \times 10^4$ along vertically downwards is applied. As a result, an oil drop of radius $8 \times 10^{-7} \text{ m}$ stops moving vertically and floats between the discs. (Neglect the buoyancy force, take acceleration due to gravity = 10 m/s^2 and $e = 1.6 \times 10^{-19} \text{ C}$)



- (A) The number of electrons present in this oil drop is 6.
 (B) The number of electrons present in this oil drop is 18.
 (C) Net electric field between disc is $2 \times 10^4 \text{ V/m}$
 (D) Net electric field between disc is $6 \times 10^4 \text{ V/m}$
12. In the balanced condition, the values of the resistances of the four arms of a wheatstone bridge are shown in figure below. The resistance R_3 has temperature coefficient $\alpha = KT \text{ } ^\circ\text{C}^{-1}$ where $K = 0.0008$ and T is in $^\circ\text{C}$. If the temperature of only R_3 is increased by 10°C , then [Take initial temperature 0°C ; Resistance of voltmeter V is very large]



- (A) the voltage developed between C and D will be approx 0.27 volt at $T = 10^\circ\text{C}$
 (B) the voltage developed between C and D will be approx 0.47 volt at $T = 10^\circ\text{C}$
 (C) the voltage developed between C and D will be 0 volt at $T = 0^\circ\text{C}$
 (D) the voltage developed between C and D will be 0.5 volt at $T = 0^\circ\text{C}$

Space for Rough Work

SECTION-II : (Maximum Marks: 18)

- This section contains **SIX** questions.
- The answer to each question is a **NUMERICAL VALUE**.
- For each question, enter the correct numerical value (in decimal notation, truncated/rounded-off to the **second decimal place**; e.g. 6.25, 7.00, -0.33, -.30, 30.27, -127.30, if answer is 11.36777..... then both 11.36 and 11.37 will be correct) by darkening the corresponding bubbles in the ORS.

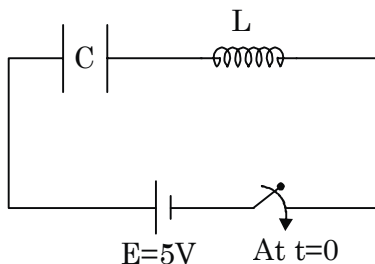
For Example : If answer is -77.25, 5.2 then fill the bubbles as follows.

+	●				
●	●	0	0	0	0
1	1	1	1	1	1
2	2	2	2	●	2
3	3	3	3	3	3
4	4	4	4	4	4
5	5	5	5	5	●
6	6	6	6	6	6
7	7	●	●	7	7
8	8	8	8	8	8
9	9	9	9	9	9

●	-				
●	●	●	0	0	●
1	1	1	1	1	1
2	2	2	2	●	2
3	3	3	3	3	3
4	4	4	4	4	4
5	5	5	●	5	5
6	6	6	6	6	6
7	7	7	7	7	7
8	8	8	8	8	8
9	9	9	9	9	9

- Answer to each question will be evaluated according to the following marking scheme:
Full Marks : +3 If **ONLY** the correct numerical value is entered as answer.
Zero Marks : 0 In all other cases.

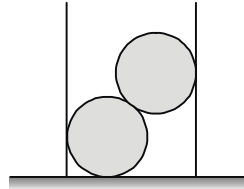
1. An initially uncharged capacitor and inductor are connected to battery at $t = 0$. Find the maximum energy stored in the inductor in Joule ? [Take $C = 1F$, $L = 1H$ and $E = 5V$]



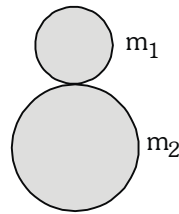
Space for Rough Work

2. A cylindrical pipe (no base) of radius R and mass M is placed vertically on a horizontal floor.

Two Identical spheres each of radius $\frac{3R}{4}$ and mass m are inserted in the cylinder as shown in the figure. At what minimum value of m/M will the arrangement topple? There is no friction between the spheres and inner wall of the cylinder.



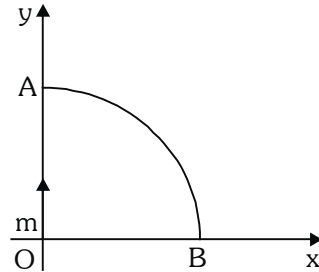
3. Two elastic balls of masses m_1 and m_2 are placed on top of each other (with a small gap between them) and then dropped onto the ground. What is the ratio m_2/m_1 , for which the upper ball ultimately receives the largest possible fraction of the total energy ?



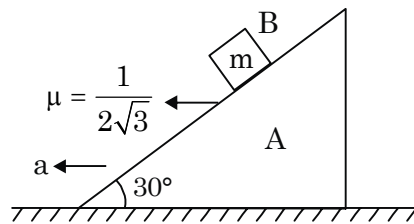
Space for Rough Work

4. Consider a quarter circular conducting ring of large radius r with its centre at the origin, where a small magnetic dipole of dipole moment \vec{m} is placed as shown in the figure. If the ring rotates at a constant angular velocity ω about the y -axis, and electromotive force induced between its ends is $p \frac{\mu_0 m \omega}{\pi r}$. Find p .

[Note : Write magnetic field due to small magnetic dipole in the same way as due to electric dipole]

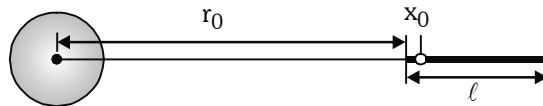


5. Wedge A with block B of mass m placed on it get a horizontal acceleration 'a' directed to the left as shown in figure. Friction coefficient between block and inclined surface $\mu = \frac{1}{2\sqrt{3}}$. Find the minimum value of the acceleration (in m/s^2) so that the block will be remain stationary w.r.t. wedge (Take : $g = 10 \text{ m/s}^2$)



Space for Rough Work

6. A small bead can slide without friction on a wooden rod of length $\ell = 10.0$ m. Initially the rod and the bead both are held motionless with the rod aligned radially with the earth. The left end of the rod is at a distance $r_0 = 4 \times 10^8$ m from the earth centre and the bead is at a distance $x_0 = 2.0$ cm away from the left end. Both the bodies are released simultaneously. Considering gravitational interaction only with the earth, if time after the release, the bead will separate from the rod is $P \times 10^4$ sec. Find P. Radius of the earth is $R = 6400$ km and acceleration due to gravity on the earth is $g = 10$ m/s².



Space for Rough Work

PART-2 : CHEMISTRY

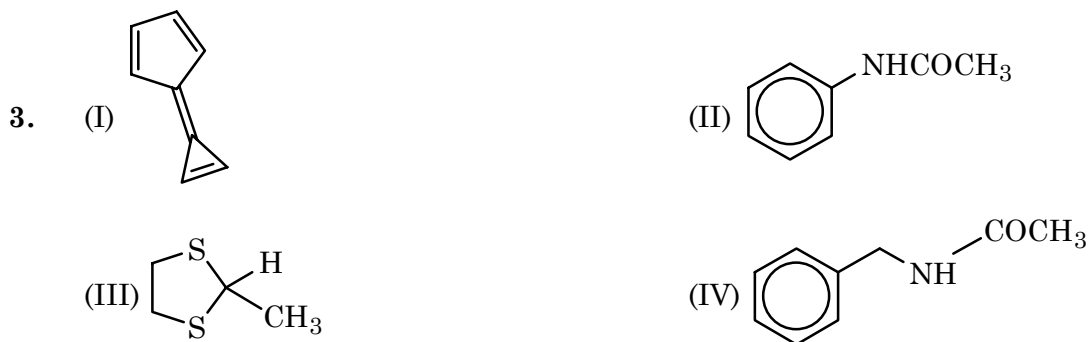
SECTION-I(i) : (Maximum Marks : 12)

- This section contains **FOUR** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is correct.
- For each question, darken the bubble corresponding to the correct option in the ORS.
- For each question, marks will be awarded in one of the following categories :
Full Marks : +3 If only the bubble corresponding to the correct option is darkened.
Zero Marks : 0 If none of the bubbles is darkened.
Negative Marks : -1 In all other cases

1. The molar conductance of H^+ ion and CH_3COO^- ion at 298K and at infinite dilution are $3.474 \times 10^{-2} \text{ ohm}^{-1} \text{ m}^2 \text{ mol}^{-1}$ and $1.351 \times 10^{-2} \text{ ohm}^{-1} \text{ m}^2 \text{ mol}^{-1}$, respectively. The resistance of 0.1 M CH_3COOH solution is 2000 ohm at 298K in a conductivity cell of cell constant 20 m^{-1} . The incorrect informations related with the given parameters at 298K is (1F = 96500 C/mol)
- (A) $\Lambda_m^0(CH_3COOH) = 4.825 \times 10^{-2} \text{ ohm}^{-1} \text{ m}^2 \text{ mol}^{-1}$
 (B) $\kappa = 1.0 \times 10^{-2} \text{ ohm}^{-1} \text{ m}^{-1}$
 (C) $\Lambda_m = 1.0 \times 10^{-4} \text{ ohm}^{-1} \text{ m}^2 \text{ mol}^{-1}$
 (D) $[H^+] = 2.07 \times 10^{-3} \text{ M}$
2. If n and ℓ are the principal and Azimuthal quantum numbers respectively, then the expression for calculating the maximum number of electrons in any orbit is

(A) $\sum_{\ell=1}^{\ell=n} 2(2\ell+1)$ (B) $\sum_{\ell=1}^{\ell=n-1} 2(2\ell+1)$ (C) $\sum_{\ell=0}^{\ell=n+1} 2(2\ell+1)$ (D) $\sum_{\ell=0}^{\ell=n-1} 2(2\ell+1)$

Space for Rough Work



Select incorrect statement(s) w.r.t these 4 species.

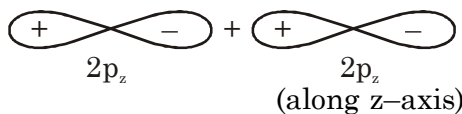
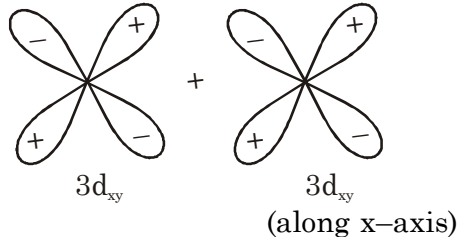
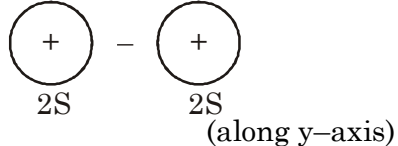
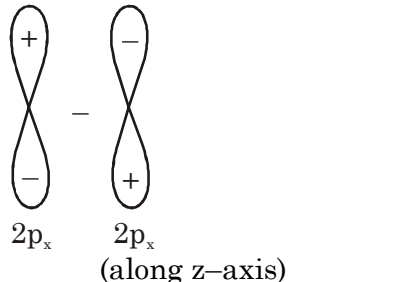
- (A) I is polar hydrocarbon
(B) II is more acidic than aniline
(C) III is more acidic than acetal formed by ethanal & ethylene glycol
(D) IV is less basic than II.
4. **Statement-1** : On increasing the temperature of an elementary bimolecular gaseous reaction by 10°C occurring at constant volume, the rate of reaction increase substantially by factor of 2 to 3.
- Statement-2** : The increase in temperature increases the collision frequency (total number of biomolecular collisions per unit time per unit volume) for the above condition.
- (A) Statement - 1 is true, Statement - 2 is true and statement - 2 is correct explanation for statement - 1.
(B) Statement - 1 is true, Statement - 2 is true and statement - 2 is NOT correct explanation for statement - 1.
(C) Statement - 1 is true, statement - 2 is false.
(D) Statement - 1 is false, statement - 2 is true.

Space for Rough Work

SECTION-I(ii) : (Maximum Marks: 32)

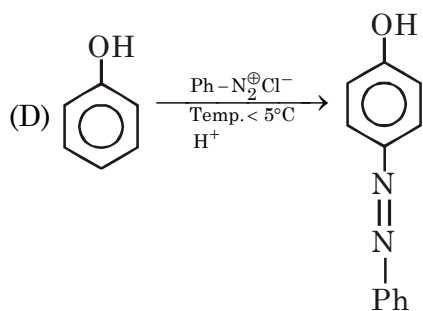
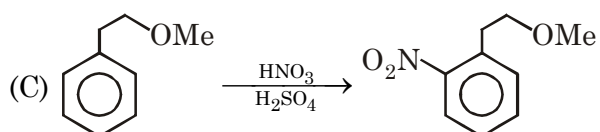
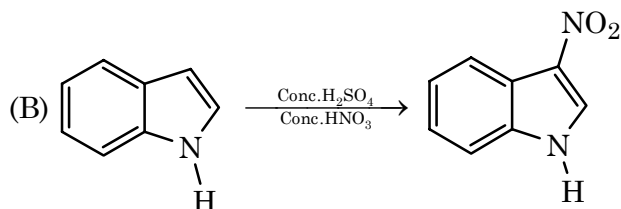
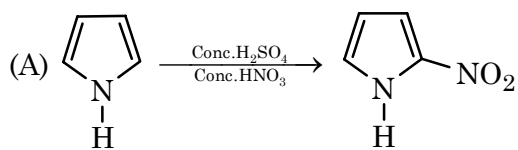
- This section contains **EIGHT** questions.
- Each question has **FOUR** options for correct answer(s). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct option(s).
- For each question, choose the correct option(s) to answer the question.
- Answer to each question will be evaluated according to the following marking scheme:
Full Marks : +4 If only (all) the correct option(s) is (are) chosen.
Partial Marks : +3 If all the four options are correct but **ONLY** three options are chosen.
Partial Marks : +2 If three or more options are correct but **ONLY** two options are chosen, both of which are correct options.
Partial Marks : +1 If two or more options are correct but **ONLY** one option is chosen and it is a correct option.
Zero Marks : 0 If none of the options is chosen (i.e. the question is unanswered).
Negative Marks : -1 In all other cases.
- **For Example** : If first, third and fourth are the **ONLY** three correct options for a question with second option being an incorrect option; selecting only all the three correct options will result in +4 marks. Selecting only two of the three correct options (e.g. the first and fourth options), without selecting any incorrect option (second option in this case), will result in +2 marks. Selecting only one of the three correct options (either first or third or fourth option), without selecting any incorrect option (second option in this case), will result in +1 marks. Selecting any incorrect option(s) (second option in this case), with or without selection of any correct option(s) will result in -1 marks.

5. Among the following **INCORRECT** with reference to MOT is/are.

Orbital overlapped	Properties
(A)  $2p_z$ $2p_z$ (along z-axis)	Gerade, LUMO of C_2
(B)  $3d_{xy}$ $3d_{xy}$ (along x-axis)	Gerade, σ -bond is formed
(C)  $2s$ $2s$ (along y-axis)	Ungerade, HOMO of Li_2
(D)  $2p_x$ $2p_x$ (along z-axis)	Ungerade, HOMO of B_2

Space for Rough Work

6. Which of the following reaction is/are correct ?



Space for Rough Work

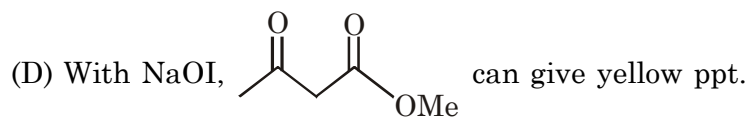
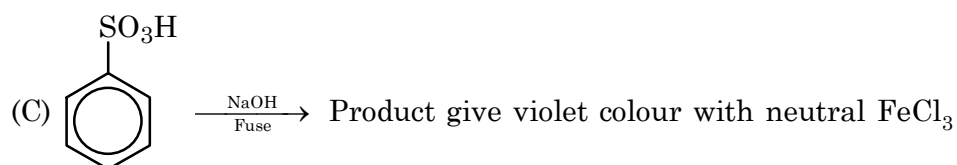
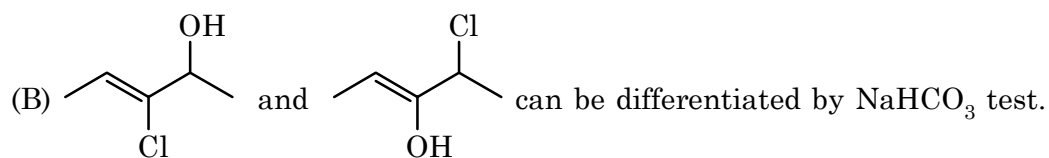
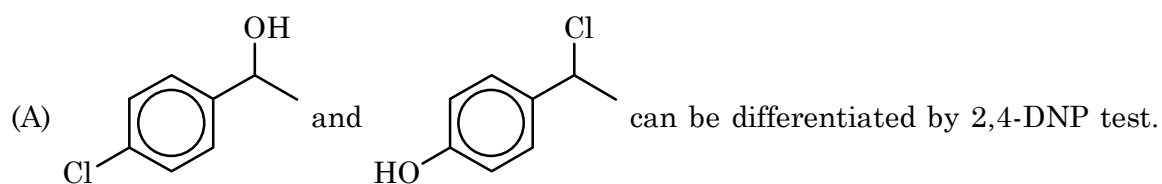
7. Which of the following statements is/are incorrect w.r.t enzyme catalysed reactions.
- (A) The cavities on enzyme "Maltase" & structure of molecules of Maltose have complimentary shapes for conversion of Maltase to glucose.
 - (B) Just like other catalysts, catalytic action of enzyme is more at a lower temperature.
 - (C) In presence of vitamins & metal ions; enzyme activity generally increases.
 - (D) Most of the enzyme catalysed reactions are elementary.
8. Which of the following option(s) represent the **INCORRECT** IUPAC name of the given co-ordination compounds ?
- (A) $\text{Li}[\text{CuMe}_2]$: Lithium dimethylcuprate(II).
 - (B) $[\text{Os}(\text{Et})(\text{NH}_3)_5]\text{Cl}$: Pentaammineethylosmium(II) chloride.
 - (C) $\text{K}_3[\text{Co}(\text{CN})_5\text{H}]$: Potassium pentacyanidoprotoniumcobaltate(I)
 - (D) $[\text{Co}(\text{en})_3]\text{Cl}_3$: Tris-(ethane-1,2-diammine)cobalt(III) chloride.

Space for Rough Work

9. Select correct options.
- (A) Meso tartaric acid is aldaric acid of L-erythrose
(B) D-Mannose & D-Galactose form same osazone
(C) D-Mannose & D-Galactose are epimers
(D) All monosaccharides are reducing sugars
10. Identify correct option(s) among following statements -
- (A) In Na_2O crystal oxide ion is present in a cubic void formed by Na^+ ions
(B) AgBr shows both schottky and frenkel defects
(C) Metals can conduct electricity in molten state
(D) $\text{Fe}_{0.95}\text{O}$ crystal can work as n-type semiconductor.
11. Select **CORRECT** "statement & reason" combinations
- | Statement | Correct reason |
|---|--|
| (A) Argentite ore is concentrated by froth floatation process. | Argentite is a sulphide ore. |
| (B) During calcination, the ore is heated well below its melting point in the limited supply of oxygen. | The process of calcination is carried out for sulphide ores only. |
| (C) Highly electropositive metals are extracted by electrolysis of their aq. salt solutions. | Highly electropositive metals cannot be reduced by chemical reduction using Carbon |
| (D) The process involved in the extraction of tin from tin stone is the carbon reduction | Reduction of cassiterite to metal by carbon is feasible at convenient temperature. |

Space for Rough Work

12. Select the incorrect options:



Space for Rough Work

SECTION-II : (Maximum Marks: 18)

- This section contains **SIX** questions.
- The answer to each question is a **NUMERICAL VALUE**.
- For each question, enter the correct numerical value (in decimal notation, truncated/rounded-off to the **second decimal place**; e.g. 6.25, 7.00, -0.33, -.30, 30.27, -127.30, if answer is 11.36777..... then both 11.36 and 11.37 will be correct) by darkening the corresponding bubbles in the ORS.

For Example : If answer is -77.25, 5.2 then fill the bubbles as follows.

+	●				
●	●	0	0	0	0
1	1	1	1	1	1
2	2	2	2	●	2
3	3	3	3	3	3
4	4	4	4	4	4
5	5	5	5	5	●
6	6	6	6	6	6
7	7	●	●	7	7
8	8	8	8	8	8
9	9	9	9	9	9

●	-				
●	●	●	0	0	●
1	1	1	1	1	1
2	2	2	2	●	2
3	3	3	3	3	3
4	4	4	4	4	4
5	5	5	●	5	5
6	6	6	6	6	6
7	7	7	7	7	7
8	8	8	8	8	8
9	9	9	9	9	9

- Answer to each question will be evaluated according to the following marking scheme:
Full Marks : +3 If **ONLY** the correct numerical value is entered as answer.
Zero Marks : 0 In all other cases.

- $$\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g}) \quad \Delta G_{f(\text{NH}_3)}^0 = -15.53 \text{ kJ/mole at } 300 \text{ K.}$$

If after 1 hour of mixing reactants, partial pressure of $\text{N}_2 = 50 \text{ Bar}$, $\text{H}_2 = 2 \text{ Bar}$, $\text{NH}_3 = 200 \text{ Bar}$ & $\Delta H_{\text{reaction}}$ is -4.2 kJ , find ΔS of reaction (in JK^{-1}).

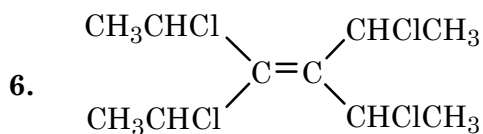
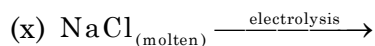
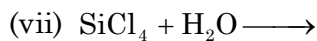
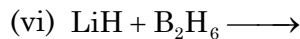
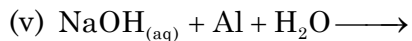
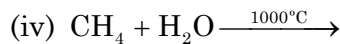
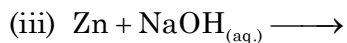
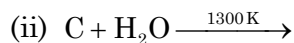
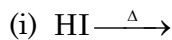
($\ln 10 = 2.3$, $R = \frac{25}{3} \text{ JK}^{-1} \text{ mol}^{-1}$).
- A solution of white crystals gives a precipitate with AgNO_3 but no precipitation with a solution of Na_2CO_3 . The action of concentrated H_2SO_4 on the crystals yields coloured fumes. Find the number of crystals given below which can give above observation :

NaI , KCl , NaNO_2 , NaBr , CH_3COONa
- An aldehyde (A) ($\text{C}_{11}\text{H}_8\text{O}$), which does not undergo self Aldol condensation, gives benzaldehyde and two moles of (B) on reductive ozonolysis. Compound (B) on oxidation with silver ion gives oxalic acid. (A) on reduction with Lindlar's catalyst produces (C), which reduces Tollen's reagent. How many geometrical isomers (C) can exhibit?

Space for Rough Work

4. The uncertainty in the position of an electron is equal to its de-Broglie wavelength. Find the minimum percentage error in measurement of its velocity under this circumstance.

5. How many of the following reactions produce H₂ gas as (one of the) product.



For above compound's

P → total number of stereoisomers.

Q → total number of enantiomeric pairs

R → total number of meso compounds

Then give your answer in 3 digit's as PQR

Space for Rough Work

PART-3 : MATHEMATICS

SECTION-I(i) : (Maximum Marks : 12)

- This section contains **FOUR** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is correct.
- For each question, darken the bubble corresponding to the correct option in the ORS.
- For each question, marks will be awarded in one of the following categories :
Full Marks : +3 If only the bubble corresponding to the correct option is darkened.
Zero Marks : 0 If none of the bubbles is darkened.
Negative Marks : -1 In all other cases

1. Suppose a, b denote the distinct real root of the quadratic polynomial $x^2 + 5x - 100 = 0$ and suppose c, d denote the distinct complex root of the polynomial $x^2 - 5x + 100 = 0$, then the value of $ac(a^2 + c^2) + bc(b^2 + c^2) + ad(a^2 + d^2) + bd(b^2 + d^2)$ is
 (A) 0 (B) -1250 (C) 15000 (D) 8125
2. If the function $f : \mathbb{R} \rightarrow \mathbb{R}$
 $f(x) = -(\sqrt{x^2} \sin x - x\sqrt{x^2})$, then which of following statement is true ?
 (A) f is one-one but not onto (B) f is one-one and onto
 (C) f is many one and onto (D) f is neither one-one nor onto
3. Let the function $f : \mathbb{R} \rightarrow \mathbb{R}$ and $g : \mathbb{R} \rightarrow \mathbb{R}$ be defined by $f(x) = e^x - e^{-|x|}$ and $g(x) = \frac{e^x + e^{-x}}{3}$ then the area bounded by the curves $y = f(x)$, $y = g(x)$ and $x = 0$ in the first quadrant is
 (A) $\frac{6\sqrt{2}}{3} - 2$ (B) $\frac{4\sqrt{2}}{3} + 2$ (C) $\frac{6\sqrt{2}}{3} + 2$ (D) $2 - \frac{4\sqrt{2}}{3}$
4. For the ellipse $\frac{x^2}{9} + \frac{y^2}{4} = 1$ with vertices A (3, 0) and A'(-3, 0), tangent drawn at the point P in the I quadrant meets the y-axis at Q and the chord A'P meet the y-axis at M. If O is the origin, then $OQ^2 - MQ^2$ equals to
 (A) 9 (B) 13 (C) 4 (D) 5

Space for Rough Work

SECTION-I(ii) : (Maximum Marks: 32)

- This section contains **EIGHT** questions.
- Each question has **FOUR** options for correct answer(s). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct option(s).
- For each question, choose the correct option(s) to answer the question.
- Answer to each question will be evaluated according to the following marking scheme:
Full Marks : +4 If only (all) the correct option(s) is (are) chosen.
Partial Marks : +3 If all the four options are correct but **ONLY** three options are chosen.
Partial Marks : +2 If three or more options are correct but **ONLY** two options are chosen, both of which are correct options.
Partial Marks : +1 If two or more options are correct but **ONLY** one option is chosen and it is a correct option.
Zero Marks : 0 If none of the options is chosen (i.e. the question is unanswered).
Negative Marks : -1 In all other cases.
- **For Example** : If first, third and fourth are the **ONLY** three correct options for a question with second option being an incorrect option; selecting only all the three correct options will result in +4 marks. Selecting only two of the three correct options (e.g. the first and fourth options), without selecting any incorrect option (second option in this case), will result in +2 marks. Selecting only one of the three correct options (either first or third or fourth option), without selecting any incorrect option (second option in this case), will result in +1 marks. Selecting any incorrect option(s) (second option in this case), with or without selection of any correct option(s) will result in -1 marks.

-
5. The probability of a man hitting a target in one fire is $\frac{1}{5}$. If N denotes the minimum number of fire required to make his chances of hitting a target more than $\frac{3}{4}$, then N + 2 is
(A) Odd number (B) Perfect square (C) Even number (D) Prime number
-

Space for Rough Work

6. Let $f(x) = \sin^2 x - \sin x + 2$, $x \in (0, \pi)$. Suppose f has local minimum at $x = \{k_1\pi, k_2\pi, \dots, k_n\pi\}$ where $0 < k_1 < k_2 < k_3 < \dots < k_n < 1$. If $N = k_1 + k_2 + \dots + k_n$, then which following options are incorrect.

(A) N is prime number

(B) N is composite number

(C) N is odd number

(D) N is even number

7. Let 'f' be a differentiable function satisfying $f(x + y) = f(x) + f(y) + (e^x - 1)(e^y - 1)$ $\forall x, y \in \mathbb{R}$ and $f'(0) = 2$. Identify the correct statement(s)

(A) $\lim_{x \rightarrow 0} \frac{f(f(x))}{f(x) - x} = 4$

(B) $\lim_{x \rightarrow 0} (f(x) + \cos x)^{\frac{1}{e^x - 1}} = e^2$

(C) Number of solutions of the equation $f(x) = 0$ is 2.

(D) Range of the function $y = f(x)$ is $(-\infty, \infty)$.

Space for Rough Work

8. If $A = \begin{bmatrix} u & 2 & -1 \\ -1 & 1 & 2 \\ 2 & -1 & 1 \end{bmatrix}$, where $u \neq -\frac{11}{3}$ and $\det(\text{adj}(\text{adj } A)) = 23^4$ then which of the following options can be TRUE?

(A) $|A| = 23$ (B) $|A| = -\sqrt{23}$ (C) $u = 4$ (D) $u = -4$

9. Let A be a subset of the real numbers such that $A = \{a \mid a = |z^2 + z - 1|\}$ in which z is a complex number such that $|z| = 1$, then

(A) Maximum possible value of a is 5 (B) Maximum possible value of a is $\sqrt{5}$

(C) Minimum possible value of a is 1 (D) Minimum possible value of a is $\sqrt{2}$

10. Suppose x, y, z are the length of side of a triangle opposite to it angles X, Y and Z respectively if

$$\tan X + \tan Y = \frac{-2}{\sqrt{3}}$$

$$\tan Y + \tan Z = \frac{2}{\sqrt{3}} \text{ and } x = 2\sqrt{3}$$

then which of the following statement is/are true?

(A) $X = Y + Z$ (B) $X = 2(Y + Z)$

(C) $\tan \frac{X}{2} = \frac{2x}{y+z}$ (D) In radius of ΔXYZ is $\frac{\sqrt{3}}{(2+\sqrt{3})}$

Space for Rough Work

11. $(1, 0, -1)$ is the image of point (p, q, r) w.r.t. plane $x + y = 3$. Then which of the following statements is/are true.

(A) $|p| + |q| + |r| = 6$

(B) $p + q + 5r = 0$

(C) $p - q + r = 0$

(D) $p = 2$

12. Which of the following is/are true

(A) $\int_0^1 x \tan x \, dx \geq \frac{2}{5}$

(B) $\int_0^1 x^2 \tan x \, dx \leq \frac{11}{36}$

(C) $\int_0^1 x^2 \tan x \, dx \geq \frac{11}{36}$

(D) $\int_0^1 x \tan x \, dx \leq \frac{2}{5}$

Space for Rough Work

SECTION-II : (Maximum Marks: 18)

- This section contains **SIX** questions.
- The answer to each question is a **NUMERICAL VALUE**.
- For each question, enter the correct numerical value (in decimal notation, truncated/rounded-off to the **second decimal place**; e.g. 6.25, 7.00, -0.33, -.30, 30.27, -127.30, if answer is 11.36777..... then both 11.36 and 11.37 will be correct) by darkening the corresponding bubbles in the ORS.

For Example : If answer is -77.25, 5.2 then fill the bubbles as follows.

+	●				
●	●	0	0	0	0
1	1	1	1	1	1
2	2	2	2	●	2
3	3	3	3	3	3
4	4	4	4	4	4
5	5	5	5	5	●
6	6	6	6	6	6
7	7	●	●	7	7
8	8	8	8	8	8
9	9	9	9	9	9

●	-				
●	●	●	0	0	●
1	1	1	1	1	1
2	2	2	2	●	2
3	3	3	3	3	3
4	4	4	4	4	4
5	5	5	●	5	5
6	6	6	6	6	6
7	7	7	7	7	7
8	8	8	8	8	8
9	9	9	9	9	9

- Answer to each question will be evaluated according to the following marking scheme:
Full Marks : +3 If **ONLY** the correct numerical value is entered as answer.
Zero Marks : 0 In all other cases.

- Let N be the maximum value of $(\log_4 p_1 + \log_4 p_2 + \log_4 p_3 + \log_4 p_4)$ where $p_1, p_2, p_3, p_4 \in \mathbb{R}^+$. Also $p_1 + p_2 + p_3 + p_4 = 16$. Find the value of $\log_2 N^2$.
- If $\{x_n\}$ is a sequence of numbers $\forall n \in \mathbb{N}$ such that

$$x_{n+1} = \frac{x_n + x_n^2}{1 + x_n + x_n^2} \quad \& \quad x_1 = \frac{1}{2}$$

$$\text{and } N = \frac{1}{x_1 + 1} + \frac{1}{x_2 + 1} + \dots + \frac{1}{x_{2012} + 1} + \frac{1}{x_{2013}}$$

Then sum of digits of N is equal to

- Find the number of solutions of θ in $(0, 2\pi)$ that satisfy the equation

$$\frac{1}{\sin^2 \theta} - \frac{1}{\cos^2 \theta} - \frac{1}{\tan^2 \theta} - \frac{1}{\cot^2 \theta} - \frac{1}{\sec^2 \theta} - \frac{1}{\operatorname{cosec}^2 \theta} = -3$$

Space for Rough Work

4. In a ΔABC , $AB = 4$, $AC = 5$, O is circumcenter of ΔABC . Find the value of $2\overline{AO} \cdot \overline{BC}$?
5. Let $f : [0, 2] \rightarrow \mathbb{R}$ be the function defined by

$$f(x) = (3 - \sin(2\pi x)) \sin\left(\pi x - \frac{\pi}{4}\right) - \sin\left(3\pi x + \frac{\pi}{4}\right)$$

If $\alpha, \beta \in [0, 2]$ are such that $\{x \in [0, 2] : f(x) \geq 0\} = [\alpha, \beta]$, then the value of $\beta - \alpha$ is _____

6. The value of limit

$$\lim_{x \rightarrow 0} \frac{\sin(3x+a) - 3\sin(2x+a) + 3\sin(x+a) - \sin a}{x^3} \text{ is } -\cos\left(\frac{3a}{\lambda}\right). \text{ Then value of } \lambda \text{ is (where } \lambda \in \mathbb{N}\text{)}$$

Space for Rough Work

Space for Rough Work

QUESTION PAPER FORMAT AND MARKING SCHEME :

16. The question paper has three parts : Physics, Chemistry and Mathematics.
 17. Each part has two sections as detailed in the following table.

Section	Que. Type	No. of Que.	Category-wise Marks for Each Question				Maximum Marks of the section
			Full Marks	Partial Marks	Zero Marks	Negative Marks	
I(i)	Single correct option	4	+3 If only the bubble corresponding to the correct option is darkened	—	0 If none of the bubbles is darkened	-1 In all other cases	12
I(ii)	One or more correct option(s)	8	+4 If only the bubble(s) corresponding to all the correct option(s) is(are) darkened	+1 For darkening a bubble corresponding to each correct option, provided NO incorrect option darkened	0 If none of the bubbles is darkened	-1 In all other cases	32
II	Numerical Value Type (Up to second decimal place)	6	+3 If only the bubble corresponding to correct answer is darkened	—	0 In all other cases	—	18

NAME OF THE CANDIDATE	
FORM NO.	
I have read all the instructions and shall abide by them. <hr style="width: 80%; margin-left: auto; margin-right: auto;"/> Signature of the Candidate	I have verified the identity, name and Form number of the candidate, and that question paper and ORS codes are the same. <hr style="width: 80%; margin-left: auto; margin-right: auto;"/> Signature of the Invigilator