

Mock Advanced Test-4 Paper-1

TIME : 3 hrs

M.M. : 264

Read the following Instructions very carefully before you proceed.

A. General

1. This booklet is your Question Paper. Do not break the seals of this booklet before being instructed to do so by the invigilators.
2. Blank papers, clipboards, log tables, slide rules, calculators, cameras, cellular phones, pagers, and electronic gadgets are NOT allowed inside the examination hall.
3. **Using a black ball point pen, darken the bubbles on the upper original sheet.** Apply sufficient pressure so that the impression is created on the bottom sheet.
4. DO NOT TAMPER WITH/MUTILATE THE OMR OR THE BOOKLET.
5. Read carefully the Instructions printed at the beginning of each section.

B. Filling the Right Part of the OMR

6. For answering a question, an ANSWER SHEET (OMR SHEET) is provided separately. Please fill your **Test Code, Roll No.** and **Group** properly in the space given in the ANSWER SHEET.

C. Question Paper Format :

The question paper consists of **3 Subjects** (Physics, Chemistry and Mathematics). Each subject consists of three sections i.e., Section I, II & III.

7. **Section I** contains 10 Multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which **ONE OR MORE** choices may be correct.
8. **Section-II** contains 8 questions. The answer to each question is a Single Digit Integer, ranging from 0 to 9 (both inclusive).
9. **Section-III** contains **2 Match the following Objective type Questions**. Each question contains statements given in 2 columns. Statements in the column I have to be matched with statements in column II and then option with the appropriate code is to be marked in the answer sheet. **The options for the correct match are provided as (A), (B), (C) and (D) out of which ONE OR MORE CHOICE may be correct.**

D. Marking Scheme :

10. **Section-I** : For each question, you will be awarded **4 marks** if you darken ALL the bubble(s) corresponding to the correct answer(s) ONLY and zero marks If no bubbles are darkened. In all other cases, **minus one (-2) mark will be awarded in this section.**
11. **Section-II** : For each question, you will be awarded **4 marks** if you darken the bubble corresponding to the correct answer ONLY and zero marks If no bubbles are darkened. **No negative marks will be awarded for incorrect answers in this section.**

12. **Section-III** : For each question, you will be given **2 Marks** if you have darkened only the bubble corresponding to the correct answer and zero mark if no bubble is darkened. In all other cases, **minus one (-1) mark (NEGATIVE MARKING)** will be given.

PART - I (PHYSICS)

88 MARKS

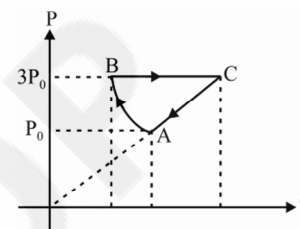
SECTION - I

MULTIPLE CORRECT ANSWERS

This section contains **10 Multiple Choice Questions**. Each Question has **4 choices A, B, C & D**, out of which **ONE or MORE Choices may be Correct**:

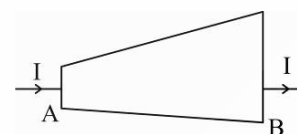
1. One mole of monoatomic gas is taken through cyclic process shown below. $T_A = 300\text{ K}$. Process AB is defined as $PT = \text{constant}$.

- (A) Work done in process AB is -400 R .
 (B) Change in internal energy in process CA is 900 R .
 (C) Heat transferred in the process BC is 2000 R .
 (D) Change in internal energy in process CA is -900 R .

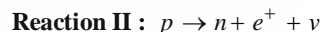
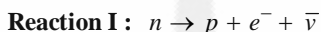


2. In the figure a conductor of non-uniform cross-section is shown. A steady current I flows in it.

- (A) The electric field at A is more than at B
 (B) The electric field at B is more than at A
 (C) The thermal power generated at A is more than at B in an element of small width
 (D) The thermal power generated at B is more than at A in an element of small width



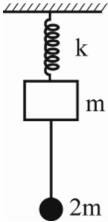
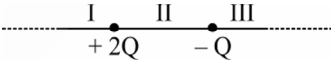
3. Consider the following nuclear reactions and select the correct statements from the options that follow.



- (A) Free neutron is unstable, therefore reaction I is possible
 (B) Free proton is stable, therefore reaction II is not possible
 (C) Inside a nucleus, both decays (reaction I and II) are possible
 (D) Inside a nucleus, reaction I is not possible but reaction II is possible.
4. A student performs an experiment to determine the Young's modulus of a wire, exactly 2 m long, by Searle's method. In a particular reading, the student measures the extension in the length of the wire to be 0.8 mm with an uncertainty of $\pm 0.05\text{ mm}$ at a load of exactly 1.0 kg . The student also measures the diameter of the wire to be 0.8 mm with an uncertainty of $\pm 0.01\text{ mm}$. Take $g = 9.8\text{ m/s}^2$ (exact). The cross sectional area A and Young's modulus Y of the wire obtained from the reading is :

- (A) $A = (5.0 \pm 0.12) \times 10^{-7}\text{ m}^2$ (B) $Y = (4.9 \pm 0.4) \times 10^{10}\text{ N/m}^2$
 (C) $A = (1.3 \pm 0.06) \times 10^{-7}\text{ m}^2$ (D) $Y = (1.9 \pm 0.2) \times 10^{11}\text{ N/m}^2$

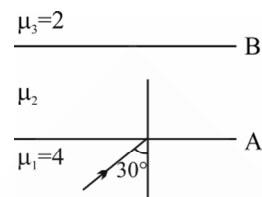
SPACE FOR ROUGH WORK

5. Which of the following dimensions are correctly matched ? (q = temperature)
- (A) Angular momentum : $M^1 L^2 T^{-2}$ (B) Torque : $M^1 L^2 T^{-2}$
 (C) Stefan's constant : $M^1 T^{-3} q^{-4}$ (D) Planck's constant : $M^1 L^2 T^{-2}$
6. A bob of mass $2m$ hangs by a string attached to the block of mass m of a spring block system. The whole arrangement is in a state of equilibrium. The bob of mass $2m$ is pulled down slowly by a distance x_0 and released.
- (A) For $x_0 = \frac{3mg}{k}$ maximum tension in string is $4mg$
 (B) For $x_0 > \frac{3mg}{k}$, minimum tension in string is mg
 (C) Frequency of oscillation of system is $\frac{1}{2\pi} \sqrt{\frac{k}{3m}}$, for all non-zero values of x_0
 (D) The motion will remain simple harmonic for $x_0 \leq \frac{3mg}{k}$
- 
7. A thin uniform rod of mass m and length l is free to rotate about its upper end. When it is at rest, it receives an impulse J as its lowest point, normal to its length. Immediately, after impact :
- (A) the angular momentum of rod about its centre of mass is Jl .
 (B) the angular velocity of rod is $\frac{3J}{ml}$
 (C) the kinetic energy of rod is $\frac{3J^2}{2m}$
 (D) the linear velocity of mid point of rod is $\frac{3J}{2m}$
8. The figure shows, two point charges $q_1 = 2Q (> 0)$ and $q_2 = -Q$. The charges divide the line joining them in three parts I, II and III :
- 
- (A) Region III has a local maxima of electric field
 (B) Region I has a local minima of electric field
 (C) Equilibrium position for a test charge lies in region II
 (D) The equilibrium for constrained motion along the line joining the charges is stable for a negative test charge

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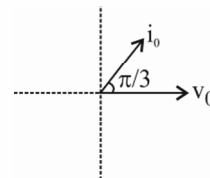
9. A light ray is incident on lower medium boundary at an angle 30° with the normal. Which of the following statement is/are true?

- (A) If $\mu_2 > 2$ then total deviation is 60°
- (B) If $\mu_2 < 2$ then total deviation is 60°
- (C) If $\mu_2 > 2$ then total deviation is 120°
- (D) If $\mu_2 < 2$ then total deviation is 120°



10. For an LCR series circuit phasors of current i and applied voltage $v = v_0 \sin \omega t$ are shown in diagram at $t = 0$. Which of the following is(are) correct ?

- (A) At $t = \frac{\pi}{2\omega}$, instantaneous power supplied by source is negative.
- (B) From $t > 0$ to $t < \frac{2\pi}{3\omega}$ average power supplied by source is positive.
- (C) At $t = \frac{5\pi}{6\omega}$, instantaneous power supplied by source is negative.
- (D) If ω is increased slightly, angle between the two phasors decreases.



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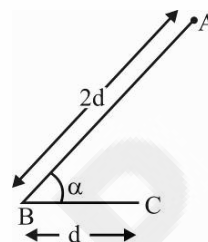
SECTION - II

SINGLE INTEGER VALUE CORRECT TYPE

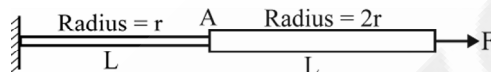
This section contains 8 single Integer Value Correct type Questions. Each question has an integer answer between 0 and 9. Fill the answer bubbles in the OMR Sheet APPROPRIATELY and CAREFULLY.

1. A satellite is moving in a circular orbit around the earth. The total energy of the satellite is $E = -2 \times 10^5 J$. If the amount of energy to be imparted to the satellite to transfer it to a circular orbit where its potential energy is $U = -2 \times 10^5 J$ is equal to $E \cdot 10^5 J$, then find E .

2. A uniform iron ribbon of mass $3m$ and length $3d$ is bent at B as shown and placed on a horizontal table in vertical plane. Side BC is in contact with table. A fly of mass m is sitting at point A . What is the value of $8 \cos \alpha$ at which the ribbon is just about to topple ?



3. Two steel wires of same length but radii r and $2r$ are connected together end to end and tied to a wall as shown.

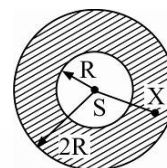


The force stretches the combination by 10 mm . How far does the midpoint A move. (in mm)

4. Determine the number of lines in Paschen series which have a wavelength greater than 1000 nm .
5. In a Young's double slit experiment a light of wavelength $\lambda = 5000 \text{ \AA}$ is used. When a thin film of transparent material is put behind one of the slits the central bright fringe moves to the position previously occupied by the 4th order bright fringe. The refractive index of film is $n = 1.2$. If thickness of film is $x \cdot 10^{-5} \text{ m}$, then find x .
6. When the gap between two identical equi-concave thin lens ($\mu = 3/2, f = 10 \text{ cm}$) placed in contact is filled with certain liquid, the image of an object placed at 15 cm from lens combination shifts away from the lens by $5/4 \text{ cm}$, when there was no liquid between them. If the refractive index of the liquid is μ , write 3μ as your answer?

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7. As shown in figure, there is an isolated thick spherical shell with the walls coated with lamp black. A point source which generates thermal energy at a constant rate P is placed at the center of the shell.



Derive an expression for the temperature T at point X in steady state, where $SX = 1.5R$. Your expression would be as follows $T = \left(\frac{P}{\sigma 16\pi R^2} \right)^{1/4} + \left(\frac{P}{3a\pi KR} \right)$ Here K is the coefficient of thermal conductivity of material of shell and σ is Stefan's constant. Find the value of a .

8. Assuming that a particle has the form of a sphere and that it absorbs all the incident light, find the radius (in $10^{-5}m$) of a particle for which its gravitational attraction to the Sun is counterbalanced by the force that light exerts on it. The power of light radiated by the Sun equals $P = 4 \times 10^{26}W$ and the density of the particle is $\rho = 1.0 g/cm^3$. Use $G = \frac{20}{3} \times 10^{-11} Nm^2/kg^2$, $\pi = \frac{25}{8}$ and mass of the Sun $= 2 \times 10^{30} kg$.

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SECTION - III
MATRIX MATCH TYPE

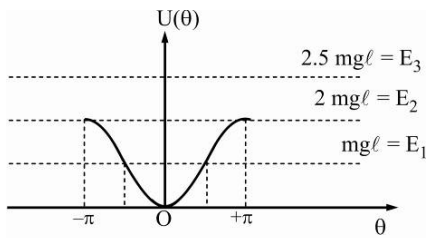
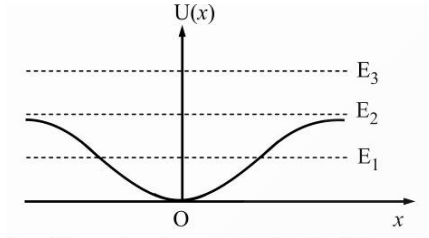
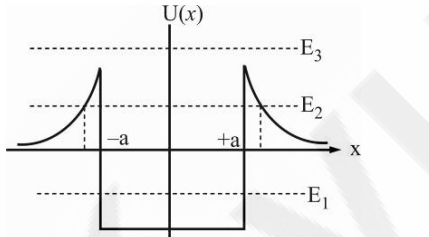
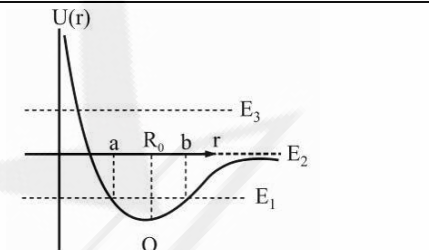
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1. Some laws/processes are given in **Column I**. Match these with the physical phenomena given in **Column II** and indicate your answer by darkening appropriate bubbles in the 4×4 matrix given in the OMR.

Column I		Column 2	
(A)	Transition between two atomic energy levels	(p)	Characteristic X-rays
(B)	Electron emission from a material	(q)	Photoelectric effect
(C)	Mosley's law	(r)	Hydrogen spectrum
(D)	Change of photon energy into kinetic energy of electrons	(s)	β -decay

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2. Column I represents potential energy graph for certain system. Column II gives statements related to graphs.

Column I		Column II	
(A)	 <p>U vs θ graph for a bob hanging vertically from a string with its lowest position as reference level and q is angle of string from vertical line</p>	(p)	If total energy is E_3 , it is not possible for the body to have any turning point in its motion.
(B)	 <p>A particle moving along x-axis with potential energy function as $U(x) = [1 - e^{x^2}]$</p>	(q)	For a small displacement about point O potential energy function is quadratic in variable plotted on x-axis.
(C)	 <p>Potential energy function of a particle in an arbitrary force field</p>	(r)	For a small displacement about position O motion is simple harmonic.
(D)	 <p>Graph represents potential energy for a particle</p>	(s)	If total energy is $E_{total} < E_2$ particle executes periodic and oscillatory motion for all energy values greater than energy at O.
		(t)	Point O is position of stable equilibrium

SPACE FOR ROUGH WORK

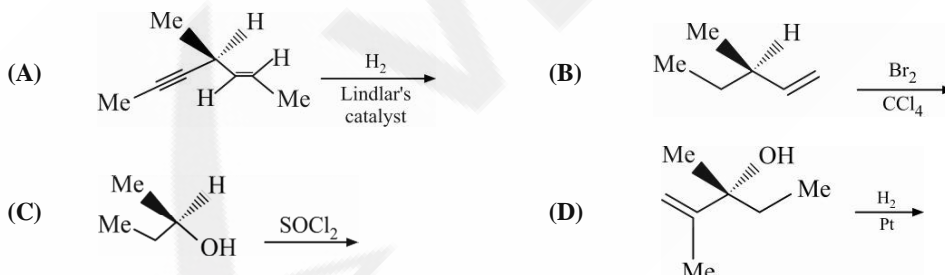
SECTION - I

MULTIPLE CORRECT ANSWERS

This section contains 10 Multiple Choice Questions. Each Question has 4 choices A, B, C & D, out of which ONE or MORE Choices may be Correct:

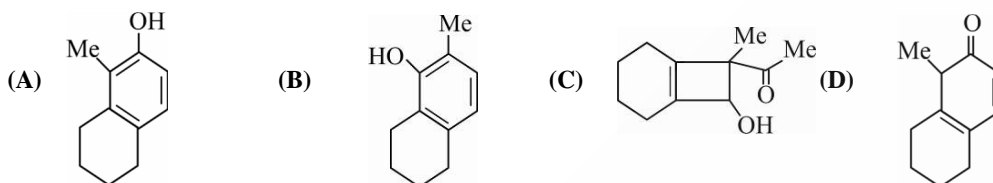
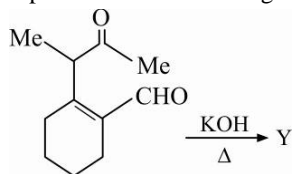
- Fe^{3+} is reduced to Fe^{2+} by using :
 (A) H_2S (B) $\text{SO}_2(\text{aq})$ (C) SnCl_2 (D) KI
- Which of the following will increase % yield of ammonia in the reaction

$$\text{N}_{2(\text{g})} + 3\text{H}_{2(\text{g})} \rightleftharpoons 2\text{NH}_{3(\text{g})}, \Delta H < 0$$
 taking place at 200 atm and 700 K ?
 (A) high pressure
 (B) presence of iron oxide with small amounts of K_2O and Al_2O_3 as catalyst
 (C) Removal of ammonia in liquid form
 (D) Increasing temperature
- The unit cell of a mineral has oxide ions on face centres and barium ions on corners of cubic unit cell. If titanium ion is present at body centre void of this unit cell then identify correct statement(s).
 (A) Unit cell has cubic close packed (ccp) array of oxide ions and barium ions
 (B) Titanium ions occupy 1/4 of octahedral voids
 (C) Oxidation state of titanium ion is +4
 (D) Titanium ions can't occupy edge centre voids
- Identify the reaction(s) that produce optically active compound.

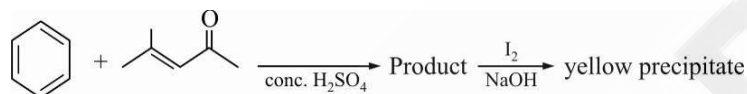


SPACE FOR ROUGH WORK

5. The major product of the following reaction is :



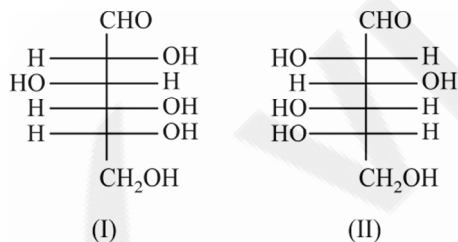
6. Which of the following is(are) correct for following reaction ?



- (A) It involve electrophilic substitution reaction
 (B) It involve nucleophilic conjugate addition reaction



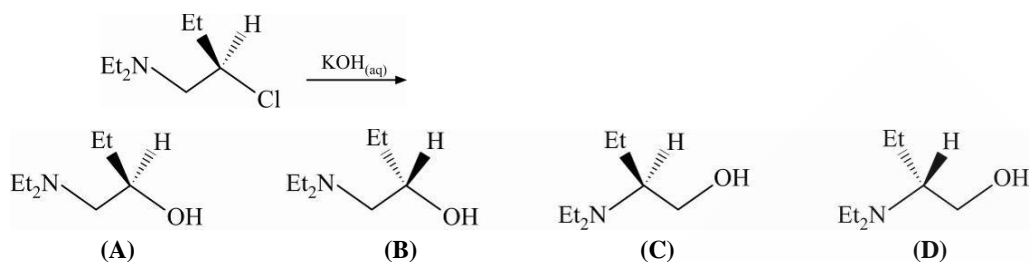
7. Which of the following is(are) correct for structure (I) and (II) ?



- (A) Both exist in two anomeric forms
 (B) Both form same osazone on reaction with excess of phenyl hydrazine
 (C) Both form pentaacetate on reaction with excess of CH_3COCl
 (D) Structure (I) is D-(+)-glucose while structure (II) is L-(-)-glucose

SPACE FOR ROUGH WORK

8. The major product of the reaction is :



9. Chemisorption is :

- (A) Highly specific
 (B) Irreversible
 (C) Increases with increase in surface area of the adsorbent
 (D) Highly exothermic compared to physisorption

10. Which of the following reaction(s) takes place during extraction of iron from haematite in blast furnace ?

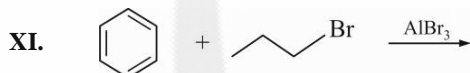
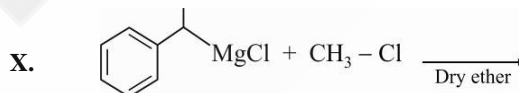
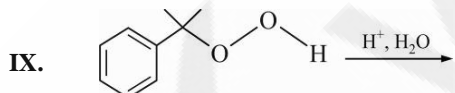
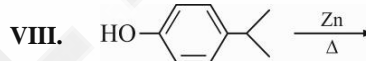
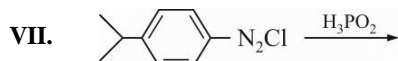
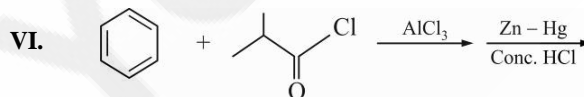
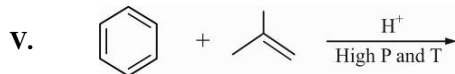
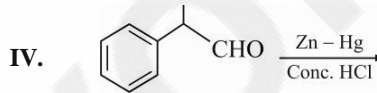
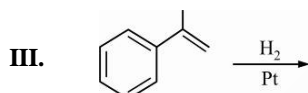
- (A) $3\text{Fe}_2\text{O}_3 + \text{CO} \longrightarrow 2\text{Fe}_3\text{O}_4 + \text{CO}_2$ (B) $\text{Fe}_3\text{O}_4 + 4\text{CO} \longrightarrow 3\text{Fe} + 4\text{CO}_2$
 (C) $\text{Fe}_2\text{O}_3 + \text{CO} \longrightarrow 2\text{FeO} + \text{CO}_2$ (D) $\text{FeO} + \text{C} \longrightarrow \text{Fe} + \text{CO}$

SPACE FOR ROUGH WORK

SECTION - II
SINGLE INTEGER VALUE CORRECT TYPE

This section contains 8 single Integer Value Correct type Questions. Each question has an integer answer between 0 and 9. Fill the answer bubbles in the OMR Sheet APPROPRIATELY and CAREFULLY.

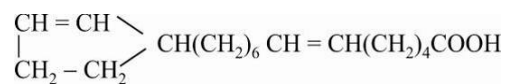
- The total number of bond pairs of electrons in gaseous N_2O_5 is _____.
- For coordination number four complex of Pd^{2+} in Cl^- and CN^- ligand environments, the difference between the spin only magnetic moments in Bohr magneton is _____. [Atomic number Pd = 48]
- Among the triatomic molecules/ions $BeCl_2$, N_3^- , N_2O , O_3 , SCl_2 , ICl_2^- , I_3^- , SCN^- , H_2O , ClO_2 , OF_2 the total number of molecules/ion(s) having non-zero value of resultant dipole moment is _____.
- Among of the following reaction, the number of reaction(s) that produce(s) cumene is _____.



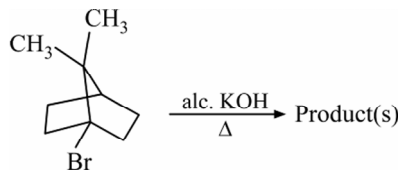
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5. For octahedral complex $\text{CrCl}_3 \cdot x\text{NH}_3$, elevation in boiling point of one molal solution is double of one molal urea solution, hence x is _____. (Complex is 100% ionised)

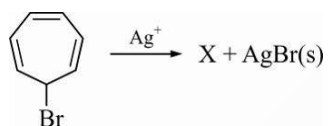
6. How many stereoisomers are possible for Goric acid ($\text{C}_{18}\text{H}_{30}\text{O}_2$) ?



7. The total number of isomeric products that can be formed in following reaction is _____.



8. How many equivalent resonating structures are possible for X ?



SPACE FOR ROUGH WORK

SECTION - III
MATRIX MATCH TYPE

This section contains 2 questions. Each question contains statements given in two columns which have to be matched. Statements in Column 1 are labelled as (A), (B), (C) & (D) whereas statements in Column 2 are labeled as p, q, r, s & t. The answers to these questions have to be appropriately bubbled. More than one choice from Column 2 can be matched with Column 1.

1. **MATCH THE COLUMN :**

	Column 1		Column 2
(A)	$\text{Fe}_{0.95}\text{O}$	(p)	Metal deficiency defect
(B)	Fe_3O_4	(q)	Metal in +2 and +3 oxidation state
(C)	CrO_2	(r)	Electrical properties like metal or insulator depending on temperature
(D)	VO_2	(s)	Metal in +4 oxidation state
		(t)	Ferromagnetism

2. **MATCH THE COLUMN :**

	Column 1		Column 2
(A)	$\text{ZnSO}_4 \cdot 7 \text{H}_2\text{O}$	(p)	Co-ordinated water
(B)	$\text{CuSO}_4 \cdot 5 \text{H}_2\text{O}$	(q)	Green
(C)	$\text{FeSO}_4 \cdot 7 \text{H}_2\text{O}$	(r)	Blue
(D)	$\text{CaSO}_4 \cdot 2 \text{H}_2\text{O}$	(s)	White precipitate with BaCl_2 (aq)
		(t)	Form two oxides of sulphur on heating strongly

SPACE FOR ROUGH WORK

SECTION - I

MULTIPLE CORRECT ANSWERS

This section contains 10 Multiple Choice Questions. Each Question has 4 choices A, B, C & D, out of which ONE or MORE Choices may be Correct:

1. Let $f(x) = \begin{cases} x+a, & x < 0 \\ x-1, & x \geq 0 \end{cases}$ and $g(x) = \begin{cases} x+1, & x < 0 \\ (x-1)^2 + b, & x \geq 0 \end{cases}$ where a and b are non negative numbers. If $g \circ f(x)$ is continuous for all real x , where $g \circ f(x)$ denote $g(f(x))$, then which of the following is(are) true ?
- (A) For $x \in (-1, 1)$ $g \circ f(x)$ is even function (B) $g \circ f(x)$ differentiable at $x = 2$
- (C) $g \circ f(x)$ is differentiable at $x = -1$ (D) $(g \circ f)'(5) = 6$
2. Consider $f(x) = \begin{cases} \cos x & 0 \leq x < \frac{\pi}{2} \\ \left(\frac{\pi}{2} - x\right)^2 & \frac{\pi}{2} \leq x < \pi \end{cases}$
- Such that $f(x)$ is periodic with period π , then :
- (A) The range of $f(x)$ is $\left[0, \frac{\pi^2}{4}\right]$
- (B) $f(x)$ is continuous for all real x , but not differentiable for some real x
- (C) $f(x)$ is continuous for all real x
- (D) The real bounded by $y = f(x)$ and the x axis from $x = -n\pi$ to $x = n\pi$ is $2n \left(1 + \frac{\pi^3}{24}\right)$ for given $n \in \mathbb{N}$
3. \vec{a}, \vec{b} are vectors with magnitudes $\sqrt{3}$ and $\sqrt{2}$ respectively \vec{r} is a unit vector such that $\vec{r} \times \vec{a} = \vec{b}$, then :
- (A) $\vec{a} \cdot \vec{r} = 1$ or -1 (B) $\vec{a} \cdot \vec{r} = 2$ (C) $\vec{r} = \frac{1}{3}(\pm \vec{a} - \vec{b} \times \vec{a})$ (D) $\vec{r} = \frac{1}{2}(\pm \vec{a} + \vec{a} \times \vec{b})$
4. If A and B are respectively symmetric and skew symmetric matrices such that $AB = BA$ then :
- (A) $(A - B)^{-1} (A + B)$ is orthogonal matrix when $(A - B)$ and $(A + B)$ are non-singular.
- (B) $(A + B)^{-1} (A - B)$ is orthogonal matrix when $(A + B)$ is non singular
- (C) $\det \left((A - B)^{-1} (A + B) \right) = 1$ and $\det \left((A + B)^{-1} (A - B) \right) = -1$
- (D) $\det \left((A - B)^{-1} (A + B) \right) = -1$ and $\det \left((A + B)^{-1} (A - B) \right) = 1$

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5. If $x \in \mathbb{N}$ and ${}^x C_i$, ${}^{x^2} C_i$ and ${}^{x^3} C_i$ ($i = 1, 2, 3$) are binomial coefficients then $12 \begin{vmatrix} {}^x C_1 & {}^x C_2 & {}^x C_3 \\ {}^{x^2} C_1 & {}^{x^2} C_2 & {}^{x^2} C_3 \\ {}^{x^3} C_1 & {}^{x^3} C_2 & {}^{x^3} C_3 \end{vmatrix}$ is divisible by :
- (A) x^3 (B) x^6 (C) x^9 (D) x^{12}
6. If the distance of the point $P(1, -2, 1)$ from the plane $x + 2y - 2z = \alpha$ is 5, then the foot of the perpendicular from P to the plane is
- (A) $\left(\frac{8}{3}, \frac{4}{3}, \frac{-7}{3}\right)$ (B) $\left(-\frac{7}{3}, \frac{4}{3}, \frac{8}{3}\right)$ (C) $\left(\frac{-2}{3}, \frac{-16}{3}, \frac{13}{3}\right)$ (D) $\left(\frac{13}{3}, \frac{-16}{3}, \frac{-2}{3}\right)$
7. In \mathbb{R}^3 , let λ be a straight line passing through $(1, 1, 1)$. Suppose that all the points on L are at a constant distance from the two planes $P_1: 2x - 3y + z - 5 = 0$ and $P_2: x + 2y - 3z + 5 = 0$. Let M be the locus of the image of the points on L about plane P_2 then which of the following points lie(s) on M ?
- (A) $\left(\frac{2}{7}, \frac{-3}{7}, \frac{22}{7}\right)$ (B) $\left(\frac{5}{7}, 0, \frac{25}{7}\right)$ (C) $\left(0, \frac{-5}{7}, \frac{-22}{7}\right)$ (D) $\left(\frac{-20}{7}, \frac{25}{7}, 0\right)$
8. Tangent is drawn at any point (x_1, y_1) other than vertex on the parabola $y^2 = 4ax$. If tangents are drawn from any point on this tangent to the circle $x^2 + y^2 = a^2$ such that all the chords of contact pass through a fixed point (x_2, y_2) then :
- (A) x_1, a, x_2 are in G.P. (B) $\frac{y_1}{2}, a, y_2$ are in G.P.
- (C) $-4, \frac{y_1}{y_2}, \frac{x_1}{x_2}$ are in G.P. (D) $x_1 x_2 + y_1 y_2 = a^2$

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9. A differentiable function satisfies $f(x) = \int_0^x (f(t)\cos t - \cos(t-x)) dt$. Which of the following is(are) true ?
- (A) $f(x)$ has minimum value $1 - e$ (B) $f(x)$ has maximum value $1 - e^{-1}$
- (C) $f''\left(\frac{\pi}{2}\right) = e$ (D) $f'(0) = 1$

10. The differential equation of all the conics touching the y -axis at the origin and having their centres on the x -axis is: $P \frac{d^2y}{dx^2} + Q \frac{dy}{dx} + y^2 = 0$.

Where P and Q are functions of x, y and $\frac{dy}{dx}$, then which of the following statements is(are) true?

- (A) $P = xy^2$ (B) $P = x^2y$
- (C) $P + Q = x^2y + x^2 \frac{dy}{dx} - 2xy$ (D) $P - Q = xy^2 - x^2 \frac{dy}{dx} - 2xy$

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SECTION - II
SINGLE INTEGER VALUE CORRECT TYPE

This section contains 8 single Integer Value Correct type Questions. Each question has an integer answer between 0 and 9. Fill the answer bubbles in the OMR Sheet APPROPRIATELY and CAREFULLY.

1. A best of 9 game series is to be played between two teams A and B (i.e. the first team to win 5 games is the winner. Team A wins any given game with probability $\frac{2}{3}$. If the winner is decided in exactly 7 games and the chance that team A will be winner is p , then find the sum of the series $p + p^2 + p^3 + \dots \infty$. [No game results in a tie]
2. There are 10 intermediate stations on a railway line from one terminal to another. A train has to stop at 3 of these intermediate stations. If n represents the no. of ways in which this can be done if all the three stations are consecutive and m represents that no two of these stations are consecutive, then find $\frac{m}{n}$.
3. The radius of circle which passes through the focus of parabola $x^2 = 4y$ and touches it at point $(6, 9)$ is $k\sqrt{10}$, find k .
4. Find $\frac{1}{144\sqrt{3}} \left(\frac{\int_0^1 \frac{x^{5/2} (1-x)^{7/2}}{12} dx}{\int_0^1 \frac{x^{5/2} (1-x)^{7/2}}{(3+x)^8} dx} \right)$
5. In a triangle ABC , $AB = AC$ and the length of median from B to the side AC is ℓ . Find $10\cos A$ for which the area of triangle ABC is maximum.
6. The minimum area bounded by the function $y = f(x)$ and $y = \alpha x + 9$ ($\alpha \in R$) where f satisfies the relation $f(x+y) = f(x) + f(y) + y\sqrt{f(x)} \forall x, y \in R$ and $f'(0) = 0$ is $9A$, value of 'A' is _____.
7. Find the number of distinct solutions of the equation $\sin^2 x + \frac{1}{4} \sin^2 3x = \sin x \sin^2 3x$ in $x \in [0, \pi]$.
8. A normal is drawn to the parabola $y^2 = 9x$ at the point $P(4, 6)$. A circle is described on SP as diameter ; where S is the focus. If the length of the intercept made by the circle on the normal at point P is ℓ , then find $[\ell]$. (where $[.]$ represents greatest integer function).

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SECTION - III
MATRIX MATCH TYPE

This section contains 2 questions. Each question contains statements given in two columns which have to be matched. Statements in Column 1 are labelled as (A), (B), (C) & (D) whereas statements in Column 2 are labeled as p, q, r, s & t. The answers to these questions have to be appropriately bubbled. More than one choice from Column 2 can be matched with Column 1.

1. MATCH THE FOLLOWING:

	Column 1		Column 2
(A)	\vec{a} and \vec{c} are unit vectors and $ \vec{b} = 4$ with $\vec{a} \times \vec{b} = 2\vec{a} \times \vec{c}$. The angle between \vec{a} and \vec{c} is $\cos^{-1}(1/4)$. If $\vec{b} - 2\vec{c} = \lambda\vec{a}$ then $ \lambda $ is _____.	(p)	1
(B)	Let a and b be real numbers such that the function $f(x) = \begin{cases} bx^2 + ax + 4; & x \geq -1 \\ ax^2 + b & x < -1 \end{cases}$ is differentiable every where, then root of $x^2 - bx + a = 0$ is(are) _____.	(q)	2
(C)	The complex root of the equation $z^3 + (1+i)z^2 + (1+i)z + i = 0$ is w^n , then n can be (where w is complex cube root of unity).	(r)	3
(D)	The p th, $2p$ th and $4p$ th terms of an A.P. are in G.P., the common ratio of the G.P., is _____.	(s)	4
		(t)	5

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2. MATCH THE FOLLOWING:

	Column 1		Column 2
(A)	In a ΔABC , if $a + b = 3c$, then possible values of $2(\cos A + \cos B)$ are [where $C = \frac{\pi}{2}$ and $C = \frac{\pi}{3}$]	(p)	1
(B)	In ΔABC , if a is the arithmetic mean and b, c are two geometric means between any two positive numbers, then the value of $\frac{\sin^3 B + \sin^3 C}{\sin A \sin B \sin C}$ is :	(q)	2
(C)	If $\vec{a}, \vec{b}, \vec{c}$ are 3 non coplanar vectors such that the volume of parallelepiped formed by $\vec{a}, \vec{b}, \vec{c}$ is k , and volume of parallelepiped formed by $\vec{a} \times \vec{b}, \vec{b} \times \vec{c}$ and $\vec{c} \times \vec{a}$ is k_2 . If $k_2 = 5k_1 - 6$, then value of k_1 is	(r)	3
(D)	$f(x) = \min(x , x - \alpha , x + \alpha)$ $\alpha \in \{1, 2\}$. If the area bounded by $f(x)$ and x axis in $x \in [-1, 1]$ is k , then $2k$ can be	(s)	5
		(t)	6

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