JEE-2007
Paper I

1. A resistance of 2 Ω is connected across one gap of a metre-bridge (the length of the wire is 100 cm) and an unknown resistance, greater than 2 Ω, is connected across the other gap. When these resistances are interchanged, the balance point shifts by 20 cm. Neglecting any corrections, the unknown resistance is

(A) 3 Ω (B) 4 Ω (C) 5 Ω (D) 6 Ω

Answer ● ○ ○ ○

(A) (B) (C) (D)

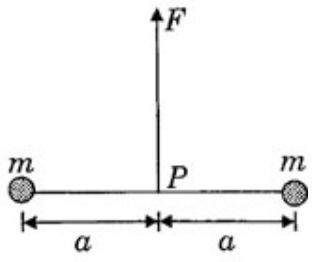
2. In an experiment to determine the focal length (f) of a concave mirror by the u-v method, a student places the object pin A on the principal axis at a distance x from the pole P. The student looks at the pin and its inverted image from a distance keeping his/her eye in line with PA. When the student shifts his/her eye towards left, the image appears to the right of the object pin. Then,

(A) $x < f$ (B) $f < x < 2f$ (C) $x = 2f$ (D) $x > 2f$

Answer ○ ● ○ ○

(A) (B) (C) (D)

3. Two particles of mass m each are tied at the ends of a light string of length $2a$. The whole system is kept on a frictionless horizontal surface with the string held tight so that each mass is at a distance 'a' from the center P (as shown in the figure). Now, the mid-point of the string is pulled vertically upwards with a small but constant force F. As a result, the particles move towards each other on the surface. The magnitude of acceleration, when the separation between them becomes $2x$, is



(A) $\frac{F}{2m}\frac{a}{\sqrt{a^2-x^2}}$ (B) $\frac{F}{2m}\frac{x}{\sqrt{a^2-x^2}}$

(C) $\frac{F}{2m}\frac{x}{a}$ (D) $\frac{F}{2m}\frac{\sqrt{a^2-x^2}}{x}$

Answer ○ ● ○ ○

(A) (B) (C) (D)

4. A long, hollow conducting cylinder is kept coaxially inside another long, hollow conducting cylinder of larger radius. Both the cylinders are initially electrically neutral.
   (A) A potential difference appears between the two cylinders when a charge density is given to the inner cylinder
   (B) A potential difference appears between the two cylinders when a charge density is given to the outer cylinder
   (C) No potential difference appears between the two cylinders when a uniform line charge is kept along the axis of the cylinders
   (D) No potential difference appears between the two cylinders when same charge density is given to both the cylinders

Answer ● ○ ○ ○

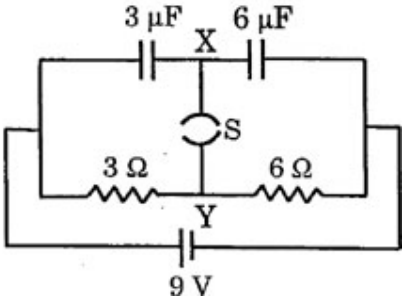
(A) (B) (C) (D)

5. Consider a neutral conducting sphere. A positive point charge is placed outside the sphere. The net charge on the sphere is then,
   (A) negative and distributed uniformly over the surface of the sphere
   (B) negative and appears only at the point on the sphere closest to the point charge
   (C) negative and distributed non-uniformly over the entire surface of the sphere
   (D) zero

Answer ○ ○ ○ ●

(A) (B) (C) (D)

6. A circuit is connected as shown in the figure with the switch S open. When the switch is closed, the total amount of charge that flows from Y to X is
   (A) 0 (B) 54 μC
   (C) 27 μC (D) 81 μC



Answer ○ ○ ● ○

(A) (B) (C) (D)

7. A ray of light traveling in water is incident on its surface open to air. The angle of incidence is θ, which is less than the critical angle. Then there will be

(A) only a reflected ray and no refracted ray

(B) only a refracted ray and no reflected ray

(C) a reflected ray and a refracted ray and the angle between them would be less than $180° - 2\theta$

(D) a reflected ray and a refracted ray and the angle between them would be greater than $180° - 2\theta$

Answer ○ ○ ● ○

(A) (B) (C) (D)

8. In the options given below, let E denote the rest mass energy of a nucleus and n a neutron. The correct option is

(A) $E\left(^{236}_{92}U\right) > E\left(^{137}_{53}I\right) + E\left(^{97}_{39}Y\right) + 2E(n)$

(B) $E\left(^{236}_{92}U\right) < E\left(^{137}_{53}I\right) + E\left(^{97}_{39}Y\right) + 2E(n)$

(C) $E\left(^{236}_{92}U\right) < E\left(^{140}_{56}Ba\right) + E\left(^{94}_{36}Kr\right) + 2E(n)$

(D) $E\left(^{236}_{92}U\right) = E\left(^{140}_{56}Ba\right) + E\left(^{94}_{36}Kr\right) + 2E(n)$

Answer ● ○ ○ ○

(A) (B) (C) (D)

9. The largest wavelength in the ultraviolet region of the hydrogen spectrum is 122 nm. The smallest wavelength in the infrared region of the hydrogen spectrum (to the nearest integer) is

(A) 802 nm (B) 823 nm (C) 1882 nm (D) 1648 nm

Answer ○ ● ○ ○

(A) (B) (C) (D)

10. STATEMENT-1

A block of mass m starts moving on a rough horizontal surface with a velocity v. It stops due to friction between the block and the surface after moving through a certain distance. The surface is now tilted to an angle of 30° with the horizontal and the same block is made to go up on the surface with the same initial velocity v. The decrease in the mechanical energy in the second situation is smaller than that in the first situation.

because

STATEMENT-2

The coefficient of friction between the block and the surface decreases with the increase in the angle of inclination.

(A) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1

(B) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1

(C) Statement-1 is True, Statement-2 is False

(D) Statement-1 is False, Statement-2 is True

Answer ○ (A) ○ (B) ● (C) ○ (D)

11. STATEMENT-1

In an elastic collision between two bodies, the relative speed of the bodies after collision is equal to the relative speed before the collision.

because

STATEMENT-2

In an elastic collision, the linear momentum of the system is conserved.

(A) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1

(B) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1

(C) Statement-1 is True, Statement-2 is False

(D) Statement-1 is False, Statement-2 is True

Answer ○ (A) ● (B) ○ (C) ○ (D)

OR

○ (A) ○ (B) ○ (C) ● (D)

12. STATEMENT-1

The formula connecting u, v and f for a spherical mirror is valid only for mirrors whose sizes are very small compared to their radii of curvature.

because

STATEMENT-2

Laws of reflection are strictly valid for plane surfaces, but not for large spherical surfaces.

(A) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1

(B) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1

(C) Statement-1 is True, Statement-2 is False

(D) Statement-1 is False, Statement-2 is True

Answer ○ ○ ● ○

(A) (B) (C) (D)

13. STATEMENT-1

If the accelerating potential in an X-ray tube is increased, the wavelengths of the characteristic X-rays do not change.

because

STATEMENT-2

When an electron beam strikes the target in an X-ray tube, part of the kinetic energy is converted into X-ray energy.

(A) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1

(B) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1

(C) Statement-1 is True, Statement-2 is False

(D) Statement-1 is False, Statement-2 is True

Answer ○ ● ○ ○

(A) (B) (C) (D)

14. The ratio x_1 / x_2 is

(A) 2 (B) $\frac{1}{2}$ (C) $\sqrt{2}$ (D) $\frac{1}{\sqrt{2}}$

Answer ○ ○ ● ○

(A) (B) (C) (D)

15. When disc B is brought in contact with disc A, they acquire a common angular velocity in time t. The average frictional torque on one disc by the other during this period is

(A) $\frac{2I\omega}{3t}$ (B) $\frac{9I\omega}{2t}$ (C) $\frac{9I\omega}{4t}$ (D) $\frac{3I\omega}{2t}$

Answer ● ○ ○ ○

(A) (B) (C) (D)

16. The loss of kinetic energy during the above process is

(A) $\frac{I\omega^2}{2}$ (B) $\frac{I\omega^2}{3}$ (C) $\frac{I\omega^2}{4}$ (D) $\frac{I\omega^2}{6}$

Answer ○ ● ○ ○

(A) (B) (C) (D)

17. The piston is now pulled out slowly and held at a distance $2L$ from the top. The pressure in the cylinder between its top and the piston will then be

(A) P_0 (B) $\frac{P_0}{2}$ (C) $\frac{P_0}{2} + \frac{Mg}{\pi R^2}$ (D) $\frac{P_0}{2} - \frac{Mg}{\pi R^2}$

Answer ● ○ ○ ○

(A) (B) (C) (D)

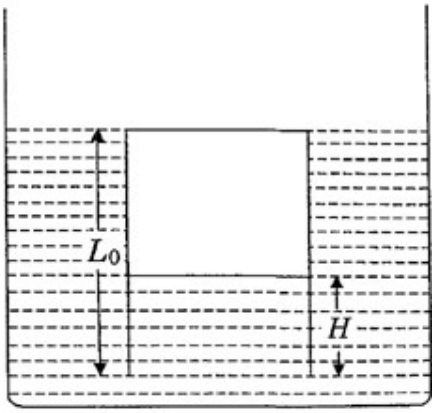
18. While the piston is at a distance $2L$ from the top, the hole at the top is sealed. The piston is then released, to a position where it can stay in equilibrium. In this condition, the distance of the piston from the top is

(A) $\left(\frac{2P_0\pi R^2}{\pi R^2 P_0 + Mg}\right)(2L)$ (B) $\left(\frac{P_0\pi R^2 - Mg}{\pi R^2 P_0}\right)(2L)$

(C) $\left(\frac{P_0\pi R^2 + Mg}{\pi R^2 P_0}\right)(2L)$ (D) $\left(\frac{P_0\pi R^2}{\pi R^2 P_0 - Mg}\right)(2L)$

Answer ○ ○ ○ ● (A) (B) (C) (D)

19. The piston is taken completely out of the cylinder. The hole at the top is sealed. A water tank is brought below the cylinder and put in a position so that the water surface in the tank is at the same level as the top of the cylinder as shown in the figure. The density of the water is ρ. In equilibrium, the height H of the water column in the cylinder satisfies



(A) $\rho g(L_0 - H)^2 + P_0(L_0 - H) + L_0P_0 = 0$

(B) $\rho g(L_0 - H)^2 - P_0(L_0 - H) - L_0P_0 = 0$

(C) $\rho g(L_0 - H)^2 + P_0(L_0 - H) - L_0P_0 = 0$

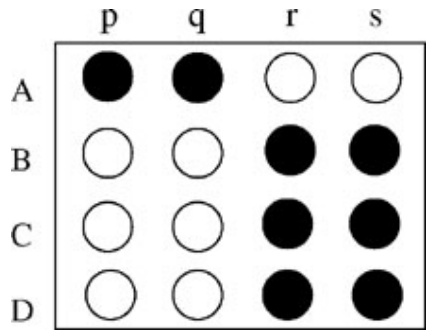
(D) $\rho g(L_0 - H)^2 - P_0(L_0 - H) + L_0P_0 = 0$

Answer ○ ○ ● ○ (A) (B) (C) (D)

20. Some physical quantities are given in **Column I** and some possible SI units in which these quantities may be expressed are given in **Column II**. Match the physical quantities in **Column I** with the units in **Column II** and indicate your answer by darkening appropriate bubbles in the 4×4 matrix given in the ORS.

	Column I	**Column II**
(A)	GM_eM_s G – universal gravitational constant, M_e – mass of the earth, M_s – mass of the Sun	(p) (volt) (coulomb) (metre)
(B)	$\frac{3RT}{M}$ R – universal gas constant, T – absolute temperature, M – molar mass	(q) (kilogram) $(\text{metre})^3$ $(\text{second})^{-2}$
(C)	$\frac{F^2}{q^2B^2}$ F – force, q – charge, B – magnetic field	(r) $(\text{metre})^2$ $(\text{second})^{-2}$
(D)	$\frac{GM_e}{R_e}$ G – universal gravitational constant, M_e – mass of the earth, R_e – radius of the earth	(s) (farad) $(\text{volt})^2$ $(\text{kg})^{-1}$

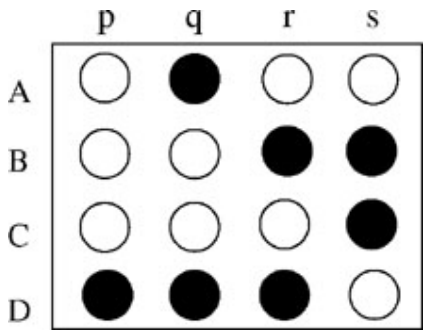
Answer



21. **Column I** gives certain situations in which a straight metallic wire of resistance R is used and **Column II** gives some resulting effects. Match the statements in **Column I** with the statements in **Column II** and indicate your answer by darkening appropriate bubbles in the 4×4 matrix given in the ORS.

Column I	**Column II**
(A) A charged capacitor is connected to the ends of the wire	(p) A constant current flows through the wire
(B) The wire is moved perpendicular to its length with a constant velocity in a uniform magnetic field perpendicular to the plane of motion	(q) Thermal energy is generated in the wire
(C) The wire is placed in a constant electric field that has a direction along the length of the wire	(r) A constant potential difference develops between the ends of the wire
(D) A battery of constant emf is connected to the ends of the wire	(s) Charges of constant magnitude appear at the ends of the wire

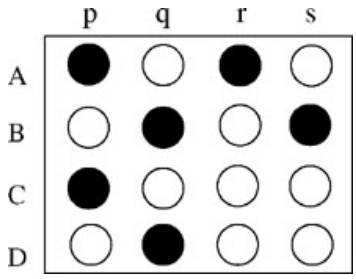
Answer



22. 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 ORS.

Column I	**Column II**
(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

Answer



23. The species having bond order different from that in CO is

(A) NO^- (B) NO^+

(C) CN^- (D) N_2

Answer

(A) (B) (C) (D)

24. Among the following, the paramagnetic compound is

(A) Na_2O_2 (B) O_3

(C) N_2O (D) KO_2

Answer

(A) (B) (C) (D)

25. Extraction of zinc from zinc blende is achieved by

(A) electrolytic reduction

(B) roasting followed by reduction with carbon

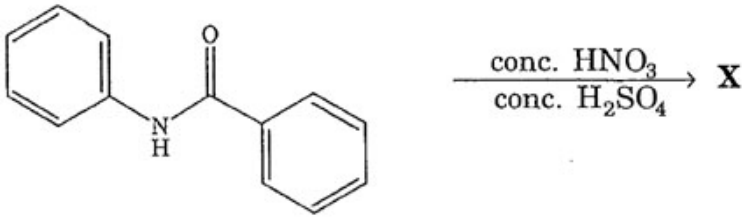
(C) roasting followed by reduction with another metal

(D) roasting followed by self-reduction

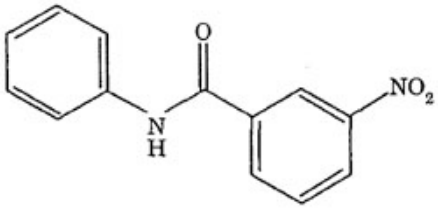
Answer ○ ● ○ ○

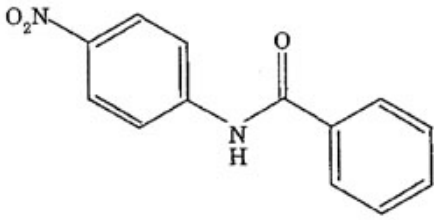
(A) (B) (C) (D)

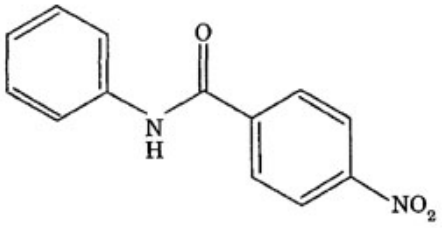
26. In the following reaction,

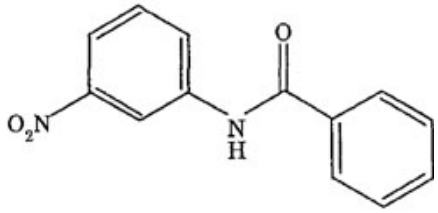


the structure of the major product '**X**' is

(A)


(B)


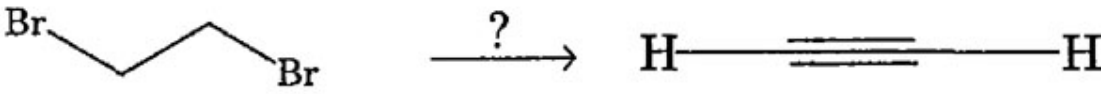
(C)


(D)


Answer ○ ● ○ ○

(A) (B) (C) (D)

27. The reagent(s) for the following conversion,



is/are

(A) alcoholic KOH

(B) alcoholic KOH followed by $NaNH_2$

(C) aqueous KOH followed by $NaNH_2$

(D) Zn/CH_3OH

Answer ○ ● ○ ○
(A) (B) (C) (D)

28. The number of structural isomers for C_6H_{14} is

(A) 3 (B) 4

(C) 5 (D) 6

Answer ○ ○ ● ○
(A) (B) (C) (D)

29. The percentage of p-character in the orbitals forming P–P bonds in P_4 is

(A) 25 (B) 33

(C) 50 (D) 75

Answer ○ ○ ○ ● (A) (B) (C) (D)

30. When 20 g of naphthoic acid ($C_{11}H_8O_2$) is dissolved in 50 g of benzene ($K_f = 1.72$ K kg mol^{-1}), a freezing point depression of 2 K is observed. The van't Hoff factor (i) is

(A) 0.5 (B) 1

(C) 2 (D) 3

Answer ● ○ ○ ○ (A) (B) (C) (D)

31. The value of $\log_{10}K$ for a reaction $A \rightleftharpoons B$ is

(Given : $\Delta_r H^\circ_{298K} = -54.07$ kJ mol^{-1}, $\Delta_r S^\circ_{298K} = 10$ $JK^{-1}mol^{-1}$ and $R = 8.314$ $JK^{-1}mol^{-1}$; $2.303 \times 8.314 \times 298 = 5705$)

(A) 5 (B) 10

(C) 95 (D) 100

Answer ○ ● ○ ○ (A) (B) (C) (D)

32. STATEMENT-1 : Boron always forms covalent bond.

because

STATEMENT-2 : The small size of B^{3+} favours formation of covalent bond.

(A) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1

(B) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1

(C) Statement-1 is True, Statement-2 is False

(D) Statement-1 is False, Statement-2 is True

Answer ● ○ ○ ○

(A) (B) (C) (D)

33. STATEMENT-1 : In water, orthoboric acid behaves as a weak monobasic acid.

because

STATEMENT-2 : In water, orthoboric acid acts as a proton donor.

(A) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1

(B) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1

(C) Statement-1 is True, Statement-2 is False

(D) Statement-1 is False, Statement-2 is True

Answer ○ ○ ● ○

(A) (B) (C) (D)

34. STATEMENT-1 : *p*–Hydroxybenzoic acid has a lower boiling point than *o*-hydroxybenzoic acid.

because

STATEMENT-2 : *o*–Hydroxybenzoic acid has intramolecular hydrogen bonding.

(A) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1

(B) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1

(C) Statement-1 is True, Statement-2 is False

(D) Statement-1 is False, Statement-2 is True

Answer ○ ○ ○ ●

(A) (B) (C) (D)

35. STATEMENT-1 : Micelles are formed by surfactant molecules above the critical micellar concentration (CMC).

because

STATEMENT-2 : The conductivity of a solution having surfactant molecules decreases sharply at the CMC.

(A) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1

(B) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1

(C) Statement-1 is True, Statement-2 is False

(D) Statement-1 is False, Statement-2 is True

Answer ○ ● ○ ○

(A) (B) (C) (D)

36. Argon is used in arc welding because of its

(A) low reactivity with metal

(B) ability to lower the melting point of metal

(C) flammability

(D) high calorific value

Answer ● ○ ○ ○

(A) (B) (C) (D)

37. The structure of XeO_3 is

(A) linear (B) planar (C) pyramidal (D) T-shaped

Answer ○ ○ ● ○

(A) (B) (C) (D)

38. XeF_4 and XeF_6 are expected to be

(A) oxidizing (B) reducing (C) unreactive (D) strongly basic

Answer ● ○ ○ ○

(A) (B) (C) (D)

OR

○ ● ○ ○

(A) (B) (C) (D)

Chemical reactions involve interaction of atoms and molecules. A large number of atoms/molecules (approximately 6.023×10^{23}) are present in a few grams of any chemical compound varying with their atomic/molecular masses. To handle such large numbers conveniently, the mole concept was introduced. This concept has implications in diverse areas such as analytical chemistry, biochemistry, electrochemistry and radiochemistry. The following example illustrates a typical case, involving chemical/electrochemical reaction, which requires a clear understanding of the mole concept.

A 4.0 molar aqueous solution of NaCl is prepared and 500 mL of this solution is electrolysed. This leads to the evolution of chlorine gas at one of the electrodes (atomic mass : Na = 23, Hg = 200; 1 Faraday = 96500 coulombs).

39. The total number of moles of chlorine gas evolved is

(A) 0.5 (B) 1.0 (C) 2.0 (D) 3.0

Answer ○ ● ○ ○

(A) (B) (C) (D)

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A 4.0 molar aqueous solution of NaCl is prepared and 500 mL of this solution is electrolysed. This leads to the evolution of chlorine gas at one of the electrodes (atomic mass : Na = 23, Hg = 200; 1 Faraday = 96500 coulombs).

40. If the cathode is a Hg electrode, the maximum weight (g) of amalgam formed from this solution is

(A) 200 (B) 225 (C) 400 (D) 446

Answer ○ (A) ○ (B) ○ (C) ● (D)

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A 4.0 molar aqueous solution of NaCl is prepared and 500 mL of this solution is electrolysed. This leads to the evolution of chlorine gas at one of the electrodes (atomic mass : Na = 23, Hg = 200; 1 Faraday = 96500 coulombs).

41. The total charge (coulombs) required for complete electrolysis is

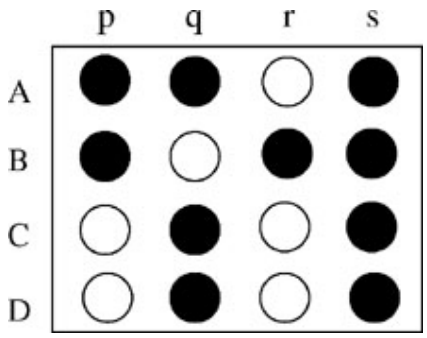
(A) 24125 (B) 48250 (C) 96500 (D) 193000

Answer ○ (A) ○ (B) ○ (C) ● (D)

42. Match the complexes in **Column I** with their properties listed in **Column II**. Indicate your answer by darkening the appropriate bubbles of the 4×4 matrix given in the ORS.

Column I	**Column II**
(A) $[Co(NH_3)_4(H_2O)_2]Cl_2$	(p) geometrical isomers
(B) $[Pt(NH_3)_2Cl_2]$	(q) paramagnetic
(C) $[Co(H_2O)_5Cl]Cl$	(r) diamagnetic
(D) $[Ni(H_2O)_6]Cl_2$	(s) metal ion with +2 oxidation state

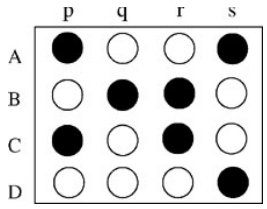
Answer



43. Match the chemical substances in **Column I** with type of polymers/type of bonds in **Column II**. Indicate your answer by darkening the appropriate bubbles of the 4×4 matrix given in the ORS.

Column I	**Column II**
(A) cellulose	(p) natural polymer
(B) nylon-6, 6	(q) synthetic polymer
(C) protein	(r) amide linkage
(D) sucrose	(s) glycoside linkage

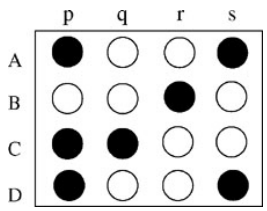
Answer



44. Match gases under specified conditions listed in **Column I** with their properties/laws in **Column II**. Indicate your answer by darkening the appropriate bubbles of the 4×4 matrix given in the ORS.

Column I	**Column II**
(A) hydrogen gas (P = 200 atm, T = 273 K)	(p) compressibility factor $\neq$ 1
(B) hydrogen gas (P ~ 0, T = 273 K)	(q) attractive forces are dominant
(C) CO_2 (P = 1 atm, T = 273 K)	(r) PV = nRT
(D) real gas with very large molar volume	(s) P(V−nb) = nRT

Answer



45. Let α, β be the roots of the equation $x^2 - px + r = 0$ and $\frac{\alpha}{2}, 2\beta$ be the roots of the equation $x^2 - qx + r = 0$. Then the value of r is

(A) $\frac{2}{9}(p-q)(2q-p)$ (B) $\frac{2}{9}(q-p)(2p-q)$

(C) $\frac{2}{9}(q-2p)(2q-p)$ (D) $\frac{2}{9}(2p-q)(2q-p)$

Answer ○ ○ ○ ● (A) (B) (C) (D)

46. Let $f(x)$ be differentiable on the interval $(0, \infty)$ such that $f(1) = 1$, and

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

for each $x > 0$. Then $f(x)$ is

(A) $\frac{1}{3x} + \frac{2x^2}{3}$ (B) $\frac{-1}{3x} + \frac{4x^2}{3}$ (C) $\frac{-1}{x} + \frac{2}{x^2}$ (D) $\frac{1}{x}$

Answer ● ○ ○ ○ (A) (B) (C) (D)

47. One Indian and four American men and their wives are to be seated randomly around a circular table. Then the conditional probability that the Indian man is seated adjacent to his wife given that each American man is seated adjacent to his wife is

(A) $\frac{1}{2}$ (B) $\frac{1}{3}$ (C) $\frac{2}{5}$ (D) $\frac{1}{5}$

Answer ○ ○ ● ○ (A) (B) (C) (D)

48. The tangent to the curve $y = e^x$ drawn at the point (c, e^c) intersects the line joining the points $(c-1, e^{c-1})$ and $(c+1, e^{c+1})$

(A) on the left of $x = c$ (B) on the right of $x = c$

(C) at no point (D) at all points

Answer ● ○ ○ ○ (A) (B) (C) (D)

49. $\lim\limits_{x \to \frac{\pi}{4}} \dfrac{\int\limits_{2}^{\sec^2 x} f(t)\, dt}{x^2 - \dfrac{\pi^2}{16}}$ equals

(A) $\dfrac{8}{\pi} f(2)$ (B) $\dfrac{2}{\pi} f(2)$ (C) $\dfrac{2}{\pi} f\left(\dfrac{1}{2}\right)$ (D) $4 f(2)$

Answer ● ○ ○ ○

(A) (B) (C) (D)

50. A hyperbola, having the transverse axis of length $2\sin\theta$, is confocal with the ellipse $3x^2 + 4y^2 = 12$. Then its equation is

(A) $x^2 \operatorname{cosec}^2\theta - y^2 \sec^2\theta = 1$ (B) $x^2 \sec^2\theta - y^2 \operatorname{cosec}^2\theta = 1$

(C) $x^2 \sin^2\theta - y^2 \cos^2\theta = 1$ (D) $x^2 \cos^2\theta - y^2 \sin^2\theta = 1$

Answer ● ○ ○ ○

(A) (B) (C) (D)

51. The number of distinct real values of λ, for which the vectors $-\lambda^2 \hat{i} + \hat{j} + \hat{k}$, $\hat{i} - \lambda^2 \hat{j} + \hat{k}$ and $\hat{i} + \hat{j} - \lambda^2 \hat{k}$ are coplanar, is

(A) zero (B) one

(C) two (D) three

Answer ○ ○ ● ○

(A) (B) (C) (D)

52. A man walks a distance of 3 units from the origin towards the north-east ($N\ 45^\circ\ E$) direction. From there, he walks a distance of 4 units towards the north-west ($N\ 45^\circ\ W$) direction to reach a point P. Then the position of P in the Argand plane is

(A) $3e^{i\pi/4} + 4i$ (B) $(3 - 4i)e^{i\pi/4}$

(C) $(4 + 3i)e^{i\pi/4}$ (D) $(3 + 4i)e^{i\pi/4}$

Answer ○ ○ ○ ● (A) (B) (C) (D)

53. The number of solutions of the pair of equations

$$2\sin^2\theta - \cos 2\theta = 0$$
$$2\cos^2\theta - 3\sin\theta = 0$$

in the interval $[0, 2\pi]$ is

(A) zero (B) one (C) two (D) four

Answer ○ ○ ● ○ (A) (B) (C) (D)

54. Let $H_1, H_2, \cdots, H_n$ be mutually exclusive and exhaustive events with $P(H_i) > 0$, $i = 1, 2, \ldots, n$. Let E be any other event with $0 < P(E) < 1$.

STATEMENT-1 : $P(H_i \mid E) > P(E \mid H_i) \cdot P(H_i)$ for $i = 1, 2, \ldots, n$.

because

STATEMENT-2 : $\sum_{i=1}^{n} P(H_i) = 1$.

(A) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1

(B) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1

(C) Statement-1 is True, Statement-2 is False

(D) Statement-1 is False, Statement-2 is True

Answer ○ ○ ○ ● (A) (B) (C) (D)

55. Tangents are drawn from the point $(17, 7)$ to the circle $x^2 + y^2 = 169$.

STATEMENT-1 : The tangents are mutually perpendicular.

because

STATEMENT-2 : The locus of the points from which mutually perpendicular tangents can be drawn to the given circle is $x^2 + y^2 = 338$.

(A) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1

(B) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1

(C) Statement-1 is True, Statement-2 is False

(D) Statement-1 is False, Statement-2 is True

Answer ● ○ ○ ○

(A) (B) (C) (D)

56. Let the vectors $\vec{PQ}$, $\vec{QR}$, $\vec{RS}$, $\vec{ST}$, $\vec{TU}$ and $\vec{UP}$ represent the sides of a regular hexagon.

STATEMENT-1 : $\vec{PQ} \times \left(\vec{RS} + \vec{ST}\right) \neq \vec{0}$.

because

STATEMENT-2 : $\vec{PQ} \times \vec{RS} = \vec{0}$ and $\vec{PQ} \times \vec{ST} \neq \vec{0}$.

(A) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1

(B) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1

(C) Statement-1 is True, Statement-2 is False

(D) Statement-1 is False, Statement-2 is True

Answer ○ ○ ● ○

(A) (B) (C) (D)

57. Let $F(x)$ be an indefinite integral of $\sin^2 x$.

STATEMENT-1 : The function $F(x)$ satisfies $F(x + \pi) = F(x)$ for all real x.

because

STATEMENT-2 : $\sin^2(x + \pi) = \sin^2 x$ for all real x.

(A) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1

(B) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1

(C) Statement-1 is True, Statement-2 is False

(D) Statement-1 is False, Statement-2 is True

Answer ○ ○ ○ ●

(A) (B) (C) (D)

M58-60 : Paragraph for Question Nos. 58 to 60

Let V_r denote the sum of the first r terms of an arithmetic progression (A.P.) whose first term is r and the common difference is $(2r - 1)$. Let

$$T_r = V_{r+1} - V_r - 2 \text{ and } Q_r = T_{r+1} - T_r \text{ for } r = 1, 2, \ldots$$

58. The sum $V_1 + V_2 + \ldots + V_n$ is

(A) $\frac{1}{12} n(n+1)(3n^2 - n + 1)$ (B) $\frac{1}{12} n(n+1)(3n^2 + n + 2)$

(C) $\frac{1}{2} n(2n^2 - n + 1)$ (D) $\frac{1}{3}(2n^3 - 2n + 3)$

Answer ○ ● ○ ○

(A) (B) (C) (D)

59. T_r is always

(A) an odd number (B) an even number

(C) a prime number (D) a composite number

Answer ○ ○ ○ ● (A) (B) (C) (D)

60. Which one of the following is a correct statement?

(A) $Q_1, Q_2, Q_3, \ldots$ are in A.P. with common difference 5

(B) $Q_1, Q_2, Q_3, \ldots$ are in A.P. with common difference 6

(C) $Q_1, Q_2, Q_3, \ldots$ are in A.P. with common difference 11

(D) $Q_1 = Q_2 = Q_3 = \ldots$

M61-63 : Paragraph for Question Nos. 61 to 63

Consider the circle $x^2 + y^2 = 9$ and the parabola $y^2 = 8x$. They intersect at P and Q in the first and the fourth quadrants, respectively. Tangents to the circle at P and Q intersect the x-axis at R and tangents to the parabola at P and Q intersect the x-axis at S.

Answer ○ ● ○ ○ (A) (B) (C) (D)

61. The ratio of the areas of the triangles PQS and PQR is

(A) $1 : \sqrt{2}$ (B) $1 : 2$ (C) $1 : 4$ (D) $1 : 8$

Answer ○ ○ ● ○ (A) (B) (C) (D)

62. The radius of the circumcircle of the triangle PRS is

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

Answer ○ ● ○ ○ (A) (B) (C) (D)

63. The radius of the incircle of the triangle PQR is

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

Answer

(A) (B) (C) (D)

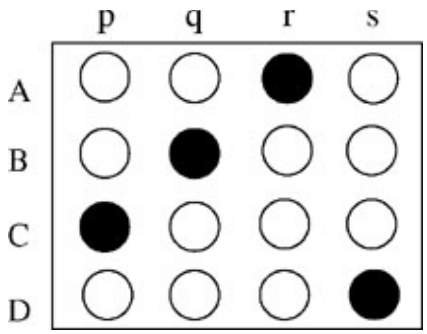
64. Consider the following linear equations

$$ax + by + cz = 0$$
$$bx + cy + az = 0$$
$$cx + ay + bz = 0$$

Match the conditions/expressions in **Column I** with statements in **Column II** and indicate your answer by darkening the appropriate bubbles in the 4×4 matrix given in the ORS.

Column I	**Column II**
(A) $a + b + c \neq 0$ and $a^2 + b^2 + c^2 = ab + bc + ca$	(p) the equations represent planes meeting only at a single point.
(B) $a + b + c = 0$ and $a^2 + b^2 + c^2 \neq ab + bc + ca$	(q) the equations represent the line $x = y = z$.
(C) $a + b + c \neq 0$ and $a^2 + b^2 + c^2 \neq ab + bc + ca$	(r) the equations represent identical planes.
(D) $a + b + c = 0$ and $a^2 + b^2 + c^2 = ab + bc + ca$	(s) the equations represent the whole of the three dimensional space.

Answer

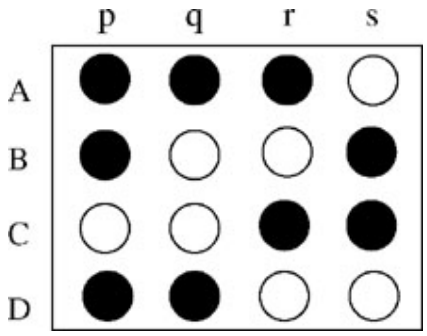


65. In the following $[x]$ denotes the greatest integer less than or equal to x.

Match the functions in **Column I** with the properties in **Column II** and indicate your answer by darkening the appropriate bubbles in the 4×4 matrix given in the ORS.

Column I	**Column II**
(A) $x\|x\|$	(p) continuous in $(-1, 1)$
(B) $\sqrt{\|x\|}$	(q) differentiable in $(-1, 1)$
(C) $x+[x]$	(r) strictly increasing in $(-1, 1)$
(D) $\|x-1\|+\|x+1\|$	(s) not differentiable at least at one point in $(-1, 1)$

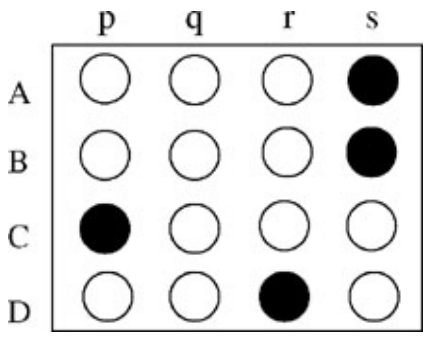
Answer



66. Match the integrals in **Column I** with the values in **Column II** and indicate your answer by darkening the appropriate bubbles in the 4×4 matrix given in the ORS.

Column I	**Column II**
(A) $\int_{-1}^{1} \frac{dx}{1+x^2}$	(p) $\frac{1}{2}\log\left(\frac{2}{3}\right)$
(B) $\int_{0}^{1} \frac{dx}{\sqrt{1-x^2}}$	(q) $2\log\left(\frac{2}{3}\right)$
(C) $\int_{2}^{3} \frac{dx}{1-x^2}$	(r) $\frac{\pi}{3}$
(D) $\int_{1}^{2} \frac{dx}{x\sqrt{x^2-1}}$	(s) $\frac{\pi}{2}$

Answer



JEE-2007
Paper 2

1. In the experiment to determine the speed of sound using a resonance column,
   (A) prongs of the tuning fork are kept in a vertical plane
   (B) prongs of the tuning fork are kept in a horizontal plane
   (C) in one of the two resonances observed, the length of the resonating air column is close to the wavelength of sound in air
   (D) in one of the two resonances observed, the length of the resonating air column is close to half of the wavelength of sound in air

Answer ● ○ ○ ○
(A) (B) (C) (D)

2. 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 ± 0.05 mm at a load of exactly 1.0 kg. The student also measures the diameter of the wire to be 0.4 mm with an uncertainty of ± 0.01 mm. Take $g = 9.8\ \text{m/s}^2$ (exact). The Young's modulus obtained from the reading is
   (A) $(2.0 \pm 0.3) \times 10^{11}\ \text{N/m}^2$ (B) $(2.0 \pm 0.2) \times 10^{11}\ \text{N/m}^2$
   (C) $(2.0 \pm 0.1) \times 10^{11}\ \text{N/m}^2$ (D) $(2.0 \pm 0.05) \times 10^{11}\ \text{N/m}^2$

Answer ● ○ ○ ○
(A) (B) (C) (D)

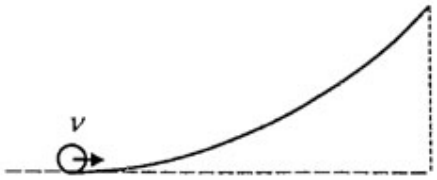
OR

○ ● ○ ○
(A) (B) (C) (D)

3. A particle moves in the X-Y plane under the influence of a force such that its linear momentum is $\vec{p}(t) = A\left[\hat{i}\cos(kt) - \hat{j}\sin(kt)\right]$, where A and k are constants. The angle between the force and the momentum is
   (A) 0° (B) 30° (C) 45° (D) 90°

Answer ○ ○ ○ ●
(A) (B) (C) (D)

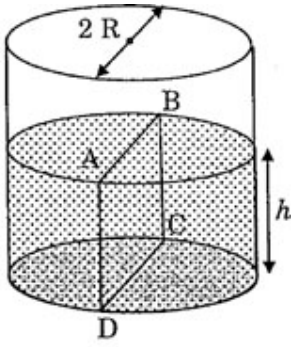
4. A small object of uniform density rolls up a curved surface with an initial velocity v. It reaches up to a maximum height of $\frac{3v^2}{4g}$ with respect to the initial position. The object is



(A) ring (B) solid sphere (C) hollow sphere (D) disc

Answer ○ ○ ○ ● (A) (B) (C) (D)

5. Water is filled up to a height h in a beaker of radius R as shown in the figure. The density of water is ρ, the surface tension of water is T and the atmospheric pressure is P_0. Consider a vertical section ABCD of the water column through a diameter of the beaker. The force on water on one side of this section by water on the other side of this section has magnitude

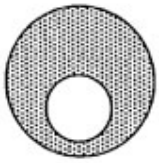


(A) $\left|2P_0Rh+\pi R^2\rho gh-2RT\right|$ (B) $\left|2P_0Rh+R\rho gh^2-2RT\right|$

(C) $\left|P_0\pi R^2+R\rho gh^2-2RT\right|$ (D) $\left|P_0\pi R^2+R\rho gh^2+2RT\right|$

Answer ○ ● ○ ○ (A) (B) (C) (D)

6. A spherical portion has been removed from a solid sphere having a charge distributed uniformly in its volume as shown in the figure. The electric field inside the emptied space is



(A) zero everywhere
(B) non-zero and uniform
(C) non-uniform
(D) zero only at its center

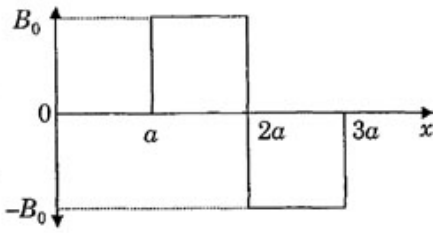
Answer ○ (A) ● (B) ○ (C) ○ (D)

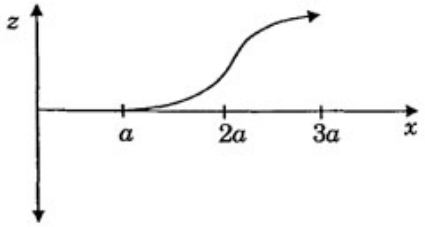
7. Positive and negative point charges of equal magnitude are kept at $\left(0, 0, \frac{a}{2}\right)$ and $\left(0, 0, \frac{-a}{2}\right)$, respectively. The work done by the electric field when another positive point charge is moved from $(-a, 0, 0)$ to $(0, a, 0)$ is

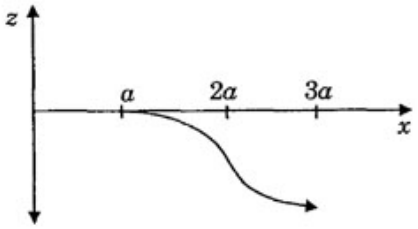
(A) positive
(B) negative
(C) zero
(D) depends on the path connecting the initial and final positions

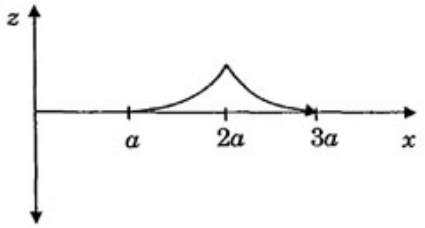
Answer ○ (A) ○ (B) ● (C) ○ (D)

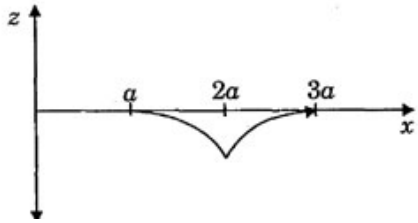
8. A magnetic field $\vec{B} = B_0\hat{j}$ exists in the region $a < x < 2a$ and $\vec{B} = -B_0\hat{j}$, in the region $2a < x < 3a$, where B_0 is a positive constant. A positive point charge moving with a velocity $\vec{v} = v_0\hat{i}$, where v_0 is a positive constant, enters the magnetic field at $x = a$. The trajectory of the charge in this region can be like,



(A) 

(B) 

(C) 

(D) 

Answer ● ○ ○ ○

(A) (B) (C) (D)

9. Electrons with de-Broglie wavelength λ fall on the target in an X-ray tube. The cut-off wavelength of the emitted X-rays is

(A) $\lambda_0 = \dfrac{2mc\lambda^2}{h}$ (B) $\lambda_0 = \dfrac{2h}{mc}$

(C) $\lambda_0 = \dfrac{2m^2c^2\lambda^3}{h^2}$ (D) $\lambda_0 = \lambda$

Answer ● ○ ○ ○

(A) (B) (C) (D)

10. STATEMENT-1

If there is no external torque on a body about its center of mass, then the velocity of the center of mass remains constant.

because

STATEMENT-2

The linear momentum of an isolated system remains constant.

(A) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1

(B) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1

(C) Statement-1 is True, Statement-2 is False

(D) Statement-1 is False, Statement-2 is True

Answer ○ ○ ○ ●

(A) (B) (C) (D)

11. STATEMENT-1

A cloth covers a table. Some dishes are kept on it. The cloth can be pulled out without dislodging the dishes from the table.

because

STATEMENT-2

For every action there is an equal and opposite reaction.

(A) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1

(B) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1

(C) Statement-1 is True, Statement-2 is False

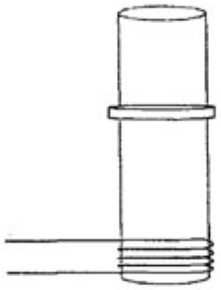
(D) Statement-1 is False, Statement-2 is True

Answer ○ ● ○ ○

(A) (B) (C) (D)

12. STATEMENT-1

A vertical iron rod has a coil of wire wound over it at the bottom end. An alternating current flows in the coil. The rod goes through a conducting ring as shown in the figure. The ring can float at a certain height above the coil.



because

STATEMENT-2

In the above situation, a current is induced in the ring which interacts with the horizontal component of the magnetic field to produce an average force in the upward direction.

(A) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1

(B) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1

(C) Statement-1 is True, Statement-2 is False

(D) Statement-1 is False, Statement-2 is True

Answer ● ○ ○ ○

(A) (B) (C) (D)

13. STATEMENT-1

The total translational kinetic energy of all the molecules of a given mass of an ideal gas is 1.5 times the product of its pressure and its volume.

because

STATEMENT-2

The molecules of a gas collide with each other and the velocities of the molecules change due to the collision.

(A) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1

(B) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1

(C) Statement-1 is True, Statement-2 is False

(D) Statement-1 is False, Statement-2 is True

Answer ○ ● ○ ○

(A) (B) (C) (D)

14. The speed of sound of the whistle is

(A) 340 m/s for passengers in A and 310 m/s for passengers in B

(B) 360 m/s for passengers in A and 310 m/s for passengers in B

(C) 310 m/s for passengers in A and 360 m/s for passengers in B

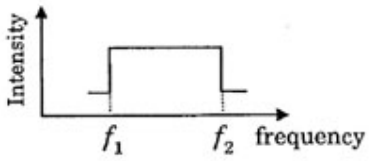
(D) 340 m/s for passengers in both the trains

Answer ○ ● ○ ○

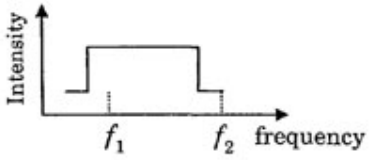
(A) (B) (C) (D)

15. The distribution of the sound intensity of the whistle as observed by the passengers in train A is best represented by

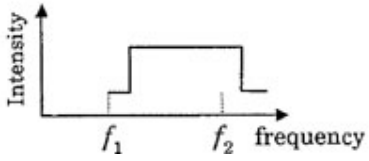
(A)



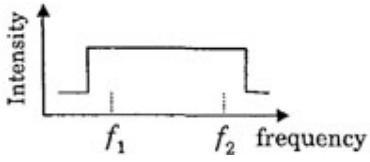
(B)



(C)



(D)



Answer ● ○ ○ ○

(A) (B) (C) (D)

16. The spread of frequency as observed by the passengers in train B is

(A) 310 Hz (B) 330 Hz (C) 350 Hz (D) 290 Hz

Answer ● ○ ○ ○

(A) (B) (C) (D)

17. Light travels as a

(A) parallel beam in each medium

(B) convergent beam in each medium

(C) divergent beam in each medium

(D) divergent beam in one medium and convergent beam in the other medium

Answer ● ○ ○ ○

(A) (B) (C) (D)

18. The phases of the light wave at c, d, e and f are ϕ_c, ϕ_d, ϕ_e and ϕ_f respectively. It is given that $\phi_c \neq \phi_f$.

(A) ϕ_c cannot be equal to ϕ_d

(B) ϕ_d can be equal to ϕ_e

(C) $(\phi_d - \phi_f)$ is equal to $(\phi_c - \phi_e)$

(D) $(\phi_d - \phi_c)$ is not equal to $(\phi_f - \phi_e)$

Answer ○ (A) ○ (B) ● (C) ○ (D)

19. Speed of light is

(A) the same in medium-1 and medium-2

(B) larger in medium-1 than in medium-2

(C) larger in medium-2 than in medium-1

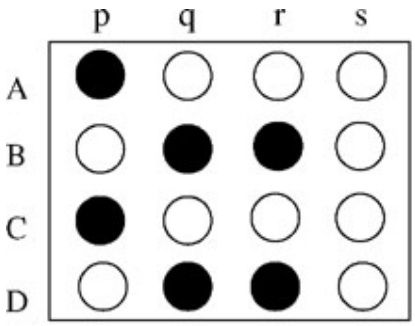
(D) different at b and d

Answer ○ (A) ● (B) ○ (C) ○ (D)

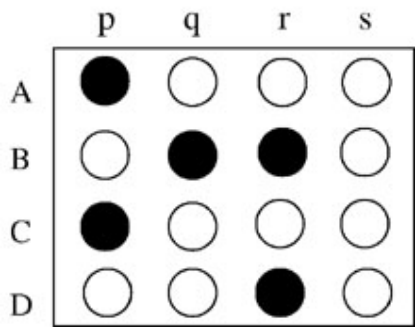
20. **Column I** describes some situations in which a small object moves. **Column II** describes some characteristics of these motions. Match the situations in **Column I** with the characteristics in **Column II** and indicate your answer by darkening appropriate bubbles in the 4×4 matrix given in the ORS.

Column I	**Column II**
(A) The object moves on the x-axis under a conservative force in such a way that its "speed" and "position" satisfy $v = c_1\sqrt{c_2 - x^2}$, where c_1 and c_2 are positive constants.	(p) The object executes a simple harmonic motion.
(B) The object moves on the x-axis in such a way that its velocity and its displacement from the origin satisfy $v = -kx$, where k is a positive constant.	(q) The object does not change its direction.
(C) The object is attached to one end of a mass-less spring of a given spring constant. The other end of the spring is attached to the ceiling of an elevator. Initially everything is at rest. The elevator starts going upwards with a constant acceleration a. The motion of the object is observed from the elevator during the period it maintains this acceleration.	(r) The kinetic energy of the object keeps on decreasing.
(D) The object is projected from the earth's surface vertically upwards with a speed $2\sqrt{GM_e/R_e}$, where, M_e is the mass of the earth and R_e is the radius of the earth. Neglect forces from objects other than the earth.	(s) The object can change its direction only once.

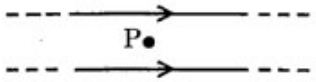
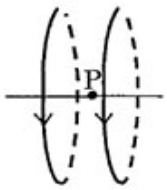
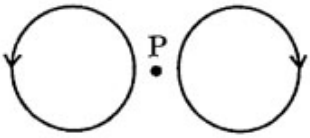
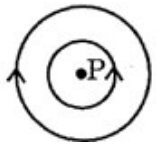
Answer



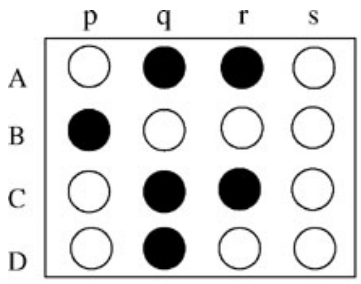
OR



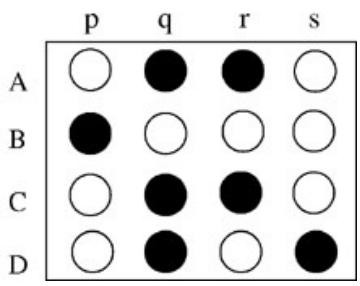
21. Two wires each carrying a steady current I are shown in four configurations in **Column I**. Some of the resulting effects are described in **Column II**. Match the statements in **Column I** with the statements in **Column II** and indicate your answer by darkening appropriate bubbles in the 4×4 matrix given in the ORS.

Column I		**Column II**
(A) Point P is situated midway between the wires.		(p) The magnetic fields (B) at P due to the currents in the wires are in the same direction.
(B) Point P is situated at the mid-point of the line joining the centers of the circular wires, which have same radii.		(q) The magnetic fields (B) at P due to the currents in the wires are in opposite directions.
(C) Point P is situated at the mid-point of the line joining the centers of the circular wires, which have same radii.		(r) There is no magnetic field at P.
(D) Point P is situated at the common center of the wires.		(s) The wires repel each other.

Answer



OR



22. **Column I** gives some devices and **Column II** gives some processes on which the functioning of these devices depend. Match the devices in **Column I** with the processes in **Column II** and indicate your answer by darkening appropriate bubbles in the 4×4 matrix given in the ORS.

Column I	**Column II**
(A) Bimetallic strip	(p) Radiation from a hot body
(B) Steam engine	(q) Energy conversion
(C) Incandescent lamp	(r) Melting
(D) Electric fuse	(s) Thermal expansion of solids

Answer **A – 's, q' OR ' s' alone**

B – 'q'

C – 'p, q' OR 'p' alone

D – 'q, r' OR 'r' alone

23. Consider a titration of potassium dichromate solution with acidified Mohr's salt solution using diphenylamine as indicator. The number of moles of Mohr's salt required per mole of dichromate is

(A) 3 (B) 4 (C) 5 (D) 6

Answer ○ ○ ○ ●

(A) (B) (C) (D)

24. Among the following metal carbonyls, the C–O bond order is lowest in

(A) $[Mn(CO)_6]^+$ (B) $[Fe(CO)_5]$ (C) $[Cr(CO)_6]$ (D) $[V(CO)_6]^-$

Answer ○ ○ ○ ●

(A) (B) (C) (D)

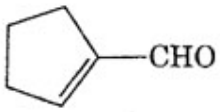
25. A solution of a metal ion when treated with KI gives a red precipitate which dissolves in excess KI to give a colourless solution. Moreover, the solution of metal ion on treatment with a solution of cobalt(II) thiocyanate gives rise to a deep blue crystalline precipitate. The metal ion is

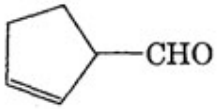
(A) Pb^{2+} (B) Hg^{2+} (C) Cu^{2+} (D) Co^{2+}

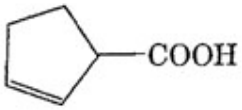
Answer ○ ● ○ ○

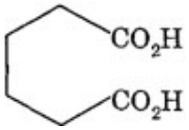
(A) (B) (C) (D)

26. Cyclohexene on ozonolysis followed by reaction with zinc dust and water gives compound **E**. Compound **E** on further treatment with aqueous KOH yields compound **F**. Compound **F** is

(A) 

(B) 

(C) 

(D) 

Answer ● ○ ○ ○

(A) (B) (C) (D)

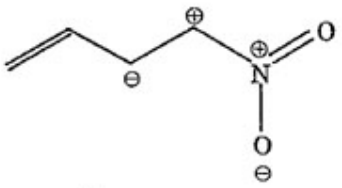
27. The number of stereoisomers obtained by bromination of *trans*-2-butene is

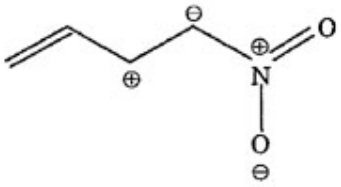
(A) 1 (B) 2 (C) 3 (D) 4

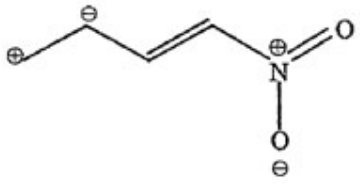
Answer ● ○ ○ ○

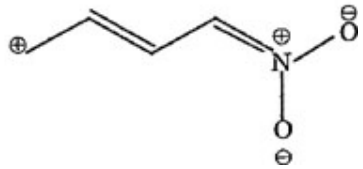
(A) (B) (C) (D)

28. Among the following, the least stable resonance structure is

(A) 

(B) 

(C) 

(D) 

Answer ● ○ ○ ○

(A) (B) (C) (D)

29. A positron is emitted from $^{23}_{11}Na$. The ratio of the atomic mass and atomic number of the resulting nuclide is

(A) 22/10 (B) 22/11

(C) 23/10 (D) 23/12

Answer ○ ○ ● ○

(A) (B) (C) (D)

30. For the process $H_2O(l)$ (1 bar, 373 K) → $H_2O(g)$ (1 bar, 373 K), the correct set of thermodynamic parameters is

(A) $\Delta G = 0$, $\Delta S = +ve$ (B) $\Delta G = 0$, $\Delta S = -ve$

(C) $\Delta G = +ve$, $\Delta S = 0$ (D) $\Delta G = -ve$, $\Delta S = +ve$

Answer ● ○ ○ ○

(A) (B) (C) (D)

31. Consider a reaction aG + bH → Products. When concentration of both the reactants G and H is doubled, the rate increases by eight times. However, when concentration of G is doubled keeping the concentration of H fixed, the rate is doubled. The overall order of the reaction is

(A) 0 (B) 1 (C) 2 (D) 3

Answer ○ ○ ○ ●

(A) (B) (C) (D)

32. STATEMENT-1 : Alkali metals dissolve in liquid ammonia to give blue solutions.

because

STATEMENT-2 : Alkali metals in liquid ammonia give solvated species of the type $[M(NH_3)_n]^+$ (M = alkali metals).

(A) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1

(B) Statement-1 is True; Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1

(C) Statement-1 is True, Statement-2 is False

(D) Statement-1 is False, Statement-2 is True

Answer ○ ● ○ ○

(A) (B) (C) (D)

33. STATEMENT-1 : Glucose gives a reddish-brown precipitate with Fehling's solution.

because

STATEMENT-2 : Reaction of glucose with Fehling's solution gives CuO and gluconic acid.

(A) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1

(B) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1

(C) Statement-1 is True, Statement-2 is False

(D) Statement-1 is False, Statement-2 is True

Answer ○ ○ ● ○

(A) (B) (C) (D)

34. STATEMENT-1 : Molecules that are not superimposable on their mirror images are chiral.

because

STATEMENT-2 : All chiral molecules have chiral centres.

(A) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1

(B) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1

(C) Statement-1 is True, Statement-2 is False

(D) Statement-1 is False, Statement-2 is True

Answer ○ ○ ● ○

(A) (B) (C) (D)

35. STATEMENT-1 : Band gap in germanium is small.

because

STATEMENT-2 : The energy spread of each germanium atomic energy level is infinitesimally small.

(A) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1

(B) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1

(C) Statement-1 is True, Statement-2 is False

(D) Statement-1 is False, Statement-2 is True

Answer ○ ● ○ ○

(A) (B) (C) (D)

36. Among the following, identify the correct statement.

(A) Chloride ion is oxidised by O_2 (B) Fe^{2+} is oxidised by iodine

(C) Iodide ion is oxidised by chlorine (D) Mn^{2+} is oxidised by chlorine

Answer ○ ○ ● ○

(A) (B) (C) (D)

37. While Fe^{3+} is stable, Mn^{3+} is not stable in acid solution because

(A) O_2 oxidises Mn^{2+} to Mn^{3+}

(B) O_2 oxidises both Mn^{2+} to Mn^{3+} and Fe^{2+} to Fe^{3+}

(C) Fe^{3+} oxidises H_2O to O_2

(D) Mn^{3+} oxidises H_2O to O_2

Answer ○ ○ ○ ●

(A) (B) (C) (D)

38. Sodium fusion extract, obtained from aniline, on treatment with iron(II) sulphate and H_2SO_4 in presence of air gives a Prussian blue precipitate. The blue colour is due to the formation of

(A) $Fe_4[Fe(CN)_6]_3$ (B) $Fe_3[Fe(CN)_6]_2$

(C) $Fe_4[Fe(CN)_6]_2$ (D) $Fe_3[Fe(CN)_6]_3$

Answer ● ○ ○ ○

(A) (B) (C) (D)

39. Which one of the following reagents is used in the above reaction?

(A) aq. NaOH + CH_3Cl (B) aq. NaOH + CH_2Cl_2

(C) aq. NaOH + $CHCl_3$ (D) aq. NaOH + CCl_4

Answer ○ ○ ● ○

(A) (B) (C) (D)

10. The electrophile in this reaction is

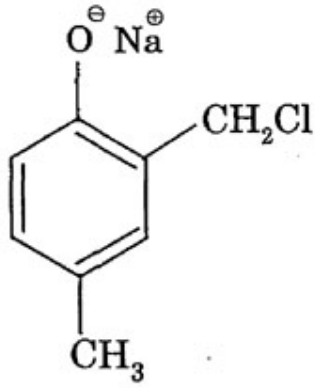
(A) :CHCl (B) $^{+}CHCl_2$ (C) $:CCl_2$ (D) $\cdot CCl_3$

Answer ○ ○ ● ○

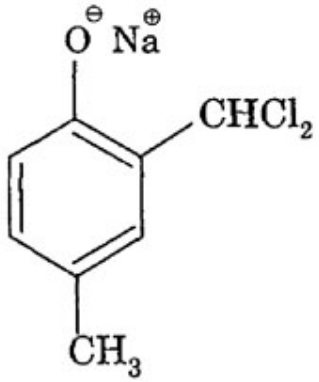
(A) (B) (C) (D)

41. The structure of the intermediate **I** is

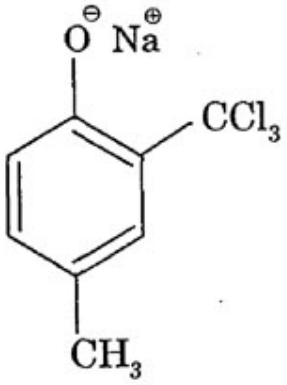
(A)



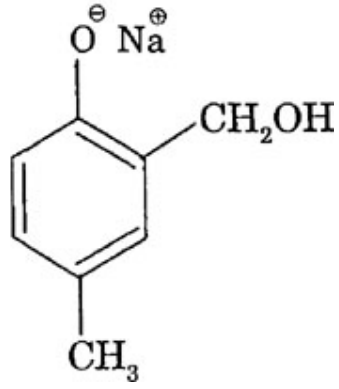
(B)



(C)



(D)



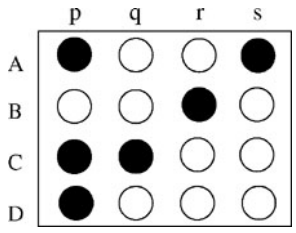
Answer ○ ● ○ ○

(A) (B) (C) (D)

42. Match the reactions in **Column I** with nature of the reactions/type of the products in **Column II**. Indicate your answer by darkening the appropriate bubbles of the 4×4 matrix given in the ORS.

Column I	**Column II**
(A) $O_2^- \rightarrow O_2 + O_2^{2-}$	(p) redox reaction
(B) $CrO_4^{2-} + H^+ \rightarrow$	(q) one of the products has trigonal planar structure
(C) $MnO_4^- + NO_2^- + H^+ \rightarrow$	(r) dimeric bridged tetrahedral metal ion
(D) $NO_3^- + H_2SO_4 + Fe^{2+} \rightarrow$	(s) disproportionation

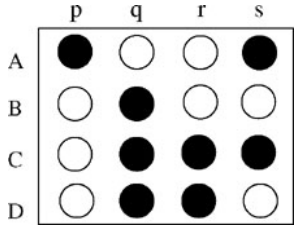
Answer



43. Match the compounds/ions in **Column I** with their properties/reactions in **Column II**. Indicate your answer by darkening the appropriate bubbles of the 4×4 matrix given in the ORS.

Column I	**Column II**
(A) C_6H_5CHO	(p) gives precipitate with 2,4-dinitrophenylhydrazine
(B) $CH_3C \equiv CH$	(q) gives precipitate with $AgNO_3$
(C) CN^-	(r) is a nucleophile
(D) I^-	(s) is involved in cyanohydrin formation

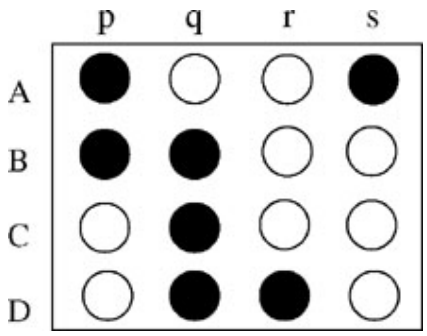
Answer



44. Match the crystal system/unit cells mentioned in **Column I** with their characteristic features mentioned in **Column II**. Indicate your answer by darkening the appropriate bubbles of the 4×4 matrix given in the ORS.

Column I	**Column II**
(A) simple cubic and face-centred cubic	(p) have these cell parameters $a=b=c$ and $\alpha=\beta=\gamma$
(B) cubic and rhombohedral	(q) are two crystal systems
(C) cubic and tetragonal	(r) have only two crystallographic angles of 90°
(D) hexagonal and monoclinic	(s) belong to same crystal system

Answer



45. Let $O(0, 0)$, $P(3, 4)$, $Q(6, 0)$ be the vertices of the triangle OPQ. The point R inside the triangle OPQ is such that the triangles OPR, PQR, OQR are of equal area. The coordinates of R are

(A) $\left(\frac{4}{3}, 3\right)$ (B) $\left(3, \frac{2}{3}\right)$

(C) $\left(3, \frac{4}{3}\right)$ (D) $\left(\frac{4}{3}, \frac{2}{3}\right)$

Answer

(A) (B) (C) (D)

46. If $|z|=1$ and $z \neq \pm 1$, then all the values of $\frac{z}{1-z^2}$ lie on

(A) a line not passing through the origin

(B) $|z|=\sqrt{2}$

(C) the x-axis

(D) the y-axis

Answer ○ (A) ○ (B) ○ (C) ● (D)

47. Let E^c denote the complement of an event E. Let E, F, G be pairwise independent events with $P(G)>0$ and $P(E \cap F \cap G)=0$. Then $P\left(E^c \cap F^c \mid G\right)$ equals

(A) $P\left(E^c\right)+P\left(F^c\right)$ (B) $P\left(E^c\right)-P\left(F^c\right)$

(C) $P\left(E^c\right)-P(F)$ (D) $P(E)-P\left(F^c\right)$

Answer ○ (A) ○ (B) ● (C) ○ (D)

48. $\frac{d^2x}{dy^2}$ equals

(A) $\left(\frac{d^2y}{dx^2}\right)^{-1}$ (B) $-\left(\frac{d^2y}{dx^2}\right)^{-1}\left(\frac{dy}{dx}\right)^{-3}$

(C) $\left(\frac{d^2y}{dx^2}\right)\left(\frac{dy}{dx}\right)^{-2}$ (D) $-\left(\frac{d^2y}{dx^2}\right)\left(\frac{dy}{dx}\right)^{-3}$

Answer ○ (A) ○ (B) ○ (C) ● (D)

49. The differential equation $\frac{dy}{dx} = \frac{\sqrt{1-y^2}}{y}$ determines a family of circles with

(A) variable radii and a fixed centre at $(0, 1)$

(B) variable radii and a fixed centre at $(0, -1)$

(C) fixed radius 1 and variable centres along the x-axis

(D) fixed radius 1 and variable centres along the y-axis

Answer ○ ○ ● ○

(A) (B) (C) (D)

50. Let $\vec{a}, \vec{b}, \vec{c}$ be unit vectors such that $\vec{a} + \vec{b} + \vec{c} = \vec{0}$. Which one of the following is correct?

(A) $\vec{a} \times \vec{b} = \vec{b} \times \vec{c} = \vec{c} \times \vec{a} = \vec{0}$

(B) $\vec{a} \times \vec{b} = \vec{b} \times \vec{c} = \vec{c} \times \vec{a} \neq \vec{0}$

(C) $\vec{a} \times \vec{b} = \vec{b} \times \vec{c} = \vec{a} \times \vec{c} \neq \vec{0}$

(D) $\vec{a} \times \vec{b}, \vec{b} \times \vec{c}, \vec{c} \times \vec{a}$ are mutually perpendicular

Answer ○ ● ○ ○

(A) (B) (C) (D)

51. Let $ABCD$ be a quadrilateral with area 18, with side AB parallel to the side CD and $AB = 2\,CD$. Let AD be perpendicular to AB and CD. If a circle is drawn inside the quadrilateral $ABCD$ touching all the sides, then its radius is

(A) 3 (B) 2 (C) $\frac{3}{2}$ (D) 1

Answer ○ ● ○ ○

(A) (B) (C) (D)

52. Let $f(x)=\dfrac{x}{\left(1+x^n\right)^{1/n}}$ for $n\geq 2$ and $g(x)=\underbrace{(f\circ f\circ\cdots\circ f)}_{f \text{ occurs } n \text{ times}}(x)$. Then $\int x^{n-2}g(x)\,dx$ equals

(A) $\dfrac{1}{n(n-1)}\left(1+nx^n\right)^{1-\frac{1}{n}}+K$ (B) $\dfrac{1}{n-1}\left(1+nx^n\right)^{1-\frac{1}{n}}+K$

(C) $\dfrac{1}{n(n+1)}\left(1+nx^n\right)^{1+\frac{1}{n}}+K$ (D) $\dfrac{1}{n+1}\left(1+nx^n\right)^{1+\frac{1}{n}}+K$

Answer ● ○ ○ ○

(A) (B) (C) (D)

53. The letters of the word **COCHIN** are permuted and all the permutations are arranged in an alphabetical order as in an English dictionary. The number of words that appear before the word **COCHIN** is

(A) 360 (B) 192 (C) 96 (D) 48

Answer ○ ○ ● ○

(A) (B) (C) (D)

54. Consider the planes $3x-6y-2z=15$ and $2x+y-2z=5$.

STATEMENT-1 : The parametric equations of the line of intersection of the given planes are $x=3+14t,\ y=1+2t,\ z=15t$.

because

STATEMENT-2 : The vector $14\hat{i}+2\hat{j}+15\hat{k}$ is parallel to the line of intersection of given planes.

(A) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1

(B) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1

(C) Statement-1 is True, Statement-2 is False

(D) Statement-1 is False, Statement-2 is True

Answer ○ ○ ○ ●

(A) (B) (C) (D)

55. STATEMENT-1 : The curve $y = \frac{-x^2}{2} + x + 1$ is symmetric with respect to the line $x = 1$.

because

STATEMENT-2 : A parabola is symmetric about its axis.

(A) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1

(B) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1

(C) Statement-1 is True, Statement-2 is False

(D) Statement-1 is False, Statement-2 is True

Answer ● ○ ○ ○

(A) (B) (C) (D)

56. Let $f(x) = 2 + \cos x$ for all real x.

STATEMENT-1 : For each real t, there exists a point c in $[t, t+\pi]$ such that $f'(c) = 0$.

because

STATEMENT-2 : $f(t) = f(t + 2\pi)$ for each real t.

(A) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1

(B) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1

(C) Statement-1 is True, Statement-2 is False

(D) Statement-1 is False, Statement-2 is True

Answer ○ ● ○ ○

(A) (B) (C) (D)

57. Lines $L_1 : y - x = 0$ and $L_2 : 2x + y = 0$ intersect the line $L_3 : y + 2 = 0$ at P and Q, respectively. The bisector of the acute angle between L_1 and L_2 intersects L_3 at R.

STATEMENT-1 : The ratio $PR : RQ$ equals $2\sqrt{2} : \sqrt{5}$.

because

STATEMENT-2 : In any triangle, bisector of an angle divides the triangle into two similar triangles.

(A) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1

(B) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1

(C) Statement-1 is True, Statement-2 is False

(D) Statement-1 is False, Statement-2 is True

Answer ○ ○ ● ○

(A) (B) (C) (D)

58. Which one of the following statements is correct?

(A) $G_1 > G_2 > G_3 > \cdots$

(B) $G_1 < G_2 < G_3 < \cdots$

(C) $G_1 = G_2 = G_3 = \cdots$

(D) $G_1 < G_3 < G_5 < \cdots$ and $G_2 > G_4 > G_6 > \cdots$

Answer ○ ○ ● ○

(A) (B) (C) (D)

59. Which one of the following statements is correct?

(A) $A_1 > A_2 > A_3 > \cdots$

(B) $A_1 < A_2 < A_3 < \cdots$

(C) $A_1 > A_3 > A_5 > \cdots$ and $A_2 < A_4 < A_6 < \cdots$

(D) $A_1 < A_3 < A_5 < \cdots$ and $A_2 > A_4 > A_6 > \cdots$

Answer ● ○ ○ ○

(A) (B) (C) (D)

60. Which one of the following statements is correct?
(A) $H_1 > H_2 > H_3 > \cdots$
(B) $H_1 < H_2 < H_3 < \cdots$
(C) $H_1 > H_3 > H_5 > \cdots$ and $H_2 < H_4 < H_6 < \cdots$
(D) $H_1 < H_3 < H_5 < \cdots$ and $H_2 > H_4 > H_6 > \cdots$

M61-63 : Paragraph for Question Nos. 61 to 63

If a continuous function f defined on the real line **R**, assumes positive and negative values in **R** then the equation $f(x) = 0$ has a root in **R**. For example, if it is known that a continuous function f on **R** is positive at some point and its minimum value is negative then the equation $f(x) = 0$ has a root in **R**.

Consider $f(x) = ke^x - x$ for all real x where k is a real constant.

Answer ○ ● ○ ○
(A) (B) (C) (D)

61. The line $y = x$ meets $y = ke^x$ for $k \leq 0$ at
(A) no point
(B) one point
(C) two points
(D) more than two points

Answer ○ ● ○ ○
(A) (B) (C) (D)

62. The positive value of k for which $ke^x - x = 0$ has only one root is
(A) $\frac{1}{e}$ (B) 1 (C) e (D) $\log_e 2$

Answer ● ○ ○ ○
(A) (B) (C) (D)

63. For $k > 0$, the set of all values of k for which $ke^x - x = 0$ has two distinct roots is
(A) $\left(0, \frac{1}{e}\right)$ (B) $\left(\frac{1}{e}, 1\right)$ (C) $\left(\frac{1}{e}, \infty\right)$ (D) $(0, 1)$

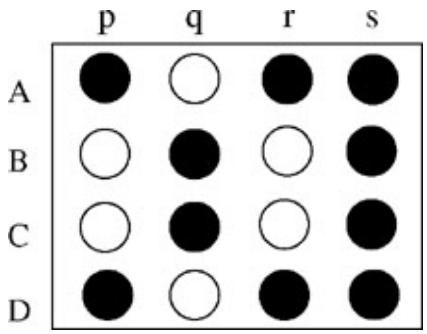
Answer ● ○ ○ ○
(A) (B) (C) (D)

64. Let $f(x)=\dfrac{x^2-6x+5}{x^2-5x+6}$.

Match the expressions/statements in **Column I** with expressions/statements in **Column II** and indicate your answer by darkening the appropriate bubbles in the 4×4 matrix given in the ORS.

Column I	**Column II**
(A) If $-1<x<1$, then $f(x)$ satisfies	(p) $0<f(x)<1$
(B) If $1<x<2$, then $f(x)$ satisfies	(q) $f(x)<0$
(C) If $3<x<5$, then $f(x)$ satisfies	(r) $f(x)>0$
(D) If $x>5$, then $f(x)$ satisfies	(s) $f(x)<1$

Answer



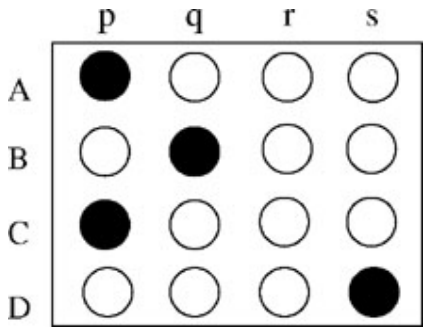
65. Let (x, y) be such that

$$\sin^{-1}(a\,x)+\cos^{-1}(y)+\cos^{-1}(b\,x\,y)=\frac{\pi}{2}.$$

Match the statements in **Column I** with statements in **Column II** and indicate your answer by darkening the appropriate bubbles in the 4×4 matrix given in the ORS.

Column I	**Column II**
(A) If $a=1$ and $b=0$, then (x, y)	(p) lies on the circle $x^2+y^2=1$
(B) If $a=1$ and $b=1$, then (x, y)	(q) lies on $(x^2-1)(y^2-1)=0$
(C) If $a=1$ and $b=2$, then (x, y)	(r) lies on $y=x$
(D) If $a=2$ and $b=2$, then (x, y)	(s) lies on $(4x^2-1)(y^2-1)=0$

Answer



66. Match the statements in **Column I** with the properties in **Column II** and indicate your answer by darkening the appropriate bubbles in the 4×4 matrix given in the ORS.

Column I	**Column II**
(A) Two intersecting circles	(p) have a common tangent
(B) Two mutually external circles	(q) have a common normal
(C) Two circles, one strictly inside the other	(r) do not have a common tangent
(D) Two branches of a hyperbola	(s) do not have a common normal

Answer