Competishun

52/6, Opposite Metro Mas Hospital, Shipra Path, Mansarovar

Date: 07/10/2024

Time: 3 hours **Max. Marks:** 300

PRAVEEN-2 (24-25)_MPT-4

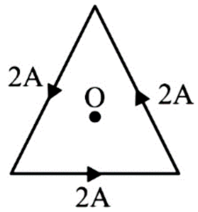
Physics

Single Choice Question

Q1 A charged particle carrying charge 1 μC is moving with velocity $(2\hat{i}+3\hat{j}+4\hat{k})ms^{-1}$. If an external magnetic field of $(5\hat{i}+3\hat{j}+6\hat{k})\times10^{-3}T$ exists in the region where the particle is moving then the force on the particle is $\vec{F}\times10^{-9}$ N. The vector $\vec{F}$ is

a) $-3.0\hat{i}+3.2\hat{j}-0.9\hat{k}$ b) $-300\hat{i}+320\hat{j}-90\hat{k}$ c) $-.030\hat{i}+0.32\hat{j}-0.09\hat{k}$ d) $-30\hat{i}+32\hat{j}-9\hat{k}$

Q2 As shown in the figure, a current of 2A flowing in an equilateral triangle of side $4\sqrt{3}$ cm. The magnetic field at the centroid O of the triangle is :



(Neglect the effect of earth's magnetic field.)

a) $4\sqrt{3}\times10^{-4}T$ b) $4\sqrt{3}\times10^{-5}T$ c) $\sqrt{3}\times10^{-4}T$ d) $3\sqrt{3}\times10^{-5}T$

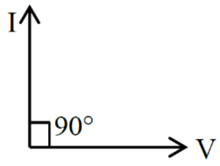
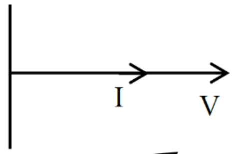
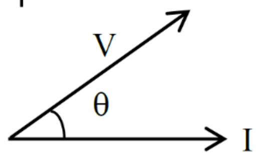
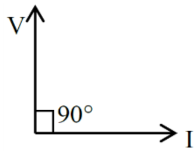
Q3 A small bar magnet placed with its axis at 30° with an external field of 0.06 T experiences a torque of 0.018 Nm. The minimum work required to rotate it from its stable to unstable equilibrium position is

a) 9.2×10^{-3} J b) 6.4×10^{-2} J c) 7.2×10^{-2} J d) 11.7×10^{-3} J

Q4 An AC current is given by $I = I_1 \sin\omega t + I_2 \cos\omega t$. A hot wire ammeter will give a reading :

a) $\sqrt{\frac{I_1^2-I_2^2}{2}}$ b) $\sqrt{\frac{I_1^2+I_2^2}{2}}$ c) $\frac{I_1^2+I_2^2}{\sqrt{2}}$ d) $\frac{I_1^2+I_2^2}{2\sqrt{2}}$

Q5 Match List I with List II

List-I		**List-II**
(A) Purely capacitive circuit	(I)	
(B) Purely inductive circuit	(II)	
(C) LCR series at resonance	(III)	
(D) LCR series circuit	(IV)	

Choose the correct answer from the options given below :

a) A-I, B-IV, C-III, D-II **b)** A-IV, B-I, C-III, D-II **c)** A-IV, B-I, C-II, D-III
d) A-I, B-IV, C-II, D-III

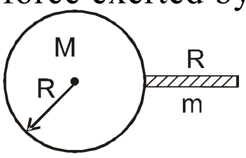
Q6 If T_1 = time period of a simple pendulum of infinite length, T_2 = time period of simple harmonic motion of a body dropped in a tunnel dug along diameter of earth and T_3 = time period of circular motion of a satellite revolving near the surface of the earth, then:

a) $T_1 > T_2 = T_3$ **b)** $T_1 = T_2 = T_3$ **c)** $T_1 = T_2 > T_3$ **d)** $T_1 < T_2 < T_3$

Q7 A cavity of radius R/2 is made inside a solid sphere of radius R. The centre of the cavity is located at a distance R/2 from the centre of the sphere. The gravitational force on a particle of mass ' m ' at a distance R/2 from the centre of the sphere on the line joining both the centres of sphere and cavity is (opposite to the centre of cavity). [Here $g = GM/R^2$, where M is the mass of the solid sphere]

a) $\frac{mg}{2}$ **b)** $\frac{3\,mg}{8}$ **c)** $\frac{mg}{16}$ **d)** none of these

Q8 A uniform thin rod of mass m and length R is placed normally on surface of earth as shown. The mass of earth is M and its radius is R. Then the magnitude of gravitational force exerted by earth on the rod is

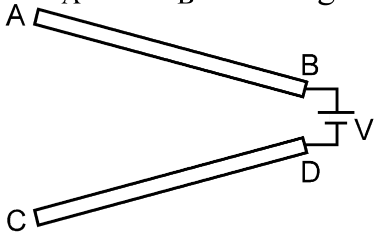


a) $\frac{GMm}{2R^2}$ **b)** $\frac{GMm}{4R^2}$ **c)** $\frac{4GMm}{9R^2}$ **d)** $\frac{GMm}{8R^2}$

Q9 A tunnel is dug along the diameter of the earth (Radius R & mass M). There is a particle of mass ' m ' at the centre of the tunnel. Find the minimum velocity given to the particle so that it just reaches to the surface of the earth :

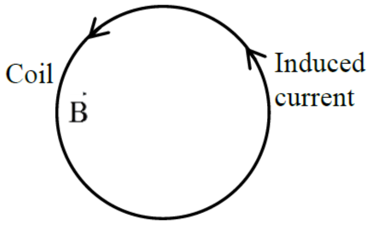
a) $\sqrt{\frac{GM}{R}}$ **b)** $\sqrt{\frac{GM}{2R}}$ **c)** $\sqrt{\frac{2GM}{R}}$ **d)** it will reach with the help of negligible velocity

Q10 AB and CD are two large non parallel metallic plates connected to a battery as shown. If σ_A and σ_B be charge densities at points A and B respectively then :



a) $\sigma_A > \sigma_B$ **b)** $\sigma_A < \sigma_B$ **c)** $\sigma_A \geq \sigma_B$ **d)** $\sigma_A \leq \sigma_B$

Q11 A coil is placed in a magnetic field B as shown below :



A current is induced in the coil because B is :

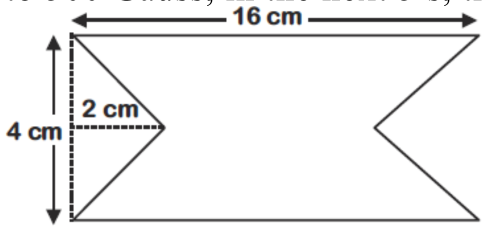
a) Outward and decreasing with time

b) Parallel to the plane of coil and decreasing with time

c) Outward and increasing with time

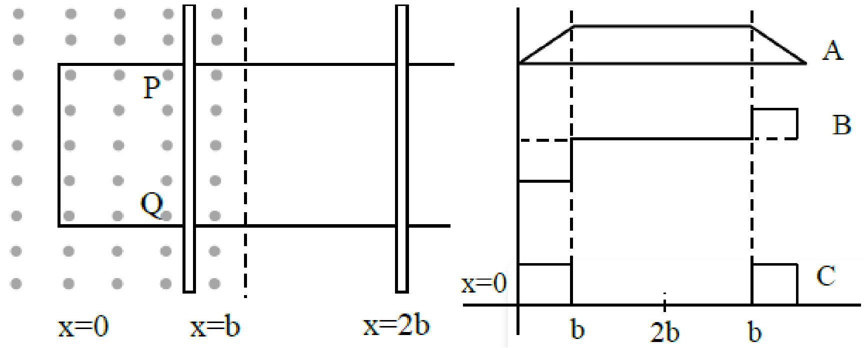
d) Parallel to the plane of coil and increasing with time

Q12 At time t = 0 magnetic field of 1000 Gauss is passing perpendicularly through the area defined by the closed loop shown in the figure. If the magnetic field reduces linearly to 500 Gauss, in the next 5 s, then induced EMF in the loop is



a) 48 μV **b)** 36 μV **c)** 56 μV **d)** 28 μV

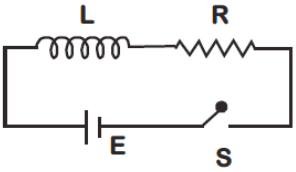
Q13 The arm PQ of a rectangular conductor is moving from x = 0 to x = 2b outwards and then inwards from x = 2b to x = 0 as shown in the figure. A uniform magnetic field perpendicular to the plane is acting from x = 0 to x = b. Identify the graph showing the variation of different quantities with distance :



a) A-Flux, B-Power dissipated, C-EMF **b)** A-Power dissipated, B-Flux, C-EMF

c) A-Flux, B-EMF, C-Power dissipated **d)** A-EMF, B-Power dissipated, C-Flux

Q14 As shown in the figure, a battery of emf E is connected to an inductor L and resistance R in series. The switch is closed at t = 0. The total charge that flows from the battery, between t = 0 and $t = t_C$ (t_C is the time constant of the circuit) is :



a) $\frac{EL}{R^2}$ **b)** $\frac{EL}{eL^2}$ **c)** $\frac{EL}{R^2}\left(1-\frac{1}{e}\right)$ **d)** $\frac{EL}{eR^2}$

Q15 Currents upto 100 A are to be measured with the help of an ammeter designed for a maximum current of 10 A and having resistance of 0.1 Ω. The resistance of additional shunt must be

a) 0.1 Ω **b)** $\frac{1}{9}\ \Omega$ **c)** $\frac{1}{100}\ \Omega$ **d)** $\frac{1}{90}\ \Omega$

Q16 When a galvanometer is shunted with a 4Ω resistance, the deflection is reduced to one - fifth. If the galvanometer is further shunted with a 2Ω wire, the further reduction (find the ratio of decrease in current to the previous current) in the deflection will be (the main current remains the same).

a) (8/13) of the deflection when shunted with 4Ω only

b) (5/13) of the deflection when shunted with 4Ω only

c) (3/4) of the deflection when shunted with 4Ω only

d) (3/13) of the deflection when shunted with 4Ω only

Q17 The dimensional formula of capacitance is: (where Q is charge)

a) $M^{-1} L^{-1} T Q$ **b)** $M^1 L^1 T^{-2} Q^2$ **c)** $M^{-1} L^{-2} T^2 Q^2$ **d)** $M^{-1} L^{-3} T^2 Q^2$

Q18 Two particles having charge Q each are kept on the x-axis at points (–a, 0) and (a, 0). A charge q is found to be in equilibrium at two positions on y-axis at point B_1 $(0, b_1)$ and B_2 $(0, b_2)$.
[Assume that x-axis is along the horizontal direction and y-axis is along the vertical direction and particles are near the surface of earth]. $(b_2 > b_1 > 0)$.

a) Particle might be in stable equilibrium at both the positions.

b) Particle might be in unstable equilibrium at both the positions.

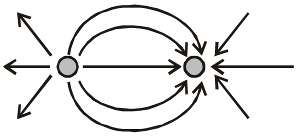
c) Particle is in stable equilibrium at point B_1 and is in unstable equilibrium at point B_2.

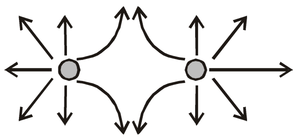
d) Particle is in unstable equilibrium at point B_1 and is in stable equilibrium at point B_2.

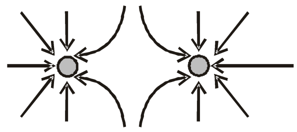
Q19 An electron is accelerated through a potential difference of 45.5 volt. The velocity acquired by it is (in ms^{-1}) :

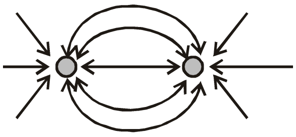
a) 10^6 **b)** Zero **c)** 4×10^6 **d)** 4×10^4

Q20 Assume that gravitational lines of forces represent gravitational field just like electric lines of forces represent electric field. Which of the following diagram correctly represents the gravitational field lines for a pair of point masses shown in options below ?

a) 

b) 

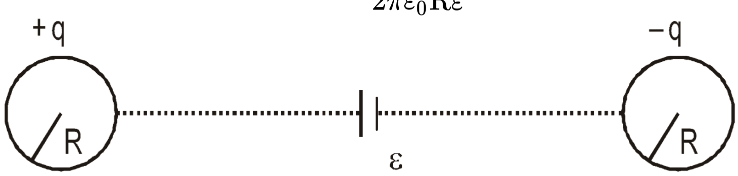
c) 

d) 

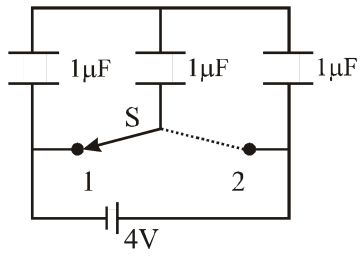
Numerical

Q21 When a coil is connected across a 20 V dc supply, it draws a current of 5 A. When it is connected across 20 V, 50 Hz ac supply, it draws a current of 4 A. The self inductance of the coil is mH. (Take π = 3)

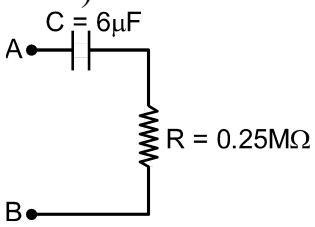
Q22 Two metallic spheres each of radius R separated by a large distance and connected with a battery of emf ε as shown. In the electric equilibrium the charge on the spheres are +q and –q. If $K = \frac{q}{2\pi\varepsilon_0 R\varepsilon}$, find the value of K.



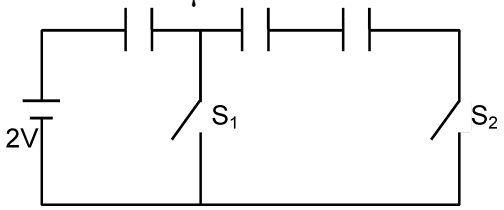
Q23 If switch S is connected with point-1. initially. Net heat produced in the circuit after switch S is connected to point 2 is $\frac{x}{12}$ μJ, then x is :



Q24 A time varying voltage is applied across A & B such that voltage across capacitor is given by $V_C = 3 \sin 2t$. What is maximum potential difference across the resistance (in volts) ?



Q25 In given circuit initially all capacitors were uncharged. First switch S_1 is closed and S_2 is kept open. After steady state First S_1 is opened and then S_2 is closed. The capacitance of each capacitor is 6μF. Find the charge flown through switch S_2 after it is closed in μC :

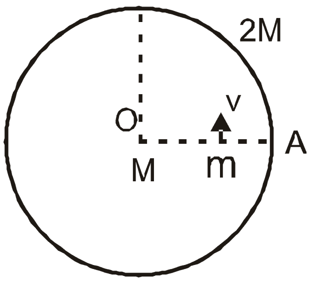


Q26 A plane electromagnetic wave with frequency of 30 MHz travels in free space. At particular point in space and time, electric field is 6 V/m. The magnetic field at this point will be $x \times 10^{-8}$ T. The value of x is _____.

Q27 An electromagnetic wave of frequency 5 GHz, is travelling in a medium whose relative electric permittivity and relative magnetic permeability both are 2. Its velocity in this medium is _____$\times 10^7$ m/s.

Q28 A 1kg ball is suspended in a uniform electric field with the help of a string fixed to a point. The ball is given a charge $\sqrt{5}$ coulomb and the string makes an angle 37^0 with the vertical in equilibrium position. In the equilibrium position the tension is double the weight of the ball. Find the magnitude of the electric field in N/Coul.

Q29 A particle of mass M is fixed at the centre (point O) of a uniform shell of mass 2M and radius R. Another particle of mass m ($<<$M) is projected from mid point of radius OA with velocity V perpendicular to the radius. The maximum value of v so that the particle does not strike the surface of the shell is $\sqrt{\frac{NGM}{3R}}$, calculate N.



Q30 A particle of mass m having a charge q is projected from ground with a speed u at angle θ with the horizontal. At the instant the particle reaches the highest point of its trajectory, horizontal electric field is switched on in such a way that the particle reaches the point of projection again. Find the magnitude of electric field (in 10^3 N/C). (Given m = 1g, q = 8 μC, u = 10 ms^{-1}, $\theta = 45^\circ$)

Chemistry

Single Choice Question

Q31 For compound having the formula $GaAlCl_4$, the correct option from the following is

a) Ga is more electronegative than Al and is present as a cationic part of the salt $GaAlCl_4$

b) Oxidation state of Ga in the salt $GaAlCl_4$ is +3.

c) Cl forms bond with both Al and Ga in $GaAlCl_4$

d) Ga is coordinated with Cl in $GaAlCl_4$

Q32 White phosphorus reacts with thionyl chloride to give

a) PCl_5, SO_2 and S_2Cl_2 **b)** PCl_3, SO_2 and S_2Cl_2 **c)** PCl_3, SO_2 and Cl_2

d) PCl_5, SO_2 and Cl_2

Q33 The compound that cannot act both as oxidising and reducing agent is

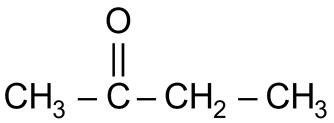
a) H_3PO_4 **b)** H_2SO_3 **c)** H_2O_2 **d)** HNO_2

Q34 The reagent used for Friedel-Craft's reaction is :

a) Dry ether **b)** $AlCl_3$ **c)** Anhydrous $AlCl_3$ **d)** P_2O_5

Q35 Which of the following reactants will give only one organic product when reacted with NaCN / H_2SO_4 (small amounts) (No other isomer is obtained)

a) CH_3CHO **b)** HCHO **c)** PhCHO **d)**



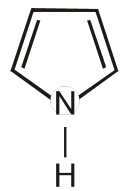
Q36 For the reaction of H_2 with I_2, the rate constant is 2.5×10^{-4} dm3 mol^{-1} s^{-1} at 327°C and 1.0 dm^3 mol^{-1} s^{-1} at 527°C. The activation energy for the reaction, in kJ mol–1 is :

($R = 8.314$ J K^{-1} mol^{-1})

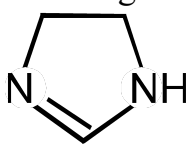
a) 150 **b)** 59 **c)** 72 **d)** 166

Q37 Which of the following is strongest base ?

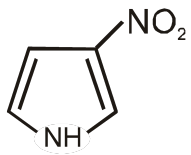
a)



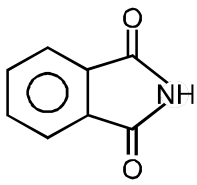
b)



c)

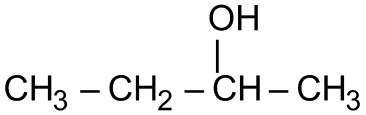


d)

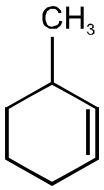


Q38 Which of the following compound is optically inactive ?

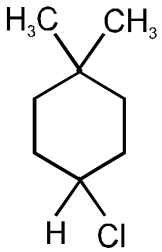
a)



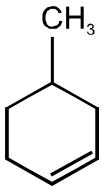
b)



c)



d)



Q39 In neutral or faintly alkaline medium, $KMnO_4$ being a powerful oxidant can oxidize, thiosulphate almost quantitatively, to sulphate. In this reaction overall change in oxidation state of manganese will be :

a) 5 **b)** 1 **c)** 0 **d)** 3

Q40 Decomposition of X exhibits a rate constant of 0.05 μg/year. How many years are required for the decomposition of 5 μg of X into 2.5 μg?

a) 40 **b)** 20 **c)** 50 **d)** 25

Q41 The strength of 11.2 volume solution of H_2O_2 is [Given that molar mass of H = 1 g mol^{-1} and O = 16 g mol^{-1}]

a) 13.6% **b)** 1.7% **c)** 3.4% **d)** 34%

Q42 An open beaker of water in equilibrium with water vapour is in a sealed container. When a few grams of glucose are added to the beaker of water, the rate at which water molecules

a) leaves the solution increases **b)** leaves the vapour increases

c) leaves the vapour decreases **d)** leaves the solution decreases

Q43 Liquids A and B form an ideal solution in the entire composition range. At 350 K, the vapor pressures of pure A and pure B are 7×10^3 Pa and 12×10^3 Pa, respectively. The composition of the vapor in equilibrium with a solution containing 40 mole percent of A at this temperature is

a) $x_A = 0.76; x_B = 0.24$ **b)** $x_A = 0.37; x_B = 0.63$ **c)** $x_A = 0.28; x_B = 0.72$

d) $x_A = 0.4; x_B = 0.6$

Q44 Which of the following 3d-metal ion will give the lowest enthalpy of hydration ($\Delta_{hyd}H$) when dissolved in water ?

a) Cr^{2+} **b)** Mn^{2+} **c)** Fe^{2+} **d)** Co^{2+}

Q45 Choose the correct option having all the elements with d^{10} electronic configuration from the following:

a) ^{27}Co, ^{28}Ni, ^{26}Fe, ^{24}Cr **b)** ^{29}Cu, ^{30}Zn, ^{48}Cd, ^{47}Ag

c) ^{46}Pd, ^{28}Ni, ^{26}Fe, ^{24}Cr **d)** ^{28}Ni, $^{24}_{2}Cr$, ^{26}Fe, ^{29}Cu

Q46 Identify the process in which change in the oxidation state is five :

a) $Cr_2O_7^{2-} \rightarrow 2Cr^{3+}$ **b)** $MnO_4^- \rightarrow Mn^{2+}$ **c)** $CrO_4^{2-} \rightarrow Cr^{3+}$

d) $C_2O_4^{2-} \rightarrow 3CO_2$

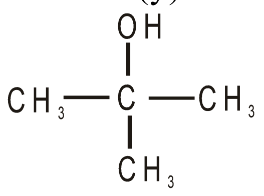
Q47 The difference between ΔH and ΔU (ΔH – ΔU), when the combustion of one mole of heptane(I) is carried out at a temperature T, is equal to :

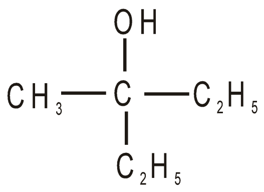
a) –3RT **b)** 4RT **c)** 3RT **d)** –4RT

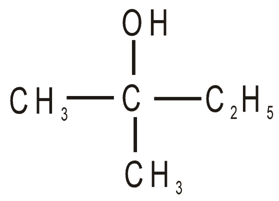
Q48 During compression of a spring the work done is 10 kJ and 2 kJ escaped to the surroundings as heat. The change in internal energy, ΔU (in kJ) is

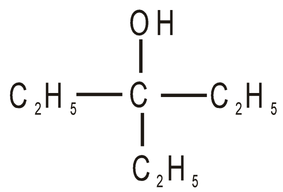
a) 12 **b)** –12 **c)** 8 **d)** –8

Q49 A sweet smelling compound(x) with molecular formula $C_8H_{16}O_2$ on reaction with excess of CH_3MgBr followed by acidification gives a single organic product(y), the structure of (y) can be:

a)


b)


c)


d)


Q50 At room temperature, a dilute solution of urea is prepared by dissolving 0.60 g of urea in 360 g of water. If the vapour pressure of pure water at this temperature is 35 mmHg, lowering of vapour pressure will be : (molar mass of urea = 60 g mol^{-1})

a) 0.031 mmHg **b)** 0.017 mmHg **c)** 0.028 mmHg **d)** 0.027 mmHg

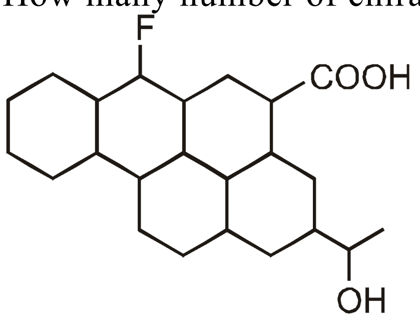
Numerical

Q51 The elevation of boiling point of 0.10 m aqueous $CrCl_3.xNH_3$ solution is two times that of 0.05 m aqueous $CaCl_2$ solution. The value of x is _______.
[Assume 100% ionisation of the complex and $CaCl_2$, coordination number of Cr as 6, and that all NH_3 molecules are present inside the coordination sphere]

Q52 A gas (Molar mass = 280 g mol^{-1}) was burnt in excess O_2 in a constant volume calorimeter and during combustion the temperature of calorimeter increased from 298.0 K to 298.45 K. If the heat capacity of calorimeter is 2.5 kJ K^{-1} and enthalpy of combustion of gas is 9 kJ mol"[1] then amount of gas burnt is ________ g. (Nearest Integer)

Q53 For water Δ_{vap} H = 41 kJ mol^{-1} at 373 K and 1 bar pressure. Assuming that water vapour is an ideal gas that occupies a much larger volume than liquid water, the internal energy change during evaporation of water is_____kJ mol–1 [Use : R = 8.3 J mol^{-1} K^{-1}]

Q54 How many number of chiral centres are present in the following compounds ?



Q55 The number of possible enantiomer pairs that can be produced during monochlorination of 2-Methylbutane is :

Q56 Total number of plane of symmetry present in CH_4

Q57 Number of oxygen atoms present in chemical formula of fuming sulphuric acid is _______

Q58 Acidified potassium permanganate solution oxidises oxalic acid. The spin-only magnetic moment of the manganese product formed from the above reaction is ______ B.M. (Nearest Integer)

Q59 The reaction $2A + B_2 \rightarrow 2AB$ is an elementary reaction.
For a certain quantity of reactants, if the volume of the reaction vessel is reduced by a factor of 3, the rate of the reaction increases by a factor of _____. (Round off to the Nearest Integer).

Q60 The reaction $2NO + Br_2 \rightarrow 2NOBr$ takes places through the mechanism given below:
$NO + Br_2 \Leftrightarrow NOBr_2$ (fast)
$NOBr_2 + NO \rightarrow 2NOBr$ (slow)
The overall order of the reaction is_____.

Mathematics

Single Choice Question

Q61 If θ_1 and θ_2 be respectively the smallest and the largest values of θ in $(0, 2\pi) - \{\pi\}$ which satisfy the equation, $2\cot^2\theta - \frac{5}{\sin\theta} + 4 = 0$, then $\int_{\theta_1}^{\theta_2} \cos^2 3\theta d\theta$, is equal to

a) $\frac{\pi}{3} + \frac{1}{6}$ **b)** $\frac{\pi}{3}$ **c)** $\frac{2\pi}{3}$ **d)** $\frac{\pi}{9}$

Q62 If $a \neq 0$ and the line $2bx + 3cy + 4d = 0$, passes through the points of intersection of the parabola as $y^2 = 4ax$ and $x^2 = 4ay$, then

a) $d^2 + (2b + 3c)^2 = 0$ **b)** $d^2 + (2b + 2c)^2 = 0$ **c)** $d^2 + (2b - 3c)^2 = 0$
d) $d^2 + (3b - 3c)^2 = 0$

Q63 If ℓ denote the semi–latus rectum of the parabola $y^2 = 4ax$ and SP and SQ denote the segments of any focal chord PQ, S being the focus, then SP, ℓ and SQ are in the relation

a) AP **b)** GP **c)** HP **d)** $\ell^2 = SP^2 + SQ^2$

Q64 The length of the chord(in units) of the parabola $y^2 = 4ax$, which passes through the vertex and makes an angle a with the axis of the parabola is

a) $|4a \cot^2\alpha \operatorname{cosec}^2 \alpha|$ **b)** $|4a \cot \alpha \operatorname{cosec} \alpha|$ **c)** $|a \cot \alpha \operatorname{cosec}^2 \alpha|$
d) $|a \cot^2 \alpha \operatorname{cosec} \alpha|$

Q65 If $I_1 = \int_0^1 (1 - x^{50})^{100} dx$ and $I_2 = \int_0^1 (1 - x^{50})^{101} dx$ such that $I_2 = \alpha I_1$ then α equals to :

a) $\frac{5051}{5050}$ **b)** $\frac{5050}{5051}$ **c)** $\frac{5050}{5049}$ **d)** $\frac{5049}{5050}$

Q66 Let P be a point on the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$, $0^2 + y^2 = a^2$ at the point Q such that P and Q are on the same side of x–axis. For two positive real numbers r and s, find the locus of the point R on PQ such that PR : RQ = r : s, as P varies over the ellipse.

a) $\frac{x^2}{a^2} + \frac{y^2(r+s)^2}{(ar+bs)^2} = 1$ **b)** $\frac{x^2(r+s)^2}{(ar+bs)^2} + \frac{y^2}{a^2} = 1$ **c)** $\frac{x^2(ar+bs)^2}{(r+s)^2} + \frac{y^2}{a^2} = 1$
d) None of these

Q67 If α, β are eccentric angles of the extremities of a focal chord of an ellipse, then eccentricity of the ellipse is

a) $\frac{\cos\alpha + \cos\beta}{\cos(\alpha+\beta)}$ **b)** $\frac{\sin\alpha - \sin\beta}{\sin(\alpha+\beta)}$ **c)** $\sin\alpha - \sin\beta$ **d)** $\frac{\sin\alpha + \sin\beta}{\sin(\alpha+\beta)}$

Q68 The equation $\frac{x^2}{2-\lambda} - \frac{y^2}{\lambda-5} - 1 = 0$ represent an ellipse, if

a) $\lambda > 5$ **b)** $\lambda < 2$ **c)** $2 < \lambda < 5$ **d)** $2 > \lambda > 5$

Q69 The equation of an ellipse whose eccentricity is $\frac{1}{2}$ and the vertices are, (4,0) and (10, 0) is

a) $3x^2 + 4y^2 - 42x + 120 = 0$ **b)** $3x^2 + 4y^2 + 42x + 120 = 0$

c) $3x^2 + 4y^2 + 42x - 120 = 0$ **d)** $3x^2 + 4y^2 - 42x - 120 = 0$

Q70 Let A_1 be the area of the region bounded by the curves y = sin x, y = cos x and y-axis in the first quadrant. Also, let A_2 be the area of the region bounded by the curves y = sin x, y = cos x, x - axis and x = $\frac{\pi}{2}$ in the first quadrant. Then,

a) $A_1 : A_2 = 1 : \sqrt{2}$ and $A_1 + A_2 = 1$ **b)** $A_1 + A_2$ and $A_1 + A_2 = \sqrt{2}$

c) $2A_1 = A_2$ and $A_1 + A_2 = 1 + \sqrt{2}$ **d)** $A_1 : A_2 = 1 : 2$ and $A_1 : A_2 = 1$

Q71 Tangents are drawn from the points on the line x – y –5 = 0 to $x^2 + 4y^2 = 4$, then all the chords of contact pass through a fixed point, whose coordinates are

a) $\left(\frac{4}{5}, -\frac{1}{5}\right)$ **b)** $\left(\frac{4}{5}, \frac{1}{5}\right)$ **c)** $\left(-\frac{4}{5}, \frac{1}{5}\right)$ **d)** None of these

Q72 Given the family of hyperbolas $\frac{x^2}{\cos^2\alpha} - \frac{y^2}{\sin^2\alpha} = 1 \text{ for } \alpha \in \left(0, \frac{\pi}{2}\right)$. Which of the following does not change with varying α?

a) Abscissa of foci **b)** Eccentricity **c)** Equation of directrices

d) Abscissa of vertices

Q73 Suppose an ellipse and a hyperbola have the same pair of foci on the x–axis with centres at the origin and that they intersect at (2, 2). If the eccentricity of the ellipse is $\frac{1}{2}$, then the eccentricity of the hyperbola is

a) $\sqrt{\frac{7}{4}}$ **b)** $\sqrt{\frac{7}{3}}$ **c)** $\sqrt{\frac{5}{4}}$ **d)** $\sqrt{\frac{5}{3}}$

Q74 Let $\vec{a}, \vec{b}$ and $\vec{c}$ be three unit vectors such that $\vec{a} + \vec{b} + \vec{c} = \vec{0}$. If $\lambda = \vec{a}\cdot\vec{b} + \vec{b}\cdot\vec{c} + \vec{c}\cdot\vec{a}$ and $\vec{d} = \vec{a}\times\vec{b} + \vec{b}\times\vec{c} + \vec{c}\times\vec{a}$ then the ordered pair, $(\lambda, \vec{d})$ is equal to

a) $\left(\frac{3}{2}, 3\vec{a}\times\vec{c}\right)$ **b)** $\left(-\frac{3}{2}, 3\vec{c}\times\vec{b}\right)$ **c)** $\left(-\frac{3}{2}, 3(\vec{a}\times\vec{b})\right)$ **d)** $\left(\frac{3}{2}, 3\vec{b}\times\vec{c}\right)$

Q75 A ray emanating from the point (5,0) is incident on the hyperbola $9x^2 - 16y^2 = 144$ at the point P with abscissa 8, then the equation of the reflected ray after first reflection is (P lies in the first quadrant)

a) $\sqrt{3}x - y + 7 = 0$ **b)** $3\sqrt{3}x - 13y + 15\sqrt{3} = 0$ **c)** $3\sqrt{3}x + 13y - 15\sqrt{3} = 0$

d) $\sqrt{3}x + y - 14 = 0$

Q76 Equation of the straight line(s) which touch (es) the hyperbola $x^2 - y^2 = \frac{8}{9}$ and parabola $y^2 = 32x$ is (are)

a) $9x + 3y - 8 = 0$ **b)** $9x - 3y + 8 = 0$ **c)** $-9x + 3y + 8 = 0$ **d)** $9x - 3y - 7 = 0$

Q77 $\int e^{tan^{-1}x} (1 + x + x^2)d(\cot^{-1} x)$ is equal to-

a) $-e^{tan^{-1}x} + C$ **b)** $e^{tan^{-1}x} + C$ **c)** $-xe^{tan^{-1}x} + C$ **d)** $xe^{tan^{-1}x} + C$

Q78 $\int \frac{sinx}{sin4x}dx = A \log \left| \frac{1+sinx}{1-sinx} \right| + B \log \left| \frac{1+\sqrt{2}sinx}{1-\sqrt{2}sinx} \right| + C$

a) $A = \frac{1}{8}, B = \frac{1}{4\sqrt{2}}$ **b)** $A = -\frac{1}{8}, B = -\frac{1}{4\sqrt{2}}$ **c)** $A = -\frac{1}{8}, B = \frac{1}{4\sqrt{2}}$

d) $A = \frac{1}{8}, B = -\frac{1}{4\sqrt{2}}$

Q79 In the curve y = y (x) is the solution of the differential equation $2(x^2 + x^{5/4})dy - y(x + x^{1/4})dx = 2x^{9/4}dx$, $x > 0$ which passes through the point $\left(1, 1 - \frac{4}{3}\log_e 2\right)$, then the value of y (16) is equal to :

a) $4\left(\frac{31}{3} + \frac{8}{3}\log_e 3\right)$ **b)** $\left(\frac{31}{3} + \frac{8}{3}\log_e 3\right)$ **c)** $4\left(\frac{31}{3} - \frac{8}{3}\log_e 3\right)$ **d)** $\left(\frac{31}{3} - \frac{8}{3}\log_e 3\right)$

Q80 A channel 27 m wide falls at a right angle into another channel 64 m wide. The greatest length of the log that can be floated along this system of channels is

a) 120 **b)** 125 **c)** 100 **d)** 110

Numerical

Q81 Number of common tangents to the parabola $y^2 = 4ax$ and $x^2 = 4by$ is

Q82 Let [t] denote the greatest integer less than or equal to t. Then the value of $\int_1^2 |2x - [3x]|\, dx$ is____.

Q83 Let $f(x) = |x - 2|$ and $g(x) = f(f(x))$, $x \in [0, 4]$. Then $\int_0^3 (g(x) - f(x))dx$ is equal to :

Q84 If the vectors, $\vec{p} = (a + 1)\hat{i} + a\hat{j} + a\hat{k}$, $\vec{q} = a\hat{i} + (a + 1)\hat{j} + a\hat{k}$, and $\vec{r} = a\hat{i} + a\hat{j} + (a + 1)\hat{k} (a \in R)$ are coplanar and $3(\vec{p} \cdot \vec{q})^2 - \lambda|\vec{r} \times \vec{q}|^2 = 0$, then the value of λ is______.

Q85 Let $\vec{a}$, $\vec{b}$ and $\vec{c}$ be three vectors such that $|\vec{a}| = \sqrt{3}$, $|\vec{b}| = 5, \vec{b}.\vec{c} = 10$ and the angle between $\vec{b}$ and $\vec{c}$ is $\frac{\pi}{3}$. If $\vec{a}$ is perpendicular to the vector $\vec{b} \times \vec{c}$, then $\left|\vec{a} \times \left(\vec{b} \times \vec{c}\right)\right|$ is equal to ________.

Q86 If $\vec{a} = 2\hat{i} + \hat{j} + 2\hat{k}$, then the value of $\left|\hat{i} \times \left(\vec{a} \times \hat{i}\right)\right|^2 + \left|\hat{j} \times \left(\vec{a} \times \hat{j}\right)\right|^2 + \left|\hat{k} \times \left(\vec{a} \times \hat{k}\right)\right|^2$ is equal to___.

Q87 If the solution curve y = y(x) of the differential equation $(1 + y^2)(1 + \log_e x)dx + xdy = 0, x > 0$ passes through the point $(1, 1)$ and $y(e) = \frac{\alpha - \tan\left(\frac{3}{2}\right)}{\beta + \tan\left(\frac{3}{2}\right)}$, then $\alpha + 2\beta$ is

Q88 Let y = y(x) be the solution curve of the differential equation $\sin(2x^2) \log_e(\tan x^2)dy + \left(4xy - 4\sqrt{2}x\sin\left(x^2 - \frac{\pi}{4}\right)\right)dx = 0$, $0 < x < \sqrt{\frac{\pi}{2}}$, which passes through the point $\left(\sqrt{\frac{\pi}{6}}, 1\right)$. Then $\left|y\left(\sqrt{\frac{\pi}{3}}\right)\right|$ is equal to ________ .

Q89 The length of the latus rectum of the hyperbola $xy - 3x - 3y + 7 = 0$ is

Q90 If the lines $x + y = a$ and $x - y = b$ touch the curve $y = x^2 - 3x + 2$ at the points where the curve intersects the x-axis, then $\frac{a}{b}$ is equal to ________. (report answer to be round of the nearest integer)

Answer Key

Que.	1	2	3	4	5	6	7	8	9	10
Ans.	**D**	**D**	**C**	**B**	**D**	**B**	**B**	**A**	**A**	**B**
Que.	11	12	13	14	15	16	17	18	19	20
Ans.	**A**	**C**	**C**	**D**	**D**	**A**	**C**	**D**	**C**	**C**
Que.	21	22	23	24	25	26	27	28	29	30
Ans.	**10**	**1**	**64**	**9**	**0**	**2**	**15**	**6**	**8**	**5**
Que.	31	32	33	34	35	36	37	38	39	40
Ans.	**A**	**B**	**A**	**C**	**B**	**D**	**B**	**C**	**D**	**C**
Que.	41	42	43	44	45	46	47	48	49	50
Ans.	**C**	**D**	**C**	**B**	**B**	**B**	**D**	**C**	**C**	**B**
Que.	51	52	53	54	55	56	57	58	59	60
Ans.	**5**	**35**	**38**	**12**	**2**	**6**	**7**	**6**	**27**	**3**
Que.	61	62	63	64	65	66	67	68	69	70
Ans.	**B**	**A**	**C**	**B**	**B**	**A**	**D**	**B**	**A**	**A**
Que.	71	72	73	74	75	76	77	78	79	80
Ans.	**A**	**A**	**B**	**C**	**B**	**B**	**C**	**C**	**C**	**B**
Que.	81	82	83	84	85	86	87	88	89	90
Ans.	**1**	**1**	**1**	**1**	**30**	**18**	**3**	**1**	**4**	**1**