

Q1. Let $f(x) = \int_0^x t(t^2 - 9t + 20) dt$, $1 \leq x \leq 5$. If the range of f is $[\alpha, \beta]$, then $4(\alpha + \beta)$ equals :

- (1) 253
 (2) 154
 (3) 125
 (4) 157

Q2. Let \hat{a} be a unit vector perpendicular to the vectors $\vec{b} = \hat{i} - 2\hat{j} + 3\hat{k}$ and $\vec{c} = 2\hat{i} + 3\hat{j} - \hat{k}$, and makes an angle of $\cos^{-1}(-\frac{1}{3})$ with the vector $\hat{i} + \hat{j} + \hat{k}$. If \hat{a} makes an angle of $\frac{\pi}{3}$ with the vector $\hat{i} + \alpha\hat{j} + \hat{k}$, then the value of α is :

- (1) $\sqrt{6}$
 (2) $-\sqrt{6}$
 (3) $-\sqrt{3}$
 (4) $\sqrt{3}$

Q3. If for the solution curve $y = f(x)$ of the differential equation $\frac{dy}{dx} + (\tan x)y = \frac{2+\sec x}{(1+2\sec x)^2}$,

- $x \in (-\frac{\pi}{2}, \frac{\pi}{2})$, $f(\frac{\pi}{3}) = \frac{\sqrt{3}}{10}$, then $f(\frac{\pi}{4})$ is equal to :
- (1) $\frac{\sqrt{3}+1}{10(4+\sqrt{3})}$
 (2) $\frac{5-\sqrt{3}}{2\sqrt{2}}$
 (3) $\frac{9\sqrt{3}+3}{10(4+\sqrt{3})}$
 (4) $\frac{4-\sqrt{2}}{14}$

Q4. Let P be the foot of the perpendicular from the point $(1, 2, 2)$ on the line $L : \frac{x-1}{1} = \frac{y+1}{-1} = \frac{z-2}{2}$. Let the line $\vec{r} = (-\hat{i} + \hat{j} - 2\hat{k}) + \lambda(\hat{i} - \hat{j} + \hat{k})$, $\lambda \in \mathbb{R}$, intersect the line L at Q. Then $2(PQ)^2$ is equal to :

- (1) 25
 (2) 19
 (3) 29
 (4) 27

Q5. Let $A = [a_{ij}]$ be a matrix of order 3×3 , with $a_{ij} = (\sqrt{2})^{i+j}$. If the sum of all the elements in the third row of A^2 is $\alpha + \beta\sqrt{2}$, $\alpha, \beta \in \mathbb{Z}$, then $\alpha + \beta$ is equal to :

- (1) 280
 (2) 224
 (3) 210
 (4) 168

Q6. Let the line $x + y = 1$ meet the axes of x and y at A and B, respectively. A right angled triangle AMN is inscribed in the triangle OAB, where O is the origin and the points M and N lie on the lines OB and AB, respectively. If the area of the triangle AMN is $\frac{4}{9}$ of the area of the triangle OAB and AN : NB = $\lambda : 1$, then the sum of all possible value(s) of λ is :

- (1) 2
 (2) $\frac{5}{2}$
 (3) $\frac{1}{2}$
 (4) $\frac{13}{6}$

Q7. If all the words with or without meaning made using all the letters of the word "KANPUR" are arranged as in a dictionary, then the word at 440th position in this arrangement, is :

- (1) PRNAUK
 (2) PRKANU
 (3) PRKAUN
 (4) PRNAKU

Q8. If the set of all $a \in \mathbb{R}$, for which the equation $2x^2 + (a-5)x + 15 = 3a$ has no real root, is the interval (α, β) , and $X = \{x \in \mathbb{Z} : \alpha < x < \beta\}$, then $\sum_{x \in X} x^2$ is equal to :

- (1) 2109
 (2) 2129
 (3) 2119
 (4) 2139

Q9. Let $A = [a_{ij}]$ be a 2×2 matrix such that $a_{ij} \in \{0, 1\}$ for all i and j . Let the random variable X denote the possible values of the determinant of the matrix A . Then, the variance of X is :

- (1) $\frac{3}{4}$
 (3) $\frac{3}{8}$

- (2) $\frac{5}{8}$
 (4) $\frac{1}{4}$

Q10. Let the function $f(x) = (x^2 + 1) |x^2 - ax + 2| + \cos |x|$ be not differentiable at the two points $x = \alpha = 2$

and $x = \beta$. Then the distance of the point (α, β) from the line $12x + 5y + 10 = 0$ is equal to :

- (1) 5
 (2) 4
 (3) 3
 (4) 2

Q11. Let the area enclosed between the curves $|y| = 1 - x^2$ and $x^2 + y^2 = 1$ be α . If $9\alpha = \beta\pi + \gamma$; β, γ are integers, then the value of $|\beta - \gamma|$ equals.

- (1) 27
 (2) 33
 (3) 15
 (4) 18

Q12. The remainder, when 7^{103} is divided by 23, is equal to :

- (1) 6
 (2) 17
 (3) 9
 (4) 14

Q13. If $\alpha x + \beta y = 109$ is the equation of the chord of the ellipse $\frac{x^2}{9} + \frac{y^2}{4} = 1$, whose mid point is $(\frac{5}{2}, \frac{1}{2})$, then $\alpha + \beta$ is equal to :

- (1) 58
 (2) 46
 (3) 37
 (4) 72

Q14. If the domain of the function $\log_5(18x - x^2 - 77)$ is (α, β) and the domain of the function

- $\log_{(x-1)}\left(\frac{2x^2+3x-2}{x^2-3x-4}\right)$ is (γ, δ) , then $\alpha^2 + \beta^2 + \gamma^2$ is equal to :

- (1) 195
 (2) 179
 (3) 186
 (4) 174

Q15. Let a circle C pass through the points $(4, 2)$ and $(0, 2)$, and its centre lie on $3x + 2y + 2 = 0$. Then the length of the chord, of the circle C , whose mid-point is $(1, 2)$, is :

- (1) $\sqrt{3}$
 (2) $2\sqrt{2}$
 (3) $2\sqrt{3}$
 (4) $4\sqrt{2}$

Q16. Let a straight line L pass through the point $P(2, -1, 3)$ and be perpendicular to the lines $\frac{x-1}{2} = \frac{y+1}{1} = \frac{z-3}{-2}$ and $\frac{x-3}{1} = \frac{y-2}{3} = \frac{z+2}{4}$. If the line L intersects the yz -plane at the point Q , then the distance between the points P and Q is :

- (1) $\sqrt{10}$
 (2) $2\sqrt{3}$
 (3) 2
 (4) 3

Q17. Bag 1 contains 4 white balls and 5 black balls, and Bag 2 contains n white balls and 3 black balls. One ball is

drawn randomly from Bag 1 and transferred to Bag 2. A ball is then drawn randomly from Bag 2. If the probability, that the ball drawn is white, is $29/45$, then n is equal to :

- (1) 6
 (2) 3
 (3) 5
 (4) 4

Q18. Let $\alpha, \beta (\alpha \neq \beta)$ be the values of m , for which the equations $x + y + z = 1$; $x + 2y + 4z = m$ and $x + 4y + 10z = m^2$ have infinitely many solutions. Then the value of $\sum_{n=1}^{10} (n^\alpha + n^\beta)$ is equal to :

- (1) 3080 (2) 560
 (3) 3410 (4) 440

Q19. Let $S = \mathbb{N} \cup \{0\}$. Define a relation R from S to \mathbf{R} by : $R = \{(x, y) : \log_e y = x \log_e \left(\frac{2}{5}\right), x \in S, y \in \mathbf{R}\}$
 Then, the sum of all the elements in the range of R is equal to :

- (1) $\frac{10}{9}$ (2) $\frac{3}{2}$
 (3) $\frac{5}{2}$ (4) $\frac{5}{3}$

Q20. If $\sin x + \sin^2 x = 1$, $x \in (0, \frac{\pi}{2})$, then

- $(\cos^{12} x + \tan^{12} x) + 3(\cos^{10} x + \tan^{10} x + \cos^8 x + \tan^8 x) + (\cos^6 x + \tan^6 x)$ is equal to :
 (1) 4 (2) 1
 (3) 3 (4) 2

Q21. If $24 \int_0^{\frac{\pi}{4}} (\sin |4x - \frac{\pi}{12}| + [2 \sin x]) dx = 2\pi + \alpha$, where $[.]$ denotes the greatest integer function, then α is equal to _____.

Q22. Let $a_1, a_2, \dots, a_{2024}$ be an Arithmetic Progression such that

$a_1 + (a_5 + a_{10} + a_{15} + \dots + a_{2020}) + a_{2024} = 2233$. Then $a_1 + a_2 + a_3 + \dots + a_{2024}$ is equal to _____

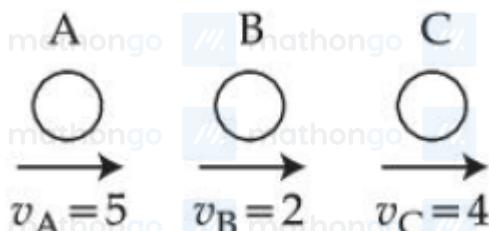
Q23. If $\lim_{t \rightarrow 0} \left(\int_0^1 (3x + 5)^t dx \right)^{\frac{1}{t}} = \frac{\alpha}{5e} \left(\frac{8}{5}\right)^{\frac{2}{3}}$, then α is equal to _____

Q24. Let $y^2 = 12x$ be the parabola and S be its focus. Let PQ be a focal chord of the parabola such that $(SP)(SQ) = \frac{147}{4}$. Let C be the circle described taking PQ as a diameter. If the equation of a circle C is $64x^2 + 64y^2 - \alpha x - 64\sqrt{3}y = \beta$, then $\beta - \alpha$ is equal to _____.

Q25. Let integers $a, b \in [-3, 3]$ be such that $a + b \neq 0$. Then the number of all possible ordered pairs (a, b) , for

which $\left| \frac{z-a}{z+b} \right| = 1$ and $\begin{vmatrix} z+1 & \omega & \omega^2 \\ \omega & z+\omega^2 & 1 \\ \omega^2 & 1 & z+\omega \end{vmatrix} = 1$, $z \in C$, where ω and ω^2 are the roots of $x^2 + x + 1 = 0$, is equal to _____.

Q26. Given below are two statements. One is labelled as Assertion (A) and the other is labelled as Reason (R).



Assertion (A) :

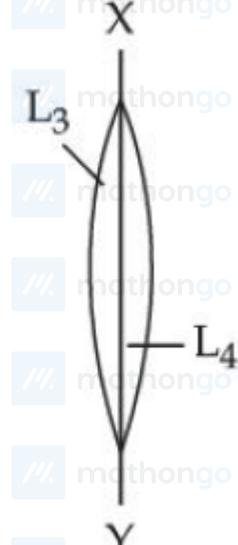
Three identical spheres of same mass undergo one dimensional motion as shown in figure with initial velocities $v_A = 5$ m/s, $v_B = 2$ m/s, $v_C = 4$ m/s. If we wait sufficiently long for elastic collision to happen, then $v_A = 4$ m/s, $v_B = 2$ m/s, $v_C = 5$ m/s will be the final velocities. Reason (R): In an elastic collision

In the light of the above statements, choose the correct answer from the options given below :

(1) (A) is false but (R) is true (2) Both (A) and (R) are true but (R) is NOT the correct explanation of (A)

(3) Both (A) and (R) are true and (R) is the correct explanation of (A) (4) (A) is true but (R) is false

Q27. Two identical symmetric double convex lenses of focal length f are cut into two equal parts L_1, L_2 by AB plane and L_3, L_4 by XY plane as shown in figure respectively. The ratio of focal lengths of lenses L_1 and L_3



(1) 1:1

(3) 1:4

(2) 1:2

(4) 2:1

Q28. Two bodies A and B of equal mass are suspended from two massless springs of spring constant k_1 and k_2 , respectively. If the bodies oscillate vertically such that their amplitudes are equal, the ratio of the maximum velocity of A to the maximum velocity of B is

(1) $\frac{k_1}{k_2}$

(3) $\sqrt{\frac{k_2}{k_1}}$

(2) $\sqrt{\frac{k_1}{k_2}}$

(4) $\frac{k_2}{k_1}$

Q29. Given below are two statements. One is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A) : With the increase in the pressure of an ideal gas, the volume falls off more rapidly in an isothermal process in comparison to the adiabatic process. Reason (R) : In isothermal process, $PV = \text{constant}$, while in adiabatic process $PV^\gamma = \text{constant}$. Here γ is the ratio of specific heats, P is the pressure and V is the volume of the ideal gas. In the light of the above statements, choose the correct answer from the options given below :

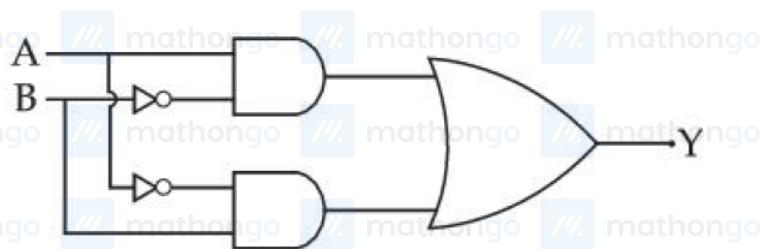
(1) Both (A) and (R) are true and (R) is the correct explanation of (A)

(3) (A) is true but (R) is false

(2) Both (A) and (R) are true but (R) is NOT the correct explanation of (A)

(4) (A) is false but (R) is true

Q30.



The truth table for the circuit given below is :

(1)	A	B	Y
0	0	0	0
1	0	0	0
1	1	0	0
0	1	1	1

(3)	A	B	Y
0	0	0	0
1	0	1	1
0	1	0	0
1	1	0	0

(2)	A	B	Y
0	0	0	0
1	1	1	1
1	0	1	1
0	1	1	1

(4)	A	B	Y
0	0	0	0
0	1	1	1
1	0	1	1
1	1	1	0

Q31. The difference of temperature in a material can convert heat energy into electrical energy. To harvest the heat energy, the material should have

- (1) high thermal conductivity and high electrical conductivity
- (2) low thermal conductivity and low electrical conductivity
- (3) high thermal conductivity and low electrical conductivity
- (4) low thermal conductivity and high electrical conductivity

Q32.

List - I

- (A) Young's Modulus
- (B) Torque
- (C) Coefficient of Viscosity
- (D) Gravitational Constant

List - II

- (I) $M L^{-1} T^{-1}$
- (II) $M L^{-1} T^{-2}$
- (III) $M^{-1} L^3 T^{-2}$
- (IV) $M L^2 T^{-2}$

Match List - I with List - II.

Choose the correct answer from the options given below :

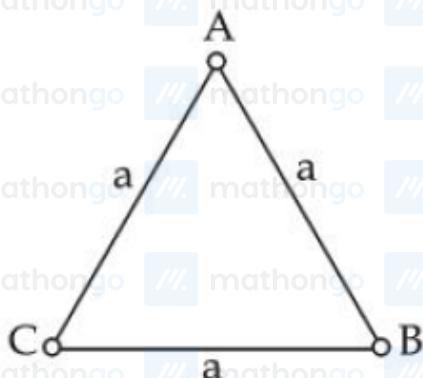
- (1) (A)-(I), (B)-(III), (C)-(II), (D)-(IV)
- (2) (A)-(IV), (B)-(II), (C)-(III), (D)-(I)
- (3) (A)-(II), (B)-(IV), (C)-(I), (D)-(III)
- (4) (A)-(II), (B)-(I), (C)-(IV), (D)-(III)

Q33. A sand dropper drops sand of mass $m(t)$ on a conveyor belt at a rate proportional to the square root of speed (v) of the belt, i.e. $\frac{dm}{dt} \propto \sqrt{v}$. If P is the power delivered to run the belt at constant speed then which of the following relationship is true?

- (1) $P \propto \sqrt{v}$
 (3) $P^2 \propto v^5$

- (2) $P \propto v$
 (4) $P^2 \propto v^3$

Q34.



Three equal masses m are kept at vertices (A, B, C) of an equilateral triangle of side a in free space. At $t = 0$, they are given an initial velocity $\vec{V}_A = V_0 \overrightarrow{AC}$, $\vec{V}_B = V_0 \overrightarrow{BA}$ and $\vec{V}_C = V_0 \overrightarrow{CB}$. Here, \overrightarrow{AC} , \overrightarrow{CB} and \overrightarrow{BA} are unit vectors along the edges of the triangle. If the three masses interact gravitationally, then the magnitude of the net angular momentum of the system at the point of collision is :

- (1) $3amV_0$
 (2) $\frac{3}{2} a mV_0$
 (3) $\frac{\sqrt{3}}{2} a mV_0$
 (4) $\frac{1}{2} a mV_0$

Q35. The number of spectral lines emitted by atomic hydrogen that is in the 4th energy level, is

- (1) 3
 (2) 1
 (3) 6
 (4) 0

Q36. A convex lens made of glass (refractive index = 1.5) has focal length 24 cm in air. When it is totally immersed in water (refractive index = 1.33), its focal length changes to

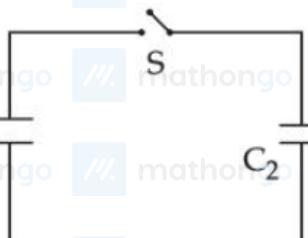
- (1) 24 cm
 (2) 96 cm
 (3) 48 cm
 (4) 72 cm

Q37. In an experiment with photoelectric effect, the stopping potential,

- | | |
|---|---|
| (1) increases with increase in the intensity of the incident light | (2) decreases with increase in the intensity of the incident light |
| (3) increases with increase in the wavelength of the incident light | (4) is $(\frac{1}{e})$ times the maximum kinetic energy of the emitted photoelectrons |

Q38. A capacitor, $C_1 = 6\mu F$ is charged to a potential difference of $V_0 = 5$ V using a 5 V battery. The battery is removed and another capacitor, $C_2 = 12\mu F$ is inserted in place of the battery. When the switch 'S' is closed, the charge flows between the capacitors for some time until equilibrium condition is reached. What are the

Q38. If charges (q_1 and q_2) on the capacitors C_1 and C_2 when equilibrium condition is reached.



- (1) $q_1 = 10\mu\text{C}$, $q_2 = 20\mu\text{C}$
 (2) $q_1 = 30\mu\text{C}$, $q_2 = 15\mu\text{C}$
 (3) $q_1 = 20\mu\text{C}$, $q_2 = 10\mu\text{C}$
 (4) $q_1 = 15\mu\text{C}$, $q_2 = 30\mu\text{C}$

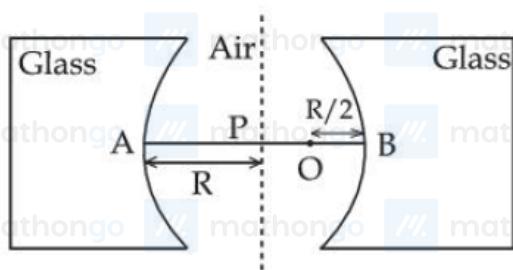
Q39. A plane electromagnetic wave propagates along the $+x$ direction in free space. The components of the electric field, \vec{E} and magnetic field, \vec{B} vectors associated with the wave in Cartesian frame are

- (1) E_x , B_y
 (2) E_y , B_z
 (3) E_z , B_y
 (4) E_y , B_x

Q40. A cup of coffee cools from 90°C to 80°C in t minutes when the room temperature is 20°C . The time taken by the similar cup of coffee to cool from 80°C to 60°C at the same room temperature is :

- (1) $\frac{13}{10}t$
 (2) $\frac{10}{13}t$
 (3) $\frac{5}{13}t$
 (4) $\frac{13}{5}t$

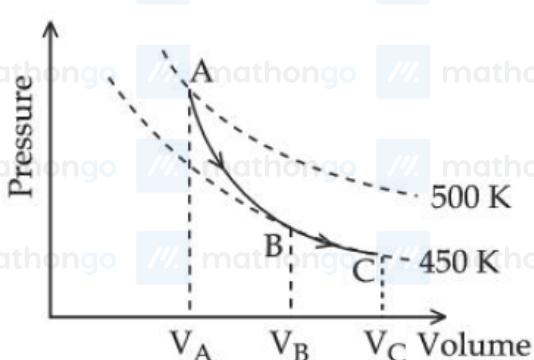
Q41.



Two concave refracting surfaces of equal radii of curvature and refractive index 1.5 face each other in air as shown in figure. A point object O is placed midway, between P and B. The separation between the images of O, formed by each refracting surface is :

- (1) 0.214 R
 (2) 0.411 R
 (3) 0.124 R
 (4) 0.114 R

Q42.



A poly-atomic molecule ($C_V = 3R$, $C_P = 4R$, where R is gas constant) goes from phase space point A ($P_A = 10^5 \text{ Pa}$, $V_A = 4 \times 10^{-6} \text{ m}^3$) to point B ($P_B = 5 \times 10^4 \text{ Pa}$, $V_B = 6 \times 10^{-6} \text{ m}^3$) to point

C ($P_C = 10^4 \text{ Pa}$, $V_C = 8 \times 10^{-6} \text{ m}^3$). A to B is an adiabatic path and B to C is an isothermal path. The net heat absorbed per unit mole by the system is :

- (1) $500R(\ln 3 + \ln 4)$ (2) $450R(\ln 4 - \ln 3)$
 (3) $500R \ln 2$ (4) $400R \ln 4$

Q43. Match List - I with List - II.

List - I

- (A) Magnetic induction
 (B) Magnetic intensity
 (C) Magnetic flux
 (D) Magnetic moment
 (1) (A)-(I), (B)-(II), (C)-(III), (D)-(IV)
 (3) (A)-(III), (B)-(II), (C)-(I), (D)-(IV)

List - II

- (I) Ampere meter²
 (II) Weber
 (III) Gauss
 (IV) Ampere/meter
 (2) (A)-(III), (B)-(IV), (C)-(I), (D)-(II)
 (4) (A)-(III), (B)-(IV), (C)-(II), (D)-(I)

Q44. A point charge causes an electric flux of $-2 \times 10^4 \text{ Nm}^2 \text{ C}^{-1}$ to pass through a spherical Gaussian surface of 8.0 cm radius, centred on the charge. The value of the point charge is : (Given $\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2}$)

- (1) $15.7 \times 10^{-8} \text{ C}$ (2) $17.7 \times 10^{-8} \text{ C}$
 (3) $-15.7 \times 10^{-8} \text{ C}$ (4) $-17.7 \times 10^{-8} \text{ C}$

Q45. An electric dipole is placed at a distance of 2 cm from an infinite plane sheet having positive charge density σ_0 .

. Choose the correct option from the following.

- (1) Potential energy and torque both are maximum.
 (2) Torque on dipole is zero and net force is directed away from the sheet.
 (3) Torque on dipole is zero and net force acts towards the sheet.
 (4) Potential energy of dipole is minimum and torque is zero.

Q46. The magnetic field inside a 200 turns solenoid of radius 10 cm is 2.9×10^{-4} Tesla. If the solenoid carries a current of 0.29 A, then the length of the solenoid is _____ π cm.

Q47. A parallel plate capacitor consisting of two circular plates of radius 10 cm is being charged by a constant current of 0.15 A. If the rate of change of potential difference between the plates is $7 \times 10^8 \text{ V/s}$ then the integer value of the distance between the parallel plates is (Take, $\epsilon_0 = 9 \times 10^{-12} \frac{\text{F}}{\text{m}}$, $\pi = \frac{22}{7}$) _____ μm .

Q48. Two planets, A and B are orbiting a common star in circular orbits of radii R_A and R_B , respectively, with $R_B = 2R_A$. The planet B is $4\sqrt{2}$ times more massive than planet A . The ratio $\left(\frac{L_B}{L_A}\right)$ of angular momentum (L_B) of planet B to that of planet A (L_A) is closest to integer _____.

Q49. Two cars P and Q are moving on a road in the same direction. Acceleration of car P increases linearly with time whereas car Q moves with a constant acceleration. Both cars cross each other at time $t = 0$, for the first time. The maximum possible number of crossing(s) (including the crossing at $t = 0$) is _____.

Q50. A physical quantity Q is related to four observables a, b, c, d as follows : $Q = \frac{ab^4}{cd}$ where, $a = (60 \pm 3)\text{Pa}$; $b = (20 \pm 0.1)\text{m}$; $c = (40 \pm 0.2)\text{Nsm}^{-2}$ and $d = (50 \pm 0.1)\text{m}$, then the percentage error in Q is $\frac{x}{1000}$, where $x =$ _____.

Q51. Consider the equilibrium $\text{CO(g)} + 3\text{H}_2(\text{g}) \rightleftharpoons \text{CH}_4(\text{g}) + \text{H}_2\text{O(g)}$ If the pressure applied over the system increases by two fold at constant temperature then (A) Concentration of reactants and products increases. (B) Equilibrium will shift in forward direction. (C) Equilibrium constant increases since concentration of products increases. (D) Equilibrium constant remains unchanged as concentration of reactants and products remain same. Choose the correct answer from the options given below :

- | | |
|---------------------------|----------------------|
| (1) (A), (B) and (C) only | (2) (A) and (B) only |
| (3) (A), (B) and (D) only | (4) (B) and (C) only |

Q52. Drug X becomes ineffective after 50% decomposition. The original concentration of drug in a bottle was 16mg/mL which becomes 4mg/mL in 12 months. The expiry time of the drug in months is _____.
Assume that the decomposition of the drug follows first order kinetics.

- | | |
|--------|-------|
| (1) 2 | (2) 6 |
| (3) 12 | (4) 3 |

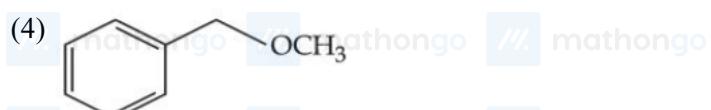
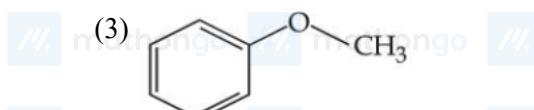
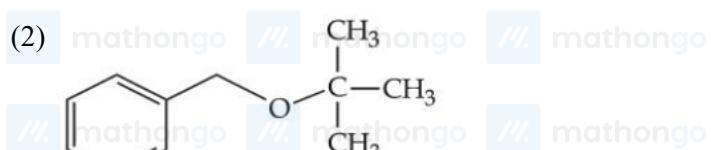
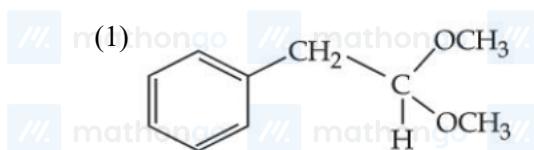
Q53. O_2 gas will be evolved as a product of electrolysis of : (A) an aqueous solution of AgNO_3 using silver electrodes. (B) an aqueous solution of AgNO_3 using platinum electrodes. (C) a dilute solution of H_2SO_4 using platinum electrodes. (D) a high concentration solution of H_2SO_4 using platinum electrodes. Choose the correct answer from the options given below :

- | | |
|----------------------|----------------------|
| (1) (A) and (C) only | (2) (B) and (C) only |
| (3) (A) and (D) only | (4) (B) and (D) only |

Q54. Identify the homoleptic complexes with odd number of d electrons in the central metal : (A) $[\text{FeO}_4]^{2-}$ (B) $[\text{Fe}(\text{CN})_6]^{3-}$ (C) $[\text{Fe}(\text{CN})_5\text{NO}]^{2-}$ (D) $[\text{CoCl}_4]^{2-}$ (E) $[\text{Co}(\text{H}_2\text{O})_3\text{F}_3]$ Choose the correct answer from the options given below :

- | | |
|---------------------------|---------------------------|
| (1) (A), (B) and (D) only | (2) (C) and (E) only |
| (3) (B) and (D) only | (4) (A), (C) and (E) only |

Q55. Which one of the following, with HBr will give a phenol? _____



- Q56.** Given below are two statements : Statement (I) : NaCl is added to the ice at 0°C, present in the ice cream box to prevent the melting of ice cream. Statement (II) : On addition of NaCl to ice at 0°C, there is a depression in freezing point. In the light of the above statements, choose the correct answer from the options given below :
- (1) Both Statement I and Statement II are false
 (2) Statement I is false but Statement II is true
 (3) Statement I is true but Statement II is false
 (4) Both Statement I and Statement II are true

Q57. Match List - I with List - II :

List - I
Applications

- (A) Transistors
 (B) Hearing aids
 (C) Invertors
 (D) Apollo space ship

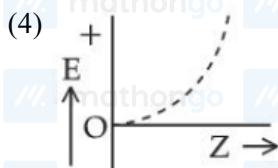
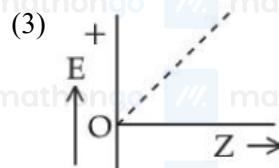
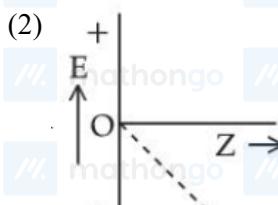
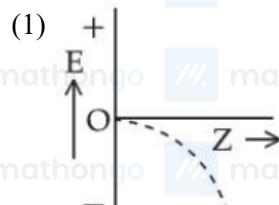
List - II
Batteries/Cell

- (I) Anode - Zn/Hg ; Cathode - HgO + C
 (II) Hydrogen fuel cell
 (III) Anode - Zn ; Cathode - Carbon
 (IV) Anode - Pb ; Cathode - Pb | PbO₂

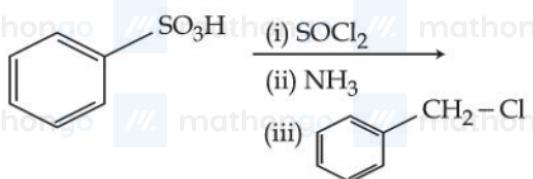
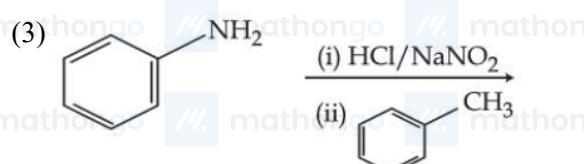
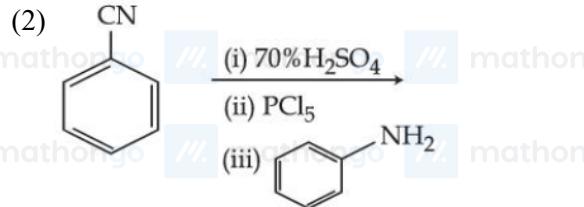
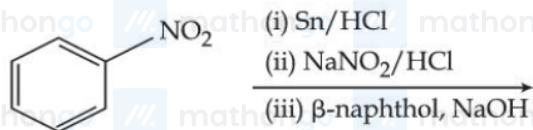
Choose the correct answer from the options given below :

- (1) (A)-(III), (B)-(II), (C)-(IV), (D)-(I)
 (2) (A)-(II), (B)-(III), (C)-(IV), (D)-(I)
 (3) (A)-(III), (B)-(I), (C)-(IV), (D)-(II)
 (4) (A)-(IV), (B)-(III), (C)-(II), (D)-(I)

Q58. For hydrogen like species, which of the following graphs provides the most appropriate representation of E vs Z plot for a constant n ? [E: Energy of the stationary state, Z : atomic number, n = principal quantum number]



Q59. Which one of the following reaction sequences will give an azo dye?



Q60. Identify the essential amino acids from below : (A) Valine (B) Proline (C) Lysine (D) Threonine (E) Tyrosine

Choose the correct answer from the options given below :

- | | |
|---------------------------|---------------------------|
| (1) (A), (C) and (E) only | (2) (A), (C) and (D) only |
| (3) (C), (D) and (E) only | (4) (B), (C) and (E) only |

Q61. The calculated spin-only magnetic moments of $K_3[Fe(OH)_6]$ and $K_4[Fe(OH)_6]$ respectively are :

- | | |
|------------------------|------------------------|
| (1) 3.87 and 4.90 B.M. | (2) 4.90 and 5.92 B.M. |
| (3) 4.90 and 4.90 B.M. | (4) 5.92 and 4.90 B.M. |

Q62. The type of oxide formed by the element among Li, Na, Be, Mg, B and Al that has the least atomic radius is :

- | | |
|------------|--------------|
| (1) A_2O | (2) A_2O_3 |
| (3) AO_2 | (4) AO |

Q63. Total number of sigma (σ) and pi(π) bonds respectively present in hex-1-en-4-yne are :

- | | |
|--------------|--------------|
| (1) 3 and 13 | (2) 11 and 3 |
| (3) 13 and 3 | (4) 14 and 3 |

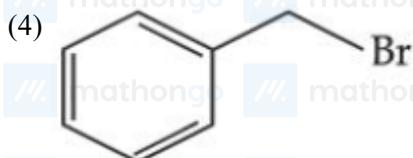
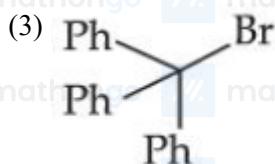
Q64. First ionisation enthalpy values of first four group 15 elements are given below. Choose the correct value for the element that is a main component of apatite family :

- | | |
|--------------------------------|-------------------------------|
| (1) 1402 kJ mol^{-1} | (2) 834 kJ mol^{-1} |
| (3) 1012 kJ mol^{-1} | (4) 947 kJ mol^{-1} |

Q65. Given below are two statements : Statement (I) : On nitration of m-xylene with HNO_3 , H_2SO_4 followed by oxidation, 4-nitrobenzene-1,3-dicarboxylic acid is obtained as the major product. Statement (II) : $-CH_3$ group is o/p-directing while $-NO_2$ group is m-directing group. In the light of the above statements, choose the correct answer from the options given below :

- (1) Both Statement I and Statement II are false
 (2) Statement I is false but Statement II is true
 (3) Statement I is true but Statement II is false
 (4) Both Statement I and Statement II are true

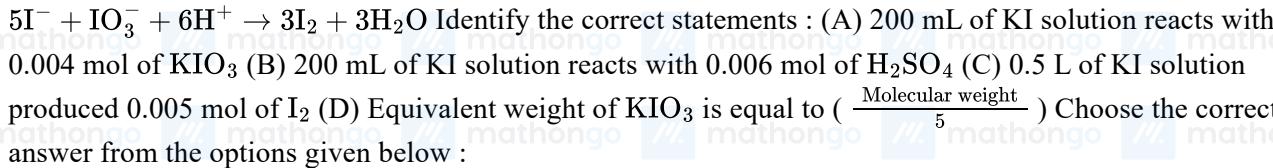
Q66. Which among the following halides will generate the most stable carbocation in the nucleophilic substitution reaction?



Q67. Given below are two statements : Statement (I) : It is impossible to specify simultaneously with arbitrary precision, both the linear momentum and the position of a particle. Statement (II) : If the uncertainty in the measurement of position and uncertainty in measurement of momentum are equal for an electron, then the uncertainty in the measurement of velocity is $\geq \sqrt{\frac{h}{\pi}} \times \frac{1}{2m}$. In the light of the above statements, choose the correct answer from the options given below :

- (1) Statement I is false but Statement II is true
 (2) Both Statement I and Statement II are false
 (3) Both Statement I and Statement II are true
 (4) Statement I is true but Statement II is false

Q68. 0.1 M solution of KI reacts with excess of H_2SO_4 and KIO_3 solutions. According to equation

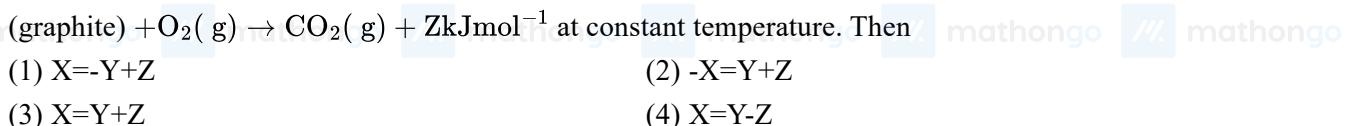


- (1) (A) and (D) only
 (2) (C) and (D) only
 (3) (B) and (C) only
 (4) (A) and (B) only

Q69. Given below are two statements : Statement (I): In partition chromatography, stationary phase is thin film of liquid present in the inert support. Statement (II) : In paper chromatography, the material of paper acts as a stationary phase. In the light of the above statements, choose the correct answer from the options given below :

- (1) Statement I is true but Statement II is false
 (2) Statement I is false but Statement II is true
 (3) Both Statement I and Statement II are false
 (4) Both Statement I and Statement II are true

Q70. If $C(\text{diamond}) \rightarrow C(\text{graphite}) + X \text{kJmol}^{-1}$ $C(\text{diamond}) + O_2(g) \rightarrow CO_2(g) + Y \text{kJmol}^{-1}$



Q71. In the sulphur estimation, 0.20 g of a pure organic compound gave 0.40 g of barium sulphate. The percentage of sulphur in the compound is _____ $\times 10^{-1}\%$. (Molar mass : O = 16, S = 32, Ba = 137 in gmol^{-1})

Q72. Isomeric hydrocarbons \rightarrow negative Baeyer's test (Molecular formula C_9H_{12}) The total number of isomers from above with four different non-aliphatic substitution sites is -

Q73. Consider the following low-spin complexes $K_3[Co(NO_2)_6]$, $K_4[Fe(CN)_6]$, $K_3[Fe(CN)_6]$, $Cu_2[Fe(CN)_6]$ and $Zn_2[Fe(CN)_6]$ The sum of the spin-only magnetic moment values of complexes having yellow colour is. _____ B.M. (answer in nearest integer)

Q74. In the Claisen-Schmidt reaction to prepare, dibenzalacetone from 5.3 g of benzaldehyde, a total of 3.51 g of product was obtained. The percentage yield in this reaction was _____ %.

Q75. Total number of non bonded electrons present in NO_2^- ion based on Lewis theory is

ANSWER KEYS

1. (4)	2. (2)	3. (4)	4. (4)	5. (2)	6. (1)	7. (3)	8. (4)
9. (3)	10. (3)	11. (2)	12. (4)	13. (1)	14. (3)	15. (3)	16. (4)
17. (1)	18. (4)	19. (4)	20. (4)	21. (12)	22. (11132)	23. (64)	24. (1328)
25. (10)	26. (1)	27. (2)	28. (2)	29. (1)	30. (4)	31. (4)	32. (3)
33. (3)	34. (3)	35. (3)	36. (2)	37. (4)	38. (1)	39. (2)	40. (4)
41. (4)	42. (2)	43. (4)	44. (4)	45. (4)	46. (8)	47. (1320)	48. (8)
49. (3)	50. (7700)	51. (2)	52. (2)	53. (2)	54. (3)	55. (3)	56. (4)
57. (3)	58. (1)	59. (1)	60. (2)	61. (4)	62. (2)	63. (3)	64. (3)
65. (4)	66. (3)	67. (3)	68. (1)	69. (1)	70. (4)	71. (275)	72. (2)
73. (0)	74. (60)	75. (12)					

Q1. Let x_1, x_2, \dots, x_{10} be ten observations such that $\sum_{i=1}^{10} (x_i - 2) = 30$, $\sum_{i=1}^{10} (x_i - \beta)^2 = 98$, $\beta > 2$, and their variance is $\frac{4}{5}$. If μ and σ^2 are respectively the mean and the variance of $2(x_1 - 1) + 4\beta$,

$2(x_2 - 1) + 4\beta, \dots, 2(x_{10} - 1) + 4\beta$, then $\frac{\beta\mu}{\sigma^2}$ is equal to :

- (1) 100 (2) 120

- (3) 110 (4) 90

Q2. Consider an A. P. of positive integers, whose sum of the first three terms is 54 and the sum of the first twenty terms lies between 1600 and 1800. Then its 11th term is :

- (1) 90 (2) 84

- (3) 122 (4) 108

Q3. The number of solutions of the equation $\left(\frac{9}{x} - \frac{9}{\sqrt{x}} + 2\right) \left(\frac{2}{x} - \frac{7}{\sqrt{x}} + 3\right) = 0$ is:

- (1) 2 (2) 3

- (3) 1 (4) 4

Q4. Define a relation R on the interval $[0, \frac{\pi}{2})$ by xRy if and only if $\sec^2 x - \tan^2 y = 1$. Then R is :

- (1) both reflexive and transitive but not symmetric (2) an equivalence relation
- (3) reflexive but neither symmetric nor transitive (4) both reflexive and symmetric but not transitive

Q5. Two parabolas have the same focus $(4, 3)$ and their directrices are the x -axis and the y -axis, respectively. If

these parabolas intersect at the points A and B , then $(AB)^2$ is equal to :

- (1) 392 (2) 384

- (3) 192 (4) 96

Q6. Let P be the set of seven digit numbers with sum of their digits equal to 11. If the numbers in P are formed by using the digits 1, 2 and 3 only, then the number of elements in the set P is :

- (1) 173 (2) 164

- (3) 158 (4) 161

Q7. Let $\vec{a} = \hat{i} + 2\hat{j} + \hat{k}$ and $\vec{b} = 2\hat{i} + 7\hat{j} + 3\hat{k}$. Let $L_1 : \vec{r} = (-\hat{i} + 2\hat{j} + \hat{k}) + \lambda\vec{a}, \lambda \in \mathbf{R}$ and

$L_2 : \vec{r} = (\hat{j} + \hat{k}) + \mu\vec{b}, \mu \in \mathbf{R}$ be two lines. If the line L_3 passes through the point of intersection of L_1 and L_2 , and is parallel to $\vec{a} + \vec{b}$, then L_3 passes through the point :

- (1) $(5, 17, 4)$ (2) $(2, 8, 5)$

- (3) $(8, 26, 12)$ (4) $(-1, -1, 1)$

Q8. Let $\vec{a} = 2\hat{i} - \hat{j} + 3\hat{k}$, $\vec{b} = 3\hat{i} - 5\hat{j} + \hat{k}$ and \vec{c} be a vector such that $\vec{a} \times \vec{c} = \vec{c} \times \vec{b}$ and $(\vec{a} + \vec{c}) \cdot (\vec{b} + \vec{c}) = 168$.

Then the maximum value of $|\vec{c}|^2$ is :

- (1) 462 (2) 77

- (3) 154 (4) 308

Q9. The integral $80 \int_0^{\frac{\pi}{4}} \left(\frac{\sin \theta + \cos \theta}{9+16 \sin 2\theta} \right) d\theta$ is equal to :

- (1) $3 \log_e 4$ (2) $4 \log_e 3$

- (3) $6 \log_e 4$ (4) $2 \log_e 3$

Q10. Let the ellipse $E_1 : \frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$, $a > b$ and $E_2 : \frac{x^2}{A^2} + \frac{y^2}{B^2} = 1$, $A < B$ have same eccentricity $\frac{1}{\sqrt{3}}$. Let the product of their lengths of latus rectums be $\frac{32}{\sqrt{3}}$, and the distance between the foci of E_1 be 4. If E_1 and E_2 meet at A, B, C and D , then the area of the quadrilateral $ABCD$ equals :

- (1) $\frac{12\sqrt{6}}{5}$ (2) $6\sqrt{6}$
 (3) $\frac{18\sqrt{6}}{5}$ (4) $\frac{24\sqrt{6}}{5}$

Q11. Let $A = [a_{ij}] = \begin{bmatrix} \log_5 128 & \log_4 5 \\ \log_5 8 & \log_4 25 \end{bmatrix}$. If A_{ij} is the cofactor of a_{ij} , $C_{ij} = \sum_{k=1}^2 a_{ik} A_{jk}$, $1 \leq i, j \leq 2$, and $C = [C_{ij}]$, then $8|C|$ is equal to :

- (1) 288 (2) 222
 (3) 242 (4) 262

Q12. Let $|z_1 - 8 - 2i| \leq 1$ and $|z_2 - 2 + 6i| \leq 2$, $z_1, z_2 \in \mathbb{C}$. Then the minimum value of $|z_1 - z_2|$ is :

- (1) 13 (2) 10
 (3) 3 (4) 7

Q13. Let $L_1 : \frac{x-1}{1} = \frac{y-2}{-1} = \frac{z-1}{2}$ and $L_2 : \frac{x+1}{-1} = \frac{y-2}{2} = \frac{z}{1}$ be two lines. Let L_3 be a line passing through the point (α, β, γ) and be perpendicular to both L_1 and L_2 . If L_3 intersects L_1 , then $|5\alpha - 11\beta - 8\gamma|$ equals :

- (1) 20 (2) 18
 (3) 25 (4) 16

Q14. Let M and m respectively be the maximum and the minimum values of

$$f(x) = \begin{vmatrix} 1 + \sin^2 x & \cos^2 x & 4 \sin 4x \\ \sin^2 x & 1 + \cos^2 x & 4 \sin 4x \\ \sin^2 x & \cos^2 x & 1 + 4 \sin 4x \end{vmatrix}, x \in \mathbb{R}$$

Then $M^4 - m^4$ is equal to :

- (1) 1280 (2) 1295
 (3) 1215 (4) 1040

Q15. Let ABC be a triangle formed by the lines $7x - 6y + 3 = 0$, $x + 2y - 31 = 0$ and $9x - 2y - 19 = 0$. Let the point (h, k) be the image of the centroid of ΔABC in the line $3x + 6y - 53 = 0$. Then $h^2 + k^2 + hk$ is equal to:

- (1) 47 (2) 37
 (3) 36 (4) 40

Q16. The value of $\lim_{n \rightarrow \infty} \left(\sum_{k=1}^n \frac{k^3 + 6k^2 + 11k + 5}{(k+3)!} \right)$ is:

- (1) $4/3$ (2) 2
 (3) $7/3$ (4) $5/3$

Q17. The least value of n for which the number of integral terms in the Binomial expansion of $(\sqrt[3]{7} + \sqrt[12]{11})^n$ is 183, is :

- (1) 2184 (2) 2196
 (3) 2148 (4) 2172

- Q18.** Let $y = y(x)$ be the solution of the differential equation $\cos x(\log_e(\cos x))^2 dy + (\sin x - 3y \sin x \log_e(\cos x))dx = 0, x \in (0, \frac{\pi}{2})$. If $y\left(\frac{\pi}{4}\right) = \frac{-1}{\log_e 2}$, then $y\left(\frac{\pi}{6}\right)$ is equal to :
 (1) $\frac{1}{\log_e(3)-\log_e(4)}$ (2) $\frac{2}{\log_e(3)-\log_e(4)}$
 (3) $\frac{1}{\log_e(4)-\log_e(3)}$ (4) $-\frac{1}{\log_e(4)}$

- Q19.** Let the line $x + y = 1$ meet the circle $x^2 + y^2 = 4$ at the points A and B. If the line perpendicular to AB and passing through the mid point of the chord AB intersects the circle at C and D, then the area of the quadrilateral ABCD is equal to :
 (1) $\sqrt{14}$ (2) $3\sqrt{7}$
 (3) $2\sqrt{14}$ (4) $5\sqrt{7}$

- Q20.** Let the area of the region $\{(x, y) : 2y \leq x^2 + 3, y + |x| \leq 3, y \geq |x - 1|\}$ be A. Then $6A$ is equal to :
 (1) 16 (2) 12
 (3) 14 (4) 18

- Q21.** Let $S = \{x : \cos^{-1} x = \pi + \sin^{-1} x + \sin^{-1}(2x + 1)\}$. Then $\sum_{x \in S} (2x - 1)^2$ is equal to _____.

- Q22.** Let $f : (0, \infty) \rightarrow \mathbf{R}$ be a twice differentiable function. If for some $a \neq 0$, $\int_0^1 f(\lambda x) d\lambda = af(x)$, $f(1) = 1$ and $f(16) = \frac{1}{8}$, then $16 - f'(\frac{1}{16})$ is equal to _____.

- Q23.** The number of 6-letter words, with or without meaning, that can be formed using the letters of the word MATHS such that any letter that appears in the word must appear at least twice, is _____.

- Q24.** Let $S = \{m \in \mathbf{Z} : A^{m^2} + A^m = 3I - A^{-6}\}$, where $A = \begin{bmatrix} 2 & -1 \\ 1 & 0 \end{bmatrix}$. Then $n(S)$ is equal to _____.

- Q25.** Let $[t]$ be the greatest integer less than or equal to t. Then the least value of $p \in \mathbf{N}$ for which $\lim_{x \rightarrow 0^+} \left(x \left(\left[\frac{1}{x} \right] + \left[\frac{2}{x} \right] + \dots + \left[\frac{p}{x} \right] \right) - x^2 \left(\left[\frac{1}{x^2} \right] + \left[\frac{2^2}{x^2} \right] + \dots + \left[\frac{9^2}{x^2} \right] \right) \right) \geq 1$ is equal to _____.

- Q26.** An electric dipole of mass m, charge q, and length l is placed in a uniform electric field $\vec{E} = E_0 \hat{i}$. When the dipole is rotated slightly from its equilibrium position and released, the time period of its oscillations will be:
 (1) $\frac{1}{2\pi} \sqrt{\frac{ml}{2qE_0}}$ (2) $2\pi \sqrt{\frac{ml}{qE_0}}$
 (3) $\frac{1}{2\pi} \sqrt{\frac{2ml}{qE_0}}$ (4) $2\pi \sqrt{\frac{ml}{2qE_0}}$

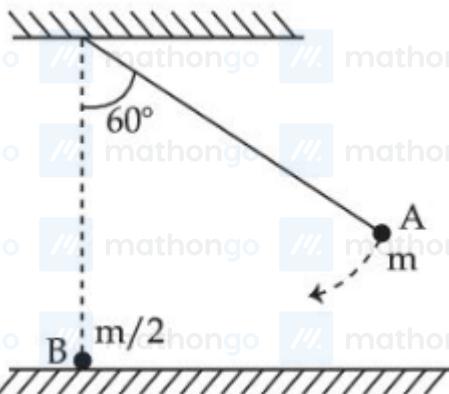
- Q27.** A coil of area A and N turns is rotating with angular velocity ω in a uniform magnetic field \vec{B} about an axis perpendicular to \vec{B} . Magnetic flux φ and induced emf ε across it, at an instant when \vec{B} is parallel to the plane of coil, are :
 (1) $\varphi = AB, \varepsilon = 0$ (2) $\varphi = 0, \varepsilon = 0$
 (3) $\varphi = 0, \varepsilon = NAB\omega$ (4) $\varphi = AB, \varepsilon = NAB\omega$

- Q28.** Given below are two statements : one is labelled as Assertion (A) and the other is labelled as Reason (R).
 Assertion (A) : Choke coil is simply a coil having a large inductance but a small resistance. Choke coils are used with fluorescent mercury-tube fittings. If household electric power is directly connected to a mercury

For tube, the tube will be damaged. Reason (R): By using the choke coil, the voltage across the tube is reduced by a factor $(R/\sqrt{R^2 + \omega^2 L^2})$, where ω is frequency of the supply across resistor R and inductor L . If the choke coil were not used, the voltage across the resistor would be the same as the applied voltage. In the light of the above statements, choose the most appropriate answer from the options given below :

- (1) (A) is true but (R) is false (2) Both (A) and (R) are true and (R) is the correct explanation of (A)
 (3) (A) is false but (R) is true (4) Both (A) and (R) are true but (R) is not the correct explanation of (A)

Q29. As shown below, bob A of a pendulum having massless string of length ' R ' is released from 60° to the vertical. It hits another bob B of half the mass that is at rest on a friction less table in the center. Assuming elastic collision, the magnitude of the velocity of bob A after the collision will be (take g as acceleration due to



gravity.)

- (1) $\frac{4}{3}\sqrt{Rg}$
 (2) $\frac{2}{3}\sqrt{Rg}$
 (3) \sqrt{Rg}
 (4) $\frac{1}{3}\sqrt{Rg}$

Q30. Given below are two statements : one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A) : Electromagnetic waves carry energy but not momentum. Reason (R) : Mass of a photon is zero.
 In the light of the above statements, choose the most appropriate answer from the options given below :

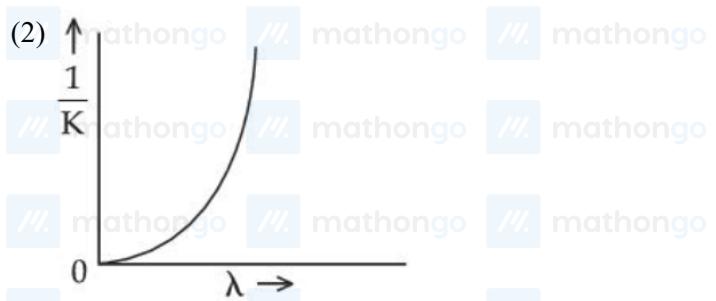
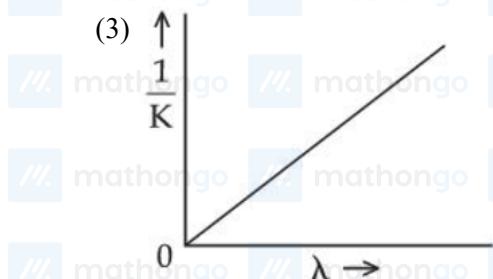
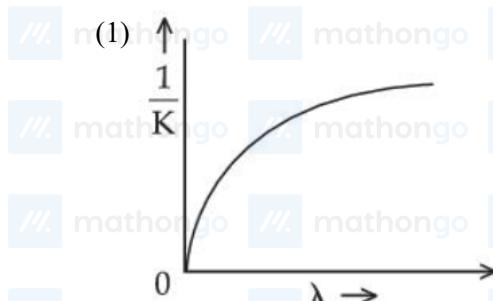
- (1) Both (A) and (R) are true and (R) is the correct explanation of (A) (2) Both (A) and (R) are true but (R) is not the correct explanation of (A)
 (3) (A) is false but (R) is true (4) (A) is true but (R) is false

Q31. Two projectiles are fired with same initial speed from same point on ground at angles of $(45^\circ - \alpha)$ and

$(45^\circ + \alpha)$, respectively, with the horizontal direction. The ratio of their maximum heights attained is :

- (1) $\frac{1-\tan\alpha}{1+\tan\alpha}$
 (2) $\frac{1-\sin 2\alpha}{1+\sin 2\alpha}$
 (3) $\frac{1+\sin 2\alpha}{1-\sin 2\alpha}$
 (4) $\frac{1+\sin\alpha}{1-\sin\alpha}$

Q32. If λ and K are de Broglie wavelength and kinetic energy, respectively, of a particle with constant mass. The correct graphical representation for the particle will be



Q33. Given below are two statements : one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A) : Emission of electrons in photoelectric effect can be suppressed by applying a sufficiently negative electron potential to the photoemissive substance. Reason (R) : A negative electric potential, which stops the emission of electrons from the surface of a photoemissive substance, varies linearly with frequency of incident radiation. In the light of the above statements, choose the most appropriate answer from the options given below :

- | | |
|---|---|
| (1) (A) is false but (R) is true | (2) (A) is true but (R) is false |
| (3) Both (A) and (R) are true and (R) is the correct explanation of (A) | (4) Both (A) and (R) are true but (R) is not the correct explanation of (A) |

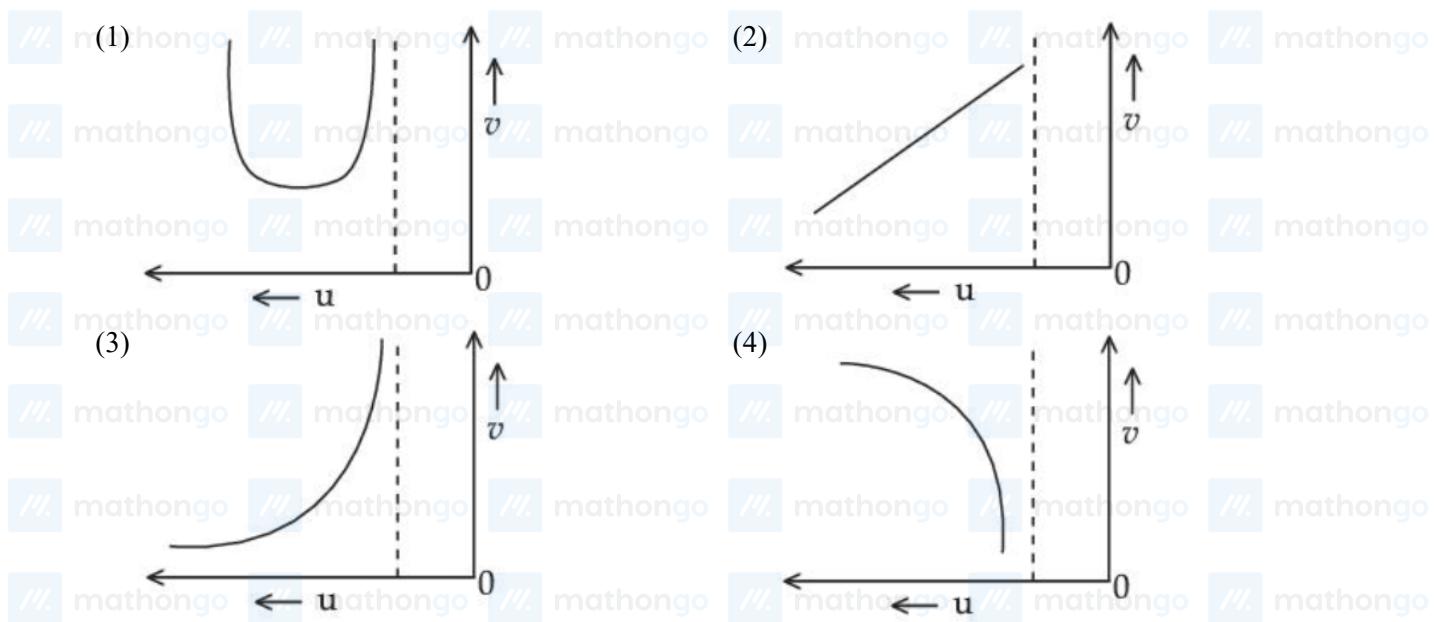
Q34. Consider a long straight wire of a circular cross-section (radius a) carrying a steady current I . The current is uniformly distributed across this cross-section. The distances from the centre of the wire's cross-section at which the magnetic field [inside the wire, outside the wire] is half of the maximum possible magnetic field, anywhere due to the wire, will be

- | | |
|-------------------|-----------------|
| (1) $[a/4, 3a/2]$ | (2) $[a/4, 2a]$ |
| (3) $[a/2, 2a]$ | (4) $[a/2, 3a]$ |

Q35. At the interface between two materials having refractive indices n_1 and n_2 , the critical angle for reflection of an em wave is θ_{1C} . The n_2 material is replaced by another material having refractive index n_3 such that the critical angle at the interface between n_1 and n_3 materials is θ_{2C} . If $n_3 > n_2 > n_1$; $\frac{n_2}{n_3} = \frac{2}{5}$ and

- $\sin \theta_{2C} - \sin \theta_{1C} = \frac{1}{2}$, then θ_{1C} is
- | | |
|---|--|
| (1) $\sin^{-1} \left(\frac{1}{6} \right)$ | (2) $\sin^{-1} \left(\frac{1}{3} \right)$ |
| (3) $\sin^{-1} \left(\frac{-5}{6} \right)$ | (4) $\sin^{-1} \left(\frac{2}{3} \right)$ |

Q36. Let u and v be the distances of the object and the image from a lens of focal length f . The correct graphical representation of u and v for a convex lens when $|u| >$, is



Q37.

List - I

Electric field inside (distance $r > 0$ from center)

- (A) of a uniformly charged spherical shell with surface charge density σ , and radius R .

Electric field at distance $r > 0$ from a uniformly

- (B) charged infinite plane sheet with surface charge density σ .

Match List - I with List - II.

Electric field outside (distance $r > 0$ from center)

- (C) of a uniformly charged spherical shell with surface charge density σ , and radius R .

Electric field between 2 oppositely charged

- (D) infinite plane parallel sheets with uniform surface charge density σ .

List - II

- (I) σ/ϵ_0

- (II) $\sigma/2\epsilon_0$

Choose

- (III) 0

- (IV) $\frac{\sigma R^2}{\epsilon_0 r^2}$

the correct answer from the options given below :

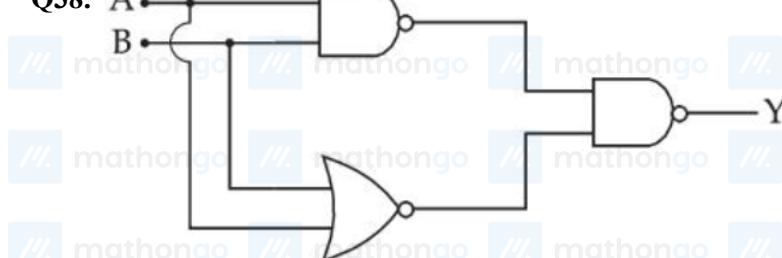
(1) (A)-(III), (B)-(II), (C)-(IV), (D)-(I)

(3) (A)-(II), (B)-(I), (C)-(IV), (D)-(III)

(2) (A)-(IV), (B)-(II), (C)-(III), (D)-(I)

(4) (A)-(IV), (B)-(I), (C)-(III), (D)-(II)

Q38.



For the circuit shown above, equivalent GATE is :

(1) OR gate

(3) NOT gate

(2) NAND gate

(4) AND gate

Q39. The expression given below shows the variation of velocity (v) with time (t), $v = At^2 + \frac{Bt}{C+t}$. The dimension of ABC is :

- (1) $[M^0 L^1 T^{-3}]$ (2) $[M^0 L^2 T^{-2}]$
 (3) $[M^0 L^1 T^{-2}]$ (4) $[M^0 L^2 T^{-3}]$

Q40. The workdone in an adiabatic change in an ideal gas depends upon only :

- (1) change in its temperature (2) change in its volume
 (3) change in its pressure (4) change in its specific heat

Q41. The fractional compression ($\frac{\Delta V}{V}$) of water at the depth of 2.5 km below the sea level is ____ %. Given, the Bulk modulus of water = $2 \times 10^9 \text{ N m}^{-2}$, density of water = 10^3 kgm^{-3} , acceleration due to gravity = $g = 10 \text{ m s}^{-2}$.

- (1) 1.25 (2) 1.0
 (3) 1.75 (4) 1.5

Q42. The pair of physical quantities not having same dimensions is :

- (1) Pressure and Young's modulus (2) Surface tension and impulse
 (3) Torque and energy (4) Angular momentum and Planck's constant

Q43. Consider I_1 and I_2 are the currents flowing simultaneously in two nearby coils 1 & 2, respectively. If L_1 = self inductance of coil 1, M_{12} = mutual inductance of coil 1 with respect to coil 2, then the value of induced emf in coil 1 will be Options

- (1) $\varepsilon_1 = -L_1 \frac{dI_2}{dt} - M_{12} \frac{dI_1}{dt}$ (2) $\varepsilon_1 = -L_1 \frac{dI_1}{dt} - M_{12} \frac{dI_2}{dt}$
 (3) $\varepsilon_1 = -L_1 \frac{dI_1}{dt} + M_{12} \frac{dI_2}{dt}$ (4) $\varepsilon_1 = -L_1 \frac{dI_1}{dt} + M_{12} \frac{dI_2}{dt}$

Q44. Given below are two statements : one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A) : Time period of a simple pendulum is longer at the top of a mountain than that at the base of the mountain. Reason (R): Time period of a simple pendulum decreases with increasing value of acceleration due to gravity and vice-versa. In the light of the above statements, choose the most appropriate answer from the options given below :

- (1) Both (A) and (R) are true and (R) is the correct explanation of (A)
 (2) (A) is true but (R) is false
 (3) (A) is false but (R) is true (4) Both (A) and (R) are true but (R) is not the correct explanation of (A)

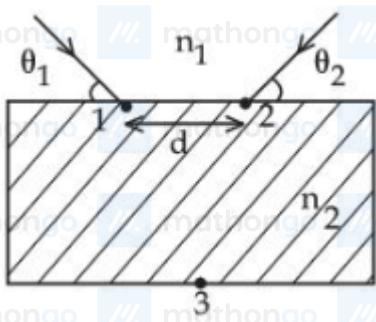
Q45. A body of mass ' m ' connected to a massless and unstretchable string goes in verticle circle of radius ' R 'under gravity g . The other end of the string is fixed at the center of circle. If velocity at top of circular path is $n\sqrt{gR}$, where, $n \geq 1$, then ratio of kinetic energy of the body at bottom to that at top of the circle is

- (1) $\frac{n^2}{n^2+4}$ (2) $\frac{n^2+4}{n^2}$
 (3) $\frac{n+4}{n}$ (4) $\frac{n}{n+4}$

Q46. In a hydraulic lift, the surface area of the input piston is 6 cm^2 and that of the output piston is 1500 cm^2 . If 100 N force is applied to the input piston to raise the output piston by 20 cm, then the work done is _____ kJ.

Q47. The coordinates of a particle with respect to origin in a given reference frame is $(1, 1, 1)$ meters. If a force of $\vec{F} = \hat{i} - \hat{j} + \hat{k}$ acts on the particle, then the magnitude of torque (with respect to origin) in z-direction is _____

Q48. Two light beams fall on a transparent material block at point 1 and 2 with angle θ_1 and θ_2 , respectively, as shown in figure. After refraction, the beams intersect at point 3 which is exactly on the interface at other end of the block. Given : the distance between 1 and 2, $d = 4\sqrt{3}$ cm and $\theta_1 = \theta_2 = \cos^{-1}\left(\frac{n_2}{2n_1}\right)$, where refractive index of the block $n_2 >$ refractive index of the outside medium n_1 , then the thickness of the block is _____



Q49. A container of fixed volume contains a gas at 27°C . To double the pressure of the gas, the temperature of gas should be raised to _____ $^\circ\text{C}$.

Q50. The maximum speed of a boat in still water is 27 km/h. Now this boat is moving downstream in a river flowing at 9 km/h. A man in the boat throws a ball vertically upwards with speed of 10 m/s. Range of the ball as observed by an observer at rest on the river bank, is _____ cm. (Take $g = 10 \text{ m/s}^2$)

Q51.

List - I

List - II

	(Complex)	(Hybridisation & Magnetic characters)
(A)	$[\text{MnBr}_4]^{2-}$	(I) d^2s^3 & diamagnetic
(B)	$[\text{FeF}_6]^{3-}$	(II) $\text{sp}^3 \text{d}^2$ & paramagnetic
(C)	$[\text{Co}(\text{C}_2\text{O}_4)_3]^{3-}$	(III) sp^3 & diamagnetic
(D)	$[\text{Ni}(\text{CO})_4]$	(IV) sp^3 & paramagnetic

Match List - I with List - II.

- Choose the correct answer from the options given below :
- (1) (A) –(IV), (B) –(II), (C) –(I), (D) –(III)
 - (2) (A) –(III), (B) –(I), (C) –(II), (D) –(IV)
 - (3) (A) –(IV), (B) –(I), (C) –(II), (D) –(III)
 - (4) (A) –(III), (B) –(II), (C) –(I), (D) –(IV)

Q52. J of energy is transferred as heat to 0.5 mol of Argon gas at 298 K and 1.00 atm. The final temperature and the change in internal energy respectively are: Given : $R = 8.3 \text{ J K}^{-1} \text{ mol}^{-1}$

- (1) 378 K and 500 J
- (2) 368 K and 500 J
- (3) 348 K and 300 J
- (4) 378 K and 300 J

Q53. At temperature T, compound $\text{AB}_{2(g)}$ dissociates as $\text{AB}_{2(g)} \rightleftharpoons \text{AB}_{(g)} + \frac{1}{2} \text{B}_{2(g)}$ having degree of dissociation x (small compared to unity). The correct expression for x in terms of K_p and p is

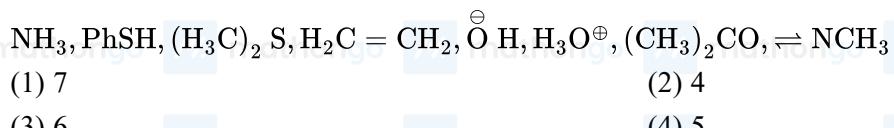
(1) $\sqrt[4]{\frac{2K_p}{p}}$
 (3) $\sqrt[3]{\frac{2K_p^2}{p}}$

(2) $\sqrt[3]{\frac{2K_p}{p}}$
 (4) $\sqrt{K_p}$

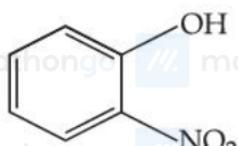
Q54. An element 'E' has the ionisation enthalpy value of 374 kJ mol^{-1} . 'E' reacts with elements A, B, C and D with electron gain enthalpy values of $-328, -349, -325$ and -295 kJ mol^{-1} , respectively. The correct order of the products EA, EB, EC and ED in terms of ionic character is :

- (1) ED > EC > EB > EA (2) EA > EB > EC > ED
 (3) EB > EA > EC > ED (4) ED > EC > EA > EB

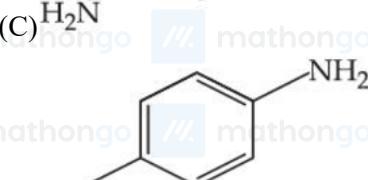
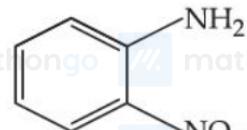
Q55. Total number of nucleophiles from the following is :



Q56.



The steam volatile compounds among the following are : (A)



Choose the correct answer from the options given below :

- (1) (B) and (D) Only (2) (A) and (C) Only
 (3) (A), (B) and (C) Only (4) (A) and (B) Only

Q57. Given below are two statements : Statement (I): The radii of isoelectronic species increases in the order $\text{Mg}^{2+} < \text{Na}^+ < \text{F}^- < \text{O}^{2-}$ Statement (II): The magnitude of electron gain enthalpy of halogen decreases in the order $\text{Cl} > \text{F} > \text{Br} > \text{I}$ In the light of the above statements, choose the most appropriate answer from the options given below :

- (1) Statement I is incorrect but Statement II is correct (2) Statement I is correct but Statement II is incorrect
 (3) Both Statement I and Statement II are incorrect (4) Both Statement I and Statement II are correct

Q58.	List - I (Carbohydrate)	List - II (Linkage Source)
Match List - I with List - II.	(A) Amylose (B) Cellulose (C) Glycogen (D) Amylopectin	(I) $\beta - C_1 - C_4$, plant (II) $\alpha - C_1 - C_4$, animal (III) $\alpha - C_1 - C_4, \alpha - C_1 - C_6$, plant (IV) $\alpha - C_1 - C_4$, plant
		Choose the
		correct answer from the options given below :
	(1) (A)-(IV), (B)-(I), (C)-(III), (D)-(II) (3) (A)-(II), (B)-(III), (C)-(I), (D)-(IV)	(2) (A)-(III), (B)-(II), (C)-(I), (D)-(IV) (4) (A)-(IV), (B)-(I), (C)-(II), (D)-(III)

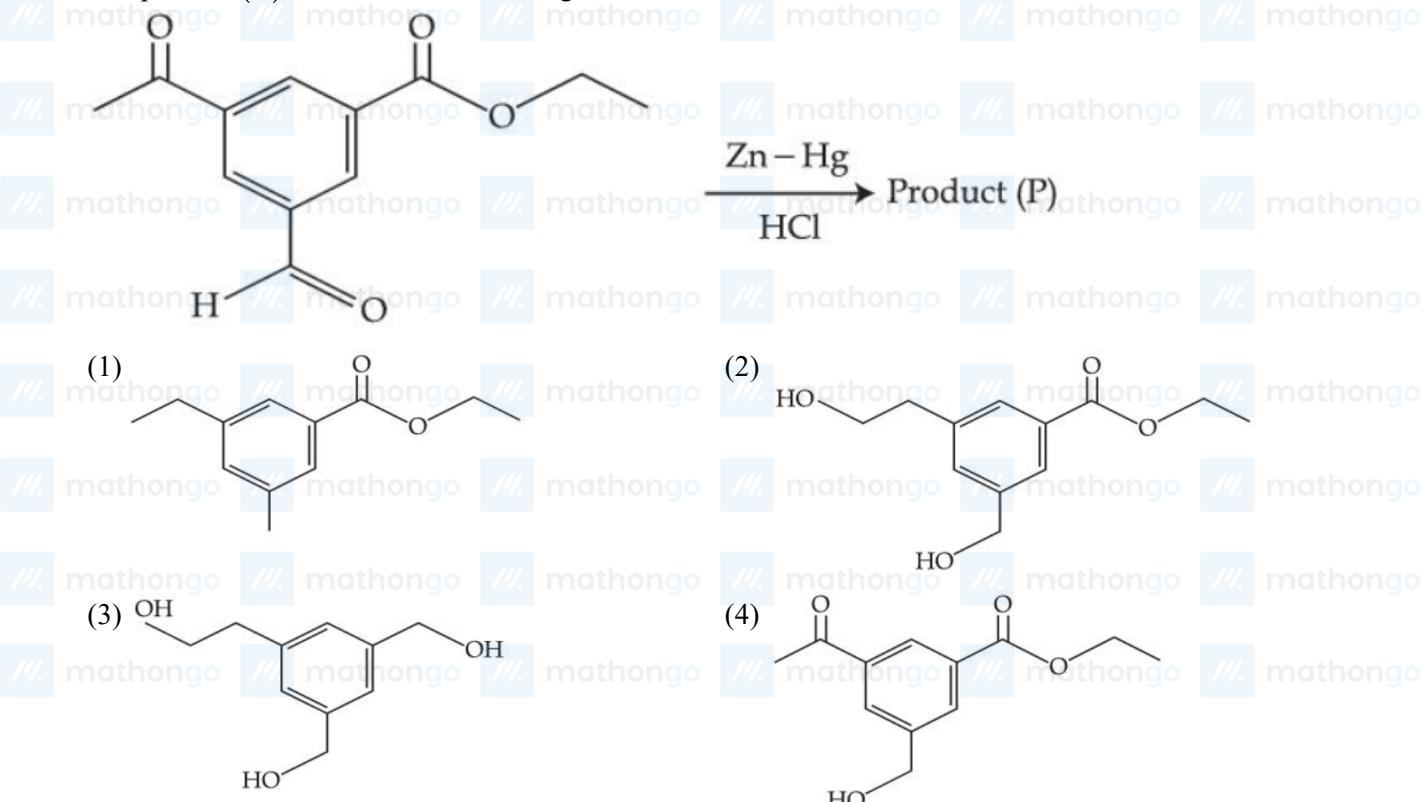
Q59. The molar conductivity of a weak electrolyte when plotted against the square root of its concentration, which of the following is expected to be observed ?

- (1) A small decrease in molar conductivity is observed at infinite dilution.
(3) A small increase in molar conductivity is observed at infinite dilution.

Q60. The standard reduction potential values of some of the p-block ions are given below. Predict the one with the strongest oxidising capacity.

- (1) $E^\ominus_{Pb^{4+}/Pb^{2+}} = +1.67\text{ V}$
(3) $E^\ominus_{Al^{3+}/Al} = -1.66\text{ V}$

Q61. The product (P) formed in the following reaction is :



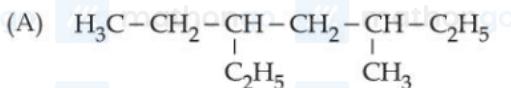
Q62. If a_0 is denoted as the Bohr radius of hydrogen atom, then what is the de-Broglie wavelength (λ) of the electron present in the second orbit of hydrogen atom? [n : any integer]

- (1) $\frac{8\pi a_0}{n}$ (2) $\frac{2a_0}{n\pi}$
 (3) $\frac{4n}{\pi a_0}$ (4) $\frac{4\pi a_0}{n}$

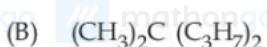
Q63.

List - I
(Structure)

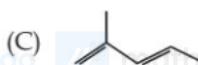
List - II
(IUPAC Name)



(I) 4-Methylpent-1-ene



(II) 3-Ethyl-5-methylheptane



(III) 4,4-Dimethylheptane



(IV) 2-Methyl-1,3-pentadiene

Match List - I with List - II.

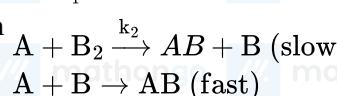
Choose the correct answer from the options given below :

- (1) (A)-(II), (B)-(III), (C)-(IV), (D)-(I) (2) (A)-(II), (B)-(III), (C)-(I), (D)-(IV)
 (3) (A)-(III), (B)-(II), (C)-(I), (D)-(IV) (4) (A)-(III), (B)-(II), (C)-(IV), (D)-(I)

Q64.



The reaction $A_2 + B_2 \rightarrow 2AB$ follows the mechanism



The overall order of the

reaction is :

- (1) 2 (2) 2.5 (3) 3 (4) 1.5

Q65. 1.24 g of AX_2 (molar mass 124 g mol⁻¹) is dissolved in 1 kg of water to form a solution with boiling point of 100.0156°C, while 25.4 g of AY_2 (molar mass 250 g mol⁻¹) in 2 kg of water constitutes a solution with a boiling point of 100.0260°C. $K_b(H_2O) = 0.52 \text{ K kg mol}^{-1}$ Which of the following is correct ?

- (1) AX_2 is fully ionised while AY_2 is completely unionised. (2) AX_2 is completely unionised while AY_2 is fully ionised.
 (3) AX_2 and AY_2 (both) are completely unionised. (4) AX_2 and AY_2 (both) are fully ionised.

Q66. Choose the correct statements. (A) Weight of a substance is the amount of matter present in it. (B) Mass is the

force exerted by gravity on an object. (C) Volume is the amount of space occupied by a substance. (D)

Temperatures below 0°C are possible in Celsius scale, but in Kelvin scale negative temperature is not possible.

(E) Precision refers to the closeness of various measurements for the same quantity. Choose the correct answer from the options given below :

- (1) (A), (D) and (E) Only (2) (C), (D) and (E) Only
 (3) (A), (B) and (C) Only (4) (B), (C) and (D) Only

Q67. The correct option with order of melting points of the pairs (Mn, Fe), (Tc, Ru) and (Re, Os) is :

- (1) Fe < Mn, Ru < Tc and Re < Os (2) Mn < Fe, Tc < Ru and Os < Re
 (3) Mn < Fe, Tc < Ru and Re < Os (4) Fe < Mn, Ru < Tc and Os < Re

Q68. For a $Mg \mid Mg^{2+}(aq) \mid Ag^+(aq) \mid Ag$ the correct Nernst Equation is :

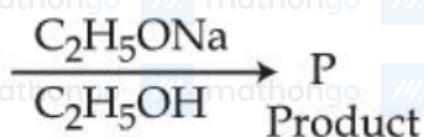
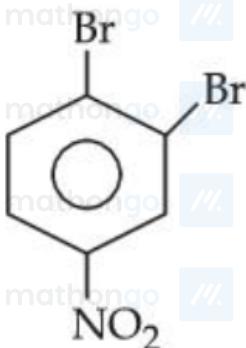
$$(1) E_{cell} = E_{cell}^o - \frac{RT}{2F} \ln \frac{[Ag^+]}{[Mg^{2+}]}$$

$$(3) E_{cell} = E_{cell}^o - \frac{RT}{2F} \ln \frac{[Ag^+]^2}{[Mg^{2+}]}$$

$$(2) E_{cell} = E_{cell}^o + \frac{RT}{2F} \ln \frac{[Ag^+]^2}{[Mg^{2+}]}$$

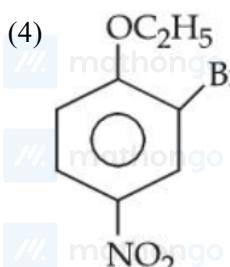
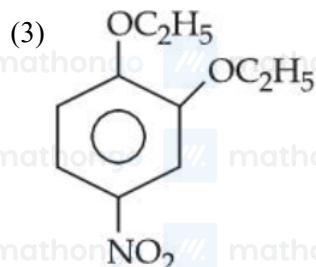
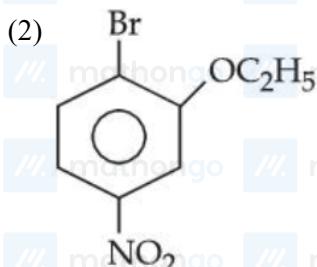
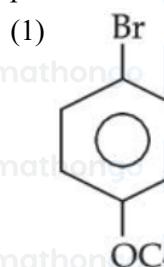
$$(4) E_{cell} = E_{cell}^o - \frac{RT}{2F} \ln \frac{[Mg^{2+}]}{[Ag^+]}$$

Q69.



In the following substitution reaction:

product 'P' formed is :



Q70. The correct increasing order of stability of the complexes based on Δ_o value is : I. $[\text{Mn}(\text{CN})_6]^{3-}$



$$(1) \text{IV} < \text{III} < \text{II} < \text{I}$$

$$(3) \text{III} < \text{II} < \text{IV} < \text{I}$$

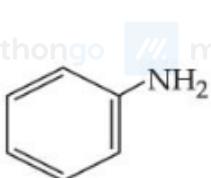
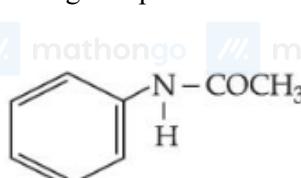
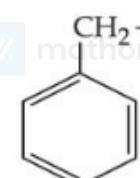
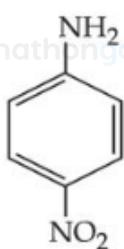
$$(2) \text{I} < \text{II} < \text{IV} < \text{III}$$

$$(4) \text{II} < \text{III} < \text{I} < \text{IV}$$

Q71. The molar mass of the water insoluble product formed from the fusion of chromite ore (FeCr_2O_4) with

Na_2CO_3 in presence of O_2 is _____ gmol $^{-1}$.

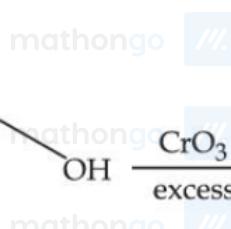
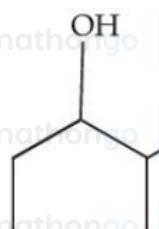
Q72. Given below are some nitrogen containing compounds



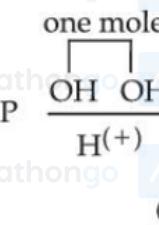
Each of them is treated with HCl separately. 1.0 g of the most basic compound will consume _____ mg of HCl. (Given molar mass in gmol⁻¹ C : 12, H : 1, O : 16, Cl : 35.5)

Q73. The sum of sigma (σ) and pi (π) bonds in Hex-1,3-dien-5-yne is _____.

Q74.



one mole



P

mathongo



mathongo

Q

mathongo

mathongo

mathongo

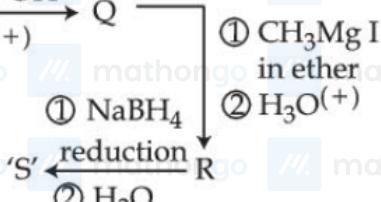
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R

mathongo

0.1 mole of compound 'S' will weigh _____ g. (Given molar mass in gmol⁻¹ C : 12, H : 1, O : 16)

Q75. If A_2B is 30% ionised in an aqueous solution, then the value of van't Hoff factor (i) is _____ $\times 10^{-1}$.

ANSWER KEYS

1. (1)	2. (1)	3. (4)	4. (2)	5. (3)	6. (4)	7. (3)	8. (4)
9. (2)	10. (4)	11. (3)	12. (4)	13. (3)	14. (1)	15. (2)	16. (4)
17. (1)	18. (1)	19. (3)	20. (3)	21. (5)	22. (112)	23. (1405)	24. (2)
25. (24)	26. (4)	27. (3)	28. (2)	29. (4)	30. (3)	31. (2)	32. (2)
33. (4)	34. (3)	35. (3)	36. (3)	37. (1)	38. (1)	39. (4)	40. (1)
41. (1)	42. (2)	43. (2)	44. (1)	45. (2)	46. (5)	47. (2)	48. (6)
49. (327)	50. (2000)	51. (1)	52. (3)	53. (3)	54. (3)	55. (4)	56. (4)
57. (4)	58. (4)	59. (2)	60. (1)	61. (1)	62. (1)	63. (1)	64. (4)
65. (1)	66. (2)	67. (2)	68. (2)	69. (4)	70. (2)	71. (160)	72. (341)
73. (15)	74. (13)	75. (16)					

Q1. Let $A = \begin{bmatrix} \frac{1}{\sqrt{2}} & -2 \\ 0 & 1 \end{bmatrix}$ and $P = \begin{bmatrix} \cos \theta & -\sin \theta \\ \sin \theta & \cos \theta \end{bmatrix}$, $\theta > 0$. If $B = PAP^T$, $C = P^T B^{10} P$ and the sum of the diagonal elements of C is $\frac{m}{n}$, where $\text{gcd}(m, n) = 1$, then $m + n$ is :

- (1) 127
- (2) 258
- (3) 65
- (4) 2049

Q2. If the components of $\vec{a} = \alpha \hat{i} + \beta \hat{j} + \gamma \hat{k}$ along and perpendicular to $\vec{b} = 3 \hat{i} + \hat{j} - \hat{k}$ respectively, are $\frac{16}{11}(3 \hat{i} + \hat{j} - \hat{k})$ and $\frac{1}{11}(-4 \hat{i} - 5 \hat{j} - 17 \hat{k})$, then $\alpha^2 + \beta^2 + \gamma^2$ is equal to :

- (1) 26
- (2) 18
- (3) 23
- (4) 16

Q3. Let A, B, C be three points in xy -plane, whose position vectors are given by $\sqrt{3} \hat{i} + \hat{j}$, $\hat{i} + \sqrt{3} \hat{j}$ and $a \hat{i} + (1-a) \hat{j}$ respectively with respect to the origin O. If the distance of the point C from the line bisecting the angle between the vectors \vec{OA} and \vec{OB} is $\frac{9}{\sqrt{2}}$, then the sum of all the possible values of a is :

- (1) 2
- (2) 9/2
- (3) 1
- (4) 0

Q4. Let the coefficients of three consecutive terms T_r , T_{r+1} and T_{r+2} in the binomial expansion of $(a+b)^{12}$ be in a G.P. and let p be the number of all possible values of r . Let q be the sum of all rational terms in the binomial expansion of $(\sqrt[4]{3} + \sqrt[3]{4})^{12}$. Then $p+q$ is equal to :

- (1) 283
- (2) 287
- (3) 295
- (4) 299

Q5. Let $[x]$ denote the greatest integer less than or equal to x . Then the domain of $f(x) = \sec^{-1}(2[x]+1)$ is :

- (1) $(-\infty, -1] \cup [0, \infty)$
- (2) $(-\infty, -1] \cup [1, \infty)$
- (3) $(-\infty, \infty) - \{0\}$

Q6. Let S be the set of all the words that can be formed by arranging all the letters of the word GARDEN. From the set S, one word is selected at random. The probability that the selected word will NOT have vowels in alphabetical order is :

- (1) $\frac{1}{2}$
- (2) $\frac{1}{4}$
- (3) $\frac{2}{3}$
- (4) $\frac{1}{3}$

Q7. If $\sum_{r=1}^{13} \left\{ \frac{1}{\sin(\frac{\pi}{4} + (r-1)\frac{\pi}{6}) \sin(\frac{\pi}{4} + \frac{r\pi}{6})} \right\} = a\sqrt{3} + b$, $a, b \in \mathbf{Z}$, then $a^2 + b^2$ is equal to :

- (1) 10
- (2) 4
- (3) 2
- (4) 8

Q8. Let f be a real valued continuous function defined on the positive real axis such that $g(x) = \int_0^x t f(t) dt$. If $g(x^3) = x^6 + x^7$, then value of $\sum_{r=1}^{15} f(r^3)$ is :

- (1) 270
- (2) 340
- (3) 320
- (4) 310

Q9. Let $f : [0, 3] \rightarrow A$ be defined by $f(x) = 2x^3 - 15x^2 + 36x + 7$ and $g : [0, \infty) \rightarrow B$ be defined by $g(x) = \frac{x^{2025}}{x^{2025} + 1}$. If both the functions are onto and $S = \{x \in \mathbf{Z} : x \in A \text{ or } x \in B\}$, then $n(S)$ is equal to :

- (1) 29
 (3) 31
- (2) 30
 (4) 36

Q10. Bag B_1 contains 6 white and 4 blue balls, Bag B_2 contains 4 white and 6 blue balls, and Bag B_3 contains 5 white and 5 blue balls. One of the bags is selected at random and a ball is drawn from it. If the ball is white, then the probability, that the ball is drawn from Bag B_2 , is :

- (1) $\frac{4}{15}$
 (3) $\frac{2}{5}$
- (2) $\frac{1}{3}$
 (4) $\frac{2}{3}$

Q11. Let $f : \mathbf{R} \rightarrow \mathbf{R}$ be a twice differentiable function such that $f(2) = 1$. If $F(x) = xf(x)$ for all $x \in \mathbf{R}$, $\int_0^2 x F'(x)dx = 6$ and $\int_0^2 x^2 F''(x)dx = 40$, then $F'(2) + \int_0^2 F(x)dx$ is equal to :

- (1) 11
 (3) 15
- (2) 13
 (4) 9

Q12. For positive integers n , if $4a_n = (n^2 + 5n + 6)$ and $S_n = \sum_{k=1}^n \left(\frac{1}{a_k}\right)$, then the value of $507S_{2025}$ is :

- (1) 540
 (3) 1350
- (2) 675
 (4) 135

Q13. Let $f : \mathbf{R} - \{0\} \rightarrow (-\infty, 1)$ be a polynomial of degree 2, satisfying $f(x)f\left(\frac{1}{x}\right) = f(x) + f\left(\frac{1}{x}\right)$. If $f(K) = -2K$, then the sum of squares of all possible values of K is :

- (1) 7
 (3) 1
- (2) 6
 (4) 9

Q14. If A and B are the points of intersection of the circle $x^2 + y^2 - 8x = 0$ and the hyperbola $\frac{x^2}{9} - \frac{y^2}{4} = 1$ and a point P moves on the line $2x - 3y + 4 = 0$, then the centroid of $\triangle PAB$ lies on the line :

- (1) $x + 9y = 36$
 (3) $6x - 9y = 20$
- (2) $4x - 9y = 12$
 (4) $9x - 9y = 32$

Q15. If $f(x) = \int \frac{1}{x^{1/4}(1+x^{1/4})} dx$, $f(0) = -6$, then $f(1)$ is equal to :

- (1) $4(\log_e 2 - 2)$
 (3) $\log_e 2 + 2$
- (2) $2 - \log_{e^2} 2$
 (4) $4(\log_e 2 + 2)$

Q16. The area of the region bounded by the curves $x(1+y^2) = 1$ and $y^2 = 2x$ is:

- (1) $2\left(\frac{\pi}{2} - \frac{1}{3}\right)$
 (3) $\frac{\pi}{4} - \frac{1}{3}$
- (2) $\frac{\pi}{2} - \frac{1}{3}$
 (4) $\frac{1}{2}\left(\frac{\pi}{2} - \frac{1}{3}\right)$

Q17. The square of the distance of the point $\left(\frac{15}{7}, \frac{32}{7}, 7\right)$ from the line $\frac{x+1}{3} = \frac{y+3}{5} = \frac{z+5}{7}$ in the direction of the vector $\hat{i} + 4\hat{j} + 7\hat{k}$ is :

- (1) 54
 (3) 41
- (2) 44
 (4) 66

Q18. If the midpoint of a chord of the ellipse $\frac{x^2}{9} + \frac{y^2}{4} = 1$ is $(\sqrt{2}, 4/3)$, and the length of the chord is $\frac{2\sqrt{\alpha}}{3}$, then α is :

- (1) 20
 (3) 18
- (2) 22
 (4) 26

Q19. If $\alpha + i\beta$ and $\gamma + i\delta$ are the roots of $x^2 - (3 - 2i)x - (2i - 2) = 0$, $i = \sqrt{-1}$, then $\alpha\gamma + \beta\delta$ is equal to :

- (1) -2
- (2) 6
- (3) -6
- (4) 2

Q20. Two equal sides of an isosceles triangle are along $-x + 2y = 4$ and $x + y = 4$. If m is the slope of its third side, then the sum, of all possible distinct values of m , is :

- (1) $-2\sqrt{10}$
- (2) 12
- (3) 6
- (4) -6

Q21. Let A and B be the two points of intersection of the line $y + 5 = 0$ and the mirror image of the parabola $y^2 = 4x$ with respect to the line $x + y + 4 = 0$. If d denotes the distance between A and B, and a denotes the area of $\triangle SAB$, where S is the focus of the parabola $y^2 = 4x$, then the value of $(a + d)$ is

Q22. The number of natural numbers, between 212 and 999, such that the sum of their digits is 15, is

Q23. If $y = y(x)$ is the solution of the differential equation,

$$\sqrt{4-x^2} \frac{dy}{dx} = \left(\left(\sin^{-1} \left(\frac{x}{2} \right) \right)^2 - y \right) \sin^{-1} \left(\frac{x}{2} \right), -2 \leq x \leq 2, y(2) = \frac{\pi^2 - 8}{4}, \text{ then } y^2(0) \text{ is equal to}$$

Q24. The interior angles of a polygon with n sides, are in an A.P. with common difference 6° . If the largest interior angle of the polygon is 219° , then n is equal to

Q25. Let $f(x) = \lim_{n \rightarrow \infty} \sum_{r=0}^n \left(\frac{\tan(x/2^{r+1}) + \tan^3(x/2^{r+1})}{1 - \tan^2(x/2^{r+1})} \right)$. Then $\lim_{x \rightarrow 0} \frac{e^x - e^{f(x)}}{(x - f(x))}$ is equal to

Q26.



A bar magnet has total length $2l = 20$ units and the field point P is at a distance $d = 10$ units from the centre of the magnet. If the relative uncertainty of length measurement is 1%, then uncertainty of the magnetic field at point P is :

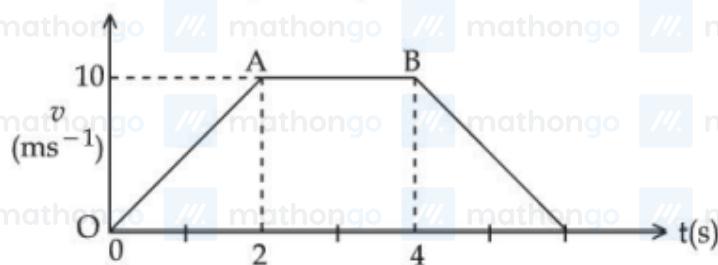
- (1) 4%
- (2) 15%
- (3) 5%
- (4) 10%

Q27. A concave mirror produces an image of an object such that the distance between the object and image is 20 cm

. If the magnification of the image is '-3', then the magnitude of the radius of curvature of the mirror is :

- (1) 30 cm
- (2) 3.75 cm
- (3) 15 cm
- (4) 7.5 cm

Q28. The velocity-time graph of an object moving along a straight line is shown in figure. What is the distance covered by the object between $t = 0$ to $t = 4$ s?



- (1) 30 m (2) 11 m
 (3) 10 m (4) 13 m
- Q29.** A body of mass 4 kg is placed on a plane at a point P having coordinate $(3, 4)$ m. Under the action of force $\vec{F} = (2\hat{i} + 3\hat{j})$ N, it moves to a new point Q having coordinates $(6, 10)$ m in 4 sec. The average power and instantaneous power at the end of 4 sec are in the ratio of :

- (1) 13 : 6 (2) 4 : 3
 (3) 1 : 2 (4) 6 : 13

Q30. Match List - I with List - II.

List - I

- (A) Angular Impulse
 (B) Latent Heat
 (C) Electrical resistivity
 (D) Electromotive force

List - II

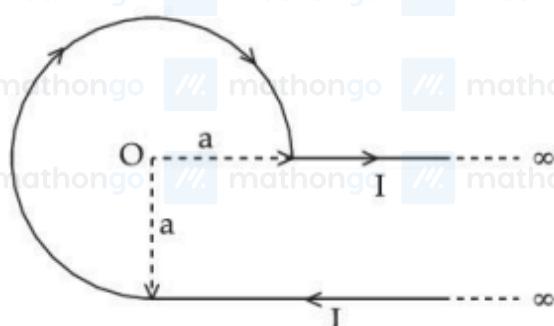
- (I) $[M^0 L^2 T^{-2}]$
 (II) $[M L^2 T^{-3} A^{-1}]$
 (III) $[M L^2 T^{-1}]$
 (IV) $[M L^3 T^{-3} A^{-2}]$

- (1) (A)-(II), (B)-(I), (C)-(IV), (D)-(III)
 (2) (A)-(I), (B)-(III), (C)-(IV), (D)-(II)
 (3) (A)-(III), (B)-(I), (C)-(II), (D)-(IV)
 (4) (A)-(III), (B)-(I), (C)-(IV), (D)-(II)

Q31. A uniform magnetic field of 0.4 T acts perpendicular to a circular copper disc 20 cm in radius. The disc is having a uniform angular velocity of $10\pi \text{ rads}^{-1}$ about an axis through its centre and perpendicular to the disc.

- What is the potential difference developed between the axis of the disc and the rim? ($\pi = 3.14$)
 (1) 0.5024 V (2) V
 (3) $0.2512V$ V (4) $0.1256V$ V

Q32.



An infinite wire has a circular bend of radius a , and carrying a current I as shown in figure. The magnitude of

magnetic field at the origin O of the arc is given by :

- (1) $\frac{\mu_0}{4\pi} \frac{I}{a} \left[\frac{\pi}{2} + 1 \right]$ (2) $\frac{\mu_0}{4\pi} \frac{I}{a} \left[\frac{3\pi}{2} + 2 \right]$
 (3) $\frac{\mu_0}{2\pi} \frac{I}{a} \left[\frac{\pi}{2} + 2 \right]$ (4) $\frac{\mu_0}{4\pi} \frac{I}{a} \left[\frac{3\pi}{2} + 1 \right]$

Q33. In a long glass tube, mixture of two liquids A and B with refractive indices 1.3 and 1.4 respectively, forms a convex refractive meniscus towards A. If an object placed at 13 cm from the vertex of the meniscus in A forms an image with a magnification of ' -2 ' then the radius of curvature of meniscus is :

- (1) $\frac{1}{3}$ cm (2) $\frac{4}{3}$ cm
 (3) 1 cm (4) $\frac{2}{3}$ cm

Q34. A 400 g solid cube having an edge of length 10 cm floats in water. How much volume of the cube is outside the water ? (Given : density of water = 1000 kg m^{-3})

- (1) 1400 cm^3 (2) 600 cm^3
 (3) 4000 cm^3 (4) 400 cm^3

Q35. Given below are two statements. One is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A) : Knowing initial position x_0 and initial momentum p_0 is enough to determine the position and momentum at any time t for a simple harmonic motion with a given angular frequency ω . Reason (R) : The amplitude and phase can be expressed in terms of x_0 and p_0 . In the light of the above statements, choose the correct answer from the options given below :

- (1) (A) is false but (R) is true (2) (A) is true but (R) is false
 (3) Both (A) and (R) are true but (R) is NOT the (4) Both (A) and (R) are true and (R) is the correct
 correct explanation of (A) explanation of (A)

Q36. A uniform rod of mass 250 g having length 100 cm is balanced on a sharp edge at 40 cm mark. A mass of 400 g is suspended at 10 cm mark. To maintain the balance of the rod, the mass to be suspended at 90 cm mark, is

- (1) 190 g (2) 200 g
 (3) 300 g (4) 290 g

Q37. Earth has mass 8 times and radius 2 times that of a planet. If the escape velocity from the earth is 11.2 km/s, the escape velocity in km/s from the planet will be :

- (1) 2.8 (2) 11.2
 (3) 5.6 (4) 8.4

Q38. The magnetic field of an E.M. wave is given by $\vec{B} = \left(\frac{\sqrt{3}}{2} \hat{i} + \frac{1}{2} \hat{j} \right) 30 \sin [\omega (t - \frac{z}{c})]$ (S.I. Units). The corresponding electric field in S.I. units is :

- (1) $\vec{E} = \left(\frac{1}{2} \hat{i} - \frac{\sqrt{3}}{2} \hat{j} \right) 30c \sin [\omega (t - \frac{z}{c})]$ (2) $\vec{E} = \left(\frac{3}{4} \hat{i} + \frac{1}{4} \hat{j} \right) 30c \cos [\omega (t - \frac{z}{c})]$
 (3) $\vec{E} = \left(\frac{1}{2} \hat{i} + \frac{\sqrt{3}}{2} \hat{j} \right) 30c \sin [\omega (t + \frac{z}{c})]$ (4) $\vec{E} = \left(\frac{\sqrt{3}}{2} \hat{i} - \frac{1}{2} \hat{j} \right) 30c \sin [\omega (t + \frac{z}{c})]$

Q39. The kinetic energy of translation of the molecules in 50 g of CO_2 gas at 17°C is

- (1) 4205.5 J (2) 4102.8 J
 (3) 3582.7 J (4) 3986.3 J

Q40. Which of the following phenomena can not be explained by wave theory of light?

- (1) Compton effect (2) Refraction of light
 (3) Reflection of light (4) Diffraction of light

Q41. A balloon and its content having mass M is moving up with an acceleration ' a '. The mass that must be released from the content so that the balloon starts moving up with an acceleration ' $3a$ ' will be (Take ' g ' as acceleration due to gravity)

- (1) $\frac{2Ma}{3a+g}$ (2) $\frac{3Ma}{2a-g}$
 (3) $\frac{3Ma}{2a+g}$ (4) $\frac{2Ma}{3a-g}$

Q42. The ratio of vapour densities of two gases at the same temperature is $\frac{4}{25}$, then the ratio of r.m.s. velocities will be:

- (1) $\frac{25}{4}$ (2) $\frac{2}{5}$
 (3) $\frac{5}{2}$ (4) $\frac{4}{25}$

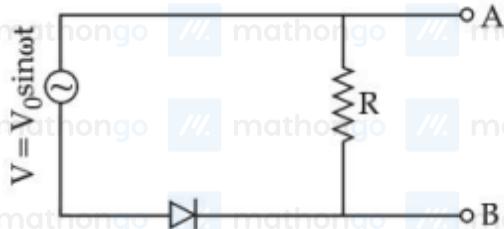
Q43. A parallel plate capacitor of capacitance $1\mu F$ is charged to a potential difference of $20 V$. The distance between plates is $1\mu m$. The energy density between plates of capacitor is.

- (1) $2 \times 10^{-4} J/m^3$ (2) $1.8 \times 10^5 J/m^3$
 (3) $1.8 \times 10^3 J/m^3$ (4) $2 \times 10^2 J/m^3$

Q44. The frequency of revolution of the electron in Bohr's orbit varies with n , the principal quantum number as

- (1) $\frac{1}{n^4}$ (2) $\frac{1}{n^2}$
 (3) $\frac{1}{n}$ (4) $\frac{1}{n^3}$

Q45.



In the circuit shown here, assuming threshold voltage of diode is negligibly small, then voltage V_{AB} is correctly represented by :

- (1) V_{AB} would be zero at all times



- (2) V_{AB} would be zero at all times



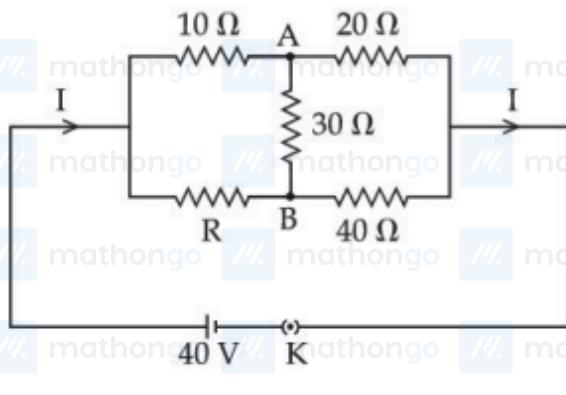
- (3) V_{AB} would be zero at all times



- (4) V_{AB} would be zero at all times

Q46. A thin transparent film with refractive index 1.4, is held on circular ring of radius 1.8 cm. The fluid in the film evaporates such that transmission through the film at wavelength 560 nm goes to a minimum every 12 seconds. Assuming that the film is flat on its two sides, the rate of evaporation is $\pi \times 10^{-13} m^3/s$.

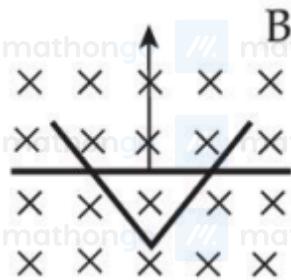
Q47. The value of current I in the electrical circuit as given below, when potential at A is equal to the potential at B, will be ____ A.



Q48. An electric dipole of dipole moment $6 \times 10^{-6} \text{ Cm}$ is placed in uniform electric field of magnitude 10^6 V/m .

Initially, the dipole moment is parallel to electric field. The work that needs to be done on the dipole to make its dipole moment opposite to the field, will be anad J.

Q49.



A conducting bar moves on two conducting rails as shown in the figure. A constant magnetic field B exists into the page. The bar starts to move from the vertex at time $t = 0$ with a constant velocity. If the induced EMF is $E \propto t^n$, then value of n is

Q50. The volume contraction of a solid copper cube of edge length 10 cm, when subjected to a hydraulic pressure of $7 \times 10^6 \text{ Pa}$, would be mm³. (Given bulk modulus of copper = $1.4 \times 10^{11} \text{ N m}^{-2}$)

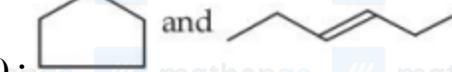
Q51. Concentrated nitric acid is labelled as 75% by mass. The volume in mL of the solution which contains 30 g of nitric acid is . Given : Density of nitric acid solution is 1.25 g/mL.

- (1) 40 (2) 32
 (3) 45 (4) 55

Q52.



and



Given below are two statements : **Statement (I)** :

are isomeric compounds. **Statement (II)** :

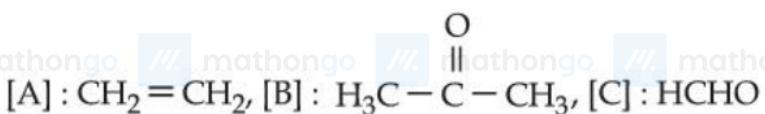
are functional group isomers.

- (1) Both **Statement (I)** and **Statement (II)** are false. (2) Both **Statement (I)** and **Statement (II)** are true.
 (3) **Statement (I)** is false but **Statement (II)** is true. (4) **Statement (I)** is true but **Statement (II)** is false.

Q53. Identify product [A], [B] and [C] in the following reaction sequence.



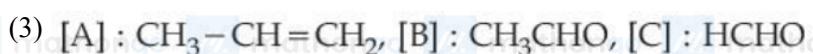
(1)



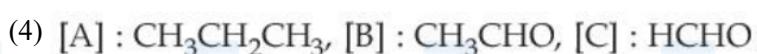
(2)



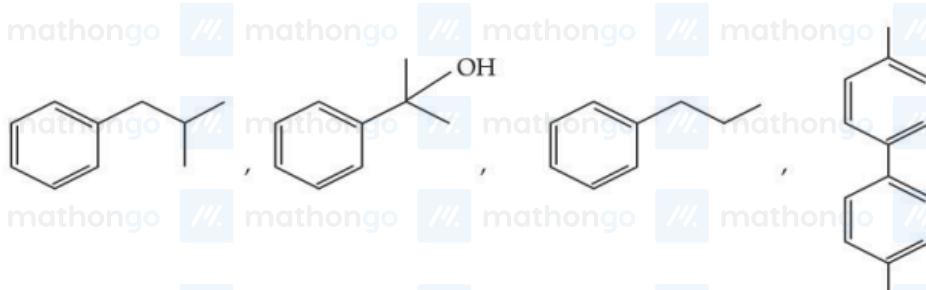
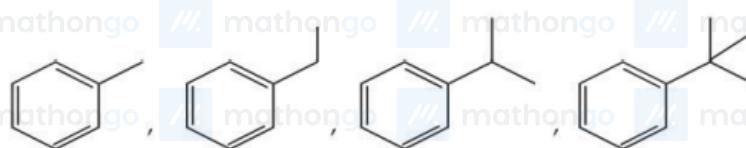
(3)



(4)



Q54. The total number of compounds from below when treated with hot KMnO_4 giving benzoic acid is :



(1) 6

(2) 3

(3) 5

(4) 4

Q55. Match List - I with List - II.

List - I

List - II

(Complex)

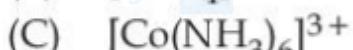
(Hybridisation of central metal ion)



(I) $d^2\text{sp}^3$



(II) sp^3



(III) sp^3d^2



(IV) dsp^2

Choose the correct answer from the options given below :

(1) (A)-(I), (B)-(IV), (C)-(III), (D)-(II)

(2) (A)-(I), (B)-(II), (C)-(III), (D)-(IV)

(3) (A)-(III), (B)-(IV), (C)-(I), (D)-(II)

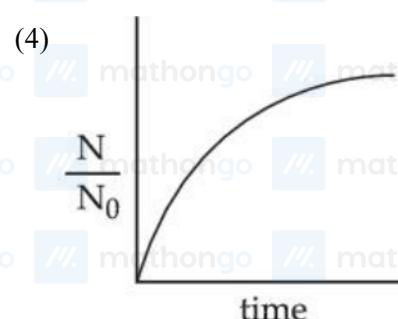
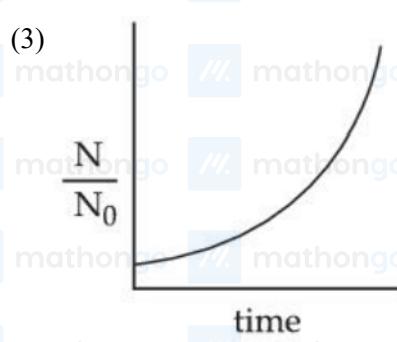
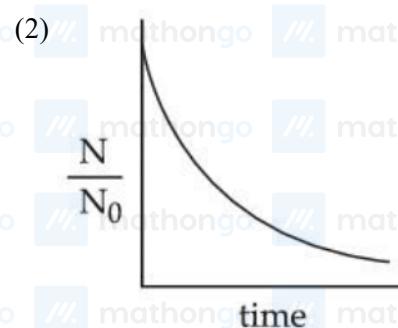
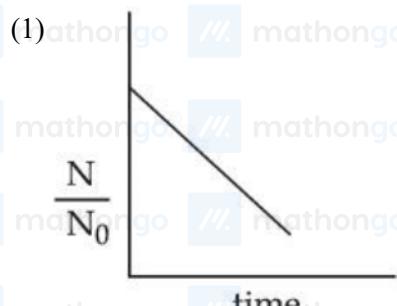
(4) (A)-(III), (B)-(II), (C)-(I), (D)-(IV)

Q56. Identify correct statements : (A) Primary amines do not give diazonium salts when treated with NaNO_2 in acidic condition. (B) Aliphatic and aromatic primary amines on heating with CHCl_3 and ethanolic KOH form

carbylamines. (C) Secondary and tertiary amines also give carbylamine test. (D) Benzenesulfonyl chloride is known as Hinsberg's reagent. (E) Tertiary amines reacts with benzenesulfonyl chloride very easily. Choose the correct answer from the options given below :

- (1) (A) and (B) only (2) (D) and (E) only
 (3) (B) and (D) only (4) (B) and (C) only

Q57. For bacterial growth in a cell culture, growth law is very similar to the law of radioactive decay. Which of the following graphs is most suitable to represent bacterial colony growth ? Where N - Number of Bacteria at any time, N_0 - Initial number of Bacteria.



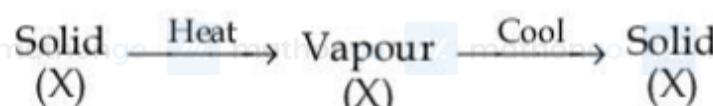
Q58. The amphoteric oxide among V_2O_3 , V_2O_4 and V_2O_5 , upon reaction with alkali leads to formation of an oxide anion. The oxidation state of V in the oxide anion is :

- (1) +3 (2) +4
 (3) +7 (4) +5

Q59. Arrange the following in increasing order of solubility product : $Ca(OH)_2$, $AgBr$, PbS , HgS

- (1) $HgS < AgBr < PbS < Ca(OH)_2$ (2) $Ca(OH)_2 < AgBr < HgS < PbS$
 (3) $PbS < HgS < Ca(OH)_2 < AgBr$ (4) $HgS < PbS < AgBr < Ca(OH)_2$

Q60. The purification method based on the following physical transformation is :



- (1) Distillation (2) Extraction
 (3) Sublimation (4) Crystallization

Q61. Which of the following is/are not correct with respect to energy of atomic orbitals of hydrogen atom? (A)

- 1 s < 2 p < 3 d < 4 s (B) 1 s < 2 s = 2 p < 3 s = 3 p (C) 1 s < 2 s < 2 p < 3 s < 3 p (D) 1 s < 2 s < 4 s < 3 d

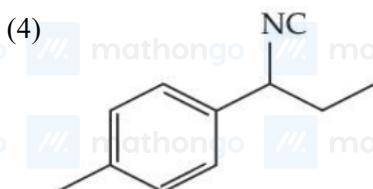
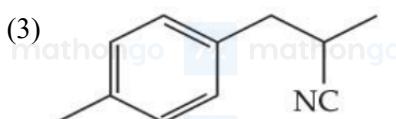
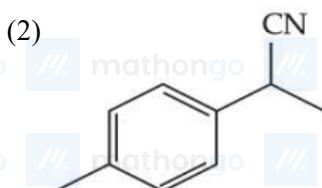
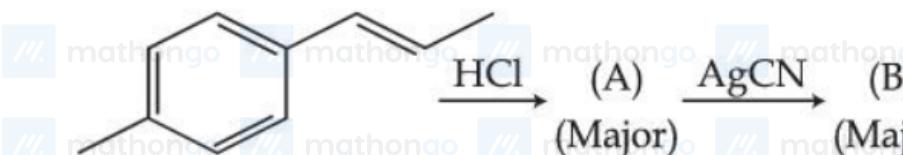
Choose the correct answer from the options given below :

- (1) (A) and (C) only (2) (B) and (D) only
- (3) (C) and (D) only (4) (A) and (B) only

Q62. Consider an elementary reaction $A(g) + B(g) \rightarrow C(g) + D(g)$ If the volume of reaction mixture is suddenly reduced to $\frac{1}{3}$ of its initial volume, the reaction rate will become ' x ' times of the original reaction rate. The value of x is :

- (1) 3 (2) $\frac{1}{9}$
- (3) 9 (4) $\frac{1}{3}$

Q63. The product B formed in the following reaction sequence is :



Q64. Assume a living cell with $0.9\%(\omega/\omega)$ of glucose solution (aqueous). This cell is immersed in another solution having equal mole fraction of glucose and water. (Consider the data upto first decimal place only) The cell will :

- (1) show no change in volume since solution is $0.9\%(\omega/\omega)$
- (2) shrink since solution is $0.5\%(\omega/\omega)$
- (3) swell up since solution is $1\%(\omega/\omega)$
- (4) None of these

Q65. Given below are two statements : **Statement (I):** According to the Law of Octaves, the elements were arranged in the increasing order of their atomic number. **Statement (II):** Meyer observed a periodically repeated pattern upon plotting physical properties of certain elements against their respective atomic numbers. In the light of the above statements, choose the correct answer from the options given below :

- (1) Both **Statement (I)** and **Statement (II)** are false. (2) Both **Statement (I)** and **Statement (II)** are true.
- (3) **Statement (I)** is false but **Statement (II)** is true. (4) **Statement (I)** is true but **Statement (II)** is false.

Q66.

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List - I

(Saccharides)

- (A) Sucrose
(B) Maltose
(C) Lactose
(D) Amylopectin

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List - II

(Glycosidic-linkages found)

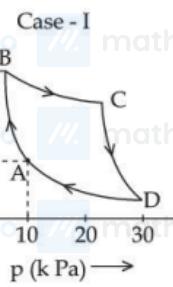
- (I) α 1-4
(II) α 1-4 and α 1-6
(III) α 1- β 2
(IV) β 1-4

Match List - I with List - II.

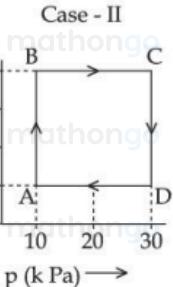
Choose the correct answer from the options given below :

- (1) (A)-(IV), (B)-(II), (C)-(I), (D)-(III)
(2) (A)-(I), (B)-(II), (C)-(III), (D)-(IV)
(3) (A)-(III), (B)-(I), (C)-(IV), (D)-(II)
(4) (A)-(II), (B)-(IV), (C)-(III), (D)-(I)

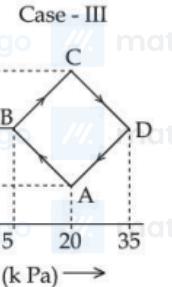
Q67.



Case - II



Case - III



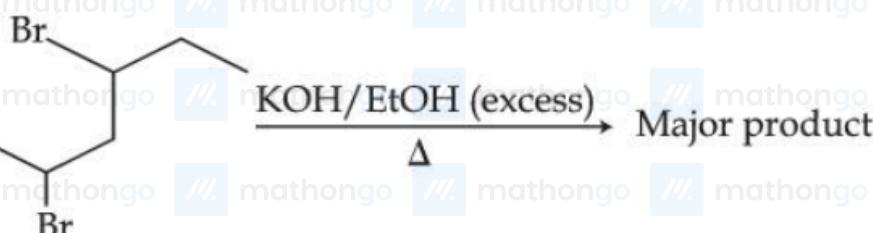
An ideal gas undergoes a cyclic transformation starting from the point A and coming back to the same point by tracing the path A → B → C → D → A as shown in the three cases above. Choose the correct option regarding ΔU :

- (1) ΔU (Case-I) = ΔU (Case-II) = ΔU (Case-III)
 (2) ΔU (Case-I) > ΔU (Case-III) > ΔU (Case-II)
 (3) ΔU (Case-III) > ΔU (Case-II) > ΔU (Case-I)
 (4) ΔU (Case-I) > ΔU (Case-II) > ΔU (Case-III)

Q68. Identify the inorganic sulphides that are yellow in colour : (A) $(\text{NH}_4)_2\text{S}$ (B) Pbs (C) Cus (D) As_2S_3 (E) As_2S_5 Choose the correct answer from the options given below :

- (1) (A), (D) and (E) only
 (2) (D) and (E) only
 (3) (A) and (B) only
 (4) (A) and (C) only

Q69. The major product of the following reaction is :



- (1) 2-Phenylhepta-2,5-diene
 (2) 6-Phenylhepta-2,4-diene
 (3) 6-Phenylhepta-3,5-diene
 (4) 2-Phenylhepta-2,4-diene

Q70. Identify correct conversion during acidic hydrolysis from the following : (A) starch gives galactose. (B) cane sugar gives equal amount of glucose and fructose. (C) milk sugar gives glucose and galactose. (D) amylopectin

gives glucose and fructose. (E) amylose gives only glucose. Choose the correct answer from the options given below :

- (1) (A), (B) and (C) only (2) (B), (C) and (E) only
(3) (C), (D) and (E) only (4) (B), (C) and (D) only

Q71. Electrolysis of 600 mL aqueous solution of NaCl for 5 min changes the pH of the solution to 12 . The current in Amperes used for the given electrolysis is _____. (Nearest integer).

Q72. A group 15 element forms $d\pi - d\pi$ bond with transition metals. It also forms hydride, which is a strongest base among the hydrides of other group members that form $d\pi - d\pi$ bond. The atomic number of the element is _____.

Q73. Total number of molecules/species from following which will be paramagnetic is _____
 $O_2, O_2^+, O_2^-, NO, NO_2, CO, K_2[NiCl_4], [Co(NH_3)_6]Cl_3, K_2[Ni(CN)_4]$

Q74. Consider the following data : Heat of formation of $CO_2(g) = -393.5 \text{ kJ mol}^{-1}$ Heat of formation of $H_2O(l) = -286.0 \text{ kJ mol}^{-1}$ Heat of combustion of benzene = $-3267.0 \text{ kJ mol}^{-1}$ The heat of formation of benzene is _ kJ mol^{-1} . (Nearest integer)

Q75. The spin only magnetic moment (μ) value (B.M.) of the compound with strongest oxidising power among Mn_2O_3 , TiO and VO is ____ B.M. (Nearest integer).

ANSWER KEYS

1. (3)	2. (1)	3. (3)	4. (1)	5. (3)	6. (1)	7. (4)	8. (4)
9. (2)	10. (1)	11. (1)	12. (2)	13. (2)	14. (3)	15. (1)	16. (2)
17. (4)	18. (2)	19. (4)	20. (3)	21. (14)	22. (64)	23. (4)	24. (20)
25. (1)	26. (1)	27. (3)	28. (1)	29. (4)	30. (4)	31. (3)	32. (4)
33. (4)	34. (2)	35. (4)	36. (1)	37. (3)	38. (1)	39. (2)	40. (1)
41. (1)	42. (3)	43. (3)	44. (4)	45. (4)	46. (54)	47. (2)	48. (12)
49. (1)	50. (50)	51. (2)	52. (2)	53. (3)	54. (3)	55. (4)	56. (3)
57. (3)	58. (4)	59. (4)	60. (3)	61. (3)	62. (3)	63. (4)	64. (4)
65. (3)	66. (3)	67. (1)	68. (1)	69. (4)	70. (2)	71. (2)	72. (15)
73. (6)	74. (48)	75. (5)					

Q1. Let O be the origin, the point A be $z_1 = \sqrt{3} + 2\sqrt{2}i$, the point $B(z_2)$ be such that $\sqrt{3}|z_2| = |z_1|$ and $\arg(z_2) = \arg(z_1) + \frac{\pi}{6}$. Then

- (1) area of triangle ABO is $\frac{11}{\sqrt{3}}$ (2) ABO is an obtuse angled isosceles triangle
 (3) area of triangle ABO is $\frac{11}{4}$ (4) ABO is a scalene triangle

Q2. Let $f : \mathbb{R} \rightarrow \mathbb{R}$ be a function defined by $f(x) = (2 + 3a)x^2 + (\frac{a+2}{a-1})x + b, a \neq 1$. If

- $f(x+y) = f(x) + f(y) + 1 - \frac{2}{7}xy$, then the value of $28 \sum_{i=1}^5 |f(i)|$ is
 (1) 545 (2) 715
 (3) 735 (4) 675

Q3. Let $ABCD$ be a trapezium whose vertices lie on the parabola $y^2 = 4x$. Let the sides AD and BC of the trapezium be parallel to y -axis. If the diagonal AC is of length $\frac{25}{4}$ and it passes through the point $(1, 0)$, then the area of $ABCD$ is

- (1) $\frac{75}{4}$ (2) $\frac{25}{2}$
 (3) $\frac{125}{8}$ (4) $\frac{75}{8}$

Q4. The sum of all local minimum values of the function

$$f(x) = \begin{cases} 1 - 2x, & x < -1 \\ \frac{1}{3}(7 + 2|x|), & -1 \leq x \leq 2 \\ \frac{11}{18}(x-4)(x-5), & x > 2 \end{cases}$$

is

- (1) $\frac{157}{72}$ (2) $\frac{131}{72}$
 (3) $\frac{171}{72}$ (4) $\frac{167}{72}$

Q5. Let ${}^nC_{r-1} = 28$, ${}^nC_r = 56$ and ${}^nC_{r+1} = 70$. Let $A(4 \cos t, 4 \sin t)$, $B(2 \sin t, -2 \cos t)$ and $C(3r-n, r^2-n-1)$ be the vertices of a triangle ABC , where t is a parameter. If $(3x-1)^2 + (3y)^2 = \alpha$, is the locus of the centroid of triangle ABC , then α equals

- (1) 6 (2) 18
 (3) 8 (4) 20

Q6. Let the equation of the circle, which touches x -axis at the point $(a, 0)$, $a > 0$ and cuts off an intercept of length b on y -axis be $x^2 + y^2 - \alpha x + \beta y + \gamma = 0$. If the circle lies below x -axis, then the ordered pair $(2a, b^2)$ is equal to

- (1) $(\gamma, \beta^2 - 4\alpha)$ (2) $(\alpha, \beta^2 + 4\gamma)$
 (3) $(\gamma, \beta^2 + 4\alpha)$ (4) $(\alpha, \beta^2 - 4\gamma)$

Q7. If $f(x) = \frac{2^x}{2^x + \sqrt{2}}$, $x \in \mathbb{R}$, then $\sum_{k=1}^{81} f(\frac{k}{82})$ is equal to

- (1) $1.81\sqrt{2}$ (2) 41
 (3) 82 (4) $\frac{81}{2}$

Q8. Two numbers k_1 and k_2 are randomly chosen from the set of natural numbers. Then, the probability that the value of $i^{k_1} + i^{k_2}$, ($i = \sqrt{-1}$) is non-zero, equals

- (1) $\frac{1}{2}$
 (3) $\frac{1}{4}$

- (2) $\frac{3}{4}$
 (4) $\frac{2}{3}$

Q9. If the image of the point $(4, 4, 3)$ in the line $\frac{x-1}{2} = \frac{y-2}{1} = \frac{z-1}{3}$ is (α, β, γ) , then $\alpha + \beta + \gamma$ is equal to

- (1) 9
 (2) 12
 (3) 7
 (4) 8

Q10. $\cos(\sin^{-1}\frac{3}{5} + \sin^{-1}\frac{5}{13} + \sin^{-1}\frac{33}{65})$ is equal to:

- (1) 1
 (2) 0
 (3) $\frac{32}{65}$
 (4) $\frac{33}{65}$

Q11. Let $A(x, y, z)$ be a point in xy -plane, which is equidistant from three points $(0, 3, 2)$, $(2, 0, 3)$ and $(0, 0, 1)$. Let $B = (1, 4, -1)$ and $C = (2, 0, -2)$. Then among the statements (S1) : $\triangle ABC$ is an isosceles right angled triangle, and (S2) : the area of $\triangle ABC$ is $\frac{9\sqrt{2}}{2}$,

- (1) both are true
 (2) only (S2) is true
 (3) only (S1) is true
 (4) both are false

Q12. The area (in sq. units) of the region $\{(x, y) : 0 \leq y \leq 2|x| + 1, 0 \leq y \leq x^2 + 1, |x| \leq 3\}$ is

- (1) $\frac{80}{3}$
 (2) $\frac{64}{3}$
 (3) $\frac{32}{3}$
 (4) $\frac{17}{3}$

Q13. The sum, of the squares of all the roots of the equation $x^2 + |2x - 3| - 4 = 0$, is

- (1) $3(3 - \sqrt{2})$
 (2) $6(3 - \sqrt{2})$
 (3) $6(2 - \sqrt{2})$
 (4) $3(2 - \sqrt{2})$

Q14. Let T_r be the r^{th} term of an A.P. If for some m , $T_m = \frac{1}{25}$, $T_{25} = \frac{1}{20}$, and $20 \sum_{r=1}^{25} T_r = 13$, then

- 5 m $\sum_{r=m}^{2m} T_r$ is equal to
 (1) 98
 (2) 126
 (3) 142
 (4) 112

Q15. Three defective oranges are accidentally mixed with seven good ones and on looking at them, it is not possible to differentiate between them. Two oranges are drawn at random from the lot. If x denote the number of defective oranges, then the variance of x is

- (1) $28/75$
 (2) $18/25$
 (3) $26/75$
 (4) $14/25$

Q16. Let for some function $y = f(x)$, $\int_0^x t f(t) dt = x^2 f(x)$, $x > 0$ and $f(2) = 3$. Then $f(6)$ is equal to

- (1) 1
 (2) 3
 (3) 6
 (4) 2

Q17. If $\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \frac{96x^2 \cos^2 x}{(1+e^x)} dx = \pi (\alpha\pi^2 + \beta)$, $\alpha, \beta \in \mathbb{Z}$, then $(\alpha + \beta)^2$ equals

- (1) 64
 (2) 196
 (3) 144
 (4) 100

Q18. Let $\langle a_n \rangle$ be a sequence such that $a_0 = 0$, $a_1 = \frac{1}{2}$ and $2a_{n+2} = 5a_{n+1} - 3a_n$, $n = 0, 1, 2, 3, \dots$. Then $\sum_{k=1}^{100} a_k$ is equal to

- (1) $3a_{99} - 100$
 (3) $3a_{99} + 100$

- (2) $3a_{100} - 100$
 (4) $3a_{100} + 100$

Q19. The number of different 5 digit numbers greater than 50000 that can be formed using the digits 0,

1, 2, 3, 4, 5, 6, 7, such that the sum of their first and last digits should not be more than 8 , is

- (1) 4608
 (2) 5720
 (3) 5719
 (4) 4607

Q20. The relation $R = \{(x, y) : x, y \in \mathbb{Z} \text{ and } x + y \text{ is even}\}$ is:

- (1) reflexive and symmetric but not transitive
 (2) an equivalence relation
 (3) symmetric and transitive but not reflexive
 (4) reflexive and transitive but not symmetric

Q21. Let $f(x) = \begin{cases} 3x, & x < 0 \\ \min\{1 + x + [x], x + 2[x]\}, & 0 \leq x \leq 2 \\ 5, & x > 2, \end{cases}$ where $[.]$ denotes greatest integer function. If α and β are the number of points, where f is not continuous and is not differentiable, respectively, then $\alpha + \beta$ equals

Q22. Let M denote the set of all real matrices of order 3×3 and let $S = \{-3, -2, -1, 1, 2\}$. Let

$$S_1 = \{A = [a_{ij}] \in M : A = A^T \text{ and } a_{ij} \in S, \forall i, j\},$$

$$S_2 = \{A = [a_{ij}] \in M : A = -A^T \text{ and } a_{ij} \in S, \forall i, j\},$$

$$S_3 = \{A = [a_{ij}] \in M : a_{11} + a_{22} + a_{33} = 0 \text{ and } a_{ij} \in S, \forall i, j\}.$$

If $n(S_1 \cup_2 S_3) = 125\alpha$, then α equals _____

Q23. If $\alpha = 1 + \sum_{r=1}^6 (-3)^{r-1} {}^{12}C_{2r-1}$, then the distance of the point $(12, \sqrt{3})$ from the line $\alpha x - \sqrt{3}y + 1 = 0$ is _____.

Q24. Let $E_1 : \frac{x^2}{9} + \frac{y^2}{4} = 1$ be an ellipse. Ellipses E_i 's are constructed such that their centres and eccentricities are same as that of E_1 , and the length of minor axis of E_i is the length of major axis of $E_{i+1}(i \geq 1)$. If A_i is the area of the ellipse E_i , then $\frac{5}{\pi}(\sum_{i=1}^{\infty} A_i)$, is equal to

Q25. Let $\vec{a} = \hat{i} + \hat{j} + \hat{k}$, $\vec{b} = 2\hat{i} + 2\hat{j} + \hat{k}$ and $\vec{d} = \vec{a} \times \vec{b}$. If \vec{c} is a vector such that $\vec{a} \cdot \vec{c} = |\vec{c}|$, $|\vec{c}| - 2\vec{a}|^2 = 8$ and the angle between \vec{d} and \vec{c} is $\frac{\pi}{4}$, then $|10 - 3\vec{b} \cdot \vec{c}| + |\vec{d} \times \vec{c}|^2$ is equal to

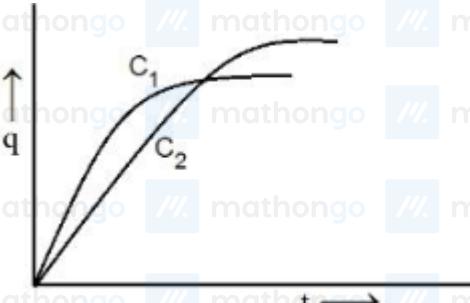
Q26. Three infinitely long wires with linear charge density λ are placed along the $x-axis$, $y-axis$ and $z-axis$ respectively. Which of the following denotes an equipotential surface?

- (1) $xyz = \text{constant}$
 (2) $xy + yz + zx = \text{constant}$
 (3) $(x^2 + y^2)(y^2 + z^2)(z^2 + x^2) = \text{constant}$
 (4) $(x+y)(y+z)(z+x) = \text{constant}$

Q27. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R Assertion A: A sound wave has higher speed in solids than gases. Reason R: Gases have higher value of Bulk modulus than solids. In the light of the above statements, choose the correct answer from the options given below

- (1) Both **A** and **R** are true but **R** is NOT the correct explanation of **A**
- (2) **A** is true but **R** is false
- (3) **A** is false but **R** is true
- (4) Both **A** and **R** are true and **R** is the correct explanation of **A**

Q28. Two capacitors C_1 and C_2 are connected in parallel to a battery. Charge-time graph is shown below for the two capacitors. The energy stored with them are U_1 and U_2 , respectively. Which of the given statements is true?

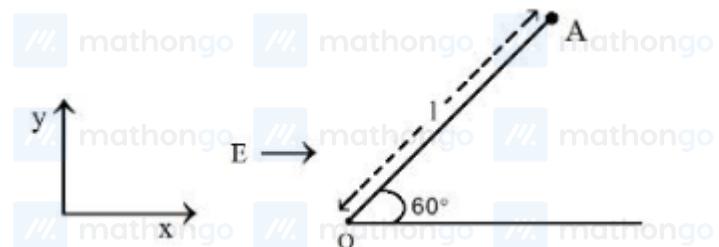


- (1) $C_2 > C_1$, $U_2 < U_1$
- (2) $C_1 > C_2$, $U_1 > U_2$
- (3) $C_1 > C_2$, $U_1 < U_2$
- (4) $C_2 > C_1$, $U_2 > U_1$

Q29. A thin prism P_1 with angle 4° made of glass having refractive index 1.54, is combined with another thin prism P_2 made of glass having refractive index 1.72 to get dispersion without deviation. The angle of the prism P_2 in degrees is

- (1) 3
- (2) $16/3$
- (3) 4
- (4) 1.5

Q30. A particle of mass ' m ' and charge ' q ' is fastened to one end 'A' of a massless string having equilibrium length l , whose other end is fixed at point 'O'. The whole system is placed on a frictionless horizontal plane and is initially at rest. If uniform electric field is switched on along the direction as shown in figure, then the



speed of the particle when it crosses the x -axis is

- (1) $\sqrt{\frac{qEl}{2m}}$
- (2) $\sqrt{\frac{qEl}{m}}$
- (3) $\sqrt{\frac{qEl}{4m}}$
- (4) $\sqrt{\frac{2qEl}{m}}$

Q31. Given below are two statements: one is labelled as Assertion **A** and the other is labelled as Reason **R**

Assertion A: In a central force field, the work done is independent of the path chosen. Reason R: Every force encountered in mechanics does not have an associated potential energy. In the light of the above statements, choose the most appropriate answer from the options given below

(1) A is false but R is true

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(2) Both A and R are true but R is NOT the correct explanation of A

(3) A is true but R is false

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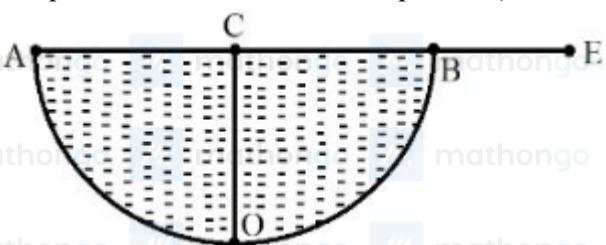
(4) Both A and R are true and R is the correct explanation of A

Q32. Choose the correct nuclear process from the below options [p: proton, n : neutron, e^- : electron, e^+ : positron, ν : neutrino, $\bar{\nu}$: antineutrino]

(1) $n \rightarrow p + e^+ + \bar{\nu}$ (2) $n \rightarrow p + e^+ + \nu$ (3) $n \rightarrow p + e^- + \nu$ (4) $n \rightarrow p + e^- + \bar{\nu}$

Q33. A hemispherical vessel is completely filled with a liquid of refractive index μ . A small coin is kept at the

lowest point (O) of the vessel as shown in figure. The minimum value of the refractive index of the liquid so that a person can see the coin from point E (at the level of the vessel) is

(1) $\sqrt{3}$ (2) $\frac{\sqrt{3}}{2}$ (3) $\frac{3}{2}$ (4) $\sqrt{2}$

Q34. A Carnot engine (E) is working between two temperatures 473 K and 273 K. In a new system two engines - engine E_1 works between 473 K to 373 K and engine E_2 works between 373 K to 273 K. If η_{12} , η_1 and η_2 are the efficiencies of the engines E, E_1 and E_2 , respectively, then

(1) $\eta_{12} = \eta_1 \eta_2$ (2) $\eta_{12} \geq \eta_1 + \eta_2$ (3) $\eta_{12} = \eta_1 + \eta_2$ (4) $\eta_{12} < \eta_1 + \eta_2$

Q35. Consider a long thin conducting wire carrying a uniform current I. A particle having mass " M " and charge " q " is released at a distance " a " from the wire with a speed v_0 along the direction of current in the wire. The particle gets attracted to the wire due to magnetic force. The particle turns round when it is at distance x from the wire. The value of x is [μ_0 is vacuum permeability]

(1) $ae^{-\frac{4\pi mv_0}{q\mu_0 I}}$ (2) $a \left[1 - \frac{mv_0}{2q\mu_0 I} \right]$ (3) $a \left[1 - \frac{mv}{q\mu_0 I} \right]$ (4) $\frac{a}{2}$

Q36. A wire of resistance R is bent into an equilateral triangle and an identical wire is bent into a square. The ratio of resistance between the two end points of an edge of the triangle to that of the square is Options

(1) 8/9

(2) 27/32

(3) 32/27

(4) 9/8

Q37. In the experiment for measurement of viscosity ' η ' of given liquid with a ball having radius R , consider following statements. A. Graph between terminal velocity V and R will be a parabola. B. The terminal velocities of different diameter balls are constant for a given liquid. C. Measurement of terminal velocity is dependent on the temperature. D. This experiment can be utilized to assess the density of a given liquid. E. If

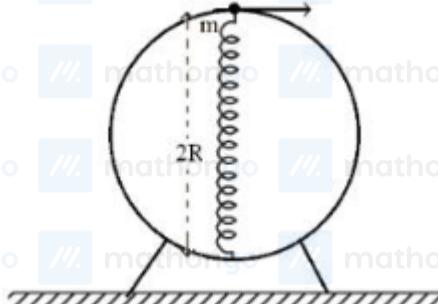
If n balls are dropped with some initial speed, the value of η will change. Choose the correct answer from the options given below:

- (1) A, B and E Only (2) B, D and E Only
 (3) A, C and D Only (4) C, D and E Only

Q38. Due to presence of an em-wave whose electric component is given by $E = 100 \sin(\omega t - kx)NC^{-1}$, a cylinder of length 200 cm holds certain amount of em-energy inside it. If another cylinder of same length but half diameter than previous one holds same amount of em-energy, the magnitude of the electric field of the corresponding em-wave should be modified as

- (1) $400 \sin(\omega t - kx)NC^{-1}$ (2) $200 \sin(\omega t - kx)NC^{-1}$
 (3) $50 \sin(\omega t - kx)NC^{-1}$ (4) $25 \sin(\omega t - kx)NC^{-1}$

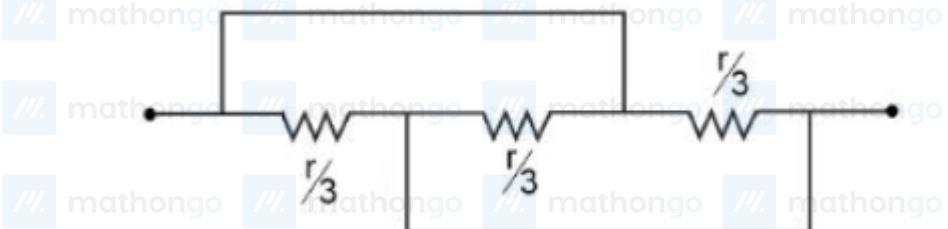
Q39. A bead of mass ' m ' slides without friction on the wall of a vertical circular hoop of radius ' R ' as shown in figure. The bead moves under the combined action of gravity and a massless spring (k) attached to the bottom of the hoop. The equilibrium length of the spring is ' R '. If the bead is released from top of the hoop with (negligible) zero initial speed, velocity of bead, when the length of spring becomes ' R ', would be (spring



constant is ' k ', g is acceleration due to gravity)

- (1) $\sqrt{3Rg + \frac{kR^2}{m}}$ (2) $2\sqrt{gR + \frac{kR^2}{m}}$
 (3) $\sqrt{2Rg + \frac{kR^2}{m}}$ (4) $\sqrt{2Rg + \frac{4kR^2}{m}}$

Q40. Find the equivalent resistance between two ends of the following circuit



- (1) $\frac{r}{9}$ (2) $\frac{r}{3}$
 (3) r (4) $\frac{r}{6}$

Q41. Consider following statements: A. Surface tension arises due to extra energy of the molecules at the interior as compared to the molecules at the surface, of a liquid. B. As the temperature of liquid rises, the coefficient of viscosity increases. C. As the temperature of gas increases, the coefficient of viscosity increases D. The onset of turbulence is determined by Reynold's number. E. In a steady flow two stream lines never intersect. Choose the correct answer from the options given below:

- (1) C, D, E Only
 (3) B, C, D Only

- (2) A, D, E Only
 (4) A, B, C Only

Q42. The center of mass of a thin rectangular plate (fig - x) with sides of length a and b , whose mass per unit area

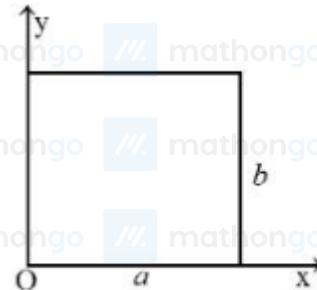
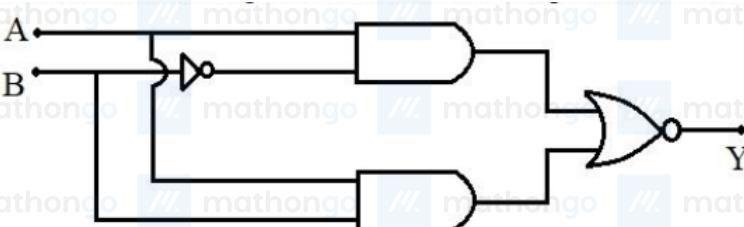


fig-x

- (σ) varies as $\sigma = \frac{\sigma_0 x}{ab}$ (where σ_0 is a constant), would be
 (1) $(\frac{2}{3}a, \frac{b}{2})$
 (3) $(\frac{1}{3}a, \frac{b}{2})$

- (2) $(\frac{a}{2}, \frac{b}{2})$
 (4) $(\frac{2}{3}a, \frac{2}{3}b)$

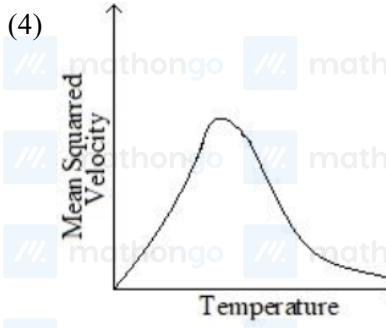
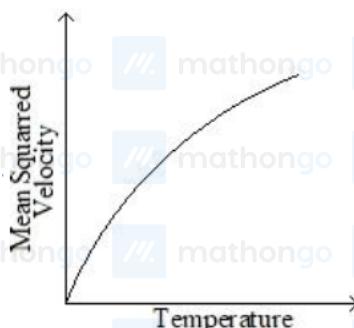
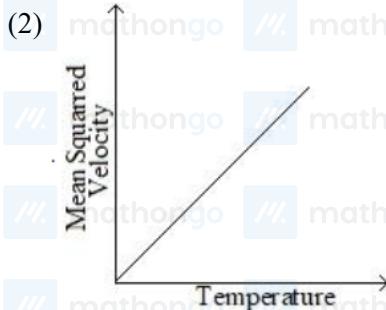
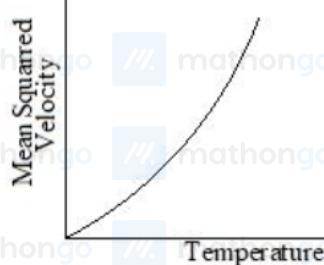
Q43. Which of the following circuits has the same output as that of the given circuit?



- (1) $B \rightarrow \text{NAND}(B) \rightarrow Y$
 (3) $A, B \rightarrow \text{NOR}(A, B) \rightarrow Y$

- (2) $A \rightarrow \text{NOT}(A) \rightarrow Y$
 (4) $A, B \rightarrow \text{NOR}(A, B) \rightarrow \text{NOT}(Y)$

Q44. For a particular ideal gas which of the following graphs represents the variation of mean squared velocity of the gas molecules with temperature?



Q45. A proton of mass ' m_p ' has same energy as that of a photon of wavelength ' λ '. If the proton is moving at non-relativistic speed, then ratio of its de Broglie wavelength to the wavelength of photon is.

(1) $\frac{1}{c} \sqrt{\frac{E}{m_p}}$

(2) $\frac{1}{c} \sqrt{\frac{2E}{m_p}}$

(3) $\frac{1}{2c} \sqrt{\frac{E}{m_p}}$

(4) $\frac{1}{c} \sqrt{\frac{E}{2m_p}}$

Q46. A double slit interference experiment performed with a light of wavelength 600 nm forms an interference fringe pattern on a screen with 10th bright fringe having its centre at a distance of 10 mm from the central maximum. Distance of the centre of the same 10th bright fringe from the central maximum when the source of light is replaced by another source of wavelength 660 nm would be _____ mm.

Q47. In a measurement, it is asked to find modulus of elasticity per unit torque applied on the system. The measured quantity has dimension of $[M^a L^b T^c]$. If $b = -3$, the value of c is _____

Q48. A tiny metallic rectangular sheet has length and breadth of 5 mm and 2.5 mm, respectively. Using a specially designed screw gauge which has pitch of 0.75 mm and 15 divisions in the circular scale, you are asked to find the area of the sheet. In this measurement, the maximum fractional error will be $\frac{x}{100}$ where x is _____.

Q49. Two iron solid discs of negligible thickness have radii R_1 and R_2 and moment of inertia I_1 and I_2 , respectively. For $R_2 = 2R_1$, the ratio of I_1 and I_2 would be $1/x$, where $x =$ _____

Q50. The moment of inertia of a solid disc rotating along its diameter is 2.5 times higher than the moment of inertia of a ring rotating in similar way. The moment of inertia of a solid sphere which has same radius as the disc and rotating in similar way, is n times higher than the moment of inertia of the given ring. Here, $n =$ _____ Consider all the bodies have equal masses.

Q51. Given below are two statements: Statement I : D-glucose pentaacetate reacts with 2, 4-dinitrophenylhydrazine Statement II : Starch, on heating with concentrated sulfuric acid at 100°C and 2-3 atmosphere pressure produces glucose. In the light of the above statements, choose the correct answer from the options given below

- (1) Statement I is false but Statement II is true
 (2) Both Statement I and Statement II are false
 (3) Both Statement I and Statement II are true
 (4) Statement I is true but Statement II is false

Q52. Both acetaldehyde and acetone (individually) undergo which of the following reactions? A. Iodoform Reaction

B. Cannizaro Reaction C. Aldol Condensation D. Tollen's Test E. Clemmensen Reduction Choose the correct answer from the options given below:

- (1) A, B and D Only
 (2) C and E Only
 (3) A, C and E Only
 (4) B, C and D Only

Q53. Which of the following oxidation reactions are carried out by both $K_2Cr_2O_7$ and $KMnO_4$ in acidic medium?

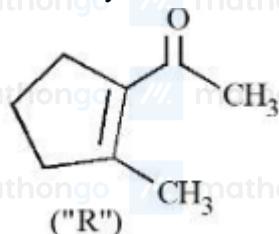
A. $\Gamma^- \rightarrow I_2$ B. $S^{2-} \rightarrow S$ C. $Fe^{2+} \rightarrow Fe^{3+}$ D. $\Gamma^- \rightarrow IO_3^-$ E. $S_2O_3^{2-} \rightarrow SO_4^{2-}$ Choose the correct answer

from the options given below:

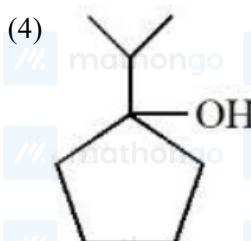
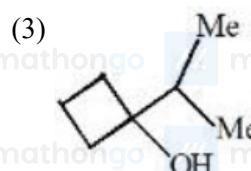
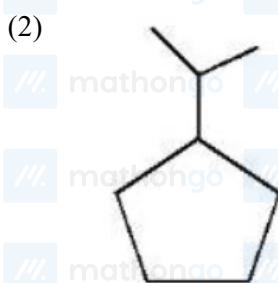
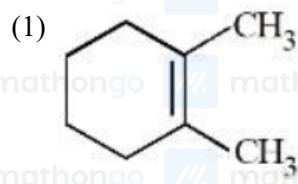
- (1) C, D and E Only
 (2) B, C and D Only
 (3) A, D and E Only
 (4) A, B and C Only

Q54. A molecule ("P") on treatment with acid undergoes rearrangement and gives ("Q"). ("Q") on ozonolysis

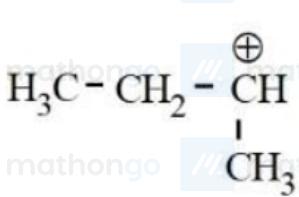
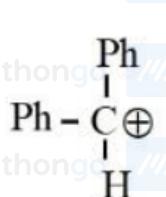
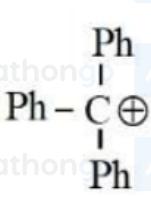
followed by reflux under alkaline condition gives ("R"). The structure of ("R") is given below.



The structure of ("P") is



Q55. The correct order of stability of following carbocations is :



A

B

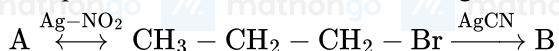
C

D

- (1) C > B > A > D
 (3) B > C > A > D

- (2) A > B > C > D
 (4) C > A > B > D

Q56. The products A and B in the following reactions, respectively are



- (1) $\text{CH}_3-\text{CH}_2-\text{CH}_2-\text{NO}_2$, $\text{CH}_3-\text{CH}_2-\text{CH}_2-\text{CN}$
 (2) $\text{CH}_3-\text{CH}_2-\text{CH}_2-\text{ONO}$, $\text{CH}_3-\text{CH}_2-\text{CH}_2-\text{NC}$
 (3) $\text{CH}_3-\text{CH}_2-\text{CH}_2-\text{ONO}$, $\text{CH}_3-\text{CH}_2-\text{CH}_2-\text{CN}$
 (4) $\text{CH}_3-\text{CH}_2-\text{CH}_2-\text{NO}_2$, $\text{CH}_3-\text{CH}_2-\text{CH}_2-\text{NC}$

Q57. In a multielectron atom, which of the following orbitals described by three quantum numbers will have same energy in absence of electric and magnetic fields? A. n = 1, l = 0, m_l = 0 B. n = 2, l = 0, m_l = 0 C.

n = 2, l = 1, m_l = 1 D. n = 3, l = 2, m_l = 1 E. n = 3, l = 2, m_l = 0 Choose the correct answer from the options given below:

- (1) B and C Only
 (3) C and D Only

- (2) A and B Only
 (4) D and E Only

Q58. A weak acid HA has degree of dissociation x. Which option gives the correct expression of (pH pK_a)?

- (1) 0
 (2) $\log(1 + 2x)$
 (3) $\log\left(\frac{1-x}{x}\right)$
 (4) $\log\left(\frac{x}{1-x}\right)$

Q59. The molecules having square pyramidal geometry are

- (1) BrF₅&PCl₅
 (3) SbF₅&XeOF₄
 (2) SbF₅&PCl₅
 (4) BrF₅&XeOF₄

Q60. Consider the following elements In, Tl, Al, Pb, Sn and Ge. The most stable oxidation states of elements with highest and lowest first ionisation enthalpies, respectively, are

- (1) +4 and +1
 (3) +4 and +3
 (2) +1 and +4
 (4) +2 and +3

Q61.

$[A]_0$	$t_{1/2}$
mol L^{-1}	min
0.100	200
0.025	100

For a given reaction $R \rightarrow P$, $t_{1/2}$ is related to $[A]_0$ as given in table. Given: $\log 2 = 0.30$. Which of the following is true? A. The order of the reaction is $1/2$. B. If $[A]_0$ is 1 M, then $t_{1/2}$ is $200\sqrt{10}$ min. C. The order of the reaction changes to 1 if the concentration of reactant changes from 0.100 M to 0.500 M. D. $t_{1/2}$ is 800 min for $[A]_0 = 1.6\text{M}$. Choose the correct answer from the options given below: Options
 (1) A and C Only (2) A, B and D Only
 (3) C and D Only (4) A and B Only

Q62. Match the LIST-I with LIST-II

LIST-I (Redox Reaction)		LIST-II (Type of Redox Reaction)	
A.	$\text{CH}_4(\text{g}) + 2\text{O}_2(\text{g}) \xrightarrow{\Delta} \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{l})$	I.	Disproportionation reaction
B.	$2\text{NaH}(\text{s}) \xrightarrow{\Delta} 2\text{Na}(\text{s}) + \text{H}_2(\text{g})$	II.	Combination reaction
C.	$\text{V}_2\text{O}_5(\text{s}) + 5\text{Ca}(\text{s}) \xrightarrow{\Delta} 2\text{V}(\text{s}) + 5\text{CaO}(\text{s})$	III.	Decomposition reaction
D.	$2\text{H}_2\text{O}_2(\text{aq}) \xrightarrow{\Delta} 2\text{H}_2\text{O}(\text{l}) + \text{O}_2(\text{g})$	IV.	Displacement reaction

Choose the correct answer from the options given below:

- (1) A-II, B-III, C-I, D-IV (2) A-III, B-IV, C-I, D-II
 (3) A-IV, B-I, C-II, D-III (4) A-II, B-III, C-IV, D-I

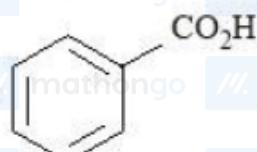
Q63. Given below are two statements: Statement I: In the oxalic acid vs KMnO_4 (in the presence of dil H_2SO_4) titration the solution needs to be heated initially to 60°C , but no heating is required in Ferrous ammonium sulphate (FAS) vs KMnO_4 titration (in the presence of dil H_2SO_4). Statement II: In oxalic acid vs KMnO_4 titration, the initial formation of MnSO_4 takes place at high temperature, which then acts as catalyst for further reaction. In the case of FAS vs KMnO_4 , heating oxidizes Fe^{2+} into Fe^{3+} by oxygen of air and error may be introduced in the experiment. In the light of the above statements, choose the correct answer from the options given below

- (1) Both Statement I and Statement II are false (2) Both Statement I and Statement II are true
 (3) Statement I is false but Statement II is true (4) Statement I is true but Statement II is false

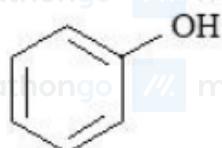
Q64. The metal ion whose electronic configuration is not affected by the nature of the ligand and which gives a violet colour in non-luminous flame under hot condition in borax bead test is

- (1) Mn^{2+} (2) Cr^{3+}
 (3) Ni^{2+} (4) Ti^{3+}

Q65.



The compounds that produce CO_2 with aqueous NaHCO_3 solution are: A.



B.



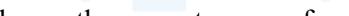
C.



D.



E.



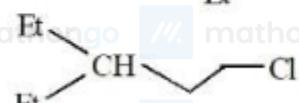
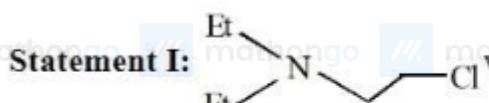
Choose the correct answer from the options given below:

- (1) A, C and D Only (2) A, B and E Only
 (3) A and C Only (4) A and B Only

Q66. What is the freezing point depression constant of a solvent, 50 g of which contain 1 g non volatile solute (molar mass 256 g mol^{-1}) and the decrease in freezing point is 0.40 K?

- (1) 3.72 K kg mol^{-1} (2) 1.86 K kg mol^{-1}
 (3) 4.43 K kg mol^{-1} (4) 5.12 K kg mol^{-1}

Q67. Given below are two statements:



will undergo alkaline hydrolysis at a faster rate than

involving lone pair of electrons on nitrogen. In the light of the above statements, choose the most appropriate answer from the options given below

- (1) Statement I is incorrect but Statement II is correct
- (2) Statement I is correct but Statement II is incorrect
- (3) Both Statement I and Statement II are correct
- (4) Both Statement I and Statement II are incorrect

Q68. Ice and water are placed in a closed container at a pressure of 1 atm and temperature 273.15 K. If pressure of the system is increased 2 times, keeping temperature constant, then identify correct observation from following

- (1) Volume of system increases.
- (2) The solid phase (ice) disappears completely.
- (3) Liquid phase disappears completely.
- (4) The amount of ice decreases.

Q69. The incorrect decreasing order of atomic radii is

- (1) Si > P > Cl > F
- (2) Be > Mg > Al > Si
- (3) Al > B > N > F
- (4) Mg > Al > C > O

Q70. Consider '*n*' is the number of lone pair of electrons present in the equatorial position of the most stable

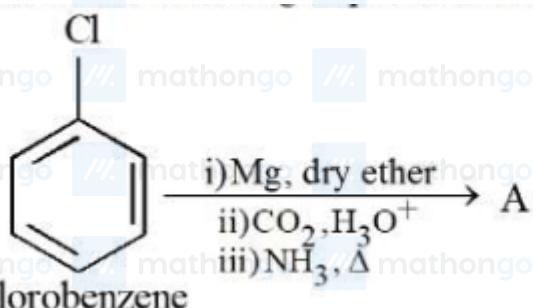
structure of ClF_3 . The ions from the following with '*n*' number of unpaired electrons are A. V^{3+} B. Ti^{3+} C. Cu^{2+} D. Ni^{2+} E. Ti^{2+} Choose the correct answer from the options given below:

- (1) A and C Only
- (2) A, D and E Only
- (3) B and D Only
- (4) B and C Only

Q71. The formation enthalpies, ΔH_f^\ominus for $\text{H}_{(g)}$ and $\text{O}_{(g)}$ are 220.0 and 250.0 kJ mol^{-1} , respectively, at 298.15 K, and ΔH_f^\ominus for $\text{H}_2\text{O}_{(g)}$ is $-242.0 \text{ kJ mol}^{-1}$ at the same temperature. The average bond enthalpy of the O – H bond in water at 298.15 K is _____ kJ mol^{-1} (nearest integer).

Q72. The molarity of a 70% (mass / mass) aqueous solution of a monobasic acid (X) is _____ $\times 10^{-1}$ M(Nearest integer) [Given: Density of aqueous solution of (X) is 1.25 g mL^{-1} Molar mass of the acid is 70 g mol^{-1}]

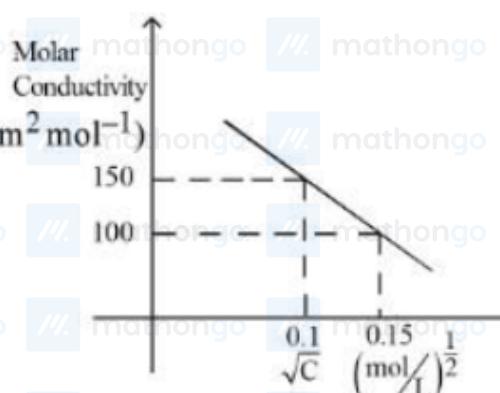
Q73. Consider the following sequence of reactions:



11.25 mg of chlorobenzene will produce _____ $\times 10^{-1}$ mg of product B. (Consider the reactions result in complete conversion.) [Given molar mass of C, H, O, N and Cl as 12, 1, 16, 14 and 35.5 g mol⁻¹ respectively]

Q74. Quantitative analysis of an organic compound (X) shows following % composition. C : 14.5% Cl : 64.46% H: 1.8 % (Empirical formula mass of the compound (X) is _____ $\times 10^{-1}$ (Given molar mass in gmol⁻¹ of C : 12, H : 1, O : 16, Cl : 35.5)

Q75. Given below is the plot of the molar conductivity vs \sqrt{C} for KCl in aqueous solution.



If, for the higher concentration of KCl solution, the resistance of the conductivity cell is 100Ω, then the resistance of the same cell with the dilute solution is ' x ' Ω The value of x is _____ (Nearest integer)

ANSWER KEYS

- | | | | | | | | |
|----------|------------|-----------|---------|---------|------------|-----------|-----------|
| 1. (2) | 2. (4) | 3. (1) | 4. (1) | 5. (4) | 6. (4) | 7. (4) | 8. (2) |
| 9. (1) | 10. (2) | 11. (3) | 12. (2) | 13. (3) | 14. (2) | 15. (1) | 16. (1) |
| 17. (4) | 18. (2) | 19. (4) | 20. (2) | 21. (5) | 22. (1613) | 23. (5) | 24. (54) |
| 25. (6) | 26. (3) | 27. (2) | 28. (4) | 29. (1) | 30. (2) | 31. (2) | 32. (4) |
| 33. (4) | 34. (4) | 35. (1) | 36. (3) | 37. (3) | 38. (2) | 39. (1) | 40. (1) |
| 41. (1) | 42. (1) | 43. (2) | 44. (2) | 45. (4) | 46. (11) | 47. (0) | 48. (3) |
| 49. (16) | 50. (4) | 51. (1) | 52. (3) | 53. (4) | 54. (4) | 55. (4) | 56. (4) |
| 57. (4) | 58. (4) | 59. (4) | 60. (3) | 61. (2) | 62. (4) | 63. (2) | 64. (3) |
| 65. (1) | 66. (4) | 67. (3) | 68. (2) | 69. (2) | 70. (2) | 71. (466) | 72. (125) |
| 73. (93) | 74. (1655) | 75. (150) | | | | | |

Q1. Group A consists of 7 boys and 3 girls, while group B consists of 6 boys and 5 girls. The number of ways, 4 boys and 4 girls can be invited for a picnic if 5 of them must be from group A and the remaining 3 from group B, is equal to :

- (1) 8750 (2) 9100
 (3) 8925 (4) 8575

Q2. $x + 2y - 3z = 2$

If the system of equations $2x + \lambda y + 5z = 5$ has infinitely many solutions, then $\lambda + \mu$ is equal to :

$$14x + 3y + \mu z = 33$$

- (1) 13 (2) 10
 (3) 12 (4) 11

Q3. Let $A = \left\{ x \in (0, \pi) - \left\{ \frac{\pi}{2} \right\} : \log_{(2/\pi)} |\sin x| + \log_{(2/\pi)} |\cos x| = 2 \right\}$ and $B = \{x \geq 0 : \sqrt{x}(\sqrt{x} - 4) - 3|\sqrt{x} - 2| + 6 = 0\}$. Then $n(A \cup B)$ is equal to :

- (1) 4 (2) 8
 (3) 6 (4) 2

Q4. The area of the region enclosed by the curves $y = e^x$, $y = |e^x - 1|$ and y -axis is:

- (1) $1 - \log_e 2$ (2) $\log_e 2$
 (3) $1 + \log_e 2$ (4) $2 \log_e 2 - 1$

Q5. The equation of the chord, of the ellipse $\frac{x^2}{25} + \frac{y^2}{16} = 1$, whose mid-point is $(3, 1)$ is :

- (1) $48x + 25y = 169$ (2) $5x + 16y = 31$
 (3) $25x + 101y = 176$ (4) $4x + 122y = 134$

Q6. Let the points $(\frac{11}{2}, \alpha)$ lie on or inside the triangle with sides $x + y = 11$, $x + 2y = 16$ and $2x + 3y = 29$. Then the product of the smallest and the largest values of α is equal to :

- (1) 44 (2) 22
 (3) 33 (4) 55

Q7. Let $f : (0, \infty) \rightarrow \mathbf{R}$ be a function which is differentiable at all points of its domain and satisfies the condition $x^2 f'(x) = 2xf(x) + 3$, with $f(1) = 4$. Then $2f(2)$ is equal to :

- (1) 39 (2) 19
 (3) 29 (4) 23

Q8. If $7 = 5 + \frac{1}{7}(5 + \alpha) + \frac{1}{7^2}(5 + 2\alpha) + \frac{1}{7^3}(5 + 3\alpha) + \dots$, then the value of α is :

- (1) $\frac{6}{7}$ (2) 6
 (3) $\frac{1}{7}$ (4) 1

Q9. Let $[x]$ denote the greatest integer function, and let m and n respectively be the numbers of the points, where the function $f(x) = [x] + |x - 2|$, $-2 < x < 3$, is not continuous and not differentiable. Then $m + n$ is equal to :

- (1) 6 (2) 8
 (3) 9 (4) 7

Q10. Let $A = [a_{ij}]$ be a square matrix of order 2 with entries either 0 or 1. Let E be the event that A is an invertible matrix. Then the probability $P(E)$ is :

- (1) $\frac{3}{16}$
 (3) $\frac{3}{8}$

- (2) $\frac{5}{8}$
 (4) $\frac{1}{8}$

Q11. Let the position vectors of three vertices of a triangle be $4\vec{p} + \vec{q} - 3\vec{r}$, $-5\vec{p} + \vec{q} + 2\vec{r}$ and $2\vec{p} - \vec{q} + 2\vec{r}$. If the position vectors of the orthocenter and the circumcenter of the triangle are $\frac{\vec{p} + \vec{q} + \vec{r}}{4}$ and $\alpha\vec{p} + \beta\vec{q} + \gamma\vec{r}$ respectively, then $\alpha + 2\beta + 5\gamma$ is equal to :

- (1) 3
 (3) 1
 (2) 4
 (4) 6

Q12. Let $\vec{a} = 3\hat{i} - \hat{j} + 2\hat{k}$, $\vec{b} = \vec{a} \times (\hat{i} - 2\hat{k})$ and $\vec{c} = \vec{b} \times \hat{k}$. Then the projection of $\vec{c} - 2\hat{j}$ on \vec{a} is :

- (1) $2\sqrt{14}$
 (3) $3\sqrt{7}$
 (2) $\sqrt{14}$
 (4) $2\sqrt{7}$

Q13. The number of real solution(s) of the equation $x^2 + 3x + 2 = \min\{|x - 3|, |x + 2|\}$ is :

- (1) 1
 (3) 2
 (2) 0
 (4) 3

Q14. The function $f : (-\infty, \infty) \rightarrow (-\infty, 1)$, defined by $f(x) = \frac{2^x - 2^{-x}}{2^x + 2^{-x}}$ is :

- (1) Neither one-one nor onto
 (3) Both one-one and onto
 (2) Onto but not one-one
 (4) One-one but not onto

Q15. In an arithmetic progression, if $S_{40} = 1030$ and $S_{12} = 57$, then $S_{30} - S_{10}$ is equal to :

- (1) 525
 (3) 515
 (2) 510
 (4) 505

Q16. Suppose A and B are the coefficients of 30th and 12th terms respectively in the binomial expansion of $(1+x)^{2n-1}$. If $2A = 5B$, then n is equal to :

- (1) 22
 (3) 21
 (2) 20
 (4) 19

Q17. Let (2, 3) be the largest open interval in which the function $f(x) = 2 \log_e(x-2) - x^2 + ax + 1$ is strictly increasing and (b, c) be the largest open interval, in which the function $g(x) = (x-1)^3(x+2-a)^2$ is strictly decreasing. Then $100(a+b-c)$ is equal to :

- (1) 420
 (3) 160
 (2) 360
 (4) 280

Q18.

For some a, b, let $f(x) = \begin{vmatrix} a + \frac{\sin x}{x} & 1 & b \\ a & 1 + \frac{\sin x}{x} & b \\ a & 1 & b + \frac{\sin x}{x} \end{vmatrix}$, $x \neq 0$, $\lim_{x \rightarrow 0} f(x) = \lambda + \mu a + \nu b$. Then

- $(\lambda + \mu + \nu)^2$ is equal to :
 (1) 16
 (3) 9
 (2) 25
 (4) 36

Q19. If the equation of the parabola with vertex V ($\frac{3}{2}, 3$) and the directrix $x + 2y = 0$ is

$\alpha x^2 + \beta y^2 - \gamma xy - 30x - 60y + 225 = 0$, then $\alpha + \beta + \gamma$ is equal to :

- (1) 7
(3) 8

- (2) 9
(4) 6

Q20. If $\alpha > \beta > \gamma > 0$, then the expression $\cot^{-1} \left\{ \beta + \frac{(1+\beta^2)}{(\alpha-\beta)} \right\} + \cot^{-1} \left\{ \gamma + \frac{(1+\gamma^2)}{(\beta-\gamma)} \right\} + \cot^{-1} \left\{ \alpha + \frac{(1+\alpha^2)}{(\gamma-\alpha)} \right\}$ is

- equal to :
(1) π
(3) $\frac{\pi}{2} - (\alpha + \beta + \gamma)$

- (2) 0
(4) 3π

Q21. Let P be the image of the point Q(7, -2, 5) in the line L : $\frac{x-1}{2} = \frac{y+1}{3} = \frac{z}{4}$ and R(5, p, q) be a point on L.

Then the square of the area of $\triangle PQR$ is _____.

Q22. If $\int \frac{2x^2+5x+9}{\sqrt{x^2+x+1}} dx = x\sqrt{x^2+x+1} + \alpha\sqrt{x^2+x+1} + \beta \log_e |x + \frac{1}{2} + \sqrt{x^2+x+1}| + C$, where C is the constant of integration, then $\alpha + 2\beta$ is equal to _____.

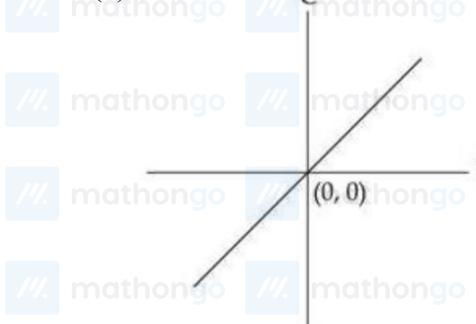
Q23. Let $y = y(x)$ be the solution of the differential equation $2 \cos x \frac{dy}{dx} = \sin 2x - 4y \sin x$, $x \in (0, \frac{\pi}{2})$. If $y(\frac{\pi}{3}) = 0$, then $y'(\frac{\pi}{4}) + y(\frac{\pi}{4})$ is equal to _____.

Q24. Number of functions $f : \{1, 2, \dots, 100\} \rightarrow \{0, 1\}$, that assign 1 to exactly one of the positive integers less than or equal to 98, is equal to _____.

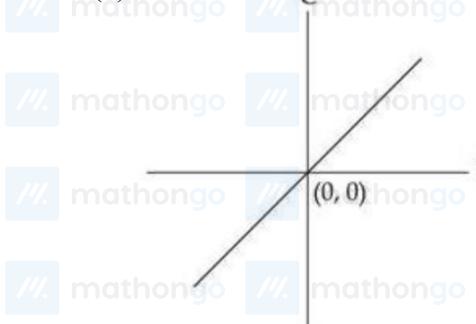
Q25. Let $H_1 : \frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ and $H_2 : -\frac{x^2}{A^2} + \frac{y^2}{B^2} = 1$ be two hyperbolas having length of latus rectums $15\sqrt{2}$ and $12\sqrt{5}$ respectively. Let their eccentricities be $e_1 = \sqrt{\frac{5}{2}}$ and e_2 respectively. If the product of the lengths of their transverse axes is $100\sqrt{10}$, then $25e_2^2$ is equal to _____.

Q26. Which of the following figure represents the relation between Celsius and Fahrenheit temperatures ?

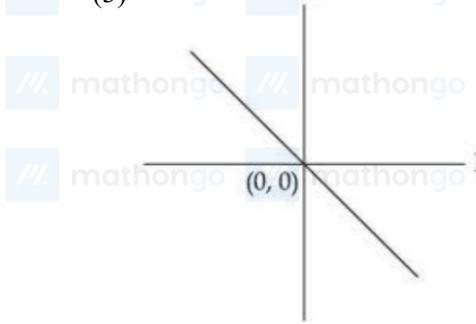
(1)



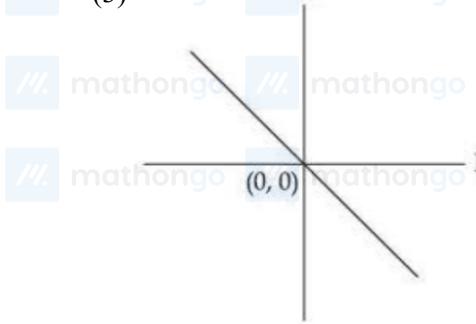
(2)



(3)



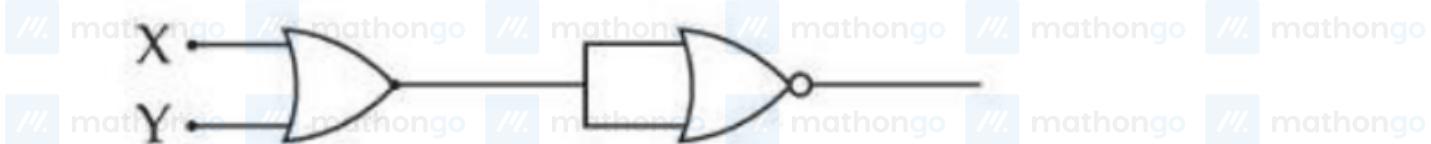
(4)



Q27. The position vector of a moving body at any instant of time is given as $\vec{r} = (5t^2\hat{i} - 5t\hat{j})$ m. The magnitude and direction of velocity at $t = 2$ s is,

- (1) $5\sqrt{15}$ m/s, making an angle of $\tan^{-1} 4$ with - ve
 Y axis X axis
 (2) $5\sqrt{15}$ m/s, making an angle of $\tan^{-1} 4$ with + ve
 X axis Y axis
 (3) $5\sqrt{17}$ m/s, making an angle of $\tan^{-1} 4$ with + ve
 Y axis X axis
 (4) $5\sqrt{17}$ m/s, making an angle of $\tan^{-1} 4$ with - ve

Q28. The output of the circuit is low (zero) for :



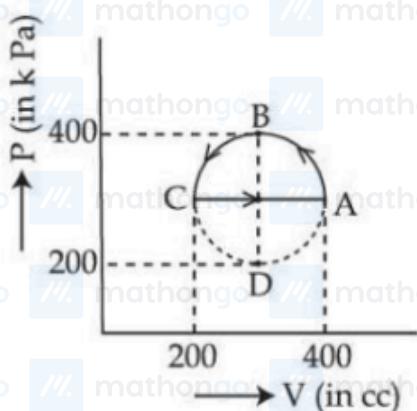
(A) $X = 0, Y = 0$ (B) $X = 0, Y = 1$ (C) $X = 1, Y = 0$ (D) $X = 1, Y = 1$ Choose the correct answer from the options given below :

- (1) (B), (C) and (D) only (2) (A), (B) and (C) only
 (3) (A), (C) and (D) only (4) (A), (B) and (D) only

Q29. Young's double slit interference apparatus is immersed in a liquid of refractive index 1.44. It has slit separation of 1.5 mm. The slits are illuminated by a parallel beam of light whose wavelength in air is 690 nm. The fringe-width on a screen placed behind the plane of slits at a distance of 0.72 m, will be :

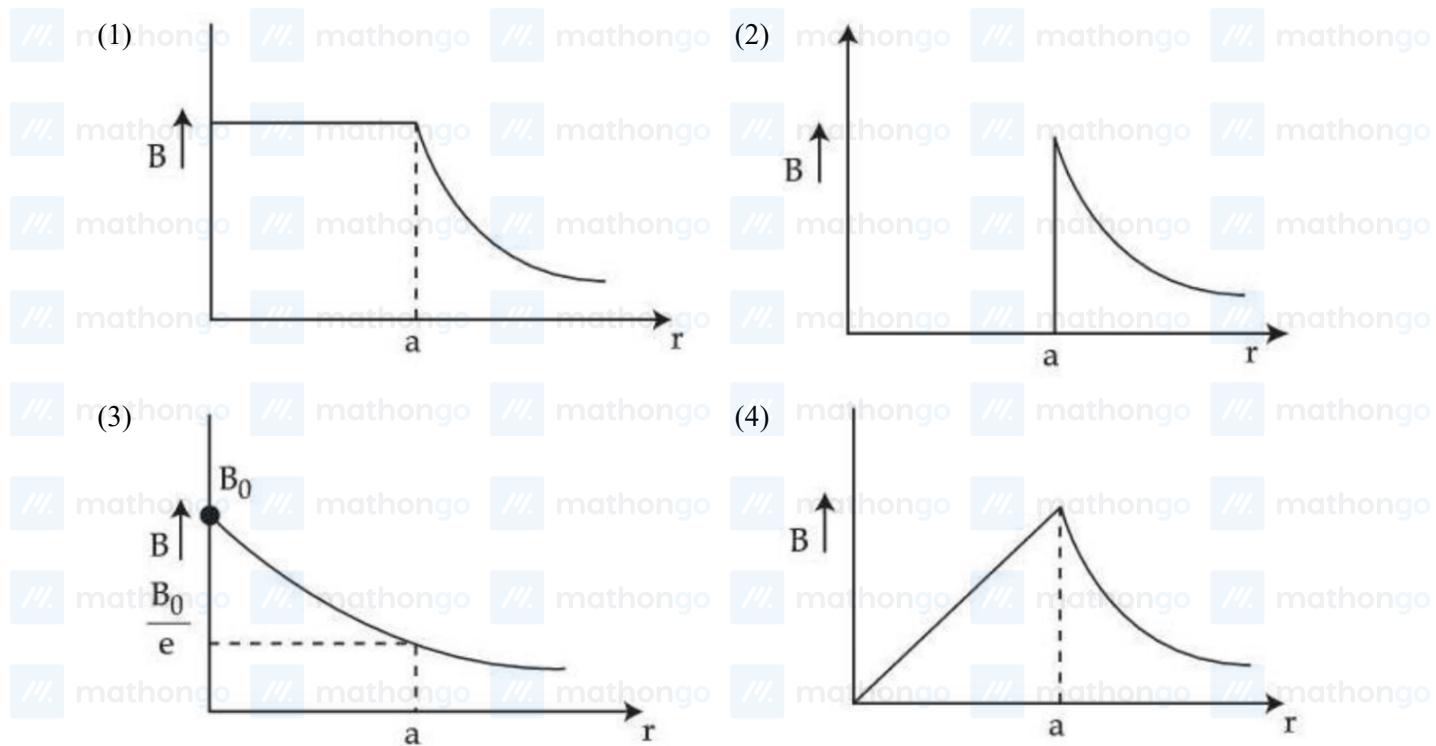
- (1) 0.23 mm (2) 0.33 mm
 (3) 0.63 mm (4) 0.46 mm

Q30. The magnitude of heat exchanged by a system for the given cyclic process ABCA (as shown in figure) is (in SI unit) :



- (1) 5π (2) 40π
 (3) 10π (4) zero

Q31. A long straight wire of a circular cross-section with radius 'a' carries a steady current I. The current I is uniformly distributed across this cross-section. The plot of magnitude of magnetic field B with distance r from the centre of the wire is given by



Q32. In photoelectric effect, the stopping potential (V_0) v/s frequency (ν) curve is plotted. (h is the Planck's constant and ϕ_0 is work function of metal) (A) $V_0\nu/s\nu$ is linear. (B) The slope of $V_0\nu/s\nu$ curve = $\frac{\phi_0}{h}$ (C) h constant is related to the slope of $V_0\nu/s\nu$ line. (D) The value of electric charge of electron is not required to determine h using the $V_0\nu/s\nu$ curve. (E) The work function can be estimated without knowing the value of h . Choose the correct answer from the options given below :

- (1) (C) and (D) only (2) (A), (C) and (E) only
 (3) (A), (B) and (C) only (4) (D) and (E) only

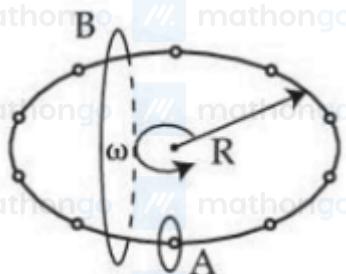
Q33. A solid sphere and a hollow sphere of the same mass and of same radius are rolled on an inclined plane. Let the time taken to reach the bottom by the solid sphere and the hollow sphere be t_1 and t_2 , respectively, then

- (1) $t_1 > t_2$ (2) $t_1 = t_2$
 (3) $t_1 < t_2$ (4) $t_1 = 2t_2$

Q34. A small uncharged conducting sphere is placed in contact with an identical sphere but having $4 \times 10^{-8} \text{ C}$ charge and then removed to a distance such that the force of repulsion between them is $9 \times 10^{-3} \text{ N}$. The distance between them is (Take $\frac{1}{4\pi\epsilon_0}$ as 9×10^9 in SI units)

- (1) 3 cm (2) 2 cm
 (3) 4 cm (4) 1 cm

Q35.

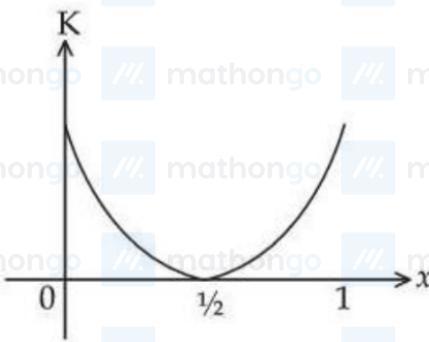


N equally spaced charges each of value q , are placed on a circle of radius R . The circle rotates about its axis with an angular velocity ω as shown in the figure. A bigger Amperian loop B encloses the whole circle where as a smaller Amperian loop A encloses a small segment. The difference between enclosed currents, $I_A - I_B$, for the given Amperian loops is

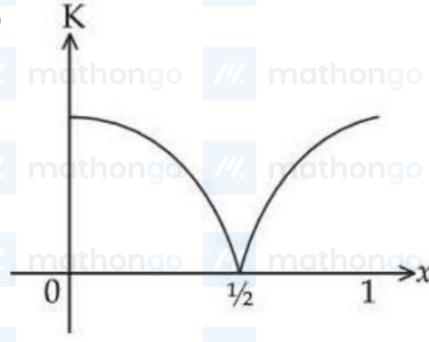
- (1) $\frac{2\pi}{N} q\omega$
 (2) $\frac{N^2}{2\pi} q\omega$
 (3) $\frac{N}{\pi} q\omega$
 (4) $\frac{N}{2\pi} q\omega$

Q36. A particle oscillates along the x -axis according to the law, $x(t) = x_0 \sin^2\left(\frac{t}{2}\right)$ where $x_0 = 1$ m. The kinetic energy (K) of the particle as a function of x is correctly represented by the graph

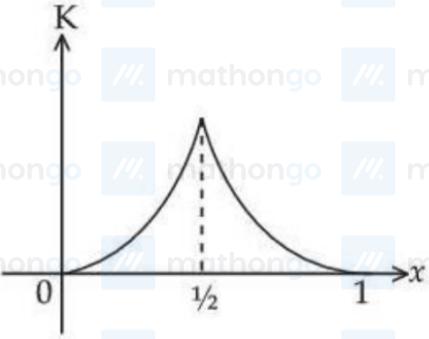
(1)



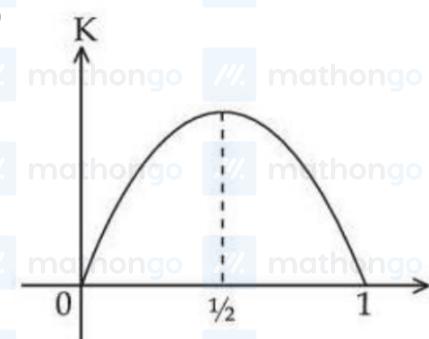
(2)



(3)



(4)

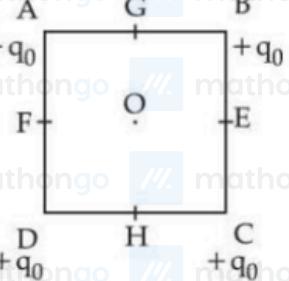


Q37. A photograph of a landscape is captured by a drone camera at a height of 18 km. The size of the camera film is $2 \text{ cm} \times 2 \text{ cm}$ and the area of the landscape photographed is 400 km^2 . The focal length of the lens in the

drone camera is :

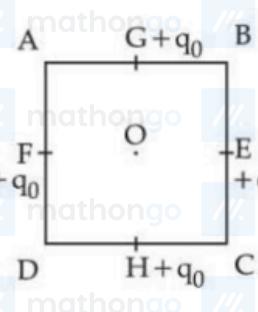
- (1) 1.8 cm
 (2) 0.9 cm
 (3) 2.8 cm
 (4) 2.5 cm

Q38.



Configuration (1)

- (1) $\frac{Kq_0^2}{a}(4 - 2\sqrt{2})$
 (3) $\frac{Kq_0^2}{a}(4\sqrt{2} - 2)$



Configuration (2)

- (2) $\frac{Kq_0^2}{a}(3 - \sqrt{2})$
 (4) $\frac{Kq_0^2}{a}(3\sqrt{2} - 2)$

Q39. Arrange the following in the ascending order of wavelength (λ) : (A) Microwaves (λ_1) (B) Ultraviolet rays(A) Infrared rays (λ_3) (D) X-rays (λ_4) Choose the most appropriate answer from the options given below :

- (1) $\lambda_4 < \lambda_3 < \lambda_2 < \lambda_1$
 (3) $\lambda_4 < \lambda_3 < \lambda_1 < \lambda_2$
 (2) $\lambda_3 < \lambda_4 < \lambda_2 < \lambda_1$
 (4) $\lambda_4 < \lambda_2 < \lambda_3 < \lambda_1$

Q40. The energy E and momentum p of a moving body of mass m are related by some equation. Given that c represents the speed of light, identify the correct equation

- (1) $E^2 = pc^2 + m^2c^2$
 (3) $E^2 = pc^2 + m^2c^4$
 (2) $E^2 = p^2c^2 + m^2c^2$
 (4) $E^2 = p^2c^2 + m^2c^4$

Q41. The temperature of a body in air falls from 40°C to 24°C in 4 minutes. The temperature of the air is 16°C . The temperature of the body in the next 4 minutes will be:

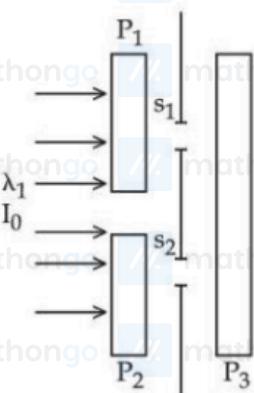
- (1) $\frac{14}{3}^\circ\text{C}$
 (3) $\frac{28}{3}^\circ\text{C}$
 (2) $\frac{42}{3}^\circ\text{C}$
 (4) $\frac{56}{3}^\circ\text{C}$

Q42. A solid sphere is rolling without slipping on a horizontal plane. The ratio of the linear kinetic energy of the centre of mass of the sphere and rotational kinetic energy is :

- (1) $\frac{3}{4}$
 (3) $\frac{5}{2}$
 (2) $\frac{4}{3}$
 (4) $\frac{2}{5}$

Q43. In a Young's double slit experiment, three polarizers are kept as shown in the figure. The transmission axes of P_1 and P_2 are orthogonal to each other. The polarizer P_3 covers both the slits with its transmission axis at 45° to those of P_1 and P_2 . An unpolarized light of wavelength λ and intensity I_0 is incident on P_1 and P_2 . The

Intensity at a point after P_3 where the path difference between the light waves from s_1 and s_2 is $\frac{\lambda}{3}$, is



- (1) $\frac{I_0}{2}$
(3) $\frac{I_0}{3}$

- (2) $\frac{I_0}{4}$
(4) I_0

Q44. Given below are two statements. One is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A) : In an insulated container, a gas is adiabatically shrunk to half of its initial volume. The temperature of the gas decreases. Reason (R): Free expansion of an ideal gas is an irreversible and an adiabatic process. In the light of the above statements, choose the correct answer from the options given below :

- (1) Both (A) and (R) are true but (R) is NOT the correct explanation of (A)

- (3) (A) is true but (R) is false
(4) Both (A) and (R) are true and (R) is the correct explanation of (A)

Q45. Given below are two statements. One is labelled as Assertion (A) and the other is labelled as Reason (R).

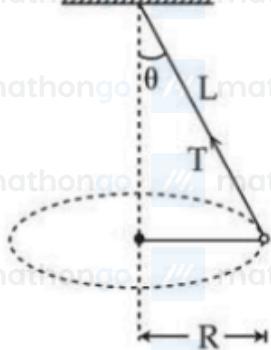
Assertion (A) : An electron in a certain region of uniform magnetic field is moving with constant velocity in a straight line path. Reason (R): The magnetic field in that region is along the direction of velocity of the electron. In the light of the above statements, choose the correct answer from the options given below :

- (1) (A) is true but (R) is false
(2) Both (A) and (R) are true but (R) is NOT the correct explanation of (A)

- (3) Both (A) and (R) are true and (R) is the correct explanation of (A)
(4) (A) is false but (R) is true

Q46. The ratio of the power of a light source S_1 to that of the light source S_2 is 2. S_1 is emitting 2×10^{15} photons per second at 600 nm. If the wavelength of the source S_2 is 300 nm, then the number of photons per second emitted by S_2 is $\times 10^{14}$.

Q47.



A string of length L is fixed at one end and carries a mass of M at the other end. The mass makes $(\frac{3}{\pi})$

rotations per second about the vertical axis passing through end of the string as shown. The tension in the string is ML .

Q48. The increase in pressure required to decrease the volume of a water sample by 0.2% is $P \times 10^5 \text{ Nm}^{-2}$. Bulk modulus of water is $2.15 \times 10^9 \text{ Nm}^{-2}$. The value of P is

Q49. A tightly wound long solenoid carries a current of 1.5 A . An electron is executing uniform circular motion

inside the solenoid with a time period of 75 ns . The number of turns per metre in the solenoid is

[Take mass of electron $m_e = 9 \times 10^{-31} \text{ kg}$, charge of electron $|q_e| = 1.6 \times 10^{-19} \text{ C}$,

$$\mu_0 = 4\pi \times 10^{-7} \frac{\text{N}}{\text{A}^2}, 1 \text{ ns} = 10^{-9} \text{ s}$$

Q50. Acceleration due to gravity on the surface of earth is ' g '. If the diameter of earth is reduced to one third of its original value and mass remains unchanged, then the acceleration due to gravity on the surface of the earth is

Q51. For hydrogen atom, the orbital/s with lowest energy is/are : (A) 4 s (B) 3 p_x (C) $3 \text{ d}_{x^2-y^2}$ (D) 3 d_{z^2} (E) 4 p_z

Choose the correct answer from the options given below :

(1) (B), (C) and (D) only

(3) (A) only

(2) (A) and (E) only

(4) (B) only

Q52. Match List - I with List - II.

List - I
(Transition metal ion)

(A) Ti^{3+}

(B) V^{2+}

(C) Ni^{2+}

(D) Sc^{3+}

List - II
(Spin only magnetic moment (B.M.))

(I) 3.87

(II) 0.00

(III) 1.73

(IV) 2.84

Choose the correct answer from the options given below :

(1) (A) –(III), (B) – (I), (C) – (IV), (D) – (II) (2) (A) –(III), (B) – (I), (C) – (II), (D) – (IV)

(3) (A) –(IV), (B) – (II), (C) – (III), (D) – (I) (4) (A) – (II), (B) – (IV), (C) – (I), (D) – (III)

Q53. Given below are two statements : Statement (I): Experimentally determined oxygen-oxygen bond lengths in the O_3 are found to be same and the bond length is greater than that of a $\text{O} = \text{O}$ (double bond) but less than

that of a single ($O - O$) bond. Statement (II) : The strong lone pair-lone pair repulsion between oxygen atoms is solely responsible for the fact that the bond length in ozone is smaller than that of a double bond ($O = O$) but more than that of a single bond ($O - O$). In the light of the above statements, choose the correct answer from the options given below :

- (1) Both Statement I and Statement II are false
 (2) Statement I is false but Statement II is true
 (3) Statement I is true but Statement II is false
 (4) Both Statement I and Statement II are true

Q54. When Ethane-1,2-diamine is added progressively to an aqueous solution of Nickel (II) chloride, the sequence of colour change observed will be :

- (1) Violet \rightarrow Blue \rightarrow Pale Blue \rightarrow Green
 (2) Pale Blue \rightarrow Blue \rightarrow Green \rightarrow Violet
 (3) Green \rightarrow Pale Blue \rightarrow Blue \rightarrow Violet
 (4) Pale Blue \rightarrow Blue \rightarrow Violet \rightarrow Green

Q55. Given below are two statements :

Statement (I) : The first ionization energy of Pb is greater than that of Sn .

Statement (II) : The first ionization energy of Ge is greater than that of Si .

In the light of the above statements, choose the correct answer from the options given below :

- (1) Statement I is false but Statement II is true
 (2) Statement I is true but Statement II is false
 (3) Both Statement I and Statement II are true
 (4) Both Statement I and Statement II are false

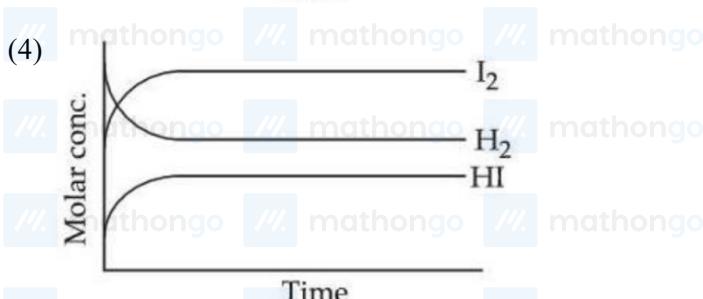
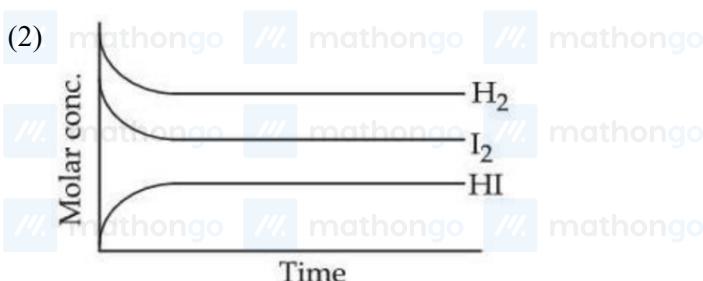
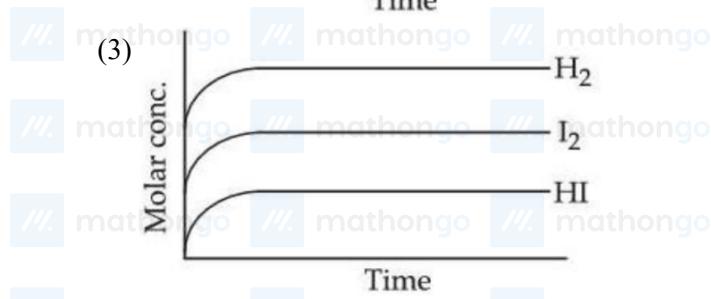
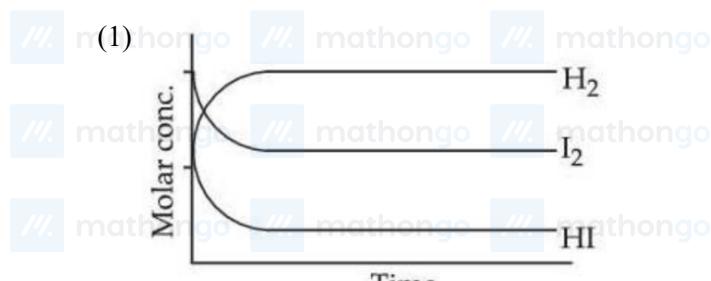
Q56. Identify correct statement/s : (A) $-OCH_3$ and $-NHCOCH_3$ are activating group. (B) -CN and -OH are meta directing group. (C) -CN and $-SO_3H$ are meta directing group. (D) Activating groups act as ortho - and para directing groups. (E) Halides are activating groups. Choose the correct answer from the options given below :

- (1) (A) only
 (2) (A), (B) and (E) only
 (3) (A) and (C) only
 (4) (A), (C) and (D) only

Q57. Based on the data given below : $E^\circ_{Cr_2O_7^{2-}/Cr^{3+}} = 1.33\text{ V}$ $E^\circ_{Cl_2/Cl(-)} = 1.36\text{ V}$
 $E^\circ_{MnO_4^-/Mn^{2+}} = 1.51\text{ V}$ $E^\circ_{Cr^{3+}/Cr} = -0.74\text{ V}$ the strongest reducing agent is :

- (1) Cr
 (2) Cl^-
 (3) MnO_4^-
 (4) Mn^{2+}

Q58. For the reaction, $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$ Attainment of equilibrium is predicted correctly by :



Q59. Find the compound 'A' from the following reaction sequences. A $\xrightarrow{\text{aqua-regia}}$ B $\xrightarrow[\text{(2) AcOH}]{\text{(1) KNO}_2|\text{NH}_4\text{OH}}$ yellow ppt

- (1) CoS
 (2) ZnS
 (3) NiS
 (4) MnS

Q60. The elemental composition of a compound is 54.2% C, 9.2% H and 36.6% O. If the molar mass of the compound is 132 g mol⁻¹, the molecular formula of the compound is : [Given : The relative atomic mass of C : H : O = 12 : 1 : 16]

- (1) C₄H₉O₃
 (2) C₆H₁₂O₆
 (3) C₄H₈O₂
 (4) C₆H₁₂O₃

Q61. The conditions and consequence that favours the $t_{2g}e_g^1$ configuration in a metal complex are

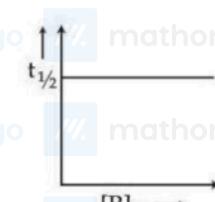
- (1) weak field ligand, low spin complex
 (2) weak field ligand, high spin complex
 (3) strong field ligand, high spin complex
 (4) strong field ligand, low spin complex

Q62. In the given structure, number of sp and sp² hybridized carbon atoms present respectively are :

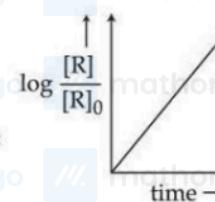


- (1) 4 and 5
 (2) 3 and 5
 (3) 3 and 6
 (4) 4 and 6

Q63.

Statement (I) :

is valid for first order reaction.

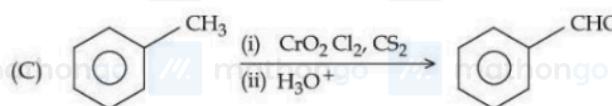
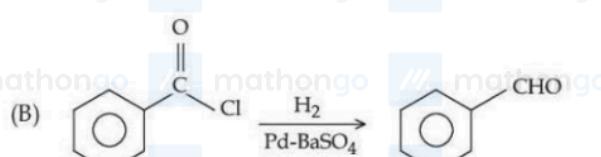
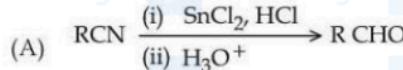
Statement (II) :

is valid for first order reaction.

Given below are two statements :

In the light of the above statements, choose the correct answer from the options given below :

- (1) Both Statement I and Statement II are true
 (2) Statement I is false but Statement II is true
 (3) Statement I is true but Statement II is false
 (4) Both Statement I and Statement II are false

Q64. Match List - I with List - II.**List - I****List - II**

(I) Etard reaction

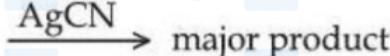
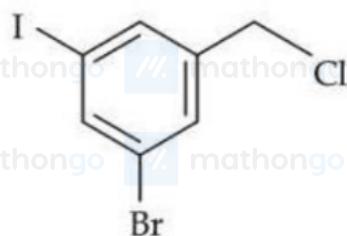
(II) Gatterman-Koch reaction

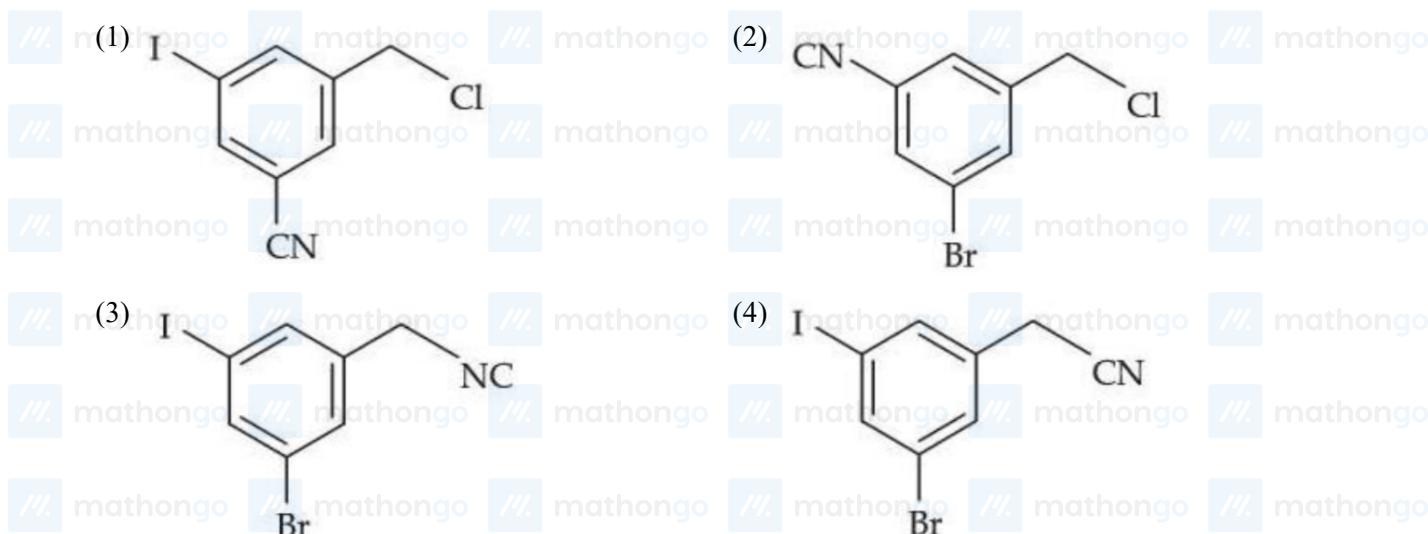
(III) Rosenmund reduction

(IV) Stephen reaction

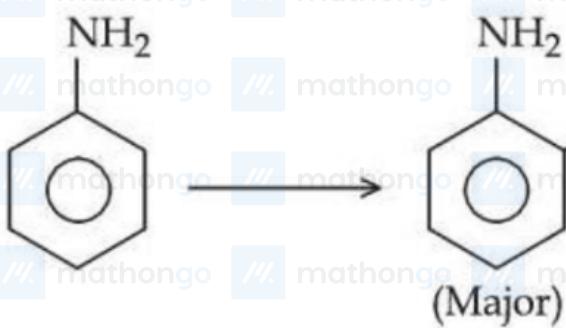
Choose the correct answer from the options given below :

- (1) (A)-(III), (B)-(IV), (C)-(II), (D)-(I)
 (2) (A)-(I), (B)-(III), (C)-(II), (D)-(IV)
 (3) (A)-(III), (B)-(IV), (C)-(I), (D)-(II)
 (4) (A)-(IV), (B)-(III), (C)-(I), (D)-(II)

Q65. The structure of the major product formed in the following reaction is :



Q66.



For reaction

The correct order of set of reagents for the above conversion is :

- (1) $\text{Br}_2 \mid \text{FeBr}_3, \text{H}_2\text{O}(\Delta), \text{NaOH}$ (2) $\text{H}_2\text{SO}_4, \text{Ac}_2\text{O}, \text{Br}_2, \text{H}_2\text{O}(\Delta), \text{NaOH}$
 (3) $\text{Ac}_2\text{O}, \text{Br}_2, \text{H}_2\text{O}(\Delta), \text{NaOH}$ (4) $\text{Ac}_2\text{O}, \text{H}_2\text{SO}_4, \text{Br}_2, \text{NaOH}$

Q67. The successive 5 ionisation energies of an element are 800, 2427, 3658, 25024 and 32824 kJ/mol, respectively. By using the above values predict the group in which the above element is present :

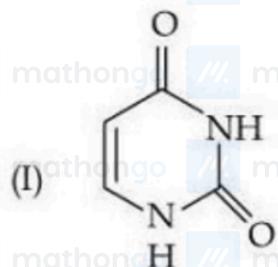
- (1) Group 13 (2) Group 14
 (3) Group 2 (4) Group 4

Q68. Match List - I with List - II.

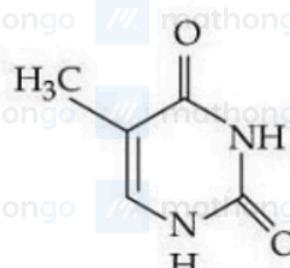
List - I

(A) Adenine

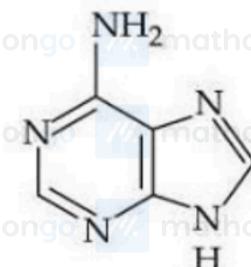
List - II



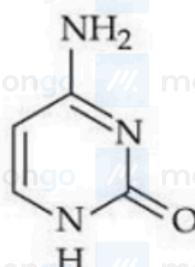
(B) Cytosine



(C) Thymine



(D) Uracil



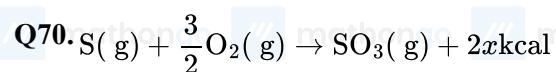
Choose the correct answer from the options given below :

- (1) (A)-(IV), (B)-(III), (C)-(II), (D)-(I)
 (3) (A)-(III), (B)-(IV), (C)-(I), (D)-(II)

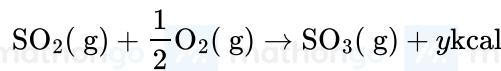
- (2) (A)-(III), (B)-(IV), (C)-(II), (D)-(I)
 (4) (A)-(III), (B)-(I), (C)-(IV), (D)-(II)

Q69. Which of the following mixing of 1 M base and 1 M acid leads to the largest increase in temperature?

- (1) 30 mL CH_3COOH and 30 mL NaOH
 (3) 30 mL HCl and 30 mL NaOH
- (2) 45 mL CH_3COOH and 25 mL NaOH
 (4) 50 mL HCl and 20 mL NaOH



The heat of formation of $SO_2(g)$ is given by :



(1) $x + y\text{kcal}$

(3) $\frac{2x}{y}\text{kcal}$

(2) $y - 2x\text{kcal}$

(4) $2x + y\text{kcal}$

Q71. In Carius method of estimation of halogen, 0.25 g of an organic compound gave 0.15 g of silver bromide ($AgBr$).

The percentage of Bromine in the organic compound is $\times 10^{-1}\%$ (Nearest integer). (Given :

Molar mass of Ag is 108 and Br is 80 g mol⁻¹)

Q72. The observed and normal molar masses of compound MX_2 are 65.6 and 164 respectively. The percent degree

of ionisation of MX_2 is %. (Nearest integer)

Q73. Consider a complex reaction taking place in three steps with rate constants k_1 , k_2 and k_3 respectively. The

overall rate constant k is given by the expression $k = \sqrt{\frac{k_1 k_3}{k_2}}$. If the activation energies of the three steps are

60,30 and 10 kJ mol⁻¹ respectively, then the overall energy of activation in kJmol⁻¹ is (Nearest integer)

Q74. The possible number of stereoisomers for 5-phenylpent-4-en-2-ol is

Q75. The hydrocarbon (X) with molar mass 80 g mol⁻¹ and 90% carbon has degree of unsaturation.

ANSWER KEYS

1. (3)	2. (3)	3. (2)	4. (1)	5. (1)	6. (3)	7. (1)	8. (2)
9. (2)	10. (3)	11. (1)	12. (1)	13. (3)	14. (4)	15. (3)	16. (3)
17. (2)	18. (1)	19. (2)	20. (1)	21. (957)	22. (16)	23. (1)	24. (392)
25. (55)	26. (4)	27. (4)	28. (1)	29. (1)	30. (1)	31. (4)	32. (2)
33. (3)	34. (2)	35. (4)	36. (4)	37. (1)	38. (4)	39. (4)	40. (4)
41. (4)	42. (3)	43. (2)	44. (2)	45. (3)	46. (5)	47. (36)	48. (43)
49. (250)	50. (9)	51. (1)	52. (1)	53. (3)	54. (3)	55. (2)	56. (4)
57. (1)	58. (2)	59. (1)	60. (4)	61. (2)	62. (2)	63. (3)	64. (4)
65. (3)	66. (2)	67. (1)	68. (2)	69. (3)	70. (2)	71. (255)	72. (75)
73. (20)	74. (4)	75. (3)					

Q1. The distance of the line $\frac{x-2}{2} = \frac{y-6}{3} = \frac{z-3}{4}$ from the point $(1, 4, 0)$ along the line $\frac{x}{1} = \frac{y-2}{2} = \frac{z+3}{3}$ is :

- (1) $\sqrt{17}$ (2) $\sqrt{15}$
 (3) $\sqrt{14}$ (4) $\sqrt{13}$

Q2. Let $A = \{(x, y) \in \mathbf{R} \times \mathbf{R} : |x + y| \geq 3\}$ and $B = \{(x, y) \in \mathbf{R} \times \mathbf{R} : |x| + |y| \leq 3\}$. If

$C = \{(x, y) \in A \cap B : x = 0 \text{ or } y = 0\}$, then $\sum_{(x,y) \in C} |x + y|$ is :

- (1) 15 (2) 24
 (3) 18 (4) 12

Q3. Let $X = \mathbf{R} \times \mathbf{R}$. Define a relation R on X as : $(a_1, b_1)R(a_2, b_2) \Leftrightarrow b_1 = b_2$ Statement I : R is an equivalence relation. Statement II : For some $(a, b) \in X$, the set $S = \{(x, y) \in X : (x, y)R(a, b)\}$ represents a line parallel to $y = x$. In the light of the above statements, choose the correct answer from the options given below :

- (1) Both Statement I and Statement II are false (2) Statement I is true but Statement II is false
 (3) Both Statement I and Statement II are true (4) Statement I is false but Statement II is true

Q4. Let $\int x^3 \sin x \, dx = g(x) + C$, where C is the constant of integration. If

$8(g(\frac{\pi}{2}) + g'(\frac{\pi}{2})) = \alpha\pi^3 + \beta\pi^2 + \gamma, \alpha, \beta, \gamma \in \mathbf{Z}$, then $\alpha + \beta - \gamma$ equals :

- (1) 48 (2) 55
 (3) 62 (4) 47

Q5. A rod of length eight units moves such that its ends A and B always lie on the lines $x - y + 2 = 0$ and $y + 2 = 0$, respectively. If the locus of the point P , that divides the rod AB internally in the ratio $2 : 1$ is

$9(x^2 + \alpha y^2 + \beta xy + \gamma x + 28y) - 76 = 0$, then $\alpha - \beta - \gamma$ is equal to :

- (1) 22 (2) 21
 (3) 23 (4) 24

Q6. If the square of the shortest distance between the lines $\frac{x-2}{1} = \frac{y-1}{2} = \frac{z+3}{-3}$ and $\frac{x+1}{2} = \frac{y+3}{4} = \frac{z+5}{-5}$ is $\frac{m}{n}$, where m, n are coprime numbers, then $m + n$ is equal to :

- (1) 21 (2) 9
 (3) 14 (4) 6

Q7. $\lim_{x \rightarrow \infty} \frac{(2x^2 - 3x + 5)(3x - 1)^{\frac{x}{2}}}{(3x^2 + 5x + 4)\sqrt{(3x + 2)^x}}$ is equal to :

- (1) $\frac{2}{\sqrt{3e}}$ (2) $\frac{2e}{\sqrt{3}}$
 (3) $\frac{2}{3\sqrt{e}}$ (4) $\frac{2e}{3}$

Q8. Let the point A divide the line segment joining the points $P(-1, -1, 2)$ and $Q(5, 5, 10)$ internally in the ratio

$r : 1(r > 0)$. If O is the origin and $(\overrightarrow{OQ} \cdot \overrightarrow{OA}) - \frac{1}{5}|\overrightarrow{OP} \times \overrightarrow{OA}|^2 = 10$, then the value of r is :

- (1) $\sqrt{7}$ (2) 14
 (3) 3 (4) 7

Q9. The length of the chord of the ellipse $\frac{x^2}{4} + \frac{y^2}{2} = 1$, whose mid-point is $(1, \frac{1}{2})$, is :

- (1) $\frac{5}{3}\sqrt{15}$ (2) $\frac{1}{3}\sqrt{15}$
 (3) $\frac{2}{3}\sqrt{15}$ (4) $\sqrt{15}$

Q10. $x + y + z = 6$

The system of equations $x + 2y + 5z = 9$, has no solution if
 $x + 5y + \lambda z = \mu$,

- (1) $\lambda = 15, \mu \neq 17$ (2) $\lambda \neq 17, \mu \neq 18$
 (3) $\lambda = 17, \mu \neq 18$ (4) $\lambda = 17, \mu = 18$

Q11. Let the range of the function $f(x) = 6 + 16 \cos x \cdot \cos(\frac{\pi}{3} - x) \cdot \cos(\frac{\pi}{3} + x) \cdot \sin 3x \cdot \cos 6x$, $x \in \mathbf{R}$ be $[\alpha, \beta]$. Then the distance of the point (α, β) from the line $3x + 4y + 12 = 0$ is :

- (1) 11 (2) 8 (3) 10 (4) 9

Q12. Let $x = x(y)$ be the solution of the differential equation $y = \left(x - y \frac{dx}{dy}\right) \sin\left(\frac{x}{y}\right)$, $y > 0$ and $x(1) = \frac{\pi}{2}$. Then $\cos(x(2))$ is equal to :

- (1) $1 - 2(\log_e 2)^2$ (2) $1 - 2(\log_e 2)$
 (3) $2(\log_e 2) - 1$ (4) $2(\log_e 2)^2 - 1$

Q13. A spherical chocolate ball has a layer of ice-cream of uniform thickness around it. When the thickness of the ice-cream layer is 1 cm, the ice-cream melts at the rate of $81 \text{ cm}^3/\text{min}$ and the thickness of the ice-cream layer decreases at the rate of $\frac{1}{4\pi} \text{ cm/min}$. The surface area (in cm^2) of the chocolate ball (without the ice-cream layer) is :

- (1) 196π (2) 256π
 (3) 225π (4) 128π

Q14. The number of complex numbers z , satisfying $|z| = 1$ and $\left|\frac{z}{\bar{z}} + \frac{\bar{z}}{z}\right| = 1$, is :

- (1) 4 (2) 8 (3) 10 (4) 6

Q15.

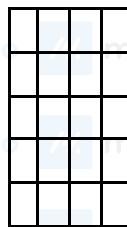
Let $A = [a_{ij}]$ be 3×3 matrix such that $A \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$, $A \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix} = \begin{bmatrix} 4 \\ 1 \\ 3 \end{bmatrix}$ and $A \begin{bmatrix} 2 \\ 1 \\ 2 \end{bmatrix} = \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}$, then a_{23} equals :

- (1) -1 (2) 2
 (3) 1 (4) 0

Q16. If $I = \int_0^{\frac{\pi}{2}} \frac{\sin^{\frac{3}{2}} x}{\sin^{\frac{3}{2}} x + \cos^{\frac{3}{2}} x} dx$, then $\int_0^{21} \frac{x \sin x \cos x}{\sin^4 x + \cos^4 x} dx$ equals :

- (1) $\frac{\pi^2}{12}$ (2) $\frac{\pi^2}{4}$
 (3) $\frac{\pi^2}{16}$ (4) $\frac{\pi^2}{8}$

Q17. A board has 16 squares as shown in the figure:



Out of these 16 squares, two squares are chosen at random. The probability that they have no side in common is :

- (1) $\frac{7}{10}$ (2) $\frac{4}{5}$
 (3) $\frac{23}{30}$ (4) $\frac{3}{5}$

Q18. Let the shortest distance from $(a, 0)$, $a > 0$, to the parabola $y^2 = 4x$ be 4. Then the equation of the circle passing through the point $(a, 0)$ and the focus of the parabola, and having its centre on the axis of the parabola is :

- (1) $x^2 + y^2 - 10x + 9 = 0$ (2) $x^2 + y^2 - 6x + 5 = 0$
 (3) $x^2 + y^2 - 4x + 3 = 0$ (4) $x^2 + y^2 - 8x + 7 = 0$

Q19. If in the expansion of $(1+x)^p(1-x)^q$, the coefficients of x and x^2 are 1 and -2, respectively, then $p^2 + q^2$ is equal to :

- (1) 18 (2) 13
 (3) 8 (4) 20

Q20. If the area of the region $\{(x, y) : -1 \leq x \leq 1, 0 \leq y \leq a + e^{|x|} - e^{-x}, a > 0\}$ is $\frac{e^2+8e+1}{e}$, then the value of a is :

- (1) 8 (2) 7
 (3) 5 (4) 6

Q21. The variance of the numbers 8, 21, 34, 47, ..., 320 is

Q22. The roots of the quadratic equation $3x^2 - px + q = 0$ are 10th and 11th terms of an arithmetic progression with common difference $\frac{3}{2}$. If the sum of the first 11 terms of this arithmetic progression is 88, then $q - 2p$ is equal to -.

Q23. The number of ways, 5 boys and 4 girls can sit in a row so that either all the boys sit together or no two boys sit together, is -

Q24. The focus of the parabola $y^2 = 4x + 16$ is the centre of the circle C of radius 5. If the values of λ , for which C passes through the point of intersection of the lines $3x - y = 0$ and $x + \lambda y = 4$, are λ_1 and λ_2 , $\lambda_1 < \lambda_2$, then $12\lambda_1 + 29\lambda_2$ is equal to -.

Q25. Let α, β be the roots of the equation $x^2 - ax - b = 0$ with $\text{Im}(\alpha) < \text{Im}(\beta)$. Let $P_n = \alpha^n - \beta^n$. If $P_3 = -5\sqrt{7}i$, $P_4 = -3\sqrt{7}i$, $P_5 = 11\sqrt{7}i$ and $P_6 = 45\sqrt{7}i$, then $|\alpha^4 + \beta^4|$ is equal to -.

Q26. A galvanometer having a coil of resistance 30Ω need 20 mA of current for full-scale deflection. If a maximum current of 3 A is to be measured using this galvanometer, the resistance of the shunt to be added to the galvanometer should be $\frac{30}{X}\Omega$, where X is Options

- (1) 596
- (2) 149
- (3) 298
- (4) 447

Q27. A ball having kinetic energy KE, is projected at an angle of 60° from the horizontal. What will be the kinetic energy of ball at the highest point of its flight ?

- (1) $\frac{(KE)}{8}$
- (2) $\frac{(KE)}{2}$
- (3) $\frac{(KE)}{16}$
- (4) $\frac{(KE)}{4}$

Q28. Two charges $7\mu C$ and $-4\mu C$ are placed at $(-7 \text{ cm}, 0, 0)$ and $(7 \text{ cm}, 0, 0)$ respectively. Given, $\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2}$, the electrostatic potential energy of the charge configuration is :

- (1) -1.8 J
- (2) -2.0 J
- (3) -1.5 J
- (4) -1.2 J

Q29. Two point charges $-4\mu C$ and $4\mu C$, constituting an electric dipole, are placed at $(-9, 0, 0) \text{ cm}$ and $(9, 0, 0) \text{ cm}$ in a uniform electric field of strength 10^4 NC^{-1} . The work done on the dipole in rotating it from the equilibrium through 180° is :

- (1) 18.4 mJ
- (2) 14.4 mJ
- (3) 12.4 mJ
- (4) 16.4 mJ

Q30. A massless spring gets elongated by amount x_1 under a tension of 5 N . Its elongation is x_2 under the tension of 7 N . For the elongation of $(5x_1 - 2x_2)$, the tension in the spring will be,

- (1) 39 N
- (2) 15 N
- (3) 11 N
- (4) 20 N

Q31. Water of mass m gram is slowly heated to increase the temperature from T_1 to T_2 . The change in entropy of the water, given specific heat of water is $1 \text{ J kg}^{-1} \text{ K}^{-1}$, is :

- (1) $m \ln \left(\frac{T_2}{T_1} \right)$
- (2) zero
- (3) $m \ln \left(\frac{T_1}{T_2} \right)$
- (4) $m(T_2 - T_1)$

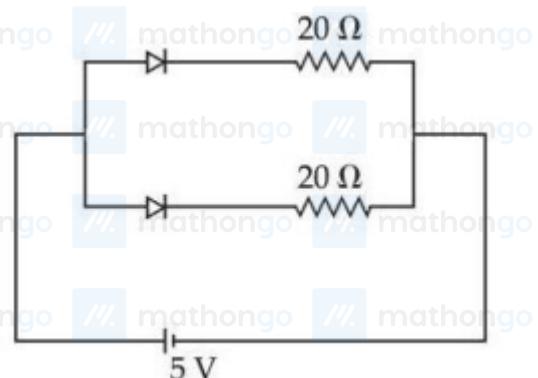
Q32. Water flows in a horizontal pipe whose one end is closed with a valve. The reading of the pressure gauge attached to the pipe is P_1 . The reading of the pressure gauge falls to P_2 when the valve is opened. The speed of water flowing in the pipe is proportional to

- (1) $P_1 - P_2$
- (2) $(P_1 - P_2)^4$
- (3) $(P_1 - P_2)^2$
- (4) $\sqrt{P_1 - P_2}$

Q33. A concave mirror of focal length f in air is dipped in a liquid of refractive index μ . Its focal length in the liquid will be:

- (1) μf
- (2) f
- (3) $\frac{f}{(\mu-1)}$
- (4) $\frac{f}{\mu}$

Q34.



What is the current through the battery in the circuit shown below

- (1) 1.5 A
- (2) 0.5 A
- (3) 0.25 A
- (4) 1.0 A

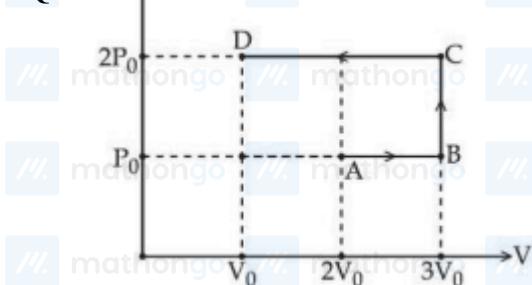
Q35. The refractive index of the material of a glass prism is $\sqrt{3}$. The angle of minimum deviation is equal to the angle of the prism. What is the angle of the prism?

- (1) 60°
- (2) 58°
- (3) 48°
- (4) 50°

Q36. The width of one of the two slits in Young's double slit experiment is d while that of the other slit is $x d$. If the ratio of the maximum to the minimum intensity in the interference pattern on the screen is 9 : 4 then what is the value of x ? (Assume that the field strength varies according to the slit width.)

- (1) 4
- (2) 5
- (3) 3
- (4) 2

Q37.



Using the given P – V diagram, the work done by an ideal gas along the path ABCD is :

- (1) $3P_0 V_0$
- (2) $-4P_0 V_0$
- (3) $-3P_0 V_0$
- (4) $4P_0 V_0$

Q38. A plane electromagnetic wave of frequency 20 MHz travels in free space along the +x direction. At a

particular point in space and time, the electric field vector of the wave is $E_y = 9.3 \text{ V m}^{-1}$. Then, the magnetic field vector of the wave at that point is

- (1) $B_z = 6.2 \times 10^{-8} \text{ T}$
- (2) $B_z = 3.1 \times 10^{-8} \text{ T}$
- (3) $B_z = 1.55 \times 10^{-8} \text{ T}$
- (4) $B_z = 9.3 \times 10^{-8} \text{ T}$

Q39. The equation of a transverse wave travelling along a string is $y(x, t) = 4.0 \sin [20 \times 10^{-3}x + 600t] \text{ mm}$, where x is in mm and t is in second. The velocity of the wave is :

- (1) -60 m/s
(3) +30 m/s

- (2) -30 m/s
(4) +60 m/s

Q40. Given below are two statements. One is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A) : The binding energy per nucleon is found to be practically independent of the atomic number A, for nuclei with mass numbers between 30 and 170. Reason (R): Nuclear force is long range. In the light of the above statements, choose the correct answer from the options given below :

- (1) (A) is true but (R) is false
(2) (A) is false but (R) is true
(3) Both (A) and (R) are true and (R) is the correct explanation of (A)
(4) Both (A) and (R) are true but (R) is NOT the correct explanation of (A)

Q41. If a satellite orbiting the Earth is 9 times closer to the Earth than the Moon, what is the time period of rotation of the satellite? Given rotational time period of Moon = 27 days and gravitational attraction between the satellite and the moon is neglected.

- (1) 27 days
(3) 81 days
(2) 1 day
(4) 3 days

Q42. A circular disk of radius R meter and mass M kg is rotating around the axis perpendicular to the disk. An external torque is applied to the disk such that $\theta(t) = 5t^2 - 8t$, where $\theta(t)$ is the angular position of the rotating disc as a function of time t. How much power is delivered by the applied torque, when $t = 2$ s ?

- (1) $72MR^2$
(3) $108MR^2$
(2) $8MR^2$
(4) $60MR^2$

Q43. The energy of a system is given as $E(t) = \alpha^3 e^{-\beta t}$, where t is the time and $\beta = 0.3 \text{ s}^{-1}$. The errors in the measurement of α and t are 1.2% and 1.6%, respectively. At $t = 5$ s, maximum percentage error in the energy is :

- (1) 6%
(3) 11.6%
(2) 8.4%
(4) 4%

Q44. Match List - I with List - II.

List - I

- (A) Permeability of free space
(B) Magnetic field
(C) Magnetic moment
(D) Torsional constant

List - II

- (I) $[M L^2 T^{-2}]$
(II) $[M T^{-2} A^{-1}]$
(III) $[M L T^{-2} A^{-2}]$
(IV) $[L^2 A]$

Choose the correct answer from the options given below :

- (1) (A)-(IV), (B)-(III), (C)-(I), (D)-(II)
(2) (A)-(III), (B)-(II), (C)-(IV), (D)-(I)
(3) (A)-(I), (B)-(IV), (C)-(II), (D)-(III)
(4) (A)-(II), (B)-(I), (C)-(III), (D)-(IV)

Q45. In photoelectric effect an em-wave is incident on a metal surface and electrons are ejected from the surface. If the work function of the metal is 2.14 eV and stopping potential is 2 V, what is the wavelength of the em-wave ? (Given $hc = 1242 \text{ eV nm}$ where h is the Planck's constant and c is the speed of light in vacuum.)

- (1) 300 nm
 (3) 600 nm

- (2) 400 nm
 (4) 200 nm

Q46. A time varying potential difference is applied between the plates of a parallel plate capacitor of capacitance

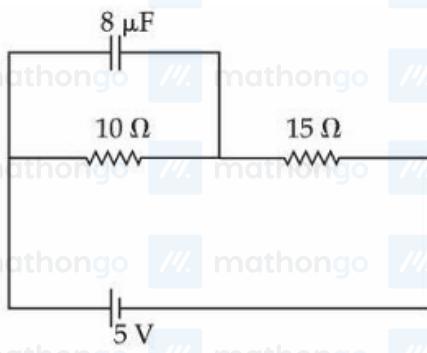
$2.5\mu F$. The dielectric constant of the medium between the capacitor plates is 1. It produces an instantaneous displacement current of 0.25 mA in the intervening space between the capacitor plates, the magnitude of the rate of change of the potential difference will be _____ Vs^{-1} .

Q47. In a series LCR circuit, a resistor of 300Ω , a capacitor of 25 nF and an inductor of 100 mH are used. For maximum current in the circuit, the angular frequency of the ac source is _____ $\times 10^4$ radians s^{-1} .

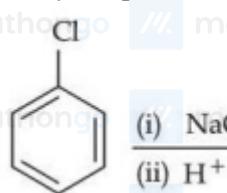
Q48. An air bubble of radius 1.0 mm is observed at a depth of 20 cm below the free surface of a liquid having surface tension 0.095 J/m^2 and density 10^3 kg/m^3 . The difference between pressure inside the bubble and atmospheric pressure is _____ N/m^2 . (Take $g = 10\text{ m/s}^2$)

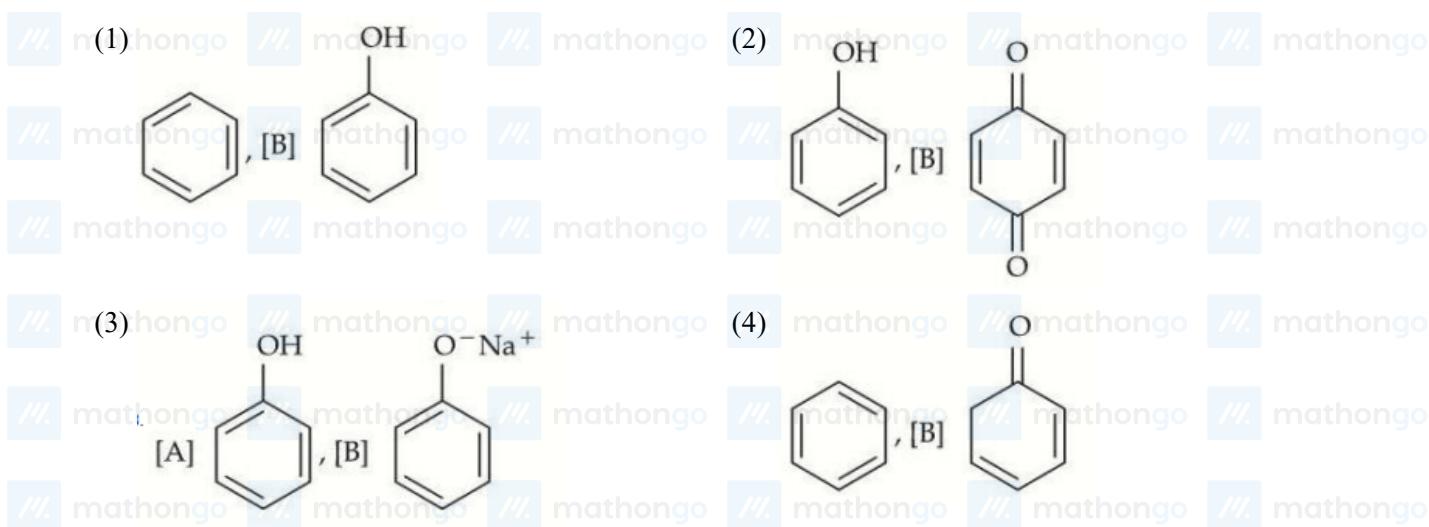
Q49. A satellite of mass $\frac{M}{2}$ is revolving around earth in a circular orbit at a height of $\frac{R}{3}$ from earth surface. The angular momentum of the satellite is $M\sqrt{\frac{GMR}{x}}$. The value of x is _____, where M and R are the mass and radius of earth, respectively. (G is the gravitational constant)

Q50. At steady state the charge on the capacitor, as shown in the circuit below, is _____ μC .



Q51. Identify the products [A] and [B], respectively in the following reaction :





Q52. Consider the following reactions $\text{K}_2\text{Cr}_2\text{O}_7 \xrightarrow[-\text{H}_2\text{O}]{\text{KOH}} [\text{A}] \xrightarrow[-\text{H}_2\text{O}]{\text{H}_2\text{SO}_4} [\text{B}] + \text{K}_2\text{SO}_4$ The products [A] and [B], respectively are :

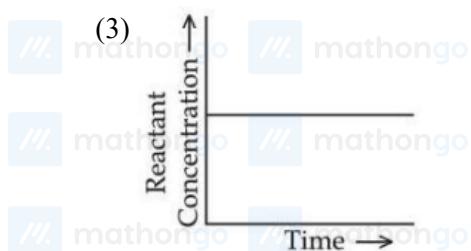
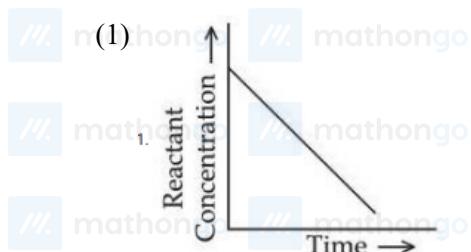
- (1) K_2CrO_4 and CrO_3
- (2) K_2CrO_4 and Cr_2O_3
- (3) K_2CrO_4 and $\text{K}_2\text{Cr}_2\text{O}_7$
- (4) $\text{K}_2\text{Cr(OH)}_6$ and Cr_2O_3

Q53. The effect of temperature on spontaneity of reactions are represented as :

	ΔH	ΔS	Temperature	Spontaneity
(A)	+	-	any T	Non
(B)	+	+	low T	spontaneous
(C)	-	-	low T	spontaneous
(D)	-	+	any T	spontaneous

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

Q54. Which of the following graphs most appropriately represents a zero order reaction ?



Q55. Consider the reaction $X_2Y(g) \rightleftharpoons X_2(g) + \frac{1}{2}Y_2(g)$. The equation representing correct relationship between the degree of dissociation (x) of $X_2Y(g)$ with its equilibrium constant K_p is _____. Assume x to be very very small.

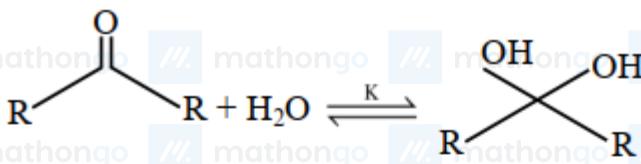
(1) $x = \sqrt[3]{\frac{2K_p}{P}}$

(2) $x = \sqrt[3]{\frac{2K_p^2}{P}}$

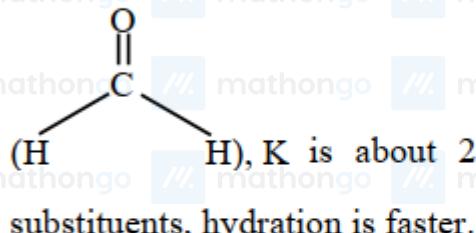
(3) $x = \sqrt[3]{\frac{K_p}{P}}$

(4) $x = \sqrt[3]{\frac{K_p}{2P}}$

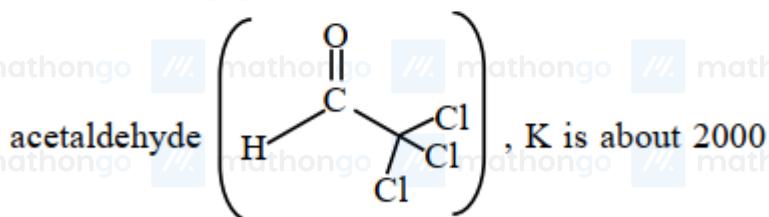
Q56. Given below are two statements : Consider the following reaction



Statement (I) : In the case of formaldehyde



Statement (II) : In the case of trichloro



In the light of the above statements, choose the correct answer from the options given below:

- | | |
|---|---|
| (1) Both Statement I and Statement II are false | (2) Statement I is true but Statement II is false |
| (3) Statement I is false but Statement II is true | (4) Both Statement I and Statement II are true |
- Q57.** Given below are two statements : Statement (I) : For a given shell, the total number of allowed orbitals is given by n^2 . Statement (II) : For any subshell, the spatial orientation of the orbitals is given by $-l$ to $+l$ values including zero. In the light of the above statements, choose the correct answer from the options given below :
- | | |
|---|---|
| (1) Both Statement I and Statement II are false | (2) Statement I is true but Statement II is false |
| (3) Both Statement I and Statement II are true | (4) Statement I is false but Statement II is true |

Q58. Standard electrode potentials for a few half cells are mentioned below :

$$E^\circ_{\text{Cu}^{2+}/\text{Cu}} = 0.34 \text{ V}, E^\circ_{\text{Zn}^{2+}/\text{Zn}} = -0.76 \text{ V}$$

$$E^\circ_{\text{Ag}^+/\text{Ag}} = 0.80 \text{ V}, E^\circ_{\text{Mg}^{2+}/\text{Mg}} = -2.37 \text{ V}$$

$$\Delta G^\circ ?$$

- | | |
|---|--|
| (1) $\text{Zn} \text{Zn}^{2+}(1\text{M}) \text{Ag}^+(1\text{M}) \text{Ag}$ | (2) $\text{Zn} \text{Zn}^{2+}(1\text{M}) \text{Mg}^{2+}(1\text{M}) \text{Mg}$ |
| (3) $\text{Ag} \text{Ag}^+(1\text{M}) \text{Mg}^{2+}(1\text{M}) \text{Mg}$ | (4) $\text{Cu} \text{Cu}^{2+}(1\text{M}) \text{Ag}^+(1\text{M}) \text{Ag}$ |

Q59. The α -Helix and β - Pleated sheet structures of protein are associated with its :

- | | |
|-------------------------|--------------------------|
| (1) tertiary structure | (2) quaternary structure |
| (3) secondary structure | (4) primary structure |

Q60. Given below are the atomic numbers of some group 14 elements. The atomic number of the element with the lowest melting point is :

- (1) 6 (2) 82 (3) 14 (4) 50

Q61. Given below are two statements about X-ray spectra of elements : Statement (I) : A plot of \sqrt{v} (v = frequency of X -rays emitted) vs atomic mass is a straight line. Statement (II) : A plot of v (v = frequency of X -rays emitted) vs atomic number is a straight line. In the light of the above statements, choose the correct answer from the options given below :

- (1) Both Statement I and Statement II are true (2) Statement I is false but Statement II is true
 (3) Both Statement I and Statement II are false (4) Statement I is true but Statement II is false

Q62. Identify A, B and C in the given below reaction sequence $A \xrightarrow{\text{HNO}_3} \text{Pb}(\text{NO}_3)_2 \xrightarrow{\text{H}_2\text{SO}_4} \text{B} \xrightarrow[\substack{(2) \text{ Acetic acid} \\ (3) \text{ K}_2\text{CrO}_4}]^{\substack{(1) \text{ Ammonium acetate}}} \text{C}$

- (1) $\text{PbCl}_2, \text{PbSO}_4, \text{PbCrO}_4$ (2) $\text{PbS}, \text{PbSO}_4, \text{Pb}(\text{CH}_3\text{COO})_2$
 (3) $\text{PbCl}_2, \text{Pb}(\text{SO}_4)_2, \text{PbCrO}_4$ (4) $\text{PbS}, \text{PbSO}_4, \text{PbCrO}_4$

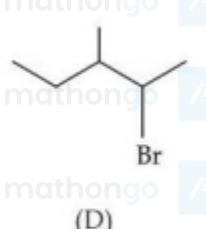
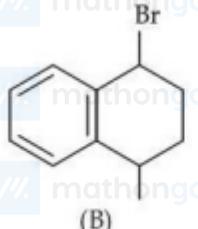
Q63. Given below are two statements : Statement (I) : The boiling points of alcohols and phenols increase with increase in the number of C-atoms. Statement (II) : The boiling points of alcohols and phenols are higher in comparison to other class of compounds such as ethers, haloalkanes. In the light of the above statements, choose the correct answer from the options given below :

- (1) Both Statement I and Statement II are false (2) Both Statement I and Statement II are true
 (3) Statement I is false but Statement II is true (4) Statement I is true but Statement II is false

Q64. Consider a binary solution of two volatile liquid components 1 and 2. x_1 and y_1 are the mole fractions of component 1 in liquid and vapour phase, respectively. The slope and intercept of the linear plot of $\frac{1}{x_1}$ vs $\frac{1}{y_1}$ are given respectively as:

- (1) $\frac{P_2^0}{P_1^0}, \frac{P_2^0 - P_1^0}{P_2^0}$ (2) $\frac{P_1^0}{P_2^0}, \frac{P_2^0 - P_1^0}{P_2^0}$
 (3) $\frac{P_1^0}{P_2^0}, \frac{P_1^0 - P_2^0}{P_2^0}$ (4) $\frac{P_2^0}{P_1^0}, \frac{P_1^0 - P_2^0}{P_1^0}$

Q65. The ascending order of relative rate of solvolysis of following compounds is :



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

Q66. Match List - I with List - II.

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List - I

- (A) Bronze
(B) Brass
(C) UK silver coin
(D) Stainless steel

List - II

- (I) Cu, Ni
(II) Fe, Cr, Ni, C
(III) Cu, Zn
(IV) Cu, Sn

Choose the correct answer from the options given below :

- (1) (A)-(IV), (B)-(II), (C)-(III), (D)-(I)
(3) (A)-(III), (B)-(IV), (C)-(II), (D)-(I)

- (2) (A)-(IV), (B)-(III), (C)-(I), (D)-(II)
(4) (A)-(III), (B)-(I), (C)-(IV), (D)-(II)

Q67. Match List - I with List - II.

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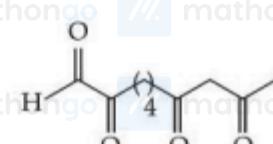
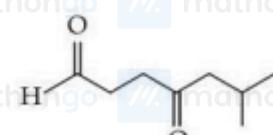
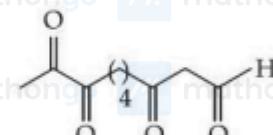
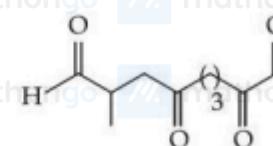
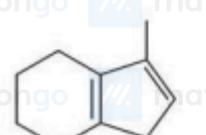
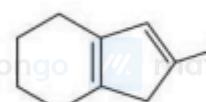
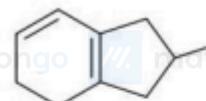
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List - I

(Isomers of $C_{10}H_{14}$)

List - II

(Ozonolysis product)



Choose the correct answer from the options given below :

- (1) (A)-(I), (B)-(IV), (C)-(III), (D)-(II)
(3) (A)-(III), (B)-(IV), (C)-(I), (D)-(II)

- (2) (A)-(III), (B)-(II), (C)-(I), (D)-(IV)
(4) (A)-(II), (B)-(III), (C)-(I), (D)-(IV)

Q68. pH of water is 7 at 25°C . If water is heated to 80°C , its pH will :

- (1) Decrease

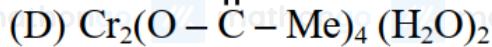
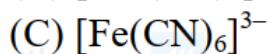
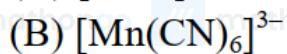
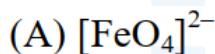
- (2) H^+ concentration increases, OH^- concentration

decreases

- (3) Remains the same

- (4) Increase

Q69. Identify the coordination complexes in which the central metal ion has d^4 configuration.



Choose the correct answer from the options given below :

(1) (B), (C) and (D) only

(2) (C) and (E) only

(3) (B) and (D) only

(4) (A), (B) and (E) only

Q70. When a non-volatile solute is added to the solvent, the vapour pressure of the solvent decreases by 10 mm of Hg. The mole fraction of the solute in the solution is 0.2. What would be the mole fraction of the solvent if decrease in vapour pressure is 20 mm of Hg?

(1) 0.8

(2) 0.4

(3) 0.2

(4) 0.6

Q71. 0.01 mole of an organic compound (X) containing 10% hydrogen, on complete combustion produced 0.9 g H_2O . Molar mass of (X) is _____ gmol⁻¹.

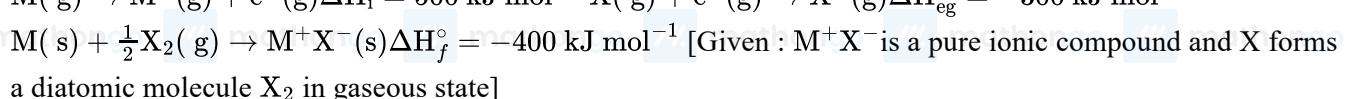
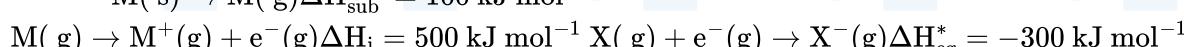
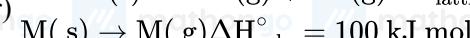
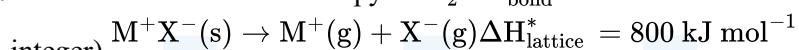
Q72. A compound 'X' absorbs 2 moles of hydrogen and 'X' upon oxidation with $\text{KMnO}_4 + \text{H}^+$ gives



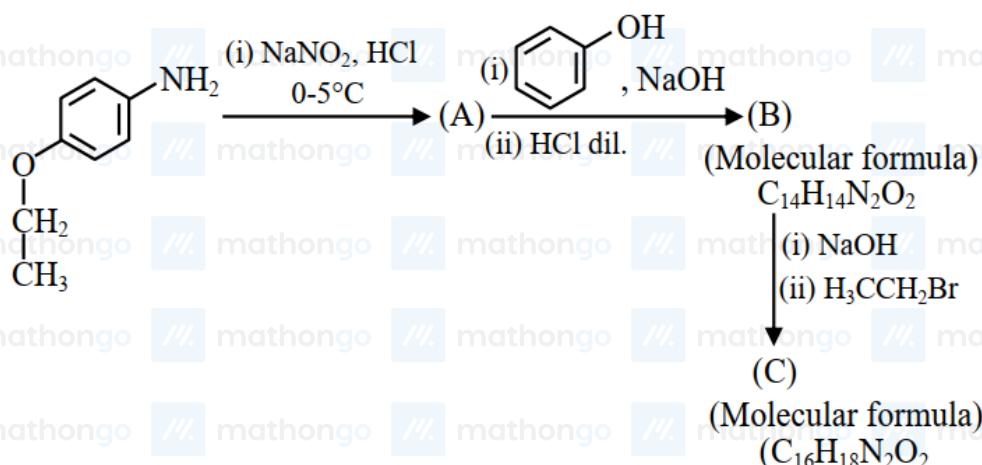
The total number of σ bonds present in the compound 'X' is _____.

Q73. When 81.0 g of aluminium is allowed to react with 128.0 g of oxygen gas, the mass of aluminium oxide produced in grams is _____ - (Nearest integer) Given : Molar mass of Al is 27.0 g mol⁻¹ Molar mass of O is 16.0 g mol⁻¹

Q74. The bond dissociation enthalpy of X_2 $\Delta\text{H}_{\text{bond}}$ calculated from the given data is _____ kJmol⁻¹. (Nearest integer)



Q75. Consider the following sequence of reactions.



Total number of sp^3 hybridised carbon atoms in the major product C formed is _____

ANSWER KEYS

1. (3)	2. (4)	3. (2)	4. (2)	5. (3)	6. (2)	7. (3)	8. (4)
9. (3)	10. (3)	11. (1)	12. (4)	13. (2)	14. (2)	15. (1)	16. (3)
17. (2)	18. (2)	19. (2)	20. (3)	21. (8788)	22. (474)	23. (17280)	24. (15)
25. (31)	26. (2)	27. (4)	28. (1)	29. (2)	30. (3)	31. (1)	32. (4)
33. (2)	34. (2)	35. (1)	36. (2)	37. (3)	38. (2)	39. (2)	40. (1)
41. (2)	42. (4)	43. (1)	44. (2)	45. (1)	46. (100)	47. (2)	48. (2190)
49. (3)	50. (16)	51. (2)	52. (3)	53. (1)	54. (1)	55. (2)	56. (4)
57. (3)	58. (1)	59. (3)	60. (4)	61. (3)	62. (4)	63. (2)	64. (2)
65. (2)	66. (2)	67. (3)	68. (1)	69. (3)	70. (4)	71. (100)	72. (27)
73. (153)	74. (200)	75. (4)					

Q1. If the first term of an A.P. is 3 and the sum of its first four terms is equal to one-fifth of the sum of the next four terms, then the sum of the first 20 terms is equal to

- (1) -1080 (2) -1020 (3) -1200 (4) -120

Q2. One die has two faces marked 1, two faces marked 2, one face marked 3 and one face marked 4. Another die has one face marked 1, two faces marked 2, two faces marked 3 and one face marked 4. The probability of getting the sum of numbers to be 4 or 5, when both the dice are thrown together, is

- (1) $\frac{2}{3}$ (2) $\frac{1}{2}$ (3) $\frac{4}{9}$ (4) $\frac{3}{5}$

Q3. Let the position vectors of the vertices A, B and C of a tetrahedron $ABCD$ be $\hat{i} + 2\hat{j} + \hat{k}$, $\hat{i} + 3\hat{j} - 2\hat{k}$ and $2\hat{i} + \hat{j} - \hat{k}$ respectively. The altitude from the vertex D to the opposite face ABC meets the median line segment through A of the triangle ABC at the point E . If the length of AD is $\frac{\sqrt{110}}{3}$ and the volume of the tetrahedron is $\frac{\sqrt{805}}{6\sqrt{2}}$, then the position vector of E is

- (1) $\frac{1}{12}(7\hat{i} + 4\hat{j} + 3\hat{k})$ (2) $\frac{1}{2}(\hat{i} + 4\hat{j} + 7\hat{k})$ (3) $\frac{1}{6}(12\hat{i} + 12\hat{j} + \hat{k})$ (4) $\frac{1}{6}(7\hat{i} + 12\hat{j} + \hat{k})$

Q4. If A, B , and $(\text{adj}(A^{-1}) + \text{adj}(B^{-1}))$ are non-singular matrices of same order, then the inverse of $A(\text{adj}(A^{-1}) + \text{adj}(B^{-1}))^{-1}B$, is equal to

- (1) $AB^{-1} + A^{-1}B$ (2) $\text{adj}(B^{-1}) + \text{adj}(A^{-1})$ (3) $\frac{AB^{-1}}{|A|} + \frac{BA^{-1}}{|B|}$ (4) $\frac{1}{|AB|}(\text{adj}(B) + \text{adj}(A))$

Q5. Marks obtained by all the students of class 12 are presented in a frequency distribution with classes of equal width.

Let the median of this grouped data be 14 with median class interval 12-18 and median class frequency 12. If the number of students whose marks are less than 12 is 18, then the total number of students is

- (1) 52 (2) 48 (3) 44 (4) 40

Q6. Let a curve $y = f(x)$ pass through the points $(0, 5)$ and $(\log_e 2, k)$. If the curve satisfies the differential equation $2(3 + y)e^{2x}dx - (7 + e^{2x})dy = 0$, then k is equal to

- (1) 4 (2) 32 (3) 8 (4) 16

Q7. If the function $f(x) = \begin{cases} \frac{2}{x}\{\sin(k_1+1)x + \sin(k_2-1)x\}, & x < 0 \\ 4, & x = 0 \\ \frac{2}{x}\log_e\left(\frac{2+k_1x}{2+k_2x}\right), & x > 0 \end{cases}$ is continuous at $x = 0$, then $k_1^2 + k_2^2$ is

- equal to
 (1) 20 (2) 5 (3) 8 (4) 10

Q8. If the line $3x - 2y + 12 = 0$ intersects the parabola $4y = 3x^2$ at the points A and B , then at the vertex of the parabola, the line segment AB subtends an angle equal to

- (1) $\tan^{-1}\left(\frac{4}{5}\right)$
 (3) $\tan^{-1}\left(\frac{11}{9}\right)$

- (2) $\tan^{-1}\left(\frac{9}{7}\right)$
 (4) $\frac{\pi}{2} - \tan^{-1}\left(\frac{3}{2}\right)$

Q9. Let P be the foot of the perpendicular from the point $Q(10, -3, -1)$ on the line $\frac{x-3}{7} = \frac{y-2}{-1} = \frac{z+1}{-2}$. Then the area of the right angled triangle PQR , where R is the point $(3, -2, 1)$, is

- (1) $9\sqrt{15}$
 (2) $\sqrt{30}$
 (3) $8\sqrt{15}$
 (4) $3\sqrt{30}$

Q10. Let the arc AC of a circle subtend a right angle at the centre O . If the point B on the arc AC , divides the arc

- AC such that $\frac{\text{length of arc } AB}{\text{length of arc } BC} = \frac{1}{5}$, and $\overrightarrow{OC} = \alpha \overrightarrow{OA} + \beta \overrightarrow{OB}$, then $\alpha + \sqrt{2}(\sqrt{3} - 1)\beta$ is equal to
 (1) $2\sqrt{3}$
 (2) $2 - \sqrt{3}$
 (3) $5\sqrt{3}$
 (4) $2 + \sqrt{3}$

Q11. Let $f(x) = \log_e x$ and $g(x) = \frac{x^4 - 2x^3 + 3x^2 - 2x + 2}{2x^2 - 2x + 1}$. Then the domain of $f \circ g$ is

- (1) $[0, \infty)$
 (2) $[1, \infty)$
 (3) $(0, \infty)$
 (4) \mathbb{R}

Q12. $(\lambda - 1)x + (\lambda - 4)y + \lambda z = 5$

- If the system of equations $\lambda x + (\lambda - 1)y + (\lambda - 4)z = 7$ has infinitely many solutions, then $\lambda^2 + \lambda$ is equal to
 (1) 6
 (2) 10
 (3) 20
 (4) 12

Q13. The number of words, which can be formed using all the letters of the word "DAUGHTER", so that all the

- vowels never come together, is
 (1) 36000
 (2) 37000
 (3) 34000
 (4) 35000

Q14. Let $R = \{(1, 2), (2, 3), (3, 3)\}$ be a relation defined on the set $\{1, 2, 3, 4\}$. Then the minimum number of

- elements, needed to be added in R so that R becomes an equivalence relation, is:
 (1) 10
 (2) 7
 (3) 8
 (4) 9

Q15. Let the area of a $\triangle PQR$ with vertices $P(5, 4)$, $Q(-2, 4)$ and $R(a, b)$ be 35 square units. If its orthocenter and centroid are $O(2, \frac{14}{5})$ and $C(c, d)$ respectively, then $c + 2d$ is equal to

- (1) $\frac{8}{3}$
 (2) $\frac{7}{3}$
 (3) 2
 (4) 3

Q16. The value of $\int_{e^2}^{e^4} \frac{1}{x} \left(\frac{e^{((\log_e x)^2 + 1)^{-1}}}{e^{((\log_e x)^2 + 1)^{-1}} + e^{((6 - \log_e x)^2 + 1)^{-1}}} \right) dx$ is

- (1) 2
 (2) $\log_e 2$
 (3) 1
 (4) e^2

Q17. Let $\left| \frac{z-i}{2\bar{z}+i} \right| = \frac{1}{3}$, $z \in C$, be the equation of a circle with center at C . If the area of the triangle, whose vertices are at the points $(0, 0)$, C and $(\alpha, 0)$ is 11 square units, then α^2 equals:

- (1) 50 (2) 100
 (3) $\frac{81}{25}$ (4) $\frac{121}{25}$

Q18. The value of $(\sin 70^\circ)(\cot 10^\circ \cot 70^\circ - 1)$ is

- (1) $2/3$ (2) 1
 (3) 0 (4) $3/2$

Q19. Let $I(x) = \int \frac{dx}{(x-11)^{13}(x+15)^{15}}$. If $I(37) - I(24) = \frac{1}{4} \left(\frac{1}{b^{13}} - \frac{1}{c^{13}} \right)$, $b, c \in \mathbb{N}$, then $3(b+c)$ is equal to

- (1) 22 (2) 39
 (3) 40 (4) 26

Q20. If $\frac{\pi}{2} \leq x \leq \frac{3\pi}{4}$, then $\cos^{-1} \left(\frac{12}{13} \cos x + \frac{5}{13} \sin x \right)$ is equal to

- (1) $x - \tan^{-1} \frac{4}{3}$ (2) $x + \tan^{-1} \frac{4}{5}$
 (3) $x - \tan^{-1} \frac{5}{12}$ (4) $x + \tan^{-1} \frac{5}{12}$

Q21. Let the circle C touch the line $x - y + 1 = 0$, have the centre on the positive x-axis, and cut off a chord of length $\frac{4}{\sqrt{13}}$ along the line $-3x + 2y = 1$. Let H be the hyperbola $\frac{x^2}{\alpha^2} - \frac{y^2}{\beta^2} = 1$, whose one of the foci is the centre of C and the length of the transverse axis is the diameter of C . Then $2\alpha^2 + 3\beta^2$ is equal to _____

Q22. If the equation $a(b-c)x^2 + b(c-a)x + c(a-b) = 0$ has equal roots, where $a+c=15$ and $b=\frac{36}{5}$, then $a^2 + c^2$ is equal to

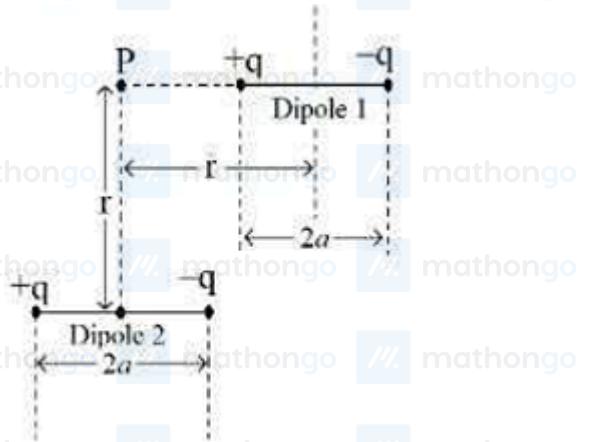
Q23. If the set of all values of a , for which the equation $5x^3 - 15x - a = 0$ has three distinct real roots, is the interval (α, β) , then $\beta - 2\alpha$ is equal to _____

Q24. The sum of all rational terms in the expansion of $(1 + 2^{1/2} + 3^{1/2})^6$ is equal to

Q25. If the area of the larger portion bounded between the curves $x^2 + y^2 = 25$ and $y = |x - 1|$ is $\frac{1}{4}(b\pi + c)$, $b, c \in \mathbb{N}$, then $b + c$ is equal to

Q26. A point particle of charge Q is located at P along the axis of an electric dipole 1 at a distance r as shown in the figure. The point P is also on the equatorial plane of a second electric dipole 2 at a distance r . The dipoles are

Q26. A dipole made of opposite charge q separated by a distance $2a$. For the charge particle at P not to experience any net force, which of the following correctly describes the situation?



force, which of the following correctly describes the situation?

- (1) $\frac{a}{r} \sim 10$
- (2) $\frac{a}{r} \sim 20$
- (3) $\frac{a}{r} \sim 0.5$
- (4) $\frac{a}{r} \sim 3$

Q27. A spherical surface of radius of curvature R , separates air from glass (refractive index = 1.5). The centre of curvature is in the glass medium. A point object 'O' placed in air on the optic axis of the surface, so that its real image is formed at 'I' inside glass. The line OI intersects the spherical surface at P and $PO = PI$. The distance PO equals to

- (1) $5 R$
- (2) $3 R$
- (3) $1.5 R$
- (4) $2 R$

Q28. The position of a particle moving on x -axis is given by $x(t) = A \sin t + B \cos^2 t + Ct^2 + D$, where t is time.

The dimension of $\frac{ABC}{D}$ is

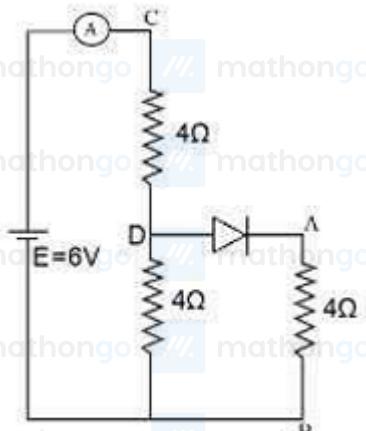
- (1) $L^2 T^{-2}$
- (2) L^2
- (3) L
- (4) $L^3 T^{-2}$

Q29. Given a thin convex lens (refractive index μ_2), kept in a liquid (refractive index μ_1 , $\mu_1 < \mu_2$) having radii of curvatures $|R_1|$ and $|R_2|$. Its second surface is silver polished. Where should an object be placed on the optic axis so that a real and inverted image is formed at the same place?

- (1) $\frac{\mu_1|R_1|\cdot|R_2|}{\mu_2(|R_1|+|R_2|)-\mu_1|R_2|}$
- (2) $\frac{\mu_1|R_1|\cdot|R_2|}{\mu_2(|R_1|+|R_2|)-\mu_1|R_1|}$
- (3) $\frac{(\mu_2+\mu_1)|R_1|}{(\mu_2-\mu_1)}$
- (4) $\frac{\mu_1|R_1|\cdot|R_2|}{\mu_2(2|R_1|+|R_2|)-\mu_1\sqrt{|R_1|\cdot|R_2|}}$

Q30. Refer to the circuit diagram given in the figure. Which of the following observations are correct? A. Total resistance of circuit is 6Ω B. Current in Ammeter is 1 A C. Potential across AB is 4 Volts. D. Potential across

Q30. If CD is 4 Volts E. Total resistance of the circuit is 8Ω . Choose the correct answer from the options given below:



- (1) A, B and D Only (2) A, B and C Only
 (3) A, C and D Only (4) B, C and E Only

Q31. Given below are two statements: Statement I: The hot water flows faster than cold water Statement II: Soap water has higher surface tension as compared to fresh water. In the light above statements, choose the correct answer from the options given below

- (1) Statement I is true but Statement II is false (2) Statement I is false but Statement II is true
 (3) Both Statement I and Statement II are false (4) Both Statement I and Statement II are true

Q32. Consider a circular disc of radius 20 cm with centre located at the origin. A circular hole of radius 5 cm is cut from this disc in such a way that the edge of the hole touches the edge of the disc. The distance of centre of mass of residual or remaining disc from the origin will be

- (1) 2.0 cm (2) 1.5 cm
 (3) 1.0 cm (4) 0.5 cm

Q33. The electric flux is $\phi = \alpha\sigma + \beta\lambda$ where λ and σ are linear and surface charge density, respectively. $\left(\frac{\alpha}{\beta}\right)$ represents

- (1) electric field (2) area
 (3) charge (4) displacement

Q34. A sub-atomic particle of mass 10^{-30} kg is moving with a velocity 2.21×10^6 m/s. Under the matter wave consideration, the particle will behave closely like $(h = 6.63 \times 10^{-34}$ J.s)
 (1) Visible radiation (2) Gamma rays
 (3) Infra-red radiation (4) X-rays

Q35. Consider a moving coil galvanometer (MCG): A. The torsional constant in moving coil galvanometer has dimensions $[ML^2 T^{-2}]$ B. Increasing the current sensitivity may not necessarily increase the voltage sensitivity. C. If we increase number of turns (N) to its double ($2N$), then the voltage sensitivity doubles. D. MCG can be converted into an ammeter by introducing a shunt resistance of large value in parallel with galvanometer. E. Current sensitivity of MCG depends inversely on number of turns of coil. Choose the correct answer from the options given below:

- (1) A, D Only (2) A, B, E Only
 (3) B, D, E Only (4) A, B Only

Q36.

	LIST-I		LIST-II
A.	Pressure varies inversely with volume of an ideal gas.	I.	Adiabatic process
B.	Heat absorbed goes partly to increase internal energy and partly to do work.	II.	Isochoric process
C.	Heat is neither absorbed nor released by a system.	III.	Isothermal process
D.	No work is done on or by a gas.	IV.	Isobaric process

- (1) A-III, B-IV, C-I, D-II (2) A-I, B-IV, C-II, D-III
 (3) A-III, B-I, C-IV, D-II (4) A-I, B-III, C-II, D-IV

Q37. The electric field of an electromagnetic wave in free space is

$$\vec{E} = 57 \cos [7.5 \times 10^6 t - 5 \times 10^{-3}(3x + 4y)] (4\hat{i} - 3\hat{j}) \text{ N/C}$$

- The associated magnetic field in Tesla is
- (1) $\vec{B} = \frac{57}{3 \times 10^8} \cos [7.5 \times 10^6 t - 5 \times 10^{-3}(3x + 4y)] (\hat{k})$
 (2) $\vec{B} = -\frac{57}{3 \times 10^8} \cos [7.5 \times 10^6 t - 5 \times 10^{-3}(3x + 4y)] (\hat{k})$
 (3) $\vec{B} = -\frac{57}{3 \times 10^8} \cos [7.5 \times 10^6 t - 5 \times 10^{-3}(3x + 4y)] (5\hat{k})$
 (4) $\vec{B} = \frac{57}{3 \times 10^8} \cos [7.5 \times 10^6 t - 5 \times 10^{-3}(3x + 4y)] (5\hat{k})$

Q38. A gun fires a lead bullet of temperature 300 K into a wooden block. The bullet having melting temperature of 600 K penetrates into the block and melts down. If the total heat required for the process is 625 J, then the mass of the bullet is grams. (Latent heat of fusion of lead = $2.5 \times 10^4 \text{ J kg}^{-1}$ and specific heat capacity of lead = $125 \text{ J kg}^{-1} \text{ K}^{-1}$)

- (1) 10 (2) 20
 (3) 5 (4) 15

Q39. What is the lateral shift of a ray refracted through a parallel-sided glass slab of thickness ' h ' in terms of the angle of incidence ' i ' and angle of refraction ' r ', if the glass slab is placed in air medium?

- (1) $\frac{h \tan(i-r)}{\tan r}$ (2) $\frac{h \sin(i-r)}{\cos r}$
 (3) h (4) $\frac{h \cos(i-r)}{\sin r}$

Q40. A radioactive nucleus n_2 has 3 times the decay constant as compared to the decay constant of another radioactive nucleus n_1 . If initial number of both nuclei are the same, what is the ratio of number of nuclei of n_2 to the number of nuclei of n_1 , after one half-life of n_1 ?

- (1) 1/8 (2) 8
 (3) 4 (4) 1/4

Q41. A light hollow cube of side length 10 cm and mass 10 g, is floating in water. It is pushed down and released to execute simple harmonic oscillations. The time period of oscillations is $y\pi \times 10^{-2}$ s, where the value of y is (Acceleration due to gravity, $g = 10 \text{ m/s}^2$, density of water = 10^3 kg/m^3)

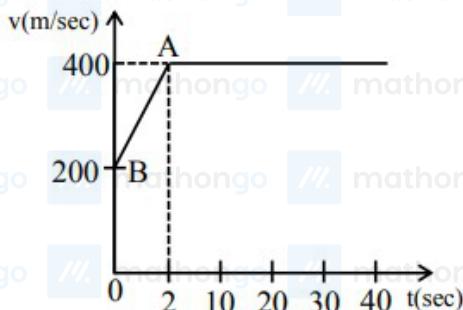
- (1) 6
(3) 4

- (2) 2
(4) 1

Q42. Regarding self-inductance: A. The self-inductance of the coil depends on its geometry. B. Self-inductance does not depend on the permeability of the medium. C. Self-induced e.m.f. opposes any change in the current in a circuit. D. Self-inductance is electromagnetic analogue of mass in mechanics. E. Work needs to be done against self-induced e.m.f. in establishing the current. Choose the correct answer from the options given below:

- (1) A, B, C, E only
(3) A, C, D, E only
- (2) B, C, D, E only
(4) A, B, C, D only

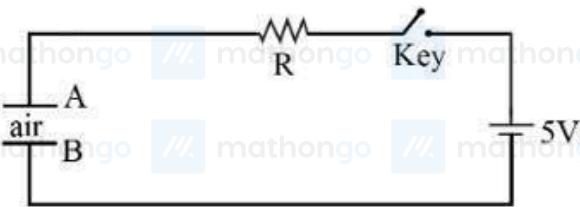
Q43. The motion of an airplane is represented by velocity-time graph as shown below. The distance covered by



airplane in the first 30.5 second is _____ km.

- (1) 12
(3) 6
- (2) 3
(4) 9

Q44. Identify the valid statements relevant to the given circuit at the instant when the key is closed.

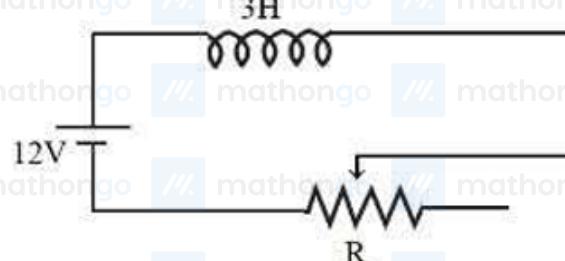


- A. There will be no current through resistor R . B. There will be maximum current in the connecting wires. C. Potential difference between the capacitor plates A and B is minimum. D. Charge on the capacitor plates is minimum. Choose the correct answer from the options given below:
- (1) A, C Only
(3) C, D Only
- (2) A, B, D Only
(4) B, C, D Only

Q45. A solid sphere of mass ' m ' and radius ' r ' is allowed to roll without slipping from the highest point of an inclined plane of length ' L ' and makes an angle 30° with the horizontal. The speed of the particle at the bottom of the plane is v_1 . If the angle of inclination is increased to 45° while keeping L constant. Then the new speed of the sphere at the bottom of the plane is v_2 . The ratio $v_1^2 : v_2^2$ is

- (1) $1 : \sqrt{2}$
(3) $1 : 3$
- (2) $1 : \sqrt{3}$
(4) $1 : 2$

Q46. A positive ion A and a negative ion B has charges $6.67 \times 10^{-19} \text{ C}$ and $9.6 \times 10^{-10} \text{ C}$, and masses $19.2 \times 10^{-27} \text{ kg}$ and $9 \times 10^{-27} \text{ kg}$ respectively. At an instant, the ions are separated by a certain distance r . At that instant the ratio of the magnitudes of electrostatic force to gravitational force is $P \times 10^{45}$, where the value of $10P$ is $(\text{Take } \frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \text{ Nm}^2 \text{ C}^{-1} \text{ and universal gravitational constant as } 6.67 \times 10^{-11} \text{ Nm}^2 \text{ kg}^{-2})$. Assume that charge may not be an integral multiple of electrons.

Q47.

In the given circuit the sliding contact is pulled outwards such that electric current in the circuit changes at the rate of 8 A/s . At an instant when R is 12Ω , the value of the current in the circuit will be _____ A.

Q48. Two particles are located at equal distance from origin. The position vectors of those are represented by $\bar{A} = 2\hat{i} + 3n\hat{j} + 2\hat{k}$ and $\bar{B} = 2\hat{i} - 2\hat{j} + 4p\hat{k}$, respectively. If both the vectors are at right angle to each other, the value of n^{-1} is _____.

Q49. An ideal gas initially at 0°C temperature, is compressed suddenly to one fourth of its volume. If the ratio of specific heat at constant pressure to that at constant volume is $3/2$, the change in temperature due to the thermodynamic process is _____ K.

Q50. A force $f = x^2\hat{i} + y^2\hat{j}$ acts on a particle in a plane $x + y = 10$. The work done by this force during a displacement from $(0, 0)$ to $(4 \text{ m}, 2 \text{ m})$ is _____ Joule (round off to the nearest integer)

Q51. Given below are two statements: Statement I: Fructose does not contain an aldehydic group but still reduces Tollen's reagent Statement II: In the presence of base, fructose undergoes rearrangement to give glucose. In the light of the above statements, choose the correct answer from the options given below

(1) Both Statement I and Statement II are true (2) Both Statement I and Statement II are false
 (3) Statement I is true but Statement II is false (4) Statement I is true but Statement II is false

Q52. The complex that shows Facial - Meridional isomerism is:

- (1) $[\text{Co}(\text{en})_2\text{Cl}_2]^+$ (2) $[\text{Co}(\text{en})_3]^{3+}$
 (3) $[\text{Co}(\text{NH}_3)_3\text{Cl}_3]$ (4) $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]^+$

Q53. $\text{FeO}_4^{2-} \xrightarrow{+2.0\text{v}} \text{Fe}^{3+} \xrightarrow{0.8\text{v}} \text{Fe}^{2+} \xrightarrow{-0.5\text{v}} \text{Fe}^0$ In the above diagram, the standard electrode potentials are given in volts (over the arrow). The value of $E_{\text{FeO}_4^{2-}/\text{Fe}^{2+}}^{\text{O}}$ is

(1) 2.1 V (2) 1.7 V
 (3) 1.4 V (4) 1.2 V

Q54. The element that does not belong to the same period of the remaining elements (modern periodic table) is:

- (1) Iridium
(3) Osmium

- (2) Platinum
(4) Palladium

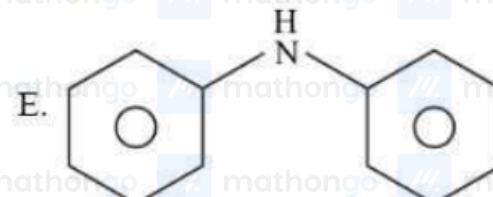
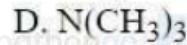
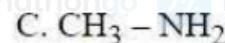
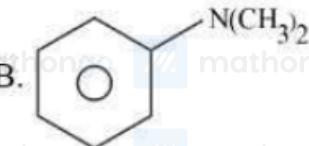
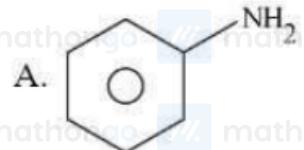
Q55. Match the LIST-I with LIST-II

LIST-I (Classification of molecules based on octet rule)		LIST-II (Example)	
A.	Molecules obeying octet rule	I.	NO, NO ₂
B.	Molecules with incomplete octet	II.	BCl ₃ , AlCl ₃
C.	Molecules with incomplete octet with odd electron	III.	H ₂ SO ₄ , PCl ₅
D.	Molecules with expanded octet	IV.	CCl ₄ , CO ₂

Choose the correct answer from the options given below:

- (1) A-IV, B-I, C-III, D-II
(2) A-IV, B-II, C-I, D-III
(3) A-II, B-IV, C-III, D-I
(4) A-III, B-II, C-I, D-IV
- Q56.** What amount of bromine will be required to convert 2 g of phenol into 2,4,6-tribromophenol? (Given molar mass in gmol⁻¹ of C, H, O, Br are 12, 1, 16, 80 respectively)
- (1) 20.44 g
(2) 4.0 g
(3) 6.0 g
(4) 10.22

Q57.



Which among the following react with Hinsberg's reagent?

- Choose the correct answer from the options given below:
- (1) A, B and E Only
(2) A, C and E Only
(3) C and D Only
(4) B and D Only

Q58. The correct set of ions (aqueous solution) with same colour from the following is:

- (1) $\text{Sc}^{3+}, \text{Ti}^{3+}, \text{Cr}^{2+}$
 (3) $\text{Ti}^{4+}, \text{V}^{4+}, \text{Mn}^{2+}$

- (2) $\text{V}^{2+}, \text{Cr}^{3+}, \text{Mn}^{3+}$
 (4) $\text{Zn}^{2+}, \text{V}^{3+}, \text{Fe}^{3+}$

Q59. Given below are two statements: Statement I: In Lassaigne's test, the covalent organic molecules are transformed into ionic compounds. Statement II: The sodium fusion extract of an organic compound having N and S gives prussian blue colour with FeSO_4 and $\text{Na}_4[\text{Fe}(\text{CN})_6]$. In the light of the above statements, choose the correct answer from the options given below.

- (1) Statement I is true but Statement II is false
 (3) Both Statement I and Statement II are true
 (2) Both Statement I and Statement II are false
 (4) Statement I is false but Statement II is true

Q60. Propane molecule on chlorination under photochemical condition gives two di-chloro products, "x" and "y".

Amongst "x" and "y", "x" is an optically active molecule. How many tri-chloro products (consider only structural isomers) will be obtained from "x" when it is further treated with chlorine under the photochemical condition?

- (1) 2
 (3) 4
 (2) 5
 (4) 3

Q61. $\text{CrCl}_3 \cdot x\text{NH}_3$ can exist as a complex. 0.1 molal aqueous solution of this complex shows a depression in freezing point of 0.558°C . Assuming 100% ionisation of this complex and coordination number of Cr is 6, the complex will be (Given $K_f = 1.86 \text{ K kg mol}^{-1}$)

- (1) $[\text{Cr}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2$
 (3) $[\text{Cr}(\text{NH}_3)_3\text{Cl}_3]$
 (2) $[\text{Cr}(\text{NH}_3)_6]\text{Cl}_3$
 (4) $[\text{Cr}(\text{NH}_3)_4\text{Cl}_2]\text{Cl}$

Q62. Which of the following happens when NH_4OH is added gradually to the solution containing 1 M A^{2+} and $1\text{M}\text{B}^{3+}$ ions? Given : $K_{sp} [\text{A}(\text{OH})_2] = 9 \times 10^{-10}$ and $K_{sp} [\text{B}(\text{OH})_3] = 27 \times 10^{-18}$ at 298 K .

- (1) Both $\text{A}(\text{OH})_2$ and $\text{B}(\text{OH})_3$ do not show precipitation with NH_4OH
 (2) $\text{A}(\text{OH})_2$ will precipitate before $\text{B}(\text{OH})_3$
 (3) $\text{B}(\text{OH})_3$ will precipitate before $\text{A}(\text{OH})_2$
 (4) $\text{A}(\text{OH})_2$ and $\text{B}(\text{OH})_3$ will precipitate together

Q63. The major product of the following reaction is: $\text{CH}_3\text{CH}_2\text{CH}=\text{O} \xrightarrow[\text{reflux}]{\substack{\text{excess HCHO} \\ \text{alkali}}} ?$

- (1)
 (2)
 (3)
 (4)

Q64. Ice at -5°C is heated to become vapor with temperature of 110°C at atmospheric pressure. The entropy change associated with this process can be obtained from

- (1) $\int_{268K}^{273K} C_p, m \frac{dT}{T} + \frac{\Delta H_m, \text{fusion}}{T_f} + \frac{\Delta H_m, \text{vaporisation}}{T_b} + \int_{273K}^{373K} C_p, m \frac{dT}{T} + \int_{373K}^{383K} C_p, m \frac{dT}{T}$
- (2) $\int_{268K}^{273K} \frac{C_p, m}{T} dT + \frac{\Delta H_m, \text{fusion}}{T_f} + \frac{\Delta H_m, \text{vaporisation}}{T_b} + \int_{273K}^{373K} \frac{C_p, m}{T} dT + \int_{373K}^{383K} \frac{C_p, m}{T} dT$
- (3) $\int_{268K}^{383K} C_p \frac{dT}{T} + \frac{q_{\text{rev}}}{T}$
- (4) $\int_{268K}^{383K} C_p \frac{dT}{T} + \frac{\Delta H_{\text{melting}}}{m273} + \frac{\Delta H_{\text{boiling}}}{373}$

Q65. The incorrect statement among the following is options

- (1) PH₃ shows lower proton affinity than NH₃. (2) SO₂ can act as an oxidizing agent, but not as a reducing agent.
- (3) PF₃ exists but NF₅ does not. (4) NO₂ can dimerise easily.

Q66. 2.8×10^{-3} mol of CO₂ is left after removing 10^{21} molecules from its 'x' mg sample. The mass of CO₂ taken initially is Given: N_A = 6.02×10^{23} mol⁻¹

- (1) 98.3 mg (2) 48.2 mg
 (3) 196.2 mg (4) 150.4 mg

Q67. Match the LIST-I with LIST-II

LIST-I		LIST-II	
Name reaction		Product obtainable	
A. Swarts reaction	I.	Ethyl benzene	
B. Sandmeyer's reaction	II.	Ethyl iodide	
C. Wurtz Fittig reaction	III.	Cyanobenzene	
D. Finkelstein reaction	IV.	Ethyl fluoride	

Choose the correct answer from the options given below:

- (1) A-II, B-I, C-III, D-IV (2) A-II, B-III, C-I, D-IV
 (3) A-IV, B-I, C-III, D-II (4) A-IV, B-III, C-I, D-II

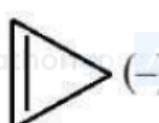
Q68. Heat treatment of muscular pain involves radiation of wavelength of about 900 nm. Which spectral line of H atom is suitable for this? Given : Rydberg constant R_H = 10^5 cm^{-1} , h = $6.6 \times 10^{-34} \text{ J s}$, c = $3 \times 10^8 \text{ m/s}$)

- (1) Balmer series, $\infty \rightarrow 2$ (2) Lyman series, $\infty \rightarrow 1$
 (3) Paschen series, $\infty \rightarrow 3$ (4) Paschen series, $5 \rightarrow 3$

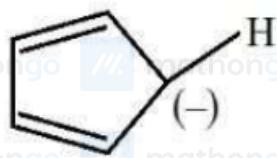
Q69. The d- electronic configuration of an octahedral Co(II) complex having magnetic moment of 3.95 BM is:

- (1) t_{2g}³e_g⁰ (2) t_{2g}⁶e_g¹
 (3) t_{2g}⁵e_g² (4) e⁴t₂³

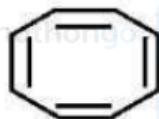
Q70. The correct stability order of the following species/molecules is:



p



q



r

(1) $q > r > p$

(3) $q > p > r$

(2) $r > q > p$

(4) $p > q > r$

Q71. ¹ The standard enthalpy and standard entropy of decomposition of N_2O_4 to NO_2 are 55.0 kJ mol^{-1} and

175.0 J/K/mol respectively. The standard free energy change for this reaction at 25°C in J mol^{-1} is _____
(Nearest integer)

Q72. For the thermal decomposition of $\text{N}_2\text{O}_5(\text{g})$ at constant volume, the following table can be formed, for the

Sr.No	Time/s	Total pressure/atm)
1	0	0.6
2	100	'x'

reaction mentioned below. $2 \text{N}_2\text{O}_5(\text{g}) \rightarrow 2 \text{N}_2\text{O}_4(\text{g}) + \text{O}_2(\text{g})$

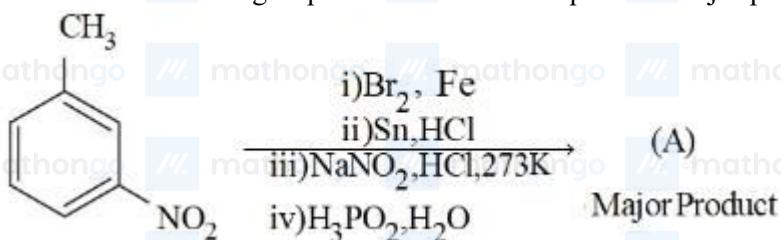
$x = \dots \times 10^{-3} \text{ atm}$ [nearest integer] Given : Rate constant for the reaction is $4.606 \times 10^{-2} \text{ s}^{-1}$.

Q73. During "S" estimation, 160 mg of an organic compound gives 466 mg of barium sulphate. The percentage of Sulphur in the given compound is ____ %. (Given molar mass in gmol⁻¹ of Ba : 137, S : 32, O : 16)

Q74. If 1 mM solution of ethylamine produces pH = 9, then the ionization constant (K_b) of ethylamine is 10^{-x} .

The value of x is _____ (nearest integer). [The degree of ionization of ethylamine can be neglected with respect to unity.]

Q75. Consider the following sequence of reactions to produce major product (A)



Molar mass of product (A) is _____ gmol⁻¹. (Given molar mass in gmol⁻¹ of

C : 12, H : 1, O : 16, Br : 80, N : 14, P : 31)

ANSWER KEYS

1. (1)	2. (2)	3. (4)	4. (4)	5. (3)	6. (3)	7. (4)	8. (2)
9. (4)	10. (2)	11. (4)	12. (4)	13. (1)	14. (2)	15. (4)	16. (3)
17. (2)	18. (2)	19. (2)	20. (3)	21. (19)	22. (117)	23. (30)	24. (612)
25. (77)	26. (4)	27. (1)	28. (1)	29. (1)	30. (1)	31. (1)	32. (3)
33. (4)	34. (4)	35. (4)	36. (1)	37. (3)	38. (1)	39. (2)	40. (4)
41. (2)	42. (3)	43. (1)	44. (4)	45. (1)	46. (5)	47. (3)	48. (3)
49. (273)	50. (152)	51. (1)	52. (3)	53. (2)	54. (4)	55. (2)	56. (4)
57. (2)	58. (2)	59. (1)	60. (4)	61. (1)	62. (3)	63. (1)	64. (2)
65. (2)	66. (3)	67. (4)	68. (3)	69. (3)	70. (1)	71. (2850)	72. (897)
73. (40)	74. (7)	75. (171)					

Q1. For a 3×3 matrix M , let trace (M) denote the sum of all the diagonal elements of M . Let A be a 3×3 matrix such that $|A| = \frac{1}{2}$ and trace (A) = 3. If $B = \text{adj}(\text{adj}(2A))$, then the value of $|B| + \text{trace}(B)$ equals :

- (1) 56 (2) 132 (3) 174 (4) 280

Q2. In a group of 3 girls and 4 boys, there are two boys B_1 and B_2 . The number of ways, in which these girls and boys can stand in a queue such that all the girls stand together, all the boys stand together, but B_1 and B_2 are not adjacent to each other, is :

- (1) 96 (2) 144 (3) 120 (4) 72

Q3. Let α, β, γ and δ be the coefficients of x^7, x^5, x^3 and x respectively in the expansion of $(x + \sqrt{x^3 - 1})^5 + (x - \sqrt{x^3 - 1})^5, x > 1$. If u and v satisfy the equations $\begin{cases} \alpha u + \beta v = 18 \\ \gamma u + \delta v = 20 \end{cases}$ then $u + v$ equals :

- (1) 5 (2) 3 (3) 4 (4) 8

Q4. Let a line pass through two distinct points $P(-2, -1, 3)$ and Q , and be parallel to the vector $3\hat{i} + 2\hat{j} + 2\hat{k}$. If the distance of the point Q from the point $R(1, 3, 3)$ is 5, then the square of the area of $\triangle PQR$ is equal to :

- (1) 148 (2) 136 (3) 144 (4) 140

Q5. If A and B are two events such that $P(A \cap B) = 0.1$, and $P(A | B)$ and $P(B | A)$ are the roots of the equation

$$12x^2 - 7x + 1 = 0, \text{ then the value of } \frac{P(A \cup B)}{P(A \cap B)}$$

- (1) $\frac{4}{3}$ (2) $\frac{7}{4}$ (3) $\frac{5}{3}$ (4) $\frac{9}{4}$

Q6. If $\int e^x \left(\frac{x \sin^{-1} x}{\sqrt{1-x^2}} + \frac{\sin^{-1} x}{(1-x^2)^{3/2}} + \frac{x}{1-x^2} \right) dx = g(x) + C$, where C is the constant of integration, then $g\left(\frac{1}{2}\right)$ equals :

- (1) $\frac{\pi}{4} \sqrt{\frac{e}{3}}$ (2) $\frac{\pi}{6} \sqrt{\frac{e}{3}}$
 (3) $\frac{\pi}{4} \sqrt{\frac{e}{2}}$ (4) $\frac{\pi}{6} \sqrt{\frac{e}{2}}$

Q7. The area of the region enclosed by the curves $y = x^2 - 4x + 4$ and $y^2 = 16 - 8x$ is :

- (1) $\frac{8}{3}$ (2) $\frac{4}{3}$ (3) 8 (4) 5

Q8. Let $f(x) = \int_0^{x^2} \frac{t^2 - 8t + 15}{e^t} dt, x \in \mathbf{R}$. Then the numbers of local maximum and local minimum points of f , respectively, are :

- (1) 2 and 3 (2) 2 and 2 (3) 3 and 2 (4) 1 and 3

Q9. Let $P(4, 4\sqrt{3})$ be a point on the parabola $y^2 = 4ax$ and PQ be a focal chord of the parabola. If M and N are the foot of perpendiculars drawn from P and Q respectively on the directrix of the parabola, then the area of the quadrilateral $PQMN$ is equal to :

- (1) $17\sqrt{3}$
 (3) $\frac{34\sqrt{3}}{3}$

- (2) $\frac{263\sqrt{3}}{8}$
 (4) $\frac{343\sqrt{3}}{8}$

Q10. Let \vec{a} and \vec{b} be two unit vectors such that the angle between them is $\frac{\pi}{3}$. If $\lambda\vec{a} + 2\vec{b}$ and $3\vec{a} - \lambda\vec{b}$ are perpendicular to each other, then the number of values of λ in $[-1, 3]$ is :

- (1) 2
 (3) 0
 (4) 3

Q11. If $\lim_{x \rightarrow \infty} \left(\left(\frac{e}{1-e} \right) \left(\frac{1}{e} - \frac{x}{1+x} \right) \right)^x = \alpha$, then the value of $\frac{\log_e \alpha}{1+\log_e \alpha}$ equals :

- (1) e^{-1}
 (2) e^2
 (3) e^{-2}
 (4) e

Q12. Let $A = \{1, 2, 3, 4\}$ and $B = \{1, 4, 9, 16\}$. Then the number of many-one functions $f : A \rightarrow B$ such that $1 \in f(A)$ is equal to :

- (1) 151
 (2) 139
 (3) 163
 (4) 127

Q13. Suppose that the number of terms in an A.P. is $2k$, $k \in N$. If the sum of all odd terms of the A.P. is 40, the sum of all even terms is 55 and the last term of the A.P. exceeds the first term by 27, then k is equal to :

- (1) 6
 (3) 8
 (4) 4

Q14. The perpendicular distance, of the line $\frac{x-1}{2} = \frac{y+2}{-1} = \frac{z+3}{2}$ from the point P(2, -10, 1), is :

- (1) 6
 (2) $5\sqrt{2}$
 (3) $4\sqrt{3}$
 (4) $3\sqrt{5}$

Q15. $x + y + 2z = 6$

If the system of linear equations : $2x + 3y + az = a + 1$ where $a, b \in \mathbb{R}$, has infinitely many solutions, then $-x - 3y + bz = 2$ and $7a + 3b$ is equal to :

- (1) 16
 (2) 12
 (3) 22
 (4) 9

Q16. If $x = f(y)$ is the solution of the differential equation $(1 + y^2) + \left(x - 2e^{\tan^{-1} y} \right) \frac{dy}{dx} = 0$, $y \in (-\frac{\pi}{2}, \frac{\pi}{2})$ with $f(0) = 1$, then $f\left(\frac{1}{\sqrt{3}}\right)$ is equal to :

- (1) $e^{\pi/12}$
 (3) $e^{\pi/3}$
 (2) $e^{\pi/4}$
 (4) $e^{\pi/6}$

Q17. Let α_θ and β_θ be the distinct roots of $2x^2 + (\cos \theta)x - 1 = 0$, $\theta \in (0, 2\pi)$. If m and M are the minimum and

the maximum values of $\alpha_\theta^4 + \beta_\theta^4$, then $16(M + m)$ equals :

(1) 24
 (2) 25
 (3) 17
 (4) 27

Q18. The sum of all values of $\theta \in [0, 2\pi]$ satisfying $2 \sin^2 \theta = \cos 2\theta$ and $2 \cos^2 \theta = 3 \sin \theta$ is

- (1) 4π
 (3) π

- (2) $\frac{5\pi}{6}$
 (4) $\frac{\pi}{2}$

Q19. Let the curve $z(1+i) + \bar{z}(1-i) = 4$, $z \in \mathbb{C}$, divide the region $|z - 3| \leq 1$ into two parts of areas α and β .

Then $|\alpha - \beta|$ equals :

- (1) $1 + \frac{\pi}{2}$
 (3) $1 + \frac{\pi}{6}$
 (2) $1 + \frac{\pi}{3}$
 (4) $1 + \frac{\pi}{4}$

Q20. Let $E : \frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$, $a > b$ and $H : \frac{x^2}{A^2} - \frac{y^2}{B^2} = 1$. Let the distance between the foci of E and the foci of H be $2\sqrt{3}$. If $a - A = 2$, and the ratio of the eccentricities of E and H is $\frac{1}{3}$, then the sum of the lengths of their latus rectums is equal to:

- (1) 10
 (3) 8
 (2) 9
 (4) 7

Q21. If $\sum_{r=1}^{30} \frac{r^2 ({}^{30}C_r)^2}{{}^{30}C_{r-1}} = \alpha \times 2^{29}$, then α is equal to _____

Q22. Let $A = \{1, 2, 3\}$. The number of relations on A , containing $(1, 2)$ and $(2, 3)$, which are reflexive and transitive but not symmetric, is _____ -

Q23. Let $A(6, 8)$, $B(10 \cos \alpha, -10 \sin \alpha)$ and $C(-10 \sin \alpha, 10 \cos \alpha)$, be the vertices of a triangle. If $L(a, 9)$ and $G(h, k)$ be its orthocenter and centroid respectively, then $(5a - 3h + 6k + 100 \sin 2\alpha)$ is equal to _____ -.

Q24. Let $y = f(x)$ be the solution of the differential equation $\frac{dy}{dx} + \frac{xy}{x^2-1} = \frac{x^6+4x}{\sqrt{1-x^2}}$, $-1 < x < 1$ such that $f(0) = 0$. If $6 \int_{-1/2}^{1/2} f(x) dx = 2\pi - \alpha$ then α^2 is equal to _____.

Q25. Let the distance between two parallel lines be 5 units and a point P lie between the lines at a unit distance from one of them. An equilateral triangle PQR is formed such that Q lies on one of the parallel lines, while R lies on the other. Then $(QR)^2$ is equal to _____ -.

Q26.



A	B	Y
0	0	1
0	1	1
1	0	0
1	1	1

To obtain the given truth table, following logic gate should be placed at G:

- (1) OR Gate
 (3) NOR Gate

- (2) AND Gate
 (4) NAND Gate

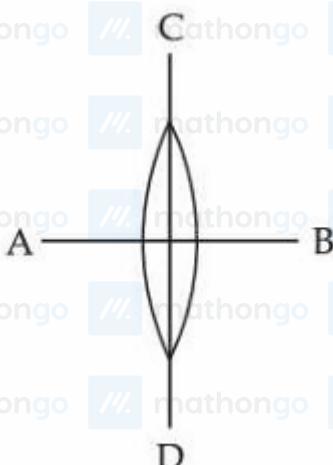
Q27. A small rigid spherical ball of mass M is dropped in a long vertical tube containing glycerine. The velocity of the ball becomes constant after some time. If the density of glycerine is half of the density of the ball, then the viscous force acting on the ball will be (consider g as acceleration due to gravity)

- (1) $2Mg$
 (3) $\frac{3}{2}Mg$
- (2) Mg
 (4) $\frac{Mg}{2}$

Q28. The torque due to the force $(2\hat{i} + \hat{j} + 2\hat{k})$ about the origin, acting on a particle whose position vector is $(\hat{i} + \hat{j} + \hat{k})$, would be

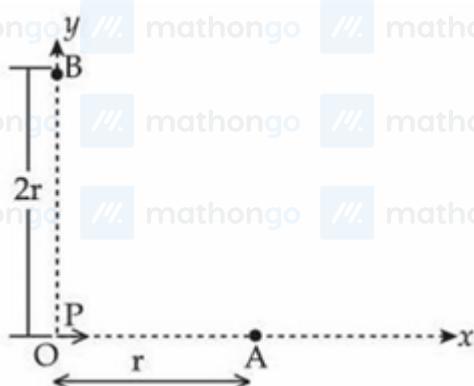
- (1) $\hat{i} - \hat{k}$
 (3) $\hat{j} + \hat{k}$
- (2) $\hat{i} + \hat{k}$
 (4) $\hat{i} - \hat{j} + \hat{k}$

Q29. A symmetric thin biconvex lens is cut into four equal parts by two planes AB and CD as shown in figure. If the power of original lens is 4 D then the power of a part of the divided lens is



- (1) D
 (3) 2D
- (2) 8D
 (4) 4D

Q30. For a short dipole placed at origin O, the dipole moment P is along x-axis, as shown in the figure. If the electric potential and electric field at A are V_0 and E_0 , respectively, then the correct combination of the electric potential and electric field, respectively, at point B on the y-axis is given by



- (1) V_0 and $\frac{E_0}{4}$
 (3) zero and $\frac{E_0}{8}$

- (2) zero and $\frac{E_0}{16}$
 (4) $\frac{V_0}{2}$ and $\frac{E_0}{16}$

Q31. A transparent film of refractive index, 2.0 is coated on a glass slab of refractive index, 1.45. What is the minimum thickness of transparent film to be coated for the maximum transmission of Green light of wavelength 550 nm. [Assume that the light is incident nearly perpendicular to the glass surface.]
 (1) 137.5 nm
 (2) 275 nm
 (3) 94.8 nm
 (4) 68.7 nm

Q32. Given are statements for certain thermodynamic variables, (A) Internal energy, volume (V) and mass (M) are extensive variables. (B) Pressure (P), temperature (T) and density (ρ) are intensive variables. (C) Volume (V), temperature (T) and density (ρ) are intensive variables. (D) Mass (M), temperature (T) and internal energy are extensive variables. Choose the correct answer from the options given below :
 (1) (B) and (C) Only
 (2) (C) and (D) Only
 (3) (D) and (A) Only
 (4) (A) and (B) Only

Q33. An electron projected perpendicular to a uniform magnetic field B moves in a circle. If Bohr's quantization is applicable, then the radius of the electronic orbit in the first excited state is :

(1) $\sqrt{\frac{h}{\pi e B}}$
 (3) $\sqrt{\frac{h}{2\pi e B}}$

(2) $\sqrt{\frac{2h}{\pi e B}}$
 (4) $\sqrt{\frac{4h}{\pi e B}}$

Q34. Given below are two statements. One is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A) : In Young's double slit experiment, the fringes produced by red light are closer as compared to those produced by blue light. Reason (R) : The fringe width is directly proportional to the wavelength of light.

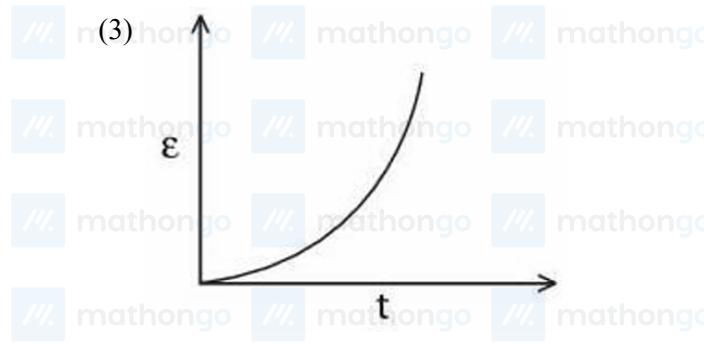
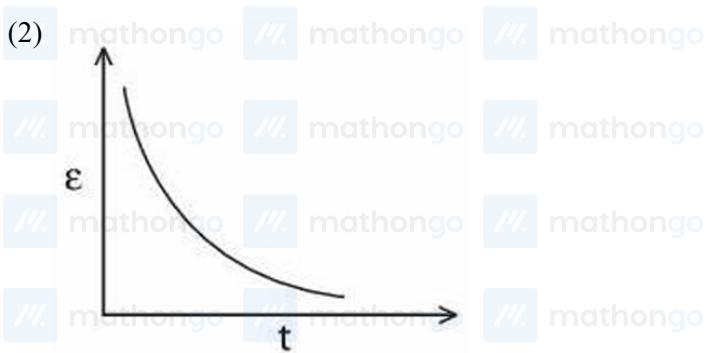
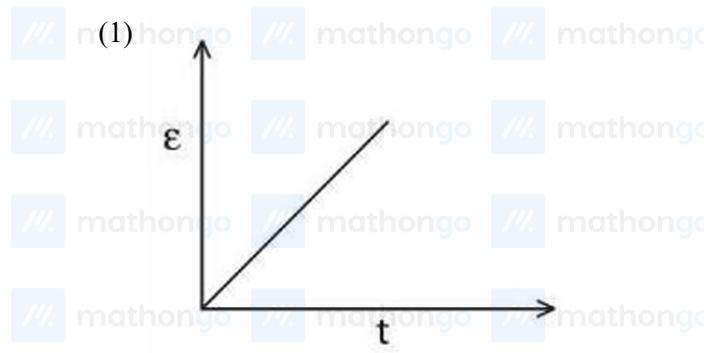
In the light of the above statements, choose the correct answer from the options given below :

- (1) Both (A) and (R) are true but (R) is NOT the (2) (A) is true but (R) is false

correct explanation of (A)

- (3) Both (A) and (R) are true and (R) is the correct (4) (A) is false but (R) is true
 explanation of (A)

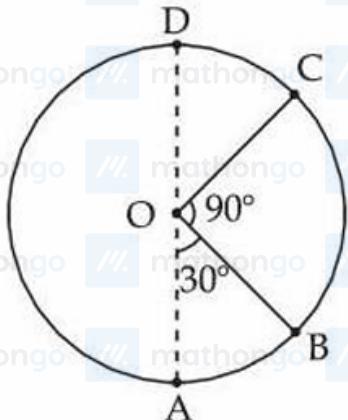
Q35. A rectangular metallic loop is moving out of a uniform magnetic field region to a field free region with a constant speed. When the loop is partially inside the magnetic field, the plot of magnitude of induced emf (ε) with time (t) is given by



Q36. A ball of mass 100 g is projected with velocity 20 m/s at 60° with horizontal. The decrease in kinetic energy of the ball during the motion from point of projection to highest point is

- (1) 5 J (2) 15 J
 (3) 20 J (4) zero

Q37. A body of mass 100 g is moving in circular path of radius 2 m on vertical plane as shown in figure. The velocity of the body at point A is 10 m/s. The ratio of its kinetic energies at point B and C is :



(Take acceleration due to gravity as 10 m/s^2)

- (1) $\frac{2+\sqrt{2}}{3}$ (2) $\frac{2+\sqrt{3}}{3}$
 (3) $\frac{3+\sqrt{3}}{2}$ (4) $\frac{3-\sqrt{2}}{2}$

Q38. Given below are two statements. One is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A) : A simple pendulum is taken to a planet of mass and radius, 4 times and 2 times, respectively, than the Earth. The time period of the pendulum remains same on earth and the planet. Reason (R) : The mass

n of the pendulum remains unchanged at Earth and the other planet. In the light of the above statements, choose the correct answer from the options given below :

- (1) (A) is false but (R) is true (2) (A) is true but (R) is false
 (3) Both (A) and (R) are true and (R) is the correct explanation of (A) (4) Both (A) and (R) are true but (R) is NOT the correct explanation of (A)

Q39. A series LCR circuit is connected to an alternating source of emf E. The current amplitude at resonant frequency is I_0 . If the value of resistance R becomes twice of its initial value then amplitude of current at resonance will be

- (1) $2I_0$ (2) I_0 (3) $\frac{I_0}{2}$ (4) $\frac{I_0}{\sqrt{2}}$

Q40. Which one of the following is the correct dimensional formula for the capacitance in F ? M, L, T and C stand for unit of mass, length, time and charge,

- (1) $[F] = [C^2 M^{-1} L^{-2} T^2]$ (2) $[F] = [C^2 M^{-2} L^2 T^2]$
 (3) $[F] = [CM^{-2} L^{-2} T^{-2}]$ (4) $[F] = [CM^{-1} L^{-2} T^2]$

Q41.



A tube of length L is shown in the figure. The radius of cross section at the point (1) is 2 cm and at the point (2) is 1 cm , respectively. If the velocity of water entering at point (1) is 2 m/s, then velocity of water leaving the point (2) will be

- (1) 4 m/s (2) 2 m/s
 (3) 6 m/s (4) 8 m/s

Q42. A light source of wavelength λ illuminates a metal surface and electrons are ejected with maximum kinetic energy of 2 eV . If the same surface is illuminated by a light source of wavelength $\frac{\lambda}{2}$, then the maximum kinetic energy of ejected electrons will be (The work function of metal is 1 eV)

- (1) 3 eV (2) 2 eV
 (3) 6 eV (4) 5 eV

Q43. The maximum percentage error in the measurement of density of a wire is [Given, mass of wire

$$= (0.60 \pm 0.003)g \text{ radius of wire} = (0.50 \pm 0.01)\text{cm length of wire} = (10.00 \pm 0.05)\text{cm}]$$

- (1) 8 (2) 5
 (3) 4 (4) 7

Q44. For a diatomic gas, if $\gamma_1 = \left(\frac{C_p}{C_v}\right)$ for rigid molecules and $\gamma_2 = \left(\frac{C_p}{C_v}\right)$ for another diatomic molecules, but also having vibrational modes. Then, which one of the following options is correct ? (C_p and C_v are specific heats of the gas at constant pressure and volume)

- (1) $\gamma_2 = \gamma_1$
 (3) $\gamma_2 < \gamma_1$

- (2) $2\gamma_2 = \gamma_1$
 (4) $\gamma_2 > \gamma_1$

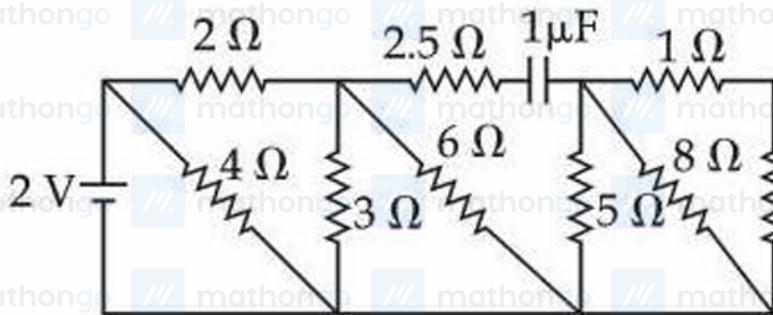
Q45. A force $\vec{F} = 2\hat{i} + b\hat{j} + \hat{k}$ is applied on a particle and it undergoes a displacement $\hat{i} - 2\hat{j} - \hat{k}$. What will be the value of b , if work done on the particle is zero.

- (1) 0
 (2) $\frac{1}{2}$
 (3) 2
 (4) $\frac{1}{3}$

Q46. A proton is moving undeflected in a region of crossed electric and magnetic fields at a constant speed of $2 \times 10^5 \text{ ms}^{-1}$. When the electric field is switched off, the proton moves along a circular path of radius 2 cm .

The magnitude of electric field is $x \times 10^4 \text{ N/C}$. The value of x is _____ Take the mass of the proton $= 1.6 \times 10^{-27} \text{ kg}$.

Q47. The net current flowing in the given circuit is _____ A.

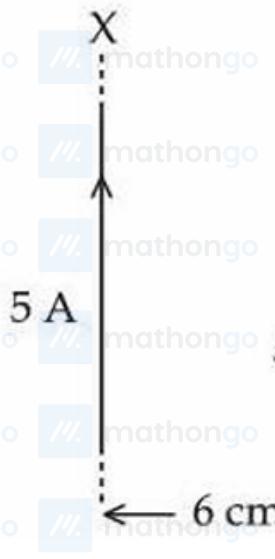


Q48. A parallel plate capacitor of area $A = 16 \text{ cm}^2$ and separation between the plates 10 cm , is charged by a DC current. Consider a hypothetical plane surface of area $A_0 = 3.2 \text{ cm}^2$ inside the capacitor and parallel to the plates. At an instant, the current through the circuit is 6A. At the same instant the displacement current through A_0 is _____ mA .

Q49. A tube of length 1 m is filled completely with an ideal liquid of mass 2 M , and closed at both ends. The tube is rotated uniformly in horizontal plane about one of its ends. If the force exerted by the liquid at the other end is F then angular velocity of the tube is $\sqrt{\frac{F}{\alpha M}}$ in SI unit. The value of α is _____.

Q50. Two long parallel wires X and Y, separated by a distance of 6 cm , carry currents of 5A and 4A, respectively, in opposite directions as shown in the figure. Magnitude of the resultant magnetic field at point P at a distance

μ_0 of 4 cm from wire Y is $x \times 10^{-5}$ T. The value of x is _____.



$$\mu_0 = 4\pi \times 10^{-7} \text{ SI units.}$$

Q51. Given below are two statements : Statement (I) : Nitrogen, sulphur, halogen and phosphorus present in an organic compound are detected by Lassaigne's Test. Statement (II) : The elements present in the compound are converted from covalent form into ionic form by fusing the compound with Magnesium in Lassaigne's test. In the light of the above statements, choose the correct answer from the options given below :

- (1) Statement I is false but Statement II is true
 (2) Both Statement I and Statement II are true
 (3) Both Statement I and Statement II are false
 (4) Statement I is true but Statement II is false

Q52. Density of 3 M NaCl solution is 1.25 g/mL. The molality of the solution is :

- (1) 1.79 m
 (2) 2.79 m
 (3) 2 m
 (4) 3 m

Q53. The correct order of the following complexes in terms of their crystal field stabilization energies is :

- (1) $[\text{Co}(\text{NH}_3)_4]^{2+} < [\text{Co}(\text{NH}_3)_6]^{2+} < [\text{Co}(\text{en})_3]^{3+} < [\text{Co}(\text{NH}_3)_6]^{3+}$
 (2) $[\text{Co}(\text{NH}_3)_6]^{2+} < [\text{Co}(\text{NH}_3)_6]^{3+} < [\text{Co}(\text{NH}_3)_4]^{2+} < [\text{Co}(\text{en})_3]^{3+}$
 (3) $[\text{Co}(\text{en})_3]^{3+} < [\text{Co}(\text{NH}_3)_6]^{3+} < [\text{Co}(\text{NH}_3)_6]^{2+} < [\text{Co}(\text{NH}_3)_4]^{2+}$
 (4) $[\text{Co}(\text{NH}_3)_4]^{2+} < [\text{Co}(\text{NH}_3)_6]^{2+} < [\text{Co}(\text{NH}_3)_6]^{3+} < [\text{Co}(\text{en})_3]^{3+}$

Q54. Given below are two statements : Statement (I) : Corrosion is an electrochemical phenomenon in which pure metal acts as an anode and impure metal as a cathode. Statement (II) : The rate of corrosion is more in alkaline medium than in acidic medium. In the light of the above statements, choose the correct answer from the options given below :

- (1) Both Statement I and Statement II are true
 (2) Statement I is false but Statement II is true
 (3) Statement I is true but Statement II is false
 (4) Both Statement I and Statement II are false

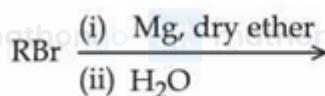
Q55.



Consider the given figure and choose the correct option :

- (1) Activation energy of both forward and backward reaction
 (2) Activation energy of forward reaction is $E_1 + E_2$
 reaction is $E_1 + E_2$ and reactant is more stable and product is less stable than reactant.
 (3) Activation energy of backward reaction is E_1 and (4) Activation energy of forward reaction is $E_1 + E_2$
 product is more stable than reactant.

Q56.



The maximum number of RBr producing 2-methylbutane by above sequence of reactions is _____ -

(Consider the structural isomers only)

- (1) 5
 (2) 4
 (3) 3
 (4) 1

Q57. The species which does not undergo disproportionation reaction is :

- (1) ClO_3^-
 (2) ClO_4^-
 (3) ClO_2^-
 (4) ClO_4^-

Q58. The molar solubility(s) of zirconium phosphate with molecular formula $(\text{Zr}^{4+})_3(\text{PO}_4^{3-})_4$ is given by relation :

- (1) $\left(\frac{K_{sp}}{9612}\right)^{\frac{1}{3}}$
 (2) $\left(\frac{K_{sp}}{6912}\right)^{\frac{1}{7}}$
 (3) $\left(\frac{K_{sp}}{8435}\right)^{\frac{1}{7}}$
 (4) $\left(\frac{K_{sp}}{5348}\right)^{\frac{1}{6}}$

Q59. Identify the homoleptic complex(es) that is/are low spin. (A) $[\text{Fe}(\text{CN})_5\text{NO}]^{2-}$ (B) $[\text{CoF}_6]^{3-}$ (C) $[\text{Fe}(\text{CN})_6]^{4-}$ (D) $[\text{Co}(\text{NH}_3)_6]^{3+}$ (E) $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$ Choose the correct answer from the options given below :

- (1) (C) only
 (2) (C) and (D) only
 (3) (A) and (C) only
 (4) (B) and (E) only

Q60.

mathongo

List - I
(Partial Derivatives)

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List - II
(Thermodynamic Quantity)

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(A) $\left(\frac{\partial G}{\partial T}\right)_P$

(I) C_p

mathongo

mathongo

mathongo

(B) $\left(\frac{\partial H}{\partial T}\right)_P$

(II) S

mathongo

mathongo

mathongo

(C) $\left(\frac{\partial G}{\partial P}\right)_T$

(III) C_V

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(D) $\left(\frac{\partial U}{\partial T}\right)_V$

(IV) V

mathongo

mathongo

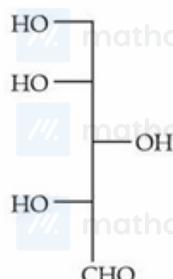
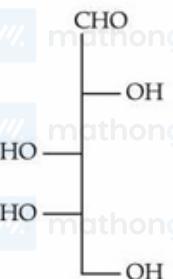
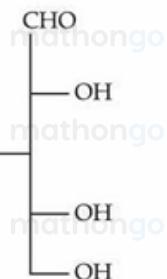
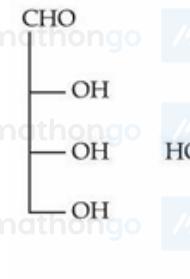
Match List - I with List - II.

Choose the correct answer from the options given below :

- (1) (A)-(II), (B)-(I), (C)-(III), (D)-(IV)
 (3) (A)-(II), (B)-(I), (C)-(IV), (D)-(III)

- (2) (A)-(I), (B)-(II), (C)-(IV), (D)-(III)
 (4) (A)-(II), (B)-(III), (C)-(I), (D)-(IV)

Q61. Identify the number of structure/s from the following which can be correlated to D-glyceraldehyde.



- (A) four
 (B) two

- (C) one
 (D) three

Q62. Given below are two statements : Statement (I) : A spectral line will be observed for a $2p_x \rightarrow 2p_y$ transition.Statement (II) : $2P_x$ and $2p_y$ are degenerate orbitals. In the light of the above statements, choose the correct answer from the options given below :

- (1) Both Statement I and Statement II are true
 (3) Both Statement I and Statement II are false

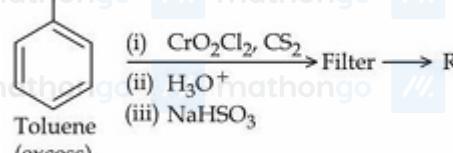
- (2) Statement I is false but Statement II is true
 (4) Statement I is true but Statement II is false

Q63. Given below are two statements : Statement (I) : An element in the extreme left of the periodic table forms acidic oxides. Statement (II) : Acid is formed during the reaction between water and oxide of a reactive element present in the extreme right of the periodic table. In the light of the above statements, choose the correct answer from the options given below :

- (1) Statement I is true but Statement II is false
 (3) Both Statement I and Statement II are false

- (2) Both Statement I and Statement II are true
 (4) Statement I is false but Statement II is true

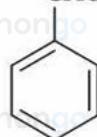
Q64.



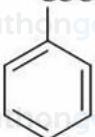
Residue (A) + HCl (dil) → Compound (B) Structure of residue (A) and compound (B) formed respectively is

[A]

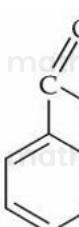
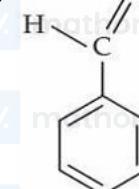
(1)



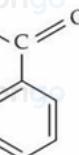
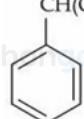
(B)



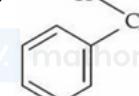
(2)



(3)



(4)



Q65. The alkane from below having two secondary hydrogens is :

- (1) 4-Ethyl-3,4-dimethyloctane
 (3) 2,2,4,5-Tetramethylheptane

- (2) 2,2,3,3-Tetramethylpentane
 (4) 2,2,4,4-Tetramethylhexane

Q66. When sec-butylcyclohexane reacts with bromine in the presence of sunlight, the major product is :

(1)



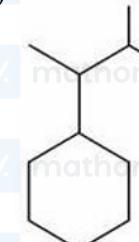
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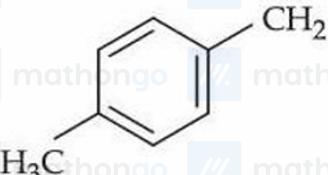
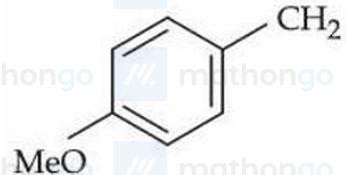
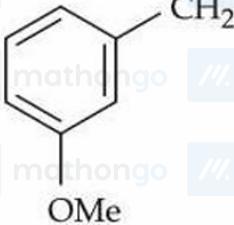
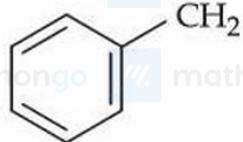
(3)



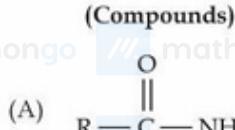
(4)



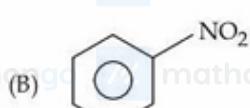
Q67. The most stable carbocation from the following is :



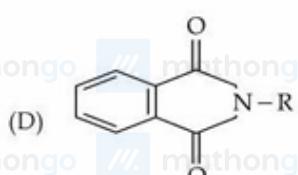
Q68. Match the Compounds (List - I) with the appropriate Catalyst/Reagents (List - II) for their reduction into corresponding amines.

List - I
(Compounds)List - II
(Catalyst/Reagents)

(I) NaOH (aqueous)



(II) H2/Ni



(III) LiAlH4, H2O



(IV) Sn, HCl

corresponding amines.

Choose the correct answer from the options given below :

- (1) (A)-(II), (B)-(I), (C)-(III), (D)-(IV)
 (3) (A)-(II), (B)-(IV), (C)-(III), (D)-(I)

- (2) (A)-(III), (B)-(II), (C)-(IV), (D)-(I)
 (4) (A)-(III), (B)-(IV), (C)-(II), (D)-(I)

Q69. Arrange the following compounds in increasing order of their dipole moment : HBr, H2S, NF3 and CHCl3

- (1) H2S < HBr < NF3 < CHCl3
 (3) HBr < H2S < NF3 < CHCl3

- (2) NF3 < HBr < H2S < CHCl3
 (4) CHCl3 < NF3 < HBr < H2S

Q70. The maximum covalency of a non-metallic group 15 element 'E' with weakest E – E bond is :

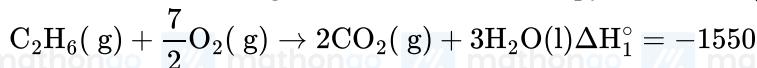
- (1) 4
 (3) 3

- (2) 6
 (4) 5

Q71. The compound with molecular formula C6H6, which gives only one monobromo derivative and takes up four moles of hydrogen per mole for complete hydrogenation has _____ = electrons.

Q72. 20 mL of 2 M NaOH solution is added to 400 mL of 0.5 M NaOH solution. The final concentration of the solution is _____ $\times 10^{-2}$ M. (Nearest integer)

Q73. Consider the following cases of standard enthalpy of reaction (ΔH_r° in kJmol^{-1})



The magnitude of $\Delta H_{f\text{C}_2\text{H}_6(\text{g})}^\circ$ is _____



Q74. Niobium (Nb) and ruthenium (Ru) have "x" and "y" number of electrons in their respective 4 d orbitals.

The value of $x + y$ is _____.

Q75. The complex of Ni^{2+} ion and dimethyl glyoxime contains _____ number of Hydrogen (H) atoms.

ANSWER KEYS

1. (4)	2. (2)	3. (1)	4. (2)	5. (4)	6. (2)	7. (1)	8. (1)
9. (4)	10. (3)	11. (4)	12. (1)	13. (2)	14. (4)	15. (1)	16. (4)
17. (2)	18. (3)	19. (1)	20. (3)	21. (465)	22. (3)	23. (145)	24. (27)
25. (28)	26. (3)	27. (4)	28. (1)	29. (3)	30. (2)	31. (1)	32. (4)
33. (1)	34. (4)	35. (4)	36. (2)	37. (3)	38. (4)	39. (3)	40. (1)
41. (4)	42. (4)	43. (2)	44. (3)	45. (2)	46. (2)	47. (1)	48. (1200)
49. (1)	50. (1)	51. (4)	52. (2)	53. (4)	54. (3)	55. (2)	56. (2)
57. (4)	58. (2)	59. (2)	60. (3)	61. (4)	62. (2)	63. (4)	64. (4)
65. (2)	66. (3)	67. (3)	68. (4)	69. (2)	70. (1)	71. (8)	72. (57)
73. (95)	74. (11)	75. (14)					

Q1. Let a_1, a_2, a_3, \dots be a G.P. of increasing positive terms. If $a_1 a_5 = 28$ and $a_2 + a_4 = 29$, then a_6 is equal to:

- (1) 628
 (2) 812
 (3) 526
 (4) 784

Q2. Let $x = x(y)$ be the solution of the differential equation $y^2 dx + \left(x - \frac{1}{y}\right) dy = 0$. If $x(1) = 1$, then $x\left(\frac{1}{2}\right)$ is :

- (1) $\frac{1}{2} + e$
 (2) $3 + e$
 (3) $3 - e$
 (4) $\frac{3}{2} + e$

Q3. Two balls are selected at random one by one without replacement from a bag containing 4 white and 6 black balls. If the probability that the first selected ball is black, given that the second selected ball is also black, is $\frac{m}{n}$, where $\text{gcd}(m, n) = 1$, then $m + n$ is equal to :

- (1) 4
 (2) 14
 (3) 13
 (4) 11

Q4. The product of all solutions of the equation $e^{5(\log_e x)^2+3} = x^8, x > 0$, is :

- (1) $e^{8/5}$
 (2) $e^{6/5}$
 (3) e^2
 (4) e

Q5. Let the triangle PQR be the image of the triangle with vertices (1, 3), (3, 1) and (2, 4) in the line $x + 2y = 2$. If the centroid of $\triangle PQR$ is the point (α, β) , then $15(\alpha - \beta)$ is equal to :

- (1) 19
 (2) 24
 (3) 21
 (4) 22

Q6. Let for $f(x) = 7 \tan^8 x + 7 \tan^6 x - 3 \tan^4 x - 3 \tan^2 x$, $I_1 = \int_0^{\pi/4} f(x) dx$ and $I_2 = \int_0^{\pi/4} x f(x) dx$. Then $7I_1 + 12I_2$ is equal to :

- (1) 2
 (2) 1
 (3) 2π
 (4) π

Q7. Let the parabola $y = x^2 + px - 3$, meet the coordinate axes at the points P, Q and R. If the circle C with centre at $(-1, -1)$ passes through the points P, Q and R, then the area of $\triangle PQR$ is :

- (1) 7
 (2) 4
 (3) 6
 (4) 5

Q8. Let $L_1 : \frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{4}$ and $L_2 : \frac{x-2}{3} = \frac{y-4}{4} = \frac{z-5}{5}$ be two lines. Then which of the following points lies on the line of the shortest distance between L_1 and L_2 ?

- (1) $(\frac{14}{3}, -3, \frac{22}{3})$
 (2) $(-\frac{5}{3}, -7, 1)$
 (3) $(2, 3, \frac{1}{3})$
 (4) $(\frac{8}{3}, -1, \frac{1}{3})$

Q9. Let $f(x)$ be a real differentiable function such that $f(0) = 1$ and $f(x+y) = f(x)f'(y) + f'(x)f(y)$ for all $x, y \in \mathbf{R}$. Then $\sum_{n=1}^{100} \log_e f(n)$ is equal to :

- (1) 2525
 (2) 5220
 (3) 2384
 (4) 2406

Q10. From all the English alphabets, five letters are chosen and are arranged in alphabetical order. The total number of ways, in which the middle letter is 'M', is :

- (1) 5148
(3) 4356

- (2) 6084
(4) 14950

Q11. Using the principal values of the inverse trigonometric functions, the sum of the maximum and the minimum values of $16 \left((\sec^{-1} x)^2 + (\operatorname{cosec}^{-1} x)^2 \right)$ is :

- (1) $24\pi^2$
(2) $22\pi^2$
(3) $31\pi^2$
(4) $18\pi^2$

Q12. Let $f : \mathbf{R} \rightarrow \mathbf{R}$ be a twice differentiable function such that $f(x+y) = f(x)f(y)$ for all $x, y \in \mathbf{R}$. If

$f'(0) = 4a$ and f satisfies $f''(x) - 3af'(x) - f(x) = 0$, $a > 0$, then the area of the region

$R = \{(x, y) \mid 0 \leq y \leq f(ax), 0 \leq x \leq 2\}$ is:

- (1) $e^2 - 1$
(2) $e^2 + 1$
(3) $e^4 + 1$
(4) $e^4 - 1$

Q13. The area of the region, inside the circle $(x - 2\sqrt{3})^2 + y^2 = 12$ and outside the parabola $y^2 = 2\sqrt{3}x$ is :

- (1) $3\pi + 8$
(2) $6\pi - 16$
(3) $3\pi - 8$
(4) $6\pi - 8$

Q14. Let the foci of a hyperbola be $(1, 14)$ and $(1, -12)$. If it passes through the point $(1, 6)$, then the length of its latus-rectum is :

- (1) $\frac{24}{5}$
(2) $\frac{25}{6}$
(3) $\frac{144}{5}$
(4) $\frac{288}{5}$

Q15. If $\sum_{r=1}^n T_r = \frac{(2n-1)(2n+1)(2n+3)(2n+5)}{64}$, then $\lim_{n \rightarrow \infty} \sum_{r=1}^n \left(\frac{1}{T_r} \right)$ is equal to :

- (1) 0
(2) $\frac{2}{3}$
(3) 1
(4) $\frac{1}{3}$

Q16. A coin is tossed three times. Let X denote the number of times a tail follows a head. If μ and σ^2 denote the mean and variance of X , then the value of $64(\mu + \sigma^2)$ is :

- (1) 51
(2) 64
(3) 32
(4) 48

Q17. The number of non-empty equivalence relations on the set $\{1, 2, 3\}$ is :

- (1) 6
(2) 5
(3) 7
(4) 4

Q18. A circle C of radius 2 lies in the second quadrant and touches both the coordinate axes. Let r be the radius of a circle that has centre at the point $(2, 5)$ and intersects the circle C at exactly two points. If the set of all possible values of r is the interval (α, β) , then $3\beta - 2\alpha$ is equal to :

- (1) 10
(2) 15
(3) 12
(4) 14

Q19. Let $A = \{1, 2, 3, \dots, 10\}$ and $B = \left\{ \frac{m}{n} : m, n \in A, m < n \text{ and } \gcd(m, n) = 1 \right\}$. Then $n(B)$ is equal to :

- (1) 36
(2) 31
(3) 37
(4) 29

Q20. Let z_1, z_2 and z_3 be three complex numbers on the circle $|z| = 1$ with $\arg(z_1) = -\frac{\pi}{4}$, $\arg(z_2) = 0$ and $\arg(z_3) = \frac{\pi}{4}$. If $|z_1\bar{z}_2 + z_2\bar{z}_3 + z_3\bar{z}_1|^2 = \alpha + \beta\sqrt{2}$, $\alpha, \beta \in \mathbf{Z}$, then the value of $\alpha^2 + \beta^2$ is :

- (1) 24 (2) 29 (3) 41 (4) 31

Q21. Let A be a square matrix of order 3 such that $\det(A) = -2$ and $\det(3 \operatorname{adj}(-6 \operatorname{adj}(3A))) = 2^{m+n} \cdot 3^{mn}$, $m > n$. Then $4m + 2n$ is equal to _____

Q22. If $\sum_{r=0}^5 \frac{11C_{22r}}{2r+2} = \frac{m}{n}$, $\gcd(m, n) = 1$, then $m - n$ is equal to _____

Q23. Let \vec{c} be the projection vector of $\vec{b} = \lambda\hat{i} + 4\hat{k}$, $\lambda > 0$, on the vector $\vec{a} = \hat{i} + 2\hat{j} + 2\hat{k}$. If $|\vec{a} + \vec{c}| = 7$, then the area of the parallelogram formed by the vectors \vec{b} and \vec{c} is _____

Q24. Let the function, $f(x) = \begin{cases} -3ax^2 - 2, & x < 1 \\ a^2 + bx, & x \geq 1 \end{cases}$ be differentiable for all $x \in \mathbf{R}$, where $a > 1, b \in \mathbf{R}$. If the area of the region enclosed by $y = f(x)$ and the line $y = -20$ is $\alpha + \beta\sqrt{3}$, $\alpha, \beta \in \mathbf{Z}$, then the value of $\alpha + \beta$ is _____

Q25. Let $L_1 : \frac{x-1}{3} = \frac{y-1}{-1} = \frac{z+1}{0}$ and $L_2 : \frac{x-2}{2} = \frac{y}{0} = \frac{z+4}{\alpha}$, $\alpha \in \mathbf{R}$, be two lines, which intersect at the point B . If P is the foot of perpendicular from the point $A(1, 1, -1)$ on L_2 , then the value of $26\alpha(PB)^2$ is _____

Q26. An electron is made to enter symmetrically between two parallel and equally but oppositely charged metal plates, each of 10 cm length. The electron emerges out of the electric field region with a horizontal component of velocity 10^6 m/s. If the magnitude of the electric field between the plates is 9.1 V/cm, then the vertical component of velocity of electron is (mass of electron = 9.1×10^{-31} kg and charge of electron = 1.6×10^{-19} C)

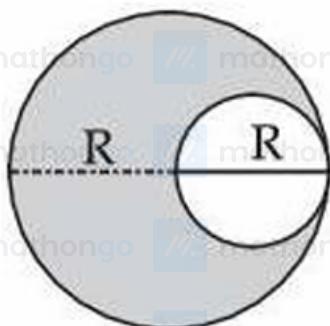
- (1) 0 (2) 1×10^6 m/s (3) 16×10^6 m/s (4) 16×10^4 m/s

Q27. Given below are two statements : Statement-I : The equivalent emf of two nonideal batteries connected in parallel is smaller than either of the two emfs. Statement-II : The equivalent internal resistance of two nonideal batteries connected in parallel is smaller than the internal resistance of either of the two batteries. In the light of the above statements, choose the correct answer from the options given below.

- (1) Both Statement-I and Statement-II are false (2) Statement-I is false but Statement-II is true
 (3) Both Statement-I and Statement-II are true (4) Statement-I is true but Statement-II is false

Q28. A uniform circular disc of radius 'R' and mass 'M' is rotating about an axis perpendicular to its plane and passing through its centre. A small circular part of radius $R/2$ is removed from the original disc as shown in

Q28. In the figure. Find the moment of inertia of the remaining part of the original disc about the axis as given above.



- (1) $\frac{7}{32}MR^2$
 (3) $\frac{17}{32}MR^2$

- (2) $\frac{9}{32}MR^2$
 (4) $\frac{13}{32}MR^2$

Q29. An amount of ice of mass 10^{-3} kg and temperature -10°C is transformed to vapour of temperature 110°C by applying heat. The total amount of work required for this conversion is, (Take, specific heat of ice

$= 2100\text{Jkg}^{-1}\text{K}^{-1}$, specific heat of water $= 4180\text{Jkg}^{-1}\text{K}^{-1}$, specific heat of steam $= 1920\text{Jkg}^{-1}\text{K}^{-1}$,

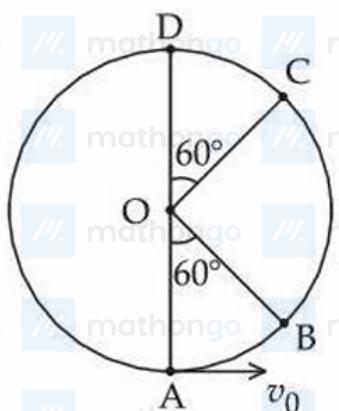
Latent heat of ice $= 3.35 \times 10^5 \text{Jkg}^{-1}$ and Latent heat of steam $= 2.25 \times 10^6 \text{Jkg}^{-1}$)

- (1) 3043 J
 (2) 3024 J
 (3) 3003 J
 (4) 3022 J

Q30. An electron in the ground state of the hydrogen atom has the orbital radius of 5.3×10^{-11} m while that for the electron in third excited state is 8.48×10^{-10} m. The ratio of the de Broglie wavelengths of electron in the excited state to that in the ground state is

- (1) 3
 (2) 16
 (3) 9
 (4) 4

Q31. A bob of mass m is suspended at a point O by a light string of length l and left to perform vertical motion (circular) as shown in figure. Initially, by applying horizontal velocity v_0 at the point 'A', the string becomes slack when, the bob reaches at the point 'D'. The ratio of the kinetic energy of the bob at the points B and C is

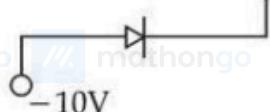
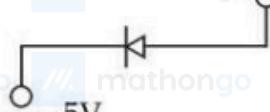


- (1) 1
 (2) 2
 (3) 4
 (4) 3

Q32. Given is a thin convex lens of glass (refractive index μ) and each side having radius of curvature R . One side is polished for complete reflection. At what distance from the lens, an object be placed on the optic axis so that

- Q32. In the image gets formed on the object itself?
- R/μ
 - $R/(2\mu - 3)$
 - μR
 - $R/(2\mu - 1)$

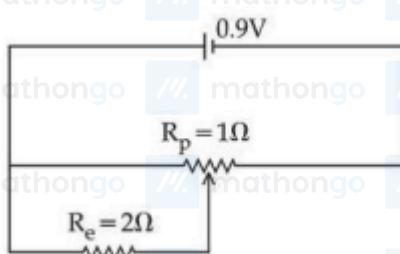
Q33. Which of the following circuits represents a forward biased diode?

- (A) 
- (B) 
- (C) 
- (D) 
- (E) 

Choose the correct answer from the options given below :

- (A) and (D) only
- (B), (D) and (E) only
- (C) and (E) only
- (B), (C) and (E) only

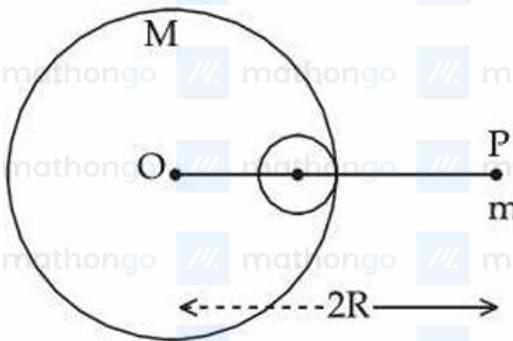
Q34.



Sliding contact of a potentiometer is in the middle of the potentiometer wire having resistance $R_p = 1\Omega$ as shown in the figure. An external resistance of $R_e = 2\Omega$ is connected via the sliding contact. The electric current in the circuit is :

- 0.9 A
- 1.35 A
- 0.3 A
- 1.0 A

Q35. A small point of mass m is placed at a distance $2R$ from the centre ' O' of a big uniform solid sphere of mass M and radius R . The gravitational force on ' m ' due to M is F_1 . A spherical part of radius $R/3$ is removed from the big sphere as shown in the figure and the gravitational force on m due to remaining part of M is found



to be F_2 . The value of ratio $F_1 : F_2$ is

- (1) 12 : 11
- (2) 11 : 10
- (3) 12 : 9
- (4) 16 : 9

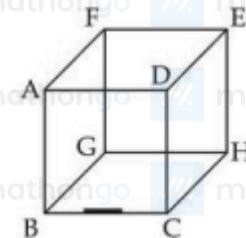
Q36. A closed organ and an open organ tube are filled by two different gases having same bulk modulus but different densities ρ_1 and ρ_2 , respectively. The frequency of 9th harmonic of closed tube is identical with 4th harmonic of open tube. If the length of the closed tube is 10 cm and the density ratio of the gases is $\rho_1 : \rho_2 = 1 : 16$, then the length of the open tube is :

- (1) $\frac{15}{7}$ cm
- (2) $\frac{20}{7}$ cm
- (3) $\frac{15}{9}$ cm
- (4) $\frac{20}{9}$ cm

Q37. If B is magnetic field and μ_0 is permeability of free space, then the dimensions of (B/μ_0) is

- (1) $ML^2 T^{-2} A^{-1}$
- (2) $MT^{-2} A^{-1}$
- (3) $L^{-1} A$
- (4) $LT^{-2} A^{-1}$

Q38. A line charge of length $\frac{a}{2}$ is kept at the center of an edge BC of a cube $ABCDEFGH$ having edge length ' a ' as shown in the figure. If the density of line charge is λ C per unit length, then the total electric flux through



all the faces of the cube will be

- (1) $\frac{\lambda a}{2\epsilon_0}$
- (2) $\frac{\lambda a}{4\epsilon_0}$
- (3) $\frac{\lambda a}{16\epsilon_0}$
- (4) $\frac{\lambda a}{8\epsilon_0}$

. (Take, ϵ_0 as the free space permittivity)

Q39. Given below are two statements : Statement I : In a vernier callipers, one vernier scale division is always smaller than one main scale division. Statement II : The vernier constant is given by one main scale division multiplied by the number of vernier scale divisions. In the light of the above statements, choose the correct answer from the options given below.

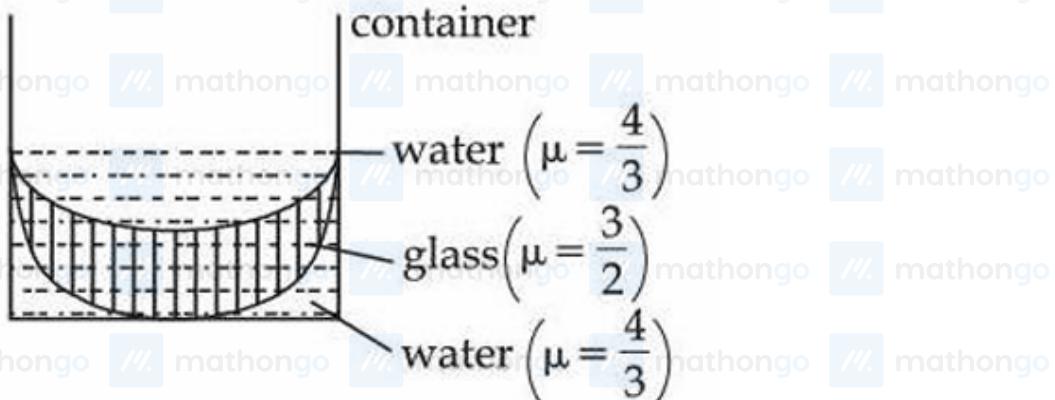
- (1) Statement I is true but Statement II is false
- (2) Statement I is false but Statement II is true
- (3) Both Statement I and Statement II are false
- (4) Both Statement I and Statement II are true

Q40. The work functions of cesium (Cs) and lithium (Li) metals are 1.9 eV and 2.5 eV, respectively. If we incident a light of wavelength 550 nm on these two metal surfaces, then photo-electric effect is possible for the case of
 (1) Both Cs and Li (2) Neither Cs nor Li
 (3) Cs only (4) Li only

Q41. Two spherical bodies of same materials having radii 0.2 m and 0.8 m are placed in same atmosphere. The temperature of the smaller body is 800 K and temperature of the bigger body is 400 K. If the energy radiated from the smaller body is E, the energy radiated from the bigger body is (assume, effect of the surrounding temperature to be negligible),

- (1) 16 E (2) E
 (3) 64 E (4) 256 E

Q42. In the diagram given below, there are three lenses formed. Considering negligible thickness of each of them as compared to $|R_1|$ and $|R_2|$, i.e., the radii of curvature for upper and lower surfaces of the glass lens, the power



of the combination is

- (1) $\frac{1}{6} \left(\frac{1}{|R_1|} - \frac{1}{|R_2|} \right)$
 (2) $-\frac{1}{6} \left(\frac{1}{|R_1|} + \frac{1}{|R_2|} \right)$
 (3) $\frac{1}{6} \left(\frac{1}{|R_1|} + \frac{1}{|R_2|} \right)$
 (4) $-\frac{1}{6} \left(\frac{1}{|R_1|} - \frac{1}{|R_2|} \right)$

Q43. Given below are two statements : one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion-(A) : If Young's double slit experiment is performed in an optically denser medium than air, then the consecutive fringes come closer. Reason-(R) : The speed of light reduces in an optically denser medium than air while its frequency does not change. In the light of the above statements, choose the most appropriate answer from the options given below :

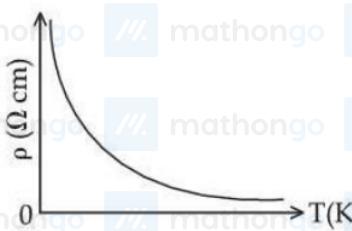
- (1) Both (A) and (R) are true but (R) is not the correct explanation of (A)
 (2) Both (A) and (R) are true and (R) is the correct explanation of (A)
 (3) (A) is true but (R) is false
 (4) (A) is false but (R) is true

Q44. A parallel-plate capacitor of capacitance $40\mu\text{F}$ is connected to a 100 V power supply. Now the intermediate space between the plates is filled with a dielectric material of dielectric constant $K = 2$. Due to the introduction of dielectric material, the extra charge and the change in the electrostatic energy in the capacitor, respectively, are

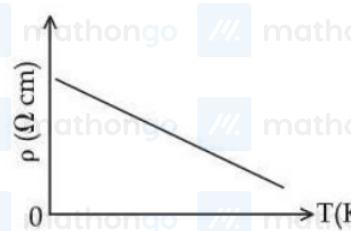
- (1) 4 mC and 0.2 J
 (2) 8 mC and 2.0 J
 (3) 2 mC and 0.4 J
 (4) 2 mC and 0.2 J

Q45. Which of the following resistivity (ρ) v/s temperature (T) curves is most suitable to be used in wire bound standard resistors?

(1)



(2)



(3)



(4)

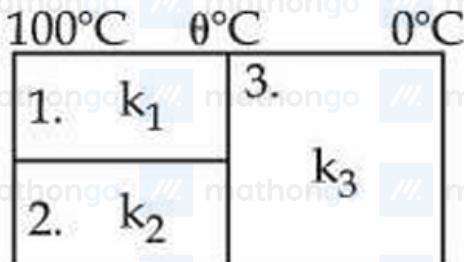


Q46. The driver sitting inside a parked car is watching vehicles approaching from behind with the help of his side view mirror, which is a convex mirror with radius of curvature $R = 2$ m. Another car approaches him from behind with a uniform speed of 90 km/hr. When the car is at a distance of 24 m from him, the magnitude of the acceleration of the image of the car in the side view mirror is ' a '. The value of $100a$ is _____ m/s².

Q47. Two soap bubbles of radius 2 cm and 4 cm, respectively, are in contact with each other. The radius of curvature of the common surface, in cm, is _____.

Q48. The position vectors of two 1 kg particles, (A) and (B), are given by $\vec{r}_A = (\alpha_1 t^2 \hat{i} + \alpha_2 t \hat{j} + \alpha_3 t \hat{k})$ m and $\vec{r}_B = (\beta_1 t \hat{i} + \beta_2 t^2 \hat{j} + \beta_3 t \hat{k})$ m, respectively; ($\alpha_1 = 1$ m/s², $\alpha_2 = 3$ nm/s, $\alpha_3 = 2$ m/s, $\beta_1 = 2$ m/s, $\beta_2 = -1$ m/s², $\beta_3 = 4$ pm/s), where t is time, n and p are constants. At $t = 1$ s, $|\vec{V}_A| = |\vec{V}_B|$ and velocities \vec{V}_A and \vec{V}_B of the particles are orthogonal to each other. At $t = 1$ s, the magnitude of angular momentum of particle (A) with respect to the position of particle (B) is \sqrt{L} kgm² s⁻¹. The value of L is _____.

Q49. Three conductors of same length having thermal conductivity k_1 , k_2 and k_3 are connected as shown in figure.



Area of cross sections of 1st and 2nd conductor are same and for 3rd conductor it is double of the 1st conductor. The temperatures are given in the figure. In steady state condition, the value of θ is _____ °C. (Given : $k_1 = 60$ Js⁻¹ m⁻¹ K⁻¹, $k_2 = 120$ Js⁻¹ m⁻¹ K⁻¹, $k_3 = 135$ Js⁻¹ m⁻¹ K⁻¹)

Q50. A particle is projected at an angle of 30° from horizontal at a speed of 60 m/s. The height traversed by the particle in the first second is h_0 and height traversed in the last second, before it reaches the maximum height, is h_1 . The ratio $h_0 : h_1$ is _____ [Take, $g = 10 \text{ m/s}^2$]

Q51. Radius of the first excited state of Helium ion is given as : $a_0 \rightarrow$ radius of first stationary state of hydrogen atom.

- (1) $r = 4a_0$ (2) $r = 2a_0$
 (3) $r = \frac{a_0}{2}$ (4) $r = \frac{a_0}{4}$

Q52. The incorrect statements regarding geometrical isomerism are : (A) Propene shows geometrical isomerism. (B) Trans isomer has identical atoms/groups on the opposite sides of the double bond. (C) Cis-but-2-ene has higher dipole moment than trans-but-2-ene. (D) 2-methylbut-2-ene shows two geometrical isomers. (E) Trans-isomer has lower melting point than cis isomer. Choose the correct answer from the options given below :

- (1) (A) and (E) Only (2) (A), (D) and (E) Only
 (3) (B) and (C) Only (4) (C), (D) and (E) Only

Q53. A liquid when kept inside a thermally insulated closed vessel at 25°C was mechanically stirred from outside. What will be the correct option for the following thermodynamic parameters ?

- (1) $\Delta U < 0, q = 0, w > 0$ (2) $\Delta U = 0, q = 0, w = 0$
 (3) $\Delta U > 0, q = 0, w > 0$ (4) $\Delta U = 0, q < 0, w > 0$

Q54. Which of the following electronegativity order is incorrect?

- (1) Mg < Be < B < N (2) S < Cl < O < F
 (3) Al < Si < C < N (4) Al < Mg < B < N

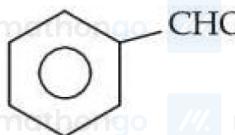
Q55. Lanthanoid ions with $4f^7$ configuration are : (A) Eu²⁺ (B) Gd³⁺ (C) Eu³⁺ (D) Tb³⁺ (E) Sm²⁺ Choose the correct answer from the options given below :

- (1) (A) and (D) only (2) (B) and (C) only
 (3) (A) and (B) only (4) (B) and (E) only

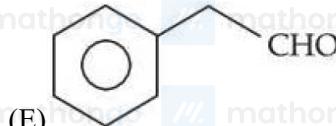
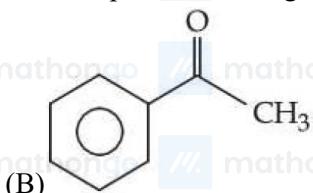
Q56. Given below are two statements : Statement I : One mole of propyne reacts with excess of sodium to liberate half a mole of H₂ gas. Statement II : Four g of propyne reacts with NaNH₂ to liberate NH₃ gas which occupies 224 mL at STP. In the light of the above statements, choose the most appropriate answer from the options given below:

- | | |
|--|--|
| (1) Statement I is incorrect but Statement II is correct
(3) Statement I is correct but Statement II is incorrect | (2) Both Statement I and Statement II are correct
(4) Both Statement I and Statement II are incorrect |
|--|--|

Q57.



The compounds which give positive Fehling's test are : (A)



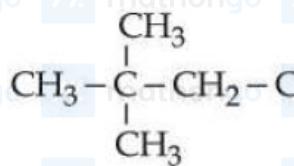
Choose the correct answer from the options given below :

- (1) (A), (D) and (E) Only (2) (C), (D) and (E) Only
 (3) (A), (C) and (D) Only (4) (A), (B) and (C) Only

Q58. Which of the following electrolyte can be used to obtain $\text{H}_2\text{S}_2\text{O}_8$ by the process of electrolysis?

- (1) Dilute solution of sodium sulphate. (2) Acidified dilute solution of sodium sulphate.
 (3) Dilute solution of sulphuric acid (4) Concentrated solution of sulphuric acid

Q59. Given below are two statements : Statement I : $\text{CH}_3 - \text{O} - \text{CH}_2 - \text{Cl}$ will undergo $\text{S}_{\text{N}}1$ reaction though it is a



primary halide. Statement II :

will not undergo $\text{S}_{\text{N}}2$ reaction very easily though it is a primary halide. In the light of the above statements,

choose the most appropriate answer from the options given below :

- (1) Both Statement I and Statement II are incorrect (2) Both Statement I and Statement II are correct
 (3) Statement I is incorrect but Statement II is correct (4) Statement I is correct but Statement II is incorrect

Q60. Which of the following acids is a vitamin?

- (1) Adipic acid (2) Ascorbic acid
 (3) Saccharic acid (4) Aspartic acid

Q61. Match List-I with List-II.

List - I

- (A) $\text{Al}^{3+} < \text{Mg}^{2+} < \text{Na}^+ < \text{F}^-$
 (B) $\text{B} < \text{C} < \text{O} < \text{N}$
 (C) $\text{B} < \text{Al} < \text{Mg} < \text{K}$
 (D) $\text{Si} < \text{P} < \text{S} < \text{Cl}$

cList - II

- (I) *Ionisation Enthalpy*
 (II) *Metallic character*
 (III) *Electronegativity*
 (IV) *Ionic radii*

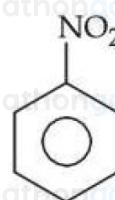
Choose the correct answer from the options given below : mathongo mathongo mathongo

- (1) (A)-(IV), (B)-(I), (C)-(II), (D)-(III) mathongo
 (2) (A)-(IV), (B)-(I), (C)-(III), (D)-(II) mathongo
 (3) (A)-(III), (B)-(IV), (C)-(II), (D)-(I) mathongo
 (4) (A)-(II), (B)-(III), (C)-(IV), (D)-(I) mathongo

Q62. Which of the following statement is not true for radioactive decay?

- (1) Decay constant increases with increase in temperature. mathongo
 (2) Amount of radioactive substance remained after three half lives is $\frac{1}{8}$ th of original amount. mathongo
 (3) Decay constant does not depend upon temperature. mathongo
 (4) Half life is $\ln 2$ times of $\frac{1}{\text{rate constant}}$. mathongo

Q63.



(i) Br_2, AcOH

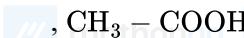
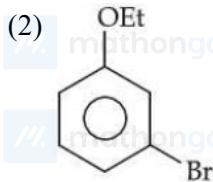
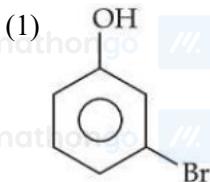
(ii) Sn, HCl

(iii) $\text{NaNO}_2, \text{HCl}, 273 \text{ K}$

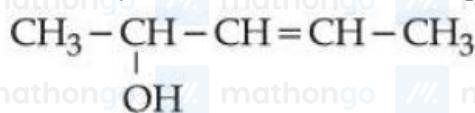
(iv) $\text{C}_2\text{H}_5\text{OH}$

$\xrightarrow{\hspace{1cm}}$ A + B

The products formed in the following reaction sequence are :



Q64. How many different stereoisomers are possible for the given molecule?



- (1) 2 mathongo
 (2) 1 mathongo
 (3) 4 mathongo
 (4) 3 mathongo

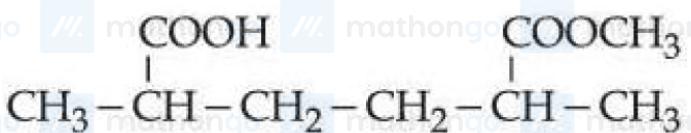
Q65. A vessel at 1000 K contains CO_2 with a pressure of 0.5 atm. Some of CO_2 is converted into CO on addition of graphite. If total pressure at equilibrium is 0.8 atm, then K_p is :

- (1) 1.8 atm mathongo
 (2) 0.3 atm mathongo
 (3) 3 atm mathongo
 (4) 0.18 atm mathongo

Q66. A solution of aluminium chloride is electrolysed for 30 minutes using a current of 2 A. The amount of the aluminium deposited at the cathode is [Given : molar mass of aluminium and chlorine are 27 g mol^{-1} and 35.5 g mol^{-1} respectively. Faraday constant = 96500 C mol^{-1}]

- (1) 1.660 g mathongo
 (2) 0.336 g mathongo
 (3) 0.441 g mathongo
 (4) 1.007 g mathongo

Q67.



The IUPAC name of the following compound is :

- (1) Methyl-6-carboxy-2,5-dimethylhexanoate. (2) 2-Carboxy-5-methoxycarbonylhexane.
 (3) 6-Methoxycarbonyl-2,5-dimethylhexanoic acid. (4) Methyl-5-carboxy-2-methylhexanoate.

Q68. In which of the following complexes the CFSE, Δ_o will be equal to zero?

- (1) $[\text{Fe}(\text{en})_3]\text{Cl}_3$ (2) $\text{K}_4[\text{Fe}(\text{CN})_6]$
 (3) $[\text{Fe}(\text{NH}_3)_6]\text{Br}_2$ (4) $\text{K}_3[\text{Fe}(\text{SCN})_6]$

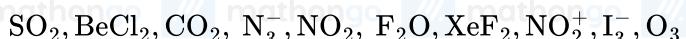
Q69. Arrange the following solutions in order of their increasing boiling points. (i) 10^{-4}M NaCl (ii) 10^{-4}M Urea

- (iii) 10^{-3}M NaCl (iv) 10^{-2}M NaCl
 (1) (i) < (ii) < (iii) < (iv) (2) (iv) < (iii) < (i) < (ii)
 (3) (ii) < (i) \equiv (iii) < (iv) (4) (ii) < (i) \leq (iii) < (iv)

Q70. From the magnetic behaviour of $[\text{NiCl}_4]^{2-}$ (paramagnetic) and $[\text{Ni}(\text{CO})_4]$ (diamagnetic), choose the correct geometry and oxidation state.

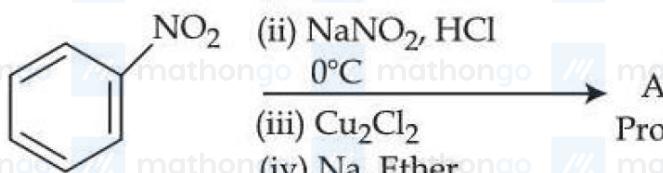
- (1) $[\text{NiCl}_4]^{2-}$: Ni^{II}, tetrahedral (2) $[\text{NiCl}_4]^{2-}$: Ni^{II}, square planar $[\text{Ni}(\text{CO})_4]$: Ni(0)
 square planar (3) $[\text{NiCl}_4]^{2-}$: Ni^{II}, tetrahedral (4) $[\text{NiCl}_4]^{2-}$: Ni(0), tetrahedral $[\text{Ni}(\text{CO})_4]$: Ni(0),
 tetrahedral square planar

Q71. The number of molecules/ions that show linear geometry among the following is _____

Q72. A \rightarrow B The molecule A changes into its isomeric form B by following a first order kinetics at a temperature of 1000 K. If the energy barrier with respect to reactant energy for such isomeric transformation is

191.48 kJ mol⁻¹ and the frequency factor is 10^{20} , the time required for 50% molecules of A to become B is _____ picoseconds (nearest integer). [R = 8.314 J K⁻¹ mol⁻¹]

Q73.



Consider the following sequence of reactions :

Molar mass of the product formed (A) is _____ gmol⁻¹.

Q74. Some CO₂ gas was kept in a sealed container at a pressure of 1 atm and at 273 K. This entire amount of CO₂ gas was later passed through an aqueous solution of Ca(OH)₂. The excess unreacted Ca(OH)₂ was later neutralized with 0.1 M of 40 mL HCl. If the volume of the sealed container of CO₂ was x, then x is _____ cm³ (nearest integer). [Given : The entire amount of CO₂(g) reacted with exactly half the initial amount of Ca(OH)₂ present in the aqueous solution.]

Q75. In Carius method for estimation of halogens, 180 mg of an organic compound produced 143.5 mg of AgCl .

The percentage composition of chlorine in the compound is _____ %. (Given : molar mass in gmol^{-1} of Ag : 108, Cl : 35.5)

ANSWER KEYS

1. (4)	2. (3)	3. (2)	4. (1)	5. (4)	6. (2)	7. (3)	8. (1)
9. (1)	10. (1)	11. (2)	12. (1)	13. (2)	14. (4)	15. (2)	16. (4)
17. (2)	18. (2)	19. (2)	20. (2)	21. (34)	22. (2035)	23. (16)	24. (34)
25. (216)	26. (3)	27. (2)	28. (4)	29. (1)	30. (4)	31. (2)	32. (4)
33. (4)	34. (4)	35. (1)	36. (4)	37. (3)	38. (4)	39. (3)	40. (3)
41. (2)	42. (4)	43. (2)	44. (1)	45. (4)	46. (8)	47. (4)	48. (90)
49. (40)	50. (5)	51. (2)	52. (2)	53. (3)	54. (4)	55. (3)	56. (3)
57. (2)	58. (4)	59. (2)	60. (2)	61. (1)	62. (1)	63. (3)	64. (3)
65. (1)	66. (2)	67. (3)	68. (4)	69. (4)	70. (3)	71. (6)	72. (69)
73. (154)	74. (45)	75. (20)					