**Q1.** A particle moves in $x-y$ plane under the influence of a force $\vec{F}$ such that its linear momentum is $\overrightarrow{\mathrm{p}}(\mathrm{t})=\hat{i}\cos(\mathrm{kt})-\hat{j}\sin(\mathrm{kt})$. If k is constant, the angle between $\overrightarrow{\mathrm{F}}$ and $\overrightarrow{\mathrm{p}}$ will be :

(1) $\frac{\pi}{4}$ (2) $\frac{\pi}{6}$

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

**Q2.** What is the dimensional formula of $ab^{-1}$ in the equation $\left(\mathrm{P}+\frac{\mathrm{a}}{\mathrm{V}^2}\right)(\mathrm{V}-\mathrm{b})=\mathrm{RT}$, where letters have their usual meaning.

(1) $\left[\mathrm{M}^{-1}\,\mathrm{L}^{5}\,\mathrm{T}^{3}\right]$ (2) $\left[\mathrm{M}^{6}\,\mathrm{L}^{7}\,\mathrm{T}^{4}\right]$

(3) $\left[\mathrm{ML}^{2}\,\mathrm{T}^{-2}\right]$ (4) $\left[\mathrm{M}^{0}\,\mathrm{L}^{3}\,\mathrm{T}^{-2}\right]$

**Q3.** A man carrying a monkey on his shoulder does cycling smoothly on a circular track of radius 9 m and completes 120 resolutions in 3 minutes. The magnitude of centripetal acceleration of monkey is ( in $\mathrm{m/s^2}$ ) :

(1) $57600\pi^2\ \mathrm{ms}^{-2}$ (2) Zero

(3) $4\pi^2\ \mathrm{ms}^{-2}$ (4) $16\pi^2\ \mathrm{ms}^{-2}$

**Q4.** A heavy box of mass 50 kg is moving on a horizontal surface. If co-efficient of kinetic friction between the box and horizontal surface is 0.3 then force of kinetic friction is :

(1) 1.47 N (2) 147 N

(3) 14.7 N (4) 1470 N

**Q5.** A body is moving unidirectionally under the influence of a constant power source. Its displacement in time t is proportional to :

(1) $t$ (2) $t^{3/2}$

(3) $t^2$ (4) $t^{2/3}$

**Q6.** A satellite revolving around a planet in stationary orbit has time period 6 hours. The mass of planet is one-fourth the mass of earth. The radius orbit of planet is : ( Given = Radius of geo-stationary orbit for earth is $4.2\times10^4$ km )

(1) $1.4\times10^4$ km (2) $1.05\times10^4$ km

(3) $8.4\times10^4$ km (4) $1.68\times10^5$ km

**Q7.** Match List-I with List-II :

| | List-I | | List-II |
|---|---|---|---|
| (A) | A force that restores an elastic body of unit area to its original state | (I) | Bulk modulus |
| (B) | Two equal and opposite forces parallel to opposite faces | (II) | Young's modulus |
| (C) | Forces perpendicular everywhere to the surface per unit area same everywhere | (III) | Stress |
| (D) | Two equal and opposite forces perpendicular to opposite faces | (IV) | Shear modulus |

Choose the correct answer from the options given below :

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

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

**Q8.** During an adiabatic process, if the pressure of a gas is found to be proportional to the cube of its absolute temperature, then the ratio of $\frac{C_P}{C_V}$ for the gas is :

(1) $\frac{5}{3}$ (2) $\frac{9}{7}$
(3) $\frac{3}{2}$ (4) $\frac{7}{5}$

**Q9.** If n is the number density and d is the diameter of the molecule, then the average distance covered by a molecule between two successive collisions (i.e. mean free path) is represented by :

(1) $\sqrt{2}\mathrm{n}\pi\mathrm{d}^2$ (2) $\frac{1}{\sqrt{2n\pi d^2}}$
(3) $\frac{1}{\sqrt{2}n\pi d^2}$ (4) $\frac{1}{\sqrt{2}n^2\pi^2 d^2}$

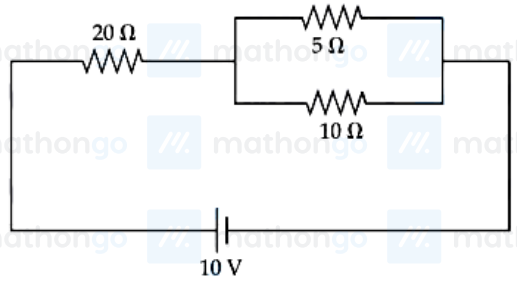
**Q10.** The vehicles carrying inflammable fluids usually have metallic chains touching the ground :

(1) To protect tyres from catching dirt from ground (2) To alert other vehicles
(3) It is a custom (4) To conduct excess charge due to air friction to ground and prevent sparking

**Q11.** A galvanometer of resistance $100\Omega$ when connected in series with $400\Omega$ measures a voltage of upto 10 V. The value of resistance required to convert the galvanometer into ammeter to read upto 10 A is $x \times 10^{-2}\Omega$. The value of $x$ is :

(1) 2 (2) 800
(3) 20 (4) 200

**Q12.** The ratio of heat dissipated per second through the resistance $5\Omega$ and $10\Omega$ in the circuit given below is :




(1) 1 : 2 (2) 2 : 1
(3) 4 : 1 (4) 1 : 1

**Q13.** The electrostatic force $\left(\overrightarrow{F_1}\right)$ and magnetic force $\left(\vec{F}_2\right)$ acting on a charge $q$ moving with velocity $v$ can be written :

(1) $\vec{F}_1 = q\vec{E}, \vec{F}_2 = q(\vec{V} \times \vec{B})$ (2) $\vec{F}_1 = q\vec{B}, \vec{F}_2 = q(\vec{B} \times \vec{V})$
(3) $\vec{F}_1 = q\vec{E}, \vec{F}_2 = q(\vec{B} \times \vec{V})$ (4) $\vec{F}_1 = q\vec{V} \cdot \vec{E}, \vec{F}_2 = q(\vec{B} \cdot \vec{V})$

**Q14.** A series LCR circuit is subjected to an ac signal of 200 V, 50 Hz. If the voltage across the inductor $(\mathrm{L} = 10\mathrm{mH})$ is 31.4 V, then the current in this circuit is _____ .

(1) 68 A (2) 63 A
(3) 10 A (4) 10 mA

**Q15.** Match List-I with List-II :

| | List-I | | List-II |
|---|---|---|---|
| | EM-Wave | | Wavelength Range |
| (A) | Infra-red | (I) | $< 10^{-3}$ nm |
| (B) | Ultraviolet | (II) | 400 nm to 1 nm |
| (C) | X-rays $S$ | (III) | 1 mm to 700 nm |
| (D) | Gamma rays | (IV) | 1 nm to $10^{-3}$ nm |

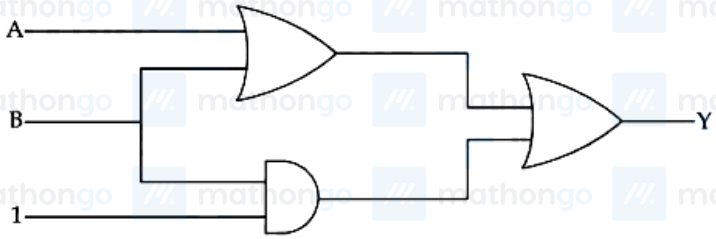
(1) (A)-(III), (B)-(II), (C)-(IV), (D)-(I)
(2) (A)-(II), (B)-(I), (C)-(IV), (D)-(III)
(3) (A)-(IV), (B)-(III), (C)-(II), (D)-(I)
(4) (A)-(I), (B)-(III), (C)-(II), (D)-(IV)

**Q16.** Given below are two statements : Statement I : When the white light passed through a prism, the red light bends lesser than yellow and violet. Statement II : The refractive indices are different for different wavelengths in dispersive medium. In the light of the above statements, chose 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

**Q17.** Which of the following statement is not true about stopping potential $(\mathrm{V}_0)$ ?
(1) It is $1/$ e times the maximum kinetic energy of electrons emitted.
(2) It increases with increase in intensity of the incident light.
(3) It depends on the nature of emitter material.
(4) It depends upon frequency of the incident light.

**Q18.** The angular momentum of an electron in a hydrogen atom is proportional to : (Where $r$ is the radius of orbit of electron)
(1) r
(2) $\sqrt{\mathrm{r}}$
(3) $\frac{1}{\sqrt{\mathrm{r}}}$
(4) $\frac{1}{\mathrm{r}}$

**Q19.** The output $(Y)$ of logic circuit given below is 0 only when :



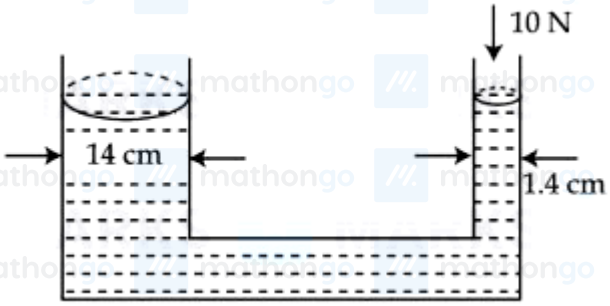

(1) $\mathrm{A}=1,\ \mathrm{B}=0$
(2) $\mathrm{A}=0,\ \mathrm{B}=1$
(3) $\mathrm{A}=0,\ \mathrm{B}=0$
(4) $\mathrm{A}=1,\ \mathrm{B}=1$

**Q20.** A vernier callipers has 20 divisions on the vernier scale, which coincides with $19^{\text{th}}$ division on the main scale. The least count of the instrument is 0.1 mm. One main scale division is equal to _____mm.
(1) 0.5
(2) 2
(3) 5
(4) 1

**Q21.** The maximum height reached by a projectile is 64 m. If the initial velocity is halved, the new maximum height of the projectile is _____ m.

**Q22.** A hollow sphere is rolling on a plane surface about its axis of symmetry. The ratio of rotational kinetic energy to its total kinetic energy is $\frac{x}{5}$. The value of $x$ is _____ .

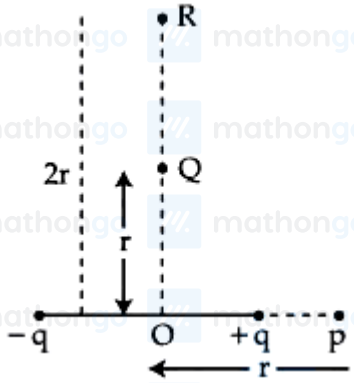
**Q23.**




A hydraulic press containing water has two arms with diameters as mentioned in the figure. A force of 10 N is applied on the surface of water in the thinner arm. The force required to be applied on the surface of water in the thicker arm to maintain equilibrium of water is _____N.

**Q24.** A sonometer wire of resonating length 90 cm has a fundamental frequency of 400 Hz when kept under some tension. The resonating length of the wire with fundamental frequency of 600 Hz under same tension _____cm .

**Q25.** The electric field at point p due to an electric dipole is E. The electric field at point R on equitorial line will be




$\frac{E}{x}$. The value of $x$ :

**Q26.** A wire of resistance 20Ω is divided into 10 equal parts, resulting pairs. A combination of two parts are connected in parallel and so on. Now resulting pairs of parallel combination are connected in series. The equivalent resistance of final combination is _____ Ω.

**Q27.** A solenoid of length 0.5 m has a radius of 1 cm and is made up of ' m ' number of turns. It carries a current of 5 A. If the magnitude of the magnetic field inside the solenoid is $6.28 \times 10^{-3}$ T then the value of $m$ is _____.

**Q28.** The current in an inductor is given by $I = (3t + 8)$ where t is in second. The magnitude of induced emf produced in the inductor is 12mV. The self-inductance of the inductor _____ mH.

**Q29.** In a single slit experiment, a parallel beam of green light of wavelength 550 nm passes through a slit of width 0.20 mm. The transmitted light is collected on a screen 100 cm away. The distance of first order minima from the central maximum will be $x \times 10^{-5}$ m. The value of $x$ is :

**Q30.** The shortest wavelength of the spectral lines in the Lyman series of hydrogen spectrum is $915\tilde{A}$ . . .. The longest wavelength of spectral lines in the Balmer series will be _____ $\tilde{A}$ . . ..

**Q31.** The number of moles of methane required to produce 11 g$CO_2$( g) after complete combustion is : (Given molar mass of methane in gmol$^{-1}$ : 16)

(1) 0.35 (2) 0.5

(3) 0.75 (4) 0.25

**Q32.** Given below are two statements : Statement I : The metallic radius of Na is 1.86 A$^\circ$ and the ionic radius of $Na^+$is lesser than 1.86 A$^\circ$. Statement II : Ions are always smaller in size than the corresponding elements. 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 incorrect but Statement II is true

(3) Both Statement I and Statement II are true (4) Statement I is correct but Statement II is false

**Q33.**

| List - I | List - II |
|---|---|
| (A) ICl | (I) T - shape |
| (B) $ICl_3$ | (II) pyramidal |
| (C) $ClF_5$ | (III) Pentagonal bipyramidal |
| (D) $IF_7$ | (IV) Linear |

Match List I with List II Choose the correct answer from the options given below :

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

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

**Q34.** Given below are two statements : one is labelled as Assertion (A) and the other is labelled as Reason (R). Assertion (A) : $NH_3$ and $NF_3$ molecule have pyramidal shape with a lone pair of electrons on nitrogen atom. The resultant dipole moment of $NH_3$ is greater than that of $NF_3$. Reason (R) : In $NH_3$, the orbital dipole due to lone pair is in the same direction as the resultant dipole moment of the N − H bonds. F is the most electronegative element. 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) (2) (A) is false but (R) is true

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

**Q35.** Given below are two statements : Statement I : On passing $HCl_{(g)}$ through a saturated solution of $BaCl_2$, at room temperature white turbidity appears. Statement II : When HCl gas is passed through a saturated solution of NaCl, sodium chloride is precipitated due to common ion effect. 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 correct (2) Statement I is correct but Statement II is incorrect

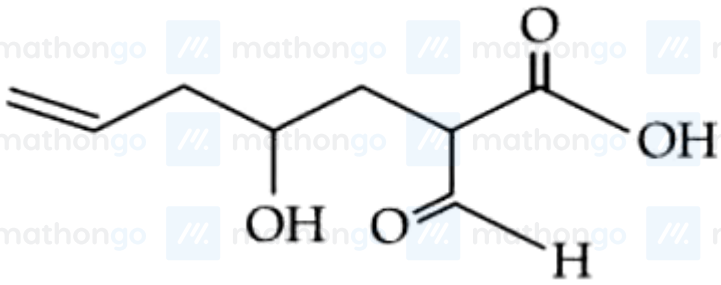
(3) Both Statement I and Statement II are incorrect (4) Statement I is incorrect but Statement II is correct

**Q36.** The correct statements from the following are : (A) The decreasing order of atomic radii of group 13 elements is Tl > In > Ga > Al > B. (B) Down the group 13 electronegativity decreases from top to bottom. (C) Al dissolves in dil. HCl and liberates $H_2$ but conc. $HNO_3$ renders Al passive by forming a protective oxide layer

on the surface. (D) All elements of group 13 exhibits highly stable +1 oxidation state. (E) Hybridisation of Al in $[Al(H_2O)_6]^{3+}$ ion is $sp^3\ d^2$. Choose the correct answer from the options given below :

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

**Q37.** The correct nomenclature for the following compound is :



(1) 2-formyl-4-hydroxyhept-7-enoic acid
(2) 2-formyl-4-hydroxyhept-6-enoic acid
(3) 2-carboxy-4-hydroxyhept-7-enal
(4) 2-carboxy-4-hydroxyhept-6-enal

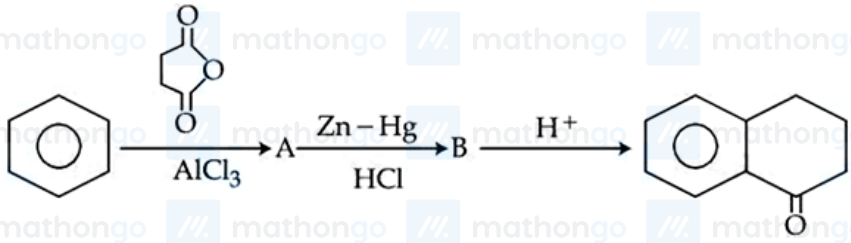
**Q38.**

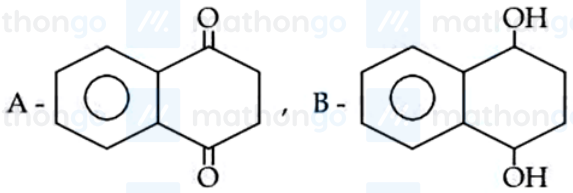
| List - I (Pair of compounds) | List - II (Isomerism) |
|---|---|
| (A) n-propanol and Isopropanol | (I) Metamerism |
| (B) Methoxypropane and ethoxyethane | (II) Chain Isomerism |
| (C) Propanone and propanal | (III) Position Isomerism |
| (D) Neopentane and Isopentane | (IV) Functional Isomerism |

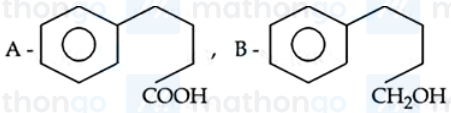
Match List I with List II Choose the correct answer from the options given below :

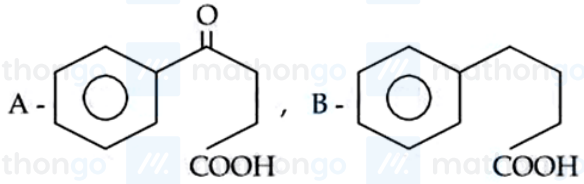
(1) (A)-(II), (B)-(I), (C)-(IV), (D)-(III)
(2) (A)-(III), (B)-(I), (C)-(II), (D)-(IV)
(3) (A)-(I), (B)-(III), (C)-(IV), (D)-(II)
(4) (A)-(III), (B)-(I), (C)-(IV), (D)-(II)

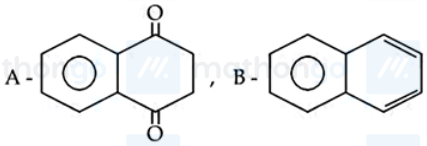
**Q39.** Identify $A$ and $B$ in the given chemical reaction sequence :



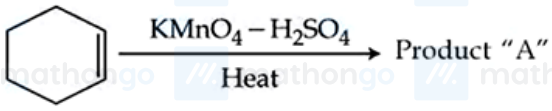
(1) 


(2) 


(3) 


(4) 


**Q40.** Consider the given chemical reaction :




Product " A " is :

(1) picric acid (2) acetic acid

(3) adipic acid (4) oxalic acid

**Q41.** The quantity of silver deposited when one coulomb charge is passed through $AgNO_3$ solution :

(1) 1 g of silver (2) 1 electrochemical equivalent of silver

(3) 1 chemical equivalent of silver (4) 0.1 g atom of silver

**Q42.** For the electro chemical cell If $E^0_{(M^{2+}/M)} = 0.46$ V and $E^0_{(x/X^{2-})} = 0.34$ V. Which of the following is correct?

(1) $M + X \rightarrow M^{2+} + X^{2-}$ is a spontaneous reaction (2) $E_{cell} = 0.80$ V

(3) $E_{cell} = -0.80$ V (4) $M^{2+} + X^{2-} \rightarrow M + X$ is a spontaneous reaction

**Q43.** The number of ions from the following that have the ability to liberate hydrogen from a dilute acid is _____.

$Ti^{2+}$, $Cr^{2+}$ and $V^{2+}$

(1) 2 (2) 3

(3) 1 (4) 0

**Q44.** While preparing crystals of Mohr's salt, dil $H_2SO_4$ is added to a mixture of ferrous sulphate and ammonium sulphate, before dissolving this mixture in water, dil $H_2SO_4$ is added here to :

(1) prevent the hydrolysis of ferrous sulphate (2) prevent the hydrolysis of ammonium sulphate

(3) make the medium strongly acidic (4) increase the rate of formation of crystals

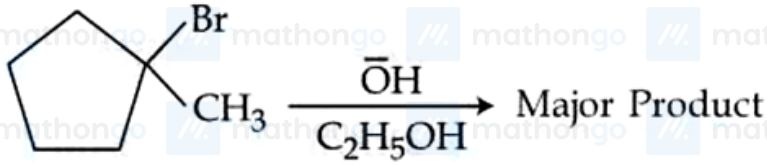
**Q45.** The number of complexes from the following with no electrons in the $t_2$ orbital is

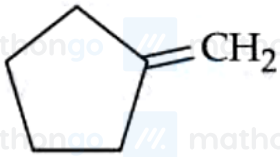
$TiCl_4$, $[MnO_4]^-$, $[FeO_4]^{2-}$, $[FeCl_4]^-$, $[CoCl_4]^{2-}$

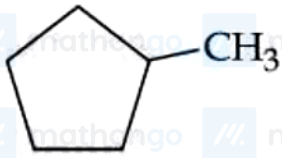
(1) 1 (2) 4
(3) 3 (4) 2

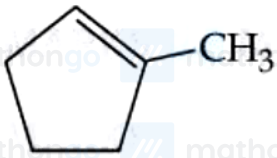
**Q46.** The metal atom present in the complex MABXL (where A, B, X and L are unidentate ligands and M is metal) involves $sp^3$ hybridization. The number of geometrical isomers exhibited by the complex is:
(1) 2 (2) 0
(3) 4 (4) 3

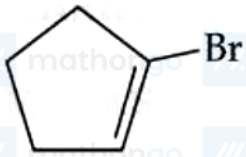
**Q47.** Identify the major product in the following reaction.



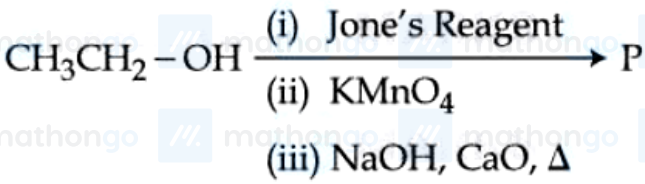

(1) 


(2) 


(3) 

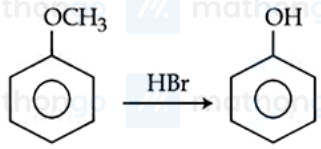

(4) 

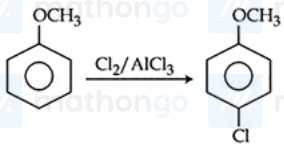

**Q48.**

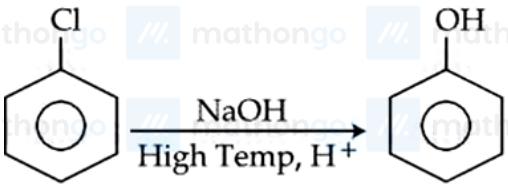


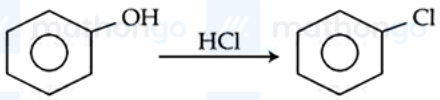

Consider the above reaction sequence and identify the major product *P*.
(1) Methoxymethane (2) Methanoic acid
(3) Methanal (4) Methane

**Q49.** Which one of the following reactions is NOT possible?

(1) 


(2) 


(3) 


(4) 


**Q50.** Coagulation of egg, on heating is because of :

(1) The secondary structure of protein remains unchanged
(2) Denaturation of protein occurs
(3) Biological property of protein remains unchanged
(4) Breaking of the peptide linkage in the primary structure of protein occurs

**Q51.** In an atom, total number of electrons having quantum numbers $n = 4, |m_l| = 1$ and $m_s = -\frac{1}{2}$ is _____

**Q52.** Number of compounds from the following with zero dipole moment is _____
$HF, H_2, H_2S, CO_2, NH_3, BF_3, CH_4, CHCl_3, SiF_4, H_2O, BeF_2$

**Q53.** Combustion of 1 mole of benzene is expressed at $C_6H_6(l) + \frac{15}{2}O_2(g) \rightarrow 6CO_2(g) + 3H_2O(l)$. The standard enthalpy of combustion of 2 mol of benzene is $-'x'$kJ. $x =$ _____ Given: 1. standard Enthalpy of formation of 1 mol of $C_6H_6(l)$, for the reaction 6C (graphite) $+3H_2(g) \rightarrow C_6H_6(l)$ is 48.5 kJ $mol^{-1}$. 2. Standard Enthalpy of formation of 1 mol of $CO_2(g)$, for the reaction C (graphite) $+O_2(g) \rightarrow CO_2(g)$ is $-393.5$ kJ $mol^{-1}$. 3. Standard and Enthalpy of formation of 1 mol of $H_2O(l)$, for the reaction $H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l)$ is $-286$ kJ $mol^{-1}$.

**Q54.** Using the given figure, the ratio of $R_f$ values of sample A and sample C is $x \times 10^{-2}$. Value of $x$ is _____

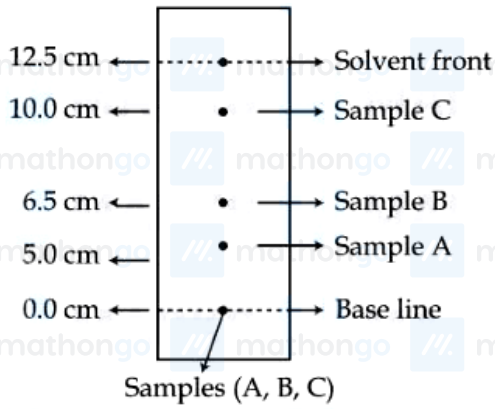


Fig : Paper chromatography of Samples

**Q55.** Considering acetic acid dissociates in water, its dissociation constant is $6.25 \times 10^{-5}$. If 5 mL of acetic acid is dissolved in 1 litre water, the solution will freeze at $-x \times 10^{-2}$°C, provided pure water freezes at 0°C. $x =$ _____ . (Nearest integer) Given : $(K_f)_{water} = 1.86$ K kg $mol^{-1}$. density of acetic acid is 1.2 g $mol^{-1}$. molar mass of water $= 18$ g $mol^{-1}$. molar mass of acetic acid=60 g$mol^{-1}$. density of water $= 1$ g $cm^{-3}$ Acetic acid dissociates as

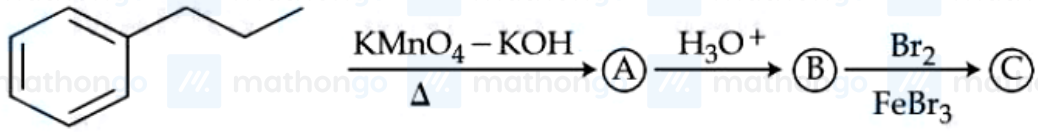
$CH_3COOH \rightleftharpoons CH_3COO^{\ominus} + H^{\oplus}$

**Q56.** Consider the following single step reaction in gas phase at constant temperature. $2A_{(g)} + B_{(g)} \rightarrow C_{(g)}$ The initial rate of the reaction is recorded as $r_1$ when the reaction starts with 1.5 atm pressure of A and 0.7 atm pressure of B. After some time, the rate $r_2$ is recorded when the pressure of C becomes 0.5 atm. The ratio $r_1 : r_2$ is _____ $\times 10^{-1}$. (Nearest integer)

**Q57.** The fusion of chromite ore with sodium carbonate in the presence of air leads to the formation of products A and B along with the evolution of $CO_2$. The sum of spin-only magnetic moment values of $A$ and $B$ is _____ B.M. (Nearest integer) [Given atomic number : C : 6, Na : 11, O : 8, Fe : 26, Cr : 24]

**Q58.** In the Claisen-Schmidt reaction to prepare 351 g of dibenzalacetone using 87 g of acetone, the amount of benzaldehyde required is _____ g. (Nearest integer)

**Q59.** The product (C) in the following sequence of reactions has _____ $\pi$ bonds.




**Q60.** Xg of ethanamine was subjected to reaction with $NaNO_2/HCl$ followed by hydrolysis to liberate $N_2$ and HCl. The HCl generated was completely neutralised by 0.2 moles of NaOH. $X$ is _____ g.

**Q61.** Let $S_1 = \{z \in C : |z| \leq 5\}, S_2 = \left\{z \in C : \text{Im}\left(\frac{z+1-\sqrt{3}i}{1-\sqrt{3}i}\right) \geq 0\right\}$ and $S_3 = \{z \in C : \text{Re}(z) \geq 0\}$. Then the area of the region $S_1 \cap S_2 \cap S_3$ is :

(1) $\frac{125\pi}{12}$ (2) $\frac{125\pi}{4}$

(3) $\frac{125\pi}{24}$ (4) $\frac{125\pi}{6}$

**Q62.** 60 words can be made using all the letters of the word BHBJO, with or without meaning. If these words are written as in a dictionary, then the $50^{\text{th}}$ word is :

(1) JBBOH (2) OBBJH

(3) OBBHJ (4) HBBJO

**Q63.** For $x \geqslant 0$, the least value of K, for which $4^{1+x} + 4^{1-x}, \frac{K}{2}, 16^x + 16^{-x}$ are three consecutive terms of an A.P., is equal to :

(1) 8 (2) 4

(3) 10 (4) 16

**Q64.** If the constant term in the expansion of $\left(\frac{\sqrt[5]{3}}{x} + \frac{2x}{\sqrt[3]{5}}\right)^{12}, x \neq 0$, is $\alpha \times 2^8 \times \sqrt[5]{3}$, then $25\alpha$ is equal to :

(1) 724 (2) 742

(3) 639 (4) 693

**Q65.** Let $A(-1, 1)$ and $B(2, 3)$ be two points and $P$ be a variable point above the line $AB$ such that the area of $\triangle$PAB is 10 . If the locus of P is a$x$ + b$y$ = 15, then 5a + 2 b is :

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

(3) 4 (4) $-\frac{12}{5}$

**Q66.** Let $ABCD$ and $AEFG$ be squares of side 4 and 2 units, respectively. The point $E$ is on the line segment AB and the point F is on the diagonal AC. Then the radius r of the circle passing through the point F and touching the line segments BC and CD satisfies:

(1) $r = 0$ (2) $2r^2 - 4r + 1 = 0$

(3) $2r^2 - 8r + 7 = 0$ (4) $r^2 - 8r + 8 = 0$

**Q67.** Let the circle $C_1 : x^2 + y^2 - 2(x + y) + 1 = 0$ and $C_2$ be a circle having centre at $(-1, 0)$ and radius 2 . If the line of the common chord of $C_1$ and $C_2$ intersects the $y$-axis at the point P, then the square of the distance of P from the centre of $C_1$ is :

(1) 2 (2) 1

(3) 4 (4) 6

**Q68.** Let the set $S = \{2, 4, 8, 16, \ldots, 512\}$ be partitioned into 3 sets $A, B, C$ with equal number of elements such that $A \cup B \cup C = S$ and $A \cap B = B \cap C = A \cap C = \phi$. The maximum number of such possible partitions of $S$ is equal to:

(1) 1680 (2) 1640

(3) 1520 (4) 1710

**Q69.** Let $\alpha\beta \neq 0$ and $A = \begin{bmatrix} \beta & \alpha & 3 \\ \alpha & \alpha & \beta \\ -\beta & \alpha & 2\alpha \end{bmatrix}$. If $B = \begin{bmatrix} 3\alpha & -9 & 3\alpha \\ -\alpha & 7 & -2\alpha \\ -2\alpha & 5 & -2\beta \end{bmatrix}$ is the matrix of cofactors of the elements of $A$, then $\det(AB)$ is equal to :

(1) 64 (2) 216

(3) 343 (4) 125

**Q70.** The values of $m, n$, for which the system of equations $\begin{matrix} x + y + z = 4, \\ 2x + 5y + 5z = 17, \\ x + 2y + \mathrm{m}z = \mathrm{n} \end{matrix}$ has infinitely many solutions, satisfy the equation:

(1) $m^2 + n^2 - mn = 39$ (2) $m^2 + n^2 - m - n = 46$

(3) $m^2 + n^2 + m + n = 64$ (4) $m^2 + n^2 + mn = 68$

**Q71.** Let $f, g : \mathbf{R} \to \mathbf{R}$ be defined as : $f(x) = |x - 1|$ and $g(x) = \begin{cases} \mathrm{e}^x, \text{ MARA} & x \geq 0 \\ x + 1, & x \leq 0 \end{cases}$

Then the function $f(g(x))$ is

(1) neither one-one nor onto. (2) one-one but not onto.

(3) onto but not one-one. (4) both one-one and onto.

**Q72.** Let $f : [-1, 2] \to \mathbf{R}$ be given by $f(x) = 2x^2 + x + \left[x^2\right] - [x]$, where $[t]$ denotes the greatest integer less than or equal to $t$. The number of points, where $f$ is not continuous, is :

(1) 5 (2) 6

(3) 3 (4) 4

**Q73.** If $y(\theta) = \frac{2\cos\theta + \cos 2\theta}{\cos 3\theta + 4\cos 2\theta + 5\cos\theta + 2}$, then at $\theta = \frac{\pi}{2}$, $y'' + y' + y$ is equal to :

(1) $\frac{1}{2}$ (2) 1

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

**Q74.** Let $\beta(\mathrm{m}, \mathrm{n}) = \int_0^1 x^{\mathrm{m}-1}(1 - x)^{\mathrm{n}-1}\, \mathrm{d}x,\ \mathrm{m}, \mathrm{n} > 0$. If $\int_0^1 \left(1 - x^{10}\right)^{20}\, \mathrm{d}x = \mathrm{a} \times \beta(\mathrm{b}, \mathrm{c})$, then $100(\mathrm{a} + \mathrm{b} + \mathrm{c})$ equals____

(1) 1021 (2) 2120

(3) 2012 (4) 1120

**Q75.** The area enclosed between the curves $y = x|x|$ and $y = x - |x|$ is :

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

(3) $\frac{2}{3}$ (4) $\frac{8}{3}$

**Q76.** The differential equation of the family of circles passing through the origin and having centre at the line $y = x$ is :

(1) $\left(x^2 - y^2 + 2xy\right)\mathrm{d}x = \left(x^2 - y^2 - 2xy\right)\mathrm{d}y$ (2) $\left(x^2 + y^2 + 2xy\right)\mathrm{d}x = \left(x^2 + y^2 - 2xy\right)\mathrm{d}y$

(3) $\left(x^2 + y^2 - 2xy\right)\mathrm{d}x = \left(x^2 + y^2 + 2xy\right)\mathrm{d}y$ (4) $\left(x^2 - y^2 + 2xy\right)\mathrm{d}x = \left(x^2 - y^2 + 2xy\right)\mathrm{d}y$

**Q77.** Consider three vectors $\vec{a}, \vec{b}, \vec{c}$. Let $|\vec{a}| = 2, |\vec{b}| = 3$ and $\vec{a} = \vec{b} \times \vec{c}$. If $\alpha \in \left[0, \frac{\pi}{3}\right]$ is the angle between the vectors $\vec{b}$ and $\vec{c}$, then the minimum value of $27|\vec{c} - \vec{a}|^2$ is equal to:

(1) 110 (2) 124

(3) 121 (4) 105

**Q78.** Let $\overrightarrow{\mathrm{a}} = 2\hat{i} + 5\hat{j} - \hat{k}, \overrightarrow{\mathrm{b}} = 2\hat{i} - 2\hat{j} + 2\hat{k}$ and $\overrightarrow{\mathrm{c}}$ be three vectors such that $(\vec{c} + \hat{i}) \times (\vec{a} + \vec{b} + \hat{i}) = \vec{a} \times (\vec{c} + \hat{i})$. If $\vec{a} \cdot \vec{c} = -29$, then $\vec{c} \cdot (-2\hat{i} + \hat{j} + \hat{k})$ is equal to:

(1) 15 (2) 12

(3) 10 (4) 5

**Q79.** Let $(\alpha, \beta, \gamma)$ be the image of the point $(8, 5, 7)$ in the line $\frac{x-1}{2} = \frac{y+1}{3} = \frac{z-2}{5}$. Then $\alpha + \beta + \gamma$ is equal to :

(1) 16 (2) 20

(3) 14 (4) 18

**Q80.** The coefficients $a, b, c$ in the quadratic equation $ax^2 + bx + c = 0$ are from the set $\{1, 2, 3, 4, 5, 6\}$. If the probability of this equation having one real root bigger than the other is $p$, then 216 p equals :

(1) 57 (2) 76

(3) 38 (4) 19

**Q81.** The number of real solutions of the equation $x|x + 5| + 2|x + 7| - 2 = 0$ is_____

**Q82.** If $1 + \frac{\sqrt{3}-\sqrt{2}}{2\sqrt{3}} + \frac{5-2\sqrt{6}}{18} + \frac{9\sqrt{3}-11\sqrt{2}}{36\sqrt{3}} + \frac{49-20\sqrt{6}}{180} + \ldots$ upto $\infty = 2 + \left(\sqrt{\frac{b}{a}} + 1\right) \log_e\left(\frac{a}{b}\right)$, where a and b are integers with $\gcd(\mathrm{a}, \mathrm{b}) = 1$, then $11\mathrm{a} + 18\,\mathrm{b}$ is equal to _____

**Q83.** The number of solutions of $\sin^2 x + \left(2 + 2x - x^2\right)\sin x - 3(x-1)^2 = 0$, where $-\pi \leq x \leq \pi$, is_____

**Q84.** Let a line perpendicular to the line $2x - y = 10$ touch the parabola $y^2 = 4(x - 9)$ at the point $P$. The distance of the point $P$ from the centre of the circle $x^2 + y^2 - 14x - 8y + 56 = 0$ is _____

**Q85.** Let $\mathrm{a} > 0$ be a root of the equation $2x^2 + x - 2 = 0$. If $\lim_{x \to \frac{1}{\mathrm{a}}} \frac{16(1-\cos(2+x-2x^2))}{(1-\mathrm{a}x)^2} = \alpha + \beta\sqrt{17}$, where $\alpha, \beta \in Z$, then $\alpha + \beta$ is equal to_____

**Q86.** Let the mean and the standard deviation of the probability distribution

| X | $\alpha$ | 1 | 0 | $-3$ |
|---|---|---|---|---|
| P(X) | $\frac{1}{3}$ | K | $\frac{1}{6}$ | $\frac{1}{4}$ |

be $\mu$ and $\sigma$, respectively. If $\sigma - \mu = 2$, then $\sigma + \mu$ is equal to_____

**Q87.** Let the maximum and minimum values of $\left(\sqrt{8x-x^2-12}-4\right)^2+(x-7)^2, x \in \mathbf{R}$ be M and m, respectively. Then $M^2-m^2$ is equal to _____

**Q88.** If $f(t)=\int_0^{\pi} \frac{2x\,dx}{1-\cos^2 t \sin^2 x}, 0<t<\pi$, then the value of $\int_0^{\frac{\pi}{2}} \frac{\pi^2 dt}{f(t)}$ equals_____

**Q89.** Let $y=y(x)$ be the solution of the differential equation $\frac{dy}{dx}+\frac{2x}{(1+x^2)^2}y=xe^{\frac{1}{(1+x^2)}}; y(0)=0$. Then the area enclosed by the curve $f(x)=y(x)e^{-\frac{1}{(1+x^2)}}$ and the line $y-x=4$ is_____

**Q90.** Let the point $(-1,\alpha,\beta)$ lie on the line of the shortest distance between the lines $\frac{x+2}{-3}=\frac{y-2}{4}=\frac{z-5}{2}$ and $\frac{x+2}{-1}=\frac{y+6}{2}=\frac{z-1}{0}$. Then $(\alpha-\beta)^2$ is equal to_____

## ANSWER KEYS

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **1.** (3) | **2.** (3) | **3.** (4) | **4.** (2) | **5.** (2) | **6.** (2) | **7.** (2) | **8.** (3) |
| **9.** (3) | **10.** (4) | **11.** (3) | **12.** (2) | **13.** (1) | **14.** (3) | **15.** (1) | **16.** (3) |
| **17.** (2) | **18.** (2) | **19.** (3) | **20.** (2) | **21.** (16) | **22.** (2) | **23.** (1000) | **24.** (60) |
| **25.** (16) | **26.** (5) | **27.** (500) | **28.** (4) | **29.** (275) | **30.** (6588) | **31.** (4) | **32.** (4) |
| **33.** (1) | **34.** (1) | **35.** (2) | **36.** (3) | **37.** (2) | **38.** (4) | **39.** (3) | **40.** (3) |
| **41.** (2) | **42.** (4) | **43.** (2) | **44.** (1) | **45.** (3) | **46.** (2) | **47.** (3) | **48.** (4) |
| **49.** (4) | **50.** (2) | **51.** (6) | **52.** (6) | **53.** (6535) | **54.** (50) | **55.** (19) | **56.** (315) |
| **57.** (6) | **58.** (318) | **59.** (4) | **60.** (9) | **61.** (1) | **62.** (2) | **63.** (3) | **64.** (4) |
| **65.** (4) | **66.** (4) | **67.** (1) | **68.** (1) | **69.** (2) | **70.** (1) | **71.** (1) | **72.** (4) |
| **73.** (3) | **74.** (2) | **75.** (1) | **76.** (1) | **77.** (2) | **78.** (4) | **79.** (3) | **80.** (3) |
| **81.** (3) | **82.** (76) | **83.** (2) | **84.** (10) | **85.** (170) | **86.** (5) | **87.** (1600) | **88.** (1) |
| **89.** (18) | **90.** (25) | | | | | | |