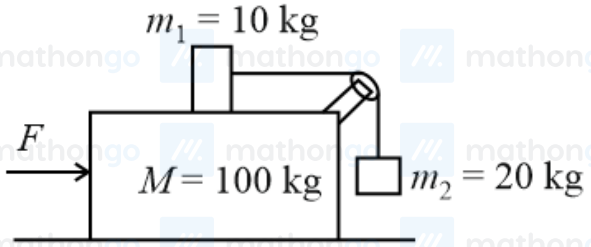
**Q1.** Two projectile thrown at $30^{\circ}$ and $45^{\circ}$ with the horizontal respectively, reach the maximum height in same time. The ratio of their initial velocities is

(1) $1 : \sqrt{2}$ (2) $2 : 1$

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

**Q2.** Three masses $M = 100$ kg, $m_1 = 10$ kg and $m_2 = 20$ kg are arranged in a system as shown in figure. All the surfaces are frictionless and strings are inextensible and weightless. The pulleys are also weightless and frictionless. A force $F$ is applied on the system so that the mass $m_2$ moves upward with an acceleration of $2\ \text{ms}^{-2}$. The value of $F$ is

(Take $g = 10\ \text{ms}^{-2}$)




(1) 3360 N (2) 3380 N

(3) 3120N (4) 3240N

**Q3.** A monkey of mass 50 kg climbs on a rope which can withstand the tension $(T)$ of 350 N. If monkey initially climbs down with an acceleration of 4 m $s^{-2}$ and then climbs up with an acceleration of 5 m $s^{-2}$. Choose the correct option $\left(g = 10\ \text{m s}^{-2}\right)$

(1) $T = 700$ N while climbing upward (2) $T = 350$ N while going downward

(3) Rope will break while climbing upward (4) Rope will break while going downward

**Q4.** As per the given figure, two blocks each of mass 250 g are connected to a spring of spring constant 2 N $m^{-1}$. If both are given velocity $v$ in opposite directions, then maximum elongation of the spring is


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

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

**Q5.** The percentage decrease in the weight of a rocket, when taken to a height of 32 km above the surface of earth will, be

(Radius of earth $= 6400$ km)

(1) 1% (2) 3%

(3) 4% (4) 0.5%

**Q6.** A water drop of radius 1 cm is broken into 729 equal droplets. If surface tension of water is 75 dyne $cm^{-1}$, then the gain in surface energy upto first decimal place will be

[Given $\pi = 3.14$]

(1) $8.5 \times 10^{-4}$ J (2) $8.2 \times 10^{-4}$ J
(3) $7.5 \times 10^{-4}$ J (4) $5.3 \times 10^{-4}$ J

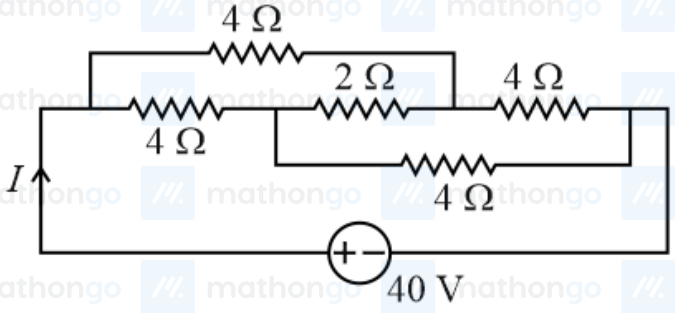
**Q7.** 7 mole of certain monoatomic ideal gas undergoes a temperature increase of 40 K at constant pressure. The increase in the internal energy of the gas in this process is
(Given $R = 8.3$ J K$^{-1}$ mol$^{-1}$)
(1) 5810 J (2) 3486 J
(3) 11620 J (4) 6972 J

**Q8.** A monoatomic gas at pressure $P$ and volume $V$ is suddenly compressed to one eighth of its original volume. The final pressure at constant entropy will be
(1) $P$ (2) $8P$
(3) $32P$ (4) $64P$

**Q9.** When a particle executes simple Harmonic motion, the nature of graph of velocity as function of displacement will be
(1) Circular (2) Ellipitical
(3) Sinusoidal (4) Straight line

**Q10.** The total charge on the system of capacitance $C_1 = 1\mu F, C_2 = 2\mu F, C_3 = 4\mu F$ and $C_4 = 3\mu F$ connected in parallel is
(Assume a battery of 20 V is connected to the combination)
(1) $200\mu C$ (2) 200C
(3) $10\mu C$ (4) 10C

**Q11.** The current $I$ in the given circuit will be




(1) 10A (2) 20A
(3) 4A (4) 40A

**Q12.** A charge particle is moving in a uniform magnetic field $\left(2\hat{i} + 3\hat{j}\right)$ T. If it has an acceleration of $\left(\alpha\hat{i} - 4\hat{j}\right)$ m s$^{-2}$, then the value of $\alpha$ will be
(1) 3 (2) 6
(3) 12 (4) 2

**Q13.** $B_X$ and $B_Y$ are the magnetic field at the centre of two coils of two coils $X$ and $Y$ respectively, each carrying equal current. If coil $X$ has 200 turns and 20 cm radius and coil $Y$ has 400 turns and 20 cm radius, the ratio of $B_X$ and $B_Y$ is

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

**Q14.** In a series $LR$ circuit $X_L = R$ and power factor of the circuit is $P_1$. When capacitor with capacitance $C$ such that $X_L = X_C$ is put in series, the power factor becomes $P_2$. The ratio $\frac{P_1}{P_2}$ is
(1) $\frac{1}{2}$ (2) $\frac{1}{\sqrt{2}}$
(3) $\frac{\sqrt{3}}{\sqrt{2}}$ (4) $2:1$

**Q15.** The magnetic field of a plane electromagnetic wave is given by $\overrightarrow{B} = 2 \times 10^{-8} \sin\left(0.5 \times 10^3 x + 1.5 \times 10^{11} t\right)\hat{j}$ T. The amplitude of the electric field would be
(1) $6\ \mathrm{Vm}^{-1}$ along $x$-axis (2) $3\ \mathrm{Vm}^{-1}$ along $z$-axis
(3) $6\ \mathrm{Vm}^{-1}$ along $z$-axis (4) $2 \times 10^{-8}\ \mathrm{Vm}^{-1}$ along $z$-axis

**Q16.** In young's double slit experiment, the fringe width is 12 mm. If the entire arrangement is placed in water of refractive index $\frac{4}{3}$, then the fringe width becomes (in mm)
(1) 16 (2) 9
(3) 48 (4) 12

**Q17.** A parallel beam of light of wavelength 900 nm and intensity $100\ \mathrm{Wm}^{-2}$ is incident on a surface perpendicular to the beam. The number of photons crossing 1 $\mathrm{cm}^2$ area perpendicular to the beam in one second is
(1) $3 \times 10^{16}$ (2) $4.5 \times 10^{16}$
(3) $4.5 \times 10^{17}$ (4) $4.5 \times 10^{20}$

**Q18.** The disintegration rate of a certain radioactive sample at any instant is 4250 disintegrations per minute. 10 minutes later, the rate becomes 2250 disintegrations per minute. The approximate decay constant is
(Take $\log_e 1.88 = 0.63$)
(1) $0.02\ \mathrm{min}^{-1}$ (2) $2.7\ \mathrm{min}^{-1}$
(3) $0.063\ \mathrm{min}^{-1}$ (4) $6.3\ \mathrm{min}^{-1}$

**Q19.** A radio can tune to any station in 6 MHz to 10 MHz band. The value of corresponding wavelength bandwidth will be
(1) 4 m (2) 20 m
(3) 30 m (4) 50 m

**Q20.** A screw gauge of pitch 0.5 mm is used to measure the diameter of uniform wire of length 6.8 cm, the main scale reading is 1.5 mm and circular scale reading is 7. The calculated curved surface area of wire to appropriate significant figures is
[Screw gauge has 50 divisions on the circular scale]
(1) $6.8\ \mathrm{cm}^2$ (2) $3.4\ \mathrm{cm}^2$
(3) $3.9\ \mathrm{cm}^2$ (4) $2.4\ \mathrm{cm}^2$

**Q21.** In an experiment of determine the Young's modulus of wire of a length exactly 1 m, the extension in the length of the wire is measured as 0.4 mm with an uncertainty of $\pm 0.02$ mm when a load of 1 kg is applied. The

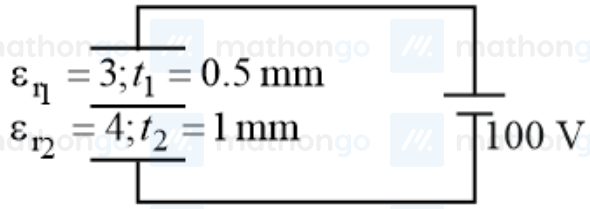
diameter of the wire is measured as $0.4$ mm with an uncertainty of $\pm 0.01$ mm. The error in the measurement of Young's modulus $(\Delta Y)$ is found to be $x \times 10^{10}$ N m$^{-2}$. The value of $x$ is _____ .

**Q22.** If the initial velocity in horizontal direction of a projectile is unit vector $\hat{i}$ and the equation of trajectory is $y = 5x(1-x)$. The $y$ component vector of the initial velocity is _____ $\hat{j}$
(Take $g = 10$ m s$^{-2}$)

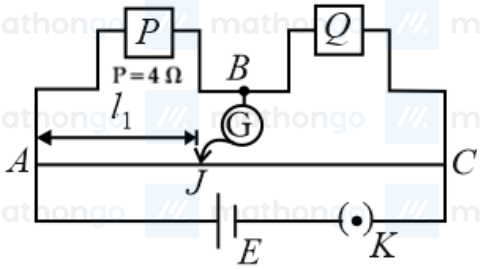
**Q23.** A disc of mass $1$ kg and radius $R$ is free of rotate about a horizontal axis passing through its centre and perpendicular to the plane of disc. A body of same mass as that of disc is fixed at the highest point of the disc. Now the system is released, when the body comes to the lowest position, its angular speed will be $4\sqrt{\frac{x}{3R}}$ rad s$^{-1}$ where $x =$ _____ .

**Q24.** When a car is approaching the observer, the frequency of horn is $100$ Hz. After passing the observer, it is $50$ Hz. If the observer moves with the car, the frequency will be $\frac{x}{3}$Hz where $x =$_____ .

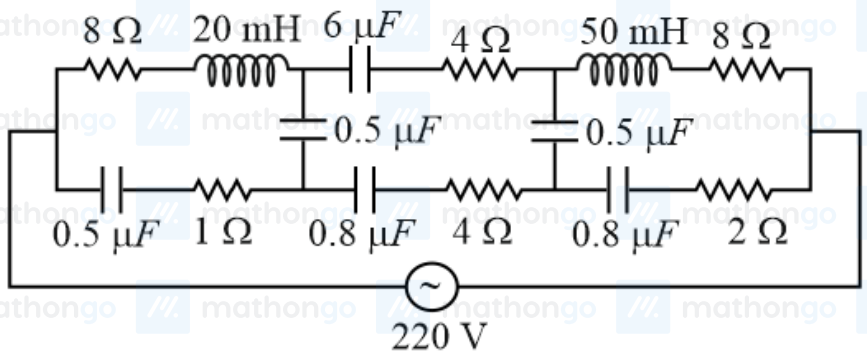
**Q25.** A composite parallel plate capacitor is made up of two different dielectric materials with different thickness ($t_1$ and $t_2$) as shown in figure. The two different dielectric material are separated by a conducting foil $F$. The voltage of the conducting foil is _____ V.




**Q26.** Resistance are connected in a meter bridge circuit as shown in the figure. The balancing length $l_1$ is $40$ cm. Now an unknown resistance $x$ is connected in series with $P$ and new balancing length is found to be $80$ cm measured from the same end. Then the value of $x$ will be _____ Ω.

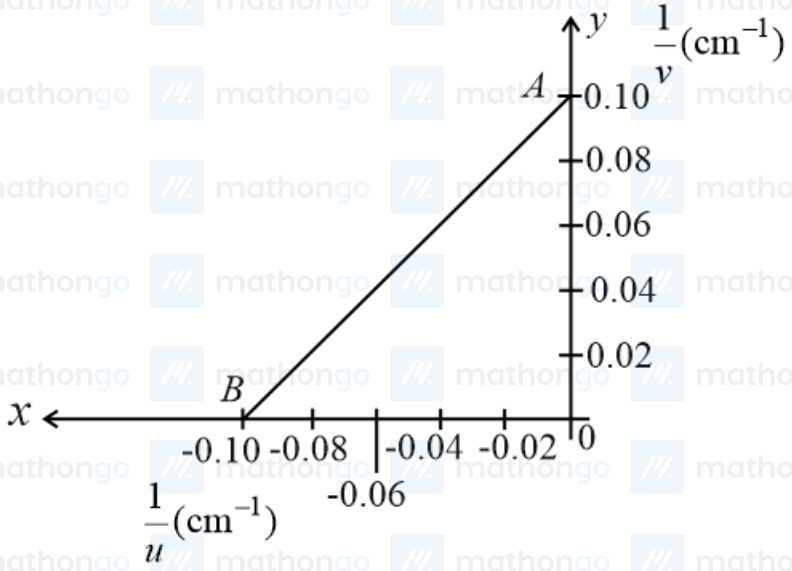



**Q27.** The effective current $I$ in the given circuit at very high frequencies will be _____ A.



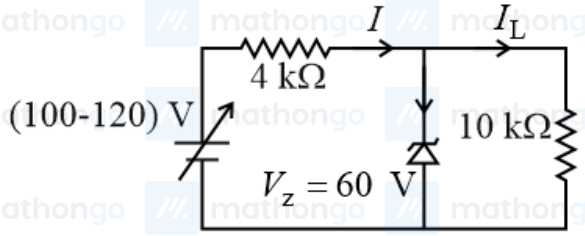

**Q28.** The graph between $\frac{1}{u}$ and $\frac{1}{v}$ for a thin convex lens in order to determine its focal length is plotted as shown in the figure. The refractive index of lens is $1.5$ and its both the surfaces have same radius of curvatures $R$. The value of $R$ will be _____ cm.

(Where $u$ = object distance, $v$ = image distance)




**Q29.** In a hydrogen spectrum $\lambda$ be the wavelength of first transition line of Lyman series. The wavelength difference will be "a$\lambda$" between the wavelength of $3^{rd}$ transition line of Paschen series and that of $2^{nd}$ transition line of Balmer Series where a = _____.

**Q30.** In the circuit shown below, maximum Zener diode current will be _____ mA.




**Q31.** Given two statements below :

Statement I : In $Cl_2$ molecule the covalent radius is double of the atomic radius of chlorine.

Statement II : Radius of anionic species is always greater than their parent atomic radius.

Choose the most appropriate answer from options given below

(1) Both Statement I and Statement II are correct.

(2) Both Statement I and Statement II are incorrect.

(3) Statement I is correct but Statement II is incorrect.

(4) Statement I is incorrect but Statement II is correct.

**Q32.** Match List - I with List - II.

| | **List-I (Compound)** | | **List-II (Shape)** |
|---|---|---|---|
| A | $BrF_5$ | I | bent |
| B | $[CrF_6]^{3-}$ | II | square pyramidal |
| C | $O_3$ | III | trigonal bipyramidal |
| D | $PCl_5$ | IV | octahedral |

Choose the correct answer from the options given below

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

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

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

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

**Q33.** Which of the given reactions is not an example of disproportionation reaction?

(1) $2H_2O_2 \rightarrow 2H_2O + O_2$

(2) $2\,NO_2 + H_2O \rightarrow HNO_3 + HNO_2$

(3) $MnO_4^- + 4H^+ + 3e^- \rightarrow MnO_2 + 2H_2O$

(4) $3\,MnO_4{}^{2-} + 4H^+ \rightarrow 2\,MnO_4{}^- + MnO_2 + 2H_2O$

**Q34.** Which of the following can be used to prevent the decomposition of $H_2O_2$?

(1) Urea

(2) Formaldehyde

(3) Formic acid

(4) Ethanol

**Q35.** Reaction of $BeCl_2$ with $LiAlH_4$ gives :

(A) $AlCl_3$

(B) $BeH_2$

(C) LiH

(D) LiCl

(E) $BeAlH_4$

Choose the correct answer from options given below

(1) (A), (D) & (E)

(2) (A), (B) & (D)

(3) (D) & (E)

(4) (B), (C) & (D)

**Q36.** Borazine, also known as inorganic benzene, can be prepared by the reaction of 3-equivalents of "X" with 6-equivalents of "Y". "X" and "Y", respectively are

(1) $B(OH)_3$ and $NH_3$

(2) $B_2H_6$ and $NH_3$

(3) $B_2H_6$ and $HN_3$

(4) $NH_3$ and $B_2O_3$

**Q37.** Which technique among the following, is most appropriate in separation of a mixture of 100 mg of p-nitrophenol and picric acid?

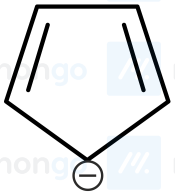
(1) Steam distillation

(2) $2-5$ ft long column of silica gel

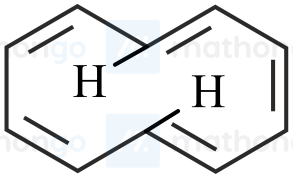
(3) Sublimation

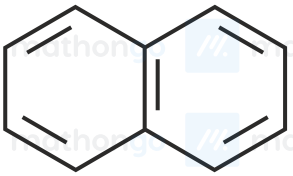
(4) Preparative TLC (Thin Layer Chromatography)

**Q38.** Which of the following compounds is not aromatic?

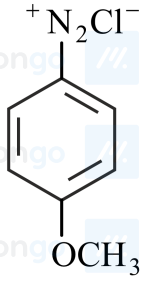
(1) 

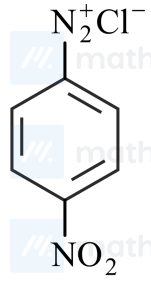
(2) 

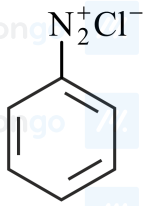
(3) 

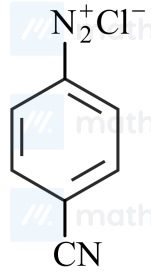

(4) 

**Q39.** The correct stability order of the following diazonium salt is

(A) 


(B) 


(C) 


(D) 

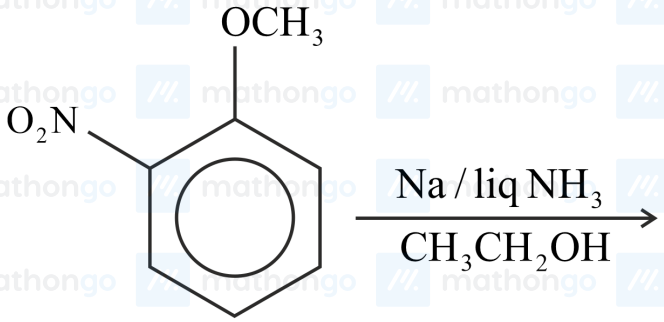

(1) (A) > (B) > (C) > (D)
(2) (A) > (C) > (D) > (B)
(3) (C) > (A) > (D) > (B)
(4) (C) > (D) > (B) > (A)

**Q40.** $\dot{Cl} + CH_4 \rightarrow A + B$

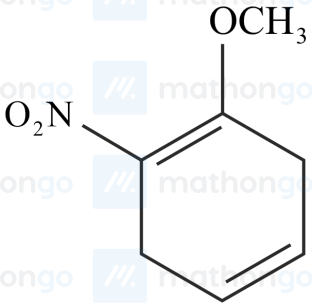
A and B in the above atmospheric reaction step are

(1) $C_2H_6$ and $Cl_2$
(2) $\dot{C}HCl_2$ and $H_2$
(3) $C\dot{H}_3$ and HCl
(4) $C_2H_6$ and HCl

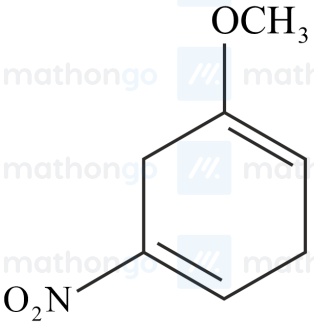
**Q41.** The major product formed in the given reaction is:



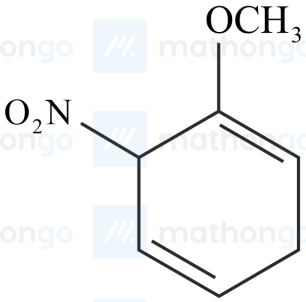

(1)



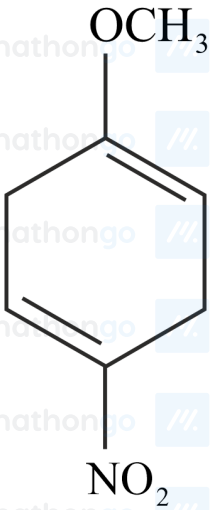

(2)




(3)




(4)




**Q42.** Match List - I with List - II.

| **List –I (Processes/Reactions)** | | **List-II (Catalyst)** |
|---|---|---|
| A | $2\,SO_2(g) + O_2(g) \rightarrow 2\,SO_3(g)$ | I $Fe(s)$ |
| B | $4\,NH_3(g) + 5O_2(g) \rightarrow 4\,NO(g) + 6H_2O(g)$ | II $Pt(s) - Rh(s)$ |
| C | $N_2(g) + 3H_2(g) \rightarrow 2\,NH_3(g)$ | III $V_2O_5$ |
| D | Vegetable oil $(l) + H_2 \rightarrow$ Vegetable ghee(s) | IV $Ni(s)$ |

Choose the correct answer from the options given below

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

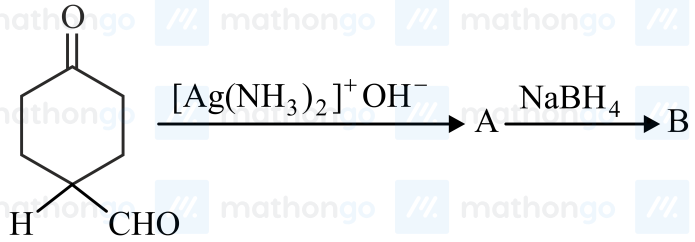
**Q43.** Refining using liquation method is the most suitable for metals with
(1) Low melting point (2) High boiling point
(3) High electrical conductivity (4) Less tendency to be soluble in melts than impurities

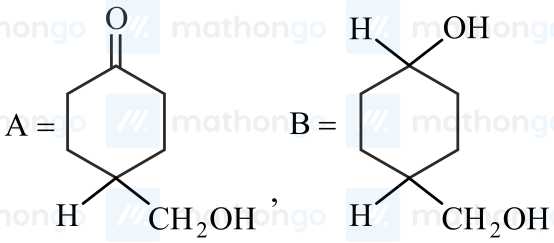
**Q44.** The dark purple colour of $KMnO_4$ disappears in the titration with oxalic acid in acidic medium. The overall change in the oxidation number of manganese in the reaction is
(1) 5 (2) 1
(3) 7 (4) 2

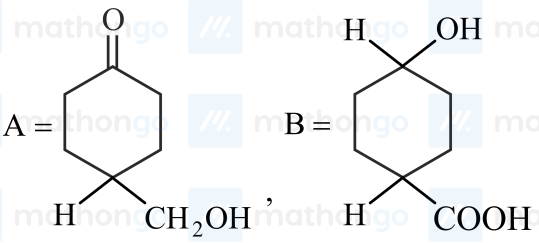
**Q45.** Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A) : Experimental reaction of $CH_3Cl$ with aniline and anhydrous $AlCl_3$ does not give o and p-methylaniline.
Reason (R) : The $-NH_2$ group of aniline becomes deactivating because of salt formation with anhydrous $AlCl_3$ and hence yields m-methyl aniline as the product.
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 true, but (R) is false. (4) (A) is false, but (R) is true.

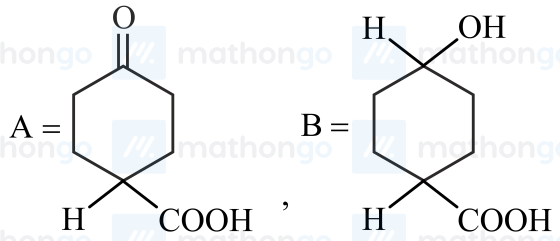
**Q46.** The difference in the reaction of phenol with bromine in chloroform and bromine in water medium is due to
(1) Hyperconjugation in substrate (2) Polarity of solvent
(3) Free radical formation (4) Electromeric effect of the substrate

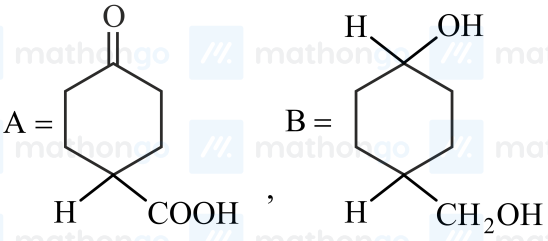
**Q47.** The products formed in the following reaction, A and B are



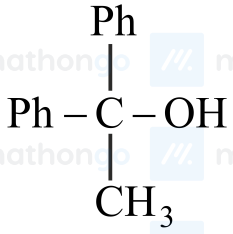
(1) 

(2) 

(3) 

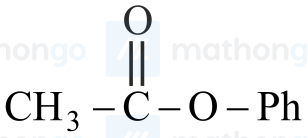
(4) 

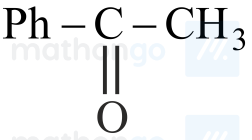
**Q48.** Which reactant will give the following alcohol on reaction with one mole of phenyl magnesium bromide (PhMgBr) followed by acidic hydrolysis?



(1) $CH_3 - C \equiv N$

(2) $Ph - C \equiv N$

(3) 

(4) 

**Q49.** Stearic acid and polyethylene glycol react to form which one of the following soap/s detergents?

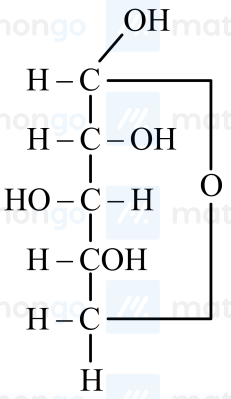
(1) Cationic detergent

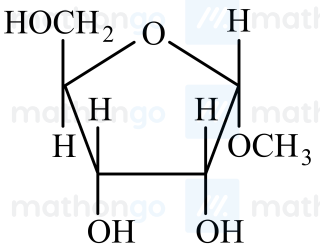
(2) Soap

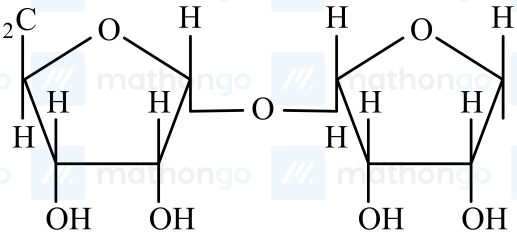
(3) Anionic detergent

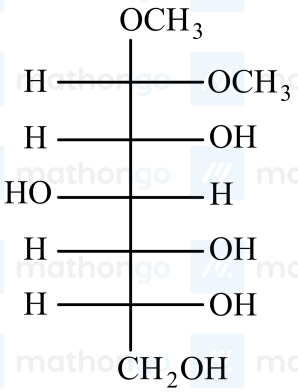
(4) Non-ionic detergent

**Q50.** Which of the following is reducing sugar?

(1)


(2)


(3)


(4)


**Q51.** Chlorophyll extracted from the crushed green leaves was dissolved in water to make 2 L solution of Mg of concentration 48ppm. The number of atoms of Mg in this solution is $x \times 10^{20}$ atoms. The value of x is (Nearest Integer) (Given : Atomic mass of Mg is 24 g $mol^{-1}$, $N_A = 6.02 \times 10^{23}$ $mol^{-1}$)

**Q52.** When 800 mL of 0.5M nitric acid is heated in a beaker, its volume is reduced to half and 11.5 g of nitric acid is evaporated. The molarity of the remaining nitric acid solution is $x \times 10^{-2}$M. (Molar mass of nitric acid is 63 g $mol^{-1}$)

**Q53.** The wavelength of an electron and a neutron will become equal when the velocity of the electron is x times the velocity of neutron. The value of x is____(the nearest integer)(Mass of electron is $9.1 \times 10^{-31}$ kg and mass of neutron is $1.6 \times 10^{-27}$ kg)

**Q54.** A mixture of hydrogen and oxygen contains 40% hydrogen by mass when the pressure is 2.2 bar. The partial pressure of hydrogen is bar.

**Q55.** 2.4 g coal is burnt in a bomb calorimeter in excess of oxygen at 298 K and 1 atm pressure.
The temperature of the calorimeter rises from 298 K to 300 K. The enthalpy change during the combustion of coal is $-x$ kJ $mol^{-1}$. The value of x is_____(Given : Heat capacity of bomb calorimeter 20.0 $kJK^{-1}$. Assume coal to be pure carbon)

**Q56.** At 298 K, the equilibrium constant is $2 \times 10^{15}$ for the reaction:
$Cu(s) + 2\,Ag^+(aq) \rightleftharpoons Cu^{2+}(aq) + 2\,Ag(s)$
The equilibrium constant for the reaction
$\frac{1}{2}Cu^{2+}(aq) + Ag(s) \rightleftharpoons \frac{1}{2}Cu(s) + Ag^+(aq)$ is $x \times 10^{-8}$. The value of x is _____. (Round off the answer to the nearest integer)

**Q57.** In the presence of sunlight, benzene reacts with $Cl_2$ to give product, X. The number of hydrogens in X is

**Q58.** The amount of charge in F (Faraday) required to obtain one mole of iron from $Fe_3O_4$ is _____. (Round off the answer to the nearest integer)

**Q59.** For a reaction $A \rightarrow 2B + C$ the half lives are 100 s and 50 s when the concentration of reactant A is $0.5$ and $1.0$ mol $L =$ respectively. The order of the reaction is

**Q60.** The difference between spin only magnetic moment values of $[Co(H_2O)_6]Cl_2$ and $[Cr(H_2O)_6]Cl_3$ is

**Q61.** Let $O$ be the origin and $A$ be the point $z_1 = 1 + 2i$. If $B$ is the point $z_2, \text{Re}(z_2) < 0$, such that $OAB$ is a right angled isosceles triangle with $OB$ as hypotenuse, then which of the following is NOT true?

(1) $\arg z_2 = \pi - \tan^{-1} 3$ (2) $\arg(z_1 - 2z_2) = -\tan^{-1}\frac{4}{3}$

(3) $|z_2| = \sqrt{10}$ (4) $|2z_1 - z_2| = 5$

**Q62.** Consider two G.Ps. $2, 2^2, 2^3, \ldots$ and $4, 4^2, 4^3, \ldots$ of 60 and $n$ terms respectively. If the geometric mean of all the $60 + n$ terms is $(2)^{\frac{225}{8}}$, then $\sum_{k=1}^{n} k(n-k)$ is equal to:

(1) 560 (2) 1540

(3) 1330 (4) 2600

**Q63.** Let $S = \left\{\theta \in [0, 2\pi] : 8^{2\sin^2\theta} + 8^{2\cos^2\theta} = 16\right\}$. Then $n(S) + \sum_{\theta \in S}\left(\sec\left(\frac{\pi}{4} + 2\theta\right) \text{ cosec } \left(\frac{\pi}{4} + 2\theta\right)\right)$ is equal to:

(1) 0 (2) $-2$

(3) $-4$ (4) 12

**Q64.** A point $P$ moves so that the sum of squares of its distances from the points $(1, 2)$ and $(-2, 1)$ is 14. Let $f(x, y) = 0$ be the locus of $P$, which intersects the $x$-axis at the points $A, B$ and the $y$-axis at the point $C, D$. Then the area of the quadrilateral $ACBD$ is equal to

(1) $\frac{9}{2}$ (2) $\frac{3\sqrt{17}}{2}$

(3) $\frac{3\sqrt{17}}{4}$ (4) 9

**Q65.** Let the tangent drawn to the parabola $y^2 = 24x$ at the point $(\alpha, \beta)$ is perpendicular to the line $2x + 2y = 5$. Then the normal to the hyperbola $\frac{x^2}{\alpha^2} - \frac{y^2}{\beta^2} = 1$ at the point $(\alpha + 4, \beta + 4)$ does NOT pass through the point:

(1) $(25, 10)$ (2) $(20, 12)$

(3) $(30, 8)$ (4) $(15, 13)$

**Q66.** The statement $(\sim(p \Leftrightarrow \sim q)) \wedge q$ is:

(1) a tautology (2) a contradiction

(3) equivalent to $(p \Rightarrow q) \wedge q$ (4) equivalent to $(p \Rightarrow q) \wedge p$

**Q67.** Let $A$ be a $2 \times 2$ matrix with $\det(A) = -1$ and $\det((A + I)(\text{Adj}(A) + I)) = 4$. Then the sum of the diagonal elements of $A$ can be:

(1) $-1$ (2) 2

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

**Q68.** If the system of linear equations.

$8x+y+4z=-2$
$x+y+z=0$
$\lambda x-3y=\mu$
has infinitely many solutions, then the distance of the point $\left(\lambda,\mu,-\frac{1}{2}\right)$ from the plane $8x+y+4z+2=0$ is:

(1) $3\sqrt{5}$ (2) $4$
(3) $\frac{26}{9}$ (4) $\frac{10}{3}$

**Q69.** $\tan\left(2\tan^{-1}\frac{1}{5}+\sec^{-1}\frac{\sqrt{5}}{2}+2\tan^{-1}\frac{1}{8}\right)$ is equal to:

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

**Q70.** Let $f:R\to R$ be a continuous function such that $f(3x)-f(x)=x$. If $f(8)=7$, then $f(14)$ is equal to:

(1) $4$ (2) $10$
(3) $11$ (4) $16$

**Q71.** If the function $f(x)=\begin{cases}\frac{\log_e(1-x+x^2)+\log_e(1+x+x^2)}{sec\,x-\cos\,x}, & x\in\left(\frac{-\pi}{2},\frac{\pi}{2}\right)-\{0\}\\ k, & x=0\end{cases}$ is continuous at $x=0$, then $k$ is equal to:

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

**Q72.** If $f(x)=\begin{cases}x+a, & x\le 0\\ |x-4|, & x>0\end{cases}$ and $g(x)=\begin{cases}x+1, & x<0\\ (x-4)^2+b, & x\ge 0\end{cases}$ are continuous on $R$, then $(gof)(2)+(fog)(-2)$ is equal to:

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

**Q73.** Let $f(x)=\begin{cases}x^3-x^2+10x-7, & x\le 1\\ -2x+\log_2\left(b^2-4\right), & x>1\end{cases}$ Then the set of all values of $b$, for which $f(x)$ has maximum value at $x=1$, is:

(1) $(-6,-2)$ (2) $(2,6)$
(3) $[-6,-2)\cup(2,6]$ (4) $\left[-\sqrt{6},-2\right)\cup\left(2,\sqrt{6}\right]$

**Q74.** If $a=\lim\limits_{n\to\infty}\sum_{k=1}^{n}\frac{2n}{n^2+k^2}$ and $f(x)=\sqrt{\frac{1-\cos x}{1+\cos x}}, x\in(0,1)$, then:

(1) $2\sqrt{2}f\left(\frac{a}{2}\right)=f'\left(\frac{a}{2}\right)$ (2) $f\left(\frac{a}{2}\right)f'\left(\frac{a}{2}\right)=\sqrt{2}$
(3) $\sqrt{2}f\left(\frac{a}{2}\right)=f'\left(\frac{a}{2}\right)$ (4) $f\left(\frac{a}{2}\right)=\sqrt{2}f'\left(\frac{a}{2}\right)$

**Q75.** The odd natural number a, such that the area of the region bounded by $y=1, y=3, x=0, x=y^a$ is $\frac{364}{3}$, equal to:

(1) $3$ (2) $5$
(3) $7$ (4) $9$

**Q76.** If $\frac{dy}{dx}+2y\tan x=\sin x, 0<x<\frac{\pi}{2}$ and $y\left(\frac{\pi}{3}\right)=0$, then the maximum value of $y(x)$ is

(1) $\frac{1}{8}$ (2) $\frac{3}{4}$
(3) $\frac{1}{4}$ (4) $\frac{3}{8}$

**Q77.** Let $\vec{a}=\alpha\hat{i}+\hat{j}-\hat{k}$ and $\vec{b}=2\hat{i}+\hat{j}-\alpha\hat{k}, \alpha>0$. If the projection of $\vec{a}\times\vec{b}$ on the vector $-\hat{i}+2\hat{j}-2\hat{k}$ is 30, then $\alpha$ is equal to
(1) $\frac{15}{2}$ (2) 8
(3) $\frac{13}{2}$ (4) 7

**Q78.** The length of the perpendicular from the point $(1,-2,5)$ on the line passing through $(1,2,4)$ and parallel to the line $x+y-z=0=x-2y+3z-5$ is:
(1) $\sqrt{\frac{21}{2}}$ (2) $\sqrt{\frac{9}{2}}$
(3) $\sqrt{\frac{73}{2}}$ (4) 1

**Q79.** The mean and variance of a binomial distribution are $\alpha$ and $\frac{\alpha}{3}$ respectively. If $P(X=1)=\frac{4}{243}$, then $P(X=4 \text{ or } 5)$ is equal to:
(1) $\frac{5}{9}$ (2) $\frac{64}{81}$
(3) $\frac{16}{27}$ (4) $\frac{145}{243}$

**Q80.** Let $E_1, E_2, E_3$ be three mutually exclusive events such that $P(E_1)=\frac{2+3p}{6}, P(E_2)=\frac{2-p}{8}$ and $P(E_3)=\frac{1-p}{2}$. If the maximum and minimum values of $p$ are $p_1$ and $p_2$ then $(p_1+p_2)$ is equal to:
(1) $\frac{2}{3}$ (2) $\frac{5}{3}$
(3) $\frac{5}{4}$ (4) 1

**Q81.** If for some $p, q, r \in R$, all have positive sign, one of the roots of the equation $\left(p^2+q^2\right)x^2-2q(p+r)x+q^2+r^2=0$ is also a root of the equation $x^2+2x-8=0$, then $\frac{q^2+r^2}{p^2}$ is equal to-

**Q82.** The number of 5-digit natural numbers, such that the product of their digits is 36, is

**Q83.** The series of positive multiples of 3 is divided into sets : $\{3\},\{6,9,12\},\{15,18,21,24,27\},\ldots$ Then the sum of the elements in the $11^{\text{th}}$ set is equal to _____.

**Q84.** If the coefficients of $x$ and $x^2$ in the expansion of $(1+x)^p(1-x)^q, p, q \leq 15$, are $-3$ and $-5$ respectively, then the coefficient of $x^3$ is equal to _____.

**Q85.** The equations of the sides $AB$, $BC$ and $CA$ of a triangle $ABC$ are $2x+y=0, x+py=15a$ and $x-y=3$ respectively. If its orthocentre is $(2,a)$, $-\frac{1}{2}<a<2$, then $p$ is equal to

**Q86.** The number of distinct real roots of the equation $x^5\left(x^3-x^2-x+1\right)+x\left(3x^3-4x^2-2x+4\right)-1=0$ is

**Q87.** Let the function $f(x)=2x^2-\log_e x, x>0$, be decreasing in $(0,a)$ and increasing in $(a,4)$. A tangent to the parabola $y^2=4ax$ at a point $P$ on it passes through the point $(8a,\ 8a-1)$ but does not pass through the point $\left(-\frac{1}{a},0\right)$. If the equation of the normal at $P$ is $\frac{x}{\alpha}+\frac{y}{\beta}=1$, then $\alpha+\beta$ is equal to

**Q88.** If $n(2n+1)\int_0^1(1-x^n)^{2n}dx=1177\int_0^1(1-x^n)^{2n+1}dx$, then $n \in N$ is equal to _____.

**Q89.** Let a curve $y = y(x)$ pass through the point $(3, 3)$ and the area of the region under this curve, above the $x$-axis and between the abscissae 3 and $x(> 3)$ be $\left(\frac{y}{x}\right)^3$. If this curve also passes through the point $\left(\alpha, 6\sqrt{10}\right)$ in the first quadrant, then $\alpha$ is equal to _____.

**Q90.** Let $Q$ and $R$ be two points on the line $\frac{x+1}{2} = \frac{y+2}{3} = \frac{z-1}{2}$ at a distance $\sqrt{26}$ from the point $P(4, 2, 7)$. Then the square of the area of the triangle $PQR$ is _____.

## ANSWER KEYS

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **1.** (3) | **2.** (1) | **3.** (3) | **4.** (2) | **5.** (1) | **6.** (3) | **7.** (2) | **8.** (3) |
| **9.** (2) | **10.** (1) | **11.** (1) | **12.** (2) | **13.** (2) | **14.** (2) | **15.** (3) | **16.** (2) |
| **17.** (2) | **18.** (3) | **19.** (2) | **20.** (2) | **21.** (2) | **22.** (5) | **23.** (5) | **24.** (200) |
| **25.** (60) | **26.** (20) | **27.** (44) | **28.** (10) | **29.** (5) | **30.** (9) | **31.** (4) | **32.** (3) |
| **33.** (3) | **34.** (1) | **35.** (2) | **36.** (2) | **37.** (4) | **38.** (3) | **39.** (2) | **40.** (3) |
| **41.** (3) | **42.** (2) | **43.** (1) | **44.** (1) | **45.** (3) | **46.** (2) | **47.** (3) | **48.** (4) |
| **49.** (4) | **50.** (1) | **51.** (24) | **52.** (54) | **53.** (1758) | **54.** (2) | **55.** (200) | **56.** (2) |
| **57.** (6) | **58.** (3) | **59.** (2) | **60.** (0) | **61.** (4) | **62.** (3) | **63.** (3) | **64.** (2) |
| **65.** (4) | **66.** (4) | **67.** (2) | **68.** (4) | **69.** (2) | **70.** (2) | **71.** (1) | **72.** (4) |
| **73.** (3) | **74.** (3) | **75.** (2) | **76.** (1) | **77.** (4) | **78.** (1) | **79.** (3) | **80.** (2) |
| **81.** (272) | **82.** (180) | **83.** (6993) | **84.** (23) | **85.** (3) | **86.** (3) | **87.** (45) | **88.** (24) |
| **89.** (6) | **90.** (153) | | | | | | |