**Q1.** The work done by a gas molecule in an isolated system is given by, $W = \alpha\beta^2 e^{-\frac{x^2}{\alpha k T}}$, where $x$ is the displacement, $k$ is the Boltzmann constant and $T$ is the temperature. $\alpha$ and $\beta$ are constants. Then the dimensions of $\beta$ will be:

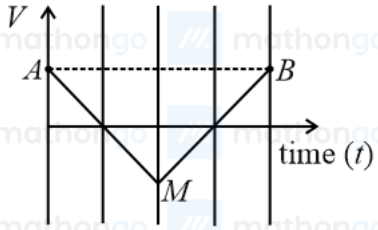
(1) $M^2 \quad L \quad T^2$

(2) $ML^2 \quad T^{-2}$

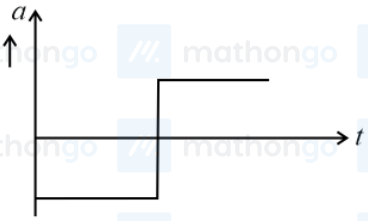
(3) $MLT^{-2}$

(4) $M^0 \quad L \quad T^0$

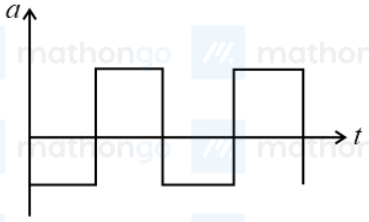
**Q2.** If the velocity-time graph has the shape AMB, what would be the shape of the corresponding acceleration-time graph?




(1)




(2)

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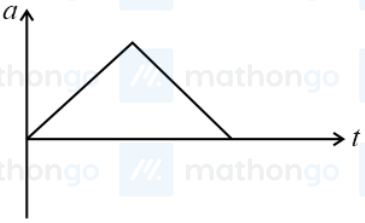


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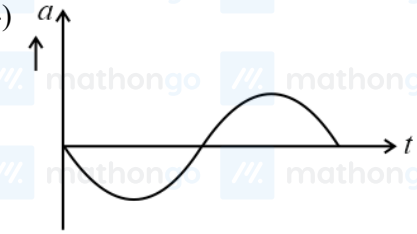



**Q3.** Moment of inertia M.I. of four bodies, having same mass and radius, are reported as;

$I_1 =$ M.I. of thin circular ring about its diameter,

$I_2 =$ M.I. of circular disc about an axis perpendicular to disc and going through the centre,

$I_3 =$ M.I. of solid cylinder about its axis and

$I_4 =$ M.I. of solid sphere about its diameter.

Then:

(1) $I_1 + I_2 = I_3 + \frac{5}{2}I_4$.

(2) $I_1 + I_3 < I_2 + I_4$

(3) $I_1 = I_2 = I_3 > I_4$

(4) $I_1 = I_2 = I_3 < I_4$

**Q4.** Consider two satellites $S_1$ and $S_2$ with periods of revolution 1hr and 8hr respectively revolving around a planet in circular orbits. The ratio of angular velocity of satellite $S_1$ to the angular velocity of satellite $S_2$ is:

(1) 8: 1

(2) 2: 1

(3) 1: 4

(4) 1: 8

**Q5.** Four identical particles of equal masses 1 kg made to move along the circumference of a circle of radius 1 m under the action of their own mutual gravitational attraction. The speed of each particle will be:

(1) $\sqrt{G1+2\sqrt{2}}$ (2) $\sqrt{\frac{G}{2}1+2\sqrt{2}}$

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

**Q6.** Two stars of masses $m$ and $2m$ at a distance $d$ rotate about their common centre of mass in free space. The period of revolution is

(1) $2\pi\sqrt{\frac{d^3}{3Gm}}$ (2) $2\pi\sqrt{\frac{3Gm}{d^3}}$

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

**Q7.** If $Y$, $K$ and $\eta$ are the values of Young's modulus, bulk modulus and modulus of rigidity of any material respectively. Choose the correct relation for these parameters.

(1) $Y=\frac{9\ K\eta}{3\ K-\eta}$ N m$^{-2}$ (2) $\eta=\frac{3YK}{9K+Y}$ N m$^{-2}$

(3) $K=\frac{Y\eta}{9\eta-3Y}$ N m$^{-2}$ (4) $Y=\frac{9\ K\eta}{2\eta+3\ K}$ N m$^{-2}$

**Q8.** Each side of a box made of metal sheet in cubic shape is $a$ at room temperature $T$, the coefficient of linear expansion of the metal sheet is $\alpha$. The metal sheet is heated uniformly, by a small temperature $\Delta T$, so that its new temperature is $T+\Delta T$. Calculate the increase in the volume of the metal box.

(1) $4a^3\alpha\Delta T$ (2) $3a^3\alpha\Delta T$

(3) $4\pi a^3\alpha\Delta T$ (4) $\frac{4}{3}\pi a^3\alpha\Delta T$

**Q9.** Match List I with List II.

| | List I | | List II |
|---|---|---|---|
| (a) | Isothermal | (i) | Pressure constant |
| (b) | Isochoric | (ii) | Temperature constant |
| (c) | Adiabatic | (iii) | Volume constant |
| (d) | Isobaric | (iv) | Heat content is constant |

Choose the correct answer from the options given below:

(1) (a) → (ii), (b) → (iii), (c) → (iv), (d) → (i)

(2) (a) → (iii), (b) → (ii), (c) → (i), (d) → (iv)

(3) (a) → (i), (b) → (iii), (c) → (ii), (d) → (iv)

(4) (a) → (ii), (b) → (iv), (c) → (iii), (d) → (i)

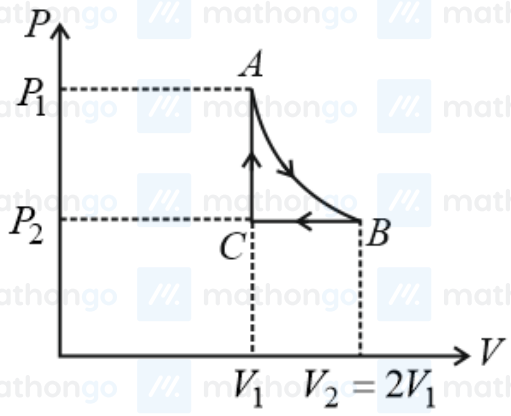
**Q10.** $n$ mole of a perfect gas undergoes a cyclic process $ABCA$ (see figure) consisting of the following processes.

$A \to B$: Isothermal expansion at temperature $T$ so that the volume is doubled from $V_1$ to $V_2=2V_1$ and pressure changes from $P_1$ to $P_2$

$B \to C$: Isobaric compression at pressure $P_2$ to initial volume $V_1$.

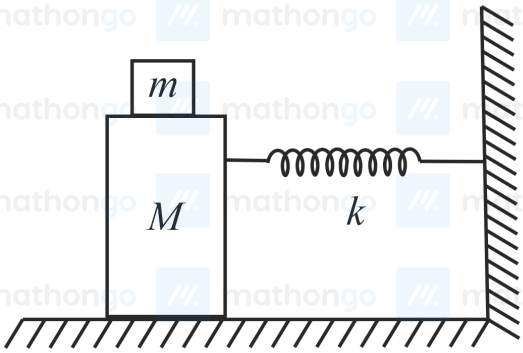
$C \to A$: Isochoric change leading to change of pressure from $P_2$ to $P_1$

Total work done in the complete cycle $ABCA$ is:



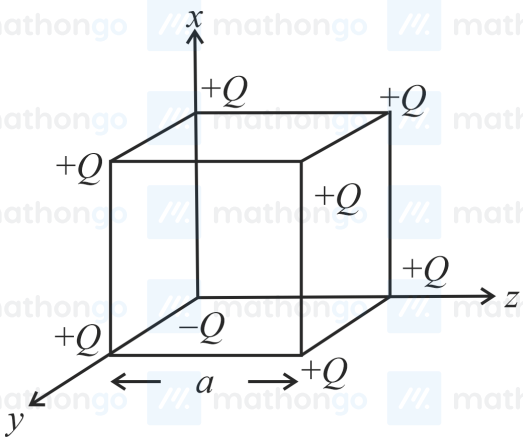

(1) $nRT\ln 2 - \frac{1}{2}$
(2) $nRT\ln 2$
(3) $nRT\ln 2 + \frac{1}{2}$
(4) 0

**Q11.** In the given figure, a mass $M$ is attached to a horizontal spring which is fixed on one side to a rigid support. The spring constant of the spring is $k$. The mass oscillates on a frictionless surface with time period $T$ and amplitude $A$. When the mass is in equilibrium position, as shown in the figure, another mass $m$ is gently fixed upon it. The new amplitude of oscillation will be:




(1) $A\sqrt{\frac{M+m}{M}}$
(2) $A\sqrt{\frac{M}{M-m}}$
(3) $A\sqrt{\frac{M-m}{M}}$
(4) $A\sqrt{\frac{M}{M+m}}$

**Q12.** A cube of side $a$ has point charges $+Q$ located at each of its vertices except at the origin where the charge is $-Q$. The electric field at the centre of cube is:




(1) $\frac{-Q}{3\sqrt{3}\pi\varepsilon_0 a^2}\hat{x}+\hat{y}+\hat{z}$ (2) $\frac{Q}{3\sqrt{3}\pi\varepsilon_0 a^2}\hat{x}+\hat{y}+\hat{z}$

(3) $\frac{-2Q}{3\sqrt{3}\pi\varepsilon_0 a^2}\hat{x}+\hat{y}+\hat{z}$ (4) $\frac{2Q}{3\sqrt{3}\pi\varepsilon_0 a^2}\hat{x}+\hat{y}+\hat{z}$

**Q13.** Two equal capacitors are first connected in series and then in parallel. The ratio of the equivalent capacities in the two cases will be:

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

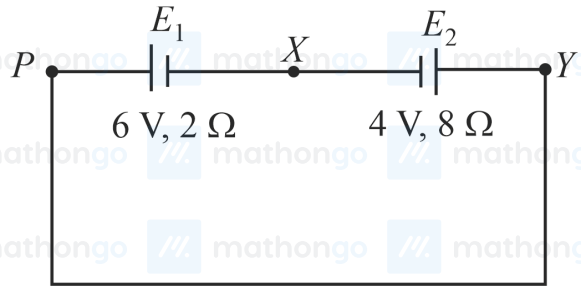
(3) 4: 1 (4) 2: 1

**Q14.** A current through a wire depends on time as $i=\alpha_0 t+\beta t^2$, where $\alpha_0=20$ A $s^{-1}$ and $\beta=8$ A $s^{-2}$. Find the charge crossed through a section of the wire in 15 s.

(1) 2250 C (2) 11250 C

(3) 2100 C (4) 260 C

**Q15.** A cell $E_1$ of emf 6 V and internal resistance 2Ω is connected with another cell $E_2$ of emf 4 V and internal resistance 8 Ω (as shown in the figure). The potential difference across points $X$ and $Y$ is:




(1) 10.0 V (2) 5.6 V

(3) 2.0 V (4) 3.6 V

**Q16.** The focal length $f$ is related to the radius of curvature $r$ of the spherical convex mirror by:

(1) $f=-\frac{1}{2}r$ (2) $f=+\frac{1}{2}r$

(3) $f=r$ (4) $f=-r$

**Q17.** In a Young's double slit experiment, the width of the one of the slit is three times the other slit. The amplitude of the light coming from a slit is proportional to the slit-width. Find the ratio of the maximum to the minimum intensity in the interference pattern.

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

**Q18.** Given below are two statements:

**Statement** I: Two photons having equal linear momenta have equal wavelengths.

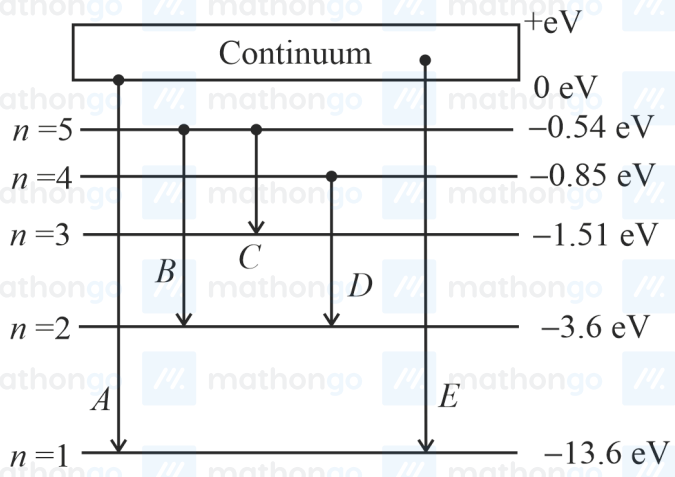
**Statement** II: If the wavelength of the photon is decreased, then the momentum and energy of a photon will also decrease.

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 true but Statement II is false (4) Statement I is false but Statement II is true

**Q19.** In the given figure, the energy levels of hydrogen atom have been shown along with some transitions marked $A, B, C, D$ and $E$.

The transitions $A, B$ and $C$ respectively represent




(1) The ionization potential of hydrogen, second member of Balmer series and third member of Paschen series.
(2) The series limit of Lyman series, second member of Balmer series and second member of Paschen series.
(3) The series limit of Lyman series, third member of Balmer series and second member of Paschen series.
(4) The first member of the Lyman series, third member of Balmer series and second member of Paschen series.

**Q20.** If an emitter current is changed by $4$ mA, the collector current changes by $3.5$ mA. The value of $\beta$ will be:

(1) 3.5 (2) 0.5
(3) 0.875 (4) 7

**Q21.** The coefficient of static friction between a wooden block of mass $0.5$ kg and a vertical rough wall is $0.2$. The magnitude of the horizontal force that should be applied on the block to keep it adhere to the wall will be_____N. $g = 10$ m $s^{-2}$

**Q22.** An inclined plane is bent in such a way that the vertical cross-section is given by $y = \frac{x^2}{4}$ where $y$ is in vertical and $x$ in horizontal direction. If the upper surface of this curved plane is rough with coefficient of friction $\mu = 0.5$, the maximum height in cm at which a stationary block will not slip downward is_____cm.

**Q23.** A ball with a speed of 9 m $s^{-1}$ collides with another identical ball at rest. After the collision, the direction of each ball makes an angle of 30° with the original direction. If the ratio of velocities of the balls after the collision is $x:y$, then what is the value of $x$?

**Q24.** A hydraulic press can lift 100 kg when a mass $m$ is placed on the smaller piston. It can lift kg when the diameter of the larger piston is increased by 4 times and that of the smaller piston is decreased by 4 times keeping the same mass $m$ on the smaller piston.

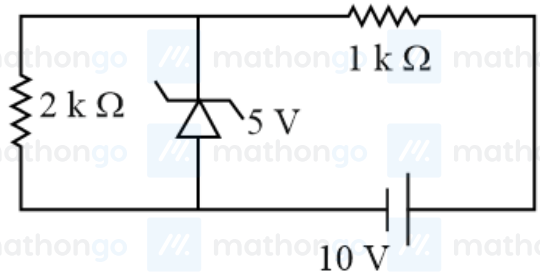
**Q25.** A common transistor radio set requires 12 V D.C. for its operation. The D.C. source is constructed by using a transformer and a rectifier circuit, which are operated at 220 V A.C. on standard domestic A.C. supply. The number of turns of secondary coil are 24, then the number of turns of primary are

**Q26.** A resonance circuit having inductance and resistance $2\times10^{-4}$ H and 6.28 Ω respectively oscillates at 10 MHz frequency. The value of quality factor of this resonator is_____. $\pi = 3.14$

**Q27.** An electromagnetic wave of frequency 5GHz, is travelling in a medium whose relative electric permittivity and relative magnetic permeability both are 2. Its velocity in this medium is _____ $\times10^{7}$ m $s^{-1}$.

**Q28.** An unpolarized light beam is incident on the polarizer of a polarization experiment and the intensity of light beam emerging from the analyzer is measured as 100 Lumens. Now, if the analyzer is rotated around the horizontal axis (direction of light) by 30° in clockwise direction, the intensity of emerging light will be _____Lumens.

**Q29.** In connection with the circuit drawn below, the value of current flowing through 2 kΩ resistor is_____ $\times10^{-4}$ A.




**Q30.** An audio signal $v_m = 20\sin2\pi1500t$ amplitude modulates a carrier $v_c = 80\sin2\pi100,000t$. The value of percent modulation is

**Q31.** Consider the elements Mg, Al, S, P and Si, the correct increasing order of their first ionisation enthalpy is:

(1) Al < Mg < Si < S < P
(2) Al < Mg < S < Si < P
(3) Mg < Al < Si < P < S
(4) Mg < Al < Si < S < P

**Q32.** Which of the following are isostructural pairs?

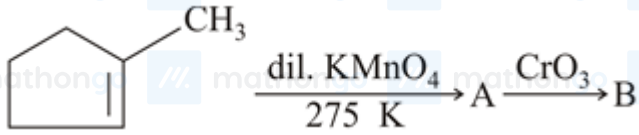
A. $SO_4^{2-}$ and $CrO_4^{2-}$
B. $SiCl_4$ and $TiCl_4$
C. $NH_3$ and $NO_3^-$
D. $BCl_3$ and $BrCl_3$

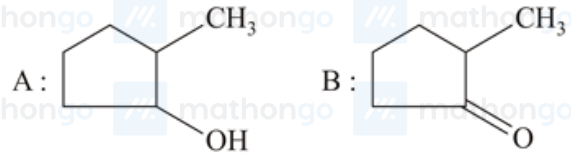
(1) A and C only (2) B and C only
(3) A and B only (4) C and D only

**Q33.** (A) $HOCl + H_2O_2 \rightarrow H_3O^+ + Cl^- + O_2$
(B) $I_2 + H_2O_2 + 2OH^- \rightarrow 2I^- + 2H_2O + O_2$
Choose the correct option.
(1) $H_2O_2$ act as oxidizing and reducing agent respectively in equations (A) and (B).
(2) $H_2O_2$ acts as oxidising agent in equations (A) and (B).
(3) $H_2O_2$ acts as reducing and oxidising agent respectively in equations (A) and (B).
(4) $H_2O_2$ acts as reducing agent in equations (A) and (B).

**Q34.** $Al_2O_3$ was leached with alkali to get X. The solution of X on passing of gas Y, forms Z. X, Y and Z respectively are
(1) $X = AlOH_3, Y = CO_2, \quad Z = Al_2O_3$
(2) $X = NaAlOH_4, Y = SO_2, \quad Z = Al_2O_3$
(3) $X = AlOH_3, \quad Y = SO_2, \quad Z = Al_2O_3 \cdot xH_2O$
(4) $X = NaAlOH_4, \quad Y = CO_2, \quad Z = Al_2O_3, \quad xH_2O$

**Q35.** Identify products A and B.




(1)
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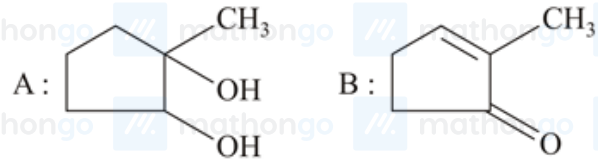
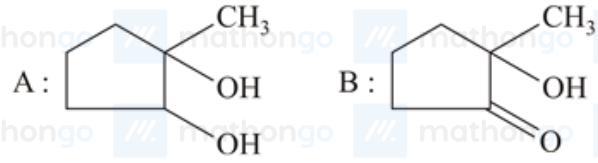
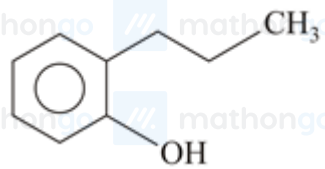


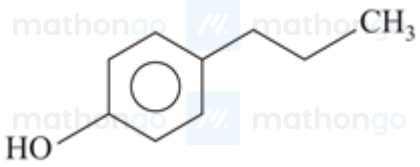

(3)


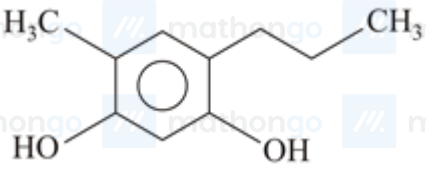

(4)

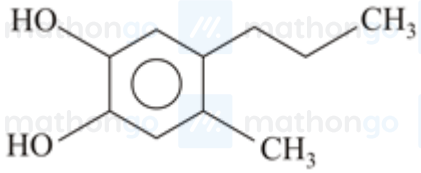


**Q36.** Which of the following compound gives pink colour on reaction with phthalic anhydride in conc. $H_2SO_4$ followed by treatment with NaOH?

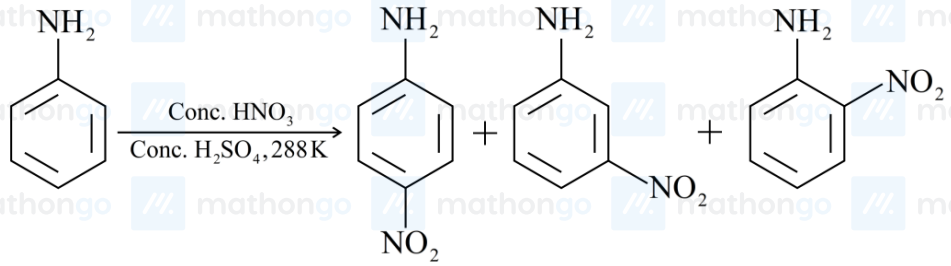
(1) 

(2) 

(3) 

(4) 

**Q37.** In the following reaction, the reason why meta-nitro product also formed is:

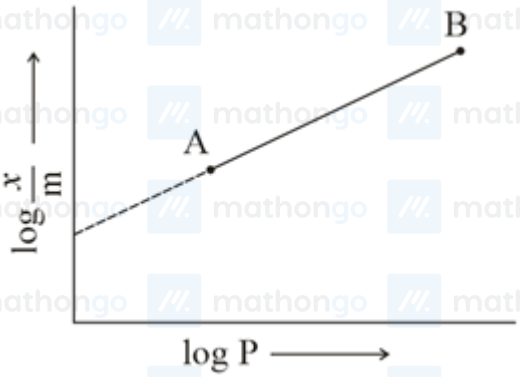


[A] 51% [B] 47% [C] 2%

(1) Formation of anilinium ion
(2) $-NH_2$ group is highly meta-directive
(3) $-NO_2$ substitution always takes place at meta-position
(4) low temperature

**Q38.** The gas released during anaerobic degradation of vegetation may lead to:
(1) Corrosion of metals
(2) Ozone hole
(3) Global warming and cancer
(4) Acid rain

**Q39.** In Freundlich adsorption isotherm, slope of AB line is:




(1) $\frac{1}{n}$ with $\frac{1}{n} = 0$ to 1
(2) n with $n = 0.1$ to $0.5$
(3) $\log\frac{1}{n}$ with $n < 1$
(4) logn with $n > 1$

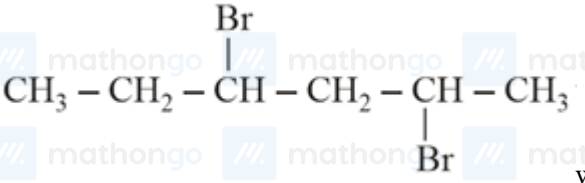
**Q40.** Which of the following ore is concentrated using group 1 cyanide salt?

(1) Malachite (2) Calamine
(3) Siderite (4) Sphalerite

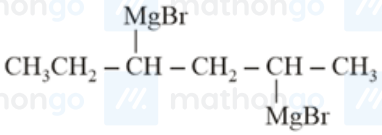
**Q41.** The major components in "Gun Metal" are:
(1) Cu, Sn and Zn (2) Al, Cu, Mg and Mn
(3) Cu, Ni and Fe (4) Cu, Zn and Ni

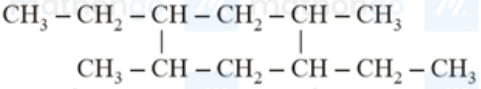
**Q42.** The electrode potential of $M^{2+}$ / M of 3 d-series elements shows positive value for?
(1) Co (2) Fe
(3) Zn (4) Cu

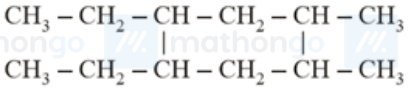
**Q43.**

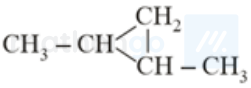


The product formed in the first step of the reaction of with excess Mg / $Et_2OEt = C_2H_5$ is

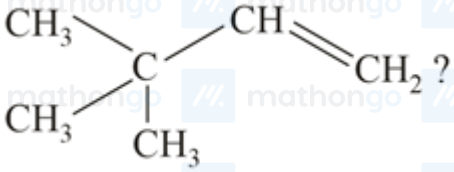
(1) 

(2) 

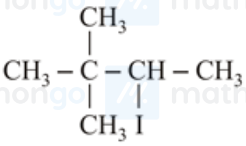
(3) 

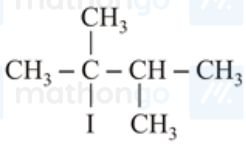
(4) 

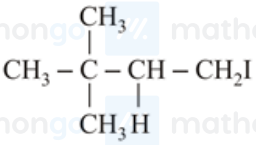
**Q44.**

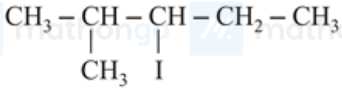


What is the major product formed by HI on reaction with

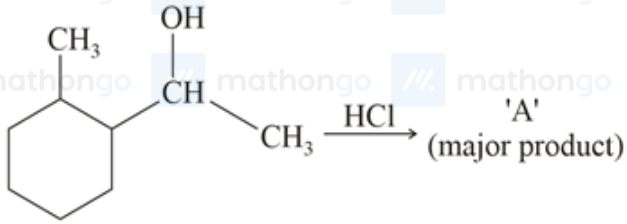
(1) 

(2) 

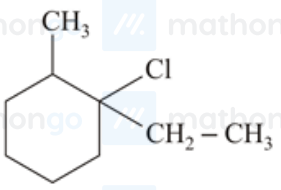
(3) 

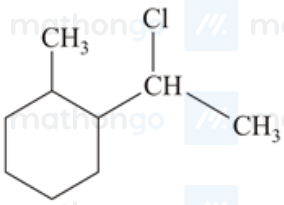
(4) 

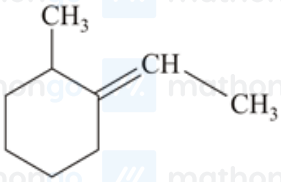
**Q45.** What is the final product (major) 'A' in the given reaction?

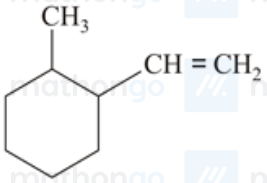


Major product among the following is?

(1) 

(2) 

(3) 

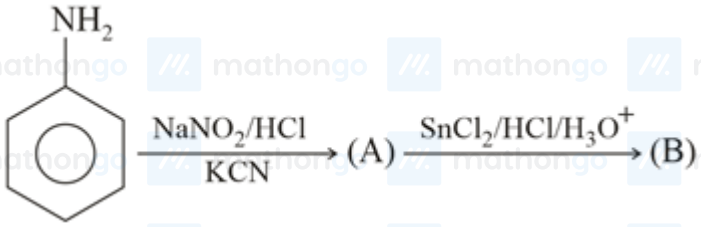
(4) 

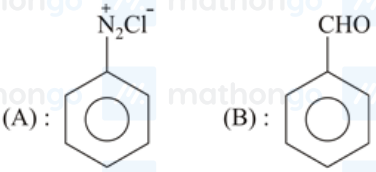
**Q46.** Which of the following reagent is used for the following reaction?

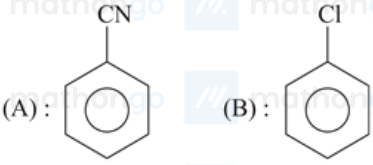
$$CH_3CH_2CH_3 \xrightarrow{?} CH_3CH_2CHO$$

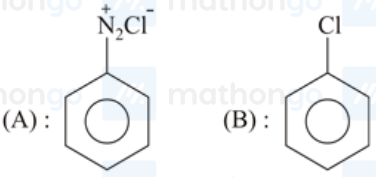
(1) Copper at high temperature and pressure
(2) Manganese acetate
(3) Molybdenum oxide
(4) Potassium permanganate

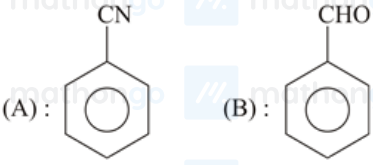
**Q47.** A and B in the following reactions are:



(1) 

(2) 

(3) 

(4) 

**Q48.** Match **List** I with **List** II.

| **List** I **(Monomer Unit)** | | **List** II **(Polymer)** | |
|---|---|---|---|
| (a) | Caprolactum | (i) | Natural rubber |
| (b) | 2 - Chloro-1, 3 - butadiene | (ii) | Buna-N |
| (c) | Isoprene | (iii) | Nylon 6 |
| (d) | Acrylonitrile | (iv) | Neoprene |

Choose the correct answer from the options given below:

(1) a → iii, b → iv, c → i, d → ii
(2) a → i, b → ii, c → iii, d → iv
(3) a → ii, b → i, c → iv, d → iii
(4) a → iv, b → iii, c → ii, d → i

**Q49.** Given below are two statements:

Statement I: Colourless cupric metaborate is reduced to cuprous metaborate in a luminous flame.

Statement II: Cuprous metaborate is obtained by heating boric anhydride and copper sulphate in a non-luminous flame.

In the light of the above statements, choose the most appropriate 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

**Q50.** Out of the following, which type of interaction is responsible for the stabilisation of $\alpha$ - helix structure of proteins?

(1) Covalent bonding (2) Ionic bonding

(3) Hydrogen bonding (4) vander Waals forces

**Q51.** $4.5$ g of compound $\mathrm{AM.W.} = 90$ was used to make $250$ mL of its aqueous solution. The molarity of the solution in M is $x \times 10^{-1}$. The value of x is_____ (Rounded off to the nearest integer)

**Q52.** A proton and a $Li^{3+}$ nucleus are accelerated by the same potential. If $\lambda_{Li}$ and $\lambda_p$ denote the de Broglie wavelengths of $Li^{3+}$ and proton respectively, then the value of $\frac{\lambda_{Li}}{\lambda_p}$ is $x \times 10^{-1}$. The value of x is _____ (Rounded off to the nearest integer) [Mass of $Li^{3+} = 8.3$ mass of proton]

**Q53.** For the reaction $A_g \rightarrow B_g$, the value of the equilibrium constant at $300$ K and $1$ atm is equal to $100.0$. The value of $\Delta G^o$ for the reaction at $300$ K and $1$ atm in $Jmol^{-1}$ is -$x$R, where x is (Rounded off to the nearest integer) $R = 8.31$ J mol$^{-1}$ K$^{-1}$ and $\ln 10 = 2.3$

**Q54.** The stepwise formation of $CuNH_3{}_4{}^{2+}$ is given below:

$$Cu^{2+} + NH_3 \overset{K_1}{\rightleftharpoons} CuNH_3{}^{2+}$$

$$CuNH_3{}^{2+} + NH_3 \overset{K_2}{\rightleftharpoons} CuNH_3{}_2{}^{2+}$$

$$CuNH_3{}_2{}^{2+} + NH_3 \overset{K_3}{\rightleftharpoons} CuNH_3{}_3{}^{2+}$$

$$CuNH_3{}_3{}^{2+} + NH_3 \overset{K_4}{\rightleftharpoons} CuNH_3{}_4{}^{2+}$$

The value of stability constants $K_1$, $K_2$, $K_3$ and $K_4$ are $10^4$, $1.58 \times 10^3$, $5 \times 10^2$ and $10^2$ respectively. The overall equilibrium constants for dissociation of $CuNH_3{}_4{}^{2+}$ is $x \times 10^{-12}$. The value of x is _____ (Rounded off to the nearest integer)

**Q55.** At $1990$ K and $1$ atm pressure, there are equal number of $Cl_2$ molecules and Cl atoms in the reaction mixture. The value of $K_p$ for the reaction $Cl_{2g} = 2Cl_g$ under the above conditions is $x \times 10^{-1}$. The value of x is_____(Rounded off to the nearest integer)

**Q56.** The reaction of sulphur in alkaline medium is given below:

$$S_{8s} + a\ OH^-_{aq} \rightarrow b\ S^{2-}_{aq} + c\ S_2O^{2-}_{3aq} + d\ H_2O_l$$

The values of '$a$' is_____ (Integer answer)

**Q57.** Number of amphoteric compounds among the following is

(A) BeO

(B) $BaO$
(C) $BeOH_2$
(D) $Sr\ OH_2$

**Q58.** The coordination number of an atom in a body-centered cubic structure is_____
[Assume that the lattice is made up of atoms.]

**Q59.** When $9.45$ g of $ClCH_2COOH$ is added to $500$ mL of water, its freezing point drops by $0.5°C$. The dissociation constant of $ClCH_2COOH$ is $x \times 10^{-3}$. The value of x is off to the nearest integer)
$K_{fH_2O} = 1.86$ K kg $mol^{-1}$

**Q60.** Gaseous cyclobutene isomerizes to butadiene in a first order process which has a 'K' value of $3.3 \times 10^{-4}$ $s^{-1}$ at $153°C$. The time in minutes it takes for the isomerization to proceed 40% to completion at this temperature is_____. (Rounded off to the nearest integer)

**Q61.** Let $p$ and $q$ be two positive numbers such that $p + q = 2$ and $p^4 + q^4 = 272$. Then $p$ and $q$ are roots of the equation:
(1) $x^2 - 2x + 2 = 0$ (2) $x^2 - 2x + 8 = 0$
(3) $x^2 - 2x + 136 = 0$ (4) $x^2 - 2x + 16 = 0$

**Q62.** A scientific committee is to be formed from 6 Indians and 8 foreigners, which includes at least 2 Indians and double the number of foreigners as Indians. Then the number of ways, the committee can be formed, is:
(1) 1050 (2) 1625
(3) 575 (4) 560

**Q63.** If $e^{\cos^2 x + \cos^4 x + \cos^6 x + \ldots \infty \log_e 2}$ satisfies the equation $t^2 - 9t + 8 = 0$, then the value of $\frac{2\sin x}{\sin x + \sqrt{3}\cos x}$, where $0 < x < \frac{\pi}{2}$, is equal to
(1) $\frac{3}{2}$ (2) $\frac{1}{2}$
(3) $\sqrt{3}$ (4) $2\sqrt{3}$

**Q64.** A man is walking on a straight line. The arithmetic mean of the reciprocals of the intercepts of this line on the coordinate axes is $\frac{1}{4}$. Three stones $A, B$ and $C$ are placed at the points $1, 1, 2, 2$ and $4, 4$ respectively. Then which of these stones is / are on the path of the man?
(1) $C$ only (2) All the three
(3) $B$ only (4) $A$ only

**Q65.** The value of $-{}^{15}C_1 + 2 \cdot {}^{15}C_2 - 3 \cdot {}^{15}C_3 + \ldots\ldots - 15 \cdot {}^{15}C_{15} + {}^{14}C_1 + {}^{14}C_3 + {}^{14}C_5 + \ldots + {}^{14}C_{11}$ is equal to
(1) $2^{14}$ (2) $2^{13} - 13$
(3) $2^{16} - 1$ (4) $2^{13} - 14$

**Q66.** The locus of the mid-point of the line segment joining the focus of the parabola $y^2 = 4ax$ to a moving point of the parabola, is another parabola whose directrix is:
(1) $x = a$ (2) $x = 0$
(3) $x = -\frac{a}{2}$ (4) $x = \frac{a}{2}$

**Q67.** The statement among the following that is a tautology is:

(1) $A \vee A \wedge B$ (2) $A \wedge A \vee B$
(3) $B \rightarrow A \wedge A \rightarrow B$ (4) $A \wedge A \rightarrow B \rightarrow B$

**Q68.** Two vertical poles are 150 m apart and the height of one is three times that of the other. If from the middle point of the line joining their feet, an observer finds the angles of elevation of their tops to be complementary, then the height of the shorter pole (in meters) is:
(1) 25 (2) 30
(3) $20\sqrt{3}$ (4) $25\sqrt{3}$

**Q69.** The system of linear equations
$3x - 2y - kz = 10$
$2x - 4y - 2z = 6$
$x + 2y - z = 5 \quad m$
is inconsistent if :
(1) $k = 3, \quad m \neq \frac{4}{5}$ (2) $k = 3, \quad m = \frac{4}{5}$
(3) $k \neq 3, \quad m \in R$ (4) $k \neq 3, \quad m \neq \frac{4}{5}$

**Q70.** Let $f: R \rightarrow R$ be defined as $fx = 2 \quad x - 1$ and $g: R - 1 \rightarrow R.$ be defined as $gx = \frac{x - \frac{1}{2}}{x - 1}$. Then the composition function $fgx$ 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

**Q71.** If $f: R \rightarrow R$ is a function defined by $fx = x - 1\cos\frac{2x - 1}{2}\pi,$ where $\cdot$ denotes the greatest integer function, then $f$ is:
(1) discontinuous only at $x = 1$ (2) discontinuous at all integral values of $x$ except at $x = 1$
(3) continuous only at $x = 1$ (4) continuous for every real $x$

**Q72.** The function $fx = \frac{4x^3 - 3x^2}{6} - 2\sin x + 2x - 1\cos x$:
(1) increases in $\frac{1}{2}, \infty$ (2) decreases in $-\infty, \frac{1}{2}$
(3) decreases in $\frac{1}{2}, \infty$ (4) increases in $-\infty, \frac{1}{2}$

**Q73.** If the tangent to the curve $y = x^3$ at the point $Pt, t^3$ meets the curve again at $Q,$ then the ordinate of the point which divides $PQ$ internally in the ratio 1: 2 is:
(1) 0 (2) $-2t^3$
(3) $-t^3$ (4) $2t^3$

**Q74.** If $\int \frac{\cos x - \sin x}{\sqrt{8 - \sin 2x}} \quad dx = a\sin^{-1}\frac{\sin x + \cos x}{b} + c,$ where $c$ is a constant of integration, then the ordered pair $a, b$ is equal to:
(1) $1, -3$ (2) $3, 1$
(3) $-1, 3$ (4) $1, 3$

**Q75.** $\lim_{x \rightarrow 0} \frac{\int_0^{x^2} \sin\sqrt{t}\, dt}{x^3}$ is equal to:

(1) 0 (2) $\frac{2}{3}$
(3) $\frac{3}{2}$ (4) $\frac{1}{15}$

**Q76.** The area (in sq. units) of the part of the circle $x^2 + y^2 = 36$, which is outside the parabola $y^2 = 9x$, is equal to
(1) $12\pi + 3\sqrt{3}$ (2) $24\pi + 3\sqrt{3}$
(3) $24\pi$ - $3\sqrt{3}$ (4) $12\pi$ - $3\sqrt{3}$

**Q77.** The population $P = Pt$ at time $t$ of a certain species follows the differential equation $\frac{dP}{dt} = 0.5P$ - 450. If $P0 = 850$, then the time at which population becomes zero is:
(1) $\log_e 9$ (2) $2\log_e 18$
(3) $\log_e 18$ (4) $\frac{1}{2}\log_e 18$

**Q78.** The distance of the point $1, 1, 9$ from the point of intersection of the line $\frac{x - 3}{1} = \frac{y - 4}{2} = \frac{z - 5}{2}$ and the plane $x + y + z = 17$ is:
(1) $19\sqrt{2}$ (2) $2\sqrt{19}$
(3) $\sqrt{38}$ (4) 38

**Q79.** The equation of the plane passing through the point $1, \quad 2, -3$ and perpendicular to the planes $3x + y - 2z = 5$ and $2x - 5y - z = 7$, is
(1) $11x + y + 17z + 38 = 0$ (2) $3x - 10y - 2z + 11 = 0$
(3) $6x - 5y + 2z + 10 = 0$ (4) $6x - 5y - 2z - 2 = 0$

**Q80.** An ordinary dice is rolled for a certain number of times. If the probability of getting an odd number 2 times is equal to the probability of getting an even number 3 times, then the probability of getting an odd number for odd number of times is:
(1) $\frac{1}{32}$ (2) $\frac{5}{16}$
(3) $\frac{3}{16}$ (4) $\frac{1}{2}$

**Q81.** If the least and the largest real values of $\alpha$, for which the equation $z + \alpha z - 1 + 2i = 0\ z \in C$ and $i = \sqrt{-1}$ has a solution, are $p$ and $q$ respectively; then $4p^2 + q^2$ is equal to_____.

**Q82.** If one of the diameters of the circle $x^2 + y^2 - 2x - 6y + 6 = 0$ is a chord of another circle '$C$', whose center is at $2, 1$, then its radius is_____.

**Q83.** Let $A = \{n \in N: n$ is a 3 - digit number$\}$ $B = 9k + 2: k \in N$ and $C = 9k + l: k \in N$ for some $l 0 < l < 9$. If the sum of all the elements of the set $A \cap B \cup C$ is $274 \times 400$, then $l$ is equal to

**Q84.** Let $P = \begin{matrix} 3 & -1 & -2 \\ 2 & 0 & \alpha \\ 3 & -5 & 0 \end{matrix}$, where $\alpha \in R$. Suppose $Q = q_{ij}$ is a matrix satisfying $PQ = kI_3$ for some non-zero $k \in R$. If $q_{23} = -\frac{k}{8}$ and $Q = \frac{k^2}{2}$, then $\alpha^2 + k^2$ is equal to_____.

**Q85.** Let $M$ be any $3 \times 3$ matrix with entries from the set $0, 1, 2$. The maximum number of such matrices, for which the sum of diagonal elements of $M^T M$ is seven, is_____.

**Q86.** $\lim_{n \to \infty} \tan \sum_{r=1}^{n} \tan^{-1} \frac{1}{1 + r + r^2}$ is equal to_____.

**Q87.** The minimum value of $\alpha$ for which the equation $\frac{4}{\sin x} + \frac{1}{1 - \sin x} = \alpha$ has at least one solution in $0, \frac{\pi}{2}$ is_____.

**Q88.** If $\int_{-a}^{a} x + x - 2dx = 22, \quad a > 2$ and $x$ denotes the greatest integer $\leq x$, then $\int_{a}^{-a} x + xdx$ is equal to

**Q89.** Let three vectors $\vec{a}, \vec{b}$ and $\vec{c}$ be such that $\vec{c}$ is coplanar with $\vec{a}$ and $\vec{b}, \vec{a} \cdot \vec{c} = 7$ and $\vec{b}$ is perpendicular to $\vec{c}$, where $\vec{a} = -\hat{i} + \hat{j} + \hat{k}$ and $\vec{b} = 2\hat{i} + \hat{k}$, then the value of $2\vec{a} + \vec{b} + \vec{c}^{2}$ is

**Q90.** Let $B_i i = 1, 2, 3$ be three independent events in a sample space. The probability that only $B_1$ occur is $\alpha$, only $B_2$ occurs is $\beta$ and only $B_3$ occurs is $\gamma$. Let $p$ be the probability that none of the events $B_i$ occurs and these 4 probabilities satisfy the equations $\alpha - 2\beta p = \alpha\beta$ and $\beta - 3\gamma p = 2\beta\gamma$ (All the probabilities are assumed to lie in the interval $0, 1$ Then $\frac{PB_1}{PB_3}$ is equal to_____.

## ANSWER KEYS

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **1.** (3) | **2.** (1) | **3.** (3) | **4.** (1) | **5.** (4) | **6.** (1) | **7.** (3) | **8.** (2) |
| **9.** (1) | **10.** (1) | **11.** (4) | **12.** (3) | **13.** (2) | **14.** (2) | **15.** (2) | **16.** (2) |
| **17.** (4) | **18.** (3) | **19.** (3) | **20.** (4) | **21.** (25) | **22.** (25) | **23.** (1) | **24.** (25600) |
| **25.** (440) | **26.** (2000) | **27.** (15) | **28.** (75) | **29.** (25) | **30.** (25) | **31.** (1) | **32.** (3) |
| **33.** (4) | **34.** (4) | **35.** (3) | **36.** (1) | **37.** (1) | **38.** (3) | **39.** (1) | **40.** (4) |
| **41.** (1) | **42.** (4) | **43.** (1) | **44.** (2) | **45.** (1) | **46.** (3) | **47.** (4) | **48.** (1) |
| **49.** (2) | **50.** (3) | **51.** (2) | **52.** (2) | **53.** (1380) | **54.** (1) | **55.** (5) | **56.** (12) |
| **57.** (2) | **58.** (8) | **59.** (36) | **60.** (26) | **61.** (4) | **62.** (2) | **63.** (2) | **64.** (3) |
| **65.** (4) | **66.** (2) | **67.** (4) | **68.** (4) | **69.** (1) | **70.** (2) | **71.** (4) | **72.** (1) |
| **73.** (2) | **74.** (4) | **75.** (2) | **76.** (3) | **77.** (2) | **78.** (3) | **79.** (1) | **80.** (4) |
| **81.** (10) | **82.** (3) | **83.** (5) | **84.** (17) | **85.** (540) | **86.** (1) | **87.** (9) | **88.** (3) |
| **89.** (75) | **90.** (6) | | | | | | |