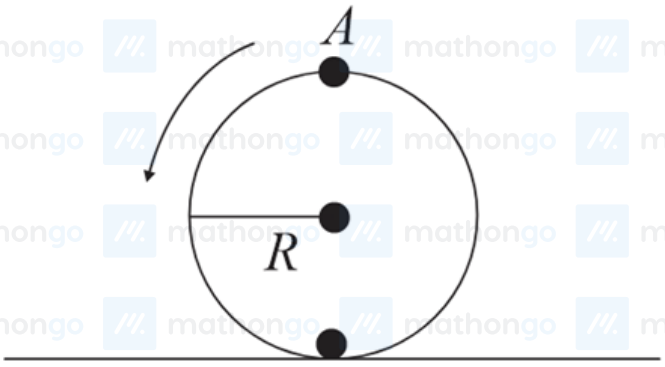
Q1. Two trains A and B of length l and $4l$ are travelling into a tunnel of length L in parallel tracks from opposite directions with velocities $108\ \text{km h}^{-1}$ and $72\ \text{km h}^{-1}$, respectively. If train A take 35 s less time than train B to cross the tunnel then, length L of tunnel is:
(Given $L = 60\ l$)
(1) 1200 m
(2) 900 m
(3) 1800 m
(4) 2700 m

Q2. A disc is rolling without slipping on a surface. The radius of the disc is R. At $t = 0$, the top most point on the disc is A as shown in figure. When the disc completes half of its rotation, the displacement of point A from its initial position is



(1) $2R$
(2) $R\sqrt{(\pi^2+4)}$
(3) $\text{R}\sqrt{(\pi^2+1)}$
(4) $2R\sqrt{(1+4\pi^2)}$

Q3. The ratio of powers of two motors is $\frac{3\sqrt{x}}{\sqrt{x+1}}$, that are capable of raising 300 kg water in 5 minutes and 50 kg water in 2 minutes respectively from a well of 100 m deep. The value of x will be
(1) 16
(2) 2
(3) 2.4
(4) 4

Q4. A body of mass (5 ± 0.5) kg is moving with a velocity of $\left(20 \pm 0.4\right)\ \text{m s}^{-1}$. Its kinetic energy will be
(1) (1000 ± 0.14) J
(2) (500 ± 0.14) J
(3) (500 ± 140) J
(4) (1000 ± 140) J

Q5. Two bodies are having kinetic energies in the ratio $16 : 9$. If they have same linear momentum, the ratio of their masses respectively is:
(1) 3 : 4
(2) 9 : 16
(3) 16 : 9
(4) 4 : 3

Q6. A bullet of 10 g leaves the barrel of gun with a velocity of $600\ \text{m s}^{-1}$. If the barrel of gun is 50 cm long and mass of gun is 3 kg, then value of impulse supplied to the gun will be:
(1) 6 N s
(2) 3 N s
(3) 36 N s
(4) 12 N s

Q7. A solid sphere is rolling on a horizontal plane without slipping. If the ratio of angular momentum about axis of rotation of the sphere to the total energy of moving sphere is $\pi : 22$ then, the value of its angular speed will be _____rad s^{-1}.

Q8. A planet having mass $9\,M_e$ and radius $4R_e$, where M_e and R_e are mass and radius of earth respectively, has escape velocity in km s^{-1} given by: (Given escape velocity on earth $V_e = 11.2 \times 10^3$ m s^{-1})

(1) 67.2 (2) 16.8

(3) 11.2 (4) 33.6

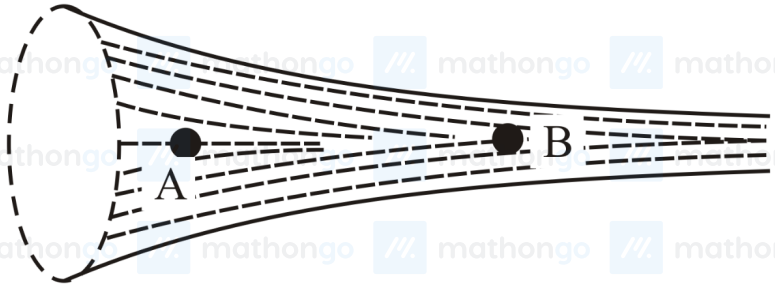
Q9. Under isothermal condition, the pressure of a gas is given by $P = aV^{-3}$, where a is a constant and V is the volume of the gas. The bulk modulus at constant temperature is equal to

(1) $3P$ (2) P

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

Q10. The elastic potential energy stored in a steel wire of length 20 m stretched through 2 cm is 80 J. The cross sectional area of the wire is _____ mm^2. (Given, $Y = 2.0 \times 10^{11}$ N m^{-2})

Q11.



The figure shows a liquid of given density flowing steadily in horizontal tube of varying cross-section. Cross-sectional areas at A is 1.5 cm^2, and B is 25 mm^2, if the speed of liquid at B is 60 cm s^{-1} then $(P_A – P_B)$ is (Given P_A and P_B are liquid pressures at A and B points.

Density $\rho = 1000$ kg m^{-3}

A and B are on the axis of tube)

(1) 135 Pa (2) 27 Pa

(3) 175 Pa (4) 36 Pa

Q12. The rms speed of oxygen molecule in a vessel at particular temperature is $\left(1 + \frac{5}{x}\right)^{\frac{1}{2}} v$, when v is the average speed of the molecule. The value of x will be:

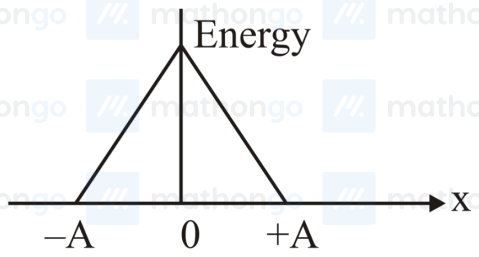
(take $\pi = \frac{22}{7}$)

(1) 27 (2) 8

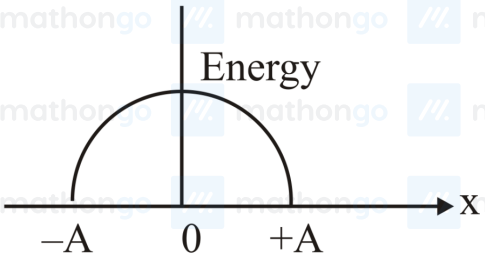
(3) 28 (4) 4

Q13. Which graph represents the difference between total energy and potential energy of a particle executing SHM vs its distance from mean position?

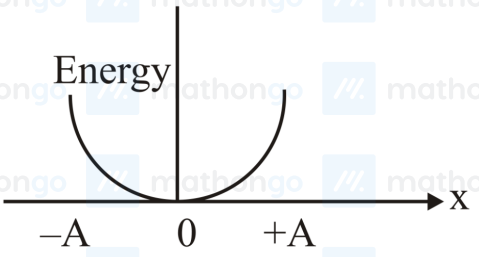
(1)



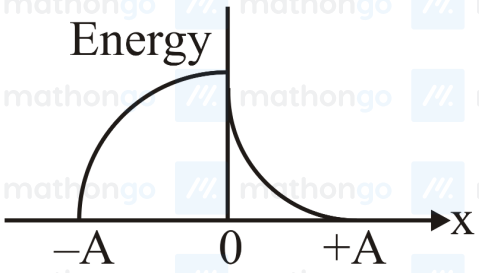
(2)



(3)



(4)



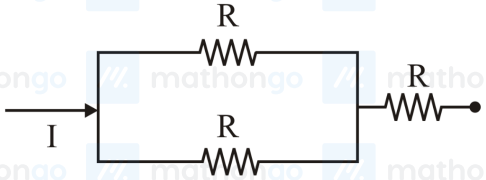
Q14. At a given point of time the value of displacement of a simple harmonic oscillator is given as $y = A\ \cos(30^\circ)$. If amplitude is 40 cm and kinetic energy at that time is 200 J, the value of force constant 1.0×10^x N m^{-1}. The value of x is _____.

Q15. Two charges of each magnitude 0.01 C and separated by a distance of 0.4 mm constitute an electric dipole. If the dipole is placed in an uniform electric field $\vec{E}$ of 10 dyne $\cdot$ C^{-1} making 30° angle with $\vec{E}$, the magnitude of torque acting on dipole is:

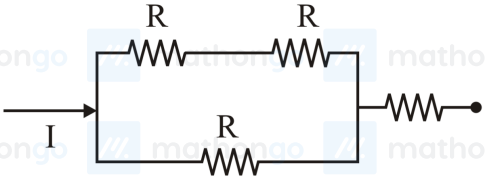
(1) 4.0×10^{-10} N m
(2) 1.0×10^{-8} N m
(3) 1.5×10^{-9} N m
(4) 2.0×10^{-10} N m

Q16. A thin infinite sheet charge and an infinite line charge of respective charge densities $+\sigma$ and $+\lambda$ are placed parallel at 5 m distance from each other. Points P and Q are at $\frac{3}{\pi}$ m and $\frac{4}{\pi}$ m perpendicular distances from line charge towards sheet charge, respectively. E_p and E_q are the magnitudes of resultant electric field intensities at point P and Q respectively. If $\frac{E_P}{E_Q} = \frac{4}{a}$ for $2|\sigma| = |\lambda|$, then the value of a is _____.

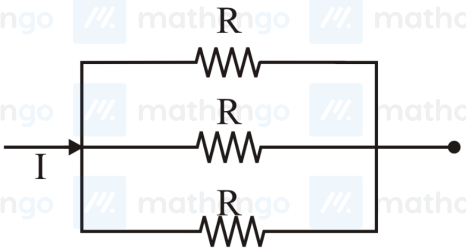
Q17. Different combination of 3 resistors of equal resistance R are shown in the figures. The increasing order for power dissipation is:



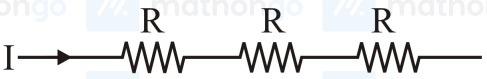
(A)



(B)



(C)



(D)

(1) $P_B < P_C < P_D < P_A$
(2) $P_C < P_D < P_A < P_B$
(3) $P_C < P_B < P_A < P_D$
(4) $P_A < P_B < P_C < P_D$

Q18. A potential V_0 is applied across a uniform wire of resistance R. The power dissipation is P_1. The wire is then cut into two equal halves and a potential of V_0 is applied across the length of each half. The total power dissipation across two wires is P_2. The ratio of $P_2 : P_1$ is $\sqrt{x} : 1$. The value of x is _____.

Q19. When a resistance of $5\ \Omega$ is shunted with a moving coil galvanometer, it shows a full scale deflection for a current of $250\ \text{mA}$, however when $1050\ \Omega$ resistance is connected with it in series, it gives full scale deflection for 25 volt. The resistance of galvanometer is_____Ω.

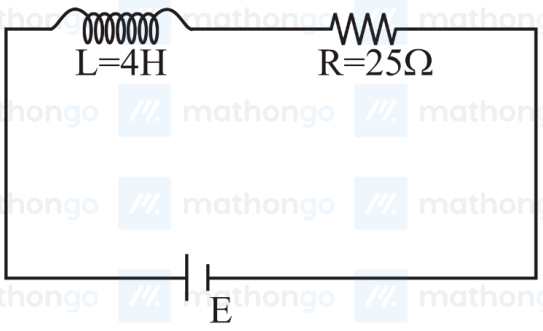
Q20. The source of time varying magnetic field may be

(A) a permanent magnet
(B) an electric field changing linearly with time
(C) direct current
(D) a decelerating charge particle
(E) an antenna fed with a digital signal

Choose the correct answer from the options given below.

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

Q21. In the given figure, an inductor and resistor are connected in series with a battery of emf E volt. $\frac{E^a}{2b}\ \text{J s}^{-1}$ represents the maximum rate at which the energy is stored in the magnetic field (inductor). The numerical value of $\frac{b}{a}$ will be _____.



Q22. Which of the following Maxwell's equation is valid for time varying conditions but not valid for static conditions:

(1) $\oint \vec{B} \cdot \vec{dl} = \mu_0 I$ (2) $\oint \vec{E} \cdot \vec{dl} = 0$

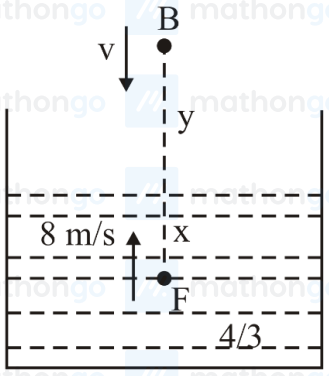
(3) $\oint \vec{D} \cdot \vec{dA} = Q$ (4) $\oint \vec{E} \cdot \vec{dl} = -\frac{\partial \phi_B}{\partial t}$

Q23. A vessel of depth d is half filled with oil of refractive index n_1 and the other half is filled with water of refractive index n_2. The apparent depth of this vessel when viewed from above will be-

(1) $\frac{2d(n_1+n_2)}{n_1+n_2}$ (2) $\frac{d(n_1+n_2)}{2n_1n_2}$

(3) $\frac{dn_1n_2}{2(n_1+n_2)}$ (4) $\frac{dn_1n_2}{(n_1+n_2)}$

Q24. A fish rising vertically upward with a uniform velocity of $8\ \text{m s}^{-1}$, observes that a bird is diving vertically downward towards the fish with the velocity of $12\ \text{m s}^{-1}$. If the refractive index of water is $\frac{4}{3}$, then the actual velocity of the diving bird to pick the fish, will be_____m s^{-1}.



Q25. The difference between threshold wavelengths for two metal surfaces A and B having work function $\phi_A = 9\,\text{eV}$ and $\phi_B = 4.5\,\text{eV}$ in nm is:

{Given, $hc = 1242\ \text{eV nm}$}

(1) 540 (2) 276

(3) 264 (4) 138

Q26. The radius of 2nd orbit of He^+ of Bohr's model is r_1 and that of fourth orbit of Be^{3+} is represented as r_2. Now the ratio $\frac{r_2}{r_1}$ is $x : 1$. The value of x is _____.

Q27. $^{238}_{92}\text{A} \rightarrow {}^{234}_{90}\text{B} + {}^{4}_{2}\text{D} + \text{Q}$

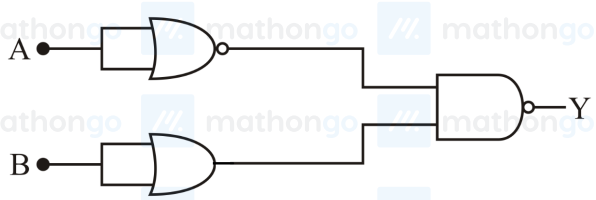
In the given nuclear reaction, the approximate amount of energy released will be:

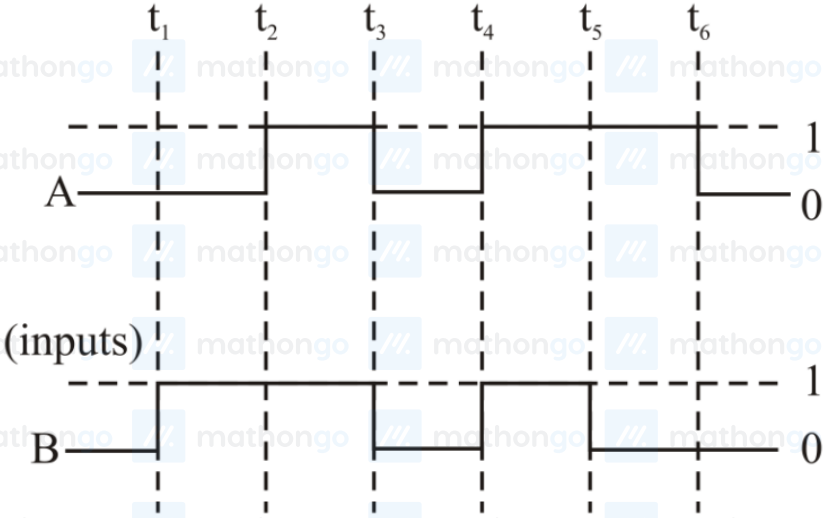
[Given, mass of $^{238}_{92}\text{A} = 238.05079 \times 931.5\ \text{MeV c}^{-2}$, mass of $^{234}_{90}B = 234.04363 \times 931.5\ \text{MeV c}^{-2}$, mass of $^{4}_{2}\text{D} = 4.00260 \times 931.5\,\text{Me}V\,\text{c}^{-2}$]

(1) $3.82\,\text{MeV}$ (2) $5.9\,\text{MeV}$

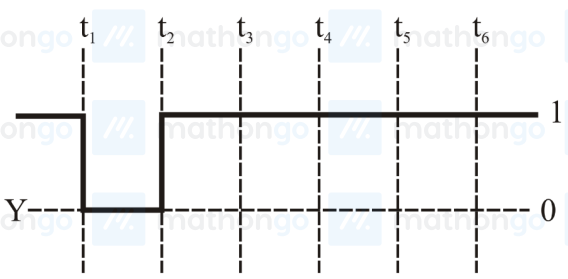
(3) $2.12\,\text{MeV}$ (4) $4.25\,\text{MeV}$

Q28. For the following circuit and given inputs A and B, choose the correct option for output 'Y'

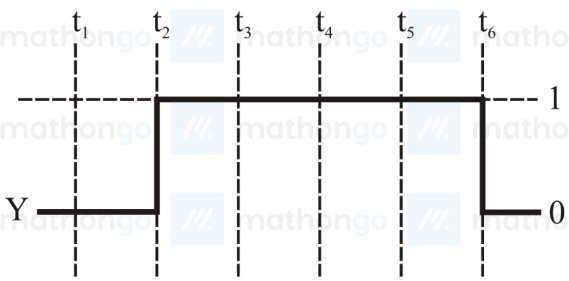




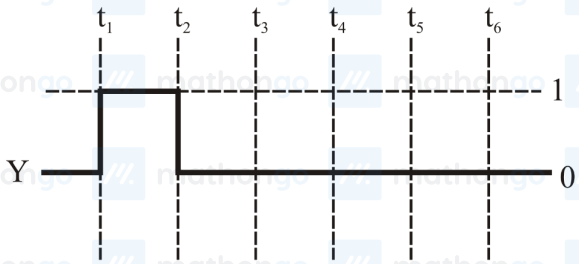
(1)



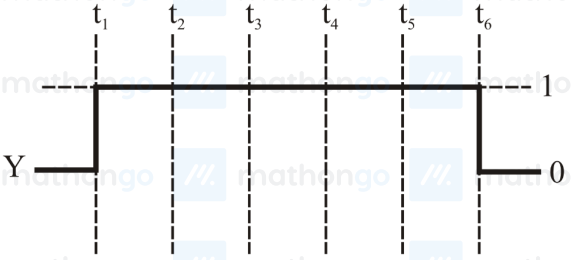
(2)



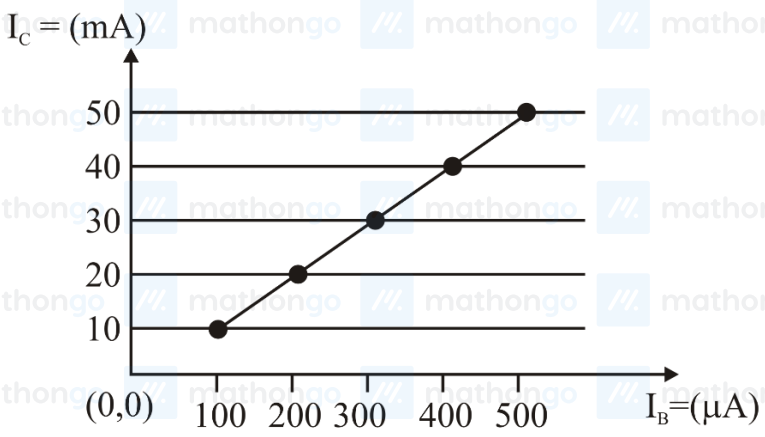
(3)



(4)



Q29. From the given transfer characteristic of a transistor in CE configuration, the value of power gain of this configuration is 10^x, for $R_B = 10\ \text{k}\Omega$, and $R_C = 1\ \text{k}\Omega$. The value of x is _____.



Q30. Match List-I with List-II

List-I (Layer of atmosphere)	List-II (Approximate height over earth's surface)
(A) F_1−Layer	(I) 10 km
(B) D−Layer	(II) 170 − 190 km
(C) Troposphere	(III) 100 km
(D) E−Layer	(V) 65 − 75 km

Choose the correct answer from the options given below.

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

Q31. An organic compound gives 0.220 g of CO_2 and 0.126 g of H_2O on complete combustion. If the % of carbon is 24 then the % of hydrogen is _____ $\times 10^{-1}$. (Nearest integer)

Q32. The energy of an electron in the first Bohr orbit of hydrogen atom is -2.18×10^{-18} J Its energy in the third Bohr orbit is_____.

(1) $\frac{1}{9}$th of the value
(2) $\frac{1}{27}$ of this value
(3) Three times of this value
(4) One third of this value

Q33. Which of the following statements are not correct?

A. The electron gain enthalpy of F is more negative than that of Cl.
B. Ionization enthalpy decreases in a group of periodic table.
C. The electronegativity of an atom depends upon the atoms bonded to it.
D. Al_2O_3 and NO are examples of amphoteric oxides.

Choose the most appropriate answer from the options given below:

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

Q34. In which of the following processes, the bond order increases and paramagnetic character changes to diamagnetic one?

(1) $O_2 \rightarrow O_2^+$
(2) $O_2 \rightarrow O_2^{2-}$
(3) $NO \rightarrow NO^+$
(4) $N_2 \rightarrow N_2^+$

Q35. ClF_5 at room temperature is a

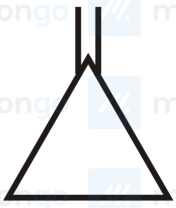
(1) Colourless liquid with trigonal bipyramidal geometry

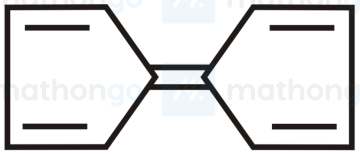
(2) Colourless gas with square pyramidal geometry

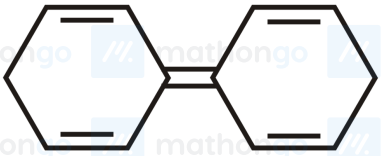
(3) Colourless gas with trigonal bipyramidal geometry

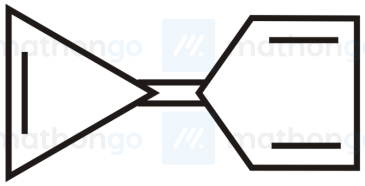
(4) Colourless liquid with square pyramidal geometry

Q36. Among the following compounds, the one which shows highest dipole moment is

(1) 

(2) 

(3) 

(4) 

Q37. A certain quantity of real gas occupies a volume of $0.15\ dm^3$ at $100\ atm$ and $500\ K$ when its compressibility factor is 1.07. Its volume at $300\ atm$ and $300\ K$ (When its compressibility factor is 1.4) is $\_\_\_\_\_ \times 10^{-4}\ dm^3$(Nearest integer)

Q38. $A_2 + B_2 \rightarrow 2\,AB.\ \Delta H_f = -200\ kJ\ mol^{-1}$

AB, A_2 and B_2 are diatomic molecules. If the bond enthalpies of A_2, B_2 and AB are in the ratio$1 : 0.5 : 1$, then the bond enthalpy of A_2 is_____kJ mol^{-1} (Nearest integer)

Q39. 25.0 mL of $0.050\ M\ Ba(NO_3)_2$ is mixed with 25.0 mL of $0.020\ M$ NaF. K_{sp} of BaF_2 is $0.5 \times 10–6$ at 298K. The ratio of $[Ba^{2+}][F^-]^2$ and K_{sp} is _____.

Q40. $KMnO_4$ is titrated with ferrous ammonium sulphate hexahydrate in presence of dilute H_2SO_4. Number of water molecules produced for 2 molecules of $KMnO_4$ is _____

Q41. 20 mL of calcium hydroxide was consumed when it was reacted with 10 mL of unknown solution of H_2SO_4. Also 20 mL standard solution of $0.5\ M$ HCl containing 2 drops of phenolphthalein was titrated with calcium hydroxide, the mixture showed pink colour when burette displayed the value of 35.5 mL whereas the burette showed 25.5 mL initially. The concentration of H_2SO_4 is _____M. (Nearest integer)

Q42. Given below are two statements:

Statement I: Permutit process is more efficient compared to the synthetic resin method for the softening of water.

Statement II: Synthetic resin method results in the formation of soluble sodium salts.

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

(1) Both the statements I and II are incorrect

(2) Statement I is incorrect but statement II is correct

(3) Both the statements I and II are correct

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

Q43. $Be(OH)_2$ reacts with $Sr(OH)_2$ to yield an ionic salt. Choose the incorrect option related to this reaction from the following

(1) Both Sr and Be elements are present in the ionic salt

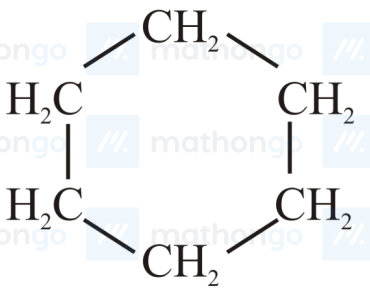
(2) Beis tetrahedrally coordinated in the ionic salt

(3) The element Be is present in the cationic part of the ionic salt

(4) The reaction is an example of acid-base neutralization reaction

Q44. In the following reaction \X/ is

$$CH_3(CH_2)_4CH_3 \xrightarrow[\triangle]{\text{Anhy.}AlCl_3,\ HCl} \underset{\text{major product}}{X}$$

(1) 

(2) $CH_3CH(CH_3)-(CH_2)_2CH_3$

(3) $CH_3(CH_2)_4CH_2Cl$

(4) $Cl-CH_2-(CH_2)_4-CH_2-Cl$

Q45. The radical which mainly causes ozone depletion in the presence of UV radiations is :

(1) $\dot{Cl}$

(2) $\dot{NO}$

(3) $\dot{OH}$

(4) $\dot{CH_3}$

Q46. Solution of 12 g of non-electrolyte (A) prepared by dissolving it in 1000 mL of water exerts the same osmotic pressure as that of 0.05 M glucose solution at the same temperature. The empirical formula of A is CH_2O. The molecular mass of A is _____g. (Nearest integer)

Q47. A metal surface of 100 cm^2 area has to be coated with nickel layer of thickness 0.001 mm. A current of 2A was passed through a solution of $Ni(NO_3)_2$ for \x/ seconds to coat the desired layer. The value of x is _____. (Nearest integer)

(ρNi (density of Nickel) is 10 g mL^{-1}, Molar mass of Nickel is 60 g mol^{-1} $F = 96500\ Cmol^{-1}$)

Q48. $t_{87.5}$ is the time required for the reaction to undergo 87.5% completion and t_{50} is the time required for the reaction to undergo 50% completion. The relation between $t_{87.5}$ and t_{50} for a first order reaction is $t_{87.5} = x \times t_{50}$

The value of x is _____. (Nearest integer)

Q49. What happens when a lyophilic sol is added to a lyophobic sol?

(1) Film of lyophilic sol is formed over lyophobic sol

(2) Lyophilic sol is dispersed in lyophobic sol

(3) Film of lyophobic sol is formed over lyophilic sol

(4) Lyophobic sol is coagulated

Q50. Which one of the following is most likely a mismatch?

(1) Zinc-Liquation (2) Copper-Electrolysis
(3) Nickel-Mond process (4) Titanium-van Arkel Method

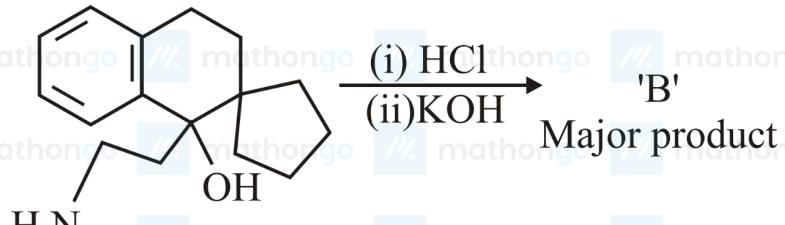
Q51. The incorrect statement from the following for borazine is:
(1) It contains banana bonds (2) It can react with water
(3) It is a cyclic compound (4) It has electronic delocalization

Q52. The pair of lanthanides in which both elements have high third-ionization energy is:
(1) Dy, Gd (2) Lu, Yb
(3) Eu, Yb (4) Eu, Gd

Q53. The mismatched combinations are
A. Chlorophyll– Co
B. Water hardness– EDTA
C. Photography $-[Ag(CN)_2]^-$
D. Wilkinson catalyst $-[(Ph_3P)_3RhCl]$
E. Chelating ligand–D–Penicillamine
Choose the correct answer from the options given below.
(1) A, C and E only (2) A and C only
(3) A and E only (4) D and E only

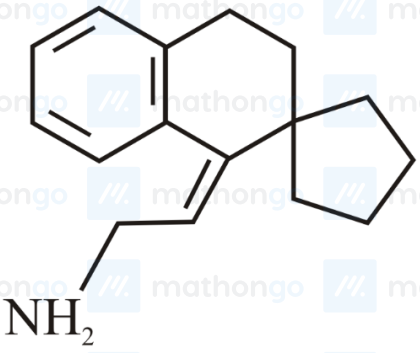
Q54. 2–Methyl propyl bromide reacts with $C_2H_5O^-$ and gives 'A' whereas on reaction with C_2H_5OH it gives 'B'. The mechanism followed in these reactions and the products 'A' and 'B' respectively are:
(1) S_N2, A =iso-butyl ethyl ether; S_N1, B =tert-butyl ethyl ether (2) S_N1, A =tert-butyl ethyl ether; S_N1, B = 2–butyl ethyl ether
(3) S_N2, A = 2–butyl ethyl ether; S_N2, B =iso-butyl ethyl ether (4) S_N1, A =tert-butyl ethyl ether; S_N2, B =iso-butyl ethyl ether

Q55. In the reaction given below

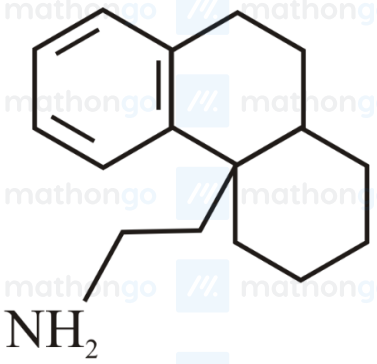


'B' is:

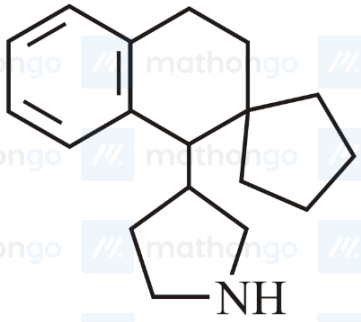
(1)



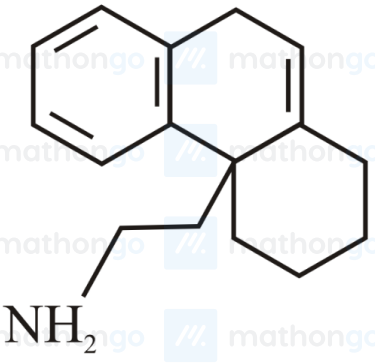
(2)



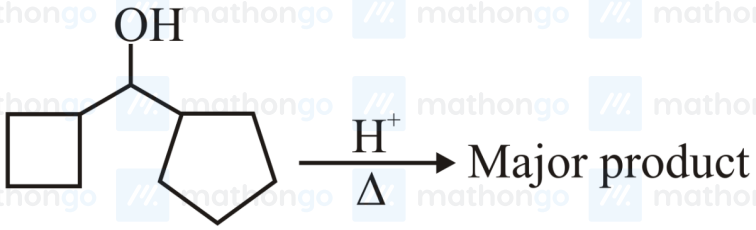
(3)



(4)



Q56.



In the above reaction, left hand side and right hand side rings are named as 'A' and 'B' respectively. They undergo ring expansion. The correct statement for this process is:

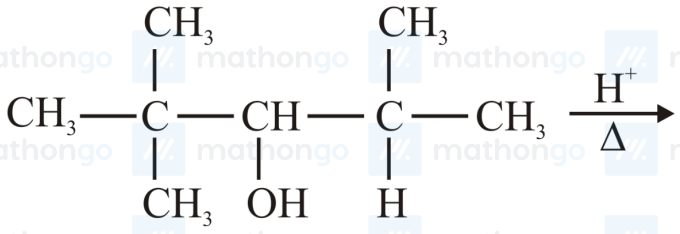
(1) Ring expansion can go upto seven membered rings

(2) Finally both rings will become six membered each.

(3) Finally both rings will become five membered each.

(4) Only A will become 6 membered.

Q57. For the given reaction



The, total number of possible products formed by tertiary carbocation of A is_____.

Q58. $D-(+)-Glyceraldehyde \xrightarrow[ii)H_2O/H^+]{i)\ HCN} \xrightarrow[iii)\ HNO_3]{}$

The products formed in the above reaction are

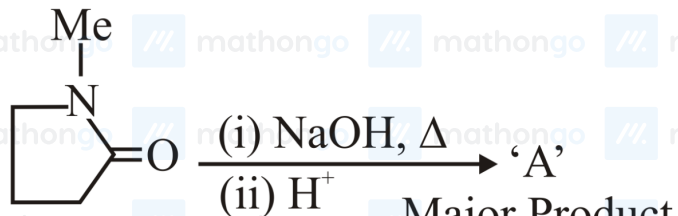
(1) One optically active and one meso product

(2) Two optically inactive products

(3) Two optically active products

(4) One optically inactive and one meso product

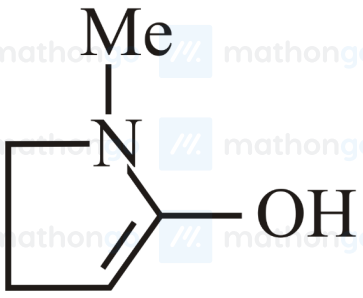
Q59.



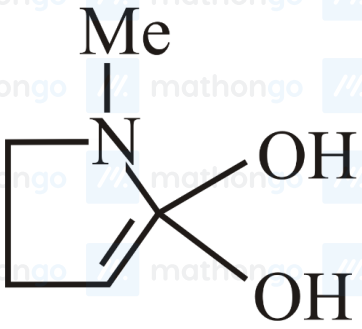
'A' is

(1)

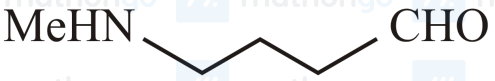
(2)



(3)



(4)



Q60. Match the following

Column−A		Column−B
a.	Nylon 6	I. Natural Rubber
b.	Vulcanized Rubber	II. Cross Linked
c.	cis−1, 4−polyisoprene	III. Caprolactam
d.	Polychloroprene	IV. Neoprene

Choose the correct answer from options given below:

(1) a → III, b → II, c → I, d → IV

(2) a → III, b → IV, c → I, d → II

(3) a → IV, b → III, c → II, d → I

(4) a → II, b → III, c → IV, d → I

Q61. Let $w = z\bar{z} + k_1 z + k_2 iz + \lambda(1+i), k_1, k_2 \in \mathbb{R}$. . Let $Re(w) = 0$ be the circle C of radius 1 in the first quadrant touching the line $y = 1$ and the $y-$axis. If the curve $Im(w) = 0$ intersects C at A and B, then $30(AB)^2$ is equal to _____.

Q62. The number of seven digit positive integers formed using the digits $1, 2, 3$ and 4 only and sum of the digits equal to 12 is_____.

Q63. Let $s_1, s_2, s_3 \ldots, s_{10}$ respectively be the sum of 12 terms of 10 A. Ps whose first terms are $1,\ 2,\ 3, \ldots, 10$ and the common differences are $1,\ 3,\ 5, \ldots, 19$ respectively. Then $\sum_{i=1}^{10} s_i$ is equal to

(1) 7220 (2) 7360

(3) 7260 (4) 7380

Q64. The sum to 20 terms of the series $2 \cdot 2^2 - 3^2 + 2 \cdot 4^2 - 5^2 + 2 \cdot 6^2 - \ldots\ldots\ldots\ldots$ is equal to_____.

Q65. Fractional part of the number $\frac{4^{2022}}{15}$ is equal to

(1) $\frac{8}{15}$ (2) $\frac{4}{15}$

(3) $\frac{14}{15}$ (4) $\frac{1}{15}$

Q66. Let α be the constant term in the binomial expansion of $\left(\sqrt{x} - \frac{6}{x^{\frac{3}{2}}}\right)^n, n \leq 15$. If the sum of the coefficients of the remaining terms in the expansion is 649 and the coefficient of x^{-n} is $\lambda\alpha$, then λ is equal to _____.

Q67. Let PQ be a focal chord of the parabola $y^2 = 36x$ of length 100, making an acute angle with the positive $x-$axis. Let the ordinate of P be positive and M be the point on the line segment PQ such that $PM : MQ = 3 : 1$. Then which of the following points does NOT lie on the line passing through M and perpendicular to the line PQ?

(1) $(-6, 45)$ (2) $(6, 29)$

(3) $(3, 33)$ (4) $(-3, 43)$

Q68. Let the tangent and normal at the point $\left(3\sqrt{3}, 1\right)$ on the ellipse $\frac{x^2}{36} + \frac{y^2}{4} = 1$ meet the $y-$axis at the points A and B respectively. Let the circle C be drawn taking AB as a diameter and the line $x = 2\sqrt{5}$ intersect C at the points P and Q. If the tangents at the points P and Q on the circle intersect at the point (α, β), then $\alpha^2 - \beta^2$ is equal to

(1) 61 (2) 60

(3) $\frac{304}{5}$ (4) $\frac{314}{5}$

Q69. Let m_1 and m_2 be the slopes of the tangents drawn from the point $P(4, 1)$ to the hyperbola $H : \frac{y^2}{25} - \frac{x^2}{16} = 1$ If Q is the point from which the tangents drawn to H have slopes $|m_1|$ and $|m_2|$ and they make positive intercepts α and β on the $x-$axis, then $\frac{(PQ)^2}{\alpha\beta}$ is equal to _____.

Q70. The negation of the statement $((A \wedge (B \vee C)) \Rightarrow (A \vee B)) \Rightarrow A$ is

(1) equivalent to $\sim C$ (2) equivalent to $B \vee \sim C$

(3) a fallacy (4) equivalent to $\sim A$

Q71. Let the mean of the data

x	1	3	5	7	9
Frequency (f)	4	24	28	α	8

be 5. If m and σ^2 are respectively the mean deviation about the mean and the variance of the data, then $\frac{3\alpha}{m+\sigma^2}$ is equal to _____.

Q72. The number of symmetric matrices of order 3, with all the entries from the set $\{0,1,2,3,4,5,6,7,8,9\}$ is

(1) 6^{10} (2) 10^6

(3) 9^{10} (4) 10^9

Q73. Let $B=\begin{bmatrix}1 & 3 & \alpha\\ 1 & 2 & 3\\ \alpha & \alpha & 4\end{bmatrix}, \alpha>2$ be the adjoint of a matrix A and $|A|=2$. Then $\begin{bmatrix}\alpha & -2\alpha & \alpha\end{bmatrix}B\begin{bmatrix}\alpha\\ -2\alpha\\ \alpha\end{bmatrix}$ is equal to

(1) 0 (2) 16

(3) -16 (4) 32

Q74. For the system of linear equations

$2x+4y+2az=b$

$x+2y+3z=4$

$2x+5y+2z=8$

which of the following is NOT correct?

(1) It has unique solution if $a=b=6$ (2) It has infinitely many solutions if $a=3,\ b=6$

(3) It has infinitely many solutions if $a=3,\ b=8$ (4) It has unique solution if $a=b=8$

Q75. If $S=\left\{x\in\mathbb{R}:\sin^{-1}\left(\frac{x+1}{\sqrt{x^2+2x+2}}\right)-\sin^{-1}\left(\frac{x}{\sqrt{x^2+1}}\right)=\frac{\pi}{4}\right\}$ then $\sum_{x\in S}\left(\sin\left(\left(x^2+x+5\right)\frac{\pi}{2}\right)-\cos\left(\left(x^2+x+5\right)\pi\right)\right)$ is equal to _____.

Q76. For $x\in\mathbb{R}$, two real valued functions $f(x)$ and $g(x)$ are such that, $g(x)=\sqrt{x}+1$ and $fog(x)=x+3-\sqrt{x}$. Then $f(0)$ is equal to

(1) 1 (2) 5

(3) 0 (4) -3

Q77. For the differentiable function $f:\mathbb{R}-\{0\}-\mathbb{R}$, let $3f(x)+2f\left(\frac{1}{x}\right)=\frac{1}{x}-10$, then $\left|f(3)+f'\left(\frac{1}{4}\right)\right|$ is equal to

(1) $\frac{33}{5}$ (2) 8

(3) $\frac{29}{5}$ (4) 13

Q78. $\max\limits_{0\le x\le\pi}\left\{x-2\sin x\cos x+\frac{1}{3}\sin 3x\right\}=$

(1) $\frac{\pi+2-3\sqrt{3}}{6}$ (2) π

(3) 0 (4) $\frac{5\pi+2+3\sqrt{3}}{6}$

Q79. The set of all $a\in\mathbb{R}$ for which the equation $x|x-1|+|x+2|+a=0$ has exactly one real root, is

(1) $(-7,\infty)$ (2) $(-\infty,\infty)$

(3) $(-6,-3)$ (4) $(-\infty,-3)$

Q80. $\int_0^\infty \frac{6}{e^{3x}+6e^{2x}+11e^x+6}dx=$

(1) $\log_e\left(\frac{32}{27}\right)$ (2) $\log_e\left(\frac{512}{81}\right)$

(3) $\log_e\left(\frac{256}{81}\right)$ (4) $\log_e\left(\frac{302}{27}\right)$

Q81. Among

$(S1):\lim\limits_{n\to\infty}\frac{1}{n^2}\left(2+4+6+\ldots+2n\right)=1$

$(S2): \lim\limits_{n\to\infty} \frac{1}{n^{16}}\left(1^{15}+2^{15}+3^{15}+\ldots+n^{15}\right)=\frac{1}{16}$

(1) Both $(S1)$ and $(S2)$ are true
(2) Only $(S1)$ is true
(3) Both $(S1)$ and $(S2)$ are false
(4) Only $(S2)$ is true

Q82. Let for $x \in \mathbb{R},\ S_0(x)=x,\ S_k(x)=C_k x+k\int_0^x S_{k-1}(t)dt$ where $C_0=1,\ C_k=1-\int_0^1 S_{k-1}(x)dx,\ k=1,2,3,\ldots$ Then $S_2(3)+6C_3$ is equal to _____.

Q83. The area of the region enclosed by the curve $f(x)=\max\{\sin x,\cos x\}, -\pi\le x\le\pi$ and the $x-$axis is
(1) $2\sqrt{2}\left(\sqrt{2}+1\right)$
(2) 4
(3) $4\left(\sqrt{2}\right)$
(4) $2\left(\sqrt{2}+1\right)$

Q84. Let $y=y_1(x)$ and $y=y_2(x)$ be the solution curves the differential equation $\frac{dy}{dx}=y+7$ with initial conditions $y_1(0)=0$ and $y_2(0)=1$ respectively. Then the curves $y=y_1(x)$ and $y=y_2(x)$ intersect at
(1) no point
(2) two points
(3) one point
(4) infinite number of points

Q85. Let $\vec{a}=\hat{i}+4\hat{j}+2\hat{k}, \vec{b}=3\hat{i}-2\hat{j}+7\hat{k}$ and $\vec{c}=2\hat{i}-\hat{j}+4\hat{k}$. If a vector $\vec{d}$ satisfies $\vec{d}\times\vec{b}=\vec{c}\times\vec{b}$ and $\vec{d}\cdot\vec{a}=24$, then $\left|\vec{d}\right|^2$ is equal to
(1) 323
(2) 423
(3) 313
(4) 413

Q86. Let $\vec{a}=3\hat{i}+\hat{j}-\hat{k}$ and $\vec{c}=2\hat{i}-3\hat{j}+3\hat{k}$. If $\vec{b}$ is a vector such that $\vec{a}=\vec{b}\times\vec{c}$ and $\left|\vec{b}\right|^2=50$, then $\left|72-\left|\vec{b}+\vec{c}\right|^2\right|$ is equal to _____.

Q87. Let the equation of plane passing through the line of intersection of the planes $x+2y+az=2$ and $x-y+z=3$ be $5x-11y+bz=6a-1$. For $c\in\mathbb{Z}$, if the distance of this plane from the point $(a,-c,c)$ is $\frac{2}{\sqrt{a}}$, then $\frac{a+b}{c}$ is equal to
(1) 2
(2) 4
(3) -4
(4) -2

Q88. The distance of the point $(-1,2,3)$ from the plane $\vec{r}\cdot\left(\hat{i}-2\hat{j}+3\hat{k}\right)=10$ parallel to the line of the shortest distance between the lines $\vec{r}=\left(\hat{i}-\hat{j}\right)+\lambda\left(2\hat{i}+\hat{k}\right)$ and $\vec{r}=\left(2\hat{i}-\hat{j}\right)+\mu\left(\hat{i}-\hat{j}+\hat{k}\right)$ is
(1) $4\sqrt{6}$
(2) $2\sqrt{5}$
(3) $2\sqrt{6}$
(4) $3\sqrt{5}$

Q89. Let the image of the point $\left(\frac{5}{3},\frac{5}{3},\frac{8}{3}\right)$ in the plane $x-2y+z-2=0$ be P. If the distance of the point $Q(6,-2,\alpha), \alpha>0$, from P is 13, then α is equal to _____.

Q90. A coin is biased so that the head is 3 times as likely to occur as tail. This coin is tossed until a head or three tails occur. If X denotes the number of tosses of the coin, then the mean of X is

(1) $\frac{38}{16}$
(2) $\frac{15}{16}$
(3) $\frac{21}{16}$
(4) $\frac{81}{64}$

ANSWER KEYS

1. (3)	**2.** (2)	**3.** (1)	**4.** (4)	**5.** (2)	**6.** (1)	**7.** (2)	**8.** (1)
9. (3)	**10.** (3)	**11.** (2)	**12.** (4)	**13.** (3)	**14.** (2)	**15.** (4)	**16.** (2)
17. (4)	**18.** (4)	**19.** (1)	**20.** (1)	**21.** (4)	**22.** (40)	**23.** (4)	**24.** (6)
25. (16)	**26.** (50)	**27.** (25)	**28.** (3)	**29.** (2)	**30.** (3)	**31.** (3)	**32.** (4)
33. (3)	**34.** (4)	**35.** (4)	**36.** (1)	**37.** (3)	**38.** (2)	**39.** (1)	**40.** (1)
41. (1)	**42.** (1)	**43.** (3)	**44.** (2)	**45.** (1)	**46.** (4)	**47.** (2)	**48.** (1)
49. (1)	**50.** (1)	**51.** (56)	**52.** (392)	**53.** (800)	**54.** (5)	**55.** (68)	**56.** (1)
57. (240)	**58.** (16)	**59.** (3)	**60.** (5)	**61.** (3)	**62.** (4)	**63.** (4)	**64.** (3)
65. (4)	**66.** (2)	**67.** (3)	**68.** (2)	**69.** (2)	**70.** (4)	**71.** (4)	**72.** (2)
73. (1)	**74.** (1)	**75.** (2)	**76.** (1)	**77.** (4)	**78.** (3)	**79.** (3)	**80.** (3)
81. (24)	**82.** (413)	**83.** (1310)	**84.** (36)	**85.** (8)	**86.** (8)	**87.** (4)	**88.** (18)
89. (66)	**90.** (15)						