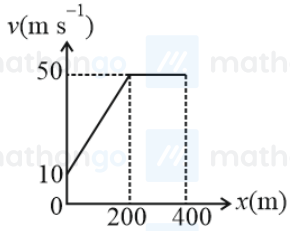
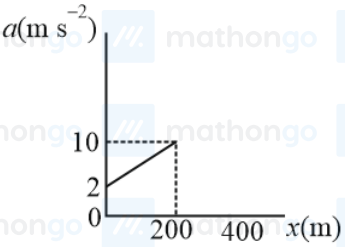
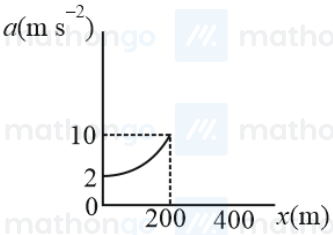
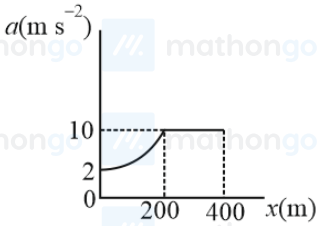
Q1. The velocity-displacement graph describing the motion of a bicycle is shown in the figure.

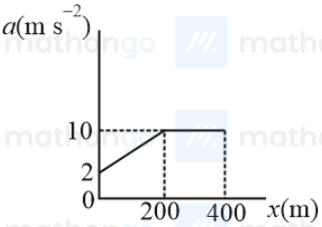


The acceleration-displacement graph of the bicycle's motion is best described by :

(1) 

(2) 

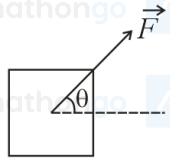
(3) 

(4) 

Q2. A block of 200 g mass moves with a uniform speed in a horizontal circular groove, with vertical side walls of radius 20 cm. If the block takes 40 s to complete one round, the normal force by the side walls of the groove is:

(1) 0.0314 N
(2) 9.859×10^{-2} N
(3) 6.28×10^{-3} N
(4) 9.859×10^{-4} N

Q3. A block of mass m slides along a floor while a force of magnitude F is applied to it at an angle θ as shown in figure. The coefficient of kinetic friction is μ_K. Then, the block's acceleration a is given by : (g is acceleration due to gravity)

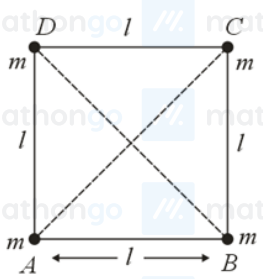


(1) $-\frac{F}{m}\cos\theta - \mu_K\left(g - \frac{F}{m}\sin\theta\right)$
(2) $\frac{F}{m}\cos\theta - \mu_K\left(g - \frac{F}{m}\sin\theta\right)$
(3) $\frac{F}{m}\cos\theta - \mu_K\left(g + \frac{F}{m}\sin\theta\right)$
(4) $\frac{F}{m}\cos\theta + \mu_K\left(g - \frac{F}{m}\sin\theta\right)$

Q4. The maximum and minimum distances of a comet from the Sun are 1.6×10^{12} m and 8.0×10^{10} m respectively. If the speed of the comet at the nearest point is 6×10^4 m s^{-1}, the speed at the farthest point is

(1) 1.5×10^3 m s^{-1}
(2) 6.6×10^3 m s^{-1}
(3) 3.0×10^3 m s^{-1}
(4) 4.5×10^3 m s^{-1}

Q5. Four equal masses, m each are placed at the corners of a square of length (l) as shown in the figure. The moment of inertia of the system about an axis passing through A and parallel to DB would be :



(1) ml^2 (2) $2\ ml^2$
(3) $3\ ml^2$ (4) $\sqrt{3}\ ml^2$

Q6. The pressure acting on a submarine is 3×10^5 Pa at a certain depth. If the depth is doubled, the percentage increase in the pressure acting on the submarine would be: (Assume that atmospheric pressure is 1×10^5 Pa density of water is 10^3 kg m^{-3}, g = 10 ms^{-2})
(1) $\frac{200}{3}\%$ (2) $\frac{200}{5}\%$
(3) $\frac{5}{200}\%$ (4) $\frac{3}{200}\%$

Q7. In thermodynamics, heat and work are :
(1) Path functions (2) Intensive thermodynamic state variables
(3) Extensive thermodynamic state variables (4) Point functions

Q8. The volume V of an enclosure contains a mixture of three gases, 16 g of oxygen, 28 g of nitrogen and 44 g of carbon dioxide at absolute temperature T. Consider R as universal gas constant. The pressure of the mixture of gases is :
(1) $\frac{88RT}{V}$ (2) $\frac{3RT}{V}$
(3) $\frac{5}{2}\frac{RT}{V}$ (4) $\frac{4RT}{V}$

Q9. Time period of a simple pendulum is T inside a lift when the lift is stationary. If the lift moves upwards with an acceleration $\frac{g}{2}$, the time period of pendulum will be :
(1) $\sqrt{3}T$ (2) $\frac{T}{\sqrt{3}}$
(3) $\sqrt{\frac{3}{2}}T$ (4) $\sqrt{\frac{2}{3}}T$

Q10. A 25 m long antenna is mounted on an antenna tower. The height of the antenna tower is 75 m. The wavelength (in meter) of the signal transmitted by this antenna would be :
(1) 300 (2) 400
(3) 200 (4) 100

Q11. For changing the capacitance of a given paralle plate capacitor, a dielectric material of dielectric constant K is used, which has the same area as the plates of the capacitor. The thickness of the dielectric slab is $\frac{3}{4}d$, where d is the separation between the plates of parallel plate capacitor. The new capacitance C' in terms of original capacitance C_0 is given by the following relation :
(1) $C' = \frac{3+K}{4K}C_0$ (2) $C' = \frac{4+K}{3}C_0$
(3) $C' = \frac{4K}{K+3}C_0$ (4) $C' = \frac{4}{3+K}C_0$

Q12. A conducting wire of length l, area of crosssection A and electric resistivity ρ is connected between the terminals of a battery. A potential difference V is developed between its ends, causing an electric current. If the

length of the wire of the same material is doubled and the area of cross-section is halved, the resultant current would be___

(1) $\frac{1}{4}\frac{VA}{\rho l}$ (2) $\frac{3}{4}\frac{VA}{\rho l}$

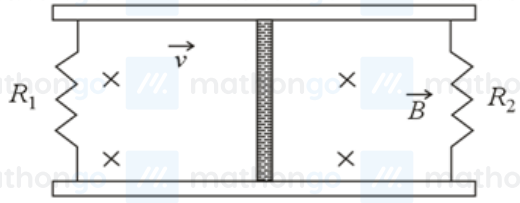
(3) $\frac{1}{4}\frac{\rho l}{VA}$ (4) $4\frac{VA}{\rho l}$

Q13. A bar magnet of length 14 cm is placed in the magnetic meridian with its north pole pointing towards the geographic north pole. A neutral point is obtained at a distance of 18 cm from the center of the magnet. If $B_H = 0.4$ G, the magnetic moment of the magnet is $\left(1\text{ G} = 10^{-4}\text{ T}\right)$

(1) 2.880×10^3 J T^{-1} (2) 2.880×10^2 J T^{-1}

(3) 2.880 J T^{-1} (4) 28.80 J T^{-1}

Q14. A conducting bar of length L is free to slide on two parallel conducting rails as shown in the figure



Two resistors R_1 and R_2 are connected across the ends of the rails. There is a uniform magnetic field $\vec{B}$ pointing into the page. An external agent pulls the bar to the left at a constant speed v.

The correct statement about the directions of induced currents I_1 and I_2 flowing through R_1 and R_2 respectively is :

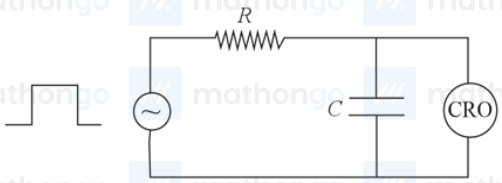
(1) Both I_1 and I_2 are in anticlockwise direction

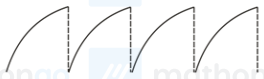
(2) Both I_1 and I_2 are in clockwise direction

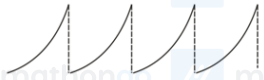
(3) I_1 is in clockwise direction and I_2 is in anticlockwise direction

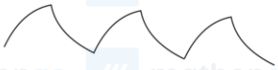
(4) I_1 is in anticlockwise direction and I_2 is in clockwise direction

Q15. An RC circuit as shown in the figure is driven by a AC source generating a square wave. The output wave pattern monitored by CRO would look close to :



(1) 

(2) 

(3) 

(4) 

Q16. A plane electromagnetic wave of frequency 500 MHz is traveling in a vacuum along the $y-$direction. At a particular point in space and time, $\vec{B} = 8.0 \times 10^{-8}\hat{z}$ T. The value of the electric field at this point is:(speed of light $= 3 \times 10^8$ ms^{-1}) $\hat{x}, \hat{y}, \hat{z}$ are unit vectors along x, y and z direction.

(1) $-24\hat{x}$ V m^{-1} (2) $2.6\hat{x}$ V m^{-1}

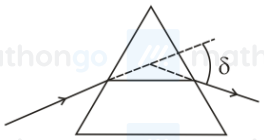
(3) $24\hat{x}$ V m^{-1} (4) $-2.6\hat{x}$ V m^{-1}

Q17. For an electromagnetic wave travelling in free space, the relation between average energy densities due to electric (U_e) and magnetic (U_m) fields is :

(1) $U_e = U_m$ (2) $U_e > U_m$

(3) $U_e < U_m$ (4) $U_e \neq U_m$

Q18. The angle of deviation through a prism is minimum when



(A) Incident ray and emergent ray are symmetric to the prism

(B) The refracted ray inside the prism becomes parallel to its base

(C) Angle of incidence is equal to that of the angle of emergence

(D) When angle of emergence is double the angle of incidence

Choose the correct answer from the options given below :

(1) Statements (A),(B) and (C) are true (2) Only statement (D) is true

(3) Only statements (A) and (B) are true (4) Statements (B) and (C) are true

Q19. The stopping potential in the context of photoelectric effect depends on the following property of incident electromagnetic radiation:

(1) Phase (2) Intensity

(3) Amplitude (4) Frequency

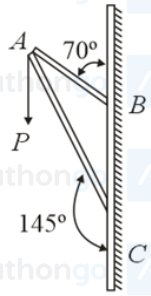
Q20. One main scale division of a vernier callipers is a cm and n^{th} division of the vernier scale coincide with $(n-1)^{\text{th}}$ division of the main scale. The least count of the callipers in mm is :

(1) $\frac{10na}{(n-1)}$ (2) $\frac{10a}{(n-1)}$

(3) $\frac{(n-1)}{10n}$ (4) $\frac{10a}{n}$

Q21. The resistance $R = \frac{V}{I}$, where $V = (50 \pm 2)$ V and $I = (20 \pm 0.2)$ A. The percentage error in R is x %. The value of x to the nearest integer is _____.

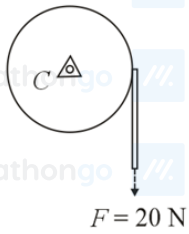
Q22. Consider a frame that is made up of two thin massless rods AB and AC as shown in the figure. A vertical force $\vec{P}$ of magnitude 100 N is applied at point A of the frame.



Suppose the force is $\vec{P}$ resolved parallel to the arms AB and AC of the frame. The magnitude of the resolved component along the arm AC is xN. The value of x, to the nearest integer, is _____.

[Given : $\sin(35^\circ) = 0.573, \cos(35^\circ) = 0.819,\ \sin(110^\circ) = 0.939, \cos(110^\circ) = -0.342$]

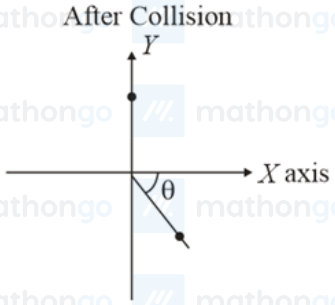
Q23. Consider a 20 kg uniform circular disk of radius 0.2 m. It is pin supported at its center and is at rest initially. The disk is acted upon by a constant force $F = 20$ N through a massless string wrapped around its periphery as shown in the figure.



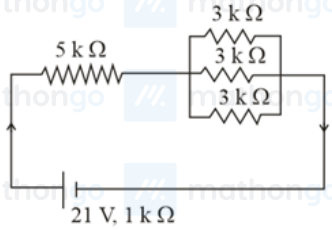
Suppose the disk makes n number of revolutions to attain an angular speed of 50 rad s^{-1}. The value of n, to the nearest integer, is _____ .

[Given : In one complete revolution, the disk rotates by 6.28 rad]

Q24. A ball of mass 10 kg moving with a velocity $10\sqrt{3}$ m s^{-1} along X-axis, hits another ball of mass 20 kg which is at rest. After the collision, the first ball comes to rest and the second one disintegrates into two equal pieces. One of the pieces starts moving along Y-axis at a speed of 10 m s^{-1}. The second piece starts moving at a speed of 20 m s^{-1} at an angle θ (degree) with respect to the X-axis. The configuration of pieces after the collision is shown in the figure. The value of θ to the nearest integer is _____.



Q25. In the figure given, the electric current flowing through the 5 kΩ resistor is x mA.



The value of x to the nearest integer is _____.

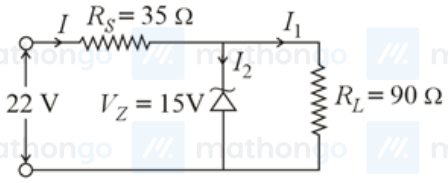
Q26. A sinusoidal voltage of peak value 250 V is applied to a series LCR circuit, in which $R = 8\ \Omega, L = 24$ mH and $C = 60\ \mu$F. The value of power dissipated at resonant condition is x kW. The value of x to the nearest integer is _____.

Q27. A fringe width of 6 mm was produced for two slits separated by 1 mm apart. The screen is placed 10 m away. The wavelength of light used is x nm. The value of x to the nearest integer is _____.

Q28. The first three spectral lines of H-atom in the Balmer series are given $\lambda_1, \lambda_2, \lambda_3$ considering the Bohr atomic model, the wave lengths of first and third spectral lines $\left(\frac{\lambda_1}{\lambda_3}\right)$ are related by a factor of approximately x

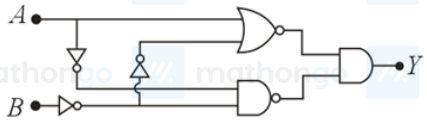
$\times 10^{-1}$. The value of x, to the nearest integer, is _____.

Q29. The value of power dissipated across the zener diode $(V_z = 15\text{ V})$ connected in the circuit as shown in the figure is $x \times 10^{-1}$ W.



The value of x to the nearest integer is _____.

Q30. In the logic circuit shown in the figure, if input A and B are 0 to 1 respectively, the output at Y would be x. The value of x is _____.



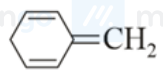
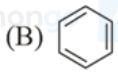
Q31. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R :
Assertion A : The H − O − H bond angle in water molecule is 104.5°.
Reason R : The lone pair − lone pair repulsion of electrons is higher than the bond pair − bond pair repulsion.
(1) A is false but R is true
(2) Both A and R are true, but R is not the correct explanation of A
(3) A is true but R is false
(4) Both A and R are true, and R is the correct explanation of A

Q32. Given below are two statements:
Statement I : H_2O_2 can act as both oxidising and reducing agent in basic medium.
Statement II : In the hydrogen economy, the energy is transmitted in the form of dihydrogen. 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

Q33. A group 15 element, which is a metal and forms a hydride with strongest reducing power among group 15 hydrides. The element is :
(1) Sb
(2) P
(3) As
(4) Bi

Q34. Given below are two statements:
Statement I : Both $CaCl_2.6H_2O$ and $MgCl_2.8H_2O$ undergo dehydration on heating.
Statement II : BeO is amphoteric, whereas the oxides of other elements in the same group are acidic.
In the light of the above statements, choose the correct answer from the options given below:
(1) Statement I is false but statement II is true
(2) Both statement I and statement II are false
(3) Both statement I and statement II are true
(4) Statement I is true but statement II is false

Q35. Among the following, the aromatic compounds are :

(A)  (B)  (C)  (D) 

Choose the correct answer from the following options :

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

Q36. Assertion A : Enol form of acetone $[CH_3COCH_3]$ exists in $< 0.1\%$ quantity. However, the enol form of acetyl acetone $[CH_3COCH_2OCCH_3]$ exists in approximately 15%quantity.

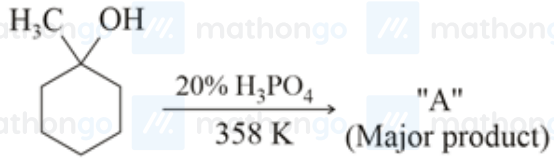
Reason R : enol form of acetyl acetone is stabilized by intramolecular hydrogen bonding, which is not possible in enol form of acetone.

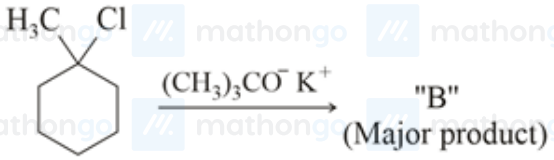
Choose the correct statement:

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

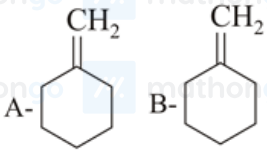
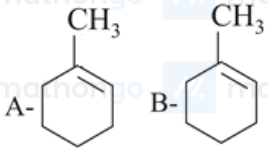
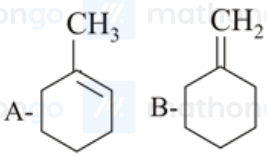
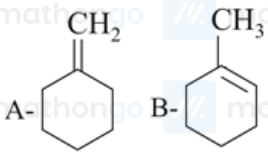
Q37. In chromatography technique, the purification of a compound is independent of:

(1) Mobility or flow of solvent system
(2) Solubility of the compound
(3) Length of the column or TLC Plate
(4) Physical state of the pure compound

Q38. 



The product "A" and "B" formed in above reactions are

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

Q39. The type of pollution that gets increased during the daytime and in the presence of O_3 is :

(1) Reducing smog
(2) Oxidising smog
(3) Global warming
(4) Acid rain

Q40. Given below are two statements :

Statement I : The E° value of Ce^{4+} / Ce^{3+} is $+1.74$ V

Statement II : Ce is more stable in Ce^{4+} state than Ce^{3+} state.

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

(1) Both statement I and statement II are correct

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

(3) Both statement I and statement II are incorrect

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

Q41. The process that involves the removal of sulphur from the ores is :

(1) Smelting (2) Roasting

(3) Leaching (4) Refining

Q42. Match List-I with List-II :

	List-I Industrial process		List-II Application
(a)	Haber's process	(i)	HNO_3 synthesis
(b)	Ostwald's process	(ii)	Aluminium extraction
(c)	Contact process	(iii)	NH_3 synthesis
(d)	Hall-Heroult process	(iv)	H_2SO_4 synthesis

Choose the correct answer from the options given below:

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

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

Q43. Match List-I with List-II

	List-I Name of oxo acid		List-II Oxidation state of 'P
(a)	Hypophosphorous acid	(i)	+5
(b)	Orthophosphoric acid	(ii)	+4
(c)	Hypophosphoric acid	(iii)	+3
(d)	Orthophosphorous acid	(iv)	+2
		(v)	+1

Choose the correct answer from the options given below :

(1) (a) – (v), (b) – (i), (c) – (ii), (d) – (iii) (2) (a) – (iv), (b) – (i), (c) – (ii), (d) – (iii)

(3) (a) – (iv), (b) – (v), (c) – (ii), (d) – (iii) (4) (a) – (v), (b) – (iv), (c) – (ii), (d) – (iii)

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

Assertion A : Size of Bk^{3+} ion is less than Np^{3+} ion.

Reason R : The above is a consequence of the lanthanide contraction.

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

(1) A is false but R is true

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

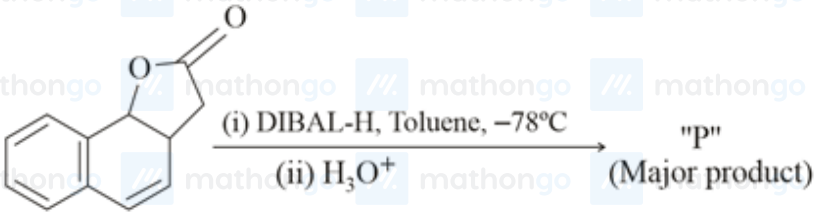
(3) A is true but R is false

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

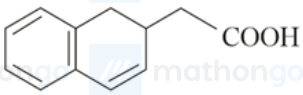
Q45. Which of the following is Lindlar catalyst?

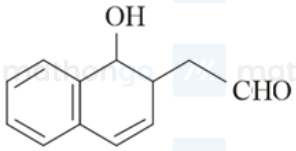
(1) Zinc chloride and HCl
(2) Cold dilute solution of $KMnO_4$
(3) Sodium and Liquid NH_3
(4) Partially deactivated palladised charcoal

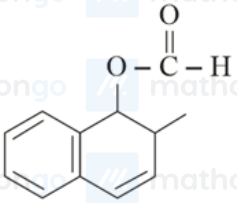
Q46.

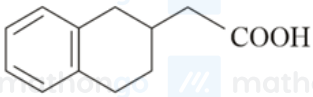


The product "P" in the above reaction is :

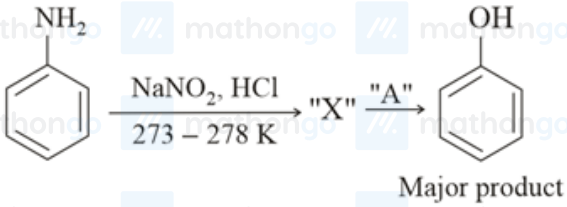
(1) 

(2) 

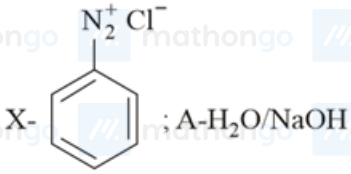
(3) 

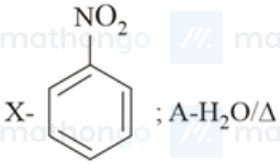
(4) 

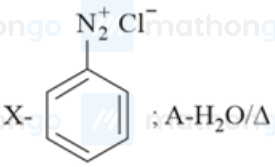
Q47.

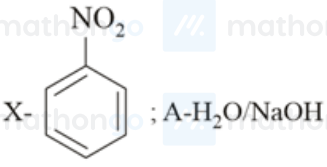


In the above chemical reaction, intermediate "X" and reagent/condition "A" are :

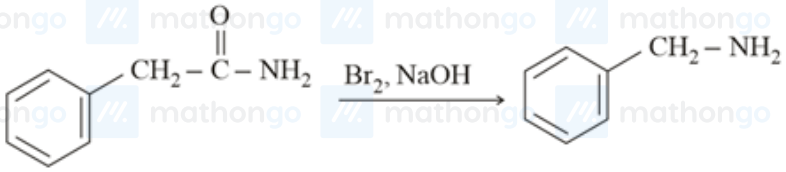
(1) 

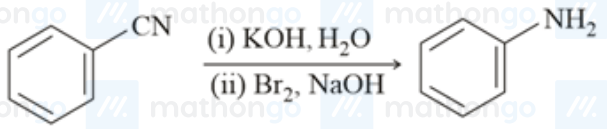
(2) 

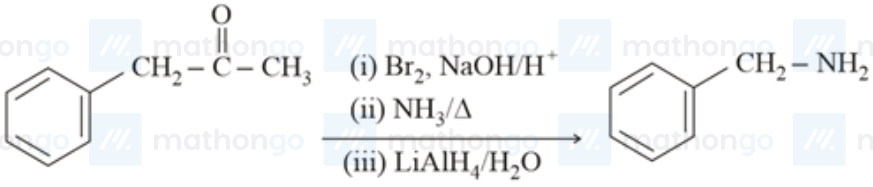
(3) 

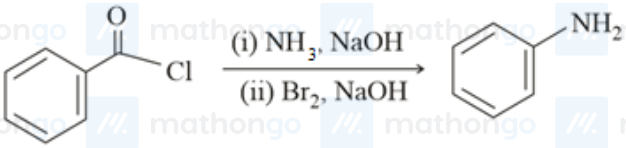
(4) 

Q48. Which of the following reaction DOES NOT involve Hoffmann Bromamide degradation ?

(1) 

(2) 

(3) 

(4) 

Q49. The functions of antihistamine are :

(1) Antiallergic and Analgesic
(2) Antacid and Antiallergic
(3) Analgesic and antacid
(4) Antiallergic and antidepressant

Q50. Which among the following pairs of Vitamins is stored in our body relatively for longer duration?

(1) Thiamine and Vitamin A
(2) Vitamin A and D
(3) Thiamine and Ascorbic acid
(4) Ascorbic acid and Vitamin D

Q51. Complete combustion of 750 g of an organic compound provides 420 g of CO_2 and 210 g of H_2O. The percentage composition of carbon and hydrogen in organic compound is 15.3 and _____ respectively. (Round off to the Nearest Integer)

Q52. A 6.50 molal solution of KOH(aq.) has a density of 1.89 g cm^{-3}. The molarity of the solution is mol dm^{-3}. (Round off to the Nearest Integer).

[Atomic masses: K : 39.0 u; O : 16.0 u; H : 1.0 u]

Q53. When light of wavelength 248 nm falls on a metal of threshold energy 3.0 eV, the de-Broglie wavelength of emitted electrons is _____ $\mathring{A}$. (Round off to the Nearest Integer).

[Use : $\sqrt{3} = 1.73,\ h = 6.63 \times 10^{-34}$ Js; $m_e = 9.1 \times 10^{-31}$ kg; $c = 3.0 \times 10^8$ ms^{-1}; $1\ eV = 1.6 \times 10^{-19}$ J]

Q54. For the reaction $A(g) \rightleftharpoons B(g)$ at 495 K, $\Delta_r G^\circ = -9.478$ kJ mol^{-1}

If we start the reaction in a closed container at 495 K with 22 millimoles of A, the amount of B is the equilibrium mixture is _____ millimoles. (Round off to the Nearest Integer).

[$R = 8.314$ J mol^{-1} K^{-1}; $\ell n10 = 2.303$]

Q55. Two salts A_2X and MX have the same value of solubility product of 4.0×10^{-12}. The ratio of their molar solubilizes i.e. $\frac{S(A_2X)}{S(MX)} =$ _____.
(Round off to the Nearest Integer).

Q56. $2\,MnO_4^- + bC_2\,O_4^{2-} + cH^+ \rightarrow xMn^{2+} + yCO_2 + zH_2\,O$
If the above equation is balanced with integer coefficients, the value of c is _____ . (Round off to the Nearest Integer).

Q57. A certain element crystallises in a bcc lattice of unit cell edge length 27 $\mathring{A}$. If the same element under the same conditions crystallises in the fcc lattice, the edge length of the unit cell in $\mathring{A}$ will be _____. (Round off to the Nearest Integer).
[Assume each lattice point has a single atom]
[Assume $\sqrt{3} = 1.73,\ \sqrt{2} = 1.41$]

Q58. AB_2 is 10% dissociated in water to A^{2+} and B^-. The boiling point of 10.0 molal aqueous solution of AB_2 is-- °C. (Round off to the Nearest Integer).
[Given : Molal elevation constant of water $K_b = 0.5$ K kg mol^{-1} boiling point of pure water= 100°C]

Q59. The decomposition of formic acid on gold surface follows first order kinetics. If the rate constant at 300 K is 1.0×10^{-3} s^{-1} and the activation energy $E_a = 11.488$ kJ mol^{-1}, the rate constant at 200 K is _____ $\times 10^{-5}$ s^{-1}. (Round of to the Nearest Integer).
(Given $R = 8.314$ J mol^{-1} K^{-1})

Q60. The equivalents of ethylene diamine required to replace the neutral ligands from the coordination sphere of the trans-complex of $CoCl_3.4\,NH_3$ is _____ . (Round off to the Nearest Integer).

Q61. If for $x \in \left(0, \frac{\pi}{2}\right), \log_{10}\sin x + \log_{10}\cos x = -1$ and $\log_{10}(\sin x + \cos x) = \frac{1}{2}(\log_{10} n - 1), n > 0,$ then the value of n is equal to :
(1) 20 (2) 12
(3) 9 (4) 16

Q62. Let a complex number $z,\ |z| \neq 1$, satisfy $\log_{\frac{1}{\sqrt{2}}}\left(\frac{|z|+11}{(|z|-1)^2}\right) \leq 2$. Then, the largest value of $|z|$ is equal to _____.
(1) 8 (2) 7
(3) 6 (4) 5

Q63. If n is the number of irrational terms in the expansion of $\left(3^{1/4} + 5^{1/8}\right)^{60}$, then $(n-1)$ is divisible by :
(1) 26 (2) 30
(3) 8 (4) 7

Q64. Let $[x]$ denote greatest integer less than or equal to x. If for $n \in N$, $\left(1 - x + x^3\right)^n = \sum_{j=0}^{3n} a_j x^j$, then $\sum_{j=0}^{\left[\frac{3n}{2}\right]} a_{2j} + 4\sum_{j=0}^{\left[\frac{3n-1}{2}\right]} a_{2j+1}$ is equal to :
(1) 2 (2) 2^{n-1}
(3) 1 (4) n

Q65. The number of roots of the equation, $(81)^{\sin^2 x} + (81)^{\cos^2 x} = 30$ in the interval $[0, \pi]$ is equal to :

(1) 3 (2) 4
(3) 8 (4) 2

Q66. If the three normals drawn to the parabola, $y^2 = 2x$ pass through the point $(a, 0),\ a \neq 0$, then a must be greater than :
(1) $\frac{1}{2}$ (2) $-\frac{1}{2}$
(3) -1 (4) 1

Q67. The locus of the midpoints of the chord of the circle, $x^2 + y^2 = 25$ which is tangent to the hyperbola, $\frac{x^2}{9} - \frac{y^2}{16} = 1$ is :
(1) $\left(x^2 + y^2\right)^2 - 16x^2 + 9y^2 = 0$ (2) $\left(x^2 + y^2\right)^2 - 9x^2 + 144y^2 = 0$
(3) $\left(x^2 + y^2\right)^2 - 9x^2 - 16y^2 = 0$ (4) $\left(x^2 + y^2\right)^2 - 9x^2 + 16y^2 = 0$

Q68. Which of the following Boolean expression is a tautology ?
(1) $(p \wedge q) \vee (p \vee q)$ (2) $(p \wedge q) \vee (p \rightarrow q)$
(3) $(p \wedge q) \wedge (p \rightarrow q)$ (4) $(p \wedge q) \rightarrow (p \rightarrow q)$

Q69. Consider three observations a, b and c such that $b = a + c$. If the standard deviation of $a + 2, c + 2$ is d, then which of the following is true?
(1) $b^2 = 3\left(a^2 + c^2\right) + 9d^2$ (2) $b^2 = a^2 + c^2 + 3d^2$
(3) $b^2 = 3\left(a^2 + c^2 + d^2\right)$ (4) $b^2 = 3\left(a^2 + c^2\right) - 9d^2$

Q70. Let $A = \begin{bmatrix} i & -i \\ -i & i \end{bmatrix}, i = \sqrt{-1}$. Then, the system of linear equations $A^8 \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 8 \\ 64 \end{bmatrix}$ has :
(1) A unique solution (2) Infinitely many solutions
(3) No solution (4) Exactly two solutions

Q71. Let $S_k = \sum_{r=1}^{k} \tan^{-1}\left(\frac{6^r}{2^{2r+1} + 3^{2r+1}}\right)$, then $\lim\limits_{k \to \infty} S_k$ is equal to :
(1) $\tan^{-1}\left(\frac{3}{2}\right)$ (2) $\frac{\pi}{2}$
(3) $\cot^{-1}\left(\frac{3}{2}\right)$ (4) $\tan^{-1}(3)$

Q72. The number of elements in the set $\{x \in R : (|x| - 3)|x + 4| = 6\}$ is equal to
(1) 3 (2) 2
(3) 4 (4) 1

Q73. Let the functions $f : R \rightarrow R$ and $g : R \rightarrow R$ be defined as :
$f(x) = \begin{cases} x + 2, & x < 0 \\ x^2, & x \geq 0 \end{cases}$ and $g(x) = \begin{cases} x^3, & x < 1 \\ 3x - 2, & x \geq 1 \end{cases}$
Then, the number of points in R where $(fog)(x)$ is NOT differentiable is equal to :
(1) 3 (2) 1
(3) 0 (4) 2

Q74. The range of $a \in R$ for which the function
$f(x) = (4a - 3)(x + \log_e 5) + 2(a - 7)\cot\left(\frac{x}{2}\right)\sin^2\left(\frac{x}{2}\right), x \neq 2n\pi, n \in N$, has critical points, is :
(1) $(-3, 1)$ (2) $\left[-\frac{4}{3}, 2\right]$
(3) $[1, \infty)$ (4) $(-\infty, -1]$

Q75. If $y = y(x)$ is the solution of the differential equation, $\frac{dy}{dx} + 2y\tan x = \sin x, y\left(\frac{\pi}{3}\right) = 0$, then the maximum value of the function $y(x)$ over R is equal to :

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

(3) $-\frac{15}{4}$ (4) $\frac{1}{8}$

Q76. Let a vector $\alpha\hat{i} + \beta\hat{j}$ be obtained by rotating the vector $\sqrt{3}\hat{i} + \hat{j}$ by an angle 45° about the origin in counterclockwise direction in the first quadrant. Then the area (in sq. units) of triangle having vertices $(\alpha, \beta), (0, \beta)$ and $(0, 0)$ is equal to

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

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

Q77. If for $a > 0$, the feet of perpendiculars from the points $A(a, -2a, 3)$ and $B(0, 4, 5)$ on the plane $lx + my + nz = 0$ are points $C(0, -a, -1)$ and D respectively, then the length of line segment CD is equal to :

(1) $\sqrt{31}$ (2) $\sqrt{41}$

(3) $\sqrt{55}$ (4) $\sqrt{66}$

Q78. Let the position vectors of two points P and Q be $3\hat{i} - \hat{j} + 2\hat{k}$ and $\hat{i} + 2\hat{j} - 4\hat{k}$, respectively. Let R and S be two points such that the direction ratios of lines PR and QS are $(4, -1, 2)$ and $(-2, 1, -2)$, respectively. Let lines PR and QS intersect at T. If the vector $\overrightarrow{TA}$ is perpendicular to both $\overrightarrow{PR}$ and $\overrightarrow{QS}$ and the length of vector $\overrightarrow{TA}$ is $\sqrt{5}$ units, then the modulus of a position vector of A is :

(1) $\sqrt{482}$ (2) $\sqrt{171}$

(3) $\sqrt{5}$ (4) $\sqrt{227}$

Q79. Let P be a plane $lx + my + nz = 0$ containing the line, $\frac{1-x}{1} = \frac{y+4}{2} = \frac{z+2}{3}$. If plane P divides the line segment AB joining points $A(-3, -6, 1)$ and $B(2, 4, -3)$ in ratio $k : 1$ then the value of k is equal to :

(1) 1. 5 (2) 3

(3) 2 (4) 4

Q80. A pack of cards has one card missing. Two cards are drawn randomly and are found to be spades. The probability that the missing card is not a spade, is :

(1) $\frac{3}{4}$ (2) $\frac{52}{867}$

(3) $\frac{39}{50}$ (4) $\frac{22}{425}$

Q81. Let z and w be two complex numbers such that $w = z\bar{z} - 2z + 2, \left|\frac{z+i}{z-3i}\right| = 1$ and Re (w) has minimum value. Then, the minimum value of $n \in N$ for which w^n is real, is equal to _____.

Q82. Consider an arithmetic series and a geometric series having four initial terms from the set $\{11, 8, 21, 16, 26, 32, 4\}$. If the last terms of these series are the maximum possible four digit numbers, then the number of common terms in these two series is equal to _____.

Q83. Let $ABCD$ be a square of side of unit length. Let a circle C_1 centered at A with unit radius is drawn. Another circle C_2 which touches C_1 and the lines AD and AB are tangent to it, is also drawn. Let a tangent line from the point C to the circle C_2 meet the side AB at E. If the length of EB is $\alpha + \sqrt{3}\beta$, where α, β are integers, then $\alpha + \beta$ is equal to _____.

Q84. If $\lim\limits_{x\to 0}\frac{ae^x-b\cos x+ce^{-x}}{x\sin x}=2$, then $a+b+c$ is equal to _____.

Q85. Let $P=\begin{bmatrix}-30 & 20 & 56\\ 90 & 140 & 112\\ 120 & 60 & 14\end{bmatrix}$ and $A=\begin{bmatrix}2 & 7 & \omega^2\\ -1 & -\omega & 1\\ 0 & -\omega & -\omega+1\end{bmatrix}$ where $\omega=\frac{-1+i\sqrt{3}}{2}$, and I_3 be the identity matrix of order 3. If the determinant of the matrix $\left(P^{-1}AP-I_3\right)^2$ is $\alpha\omega^2$, then the value of α is equal to _____.

Q86. The total number of 3×3 matrices A having enteries from the set $(0,1,2,3)$ such that the sum of all the diagonal entries of AA^T is 9, is equal to

Q87. Let $f:(0,2)\to R$ be defined as $f(x)=\log_2\left(1+\tan\left(\frac{\pi x}{4}\right)\right)$.
Then, $\lim\limits_{n\to\infty}\frac{2}{n}\left(f\left(\frac{1}{n}\right)+f\left(\frac{2}{n}\right)+\ldots.+f(1)\right)$ is equal to _____.

Q88. If the normal to the curve $y(x)=\int_0^x\left(2t^2-15t+10\right)dt$ at a point (a,b) is parallel to the line $x+3y=-5, a>1$, then the value of $|a+6b|$ is equal to _____.

Q89. Let $f:R\to R$ be a continuous function such that $f(x)+f(x+1)=2$ for all $x\in R$. If $I_1=\int_0^8 f(x)dx$ and $I_2=\int_{-1}^3 f(x)dx$, then the value of I_1+2I_2 is equal to _____.

Q90. Let the curve $y=y(x)$ be the solution of the differential equation, $\frac{dy}{dx}=2(x+1)$. If the numerical value of area bounded by the curve $y=y(x)$ and x-axis is $\frac{4\sqrt{8}}{3}$, then the value of $y(1)$ is equal to _____.

ANSWER KEYS

1. (1)	**2.** (4)	**3.** (2)	**4.** (3)	**5.** (3)	**6.** (1)	**7.** (1)	**8.** (3)
9. (4)	**10.** (4)	**11.** (3)	**12.** (1)	**13.** (3)	**14.** (3)	**15.** (3)	**16.** (1)
17. (1)	**18.** (1)	**19.** (4)	**20.** (4)	**21.** (5)	**22.** (82)	**23.** (20)	**24.** (30)
25. (3)	**26.** (4)	**27.** (600)	**28.** (15)	**29.** (5)	**30.** (0)	**31.** (4)	**32.** (2)
33. (4)	**34.** (2)	**35.** (2)	**36.** (2)	**37.** (4)	**38.** (3)	**39.** (2)	**40.** (4)
41. (2)	**42.** (3)	**43.** (1)	**44.** (3)	**45.** (4)	**46.** (2)	**47.** (3)	**48.** (3)
49. (2)	**50.** (2)	**51.** (3)	**52.** (9)	**53.** (9)	**54.** (20)	**55.** (50)	**56.** (16)
57. (33)	**58.** (106)	**59.** (10)	**60.** (2)	**61.** (2)	**62.** (2)	**63.** (1)	**64.** (3)
65. (2)	**66.** (4)	**67.** (4)	**68.** (4)	**69.** (4)	**70.** (3)	**71.** (3)	**72.** (2)
73. (2)	**74.** (2)	**75.** (4)	**76.** (1)	**77.** (4)	**78.** (2)	**79.** (3)	**80.** (3)
81. (4)	**82.** (3)	**83.** (1)	**84.** (4)	**85.** (36)	**86.** (766)	**87.** (1)	**88.** (406)
89. (16)	**90.** (2)						