Q1. The de-Broglie wavelength associated with a particle of mass m and energy E is $h/\sqrt{2mE}$. The dimensional formula for Planck's constant is :

(1) $\left[\mathrm{ML}^2\ \mathrm{T}^{-1}\right]$ (2) $\left[\mathrm{ML}^{-1}\ \mathrm{T}^{-2}\right]$

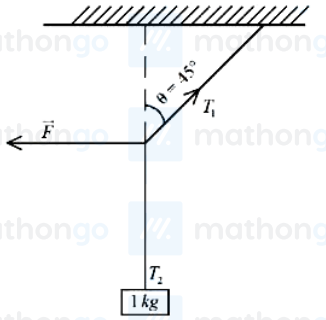
(3) $\left[\mathrm{MLT}^{-2}\right]$ (4) $\left[\mathrm{M}^2\ \mathrm{L}^2\ \mathrm{T}^{-2}\right]$

Q2. Two cars are travelling towards each other at speed of 20 m s^{-1} each. When the cars are 300 m apart, both the drivers apply brakes and the cars retard at the rate of 2 m s^{-2}. The distance between them when they come to rest is :

(1) 200 m (2) 100 m

(3) 50 m (4) 25 m

Q3. A 1 kg mass is suspended from the ceiling by a rope of length 4 m. A horizontal force ' F ' is applied at the mid point of the rope so that the rope makes an angle of 45° with respect to the vertical axis as shown in figure. The



magnitude of F is : (Assume that the system is in equilibrium and $g = 10\ \mathrm{m/s^2}$)

(1) 10 N (2) $\frac{10}{\sqrt{2}}$ N

(3) 1 N (4) $\frac{1}{10\times\sqrt{2}}N$

Q4. A satellite of 10^3 kg mass is revolving in circular orbit of radius $2R$. If $\frac{10^4R}{6}J$ energy is supplied to the satellite, it would revolve in a new circular orbit of radius (use $g = 10\ \mathrm{m/s^2}$, $R =$ radius of earth)

(1) $2.5R$ (2) $3R$

(3) $4R$ (4) $6R$

Q5. The excess pressure inside a soap bubble is thrice the excess pressure inside a second soap bubble. The ratio between the volume of the first and the second bubble is:

(1) 1 : 9 (2) 1 : 3

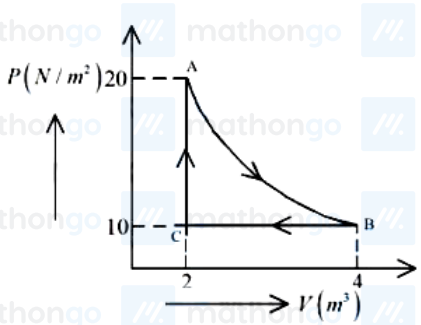
(3) 1 : 27 (4) 1 : 81

Q6. A spherical ball of radius 1×10^{-4} m and density 10^5 kg/m^3 falls freely under gravity through a distance h before entering a tank of water, If after entering in water the velocity of the ball does not change, then the value of h is approximately: (The coefficient of viscosity of water is 9.8×10^{-6} N s/m^2)

(1) 2296 m (2) 2518 m

(3) 2249 m (4) 2396 m

Q7. A real gas within a closed chamber at 27°C undergoes the cyclic process as shown in figure. The gas obeys $PV^3 = RT$ equation for the path A to B. The net work done in the complete cycle is (assuming $R = 8$ J/molK



):

(1) 20 J
(2) 205 J
(3) -20 J
(4) 225 J

Q8. The temperature of a gas is $-78^{\circ}\mathrm{C}$ and the average translational kinetic energy of its molecules is K. The temperature at which the average translational kinetic energy of the molecules of the same gas becomes 2 K is :

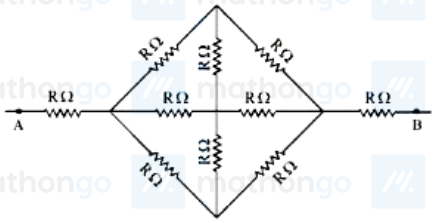
(1) $127^{\circ}\mathrm{C}$
(2) $117^{\circ}\mathrm{C}$
(3) $-39^{\circ}\mathrm{C}$
(4) $-78^{\circ}\mathrm{C}$

Q9. Five charges $+q, +5q, -2q, +3q$ and $-4q$ are situated as shown in the figure. The electric flux due to this

configuration through the surface S is :

(1) $\frac{4q}{\epsilon_0}$
(2) $\frac{5q}{\epsilon_0}$
(3) $\frac{q}{\epsilon_0}$
(4) $\frac{3q}{\epsilon_0}$

Q10. The effective resistance between A and B, if resistance of each resistor is R, will be

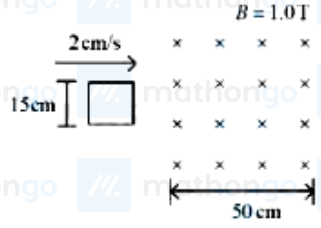


(1) $\frac{8R}{3}$
(2) $\frac{5R}{3}$
(3) $\frac{4R}{3}$
(4) $\frac{2}{3}R$

Q11. A proton and a deutron ($q = +\mathrm{e}, m = 2.0\mathrm{u}$) having same kinetic energies enter a region of uniform magnetic field $\vec{B}$, moving perpendicular to $\vec{B}$. The ratio of the radius r_d of deutron path to the radius r_p of the proton path is:

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

Q12. A square loop of side 15 cm being moved towards right at a constant speed of 2 cm/s as shown in figure. The front edge enters the 50 cm wide magnetic field at $t = 0$. The value of induced emf in the loop at $t = 10$ s will



be :

(1) 0.3mV (2) zero

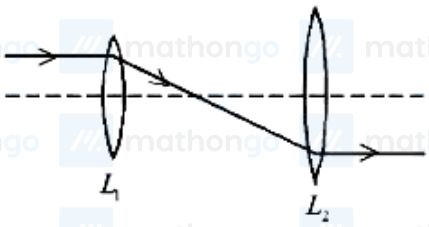
(3) 4.5mV (4) 3mV

Q13. The magnetic field in a plane electromagnetic wave is $\mathrm{B_y} = \left(3.5 \times 10^{-7}\right) \sin\left(1.5 \times 10^3 x + 0.5 \times 10^{11} t\right) \mathrm{T}$. The corresponding electric field will be :

(1) $E_y = 10.5 \sin\left(1.5 \times 10^3 x + 0.5 \times 10^{11} t\right) \mathrm{Vm^{-1}}$ (2) $E_z = 1.17 \sin\left(1.5 \times 10^3 x + 0.5 \times 10^{11} t\right) \mathrm{Vm^{-1}}$

(3) $E_y = 1.17 \sin\left(1.5 \times 10^3 x + 0.5 \times 10^{11} t\right) \mathrm{Vm^{-1}}$ (4) $E_z = 105 \sin\left(1.5 \times 10^3 x + 0.5 \times 10^{11} t\right) \mathrm{Vm^{-1}}$

Q14. The following figure represents two biconvex lenses L_1 and L_2 having focal length 10 cm and 15 cm



respectively. The distance between $L_1 \& L_2$ is :

(1) 10 cm (2) 35 cm

(3) 25 cm (4) 15 cm

Q15. UV light of 4.13eV is incident on a photosensitive metal surface having work function 3.13eV. The maximum kinetic energy of ejected photoelectrons will be:

(1) 4.13eV (2) 3.13eV

(3) 1eV (4) 7.26eV

Q16. A hydrogen atom in ground state is given an energy of 10.2eV. How many spectral lines will be emitted due to transition of electrons?

(1) 6 (2) 3

(3) 10 (4) 1

Q17. A nucleus at rest disintegrates into two smaller nuclei with their masses in the ratio of 2 : 1. After disintegration they will move :

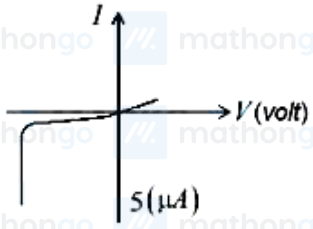
(1) in the same direction with same speed. (2) in opposite directions with the same speed.

(3) in opposite directions with speed in the ratio of 2 : 1 respectively. (4) in opposite directions with speed in the ratio of 1 : 2 respectively.

Q18. The energy released in the fusion of 2 kg of hydrogen deep in the sun is E_H and the energy released in the fission of 2 kg of $^{235}\mathrm{U}$ is E_U. The ratio $\frac{E_H}{E_U}$ is approximately: (Consider the fusion reaction as $4 \mid H + 2\mathrm{e}^- \rightarrow {}_2^4\mathrm{He} + 2v + 6\gamma + 26.7\text{MeV}$, energy released in the fission reaction of $^{235}\mathrm{U}$ is 200MeV per fission nucleus and $\mathrm{N_A} = 6.023 \times 10^{23}$)

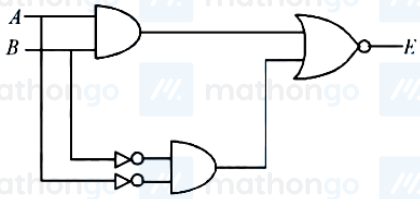
(1) 7.62 (2) 25.6
(3) 15.04 (4) 9.13

Q19. The $I-V$ characteristics of an electronic device shown in the figure. The device is:



(1) a diode which can be used as a rectifier
(2) a zener diode which can be used as a voltage regulator
(3) a transistor which can be used as an amplifier
(4) a solar cell

Q20.



A	B	E
0	0	0
0	1	X
1	0	Y
1	1	0

In the truth table of the above circuit the value of X and Y are :
(1) 0,0 (2) 1,1
(3) 1,0 (4) 0,1

Q21. The resultant of two vectors $\vec{A}$ and $\vec{B}$ is perpendicular to $\vec{A}$ and its magnitude is half that of $\vec{B}$. The angle between vectors $\vec{A}$ and $\vec{B}$ is _____ $\circ$.

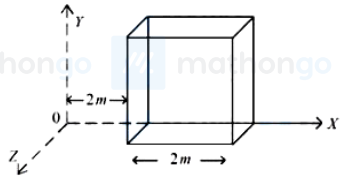
Q22. A force $\left(3x^2+2x-5\right)$N displaces a body from $x=2$ m to $x=4$ m. Work done by this force is _____ J.

Q23. A circular disc reaches from top to bottom of an inclined plane of length l. When it slips down the plane, if takes t s. When it rolls down the plane then it takes $\left(\frac{\alpha}{2}\right)^{1/2}t$ s, where α is _____

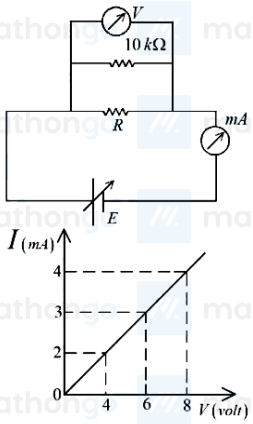
Q24. At room temperature $(27^{\circ}\mathrm{C})$, the resistance of a heating element is 50Ω. The temperature coefficient of the material is $2.4\times10^{-4}{}^{\circ}\mathrm{C}^{-1}$. The temperature of the element, when its resistance is 62Ω, is _____ $^{\circ}$C.

Q25. A particle of mass 0.50 kg executes simple harmonic motion under force $F=-50\left(\mathrm{Nm}^{-1}\right)x$. The time period of oscillation is $\frac{x}{35}$ s. The value of x is _____ (Given $\pi=\frac{22}{7}$)

Q26. An electric field $\vec{E}=(2x\hat{i})NC^{-1}$ exists in space. A cube of side 2 m is placed in the space as per figure given below. The electric flux through the cube is _____ Nm^2/C.



Q27. To determine the resistance (R) of a wire, a circuit is designed below. The $V-I$ characteristic curve for this circuit is plotted for the voltmeter and the ammeter readings as shown in figure. The value of R is _____ Ω.



Q28. A straight magnetic strip has a magnetic moment of $44 \mathrm{Am}^2$. If the strip is bent in a semicircular shape, its magnetic moment will be _____ Am^2. (given $\pi=\frac{22}{7}$)

Q29. A capacitor of reactance $4\sqrt{3}\Omega$ and a resistor of resistance 4Ω are connected in series with an ac source of peak value $8\sqrt{2}$ V. The power dissipation in the circuit is _____ W.

Q30. Monochromatic light of wavelength 500 nm is used in Young's double slit experiment. An interference pattern is obtained on a screen. When one of the slits is covered with a very thin glass plate (refractive index $=1.5$), the central maximum is shifted to a position previously occupied by the 4^{th} bright fringe. The thickness of the glass-plate is _____ μm.

Q31. The candela is the luminous intensity, in a given direction, of a source that emits monochromatic radiation of frequency ' A ' $\times 10^{12}$ hertz and that has a radiant intensity in that direction of $\frac{1}{7 \mathrm{B}^{\prime}}$ watt per steradian. 'A' and 'B' are respectively

(1) 540 and 683
(2) 450 and 683
(3) 450 and $\frac{1}{683}$
(4) 540 and $\frac{1}{683}$

Q32. The electronic configuration of Einsteinium is : (Given atomic number of Einsteinium $=99$)

(1) $[\mathrm{Rn}] 5 \mathrm{f}^{10} 6 \mathrm{~d}^{\circ} 7 \mathrm{~s}^2$
(2) $[\mathrm{Rn}] 5 \mathrm{f}^{13} 6 \mathrm{~d}^{\circ} 7 \mathrm{~s}^2$
(3) $[\mathrm{Rn}] 5 \mathrm{f}^{11} 6 \mathrm{~d}^{\circ} 7 \mathrm{~s}^2$
(4) $[\mathrm{Rn}] 5 \mathrm{f}^{12} 6 \mathrm{~d}^{\circ} 7 \mathrm{~s}^2$

Q33.

	List - I (Element)		List - II (Electronic configuration)
A.	N	I.	$[\mathrm{Ar}] 3 \mathrm{~d}^{10} 4 \mathrm{~s}^2 4 \mathrm{p}^5 \mathrm{AR}$
B.	S	II.	$[\mathrm{Ne}] 3 \mathrm{~s}^2 3 \mathrm{p}^4$
C.	Br	III.	$[\mathrm{He}] 2 \mathrm{~s}^2 2 \mathrm{p}^3$
D.	Kr	IV.	$[\mathrm{Ar}] 3 \mathrm{~d}^{10} 4 \mathrm{~s}^2 4 \mathrm{p}^6$

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

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

Q34. Match List I with List II

	List - I		List - II
A.	Melting Point [K]	I.	$T1 > In > Ga > A1 > B$
B.	Ionic Radius $\left[M^{+3}/pm\right]$	II.	$B > T1 > A1 \approx Ga > In$
C.	$\Delta_i H_1$ [kJ mol^{-1}]	III.	$T1 > In > A1 > Ga > B$
D.	Atomic Radius [pm]	IV.	$B > A1 > T1 > In > Ga$

Choose the correct answer from the options given below:

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

Q35. The correct increasing order for bond angles among BF_3, PF_3 and ClF_3 is :

(1) $BF_3 < PF_3 < ClF_3$
(2) $ClF_3 < PF_3 < BF_3$
(3) $PF_3 < BF_3 < ClF_3$
(4) $BF_3 = PF_3 < ClF_3$

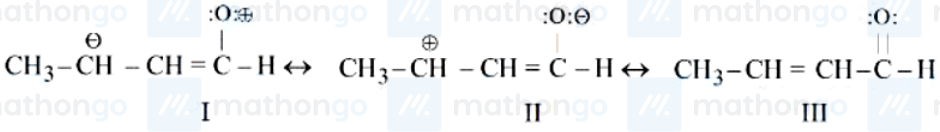
Q36. The incorrect statement regarding ethyne is

(1) The $C - C$ bonds in ethyne is shorter than that in ethene
(2) Both carbons are sp hybridised
(3) Ethyne is linear
(4) The corbon - carbon bonds in ethyne is weaker than that in ethene

Q37. For a sparingly soluble salt AB_2, the equilibrium concentrations of A^{2+} ions and B^- ions are 1.2×10^{-4}M and 0.24×10^{-3}M, respectively. The solubility product of AB_2 is :

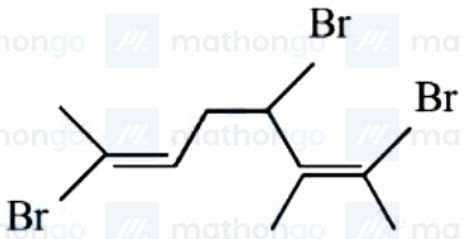
(1) 6.91×10^{-12}
(2) 0.276×10^{-12}
(3) 27.65×10^{-12}
(4) 0.069×10^{-12}

Q38. The correct stability order of the following resonance structures of $CH_3 - CH = CH - CHO$ is



(1) I > II > III
(2) II > III > I
(3) II > I > III
(4) III > II > I

Q39.



Total number of stereo isomers possible for the given structure :

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

Q40. Which out of the following is a correct equation to show change in molar conductivity with respect to concentration for a weak electrolyte, if the symbols carry their usual meaning :

(1) $\Lambda_m - \Lambda_m^0 + AC^{\frac{1}{2}} = 0$ (2) $\Lambda_m^2 C - K_a \Lambda_m^{\circ 2} + K_a \Lambda_m \Lambda_m = 0$

(3) ${\Lambda^2}_m C + K_a \Lambda_m^{\circ 2} - K_a \Lambda_m \Lambda_m^{\circ} = 0$ (4) $\Lambda_m - \Lambda_m^{\circ} - AC^{\frac{1}{2}} = 0$

Q41. Match List I with List II

	List - I (Cell)		List - II (Use/Property/Reaction)
A.	Leclanche cell	I.	Converts energy of combustion into electrical energy
B.	$Ni - Cd$ cell	II.	Does not involve any ion in solution and is used in hearing aids
C.	Fuel cell	III.	Rechargeable
D.	Mercury cell	IV.	Reaction at anode $Zn \rightarrow Zn^{2+} + 2e^-$

Choose the correct answer from the options given below:

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

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

Q42. Give below are two statements: Statement I : The higher oxidation states are more stable down the group among transition elements unlike p-block elements. Statement II : Copper can not liberate hydrogen from weak acids. In the light of the above statements, choose the correct answer from the options given below :

(1) Both Statement I and Statement II are true (2) Statement I is false but Statement II is true

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

Q43. Match List I with List II

	List - I		List - II
A.	$K_2[Ni(CN)_4]$	I.	sp^3
B.	$[Ni(CO)_4]$	II.	$sp^3 d^2$
C.	$[Co(NH_3)_6]Cl_3$	III.	dsp^2
D.	$Na_3[CoF_6]$	IV.	d^2sp^3

Choose the correct answer from the options given below:

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

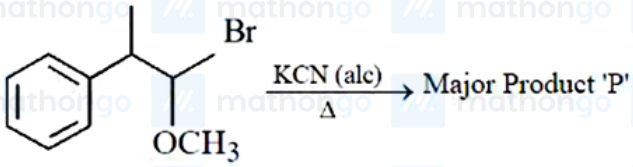
(3) A-I, B-III, C-II, D-IV (4) A-III, B-II, C-IV, D-I

Q44. The coordination environment of Ca^{2+} ion in its complex with $EDTA^{4-}$ is :

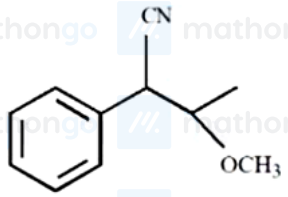
(1) tetrahedral (2) trigonal prismatic

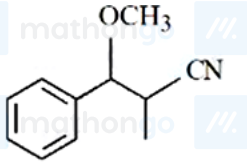
(3) octahedral (4) square planar

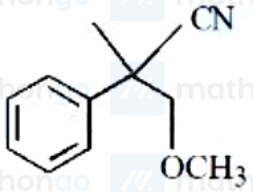
Q45.

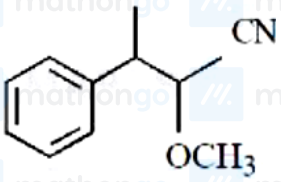


In the above reaction product ' P ' is

(1) 

(2) 

(3) 

(4) 

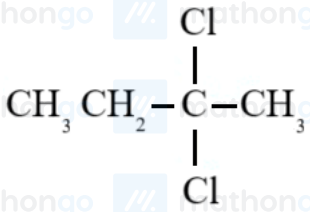
Q46. Match List I with List II

	List - I (Test)		List - II (Observation)
A.	Br_2 water test	I.	Yellow orange or orange red precipitate formed
B.	Ceric ammonium nitrate test	II.	Reddish orange colour disappears
C.	Ferric chloride test	III.	Red colour appears
D.	2, 4 - DNP test	IV.	Blue, Green, Violet or Red colour appear

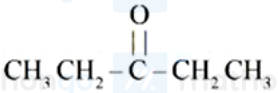
Choose the correct answer from the options given below:

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

Q47. Which of the following compound can give positive iodoform test when treated with aqueous KOH solution followed by potassium hypoiodite.

(1) 

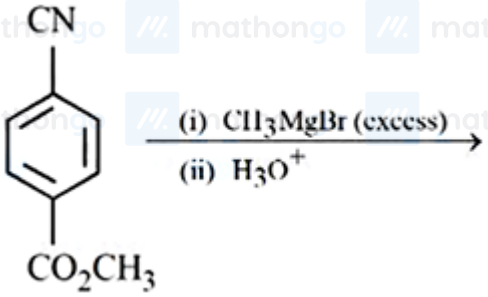
(2) 

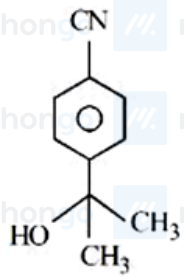
(3) 

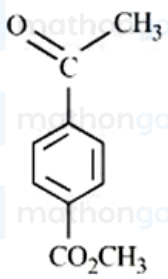
(4) $CH_3CH_2CH_2CHO$

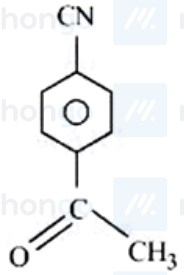
Q48. Which of the following compounds will give silver mirror with ammoniacal silver nitrate? A. Formic acid B. Formaldehyde C. Benzaldehyde D. Acetone Choose the correct answer from the options given below :

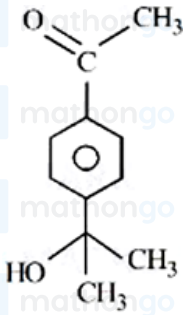
(1) A, B and C only
(2) C and D only
(3) B and C only
(4) A only

Q49. Major product of the following reaction is 

(1) 

(2) 

(3) 

(4) 

Q50. The incorrect statement about Glucose is :

(1) Glucose is soluble in water because of having aldehyde functional group

(2) Glucose remains in multiple isomeric form in its aqueous solution

(3) Glucose is one of the monomer unit in sucrose

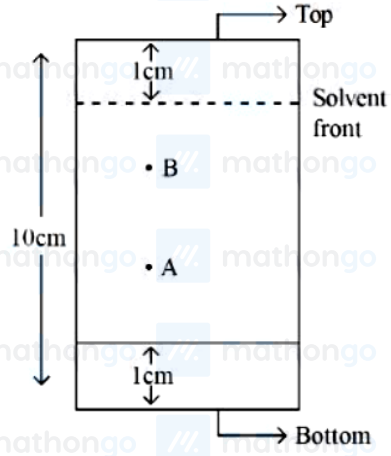
(4) Glucose is an aldohexose

Q51. Based on Heisenberg's uncertainty principle, the uncertainty in the velocity of the electron to be found within an atomic nucleus of diameter 10^{-15} m is _____. 10^9 ms^{-1} (nearest integer) [Given : mass of electron $= 9.1 \times 10^{-31}$ kg, Plank's constant $(h) = 6.626 \times 10^{-34}$Js] (Value of $\pi = 3.14$)

Q52. Total number of electrons present in (π^*) molecular orbitals of O_2, O_2^+ and O_2^- is _____.

Q53. When $\Delta H_{vap} = 30$ kJ/mol and $\Delta S_{vap} = 75$ J mol^{-1} K^{-1}, then the temperature of vapour, at one atmosphere is _____ K.

Q54.



In the given TLC, the distance of spot A & B are 5 cm & 7 cm, from the bottom of TLC plate, respectively. R_f value of B is $x \times 10^{-1}$ times more than A. The value of x is _____.

Q55. Number of compounds from the following which cannot undergo Friedel-Crafts reactions is: _____.

toluene, nitrobenzene, xylene, cumene, aniline, chlorobenzene, m-nitroaniline, m-dinitrobenzene

Q56. The vapour pressure of pure benzene and methyl benzene at $27^{\circ}C$ is given as 80 Torr and 24 Torr, respectively. The mole fraction of methyl benzene in vapour phase, in equilibrium with an equimolar mixture of those two liquids (ideal solution) at the same temperature is _____ $\times 10^{-2}$ (nearest integer)

Q57. Consider the following first order gas phase reaction at constant temperature $A(g) \rightarrow 2\ B(\ g) + C(g)$ If the total pressure of the gases is found to be 200 torr after 23sec. and 300 torr upon the complete decomposition of A after a very long time, then the rate constant of the given reaction is _____ $\times 10^{-2}\ s^{-1}$ (nearest integer) [Given : $\log_{10}(2) = 0.301$]

Q58. Number of oxygen atoms present in chemical formula of fuming sulphuric acid is _____.

Q59. A transition metal ' M ' among Sc, Ti, V, Cr, Mn and Fe has the highest second ionisation enthalpy. The spin-only magnetic moment value of M^{+}ion is _____. BM (Near integer) (Given atomic number Sc : 21, Ti : 22, V : 23, Cr : 24, Mn : 25, Fe : 26)

Q60. Consider the following test for a group-IV cation. $\begin{array}{l} M^{2+} + H_2S \rightarrow A \text{ (Black precipitate) } + \text{ by product} \\ A + \text{ aqua regia } \rightarrow B + NOCl + S + H_2O \\ B + KNO_2 + CH_3COOH \rightarrow C + \text{ by product} \end{array}$ The spin-only magnetic moment value of the metal complex C is _____ BM (Nearest integer)

Q61. Let $\alpha, \beta; \alpha > \beta$, be the roots of the equation $x^2 - \sqrt{2}x - \sqrt{3} = 0$. Let $P_n = \alpha^n - \beta^n, n \in N$. Then $(11\sqrt{3} - 10\sqrt{2})P_{10} + (11\sqrt{2} + 10)P_{11} - 11P_{12}$ is equal to

(1) $10\sqrt{3}P_9$ (2) $11\sqrt{3}P_9$

(3) $10\sqrt{2}P_9$ (4) $11\sqrt{2}P_9$

Q62. Let z be a complex number such that the real part of $\frac{z-2i}{z+2i}$ is zero. Then, the maximum value of $|z-(6+8i)|$ is equal to

(1) 12 (2) 10

(3) 8 (4) ∞

Q63. Let $a, ar, ar^2,$ be an infinite G.P. If $\sum_{n=0}^{\infty} ar^n = 57$ and $\sum_{n=0}^{\infty} a^3r^{3n} = 9747$, then $a + 18r$ is equal to

(1) 46 (2) 38

(3) 31 (4) 27

Q64. The sum of the coefficient of $x^{2/3}$ and $x^{-2/5}$ in the binomial expansion of $\left(x^{2/3} + \frac{1}{2}x^{-2/5}\right)^9$ is

(1) $21/4$ (2) $63/16$

(3) $19/4$ (4) $69/16$

Q65. Two vertices of a triangle ABC are $A(3, -1)$ and $B(-2, 3)$, and its orthocentre is $P(1, 1)$. If the coordinates of the point C are (α, β) and the centre of the of the circle circumscribing the triangle PAB is (h, k), then the value of $(\alpha + \beta) + 2(\ h + k)$ equals

(1) 5 (2) 81

(3) 15 (4) 51

Q66. Let the foci of a hyperbola H coincide with the foci of the ellipse $E: \frac{(x-1)^2}{100} + \frac{(y-1)^2}{75} = 1$ and the eccentricity of the hyperbola H be the reciprocal of the eccentricity of the ellipse E. If the length of the transverse axis of

H is α and the length of its conjugate axis is β, then $3\alpha^2 + 2\beta^2$ is equal to

(1) 237 (2) 242

(3) 205 (4) 225

Q67. $\lim_{x\to\frac{\pi}{2}} \left(\frac{\int_3^{(\pi/2)^3} \left(\sin\left(2t^{1/3}\right)+\cos\left(t^{1/3}\right)\right)dt}{\left(x-\frac{\pi}{2}\right)^2} \right)$ is equal to

(1) $\frac{5\pi^2}{9}$ (2) $\frac{9\pi^2}{8}$

(3) $\frac{11\pi^2}{10}$ (4) $\frac{3\pi^2}{2}$

Q68. $\lim_{x\to 0} \frac{e-(1+2x)^{\frac{1}{2x}}}{x}$ is equal to

(1) 0 (2) $\frac{-2}{e}$

(3) e (4) $e - e^2$

Q69. If the variance of the frequency distribution

x	c	$2c$	$3c$	$4c$	$5c$	$6c$
f	2	1	1	1	1	1

is 160, then the value of $c \in N$ is

(1) 7 (2) 8

(3) 5 (4) 6

Q70. Let $B = \begin{bmatrix} 1 & 3 \\ 1 & 5 \end{bmatrix}$ and A be a 2×2 matrix such that $AB^{-1} = A^{-1}$. If $BCB^{-1} = A$ and $C^4 + \alpha C^2 + \beta I = O$, then $2\beta - \alpha$ is equal to

(1) 16 (2) 2

(3) 8 (4) 10

Q71. The integral $\int_{1/4}^{3/4} \cos\left(2\cot^{-1}\sqrt{\frac{1-x}{1+x}}\right)dx$ is equal to

(1) $1/2$ (2) $-1/2$

(3) $-1/4$ (4) $1/4$

Q72. Let the range of the function $f(x) = \frac{1}{2+\sin 3x+\cos 3x}, x \in \mathbb{R}$ be $[a, b]$. If α and β are respectively the A.M. and the G.M. of a and b, then $\frac{\alpha}{\beta}$ is equal to

(1) π (2) $\sqrt{\pi}$

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

Q73. If $\log_e y = 3\sin^{-1} x$, then $\left(1-x^2\right)y'' - xy'$ at $x = \frac{1}{2}$ is equal to

(1) $3e^{\pi/6}$ (2) $9e^{\pi/2}$

(3) $3e^{\pi/2}$ (4) $9e^{\pi/6}$

Q74. Let $\int_0^x \sqrt{1-(y'(t))^2}dt = \int_0^x y(t)dt, 0 \le x \le 3, y \ge 0, y(0) = 0$. Then at $x = 2, y'' + y + 1$ is equal to

(1) 1 (2) 2

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

Q75. The value of the integral $\int_{-1}^{2} \log_e\left(x + \sqrt{x^2+1}\right)dx$ is

(1) $\sqrt{5}-\sqrt{2}+\log_e\left(\frac{7+4\sqrt{5}}{1+\sqrt{2}}\right)$ (2) $\sqrt{5}-\sqrt{2}+\log_e\left(\frac{9+4\sqrt{5}}{1+\sqrt{2}}\right)$

(3) $\sqrt{2}-\sqrt{5}+\log_e\left(\frac{7+4\sqrt{5}}{1+\sqrt{2}}\right)$ (4) $\sqrt{2}-\sqrt{5}+\log_e\left(\frac{9+4\sqrt{5}}{1+\sqrt{2}}\right)$

Q76. The area (in square units) of the region enclosed by the ellipse $x^2+3y^2=18$ in the first quadrant below the line $y=x$ is

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

(3) $\sqrt{3}\pi$ (4) $\sqrt{3}\pi+\frac{3}{4}$

Q77. Between the following two statements: Statement I : Let $\vec{a}=\hat{i}+2\hat{j}-3\hat{k}$ and $\vec{b}=2\hat{i}+\hat{j}-\hat{k}$. Then the vector $\vec{r}$ satisfying $\vec{a}\times\vec{r}=\vec{a}\times\vec{b}$ and $\vec{a}\cdot\vec{r}=0$ is of magnitude $\sqrt{10}$.

Statement II : In a triangle ABC, $\cos 2A+\cos 2B+\cos 2C\geq -\frac{3}{2}$.

(1) Statement I is incorrect but Statement II is correct. (2) Both Statement I and Statement II are correct.

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

Q78. Let $\vec{a}=2\hat{i}+\alpha\hat{j}+\hat{k}, \vec{b}=-\hat{i}+\hat{k}, \vec{c}=\beta\hat{j}-\hat{k}$, where α and β are integers and $\alpha\beta=-6$. Let the values of the ordered pair (α,β), for which the area of the parallelogram of diagonals $\vec{a}+\vec{b}$ and $\vec{b}+\vec{c}$ is $\frac{\sqrt{21}}{2}$, be (α_1,β_1) and (α_2,β_2). Then $\alpha_1^2+\beta_1^2-\alpha_2\beta_2$ is equal to

(1) 19 (2) 17

(3) 24 (4) 21

Q79. Consider the line L passing through the points $(1,2,3)$ and $(2,3,5)$. The distance of the point $\left(\frac{11}{3},\frac{11}{3},\frac{19}{3}\right)$ from the line L along the line $\frac{3x-11}{2}=\frac{3y-11}{1}=\frac{3z-19}{2}$ is equal to

(1) 6 (2) 5

(3) 4 (4) 3

Q80. If an unbiased dice is rolled thrice, then the probability of getting a greater number in the i^{th} roll than the number obtained in the $(i-1)^{\text{th}}$ roll, $i=2,3$, is equal to

(1) $3/54$ (2) $2/54$

(3) $1/54$ (4) $5/54$

Q81. The number of integers, between 100 and 1000 having the sum of their digits equals to 14 , is _____

Q82. If $\left(\frac{1}{\alpha+1}+\frac{1}{\alpha+2}+\ldots\ldots+\frac{1}{\alpha+1012}\right)-\left(\frac{1}{2\cdot1}+\frac{1}{4\cdot3}+\frac{1}{6\cdot5}+\ldots\ldots+\frac{1}{2024\cdot2023}\right)=\frac{1}{2024}$, then α is equal to_____

Q83. Let A, B and C be three points on the parabola $y^2=6x$ and let the line segment AB meet the line L through C parallel to the x-axis at the point D. Let M and N respectively be the feet of the perpendiculars from A and B on L. Then $\left(\frac{AM\cdot BN}{CD}\right)^2$ is equal to _____

Q84. Consider the circle $C: x^2+y^2=4$ and the parabola $P: y^2=8x$. If the set of all values of α, for which three chords of the circle C on three distinct lines passing through the point $(\alpha,0)$ are bisected by the parabola P is the interval (p,q), then $(2q-p)^2$ is equal to _____

Q85. Consider the matrices : $A=\begin{bmatrix}2 & -5\\ 3 & m\end{bmatrix}, B=\begin{bmatrix}20\\ m\end{bmatrix}$ and $X=\begin{bmatrix}x\\ y\end{bmatrix}$. Let the set of all m, for which the system of equations $AX=B$ has a negative solution (i.e., $x<0$ and $y<0$), be the interval (a, b). Then $8\int_a^b|A| dm$ is equal to_____

Q86. Let the inverse trigonometric functions take principal values. The number of real solutions of the equation $2\sin^{-1}x+3\cos^{-1}x=\frac{2\pi}{5}$, is _____

Q87. Let $A=\{(x, y): 2x+3y=23, x, y\in\mathbb{N}\}$ and $B=\{x:(x, y)\in A\}$. Then the number of one-one functions from A to B is equal to _____

Q88. For a differentiable function $f:\mathbb{R}\to\mathbb{R}$, suppose $f'(x)=3f(x)+\alpha$, where $\alpha\in\mathbb{R}$, $f(0)=1$ and $\lim_{x\to-\infty}f(x)=7$. Then $9f(-\log_e 3)$ is equal to_____

Q89. Let the set of all values of p, for which $f(x)=\left(p^2-6p+8\right)\left(\sin^2 2x-\cos^2 2x\right)+2(2-p)x+7$ does not have any critical point, be the interval (a, b). Then $16ab$ is equal to _____

Q90. The square of the distance of the image of the point $(6, 1, 5)$ in the line $\frac{x-1}{3}=\frac{y}{2}=\frac{z-2}{4}$, from the origin is _____

ANSWER KEYS

1. (1)	**2.** (2)	**3.** (1)	**4.** (4)	**5.** (3)	**6.** (2)	**7.** (2)	**8.** (2)
9. (1)	**10.** (1)	**11.** (1)	**12.** (2)	**13.** (4)	**14.** (3)	**15.** (3)	**16.** (4)
17. (4)	**18.** (1)	**19.** (2)	**20.** (2)	**21.** (150)	**22.** (58)	**23.** (3)	**24.** (1027)
25. (22)	**26.** (16)	**27.** (2500)	**28.** (28)	**29.** (4)	**30.** (4)	**31.** (1)	**32.** (3)
33. (1)	**34.** (2)	**35.** (2)	**36.** (4)	**37.** (1)	**38.** (4)	**39.** (4)	**40.** (2)
41. (4)	**42.** (1)	**43.** (1)	**44.** (3)	**45.** (4)	**46.** (4)	**47.** (1)	**48.** (1)
49. (4)	**50.** (1)	**51.** (58)	**52.** (6)	**53.** (400)	**54.** (15)	**55.** (4)	**56.** (23)
57. (3)	**58.** (7)	**59.** (6)	**60.** (0)	**61.** (1)	**62.** (1)	**63.** (3)	**64.** (1)
65. (1)	**66.** (4)	**67.** (2)	**68.** (3)	**69.** (1)	**70.** (4)	**71.** (3)	**72.** (4)
73. (2)	**74.** (1)	**75.** (4)	**76.** (3)	**77.** (1)	**78.** (1)	**79.** (4)	**80.** (4)
81. (70)	**82.** (1011)	**83.** (36)	**84.** (80)	**85.** (450)	**86.** (0)	**87.** (24)	**88.** (61)
89. (252)	**90.** (62)						