Q1. Given below are two statements: One is labelled as Assertion (A) and other is labelled as Reason (R)

Assertion (A) : Time period of oscillation of a liquid drop depends on surface tension (S), if density of the liquid is ρ and radius of the drop is r, then $T = K\sqrt{\frac{\rho r^3}{S^{\frac{3}{2}}}}$ is dimensionally correct, where K is dimensionless.

Reason (R) : Using dimensional analysis we get R.H.S. having different dimension than that of time period. In the light of above statements, choose the correct answer from the options given below.

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

Q2. A ball is thrown up vertically with a certain velocity so that, it reaches a maximum height h. Find the ratio of the times in which it is at height $\frac{h}{3}$ while going up and coming down respectively.

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

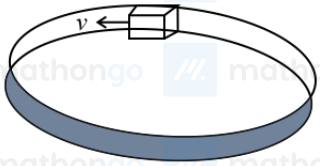
Q3. If $t = \sqrt{x} + 4$, then $\left(\frac{dx}{dt}\right)_{t=4}$ is:

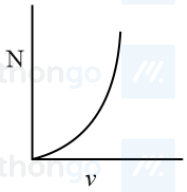
(1) 4 (2) Zero
(3) 8 (4) 16

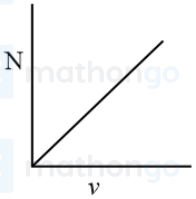
Q4. A ball is projected with kinetic energy E, at an angle of 60° to the horizontal. The kinetic energy of this ball at the highest point of its flight will become :

(1) Zero (2) $\frac{E}{2}$
(3) $\frac{E}{4}$ (4) E

Q5. A smooth circular groove has a smooth vertical wall as shown in figure. A block of mass m moves against the wall with a speed v. Which of the following curve represents the correct relation between the normal reaction on the block by the wall (N) and speed of the block (v)?



(1)


(2)


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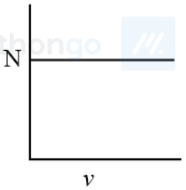
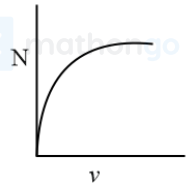


(4)


Q6. Two bodies of mass 1 kg and 3 kg have position vectors $\hat{i}+2\hat{j}+\hat{k}$ and $-3\hat{i}-2\hat{j}+\hat{k}$ respectively. The magnitude of position vector of centre of mass of this system will be similar to the magnitude of vector :

(1) $\hat{i}-2\hat{j}+\hat{k}$ (2) $-3\hat{i}-2\hat{j}+\hat{k}$

(3) $-2\hat{i}+2\hat{k}$ (4) $-2\hat{i}-\hat{j}+2\hat{k}$

Q7. If the length of a wire is made double and radius is halved of its respective values. Then, the Young's modulus of the material of the wire will :

(1) Remain same (2) Become 8 times its initial value

(3) Become $\frac{1^{th}}{4}$ of its initial value (4) Become 4 times its initial value

Q8. Given below are two statements: One is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A): Clothes containing oil or grease stains cannot be cleaned by water wash.

Reason (R) : Because the angle of contact between the oil/ grease and water is obtuse. In the light of the above statements, choose the correct answer from the option given below.

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

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

(3) (A) is true but (R) is false

(4) (A) is true but (R) is true

Q9. Two metallic wires of identical dimensions are connected is series. If σ_1 and σ_2 are the conductivities of the these wires respectively, the effective conductivity of the combination is :

(1) $\frac{\sigma_1\sigma_2}{\sigma_1+\sigma_2}$ (2) $\frac{2\sigma_1\sigma_2}{\sigma_1+\sigma_2}$

(3) $\frac{\sigma_1+\sigma_2}{2\sigma_1\sigma_2}$ (4) $\frac{\sigma_1+\sigma_2}{\sigma_1\sigma_2}$

Q10. The time period of oscillation of a simple pendulum of length L suspended from the roof of a vehicle, which moves without friction down an inclined plane of inclination α, is given by :

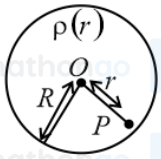
(1) $2\pi\sqrt{\frac{L}{(g\cos\alpha)}}$ (2) $2\pi\sqrt{\frac{L}{(g\sin\alpha)}}$

(3) $2\pi\sqrt{\frac{L}{g}}$ (4) $2\pi\sqrt{\frac{L}{(g\tan\alpha)}}$

Q11. A spherically symmetric charge distribution is considered with charge density varying as

$$\rho(r)=\begin{cases}\rho_0\left(\frac{3}{4}-\frac{r}{R}\right) & \text{for } r\le R\\ \text{Zero} & \text{for } r>R\end{cases}$$

Where, $r(r<R)$ is the distance from the centre O (as shown in figure). The electric field at point P will be :



(1) $\frac{\rho_0 r}{4\varepsilon_0}\left(\frac{3}{4}-\frac{r}{R}\right)$ (2) $\frac{\rho_0 r}{3\varepsilon_0}\left(\frac{3}{4}-\frac{r}{R}\right)$

(3) $\frac{\rho_0 r}{4\varepsilon_0}\left(1-\frac{r}{R}\right)$ (4) $\frac{\rho_0 r}{5\varepsilon_0}\left(1-\frac{r}{R}\right)$

Q12. Given below are two statements.

Statement I : Electric potential is constant within and at the surface of each conductor.

Statement II : Electric field just outside a charged conductor is perpendicular to the surface of the conductor at every point.

In the light of the above statements, choose the most appropriate answer from the options give below.

(1) Both statement I and statement II are correct (2) Both statement I and statement II are incorrect

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

Q13. An alternating emf $E = 440 \sin 100\pi t$ is applied to a circuit containing an inductance of $\frac{\sqrt{2}}{\pi}$H. If an a.c. ammeter is connected in the circuit, its reading will be :

(1) 4.4 A (2) 1.55 A

(3) 2.2 A (4) 3.11 A

Q14. A coil of inductance 1 H and resistance $100\ \Omega$ is connected to a battery of 6 V. Determine approximately :

(a) The time elapsed before the current acquires half of its steady-state value

(b) The energy stored in the magnetic field associated with the coil at an instant 15 ms after the circuit is switched on. (Given $\ln 2 = 0.693$, $e^{\frac{-3}{2}} = 0.25$)

(1) $t = 10$ ms; $U = 2$ mJ (2) $t = 10$ ms; $U = 1$ mJ

(3) $t = 7$ ms; $U = 1$ mJ (4) $t = 7$ ms; $U = 2$ mJ

Q15. Match List - I with List - II

	List-I		**List-II**
(a)	UV rays	(i)	Diagnostic tool in medicine
(b)	X-rays	(ii)	Water purification
(c)	Microwave	(iii)	Communication, Radar
(d)	Infrared wave	(iv)	Improving visibility in foggy days

Choose the correct answer from the options given below :

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

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

Q16. The kinetic energy of emitted electron is E when the light incident on the metal has wavelength λ. To double the kinetic energy, the incident light must have wavelength:

(1) $\frac{hc}{E\lambda - hc}$ (2) $\frac{hc\lambda}{E\lambda + hc}$

(3) $\frac{h\lambda}{E\lambda + hc}$ (4) $\frac{hc\lambda}{E\lambda - hc}$

Q17. Find the ratio of energies of photons produced due to transition of an election of hydrogen atom from its(i) second permitted energy level to the first level, and (ii) the highest permitted energy level to the first permitted level.

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

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

Q18. Find the modulation index of an AM wave having 8 V variation where maximum amplitude of the AM wave is 9 V.

(1) 0.8 (2) 0.5

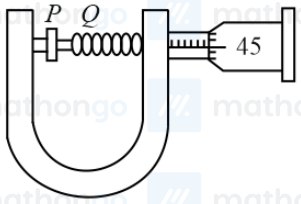
(3) 0.2 (4) 0.1

Q19. A travelling microscope has 20 divisions per cm on the main scale while its Vernier scale has total 50 divisions and 25 Vernier scale divisions are equal to 24 main scale divisions, what is the least count of the travelling microscope ?

(1) 0.001 cm (2) 0.002 mm

(3) 0.002 cm (4) 0.005 cm

Q20. In an experiment to find out the diameter of wire using screw gauge, the following observation were noted:



(a) Screw moves 0.5 mm on main scale in one complete rotation

(b) Total divisions on circular scale $= 50$

(c) Main scale reading is 2.5 mm

(d) 45^{th} division of circular scale is in the pitch line

(e) Instrument has 0.03 mm negative error Then the diameter of wire is :

(1) 2.92 mm (2) 2.54 mm

(3) 2.98 mm (4) 3.45 mm

Q21. An object is projected in the air with initial velocity u at an angle θ. The projectile motion is such that the horizontal range R, is maximum. Another object is projected in the air with a horizontal range half of the range of first object. The initial velocity remains same in both the case. The value of the angle of projection, at which the second object is projected, will be _____ degree.

Q22. If the acceleration due to gravity experienced by a point mass at a height h above the surface of earth is same as that of the acceleration due to gravity at a depth $\alpha h (h \ll R_e)$) from the earth surface. The value of α will be _____ .

(use $R_e = 6400$ km)

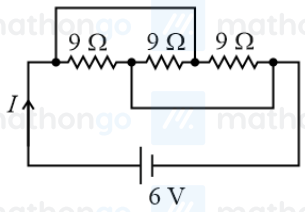
Q23. The pressure P_1 and density d_1 of diatomic gas $\left(\gamma = \frac{7}{5}\right)$ changes suddenly to $P_2 (> P_1)$ and d_2 respectively during an adiabatic process. The temperature of the gas increases and becomes____times of its initial temperature.

(given $\frac{d_2}{d_1} = 32$)

Q24. One mole of a monoatomic gas is mixed with three moles of a diatomic gas. The molecular specific heat of mixture at constant volume is $\frac{\alpha^2}{4} R$ J mol K^{-1}; then the value of α will be _____ . (Assume that the given diatomic gas has no vibrational mode.)

Q25. Two light beams of intensities $4I$ and $9I$ interfere on a screen. The phase difference between these beams on the screen at point A is zero and at point B is π. The difference of resultant intensities, at the point A and B, will be _____ I.

Q26. The current I flowing through the given circuit will be _____ A.



Q27. A closely wounded circular coil of radius 5 cm produces a magnetic field of 37.68×10^{-4} T at its center. The current through the coil is _____ A. [Given, number of turns in the coil is 100 and $\pi = 3.14$]

Q28. A wire of length 314 cm carrying current of 14 A is bent to form a circle. The magnetic moment of the coil is $\mathrm{A-m^2}$. [Given $\pi = 3.14$]

Q29. The $X-Y$ plane be taken as the boundary between two transparent media M_1 and M_2. M_1 in $Z \geq 0$ has a refractive index of $\sqrt{2}$ and M_2 with $Z < 0$ has a refractive index of $\sqrt{3}$. A ray of light travelling in M_1 along the direction given by the vector $\vec{A} = 4\sqrt{3}i - 3\sqrt{3}j - 5\hat{k}$, is incident on the plane of separation. The value of difference between the angle of incident in M_1 and the angle of refraction in M_2 will be _____ degree.

Q30. If the potential barrier across a $p-n$ junction is 0.6 V. Then the electric field intensity, in the depletion region having the width of 6×10^{-6} m, will be _____ $\times 10^5$ N $\mathrm{C^{-1}}$

Q31. $\mathrm{N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2\,NH_{3(g)}}$ 20 g 5 g

Consider the above reaction. If 20g of dinitrogen reacts with 5g of dihydrogen, then the limiting reagent of the reaction and number of moles of $\mathrm{NH_3}$ formed respectively are

(1) $\mathrm{H_2}$, 1.42 moles
(2) $\mathrm{H_2}$, 0.71 moles
(3) $\mathrm{N_2}$, 1.42 moles
(4) $\mathrm{N_2}$, 0.71 moles

Q32. The first ionization enthalpy of Na, Mg and Si, respectively, are: 496, 737 and 786 kJ mo 1^{-1}. The first ionization enthalpy $\left(\mathrm{kJmol^{-1}}\right)$ of Al is

(1) 487
(2) 768
(3) 577
(4) 856

Q33. Which of the following pair of molecules contain odd electron molecule and an expanded octet molecule?

(1) $\mathrm{BCl_3}$ and $\mathrm{SF_6}$
(2) NO and $\mathrm{H_2\,SO_4}$
(3) $\mathrm{SF_6}$ and $\mathrm{H_2\,SO_4}$
(4) $\mathrm{BCl_3}$ and NO

Q34. Number of lone pairs of electrons in the central atom of $\mathrm{SCl_2}$, $\mathrm{O_3}$, $\mathrm{ClF_3}$ and $\mathrm{SF_6}$, respectively, are

(1) 0, 1, 2 & 2
(2) 2, 1, 2 & 0
(3) 1, 2, 2 & 0
(4) None of these

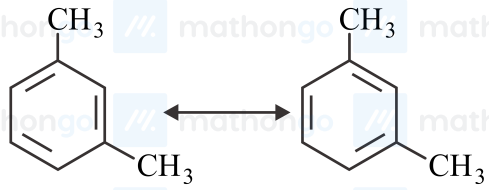
Q35. The reaction of zinc with excess of aqueous alkali, evolves hydrogen gas and gives

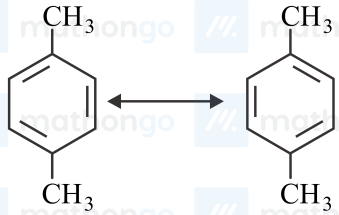
(1) $\mathrm{Zn(OH)_2}$
(2) ZnO
(3) $\mathrm{[Zn(OH)_4]^{2-}}$
(4) $\mathrm{[ZnO_2]^{2-}}$

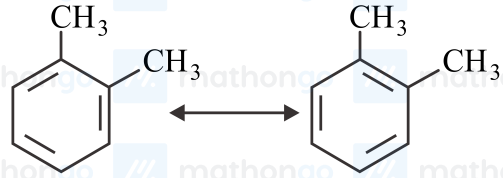
Q36. Lithium nitrate and sodium nitrate, when heated separately, respectively, give

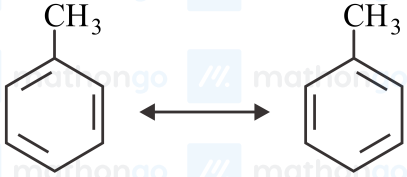
(1) $\mathrm{LiNO_2}$ and $\mathrm{NaNO_2}$
(2) $\mathrm{Li_2\,O}$ and $\mathrm{Na_2\,O}$
(3) $\mathrm{Li_2\,O}$ and $\mathrm{NaNO_2}$
(4) $\mathrm{LiNO_2}$ and $\mathrm{Na_2\,O}$

Q37. Which among the following pairs of the structures will give different products on ozonolysis? (Consider the double bonds in the structures are rigid and not delocalized.)

(1) 

(2) 

(3) 

(4) 

Q38. Which among the following pairs has only herbicides?

(1) Aldrin and Dieldrin
(2) Sodium chlorate and Aldrin
(3) Sodium arsinate and Dieldrin
(4) Sodium chlorate and sodium arsenite.

Q39. 100 mL of 5%(w/v) solution of NaCl in water was prepared in 250 mL beaker. Albumin from the egg was poured into NaCl solution and stirred well. This resulted in a/ an

(1) Lyophilic sol
(2) Lyophobic sol
(3) Emulsion
(4) Precipitate

Q40. In metallurgy the term "gangue" is used for

(1) Contamination of undesired earthy materials.
(2) Contamination of metals, other than desired metal
(3) Minerals which are naturally occuring in pure form
(4) Magnetic impurities in an ore.

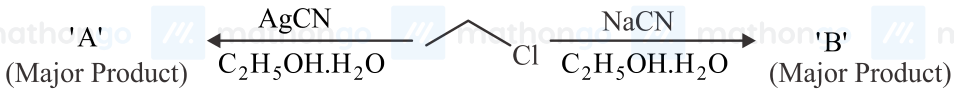
Q41. In following pairs, the one in which both transition metal ions are colourless is

(1) Sc^{3+}, Zn^{2+}
(2) Ti^{4+}, Cu^{2+}
(3) V^{2+}, Ti^{3+}
(4) Zn^{2+}, Mn^{2+}

Q42. In neutral or faintly alkaline medium, $KMnO_4$ being a powerful oxidant can oxidise, thiosulphate almost quantitatively, to sulphate. In this reaction overall change in oxidation state of manganese will be

(1) 5
(2) 1
(3) 0
(4) 3

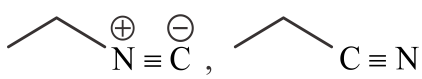
Q43.



Considering the above reactions, the compound 'A' and compound 'B' respectively are

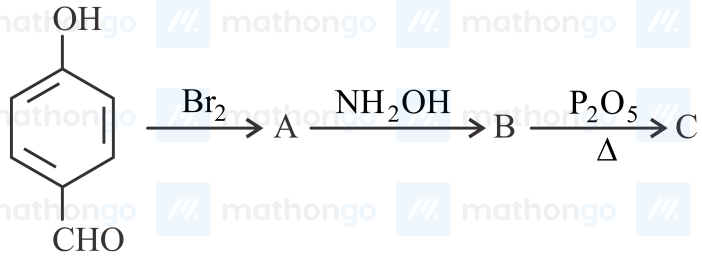
(1) 

(2) 

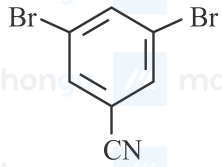
(3) 

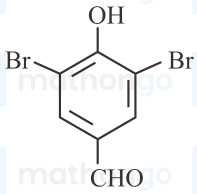
(4) 

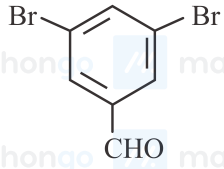
Q44.

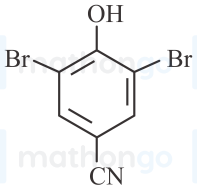


Consider the above reaction sequence, the Product 'C' is

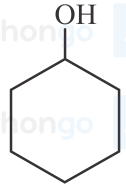
(1) 

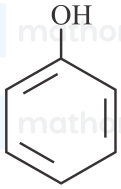
(2) 

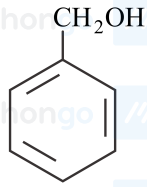
(3) 

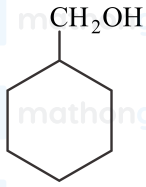
(4) 

Q45. A compound 'X' is acidic and it is soluble in NaOH solution, but insoluble in $NaHCO_3$ solution. Compound 'X' also gives violet colour with neutral $FeCl_3$ solution. The compound 'X' is

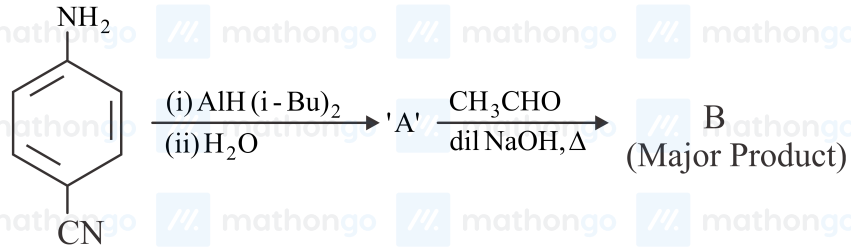
(1) 

(2) 

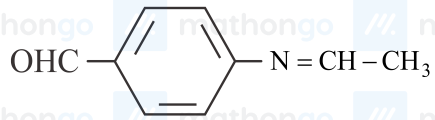
(3) 

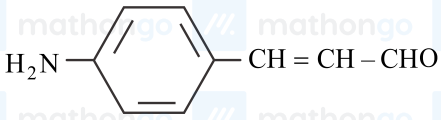
(4) 

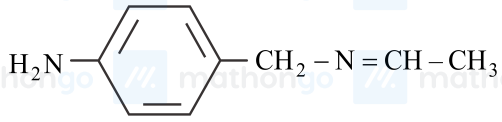
Q46. Consider the following reaction sequence

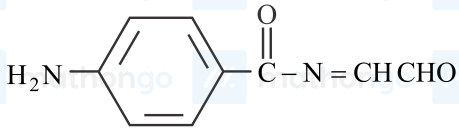


The product 'B' is

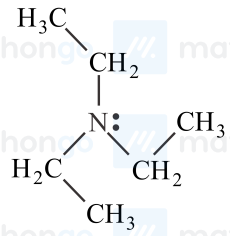
(1) 

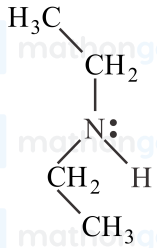
(2) 

(3) 

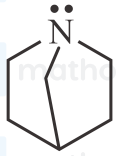
(4) 

Q47. Which among the following is the strongest Bronsted base?

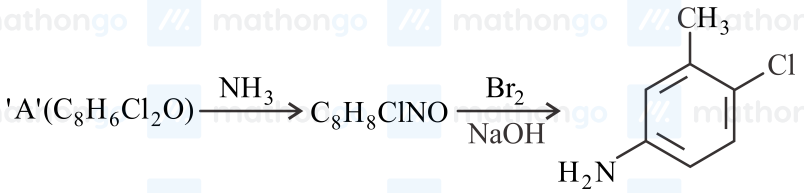
(1) 

(2) 

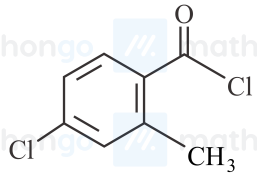
(3) 

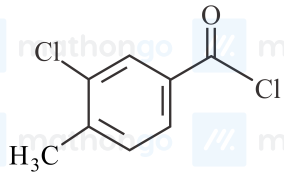
(4) 

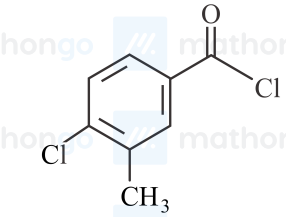
Q48.

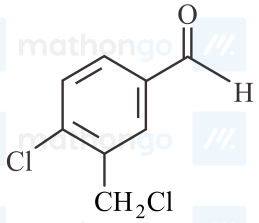


Consider the above reaction, the compound 'A' is

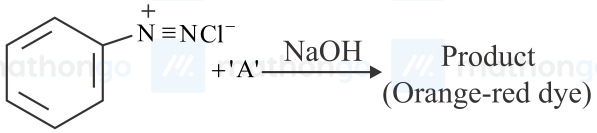
(1) 

(2) 

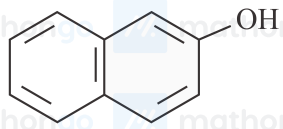
(3) 

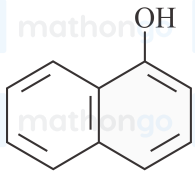
(4) 

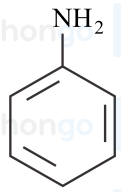
Q49.

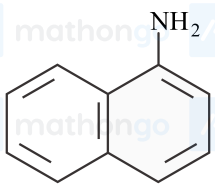


Which among the following represent reagent 'A'?

(1) 

(2) 

(3) 

(4) 

Q50. Which of the following compounds is an example of hypnotic drug?

(1) Seldane (2) Amytal

(3) Aspartame (4) Prontosil

Q51. The minimum uncertainty in the speed of an electron in one dimensional region of length $2a_o$ (Where a_o = Bohr radius 52.9 pm) is____kms^{-1} (Nearest integer) (Given : Mass of electron $= 9.1 \times 10^{-31}$ kg, Planck's constant $h = 6.63 \times 10^{-34}$ Js)

Q52. When 600 mL of $0.2M$ HNO_3 is mixed with 400 mL of $0.1M$ NaOH solution in a flask, the rise in temperature of the flask is_____$\times 10^{-2}$ °C
(Enthalpy of neutralisation $= 57$ kJ mol^{-1} and Specific heat of water $= 4.2\,JK^{-1}\ g^{-1}$) (Neglect heat capacity of flask)

Q53. If the solubility product of PbS is 8×10^{-28}, then the solubility of PbS in pure water at 298 K is $x \times 10^{-16}$ mol L^{-1}. The value of x is____ (Nearest integer) [Given $\sqrt{2} = 1.41$]

Q54. In bromination of Propyne, with Bromine 1, 1, 2, 2-tetrabromopropane is obtained in 27% yield. The amount of 1, 1, 2, 2 tetrabromopropane obtained from 1 g of Bromine in this reaction is_____$\times 10^{-1}$ g . (Molar Mass : Bromine = 80 g/ mol)

Q55. Ionic radii of cation A^+ and anion B^- are 102 and 181 pm respectively. These ions are allowed to crystallize into an ionic solid. This crystal has cubic close packing for B^-. A^+ is present in all octahedral voids. The edge length of the unit cell of the crystal AB is___pm.

Q56. If O_2 gas is bubbled through water at 303 K, the number of millimoles of O_2 gas that dissolve in 1 litre of water is____(Nearest integer) (Given : Henry's Law constant for O_2 at 303 K is 46.82k bar and partial pressure of $O_2 = 0.920$ bar)
(Assume solubility of O_2 in water is too small, nearly negligible)

Q57. Resistance of a conductivity cell (cell constant 129 m^{-1}) filled with 74.5 ppm solution of KCl is 100 Ω (labelled as solution 1). When the same cell is filled with KCl solution of 149 ppm, the resistance is 50 Ω (labelled as solution 2). The ratio of molar conductivity of solution 1 and solution 2 is i.e. $\frac{\wedge_1}{\wedge_2} = x \times 10^{-3}$. The value of x is____Given, molar mass of KCl is 74.5 g mol^{-1})

Q58. The reaction between X and Y is first order with respect to X and zero order with respect to Y.

Experiment	$\frac{[X]}{molL^{-1}}$	$\frac{[Y]}{molL^{-1}}$	$\frac{\text{Initial rate}}{molL^{-1}min^{-1}}$

I	0.1	0.1	2×10^{-3}
II	L	0.2	4×10^{-3}
III	0.4	0.4	$\mathrm{M} \times 10^{-3}$
IV	0.1	0.2	2×10^{-3}

Examine the data of table and calculate ratio of numerical values of M and L.

Q59. $\left[\mathrm{Fe}\left(\mathrm{CN}\right)_6\right]^{3-}$ should be an inner orbital complex. Ignoring the pairing energy, the value of crystal field stabilization energy for this complex is $(-)$_____Δ_0.

Q60. In a linear tetrapeptide (Constituted with different amino acids), (number of amino acids) - (number of peptide bonds) is

Q61. If $z = 2 + 3i$, then $z^5 + (\bar{z})^5$ is equal to:

(1) 244 (2) 224

(3) 245 (4) 265

Q62. If $\frac{1}{(20-a)(40-a)} + \frac{1}{(40-a)(60-a)} + \ldots\ldots + \frac{1}{(180-a)(200-a)} = \frac{1}{256}$, then the maximum value of a is

(1) 198 (2) 202

(3) 212 (4) 218

Q63. Let the circumcentre of a triangle with vertices $A(a, 3), B(b, 5)$ and $C(a, b), ab > 0$ be $P(1, 1)$. If the line AP intersects the line BC at the point $Q(k_1, k_2)$, then $k_1 + k_2$ is equal to

(1) 2 (2) $\frac{4}{7}$

(3) $\frac{2}{7}$ (4) 4

Q64. Let a line L pass through the point of intersection of the lines $bx + 10y - 8 = 0$ and $2x - 3y = 0$, $b \in R - \left\{\frac{4}{3}\right\}$. If the line L also passes through the point $(1, 1)$ and touches the circle $17\left(x^2 + y^2\right) = 16$, then the eccentricity of the ellipse $\frac{x^2}{5} + \frac{y^2}{b^2} = 1$ is

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

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

Q65. Let the focal chord of the parabola $P : y^2 = 4x$ along the line $L : y = mx + c, m > 0$ meet the parabola at the points M and N. Let the line L be a tangent to the hyperbola $H : x^2 - y^2 = 4$. If O is the vertex of P and F is the focus of H on the positive x-axis, then the area of the quadrilateral $OMFN$ is

(1) $2\sqrt{6}$ (2) $2\sqrt{14}$

(3) $4\sqrt{6}$ (4) $4\sqrt{14}$

Q66. If $\lim\limits_{x \to 0} \frac{\alpha e^x + \beta e^{-x} + \gamma \sin x}{x \sin^2 x} = \frac{2}{3}$, where $\alpha, \beta, \gamma \in R$, then which of the following is NOT correct?

(1) $\alpha^2 + \beta^2 + \gamma^2 = 6$ (2) $\alpha\beta + \beta\gamma + \gamma\alpha + 1 = 0$

(3) $\alpha\beta^2 + \beta\gamma^2 + \gamma\alpha^2 + 3 = 0$ (4) $\alpha^2 - \beta^2 + \gamma^2 = 4$

Q67. The statement $(p \wedge q) \Rightarrow (p \wedge r)$ is equivalent to

(1) $q \Rightarrow (p \wedge r)$ (2) $p \Rightarrow (p \wedge r)$

(3) $(p \wedge r) \Rightarrow (p \wedge q)$ (4) $(p \wedge q) \Rightarrow r$

Q68. The angle of elevation of the top of a tower from a point A due north of it is α and from a point B at a distance of 9 units due west of A is $\cos^{-1}\left(\frac{3}{\sqrt{13}}\right)$. If the distance of the point B from the tower is 15 units, then $\cot\alpha$ is equal to

(1) $\frac{6}{5}$ (2) $\frac{9}{5}$
(3) $\frac{4}{3}$ (4) $\frac{7}{3}$

Q69. Let R be a relation from the set $\{1,2,3.....,60\}$ to itself such that $R=\{(a,b): b=pq$, where $p,q\geq 3$ are prime numbers$\}$. Then, the number of elements in R is

(1) 600 (2) 660
(3) 540 (4) 720

Q70. Let A and B be two 3×3 non-zero real matrices such that AB is a zero matrix. Then

(1) The system of linear equations $AX=0$ has a unique solution (2) The system of linear equations $AX=0$ has infinitely many solutions
(3) B is an invertible matrix (4) $\text{adj}(A)$ is an invertible matrix

Q71. The number of points, where the function
$f: R\to R,\ f(x)=|x-1|\cos|x-2|\sin|x-1|+(x-3)\left|x^2-5x+4\right|$, is NOT differentiable, is

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

Q72. Let $f(x)=3^{(x^2-2)^3+4}$, x $\in R$. Then which of the following statements are true?
$P:\ x=0$ is a point of local minima of f
$Q:\ x=\sqrt{2}$ is a point of inflection of f
$R: f'$ is increasing for $x>\sqrt{2}$

(1) Only P and Q (2) Only P and R
(3) Only Q and R (4) All P, Q and R

Q73. The integral $\int_0^{\frac{\pi}{2}}\frac{1}{3+2\sin x+\cos x}dx$ is equal to:

(1) $\tan^{-1}(2)$ (2) $\tan^{-1}(2)-\frac{\pi}{4}$
(3) $\frac{1}{2}\tan^{-1}(2)-\frac{\pi}{8}$ (4) $\frac{1}{2}$

Q74. If $f(\alpha)=\int_1^{\alpha}\frac{\log_{10}t}{1+t}dt, \alpha>0$, then $f\left(e^3\right)+f\left(e^{-3}\right)$ is equal to

(1) 9 (2) $\frac{9}{2}$
(3) $\frac{9}{\log_e(10)}$ (4) $\frac{9}{2\log_e(10)}$

Q75. The area of the region $\left\{(x,y):|x-1|\leq y\leq\sqrt{5-x^2}\right\}$ is equal to

(1) $\frac{5}{2}\sin^{-1}\left(\frac{3}{5}\right)-\frac{1}{2}$ (2) $\frac{5\pi}{4}-\frac{3}{2}$
(3) $\frac{3\pi}{4}+\frac{3}{2}$ (4) $\frac{5\pi}{4}-\frac{1}{2}$

Q76. Let the solution curve $y=y(x)$ of the differential equation $\left(1+e^{2x}\right)\left(\frac{dy}{dx}+y\right)=1$ pass through the point $\left(0,\frac{\pi}{2}\right)$. Then, $\lim\limits_{x\to\infty}e^x y(x)$ is equal to

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

Q77. Let $\vec{a}=3\hat{i}+\hat{j}$ and $\vec{b}=\hat{i}+2\hat{j}+\hat{k}$. Let $\vec{c}$ be a vector satisfying $\vec{a}\times\left(\vec{b}\times\vec{c}\right)=\vec{b}+\lambda\vec{c}$. If $\vec{b}$ and $\vec{c}$ are non-parallel, then the value of λ is

(1) -5 (2) 5
(3) 1 (4) -1

Q78. Let $\hat{a}$ and $\hat{b}$ be two unit vectors such that the angle between them is $\frac{\pi}{4}$. If θ is the angle between the vectors $\left(\hat{a}+\hat{b}\right)$ and $\left(\hat{a}+2\hat{b}+2\left(\hat{a}\times\hat{b}\right)\right)$ then the value of $164\cos^2\theta$ is equal to

(1) $90+27\sqrt{2}$ (2) $45+18\sqrt{2}$
(3) $90+3\sqrt{2}$ (4) $54+90\sqrt{2}$

Q79. If the foot of the perpendicular from the point $A(-1,4,3)$ on the plane $P: 2x+my+nz=4$, is $\left(-2,\frac{7}{2},\frac{3}{2}\right)$, then the distance of the point A from the plane P, measured parallel to a line with direction ratios $3,-1,-4$, is equal to

(1) 1 (2) $\sqrt{26}$
(3) $2\sqrt{2}$ (4) $\sqrt{14}$

Q80. Let $S=\{1,2,3,\ldots,2022\}$. Then the probability, that a randomly chosen number n from the set S such that $HCF(n,2022)=1$, is

(1) $\frac{128}{1011}$ (2) $\frac{166}{1011}$
(3) $\frac{127}{337}$ (4) $\frac{112}{337}$

Q81. Let $S=\{4,6,9\}$ and $T=\{9,10,11,\ldots,1000\}$. If $A=\{a_1+a_2+\ldots+a_k: k\in N, a_1,a_2,a_3,\ldots,a_k\in S\}$ then the sum of all the elements in the set $T-A$ is equal to _____.

Q82. Let $a_1,a_2,a_3,\ldots$ be an A.P. If $\sum_{r=1}^{\infty}\frac{a_r}{2^r}=4$, then $4a_2$ is equal to _____.

Q83. If $\frac{1}{2\times3\times4}+\frac{1}{3\times4\times5}+\frac{1}{4\times5\times6}+\ldots+\frac{1}{100\times101\times102}=\frac{k}{101}$, then $34k$ is equal to _____.

Q84. Let the ratio of the fifth term from the beginning to the fifth term from the end in the binomial expansion of $\left(\sqrt[4]{2}+\frac{1}{\sqrt[4]{3}}\right)^n$, in the increasing powers of $\frac{1}{\sqrt[4]{3}}$ be $\sqrt[4]{6}:1$. If the sixth term from the beginning is $\frac{\alpha}{\sqrt[4]{3}}$, then α is equal to _____.

Q85. Let $S=\left\{\theta\in\left(0,2\pi\right): 7\cos^2\theta-3\sin^2\theta-2\cos^2 2\theta=2\right\}$. Then, the sum of roots of all the equations $x^2-2\left(\tan^2\theta+\cot^2\theta\right)x+6\sin^2\theta=0\ \theta\in\mathrm{S}$, is _____.

Q86. Let the mirror image of a circle $c_1: x^2+y^2-2x-6y+\alpha=0$ in line $y=x+1$ be $c_2: 5x^2+5y^2+10gx+10fy+38=0$. If r is the radius of circle c_2, then $\alpha+6r^2$ is equal to _____

Q87. Let the mean and the variance of 20 observations $x_1,x_2,\ldots x_{20}$ be 15 and 9, respectively. For $\alpha\in R$, if the mean of $(x_1+\alpha)^2,(x_2+\alpha)^2,\ldots,(x_{20}+\alpha)^2$ is 178, then the square of the maximum value of α is equal to

_____.

Q88. The number of matrices of order 3×3, whose entries are either 0 or 1 and the sum of all the entries is a prime number, is _____.

Q89. Let p and $p+2$ be prime numbers and let

$$\Delta = \begin{vmatrix} p! & (p+1)! & (p+2)! \\ (p+1)! & (p+2)! & (p+3)! \\ (p+2)! & (p+3)! & (p+4)! \end{vmatrix}$$

Then the sum of the maximum values of α and β, such that p^{α} and $(p+2)^{\beta}$ divide Δ, is _____.

Q90. Let a line with direction ratios $a, -4\ a, -7$ be perpendicular to the lines with direction ratios $3, -1, 2b$ and $b,\ a, -2$. If the point of intersection of the line $\frac{x+1}{a^2+b^2} = \frac{y-2}{a^2-b^2} = \frac{z}{1}$ and the plane $x - y + z = 0$ is (α, β, γ), then $\alpha + \beta + \gamma$ is equal to _____.

ANSWER KEYS

1. (4)	**2.** (2)	**3.** (2)	**4.** (3)	**5.** (1)	**6.** (1)	**7.** (1)	**8.** (1)
9. (2)	**10.** (1)	**11.** (3)	**12.** (1)	**13.** (3)	**14.** (3)	**15.** (2)	**16.** (2)
17. (1)	**18.** (1)	**19.** (3)	**20.** (3)	**21.** (15)	**22.** (2)	**23.** (4)	**24.** (3)
25. (24)	**26.** (2)	**27.** (3)	**28.** (11)	**29.** (15)	**30.** (1)	**31.** (3)	**32.** (3)
33. (2)	**34.** (2)	**35.** (4)	**36.** (3)	**37.** (3)	**38.** (4)	**39.** (1)	**40.** (1)
41. (1)	**42.** (4)	**43.** (3)	**44.** (4)	**45.** (2)	**46.** (2)	**47.** (4)	**48.** (3)
49. (1)	**50.** (2)	**51.** (548)	**52.** (54)	**53.** (282)	**54.** (3)	**55.** (566)	**56.** (1)
57. (1000)	**58.** (40)	**59.** (2)	**60.** (1)	**61.** (1)	**62.** (3)	**63.** (2)	**64.** (2)
65. (2)	**66.** (3)	**67.** (4)	**68.** (1)	**69.** (2)	**70.** (2)	**71.** (2)	**72.** (4)
73. (2)	**74.** (4)	**75.** (4)	**76.** (2)	**77.** (1)	**78.** (1)	**79.** (2)	**80.** (4)
81. (11)	**82.** (16)	**83.** (286)	**84.** (84)	**85.** (16)	**86.** (12)	**87.** (4)	**88.** (282)
89. (4)	**90.** (10)						