

Competishun

52/6, Opposite Metro Mas Hospital, Shipra Path, Mansarovar

Date: 14/12/2023

Time: 3 hours

Max. Marks: 300

MFST-4 (23-24)

Physics

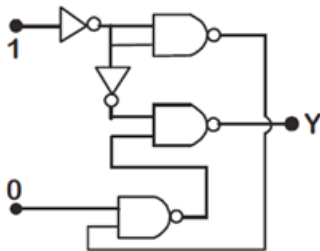
Single Choice Question

- Q1** The dimension of $\frac{B^2}{2\mu_0}$, where B is magnetic field and μ_0 is the magnetic permeability of vacuum, is
 a) $ML^{-1}T^{-2}$ b) ML^2T^{-2} c) ML^2T^{-1} d) MLT^{-2}
- Q2** A parallel plate capacitor has plates of area A separated by distance 'd' between them. It is filled with a dielectric which has a dielectric constant that varies as $k(x) = K(1 + \alpha x)$ where 'x' is the distance measured from one of the plates. If $(\alpha d) \ll 1$, the total capacitance of the system is best given by the expression



- a) $\frac{AK\epsilon_0}{d}(1 + \alpha d)$ b) $\frac{A\epsilon_0 K}{d}(1 + \frac{\alpha^2 d^2}{2})$
 c) $\frac{AK\epsilon_0}{d}(1 + \frac{\alpha d}{2})$ d) $\frac{A\epsilon_0 K}{d}\left(1 + \left(\frac{\alpha d}{2}\right)^2\right)$
- Q3** The magnetic field of a plane electromagnetic wave is given by
 $\vec{B} = 2 \times 10^{-8} \sin(0.5 \times 10^3 x + 1.5 \times 10^{11} t) \hat{j} \text{ T}$
 The amplitude of the electric field would be
 a) 6 Vm^{-1} along x-axis b) 3 Vm^{-1} along x-axis
 c) 6 Vm^{-1} along z-axis d) $2 \times 10^{-8} \text{ Vm}^{-1}$ along z-axis
- Q4** Visible light of wavelength $6000 \times 10^{-8} \text{ cm}$ falls normally on a single slit and produces a diffraction pattern. It is found that the second diffraction minimum is at 60° from the central maximum. If the first minimum is produced at θ_1 , then θ_1 is close to
 a) 25° b) 30° c) 20° d) 45°

Q5 In the given circuit, value of Y is

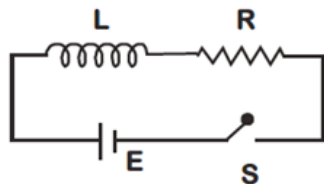


- a) Toggles between 0 and 1 b) 0
c) 1 d) Will not execute

Q6 Consider a mixture of n moles of helium gas and $2n$ moles of oxygen gas (molecules taken to be rigid) as an ideal gas. Its C_p/C_v value will be

- a) 40/27 b) 19/13 c) 67/45 d) 23/15

Q7 As shown in the figure, a battery of emf E is connected to an inductor L and resistance R in series. The switch is closed at $t = 0$. The total charge that flows from the battery, between $t = 0$ and $t = t_c$ (t_c is the time constant of the circuit) is :



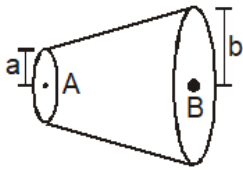
- a) $\frac{EL}{R^2}$ b) $\frac{EL}{eL^2}$ c) $\frac{EL}{R^2} \left(1 - \frac{1}{e}\right)$ d) $\frac{EL}{eR^2}$

Q8 Four identical square metal plates are located in air at equal distances ' d ' from one another. The area of each plate is equal to S . Find the capacitance of the system between points A and B if the plates are interconnected as shown in the figure. (Assume $d \ll \sqrt{S}$)



- a) $C = \frac{2\epsilon_0 S}{3d}$ b) $C = \frac{3\epsilon_0 S}{2d}$ c) $C = \frac{3\epsilon_0 S}{4d}$ d) None of these

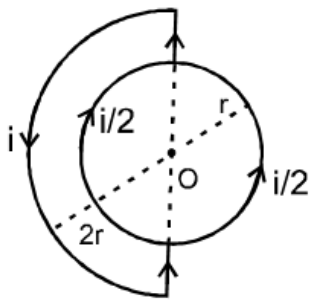
- Q9** An electric current passes through non uniform cross-section wire made of homogeneous and isotropic material. If the j_A and j_B be the current densities and E_A and E_B be the electric field intensities at A and B respectively, then



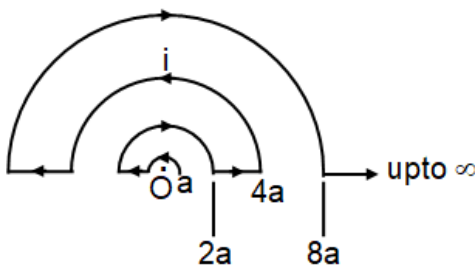
- a) $j_A > j_B$; $E_A > E_B$ b) $j_A > j_B$; $E_A < E_B$
 c) $j_A < j_B$; $E_A > E_B$ d) $j_A < j_B$; $E_A < E_B$
- Q10** A capacitor of capacitance C_1 is charged to potential V and battery is disconnected. Now the capacitor is connected to a uncharged capacitor of capacitance C_2 then what will be common potential of the combination

- a) $\frac{C_1 V}{C_1 + C_2}$ b) $\frac{C_2 V}{C_1 + C_2}$ c) $\frac{(C_1 + C_2) V}{C_1 + C_2}$ d) $\frac{C_2}{C_1 + C_2}$

- Q11** The current flowing in the loop is shown in figure. Then the magnetic field at point O (centre) is :

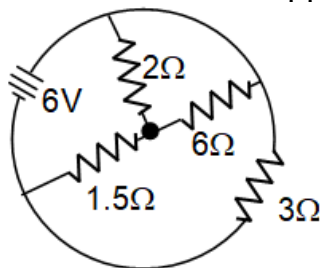


- a) $\frac{3\mu_0 i}{8r}$ b) $\frac{5\mu_0 i}{8r}$ c) $\frac{\mu_0 i}{8r}$ d) None of these
- Q12** A conductor carrying current 'i' is bent in the form of concentric semicircles as shown in the figure. The magnetic field at the centre O is :



- a) zero b) $\frac{\mu_0 i}{6a}$ c) $\frac{\mu_0 i}{a}$ d) $\frac{\mu_0 i \ln 2}{4a}$

Q13 The total current supplied to the circuit by the battery is -

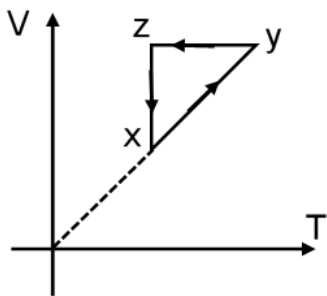


- a) 1A b) 2A c) 4A d) 6A

Q14 A thin uniform rod is of mass M and length L . Find the radius of gyration for rotation about an axis passing through a point at a distance of $\frac{L}{4}$ from centre and perpendicular to rod.

- a) $\sqrt{\frac{7}{48}}L$ b) $\sqrt{\frac{5}{48}}L$ c) $\sqrt{\frac{7}{24}}L$ d) $\sqrt{\frac{19}{24}}L$

Q15 Choose the correct P-V graph of ideal gas for given V-T graph.

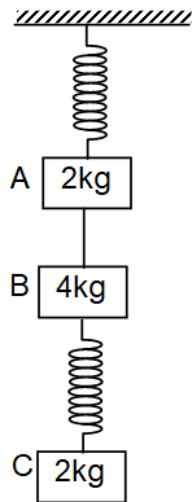


- a) b)
- c) d)

Q16 A screw gauge advances by 3mm in 6 rotations. There are 50 divisions on circular scale. Find least count of screw gauge?

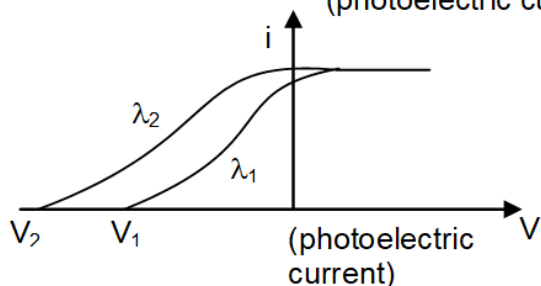
- a) 0.002 cm b) 0.001 cm c) 0.01 cm d) 0.02 cm

- Q17** Three blocks A, B and C are in equilibrium. If string is cut between block A and B then calculate acceleration of block 'B' just after cutting the string.



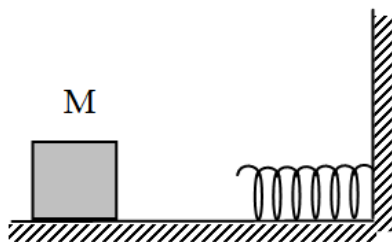
- a) 0
b) 15 m/s² upward
c) 15 m/s² downward
d) 30 m/s² upward

- Q18** In the following diagram if $V_2 > V_1$ then -
(photoelectric current)



- a)** $\lambda_1 = \sqrt{\lambda_2}$ **b)** $\lambda_1 < \lambda_2$ **c)** $\lambda_1 = \lambda_2$ **d)** $\lambda_1 > \lambda_2$

- Q19** The block of mass M moving on the frictionless horizontal surface collides with the spring of spring constant K and compresses it by length L . The maximum momentum of the block after collision is -



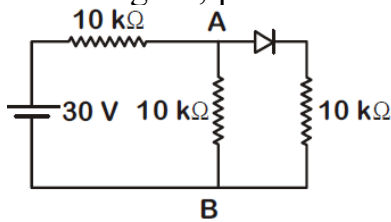
- a) \sqrt{MKL} b) $\frac{KL^2}{2M}$ c) zero d) $\frac{ML^2}{K}$

- Q20** A force F is needed to break a copper wire having radius R . The force needed to break a copper wire of the same length and radius $2R$ will be -

- a) $\frac{F}{2}$ b) $2F$ c) $4F$ d) $\frac{F}{4}$

Numerical

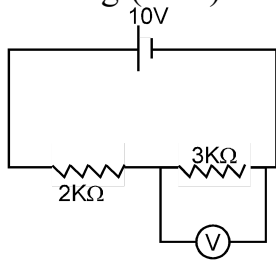
Q21 In the figure, potential difference (in V) between A and B is :



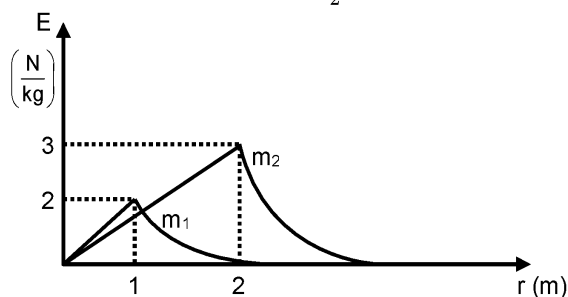
Q22 The percentage increase in the speed of transverse waves produced in a stretched string if the tension is increased by 4%, will be _____%.

Q23 The amplitude of wave disturbance propagating in the positive x-direction is given by $y = \frac{1}{(1+x)^2}$ at time $t = 0$ and $y = \frac{1}{1+(x-2)^2}$ at $t = 1$ s, where x and y are in metres. The shape of wave does not change during the propagation. The velocity of the wave will be _____ m/s.

Q24 In the circuit shown in figure, the resistance of voltmeter is $6\text{ K}\Omega$. The voltmeter reading (in V) will be:



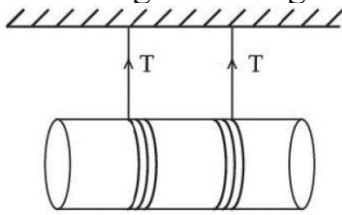
Q25 Two spherical bodies of mass m_1 and m_2 have radii 1 m and 2 m respectively. The gravitational field of the two bodies with the radial distance from centre is shown below. The value of $\frac{m_1}{m_2}$ is $\frac{x}{6}$ then find the value of x –



Q26 If relative permittivity and relative permeability of a medium are 3 and $\frac{4}{3}$ respectively. The critical angle (in degree) for this medium is -

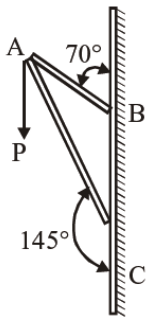
Q27 A square shaped wire with resistance of each side 3Ω is bent to form a complete circle. The resistance between two diametrically opposite points of the circle in unit of Ω will be _____.

- Q28** A solid cylinder length is suspended symmetrically through two massless strings, as shown in the figure. The distance from the initial rest position, the cylinder should by unbinding the strings to achieve a speed of 4 ms^{-1} , iscm. (take $g = 10 \text{ ms}^{-2}$)



- Q29** The RI of prism for a monochromatic wave is $\sqrt{2}$ and its refracting angle is 60° . For minimum deviation, the angle of incidence (in degree) will be

- Q30** 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.

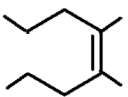


Suppose the force is \vec{P} resolved parallel to the arms AB and AC of the frame. The magnitude of the resolved component along the arm AC is xN. The value of x, to the nearest integer, is _____.

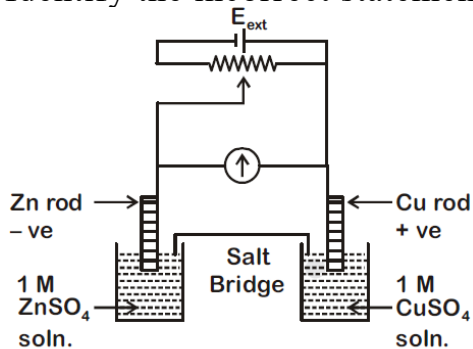
[Given : $\sin(35^\circ) = 0.573$, $\cos(35^\circ) = 0.819$
 $\sin(110^\circ) = 0.939$, $\cos(110^\circ) = -0.342$]

Chemistry

Single Choice Question

- Q31** 5.1 g NH_4SH is introduced in 3.0 L evacuated flask at 327°C . 30% of the solid NH_4SH decomposed to NH_3 and H_2S as gases. The K_p of the reaction at 327°C is ($R = 0.082 \text{ L atm mol}^{-1}\text{K}^{-1}$, Molar mass of $\text{S} = 32 \text{ g mol}^{-1}$, molar mass of $\text{N} = 14 \text{ g mol}^{-1}$)
 a) $4.9 \times 10^{-3} \text{ atm}^2$ b) 0.242 atm^2 c) $1 \times 10^{-4} \text{ atm}^2$ d) $0.242 \times 10^{-4} \text{ atm}^2$
- Q32** Two pi and half sigma bonds are present in
 a) O_2^+ b) O_2 c) N_2^+ d) N_2
- Q33** Which of the following statements are correct ?
 (A) The electronic configuration of Cr is $[\text{Ar}] 3d^5 4s^1$.
 (B) The magnetic quantum number may have a negative value.
 (C) In the ground state of an atom, the orbitals are filled in order of their increasing energies.
 (D) The total number of nodes are given by $n - 2$.
 Choose the most appropriate answer from the options given below :
 a) (A), (C) and (D) only b) (A) and (B) only
 c) (A) and (C) only d) (A), (B) and (C) only
- Q34** The IUPAC name of the given compound
 is -
 a) 4, 5-Dimethyl-4-octene b) 4, 5-Dimethyl-5-octene
 c) 3, 4-Dimethyl-5-octene d) 2, 3-Dipropyl-2-butene
- Q35** Which is/are incorrect statements ?
 a) diamond is unaffected by conc. acids but graphite reacts with hot conc. HNO_3 forming mellitic acid $\text{C}_6(\text{COOH})_6$
 b) CO is toxic because it forms a complex with haemoglobin in the blood
 c) C_3O_2 , carbon suboxide, is a foul-smelling gas
 d) COCl_2 is called phosphine gas
- Q36** The ionic radii of F^- and O^{2-} respectively are 1.33 \AA and 1.4 \AA , while the covalent radius of N is 0.74 \AA .
 The correct statement for the ionic radius of N^{3-} from the following is :
 a) It is smaller than F^- and N
 b) It is bigger than O^{2-} and F^-
 c) It is bigger than F^- and N, but smaller than of O^{2-}
 d) It is smaller than O^{2-} and F^- , but bigger than of N

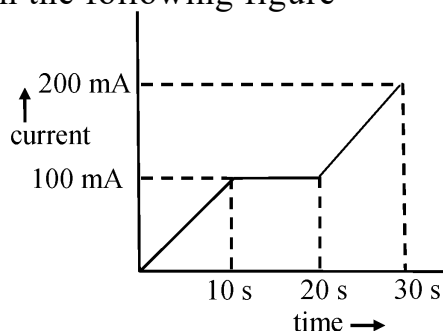
Q37 Identify the incorrect statement from the option below for the above cell:



$$E_{\text{Cu}^{2+}|\text{Cu}}^0 = +0.34 \text{ V}$$

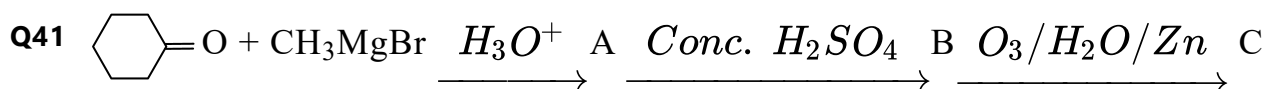
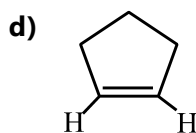
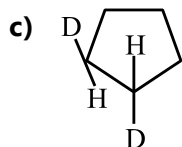
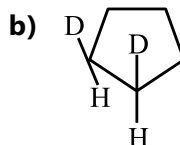
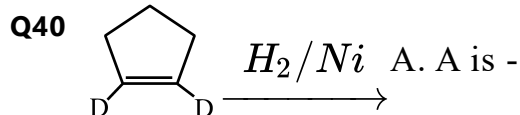
$$E_{\text{Zn}^{2+}|\text{Zn}}^0 = -0.76 \text{ V}$$

- a) If $E_{\text{ext}} < 1.1 \text{ V}$, Zn dissolves at anode and Cu deposits at cathode
 b) If $E_{\text{ext}} = 1.1 \text{ V}$, no flow of e^- or current occurs
 c) If $E_{\text{ext}} > 1.1 \text{ V}$, e^- flows from Cu to Zn
 d) If $E_{\text{ext}} > 1.1 \text{ V}$, Zn dissolves at Zn electrode and Cu deposits at Cu electrode
- Q38** In a Cu-voltameter, mass deposited in 30s is m gm. If the time-current graph is shown in the following figure

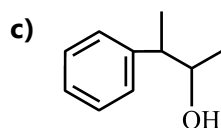
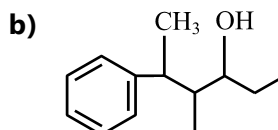
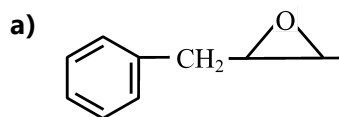
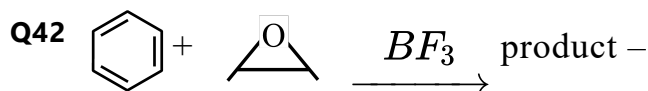
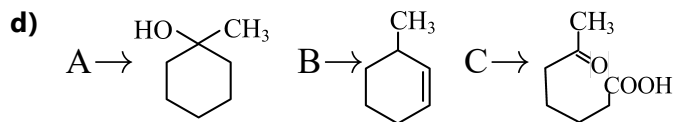
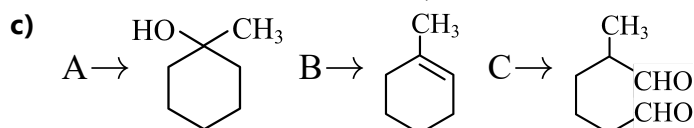
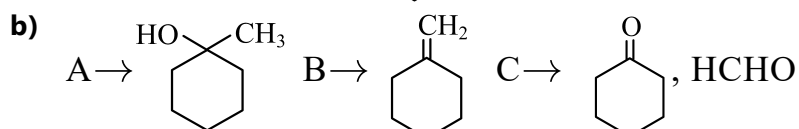
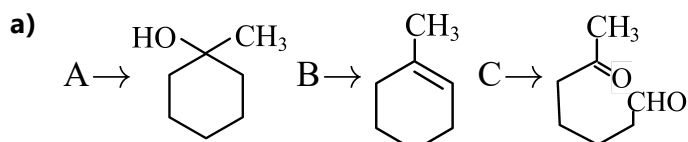


What is the electrochemical equivalent of Cu?

- a) $m/2$ b) $m/3$ c) $m/4$ d) $\frac{m}{63.5}$
- Q39** Which of the following pairs of structures do not represent resonating structures ?
- a) $\text{CH}_3 - \overset{\text{O}}{\parallel} \text{C} - \text{CH}_3$; $\text{CH}_3 - \overset{\text{OH}}{\text{C}} = \text{CH}_2$
- b) $\text{C}_6\text{H}_5\text{CHO}$; $\text{C}_6\text{H}_5\text{O}^-$
- c) $\text{CH}_3 - \overset{\oplus\text{OH}}{\parallel} \text{C} - \text{CH}_3$; $\text{CH}_3 - \overset{\text{OH}}{\text{C}} - \text{CH}_3$
- d) $\text{CH}_3 - \overset{\text{O}}{\parallel} \text{C} - \text{OH}$; $\text{CH}_3 - \overset{\oplus}{\text{C}} = \text{OH}$

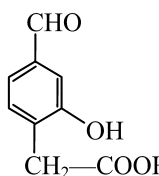


A, B and C are -



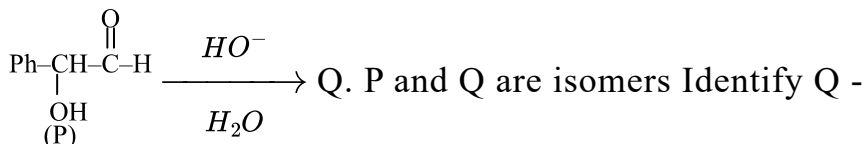
d) none of the above

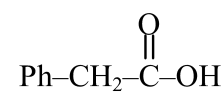
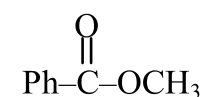
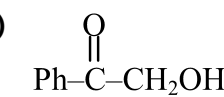
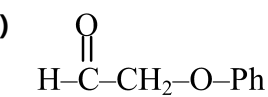
Q43

An organic compound has the structure . It will give

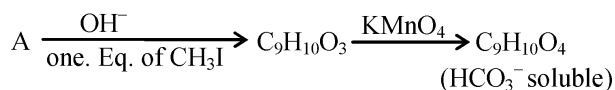
- Red solution with ceric ammonium nitrate test with
- give brisk effervescence with sodium bicarbonate.
- it will give a characteristic colouration with neutral ferric chloride after decarboxylation and reduction by Clemmenson's method.
- Both (2) and (3)

Q44

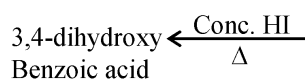


- 
- 
- 
- 

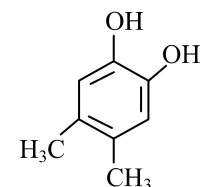
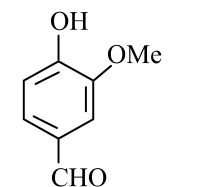
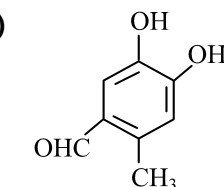
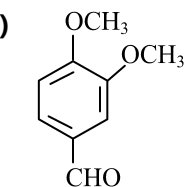
Q45



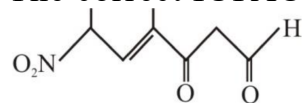
(It gives intense colour with FeCl_3 and Positive Tollen's test)



Starting substrate 'A' is -

- 
- 
- 
- 

Q46 The correct IUPAC name of the following compound is :



- 4-methyl-2-nitro-5-oxohept-3-enal
- 4-methyl-5-oxo-2-nitrohept-3-enal
- 4-methyl-6-nitro-3-oxohept-4-enal
- 6-formyl-4-methyl-2-nitrohex-3-enal

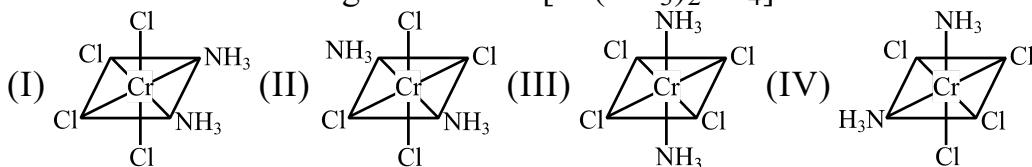
Q47 In which of the following hexose C-4 epimer of D-glucose is

- D-Altrose
- D-mannose
- D-Galactose
- D-fructose

Q48 Which one of the following group-15 hydride is the strongest reducing agent ?

- AsH_3
- BiH_3
- PH_3
- SbH_3

Q49 Consider the following isomers of $[\text{Cr}(\text{NH}_3)_2\text{Cl}_4]^-$



- (I) & (IV) are identical (II) and (III) are also identical
- All have chiral centres
- (I) and (III) are enantiomers
- (II) and (IV) are enantiomers

Q50 Which of the following equations is not correctly formulated ?

- $3\text{Cu} + 8\text{HNO}_3 (\text{dil}) \longrightarrow 3\text{Cu}(\text{NO}_3)_2 + 2\text{NO} + 4\text{H}_2\text{O}$
- $3\text{Zn} + 8\text{HNO}_3 (\text{very dil}) \longrightarrow 3\text{Zn}(\text{NO}_3)_2 + 2\text{NO} + 4\text{H}_2\text{O}$
- $4\text{Sn} + 10\text{HNO}_3 (\text{dil}) \longrightarrow 4\text{Sn}(\text{NO}_3)_2 + \text{NH}_4\text{NO}_3 + 3\text{H}_2\text{O}$
- $\text{As} + 3\text{HNO}_3 (\text{dil}) \longrightarrow \text{H}_3\text{AsO}_3 + 3\text{NO}_2$

Numerical

Q51 The following results were obtained during kinetic studies of the reaction ; $2\text{A} + \text{B} \longrightarrow \text{Products}$

Experiment	[A] (in mol L^{-1})	[B] (in mol L^{-1})	Initial Rate of reaction (in $\text{mol L}^{-1} \text{min}^{-1}$)
I	0.10	0.20	6.93×10^{-3}
II	0.10	0.25	6.93×10^{-3}
III	0.20	0.30	1.386×10^{-2}

The time (in minutes) required to consume half of A is

- 20 ml of 0.1 M H_2SO_4 solution is added to 30 ml of 0.2 M NH_4OH solution. The pH of the resultant mixture is : [pK_b of $\text{NH}_4\text{OH} = 4.7$]
- A solution of sodium sulfate contains 92 g of Na^+ ions per kilogram of water. The molality of Na^+ ions in that solution in mol kg^{-1} is:
- The standard free energy change (ΔG°) for 50% dissociation of N_2O_4 into NO_2 at 27°C and 1 atm pressure is $-x \text{ J mol}^{-1}$. The value of x is _____. (Report Your answer by dividing 10)
[Given : $R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$, $\log 1.33 = 0.1239$ $\ln 10 = 2.3$]
- A process had $\Delta H = 200 \text{ J mol}^{-1}$ and $\Delta S = 40 \text{ JK}^{-1} \text{ mol}^{-1}$. Out of the values given below, choose the minimum temperature (in K) above which the process will be spontaneous.
- The number of f electrons in the ground state electronic configuration of Np ($Z = 93$) is _____.
(Nearest integer)

- Q57** The elevation of boiling point of 0.10 m aqueous $\text{CrCl}_3 \cdot x\text{NH}_3$ solution is two times that of 0.05 m aqueous CaCl_2 solution. The value of x is _____.
[Assume 100% ionisation of the complex and CaCl_2 , coordination number of Cr as 6, and that all NH_3 molecules are present inside the coordination sphere]
- Q58** How many benzanoid Structure isomers possible for $\text{C}_7\text{H}_8\text{O}$
- Q59** Oxalic acid is a dibasic acid with dissociation constants $\text{pK}_{a1} = 1.2$ & $\text{pK}_{a2} = 4.2$. 20 cm^3 of 0.05 M of this acid was treated with 30 cm^3 of 0.1 M NaOH & final pH was x . On further addition of 10 ml of 0.1 M H_2SO_4 to solution pH became y . Find difference $(x - y)$. (Nearest Integer)
- Q60** 100 mL of Na_3PO_4 solution contains 3.45 g of sodium. The molarity of the solution is $\frac{\quad}{31.0} \times 10^{-2} \text{ mol L}^{-1}$. (Nearest integer) [Atomic Masses - Na : 23.0 u, O : 16.0 u, P : 31.0 u]

Mathematics

Single Choice Question

- Q61** If A is a symmetric matrix and B is a skew-symmetric matrix such that $A+B = \begin{bmatrix} 2 & 3 \\ 5 & -1 \end{bmatrix}$, then AB is equal to :
- a) $\begin{bmatrix} 4 & -2 \\ 1 & -4 \end{bmatrix}$ b) $\begin{bmatrix} 4 & -2 \\ -1 & -4 \end{bmatrix}$ c) $\begin{bmatrix} -4 & -2 \\ -1 & 4 \end{bmatrix}$ d) $\begin{bmatrix} -4 & 2 \\ 1 & 4 \end{bmatrix}$
- Q62** Let α be the angle between the lines whose direction cosines satisfy the equations $l + m - n = 0$ and $l^2 + m^2 - n^2 = 0$. Then the value of $\sin^4 \alpha + \cos^4 \alpha$ is :
- a) $\frac{3}{4}$ b) $\frac{3}{8}$ c) $\frac{5}{8}$ d) $\frac{1}{2}$
- Q63** If $x \in \left(\frac{3\pi}{2}, 2\pi\right)$ then value of the expression $\sin^{-1}(\cos(\cos^{-1}(\cos x) + \sin^{-1}(\sin x)))$ equals
- a) $-\frac{\pi}{2}$ b) $\frac{\pi}{2}$ c) 0 d) None
- Q64** The set of all values of λ for which the equation $\cos^2 2x - 2 \sin^4 x - 2 \cos^2 x = \lambda$
- a) $[-2, -1]$ b) $\left[-2, -\frac{3}{2}\right]$ c) $\left[-1, -\frac{1}{2}\right]$ d) $\left[-\frac{3}{2}, -1\right]$
- Q65** Which is the correct order for a given number $\alpha > 1$ in increasing order ?
- a) $\log_2 \alpha, \log_3 \alpha, \log_e \alpha, \log_{10} \alpha$ b) $\log_{10} \alpha, \log_3 \alpha, \log_e \alpha, \log_2 \alpha$
c) $\log_{10} \alpha, \log_e \alpha, \log_2 \alpha, \log_3 \alpha$ d) $\log_3 \alpha, \log_e \alpha, \log_2 \alpha, \log_{10} \alpha$
- Q66** The equation of straight line equally inclined to the axes and equidistant from the point $(1, -2)$ and $(3, 4)$ is -
- a) $x + y = 1$ b) $y - x - 1 = 0$ c) $y - x = 2$ d) $y - x + 1 = 0$
- Q67** Let $f: \mathbb{R} \rightarrow \mathbb{R}$ be defined as $f(x) = \begin{cases} -\frac{4}{3}x^3 + 2x^2 + 3x, & x > 0 \\ 3xe^x, & x \leq 0 \end{cases}$. Then f is increasing function in the interval
- a) $\left(-\frac{1}{2}, 2\right)$ b) $(0, 2)$ c) $\left(-1, \frac{3}{2}\right)$ d) $(-3, -1)$
- Q68** If the shortest distance between the lines $\frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{\lambda}$ and $\frac{x-2}{1} = \frac{y-4}{4} = \frac{z-5}{5}$ is $\frac{1}{\sqrt{3}}$, then the sum of all possible values of λ is :
- a) 16 b) 6 c) 12 d) 15
- Q69** The number of rational points on the ellipse $\frac{x^2}{9} + \frac{y^2}{4} = 1$ is -
- a) ∞ b) 4 c) 0 d) 2

- Q70** If $f(x)$ is an even function and satisfies the relation $x^2 f(x) - 2f\left(\frac{1}{x}\right) = g(x)$ where $g(x)$ is an odd function then $f(5)$ equals
 a) 0 b) $\frac{50}{75}$ c) $\frac{49}{75}$ d) None of these
- Q71** $\lim_{x \rightarrow 0} \frac{(2^{\sin x} - 1)[\ln(1 + \sin 2x)]}{x \tan^{-1} x}$ is equal to
 a) $\ln 2$ b) $2 \ln 2$ c) $(\ln 2)^2$ d) 0
- Q72** $\lim_{x \rightarrow 0} \frac{1}{x^5} \int_0^x e^{-t^2} dt - \frac{1}{x^4} + \frac{1}{3x^2}$ is equal to
 a) 1 b) $3/5$ c) $1/2$ d) $3/10$
- Q73** $\int \frac{\sec x \cdot \operatorname{cosec} x}{2 \cot x - \sec x \operatorname{cosec} x} dx$ is equal to-
 a) $\frac{1}{2} \ln |\sec 2x + \tan 2x| + C$ b) $\ln |\sec x + \operatorname{cosec} x| + C$
 c) $\ln |\sec x + \tan x| + C$ d) $\frac{1}{2} \ln |\sec x + \operatorname{cosec} x| + C$
- Q74** If $I_{10} = \int_0^{\pi/2} x^{10} \sin x dx$, then $I_{10} + 90 I_8$ is
 a) $10 (\pi/2)^6$ b) $10 (\pi/2)^9$ c) $10 (\pi/2)^8$ d) $10 (\pi/2)^7$
- Q75** The solution of $\frac{x^3 dx + yx^2 dy}{\sqrt{x^2 + y^2}} = y dx - x dy$ is:
 a) $\sqrt{x^2 + y^2} = Cx$ b) $\sqrt{x^2 + y^2} + y/x = C$
 c) $\sqrt{x^2 + y^2} + y/x^2 = C$ d) $(x^2 + y^2)^2 + xy^2 = C$
- Q76** The least positive integer n for which $\left(\frac{1+i}{1-i}\right)^n = \frac{2}{\pi} \left(\sec^{-1} \frac{1}{x} + \sin^{-1} x\right)$ (where $x \neq 0$; $-1 \leq x \leq 1$) is
 a) 2 b) 4 c) 6 d) 8
- Q77** A letter is known to have come from either TATANAGAR or CALCUTTA. On the envelope, just two consecutive letters TA are visible. The probability that the letter has come from CALCUTTA is
 a) $4/11$ b) $1/3$ c) $5/12$ d) None of these
- Q78** If three linear equations $x + 4ay + az = 0$, $x + 3by + bz = 0$ and $x + 2cy + cz = 0$ have a non-trivial solution, then a, b, c are in-
 a) H.P. b) G.P. c) A.P. d) None
- Q79** Let a, b, c be distinct non-negative numbers and the vectors $a\hat{i} + a\hat{j} + c\hat{k}$, $\hat{i} + \hat{k}$, $c\hat{i} + c\hat{j} + b\hat{k}$ lie in a plane, then the quadratic equation $ax^2 + 2cx + b = 0$ has -
 a) real and equal roots b) real unequal roots
 c) unreal roots d) both roots real and positive

- Q80** If for some $x \in \mathbb{R}$, the frequency distribution of the marks obtained by 20 students in a test is :

Marks	2	3	5	7
Frequency	$(x+1)^2$	$2x-5$	x^2-3x	x

Then the mean of the marks is :

- a) 3.2 b) 3.0 c) 2.5 d) 2.8

Numerical

- Q81** The number of ordered pairs (r, k) for which $6 \cdot {}^{35}C_r = (k^2 - 3) \cdot {}^{36}C_{r+1}$, where k is an integer, is
- Q82** If the sum of the first 40 terms of the series, $3 + 4 + 8 + 9 + 13 + 14 + 18 + 19 + \dots$ is $(102)m$, then m is equal to
- Q83** The greatest positive integer k , for which $49^k + 1$ is a factor of the sum $49^{125} + 49^{124} + \dots + 49^2 + 49 + 1$, is
- Q84** Let α and β be two real roots of the equation $(k+1)\tan^2 x - \sqrt{2} \cdot \lambda \tan x = (1-k)$, where $k (\neq -1)$ and λ are real numbers. If $\tan^2(\alpha + \beta) = 50$, then a value of λ is :
- Q85** Let $P(a_1, b_1)$ and $Q(a_2, b_2)$ be two distinct points on a circle with center $C(\sqrt{2}, \sqrt{3})$. Let O be the origin and OC be perpendicular to both CP and CQ . If the area of the triangle OCP is $\frac{\sqrt{35}}{2}$, then $a_1^2 + a_2^2 + b_1^2 + b_2^2$ is equal to _____.
- Q86** If $y(\alpha) = \sqrt{2 \left(\frac{\tan \alpha + \cot \alpha}{1 + \tan^2 \alpha} \right) + \frac{1}{\sin^2 \alpha}}$, $\alpha \in \left(\frac{3\pi}{4}, \pi \right)$ then $\frac{dy}{d\alpha}$ at $\alpha = \frac{5\pi}{6}$ is
- Q87** Let $f(x)$ be a polynomial of degree 3 such that $f(-1) = 10$, $f(1) = -6$, $f(x)$ has a critical point at $x = -1$, and $f'(x)$ has a critical point $x = 1$. Then $f(x)$ has a local minima at $x =$ _____.
- Q88** $\lim_{x \rightarrow 0} \frac{\int_0^x t \sin(10t) dt}{x}$ is equal to
- Q89** Number of solution of equation $|x-1| = e^x$ is-
- Q90** The sum of the factor of $8!$ which are odd and are of the form $(3m+2)$ where $m \in \mathbb{N}$, is

Answer Key

Que.	1	2	3	4	5	6	7	8	9	10
Ans.	A	C	C	A	B	B	D	A	A	A
Que.	11	12	13	14	15	16	17	18	19	20
Ans.	C	B	C	A	A	B	C	D	A	C
Que.	21	22	23	24	25	26	27	28	29	30
Ans.	10	2	2	5	1	30	3	120	45	82
Que.	31	32	33	34	35	36	37	38	39	40
Ans.	B	C	D	A	D	B	D	B	A	B
Que.	41	42	43	44	45	46	47	48	49	50
Ans.	A	C	D	C	B	C	C	B	A	B
Que.	51	52	53	54	55	56	57	58	59	60
Ans.	5	9	4	71	5	18	5	5	10	50
Que.	61	62	63	64	65	66	67	68	69	70
Ans.	B	C	B	D	B	D	C	A	A	A
Que.	71	72	73	74	75	76	77	78	79	80
Ans.	B	D	A	B	B	B	A	A	A	D
Que.	81	82	83	84	85	86	87	88	89	90
Ans.	4	20	63	10	24	4	3	0	1	40