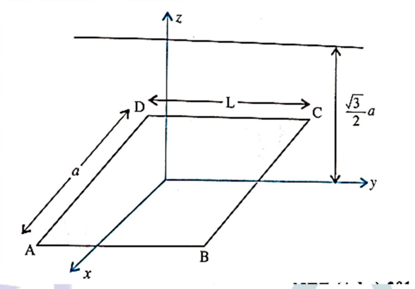
NEW STANDARD ACADEMY

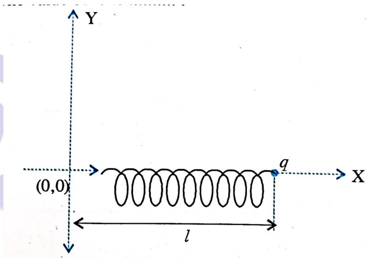
Date : 15-07-24 **CLASS : 12^{TH} JEE** **Marks: 60** **Time: 3 HRS**

PHYSICS

1. An infinitely long uniform charge distribution of per unit length λ lies parallel to the y-axis in the y-z plane at z = $\frac{\sqrt{3}}{2}$a(see Fig.) If the magnitude of the flux of the field through the rectangular surface ABCD lying in the x-y plane with its centre at the origin is $\lambda L/(n\,\epsilon_0)$ (ϵ_0 = permittivity of free space), then the value of n is



2. A circular disc of radius R carries surface charge density $\sigma(r) = \left(1 - \frac{r}{R}\right)$where σ_0 is constant and r is the distance from the centre of the disc. Electric flux through a large spherical surface that encloses the charged disc completely is ϕ_0. Electric flux through another spherical surface of radius $\frac{R}{4}$ and concentric with the disc is ϕ. Then the ratio $\frac{\phi_0}{\phi}$ is………………..
3. One end of a spring of negligible unstretched length and spring constant k is fixed at the origin (0, 0). A point particle of mass m carrying a positive charge q is attached at its other end. The entrie system is kept on a smooth horizontal surface. When a point dipole $\vec{p}$ pointing towards the charge q is fixed at the origin, the spring gets stretched to a length l and attains a new equilibrium positive (see figure below). If the point mass is now displaced slightly by $\Delta l << l$ from its equilibrium position and released, it is found to oscillate at frequency $\frac{1}{\delta}\sqrt{\frac{k}{m}}$ The value of δ is..........



4. A charge 'q' is placed at the centre of the line joining two equal charges 'Q'. The system of the three charges will be in equilibrium if q is equal to
5. Two spheres having same radius and mass are suspended by two strings of equal length from the same point, in such a way that their surface touch each other. On depositing charge 4×10^{-6} C on them they repel each other in such a way that in equilibrium the angle between their strings become 60°. If the distance from the point of suspension to the centre of the sphere is 10 cm. Find the mass of each sphere
6. Two charges -q and+q are located at points A(0, 0, - a) and B(0, 0, a) respectively. How much work is done in moving a test charge from point P (7, 0, 0) to Q(- 3, 0, 0) ?
7. Eight charged water droplets, each with a radius of 1 mm and charge 10^{-9} C coalesce to form a single drop. Calculate potential of bigger drop.
8. n small drops of same size are charged to V volt each. They coalesce to form a bigger drop. Calculate potential of bigger drop.
9. To what potential we must charge an insulated sphere of radius 14 cm so that the surface charge density is equal to $1\mu Cm^{-2}$?
10. 6. A short dipole is of electric dipole moment of 4×10^{-9} Cm. Determine the electric potential due to the dipole at a

point distance 0.3 m from the centre of dipole situated (a) on the axial line (b) on the equatorial line (c) on a line making an angle of 60° with the dipole axis.

CHEMISTRY

1. Calculate the degree of dissociation of 1.25% NaCl aqueous solution which is isotonic with 7.5% aqueous solution of glucose. Percentage given is by mass/volume
2. Phenol associates in benzene to form dimer. A solution containing 20×10^{-3} kg of phenol in 1kg of benzene has its freezing point depressed by 0.69K. If K_f for benzene is 5.12 K kg/mol, what is the degree of association of phenol?
3. Calculate the mass of a non-volatile solute (molar mass 40g mol^{-1}) which should be dissolved in 114g octane to reduce its vapour pressure to 80%.
4. A conductivity cell contains two electrodes. The area of each electrode is $10cm^2$ and are 1.5 cm apart. Conductivity cell is filled with N/20 solution of an electrolyte. If the electrodes are exactly half-dipped in the solution, find the equivalent conductivity of the electrolyte. The resistance of the solution determined is 50 ohms.
5. A copper-silver cell is set up. The copper ion concentration in it is 0.10 M. The concentration of silver ion is not known. The cell potential measured 0.422 V. Determine the concentration of silver ion in the cell. (Given $E^0_{Ag^+/Ag}$= +0.80V, $E^0_{Cu^{2+}/Cu}$= +0.34V)
6. Rate constant for first order reaction is 5.78×10^{-5} sec^{-1} .What % of initial reactant will react in 10 hours?
7. The reaction $SO_2Cl_2 \xrightarrow{k_1} SO_2 + Cl_2$ is a first order reaction with $k_1 = 2.2\times10^{-5}$ sec^{-1} at 575 K. What percentage of SO_2Cl_2 will get decomposed in 90 minutes when the reaction is carried out at 575 K?
8. The rate constant at 427°C is 2 $second^{-1}$. The activation energy is 129.1 kJ/mol. Calculate the rate constant at 527°C
9. E° for Mn^{3+}/Mn^{2+} couple is much more + ve than for Fe^{3+}/Fe^{2+} Why?
10. (a) Complete the following chemical reactions:
    (i) $Na_2Cr_2O_7 + KCl \rightarrow$
    (ii) $2MnO_4^- + 5SO_3^{2-} + 6H^+ \rightarrow$
    (b) How does the colour of $Cr_2O_7^{2-}$ change when treated with an alkali?

MATHS

1. Show that the relation in the set N×N defined by (a,b) R(c,d) iff $a^2+d^2 = b^2+c^2$ for all a,b,c ,d ∈ N is an equivalence relation.
2. Prove that a function $f\,[0,\infty) \rightarrow [-5,\infty)$ defined as $f(x) = 4x^2+4x-5$ is both one –one and onto.
3. Find the domain function :- $\sin^{-1}(x^2-4)$.
4. Evaluate $\sin^{-1}\left(\sin\frac{3\pi}{4}\right) + \cos^{-1}\left(\cos\frac{3\pi}{4}\right) + \tan^{-1}(1)$
5. If A is a square matrix such that $A^2 = A$, then find the value of $7A-(I+A)^3$,where I is the identity matrix
6. If $A=\begin{bmatrix}-1 & 2\\ 3 & 1\end{bmatrix}$, find $f(A)$,where $f(x) = x^2-2x-3$
7. If A and B are symmetric matrices such that AB and BA are both defined, then prove that AB – BA is a skew – symmetric matrix.
8. If $A=\begin{bmatrix}-3 & -2 & -4\\ 2 & 1 & 2\\ 2 & 1 & 3\end{bmatrix}, \begin{bmatrix}1 & 2 & 0\\ -2 & -1 & -2\\ 0 & -1 & 1\end{bmatrix}$ then find AB and use it to solve the following system of equations : $x-2y=3; 2x-y-z=2; -2y+z=3.$
9. If the function f defined by $f(x) = \begin{cases} 3ax+b, & if\ x>1\\ 11, & if\ x=1\\ 5ax-2b, & if x<1\end{cases}$ is continuous at x = 1, find the values of a and b.
10. If $y=(\sin x)^x + (\cos x)^{\tan x}$, find $\frac{dy}{dx}$