

NEW STANDARD ACADEMY

Marks: 60

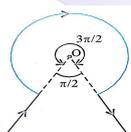
Date : 30-06-25

CLASS : 12TH JEE

Time: 3 hours.

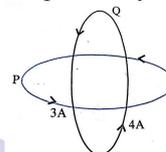
PHYSICS

- Three charges $-q, +Q$ and $-q$ are placed at equal distances on a straight line. If the potential energy of the system of three charge is zero, find the ratio $\frac{Q}{q}$.
- An electric dipole of length 2 cm is placed with its axis making an angle 60° to a uniform electric field of 10^5 NC^{-1} . If it experiences a torque of $8\sqrt{3} \text{ Nm}$. Calculate
(a) Magnitude of the charge on dipole.
(b) potential energy of dipole.
- N drop of mercury of equal radii and possessing equal combine to form a big drop. Compare the charge, capacitance and potential of bigger drop with the corresponding quantities of individual drops.
- A capacitor of unknown capacitance is connected across a battery of V volts. A charge of $120 \mu\text{C}$ is stored in it. When the potential across the capacitor is reduced by 40V, the charge stored in the capacitor becomes $40 \mu\text{C}$. Calculate V and the unknown capacitance. What would have been charge in the capacitor if the voltage is increased by 40 V?
- A variable capacitor has n plates and the distance between two successive plates is d . determine its capacitance.
- The magnetic field due to a current carrying circular loop of radius 12 cm at its centre is $1.5 \times 10^{-4} \text{ T}$. Find the magnetic field due to this loop at a point on the axis at a distance 5 cm from the Centre.
- The wire shown in the figure carries a current of 10A. Determine the magnitude of magnetic field at the centre O. Given radius of bent coil is 3 cm.



- Two identical loops P and Q each of radius 5 cm are lying in perpendicular planes such that they have a common Centre as shown. Find the magnitude and direction of the net magnetic field at the common centre of two

coils, if the coils carry currents equal to 3 A and 4 A respectively.



- A straight thick long wire of uniform area of cross-section of radius a is carrying a steady current I . Calculate the ratio of magnetic field at a point $a/2$ above the surface of wire to that at a point $a/2$ below its surface. What is the maximum value of field of this wire?
- A charge particle of charge $2.0 \mu\text{C}$ Moving along x - axis with a speed of $3 \times 10^6 \text{ m s}^{-1}$ enters a magnetic field, $\vec{B} = (0.03\hat{j} + 0.4\hat{k}) \text{ T}$ acting in space. What is the magnitude of magnetic force on charged particle

CHEMISTRY

- State and explain Raoult's Law for a binary solution of two volatile liquids.
- Differentiate between molarity and mole fraction. Which one is temperature-dependent and why?
- Why is the elevation in boiling point a colligative property? Give the mathematical expression.
- What is the relationship between Gibbs free energy (ΔG) and cell potential (E_{cell})? Give the formula.
- Why does conductivity of a solution decrease with dilution, but molar conductivity increases?
- Calculate the molar conductivity of a solution if conductivity (κ) = $1.5 \times 10^{-2} \text{ S cm}^{-1}$ and concentration = 0.05 mol L^{-1} .
- Calculate the emf of a cell at 298 K:
 $\text{Zn} | \text{Zn}^{2+} (0.1 \text{ M}) || \text{Cu}^{2+} (1 \text{ M}) | \text{Cu}$
($E^\circ_{\text{cell}} = 1.10 \text{ V}$)
(Use Nernst equation and $\log 10 = 1$)
- For a reaction, the rate is given by $\text{Rate} = k[\text{A}][\text{B}]^2$. What will be the effect on the rate if:
(a) $[\text{A}]$ is doubled, (b) $[\text{B}]$ is halved?
- For a first-order reaction, the time taken to reduce the concentration to half is constant. Prove it mathematically.
- The rate constant of a reaction doubles when temperature increases from 300 K to 310 K.

Calculate the activation energy (E_a). ($R = 8.314 \text{ J/mol}\cdot\text{K}$)

MATHS

1. Show that the relation R in the set \mathbb{R} of real numbers, defined as $R = \{(a,b) : a \leq b^2\}$ is neither reflexive nor symmetric nor transitive.
2. Check the injectivity and surjectivity of the following functions:
 - (i) $f: \mathbb{N} \rightarrow \mathbb{N}$ given by $f(x) = x^2$
 - (ii) $f: \mathbb{Z} \rightarrow \mathbb{N}$ given by $f(x) = x^2$
3. Let $A = \{1,2,3\}$, $B = \{4,5,6,7\}$ and let $f = \{(1,4), (2,5), (3,6)\}$ be a function from A to B . Show that f is one-one.
4. The domain of the function $F(x) = \sqrt{x - x^2} + \sqrt{4 + x} + \sqrt{4 - x}$ is
5. Range of $f(x) = \frac{x^2 + 34x - 71}{x^2 + 2x - 7}$ is
6. The number of relations on the set $A = \{1,2,3\}$ containing at most 6 elements including $(1,2)$, which are reflexive and transitive but not symmetric is
7. If $f(x)$ is an odd function such that $f(1) = a$, and $f(x+2) = f(x) + f(2)$ then the value of $f(3)$ is
8. Let $f: g(1, \infty) \rightarrow \mathbb{R}$ be defined as $f(x) = \frac{2x+3}{5x+2}$ and $g(x) = \frac{2-3x}{1-x}$. If the range of the function $f \circ g: [2,4] \rightarrow \mathbb{R}$ is $[\alpha, \beta]$, the $\frac{1}{\beta - \alpha}$ is equal to
9. Using principal values, find the values of:
 - (i) $\cos^{-1}\left(\frac{1}{2}\right) - 2\sin^{-1}\left(-\frac{1}{2}\right)$
 - (ii) $\tan^{-1}(\sqrt{3}) - \cot^{-1}(\sqrt{3})$
10. Find the domain of $f(x) = \sin^{-1}(x^2 - 4)$. Also find its range