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2020-2021

XII - Physics

Unit 10, 27

Answer the following

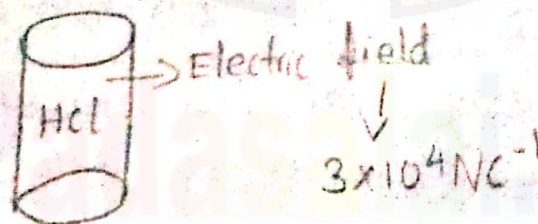
1. What is electric dipole?

* Two equal and opposite charges separated by a small distance constitute an electric dipole.

* Eg: CO, water, HCl, ammonia etc...

* The SI unit of electric dipole moment is coulomb metre (Cm).

2. A sample of HCl gas is placed in a uniform electric field of magnitude $3 \times 10^4 \text{ NC}^{-1}$. The dipole moment of each HCl molecule is 3.4×10^{-30} Cm. Calculate the maximum torque experienced by each HCl molecule.



$$\text{Dipole moment (P)} = 3.4 \times 10^{-30}$$

$$\text{torque (T)} \quad T = PE \sin \theta$$

$$T = PE \sin \theta$$

$P \rightarrow$ Electron dipole moment
 $E \rightarrow$ Electric field

Electric field (E)

$$\tau = P E \sin \theta$$

$$\theta = 90^\circ / \sin 90^\circ$$

$$\tau = (3.4 \times 10^{-30}) \times (3 \times 10^4) \times 1$$

$$\tau = (3.4 \times 10^{-30} \times 3 \times 10^4)$$

$$\tau = 10.2 \times 10^{-26} \text{ Nm}$$

3. What is dielectrics?

* A dielectrics is a non-conducting material and has no free electrons. The electrons in a dielectrics are bound within the atoms.

* Eg; Ebonite, Mica, glass, are some example for dielectrics.

4. What is capacitance? Give its unit

* The capacitance of the capacitor C is defined as the ratio of the magnitude of charges on either of the conductor plates to the potential difference existing between them.

$$C = \frac{q}{V}$$

* Its SI unit is coulomb per volt (or) farad.

6. State ohm's law.

* The resistance is the ratio of the potential difference across the given conductor to the current passing through conductor.

$$R = \frac{V}{I}$$

* The SI unit of resistance is ohm Ω .

7. To find the value of resistance

i) Green, blue, orange Gold

$$56000 \Omega \pm 5\%$$

$$56 \times 10^3 \Omega \pm 5\%$$

$$56k\Omega \pm 5\%$$

8. To find the value of resistance

i) orange, orange, orange

$$33000 \Omega \pm 20\%$$

$$33 \times 10^3 \Omega \pm 20\%$$

$$33k\Omega \pm 20\%$$

9. To find the value of resistance

ii) violet, blue, orange silver

$$76000 \Omega \pm 10\%$$

$$76 \times 10^3 \Omega \pm 10\%$$

$$76k\Omega \pm 10\%$$

10. If the resistance of coil is 3Ω at 20°C and $\alpha = 0.004/^\circ\text{C}$ then determine its resistance at 100°C .

$$\alpha = 0.004/^\circ\text{C}$$

$$R_0 = 3\Omega$$

$$T_0 = 20^\circ\text{C}$$

$$T = 100^\circ\text{C}$$

$$R_T = ?$$

$$R_T = R[1 + \alpha(T - T_0)]$$

$$R_T = R[1 + \alpha(T - T_0)]$$

$$R_T = 3[1 + 0.004(100 - 20)]$$

$$R_T = 3[1 + 0.004(80)]$$

$$R_T = 3[1 + 0.32]$$

$$R_T = 3[1.32]$$

$$R_T = 3.96\Omega$$

11. Joules Law?

* The heat developed in an electric circuit due to the flow of current varies directly as

- * The square of the current
- * The resistance of the circuit
- * and the time of flow.

2. Find the heat energy produced in a resistance of 10Ω when 5A current flows through it for 5 minutes.

$$R = 10 \Omega$$

$$I = 5 A$$

$$t = 5 \text{ minutes} \rightarrow 5 \times 60$$

$$H = I^2 R t$$

$$H = 5^2 \times 10 \times 5 \times 60$$

$$H = 25 \times 10 \times 300$$

$$H = 25 \times 3000$$

$$H = 75000$$

$$H = 75 \text{ kJ}$$

13. Define peltier effect?

* When an electric current is passed through a circuit of a thermocouple, heat is evolved at one junction and absorbed at the other junction. This is known as peltier effect.

14. What is magnetic dipole moment?

* The magnetic dipole moment is defined as the product of its pole strength and magnetic length.

* It is vector quantity denoted by $\vec{P}_m$.

The repulsive force between two magnetic poles in air is $9 \times 10^{-3} \text{ N}$. If the two poles are equal in strength and are separated by a distance of 10 cm , calculate the pole strength of each pole.

Repulsive force

$$F = 9 \times 10^{-3} \text{ N}$$

Two poles

$$q_{mA} \ q_{mB} = q_m \ q_m = q_m^2 \text{ are equal}$$

$$\text{distance} = 10 \text{ cm} = 10 \times 10^{-2} \text{ m}$$

$$r = 10 \times 10^{-2} \text{ m}$$

Pole strength of each pole

$$F = k \frac{q_{mA} q_{mB}}{r^2}$$

$k \rightarrow$ constant

$F \rightarrow$ Force

$q_{mA} q_{mB} \rightarrow$ Two magnetic pole

$r \rightarrow$ distance

$$F = k \frac{q_{mA} q_{mB}}{r^2}$$

$$k = 1$$

$$F = 9 \times 10^{-3} \text{ N}$$

$$r = 10 \times 10^{-2}$$

$$q_{mA} q_{mB} = q_m^2$$

$$9 \times 10^{-3} = (1) \frac{q_m^2}{(10 \times 10^{-2})^2}$$

$$9 \times 10^{-3} = \frac{q_m^2}{(10)^2 \times (10^{-2})^2}$$

$$9 \times 10^{-3} = \frac{q_m^2}{100 \times 10^{-4}}$$

$$k = \frac{\mu_0}{4\pi}$$

$k \rightarrow$ constant

$\mu_0 \rightarrow$ permeability of free space

$$\mu_0 = 4\pi \times 10^{-7} \text{ h/m}$$

$$k = \frac{\mu_0}{4\pi}$$

$$k = \frac{4\pi \times 10^{-7}}{4\pi}$$

$$k = 10^{-7} \text{ h/m}$$

$h \rightarrow$ henry

$m \rightarrow$ metre

$$F = k \frac{q_1 q_2}{r^2}$$

$$9 \times 10^{-3} = \frac{10^{-7} q_1 q_2}{100 \times 10^{-4}}$$

$$9 \times 10^{-3} \times 100 \times 10^{-4} = 10^{-7} \times q_1 q_2$$

$$900 \times 10^{-3} \times 10^{-4} = 10^{-7} \times q_1 q_2$$

$$900 \times 10^{-7} = 10^{-7} \times q_1 q_2$$

$$900 = q_1 q_2$$

$$\sqrt{900} = q_1 q_2$$

$$\sqrt{30 \times 30} = q_1 q_2$$

$$30 = q_1 q_2$$

$$q_1 q_2 = 30 \text{ NT}^{-1} \quad T \rightarrow \text{Tesla}$$

5. What is electric current?

*If a net charge Q passes through any cross section of a conductor in time t , then the current is defined as $I = \frac{Q}{t}$.

*The SI unit of electric current is Ampere (A).

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