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Quick Review of Unit 01

- **ELECTRIC FIELD DUE TO A DIPOLE** at a point on the axial lines, $E_{axial} = 2E_{equatorial}$, where $E_{equatorial}$ is the electric field due to the dipole at a point on the equatorial line.
- **TORQUE ON A DIPOLE IN A UNIFORM ELECTRIC FIELD** Torque $(\vec{\tau})$ acting on electric dipole of dipole moment $(\vec{p})$ placed in a uniform electric field $(\vec{E})$ is given by $\vec{\tau} = \vec{p} \times \vec{E}$ or $\tau = pE \sin\theta$, where θ is the angle between $\vec{p}$ and $\vec{E}$.
- **ELECTRIC POTENTIAL ENERGY OF ELECTRIC DIPOLE** of dipole moment $\vec{p}$ in a uniform electric field $\vec{E}$ is given by, $U = -pE\cos\theta = -\vec{p}\cdot\vec{E}$.
- **ELECTRIC FLUX** through a surface is defined as the total number of electric field lines passing through the surface.
- Electric flux (ϕ) through a surface of area S in the electric field is given by, $\phi = \int_S \vec{E}\cdot d\vec{S} = \int_S E\, dS\cos\theta$,

  where θ is the angle between $\vec{E}$ and $d\vec{S}$.
- S.I. unit of electric flux is $N\ m^2\ C^{-1}$.
- **GAUSS' LAW.** It states that the total electric flux ϕ through any closed surface (S) in free space is equal to $\frac{1}{\epsilon_0}$ times the charge q enclosed by the surface

  i.e.,
  $$\phi = \oint_S \vec{E}.d\vec{S} = \frac{q}{\epsilon_0}$$
- If a closed surface encloses net electric charge q, then the Gauss' law becomes,
  $$\phi = \oint_S \vec{E}.d\vec{S} = 0$$
- If a closed surface encloses number of charges, then the Gauss' law becomes,
  $$\phi = \oint_S \vec{E}.d\vec{S} = \frac{\sum_{i=1}^{n} q_i}{\epsilon_0}$$
- Gaussian surface is an imaginary closed surface containing electric charges such that the electric field intensity at all points on its surface is same.
- Electric field intensity due to an infinitely long straight uniformly charged wire at a distance r from the wire is given by,
  $$E = \frac{\lambda}{2\pi\epsilon_0 r} = \frac{2\lambda}{4\pi\epsilon_0 r},$$
  where λ is the linear charge density of the charged wire.
- **ELECTRIC FIELD INTENSITY DUE TO A UNIFORMLY CHARGED INFINITE SHEET** at a distance r is given by
  $$E = \frac{\sigma}{2\epsilon_0}$$
  where σ is the surface charge density of the charged sheet.

NOTE *Electric field intensity, due to a uniformly char[illegible]finite sheet E is independent of the distance of the point of observation.*

- Electric field intensity between two equally and oppositely charged parallel sheets, $E = \frac{\sigma}{\epsilon_0}$
- **ELECTRIC FIELD INTENSITY DUE TO A UNIFORMLY CHARGED THIN SPHERICAL SHELL (a HOLLOW SPHERE)**

Electric Field Inside. Field at a point inside the shell ($r < R$)is given by,

$$E = 0$$

Electric Field Outside. Field at a distance $r > R$ (where R is the radius of the sphere) is given by,

$$E = \frac{1}{4\pi\epsilon_0}\frac{q}{r^2}$$

Electric Field at a point on the sphere of the shell ($r = R$) is given by,

$$E = \frac{1}{4\pi\epsilon_0}\frac{q}{R^2} = \frac{\sigma}{\epsilon_0}$$

- Variation of electric field intensity E due to the uniformly charged spherical shell (of radius R) with distance r from the centre O of the shell is shown in the figure 68.
- **ELECTRIC FIELD INTENSITY DUE TO A UNIFORMLY CHARGED SOLID SPHERE**

(i) At a point outside the sphere, $E = \frac{1}{4\pi\epsilon_0}\frac{q}{r^2}$ q is the charge on the sphere and r is the distance of point outsi

the sphere from the centre of the sphere.

(ii) At the point on the surface of the sphere, $E = \frac{1}{4\pi\epsilon_0}\frac{q}{r^2}$, where R is the radius of the sphere.

(iii) At a point inside the surface of the sphere, $E = \frac{1}{4\pi\epsilon_0}\frac{qr}{R^3}$

Note-From tomorrow questions in different pattern will be given based on 1st lesson of the 1st unit.