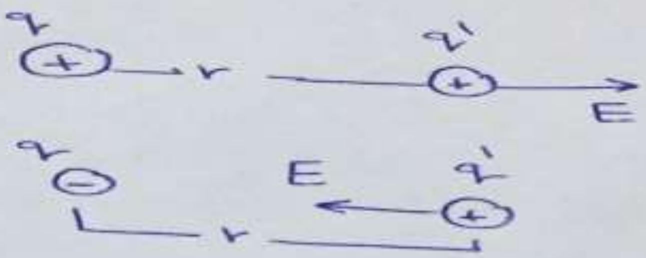
lecture -3-

Calculation of electric field intensity

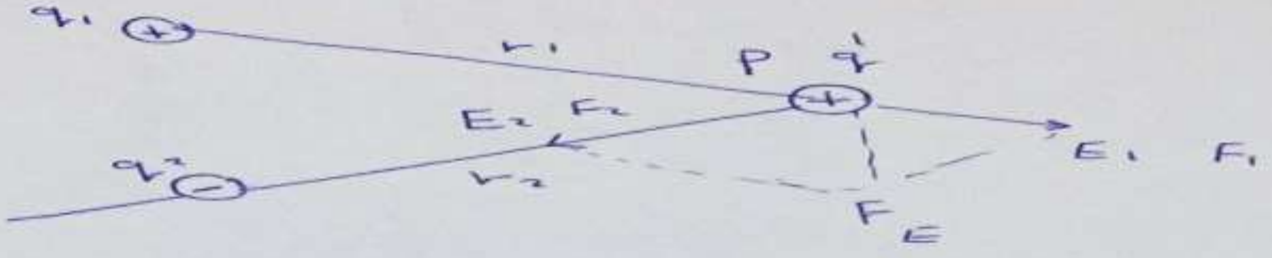
$$F = k\frac{qq'}{r^2} = \frac{1}{4\pi\epsilon_0}\frac{qq'}{r^2}$$

But $E = \frac{F}{q'}$



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

$$E = k\frac{q}{r^2}$$



Calculate F, E for point (p)
test charge q' for point $\underline{p}$

$$F = F_1 + F_2$$

$$F_1 = \frac{1}{4\pi\epsilon_0}\frac{q_1 q'}{r_1^2} \quad , \quad F_2 = \frac{1}{4\pi\epsilon_0}\frac{q_2 q'}{r_2^2}$$

$$F = F_1 + F_2 = \frac{1}{4\pi\epsilon_0}\frac{q_1 q'}{r_1^2} + \frac{1}{4\pi\epsilon_0}\frac{q_2 q'}{r_2^2}$$

$$F = \frac{1}{4\pi\epsilon_0} q' \left(\frac{q_1}{r_1^2} + \frac{q_2}{r_2^2}\right) + \dots$$

$$F = \frac{1}{4\pi\epsilon_0} q' \sum \frac{q}{r^2}$$

But $E = \frac{F}{q'}$ if n for charged bodies

$$F = \sum_{n=1}^{n} F_1 + F_2 + \dots$$

But $E = \sum_{n=1}^{n} E_1 + E_2 + \cdots + E_n$

$$E = \frac{F}{q} = \frac{F_1 + F_2 + F_2}{q}$$

$$E = \frac{F}{q}$$

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

$$dE = \frac{1}{4\pi\epsilon_0} \frac{dq}{r^2}$$

$$\int dE = \frac{1}{4\pi\epsilon_0} \int \frac{dq}{r^2}$$

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

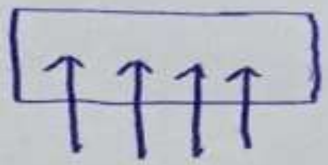
- Strength of the electric field depends on the density of lines in the region.

- It is the electric field times the area when the field is perpendicular to the surface.

- It is zero if the electric field is parallel to the surface.

- denoted by symbol Φ_E

- Unit Φ_E are $Nt.m^2/coul^2$

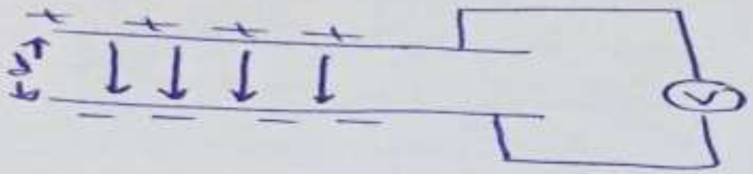


$$\Phi_E = EA$$

E : electric field

A : area

Electric field strength - Uniform field



The field strenght at any point in this field

$$E = \frac{V}{d}$$

E : Electric field strength
V/m or Vm^{-1}

V : potential difference (volt)

d : plate separation (m)

Example (6) : An electron ($m_e = 9.11 \times 10^{-31}$ kgm) is accelerated in the uniform field $E = 1.33 \times 10^{4}$ Nt/coul between two parallel charged plates. The separation the plates 1.25 cm. The electron is accelerated from rest near negative plate. as seen in the figure with what speed (v_f) does it leave the hole.

$$F = qE = ma$$

$$a = \frac{qE}{m}$$

$$v_f^2 = v_o^2 + 2ad$$

$$v_f^2 = 0^2 + 2ad \quad [\text{at rest } v_o = 0]$$

$$v_f = \sqrt{2ad} = \sqrt{2 \times \frac{qE}{m} \times d}$$

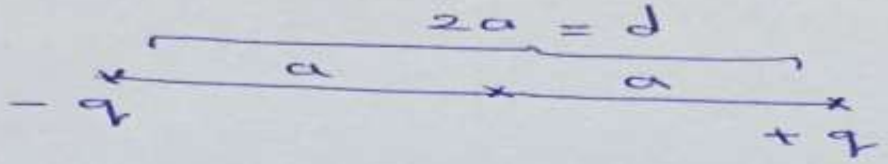
$$= \sqrt{2 \times \frac{1.6 \times 10^{-19} \times 1.33 \times 10^{4} \times 1.25 \times 10^{-2}}{9.11 \times 10^{-31}}}$$

$$= ? \text{ m/sec}$$

Field of Electric Dipole

[illegible]

The field setup by two charges of equal magnitude but of opposit sign

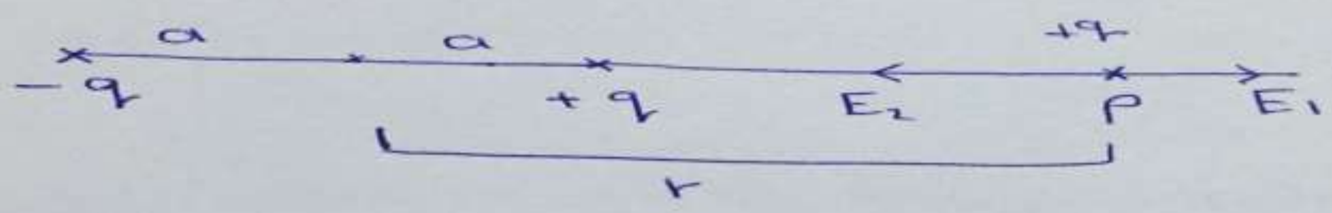


The pair of equal and opposite charges is called Dipole momentum

$(p) = qd = 2aq \quad [2a = d]$

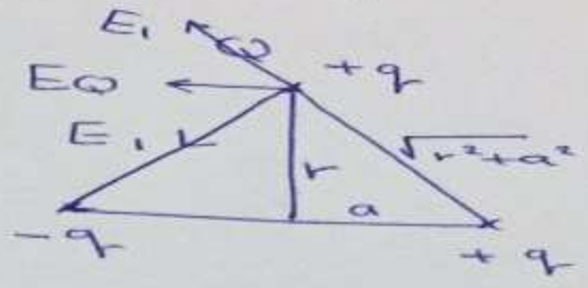
Field of Electric Dipole

(1) The field at point (P) on the prolengated axis of the dipole, at adistance r from the med point at the dipole.



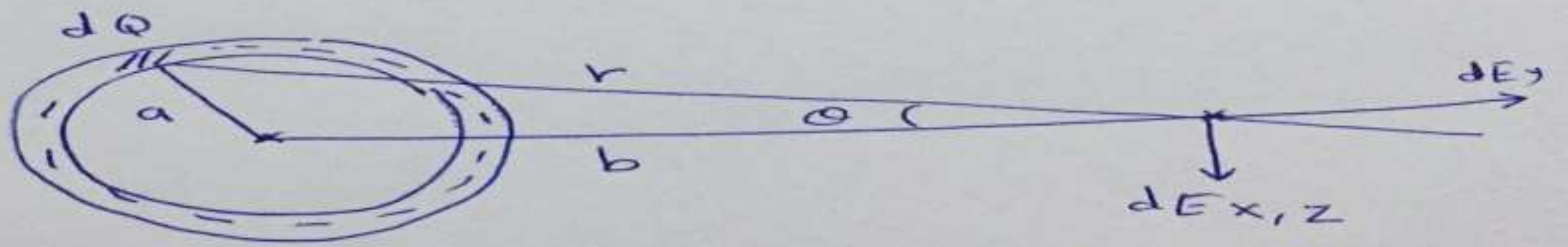
$$E = \frac{2P}{4\pi\epsilon_0 r^3}$$

(2) The field at point (Q) on the perpendicular besector the axis of the dipole



$$E = \frac{1}{4\pi\epsilon_0}\frac{P}{r^3}$$

(3) The electric field for a circular Ring



$$E = \frac{1}{4\pi\epsilon_0}\frac{Q}{b^2}$$