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24
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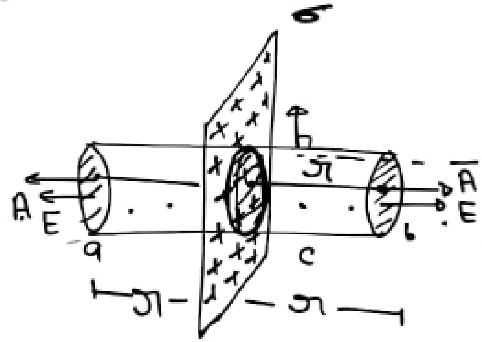
⇒ Application of Gauss Law :-

Electric field due to infinite long sheet (having surface charge density) is (σ)

σ = Charge per unit area



$$\sigma = \frac{q}{A}$$

$$q_{in} = \sigma A$$

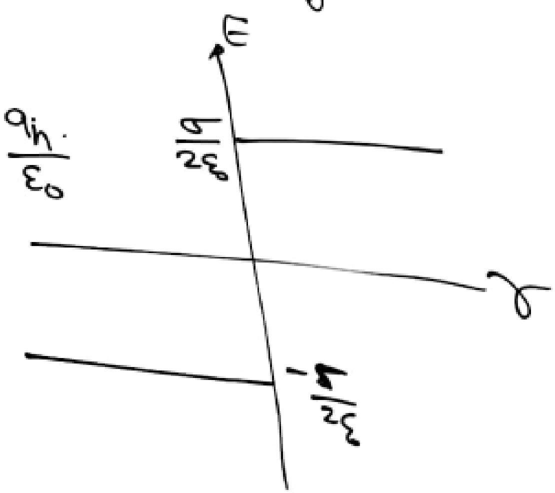
Total flux through Gaussian surface

$$\phi_{Total} = \frac{q_{in}}{\varepsilon_0}$$

$$EA + EA + 0 = \frac{q_{in}}{\varepsilon_0}$$

$$2E\cancel{A} = \frac{\sigma \cancel{A}}{\varepsilon_0}$$

$$\boxed{E = \frac{\sigma}{2\varepsilon_0}}$$

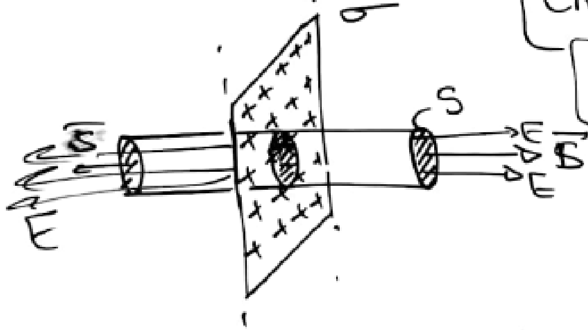


Using Gauss law :- Find Electric field due to charged Infinite sheet :-

[Charge on plate = Q , Surface area A]

[Charge density on plate = $\frac{Q}{A} = \sigma$]

($\sigma = \frac{Q}{A}$, Unit C/m^2)



S = area of Cross-section of Cylinder

$$E = \frac{\sigma}{2\varepsilon} = \frac{Q}{2A\varepsilon_0}$$

$$\phi_{Total} = ES + ES + 0 = \frac{q_{in}}{\varepsilon_0}$$

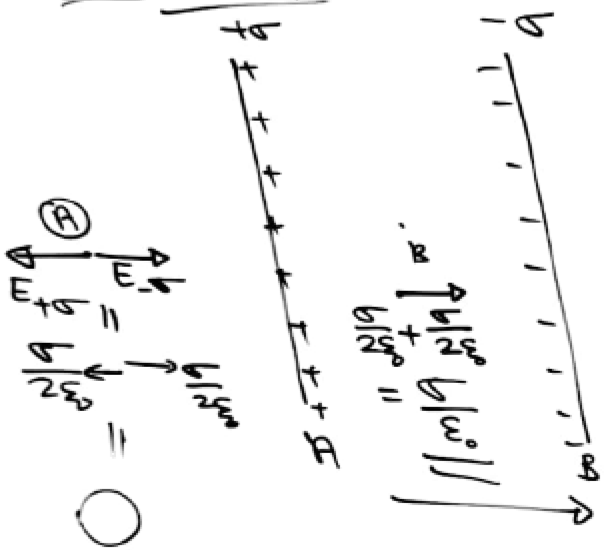
$$2ES = \frac{\sigma \times S}{\varepsilon_0}$$

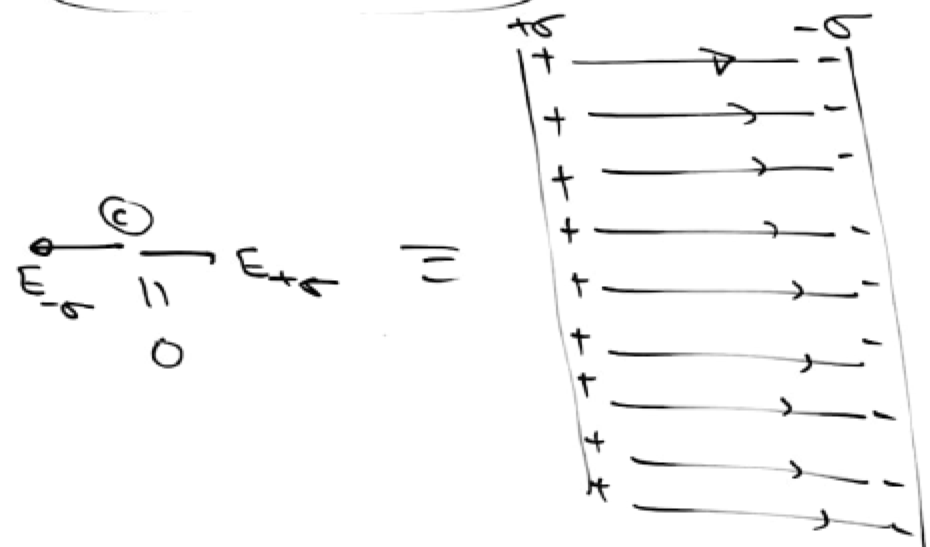
$$E = \frac{\sigma}{2\varepsilon_0} = \frac{Q}{2A\varepsilon_0}$$

Using Gauss law-1

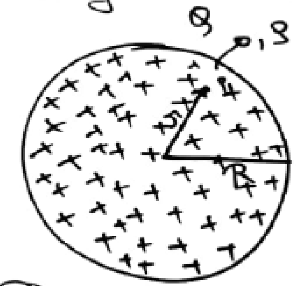
Q24) NCERT

$\sigma = 17 \times 10^{-22}\, C/m^2$





* Using Gauss Law, find Electric field due to non-conducting uniform charge distributed sphere

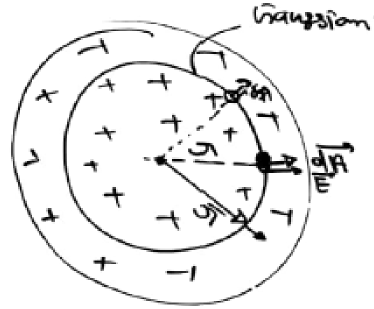


ρ = Volume charge density = $\dfrac{Q}{\frac{4}{3}\pi R^3} = \dfrac{3Q}{4\pi R^3}$

(a) find Electric field at inner point of sphere.

$r < R$

$q_{in} = \rho \times \frac{4}{3}\pi r^3$



$$\oint \vec{E}\cdot\vec{dA} = \phi_{Total}$$

$$E \times 4\pi r^2 = \frac{q_{in}}{\varepsilon_0}$$

$$E \times 4\pi r^2 = \frac{\rho \times \frac{4}{3}\pi r^3}{\varepsilon_0}$$

$$E = \frac{\rho r}{3\varepsilon_0}$$

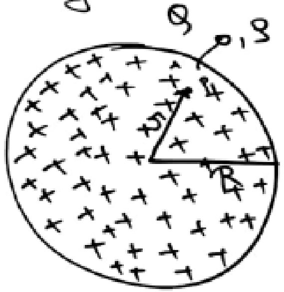
Inner point $\implies \vec{E} = \dfrac{\rho \vec{r}}{3\varepsilon_0}$

$$\vec{E} = \frac{\rho \vec{r}}{3\varepsilon_0}$$

$$\vec{E} \propto \vec{r}$$

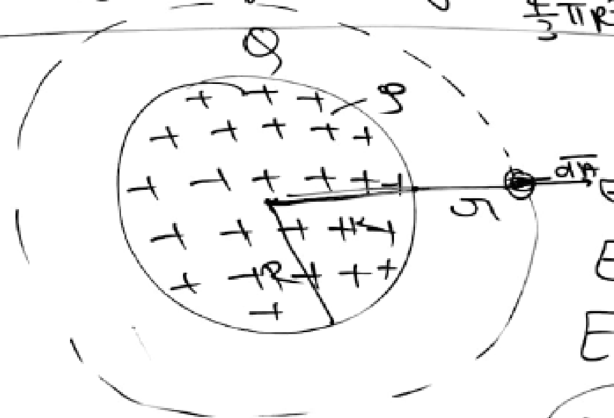
Using Gauss Law, find Electric field due to non-conducting uniform charge distributed sphere-

ρ = Volume charge density = $\frac{Q}{\frac{4}{3}\pi R^3} = \frac{3Q}{4\pi R^3}$



(b) For outer point

$r > R$



$$\oint \vec{E}\cdot\vec{dA} = \frac{q_{in}}{\varepsilon_0}$$

$$E \times 4\pi r^2 = \frac{Q}{\varepsilon_0}$$

$$E = \frac{Q}{4\pi\varepsilon_0 r^2}$$

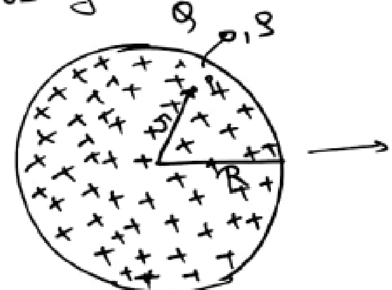
$$E = K\frac{Q}{r^2}$$

For outer point sphere behave like a point charge.

(c) at Surface, $r = R$, $E = \frac{KQ}{R^2}$

Using Gauss Law, find Electric field due to non-conducting uniform charge distributed sphere

ρ = Volume charge density = $\dfrac{Q}{\frac{4}{3}\pi R^3} = \dfrac{3Q}{4\pi R^3}$



(a) $r < R$ [inside point]

$$\vec{E} = \frac{\rho \vec{r}}{3\varepsilon_0}$$

$E \propto r$

(b) $r > R$

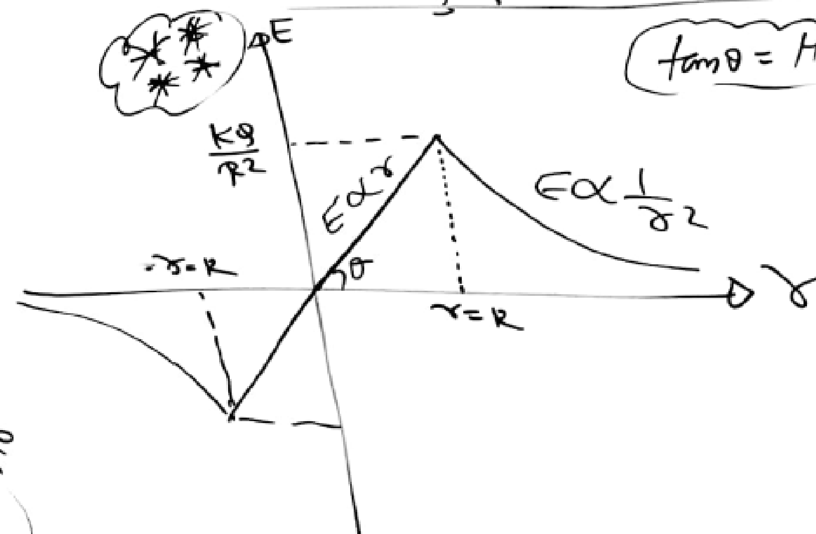
$$E = \frac{KQ}{r^2}$$

$E \propto \frac{1}{r^2}$

(c) at surface

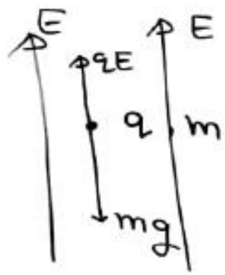
$$E = \frac{KQ}{R^2}$$

$\tan\theta$ = H.G



balancing of charge in electric field :-

(a)

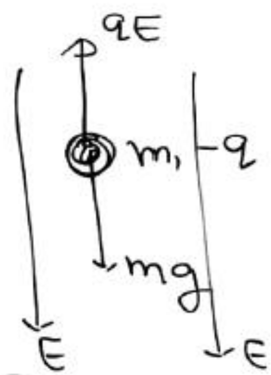


$qE = mg$

$E = \frac{mg}{E}$

[Upward dirn]

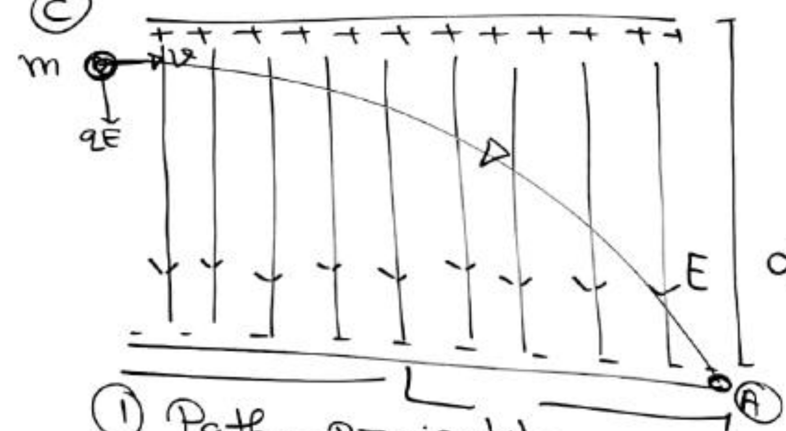
(b)



$qE = mg$

$E = \frac{mg}{E}$ [downward dirn]

(c)



① Path - projectile

ⓑ find time of flight

balancing of charge in electric field :-

$u_x = v \qquad a_x = 0 \;,\; F_x = 0$

Y-dirn

$u_y = 0 \qquad F_y = qE \;,\; a_y = \frac{F_y}{m} = \frac{qE}{m}$

{1 to 34}
⇑
NCERT

$S_y = d$

$S = ut + \frac{1}{2}at^2$

$S_y = u_y t + \frac{1}{2} a_y t^2$

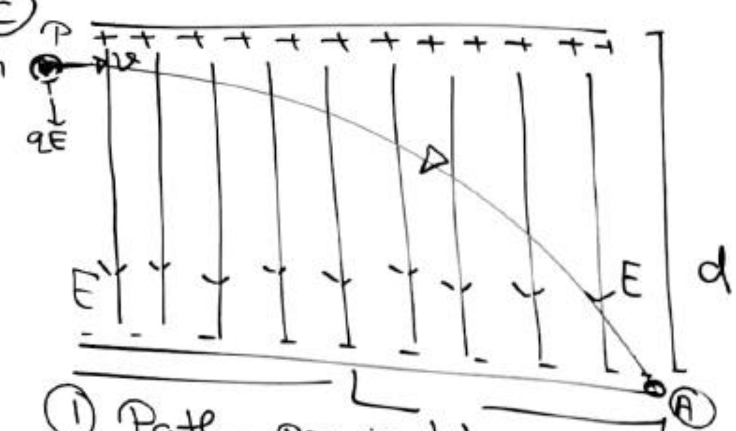
$d = 0 + \frac{1}{2}\left(\frac{qE}{m}\right)t^2$

$\frac{2dm}{qE} = t^2$

$t = \sqrt{\frac{2dm}{qE}}$

NCERT Exemplar
⇓
1 to 4

(c)



(1) Path - projectile

(b) find time of flight