
Muhammad Suhail
WhatsApp :
03114375275

CHAP : 1

"ELECTROSTATICS"

CHARGE:

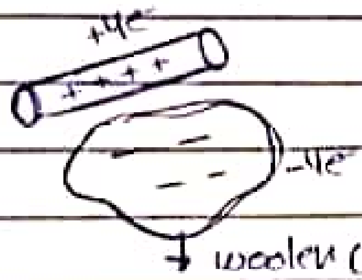
=> property which produced Electric field

=> This is conserved & quantized.

$\boxed{q = ne}$ → charges are quantized i.e. 1e, 2e, 3e, ...

→ smallest charge in nature

$e = 1.6 \times 10^{-19} C$



Net charge produced is always zero i.e. conserved

$+4e - 4e = 0e^-$

ELECTRIFICATION:

=> process of charging of bodies

① => By conduction → physical contact is used

② => By Induction → just field Interaction.

CHARGE DENSITY:

charges per unit dimension (l, A, V)

① LINEAR CHARGE DENSITY:

$$\rho_l = q/l \quad \begin{cases} \rho_l \propto q \\ \rho_l \propto 1/l \end{cases}$$

② SURFACE CHARGE DENSITY:

$$\rho_A = q/A \quad \begin{cases} \rho_A \propto q \\ \rho_A \propto 1/A \end{cases}$$

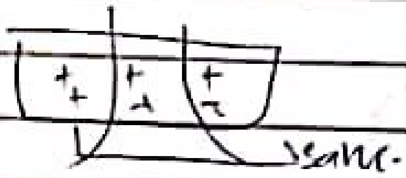
(3) Volume Charge Dencity:

$$\rho_V = \frac{q}{V} \quad \rightarrow \rho_V \propto q \quad \rightarrow \rho_V \propto 1/V$$

Uniform charge Distribution:

⇒ charge density is constant

If we divide a sheet → and sheet is uniformly charge distributed & we divide the sheet into 3 parts then the surface charge density on all the parts will be same.



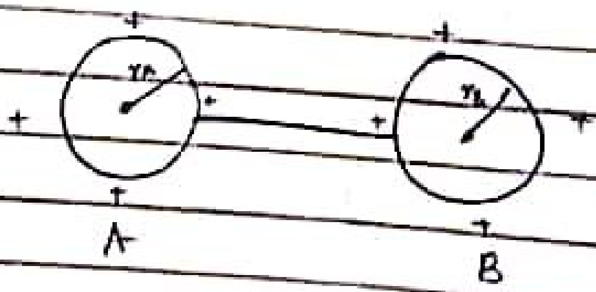
on all the parts will be same!

diff in potential

CHARGES → cause → ΔV → difference in charge density

⇒ charges will flow b/w 2 bodies unless charge density becomes same.

MCQ:



no potential diff b/w the

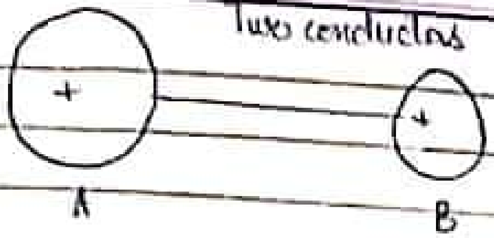
$q_A = q_B$ same

so; no charges flow coz $\Delta V = 0$ so potential = const and $I = 0$

If r ≠ constant then $\Delta V \neq 0$

MCQ:-

Two conductors



(b)

mag q $\rightarrow$ $q_A = q_B$
$r_A > r_B$

more radius $\rightarrow$ less charge density so charges will flow from B to A

Correct statement:

(a) charges flow from A to B
(b) from B to A
(c) no charges flow
(d) none

$\sigma \propto 1/r$

less size $\rightarrow$ more charge density so flow is from high charge density to low charge density

COULOMB'S LAW:

$F \propto q_1 q_2$ (r & medium = constant)

$F \propto \frac{1}{r^2}$ (q_1 & q_2 & ε_m = constant)

$F \propto \frac{1}{\varepsilon_r}$ or $F \propto \frac{1}{\varepsilon_m}$ ($q_1 q_2$ & r = constant) (permittivity of medium)

$$F = \frac{kq_1q_2}{r^2}$$

$$F = \frac{1}{4\pi\varepsilon_0} \times \frac{q_1q_2}{r^2}$$

$$F_m = \frac{1}{4\pi\varepsilon_m} \times \frac{q_1q_2}{r^2}$$

or//

$$F_m = \frac{1}{4\pi\varepsilon_0\varepsilon_r} \frac{q_1q_2}{r^2}$$

$$F_m = \frac{F_v}{\varepsilon_r}$$ $\varepsilon_r = \frac{1 \, vac}{1 \, med}$

$$\boxed{\varepsilon_r = \frac{\varepsilon_m}{\varepsilon_0}}$$ → permittivity of medium / → permittivity of free space/vacuum

relative permittivity

ε

$$\boxed{\varepsilon_m = \varepsilon_r \varepsilon_0}$$

for vacuum

$$\boxed{\varepsilon_r = 1}$$

for air

$$\boxed{\varepsilon_r = 1.0006}$$

for all other mediums

$$\boxed{\varepsilon_r > 1}$$

$$\boxed{\varepsilon_r = \frac{F_v}{F_m}}$$

$$\boxed{\varepsilon_r^{-1} = \frac{1}{\varepsilon_r} = \frac{F_m}{F_v}}$$

M.CQ:

$F_v = 40N$ $F_m = 5N$ (a)

$\varepsilon_r = ?$ $\varepsilon_r = F_v/F_m = 8$

(a) 8 (b) 16 (c) 40 (d) 5

ε_r ε_r - dimensionless

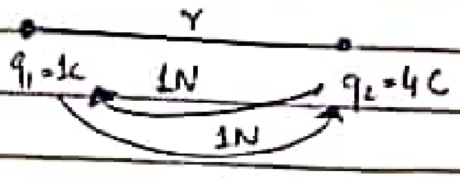
ε_m = not dimensionless

$\hookrightarrow \varepsilon_m = \dfrac{q_1 q_2}{F r^2}$

Coulomb's law also obey newton's 3rd law.

$\vec{F}_{12} = -\vec{F}_{21}$

Coulombic force is a mutual force.



If q_1 exerts 1N force on q_2 then q_2 will exert same force on q_1 i.e $F_{12} = -F_{21}$ & q_2 will not exert 4N force.

MCQ:

$q_1 = 8C$ —— x − 5 C

$q_2 = 3C$ —— x − 5C

$F_1 = F$ $\quad q_1 \times q_2 = 24$ C

$F_2 = ?$ $\quad q_1' \times q_2 = -6$ C

$q_1' = 3C$ $\quad \dfrac{24}{?} = 6$

$q_2' = -2C$

so; $\dfrac{24}{4} = 6$

$q_1' q_2'$ decreases 4 times so force will be decrease 4 times so;

$F_2 = F/4$

or

$F_2 = -F/4$

ELECTRIC FIELD INTENSITY:

$E = F/q_0$ — $q_0 \to$ test charge.
$q \to$ source charge.

field strength of source charge.

To test field of source charge.

$\boxed{q_0 << q}$

$$\vec{E} = \lim_{q_0 \to 0} \vec{F}/q_0$$

$\boxed{E = F/q_0} \to$ analogue of $\boxed{g = \frac{w}{m}} \to$ gr. field streng.

Unit: $N/C = V/m$

$\vec{E}$ is a vector

① has mag $E = F/q_0$

② direction $\to$ as that of $E = F/q_0$
force

Electric field Intensity due to pt charge:

$E = Kq/r^2$

or

$E_s = \frac{1}{4\pi\varepsilon_0} \times q/r^2$

or//

$E_m = \frac{1}{4\pi\varepsilon_m} \times q/r^2$

$E_m = \frac{1}{4\pi\varepsilon_0\varepsilon_r} \times q/r^2 \to E \propto 1/r^2$

$\to E \propto q$

$\to E \propto 1/\varepsilon_m$ or $E \propto 1/\varepsilon_m$

- Primary source to observe electric field is test charge.

&

$$E_m = \frac{E_V}{\varepsilon_r}$$

$$\Rightarrow \boxed{\varepsilon_r = \frac{E_{vacc}}{E_{med}}}$$

$$\boxed{E_{med} < E_{vacc}}$$

- **Electric polarization:**

slightly displacement b/w nucleus & electrons of an atom known as electric polarization.

- **permittivity:**

The capability of medium to polarize → permittivity

⇒

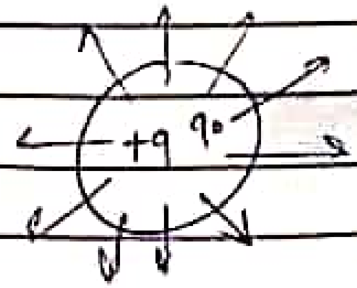
Coulombs law is only applicable for pt charges & is always known as "Action of at distance Law".

ELECTRIC FIELD LINES:

Electric field.

⇒ This is a vector field & a real field

→ The imaginary lines drawn in the direction of force → electric field lines.



for +ve test charge: positive source charge is source of field lines & -ve source charge is sink of field lines. & opp for -ve charge

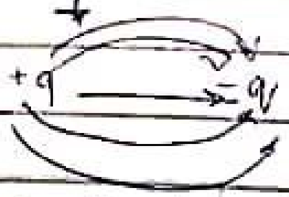
strength -

$\vec{E} = \vec{F}/q_0$

→ Infinite field lines can be drawn around a single charge.

⇒ Field lines are discrete and not continuous.

→ field lines can be straight or curved.



B/w 2 similar charges → there is a pt where $E = 0$ but only at a single pt.

$E = 0$ $\quad E_1 = E_2$

$+q_1 \xrightarrow{E_1} \uparrow \xleftarrow{E_2} +q_2$ $\quad q_1/r_1^2 = q_2/r_2^2$

B/w similar charges, there will be single point on a line joining two charges where $E = 0$. (null pt)

but b/w 2 opposite charge, null pt donot lie on line joining two opp charges, b/w 2 charges.

$E \neq 0$

$+q_1 \rightarrow q_0 \longrightarrow -q_2$

$$E_1 = E_2$$

$$\frac{q_1}{r_1^2} = \frac{q_2}{r_2^2}$$

$\frac{q}{r^2}$ = constant (at null pt)

$$\boxed{q \propto r^2}$$

$$\boxed{r \propto \sqrt{q}}$$

$$\frac{r_1}{r_2} = \sqrt{\frac{q_1}{q_2}}$$

Scanned by CamScanner

MCQ.

$q_1 = 1C$

$q_2 = 4C$ $\qquad \frac{r_1}{r_2} = \sqrt{\frac{q_1}{q_2}}$

$r = 3m$

$\frac{r_1}{r_2} = \sqrt{1/4}$

$\frac{r_1}{r_2} = \frac{1}{2}$] sum the ratio & divide the total dist on by that sum.

$\frac{r_1}{r_2} = \underbrace{1m : 2m}_{1+2=3m}$ $\qquad r_1 = 1m \; ; \; r_2 = 2m$

MCQ. trick → divide the given distance in ratio

$q_1 = \cancel{9C}$ $\quad$ (d $\quad q_1 = 6C$

$q_2 = \cancel{1C}$ $\quad\quad\; q_2 = 2C$

where distance b/w charges is 8cm then pt where electric field intensity will be 0 will be ___ (a)

(a) 2cm from q_2 & 6cm from q_1

(b) 6cm from q_2 & 2cm from q_1

(c) 3cm from q_2 & 5cm from q_1

(d) None

$\therefore \frac{r_1}{r_2} = \sqrt{\frac{q_1}{q_2}}$ $\qquad$ If $q_1 = 9C$ $\qquad$ (a)

$\qquad\qquad\qquad\qquad\qquad q_2 = 1C$

$\frac{r_1}{r_2} = \sqrt{\frac{6\cancel{C}}{\cancel{2}}} = \sqrt{\frac{\cancel{6}^{3}}{\cancel{2}}}$ $\qquad \frac{r_1}{r_2} = 3 : 1$

$\frac{r_1}{r_2} = \frac{\sqrt{3}}{1} = \frac{\sqrt{3}}{1}$ $\qquad$ sum = 4

$\frac{r_1}{r_2} = \sqrt{3} : 1$ $\qquad$ give $r = 8cm$ so × 4 with a no so we get 8 i.e $8/4 = 2cm$.

(2×3)

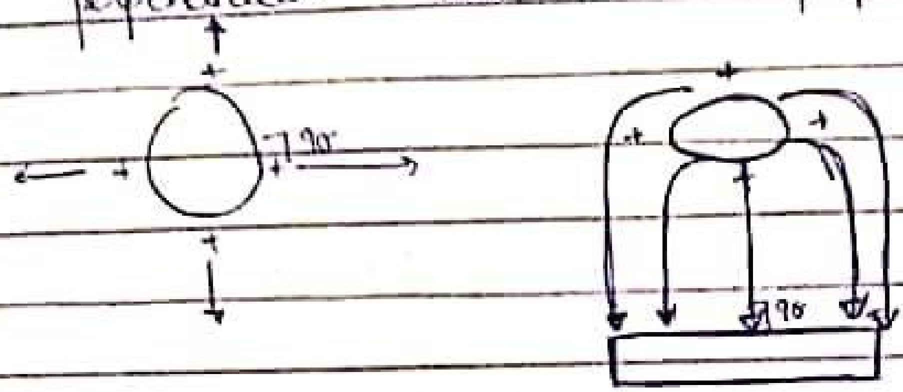
1 part = 2cm $\quad$ (3 : 1)

$\frac{r_1}{r_2} = 6cm : 2cm$

= divide the given distance in the given ratio simply

→ Electric field lines will always originate perpendicular & also terminate perpendicular.

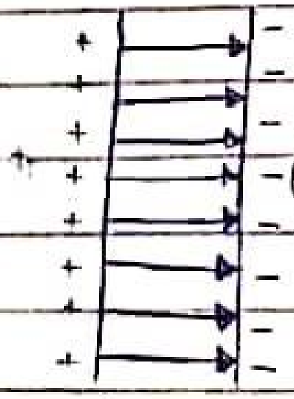
coz if other θ (angle) the the lines will overlap.



Uniform field:

→ constant magnitude & constant direction ($\vec{E}$ = constant)

⇒ 100% uniform field can't be produced but electric field b/w 2 oppositely charged plates having infinite length & negligibly small separation is approximately uniform



If field is uniform the 'E' will be independent of 'r' (distance)

→ Electric field around a pt charge can never be zero. then $E \propto 1/r^2$ and for uniform E → independent of 'r'.

+q $\xrightarrow{1cm}$ E $E_1 = 4N/C$

2cm $E_2 = 1N/C$

$E/_{2} = 1N/...$

APPLICATION OF ELECTROSTATICS:

XEROGRAPHY.

Working Principles

-) neutralization of charges / electrostatic interaction

-) Aluminium drum → heart of Photocopier machine.

-) page is more +vely charged than aluminium drum.

Electric Flux :

$$\phi_e = \vec{E} \cdot \vec{A}$$

$$\phi_e = EA\cos\theta$$

$$E = \frac{\phi_e}{A\cos\theta}$$

-ve flux → inward flux.

$$\theta = 0^\circ$$

$$\cos 0^\circ = 1$$

$$\boxed{E = \frac{\phi_e}{A}} \text{] field lines density}$$

$$\boxed{E \propto \text{field lines density}} \rightarrow \phi_e/A$$

$$\phi_e = 10 Nm^2/C$$

$$A = 1 m^2$$

E = 10 field lines per 1 m^2 area.

$$E \propto q$$

$$\boxed{\text{Electric field line density} \propto \text{charge } (q)}$$

GAUSS'S LAW. (Generalized form of Columb's law)

$\phi_e = \vec{E} \cdot \vec{A} \rightarrow$ for open / flat area

flat area $\rightarrow$ vector area
closed area $\rightarrow$ never a vector

flux through closed surface

$$\phi_{eT} = \sum_{i=1}^{n} \vec{E_i} \cdot \vec{\Delta A_i}$$

$$\phi_{eT} = \vec{E_1} \cdot \vec{\Delta A_1} + \vec{E_2} \cdot \vec{\Delta A_2} + \cdots + \vec{E_n} \cdot \vec{\Delta A_n}.$$

- Coulombs law is only for point charges.
- Guasses law is for point charges & distribution of charges.

Total flux is equal to $1/\varepsilon_0$ the total charge enclosed

$$\phi_{eT} = \frac{1}{\varepsilon_0}(Q) \qquad et \rightarrow \text{total electric flux}$$

$$\phi_{eT} = \frac{Q}{\varepsilon_m}$$

- Guass's for 1st time measured magnitude of charge from flux.
  $\downarrow$ source

$$Q = \varepsilon_0 \phi_{eT}$$

$$Q = \phi\varepsilon_0$$

$Q = \epsilon_m \phi_{ci}$

$$\boxed{Q = \epsilon_r \epsilon_0 \phi_{ci}}$$

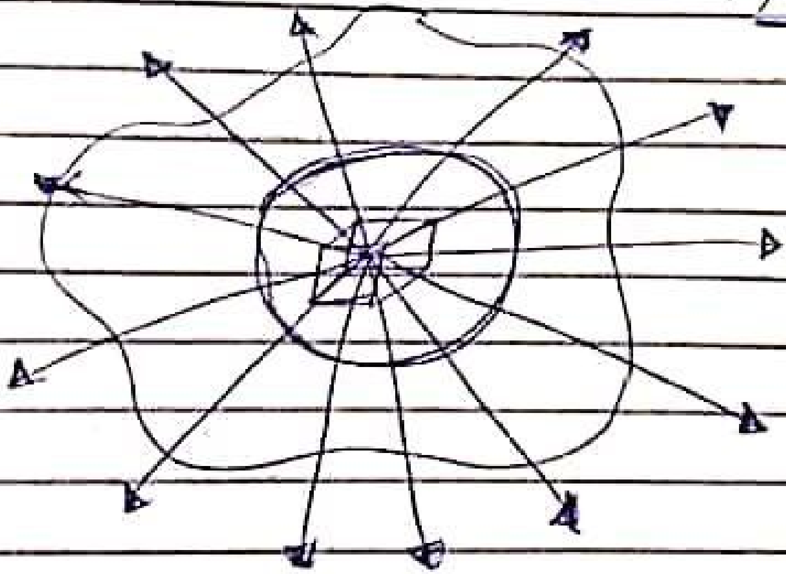
→ Gauss's law is only for closed surfaces.

$\phi_{ci} \propto Q$ (ϵ_m - constant)

$\phi_{ci} \propto \frac{1}{\epsilon_m}$ (Q = constant)

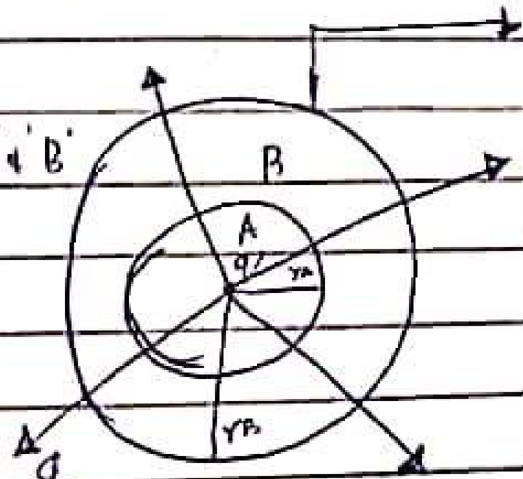
→ Independent of (i) shape of closed surface

(ii) size of closed surface



flux through all the surfaces is same either cube sphere or arbitary body

If 2 spheres 'A' & 'B' and ∃ $r_B > r_A$ then and charge lie at the centre of sphere then correct stateme-



:- Correct Statement (a)

(a) flux $\phi_A = \phi_B$

(b) $\phi_A > \phi_B$

(c) $\phi_A < \phi_B$

(d) None

⇒ i.e flux through both spheres.

Two spheres of radius r_A & r_B which is concentric & 'q' charge lie at the centre of 2 spheres then which statement is correct about flux through unit area of both sphere. $r_B > r_A$ $\quad \phi \propto 1/r^2$ (b)

(a) $\phi_A = \phi_B$ $\qquad$ (b) $\phi_A > \phi_B$

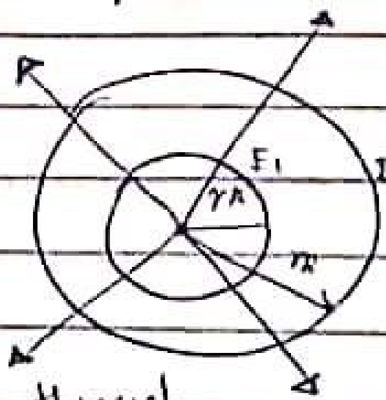
(c) $\phi_A < \phi_B$ $\qquad$ (d) None

Flux:

as unit area → so same area and not mentioned ~~close or open surface~~.

$$\phi = EA = \frac{kq}{r^2} \times A$$

$$\phi \propto 1/r^2 \qquad \phi_A > \phi_B$$



$E_1 \neq E_2$

$E \propto 1/r^2$

$E_1 > E_2$ $(r_B > r_A)$

flux through both sphere = same

flux throug unit area is not same

flat area is given

close area = same flux → independent on "r"

unit flat area — diff flux → depends on "r"

$r_A = 1cm$
$E_A = 4N/C$ $\qquad E_B = 1N/C \qquad E \propto 1/r^2$
$E_B = ?$ $\qquad \frac{E_B}{E_A} = \frac{r_A^2}{r_B^2}$
$r_B = 2cm$

Flux:

(a) $\phi_{eT} = +q/\varepsilon_0$

→ If flux = +ve
→ outward flux
→ Q = +ve

(b) $\phi_{eT} = -q/\varepsilon_0$

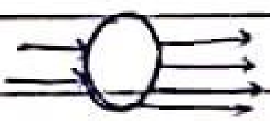
→ If flux = −ve
→ Inward flux
→ Q inclosed is −ve.

Imp Concept:

ϕ_{net} = −ve (flux)
Q_{enc} = −ve (charge)

coz inward flux is more than outward flux.

or inward flux < outward flux

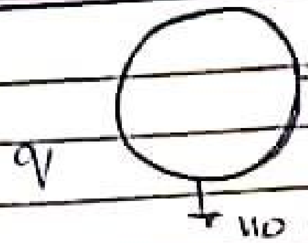


ϕ_{net} = +ve
Q_{enc} = +ve

inward flux > outward flux
−ve > +ve

$\phi_{net} = 0$
$Q_{encl} = 0$

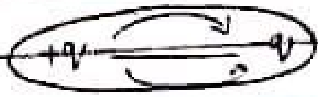
Scanned by CamScanner



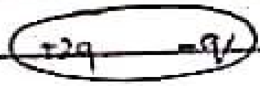
$\rightarrow Q = 0$

$\phi_{et} = 0$ $\quad \phi_{et} = q/\varepsilon_0$

no charge enclosed so $Q = 0$ & $\phi = 0$

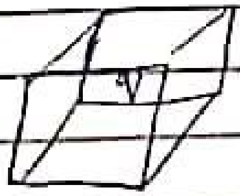


$q_{net} = 0$ $\quad q_{net} = -q + q = 0$



⊕ $q_{net} = +ve$

$\phi_{net} = +ve$



$\phi_{net} = q/\varepsilon_0$

$\phi = \frac{1}{6}\left(q/\varepsilon_0\right)$

from 2 faces

$\phi = \frac{2}{6}\left(q/\varepsilon_0\right)$

from 3 faces

$\phi = \frac{3}{6}\left(q/\varepsilon_0\right)$

from haf faces

$\phi = \frac{3}{6}\, q/\varepsilon_0$ or $\frac{1}{2}\left(q/\varepsilon_0\right)$

Application Of Gaus's Law:

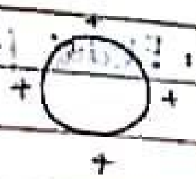
(i) :-

$E = 0$ inside a charged conductor

↓

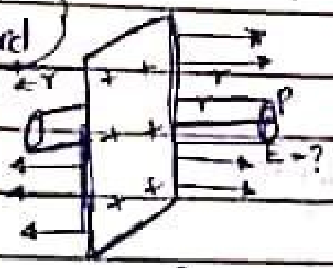
Electrostatic Equilibrium :

⇒ Electric field lines doesnt passes through conductor.



(ii) :- Electric field intensity due to Infinite sheet of charge:

If charges are distributed uniformly then E is indendent on distance 'r'



$$\boxed{E = \frac{\sigma}{2\epsilon_0}}$$

Dependence: ① magnitude of charge, ② surface area & ③ medium.

$\sigma = q/A$

$$E = \frac{Q}{2A\epsilon_0}$$

$$E_m = \frac{Q}{2A\epsilon_m}$$

$$E = \frac{Q}{2A\epsilon_r\epsilon_0}$$

/ $E = -\frac{\sigma}{2\epsilon_0}$ (-ve charge distribution).

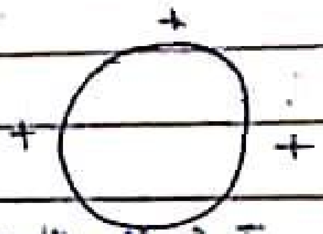
E is always normal to the surface.

$$\vec{E} = \frac{\sigma}{2\epsilon_0}\hat{n}$$

If charge distribution is uniform
then field on b/s will be same.

(iii): Electric field intensity inside + outside a shell:
a hollow body.

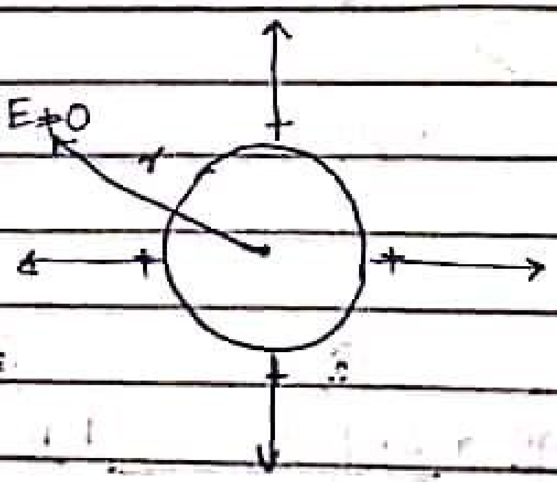
Case a:



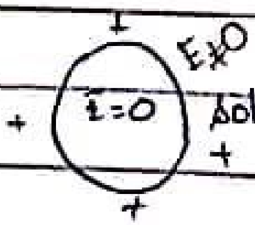
Inside $\Rightarrow E=0$ $(q=0)$

Case b:

Outside a shell:



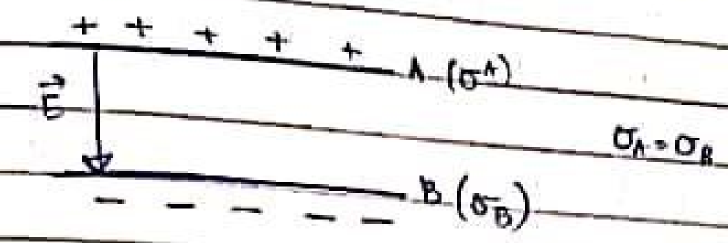
$\Rightarrow$ for outside points charge conductor will behave like a point charge lie at the centre of charged shell.



solid cylinder $E_{inside} = 0$

$E_{outside} \neq 0$

(iv) Electric field intensity due to oppositely charged sheet:



$E = \frac{\sigma}{\varepsilon_0}$ If $\sigma_A = \sigma_B$

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

If $\sigma_A \neq \sigma_B$
then

$$\boxed{E = \frac{\sigma_A}{2\epsilon_0} + \frac{\sigma_B}{2\epsilon_0}}$$

If $\sigma_A = \sigma_B$

$$E = \frac{\sigma}{2\epsilon_0} + \frac{\sigma}{2\epsilon_0}$$

$$E = \frac{2\sigma}{2\epsilon_0}$$

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

→ If oppositely charged sheets
E

$E = 2\sigma_s$ (single sheet)

2 opp charged sheets ← $E = 2E_s$ (single sheet)

$$\frac{E}{E_s} = 2$$

opp charge plates — due to 2 opp charge plates = E then if we remove 1 sheet then $E/2$

and if 1 sheet + other is ~~removed~~ added then
$$E = 2E$$

Same [$E = 0$

(i) $E = 0$

If $\sigma_A = \sigma_B$

(ii) If $\sigma_A > \sigma_B$

then $E_A > E_B$

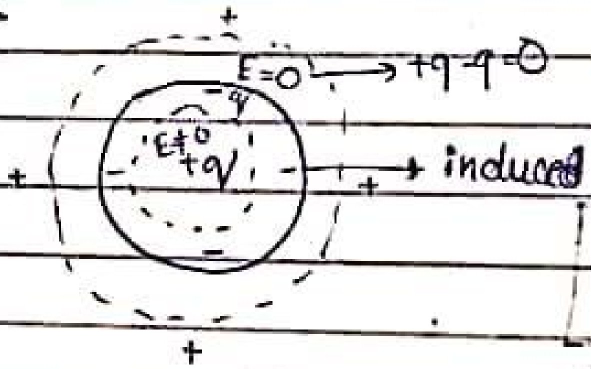
$E_{net} \rightarrow$ directed along E_A.

(iii) If $\sigma_A < \sigma_B$

then $E_A < E_B$

$E_{net} \rightarrow$ directed along E_B.

→



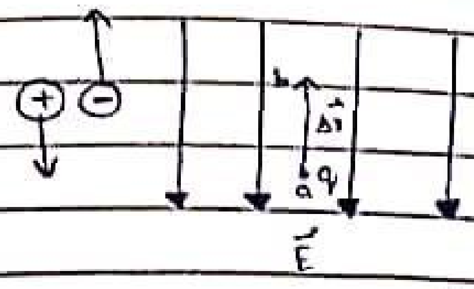
mag of -ve = that of q

If we induce 1C charge on inner surface then same amount of charge will be induced on outer surface.

E. b/w upper & lower surface = 0 coz net charge = 0

If we construct a surface below the -ve charge then $E \neq 0$ cos charge enclosed $\neq 0$

- ELECTRIC POTENTIAL ENERGY:



If we do work against field then work will be store as energy (P.E).

$W_{a \to b} = \Delta U = U$

If v = constant

electric potential energy

If $+q$ $\xrightarrow{\text{in}}$ direction of Electric field

If $v \neq$ contant (velocity)

$a \neq 0$

$\boxed{W_{a \to b} \neq \Delta U}$

b/c of energy lost.

Electric Potential is the work done per unit charge

or

P.E change per unit charge.

$$\Delta V = \frac{W_{a \to b}}{q_0}$$

or

$$\Delta V = \frac{\Delta U}{q_0}$$

$$\boxed{V = \frac{W}{q_0}}$$

$1 \text{ volt} = 1J/1C$

Potential Energy = Total work done = W

Potential = work done per unit charge = W/q_0

→ ABSOLUTE ELECTRIC POTENTIAL:

$$V = \frac{Kq}{r}$$

$$V_v = \frac{1}{4\pi\varepsilon_0}\frac{q}{r}$$

$$V_{med} = \frac{1}{4\pi\varepsilon_m} \times \frac{q}{r}$$

or

$$V_m = \frac{1}{4\pi\varepsilon_r\varepsilon_0}\frac{q}{r}$$

$$V_m = \frac{V_v}{\varepsilon_r}$$

$$\boxed{V_m < V_v}$$

$V \propto q$ → source charge.

$V \propto 1/r$

$V \propto 1/\varepsilon_m$ or $V \propto \frac{1}{\varepsilon_r}$

$$\boxed{\varepsilon_r = \frac{V_{vac}}{V_{med}}}$$

$$\frac{1}{\varepsilon_r} = \frac{V_{med}}{V_{vac}}$$

Scanned by CamScanner

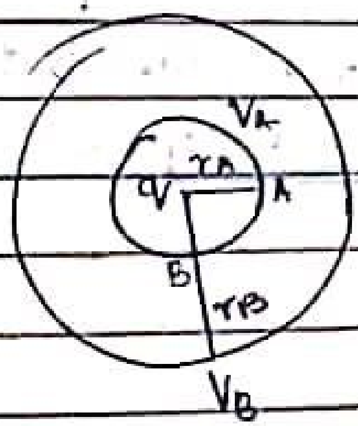
MCQ: At some pt, at 'r' distance source charge 'q' (c) Electric field intensity were "E" and electric potential were "V". Now at some other point electric field intensity is $E/4$ then potential at this point will be ___

(a) $V/4$ (b) $4V$

(c) $V/2$ (d) V

~~$\because E \propto 1/r^2$ & $V \propto 1/r$~~

$E \propto \frac{1}{(2)^2}$ & $V \propto \frac{1}{2}$



$\therefore V_A > V_B$

co2

$V \propto 1/r$

$r_B > r_A$

If $r_B = 2r_A$

$V_B = V_A/2$

$\boxed{\text{V → independent of magnitude of test charge.}}$

but E → depends upon mag of test charge

$W = \frac{}{}$
$F = q_0 E$

$W = q_0 E \Delta r$ or $W = q_0 E \Delta r \cos\theta$

$\boxed{\begin{array}{c} W \propto q_0 \\ W \propto E \\ W \propto \Delta r \end{array}}$

1J, b, V_B, 2J

$q_1 = 1C$ a V_A $q_2 = 2C$

Work done depends on mag of test charge.

$\Delta V = W/q_0$

If ; $\Delta V = 1J/1C = 1V$

$\Delta V = 2J/2C = 1V$

$\Delta V = 10J/10C = 1V$

coz if we do work the of 1J on 1C charge then if we do work of 10J the charge will be 10C coz $\boxed{W \propto q_0}$

here 'W' & P.E will not be same but 'V' = 0
coz independent of q_0 but depends on mag of
'V' will be same for source charge q.

- Equipotential Surface:

Surface at which electric potential is constant or same.

- Equipotential lines/circles:

V = constant.

$V_A > V_B > V_C$ $(r_C > r_B > r_A)$

but $V_1 = V_2 = V_3$

coz 'r' is same 'a' is

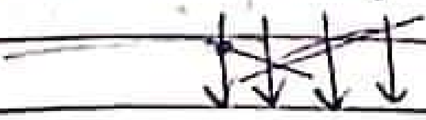
→ equipotential line

$V_A = V_B = V_C$

→ equipotential surface

$V_x = V_y = V_z$

equipotential line & surface is always perpendicular to electric field line.



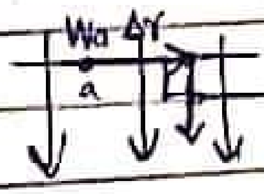
$V_D \neq V_E$

they can't overlap and are not perpendicular.

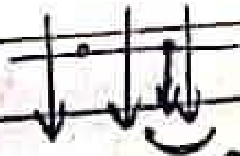
* $\boxed{\text{Work done to move a charge on equipotential surface or equipotential line is zero.}}$

$\cos\theta = 90°$

* But if we move charge b/w 2 equipotential surface or line/circle, then work done will be non-zero.



$\rightarrow \theta = 90°$ $W = 0$



$\theta = 0°$

Potential Gradient:

Gradient → change w.r.t distance / displacement
$(\Delta / \Delta r)$

E = negative gradient of electric potential.

$E = -\frac{\Delta V}{\Delta r}$ → $E = \frac{\Delta V}{\Delta r}$ → E → −ve (opp to direction of $\vec{E}$)
ΔV = +ve
V → increases

→ E → +ve (in the direction of E).
$-E = \Delta V / \Delta r$ →
ΔV = −ve
V → decreases

we move
If +ve test charge in the direction of E Then V → decreases & opp to E then V → increases.
and if perpendicular then V=0

and if −ve test charge then along $\vec{E}$ then V → increases
and opp V → decreases.

gradient (scalar) = vector

$\Delta V \; (di) = \vec{E}$

$E = \Delta V / \Delta r$

$\Delta V = E \Delta r$

$\boxed{V = Ed}$

K. Energy

K. Energy Of Charge :- accelerating by using potential :

$$K.E = q\Delta V$$
$$E.E = qV$$

for speed :

$$\frac{1}{2}mv^2 = qV$$

$$\boxed{v = \sqrt{\frac{2qV}{m}}}$$

Electron Volt : → unit of energy (smaller)

$$1eV = 1.6 \times 10^{-19} J$$

$$n(1eV) = n(1.6 \times 10^{-19} J)$$

$$1J = \frac{1}{1.6 \times 10^{-19}} eV$$

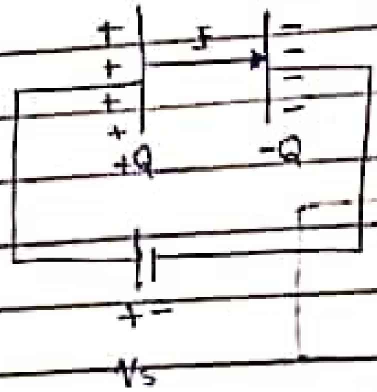
$$n(1J) = n\left(\frac{1}{1.6 \times 10^{-19}} eV\right)$$

$$\boxed{E = qV}$$

CAPACITOR:

Device used to store electrical charges & electric energy.

$V_c = F_c d_c$



net ?

$Q_{net} = Q - Q = 0$

$|Q| = |-Q| = Q$

magnitude of charge

during charging $V_c < V_s$

but when capacitor is fully charged

$V_c = V_s$

$V_{max} = V_s$ $(V_c = V_s = V_{max})$

$Q \propto V$

$\boxed{Q = CV}$

unit → farad → larger unit

$1F = \frac{1C}{1V}$

$\boxed{C \rightarrow \text{independent of } Q \text{ \& } V}$

$C = Q/V$ → always constant.

C → depends upon

(a) geometric shape

(b) dimension (l, A, V)

(c) separation b/w plates

(d) medium

$\epsilon_r = \frac{F_v}{F_m}$ $\epsilon_r = \frac{V_v}{V_m}$ $\epsilon_r = \frac{E_v}{E_m}$ $\epsilon_r = \frac{C_m}{C_v}$

$\epsilon_r = K_v/K_m$ $\epsilon_r = \frac{\epsilon_m}{\epsilon_v}$

Capacitance of a Capacitor & its dependencies

$\cancel{C = A\epsilon_0\epsilon}$

$$\boxed{C = \frac{A\epsilon_0}{d}}$$

$$C_m = \frac{A\epsilon_m}{d} = \frac{A\epsilon_r\epsilon_0}{d}$$

$$C_m = \epsilon_r C_v$$

$$\boxed{\epsilon_r = \frac{C_m}{C_v}}$$

$$\boxed{C_m > C_v}$$

$$C = \frac{A\epsilon_0}{d} \quad \left(\epsilon_0 = \frac{1}{4\pi k}\right)$$

$$\boxed{C = \frac{A}{4\pi k d}}$$

$C \propto A$

$C \propto \epsilon_m$ $C \propto \epsilon_r$ $C \propto \epsilon_0$

$C \propto 1/d$

Energy stored in a capacitor:

$U = \frac{1}{2} QV$ or, $U = \frac{1}{2} \frac{Q^2}{C}$

$\Delta U = \frac{1}{2} CV^2$ or $U = \frac{1}{2} \epsilon_0 E^2 (Ad)$

$U = \frac{1}{2} \epsilon_0 E^2 (Vol)$

$U = \epsilon_m E^2 (Ad)$

$$\boxed{U_m = \frac{1}{2} \epsilon_0 \epsilon_r E^2 (Vol)}$$

If we put the medium → energy stored will be increases → mag of charges increases on each plate.

$U \propto Q^2$	$U \propto$ volume
$U \propto C$	$U \propto A$

$\boxed{U \propto V^2}$ (imp)

$U \propto E^2$

$U \propto \epsilon_m$ or $U \propto \epsilon_r$

If $\boxed{V_c = E_c d_c}$

If d_c → increases

V_c increases then battery discharges

during charging $\Delta V_{circuit} = V_s - V_c$

↳ V_c - increases

so ΔV – decreases

when capacitor is fully charged

$\Delta V_{circuit} = 0$

Scanned by CamScanner