(Physics)

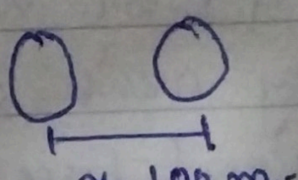
* States of matter are more than five.
* Columb's law is applied on charges.
* Variation can come on the source of charges.
* By changing medium Force will ~~always~~ also change.
(World's Forces).
*
  - → Gravitional force
  - → Strong force
  - → Electromagnetic force.
  - → weak Force.

* Electricity & magnetic force were different in past

Problem # 2. Sp 25.2

(same charge).

* 2 copper coins a magnitude (charge) $q = 1.35 \times 10^{5} C$.



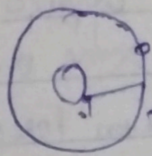
$x = 100 m$

$F = kq_1q_2/x^2$

$$\boxed{F = 1.69 \times 10^{16} N.}$$

* A huge amount of charge is making them neutral. (bcoz charges are neutral).
* If charges are unbalanced so we would start attracting to things.
* There is gravitational force between each other but we are not experiencing it.

Eg.3.- nucleus
Electron



e^-

$r = 5.3 \times 10^{-11}$ m.

Electrostatic force yes or no?
Gravitational Force.

$$F_E = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r^2} = 8.2 \times 10^{-8} N. \uparrow$$

$$F_G = \frac{G m_1 m_2}{r^2} = 3.67 \times 10^{-47} N \downarrow$$

Dominate F_E.

* object which has mass G.F is up

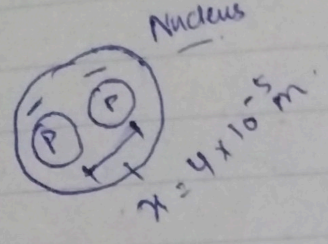
Earth & Moon both have neutrons, electrons but they aren't collapsing but they do have gravitational force due to which they are revolving.

* EF is not dominating bcoz charges are equal.

* Neutron was discovered later.

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

25.4



proton = 26.

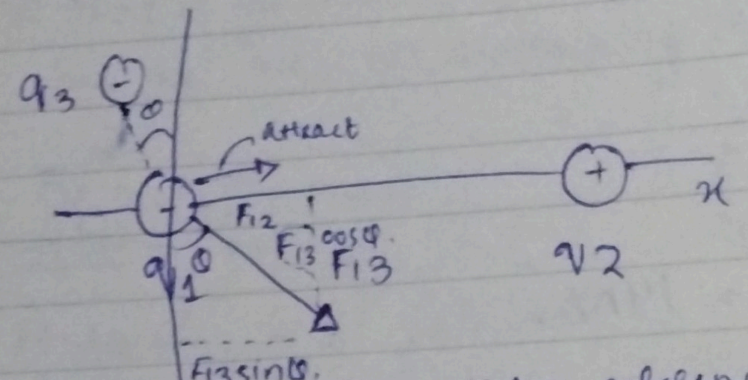
$F_E = \frac{1}{4\pi\epsilon_0} \frac{q_1 q_2}{r^2} = 14N.$

* F_E is greater & atoms are so small force is large but they still ~~are~~ aren't destroying. But nucleus of iron is isn't destroying. There is any force which is holding them. Strong force is also called nuclear force. G_F is present but they are not experiencing it. F_E is also present but they are not experiencing it.

* Atoms having radioactivity a force dominating it is known as weak force.

Dynamics :- 1) Rest
2) Motion.

* We have refrence charge



* Direction wahi se jisko refrence banarhy hai.

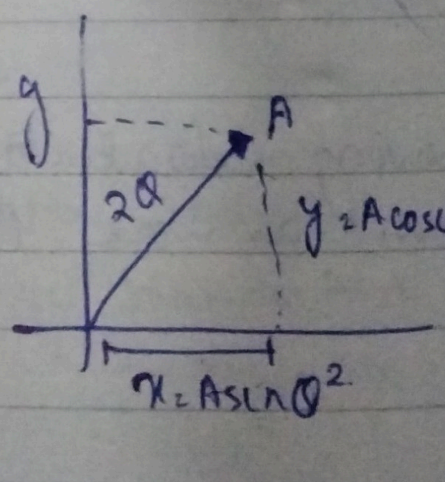
$F_1 = ?$ $\quad q_1 = -1.2\mu C$ $\quad r_{12} = 15cm$

$q_{12} ?$ $\quad q_2 = 3.7\mu C$ $\quad r_{12} = 10cm$

$q_3 = -2.3\mu C$ $\quad \theta = 32$.

$$F_{13} = \frac{k q_1 q_3}{r_{13}} = 2.48N$$

$$F_{12} = \frac{k q_1 q_2}{r_{12}^2} = 1.72N.$$



$\underline{X}$:-

$F_{1x} = F_{12} + F_{13}\sin\theta$.

(5)

$x//$

$F_{1x} = F_{12} + F_{13} \sin \theta$

$= 1.77 + 2.48 \sin(32)$

$\boxed{F_{1x} = 3.08 \text{ N}}$

$y//$

$F_{1y} = 0 - (F_{13} \cos \theta)$

$\boxed{F_{1y} = -2.10 \text{ N}}$

$F_1 = 3.73 \text{N}$.

$F_1 = \sqrt{(F_{1x})^2 + (F_{1y})^2}$

→ solve it by own.

30 Aug. 20

Field:-

Area having boundary.

"Area around which we can experience force. Something"

"Earth has gravitational field a thing having mass will attract it.

* If we come under the boundary the earth will attract us.
* A rounded surface area.
* Gravity communicate with mass. (objects having mass).
* photon is in rest so it's mass is zero.
* Just photon have no mass (in rest position).
* light have also mass while travelling.
* Charge communicate with force.

Scalar field	Vector field.
i) Temperature (doesn't depend on any direction).	having mass & direction.
*) $T(x, y, z)$.	*) velocity. velocity can varry acc to direction.
	*) Velocity / vector field. $\vec{V}(x, y, z)$

⇒ There is a diff b/w wave & field.

Field types :- i) State ii) dynamic.

Eg: Bedsheet → plain (static).
Disturbance creating waves (dynamic)

* Every bar which is dropping has not same distance.

⇒ Electric field :-
A field experience a unit charge.

q_0 = Test charge

$\boxed{E = F/q_0}$ (due to force on charge) that can vary.

⇒ objects experiencing force due to charge.

$\vec{g} = F/m$.

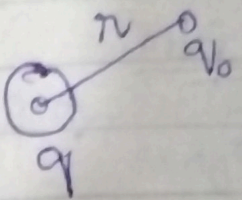
$W = mg$. (due to mass)

⇒ In specific region we will experience gravitation force.

Test charge q_0:- Ideal charge which doesn't ca

- ideal charge
- +ve charge
- mag 1
- field disturb ✗

-P



$$F = \frac{1}{4\pi \varepsilon_0} \frac{q\cancel{q_0}}{r^2} \frac{1}{\cancel{q_0}}$$

$$\boxed{E = \frac{1}{4\pi \varepsilon_0} \frac{q}{r^2}}$$

attract

(+) (-)

- charge ⇄ charge
- charge ⇄ field ⇄ charge

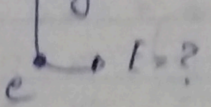
(7)

Krypton's gravity 100 times of Earth

$\vec{E} = \frac{\vec{F}}{q_0}$ $\left[\frac{N}{C}\right]$

Sp 26.1

$F = 3.60 \times 10^{-8}$ N



a). ⊖ charged

$E = F/q = F/e$. $\boxed{q = -e}$

$E = -2.25 \times 10^{11}$ N/C.

Away so E.F will become weak

Field is same

Consider at point P the electric field

b) ⊖ charged

alpha

F

$\boxed{q = 2e}$

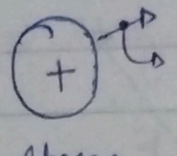
charge isn't changing.

$F = qE$

$F = (2e)(-2.25 \times 10^{11})$.

$\boxed{F = -7.20 \times 10^{-8} \text{ N}}$

6 sept-2022



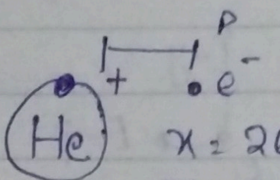
$\vec{E}$

E : ------

charge

→ Basic requirement of a field is to feel a force.

Sp 26-2:-



$x = 26.5\,pm$

$x = 26.5 \times 10^{-12}\,m$

nucleus = +2e

$E_r = ?$

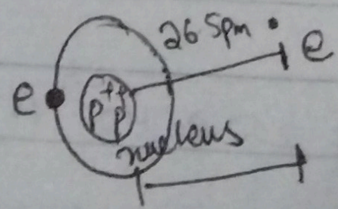
$$E = \frac{1}{4\pi\varepsilon_0}\frac{q}{r^2}$$

$$= \frac{1 \cdot 2(1.6\times10^{-19})}{4\pi\varepsilon_0 (26.5\times10^{-12})^2}$$

→ ~~Electric~~ field

$$\boxed{E_p = 4.10\times10^{12}\,N/C}$$

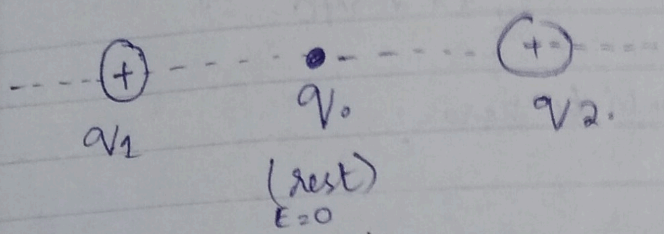
Conclusion:- Due to two positive charges, the electric field at point P is $\boxed{E = 4.10\times10^{12}\,N/C}$

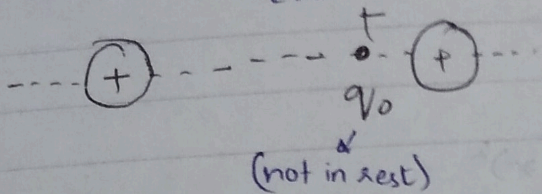


E ^

Test charge:- Test charge is not going to disturb other charges.

q_0 +ve , unit 1.



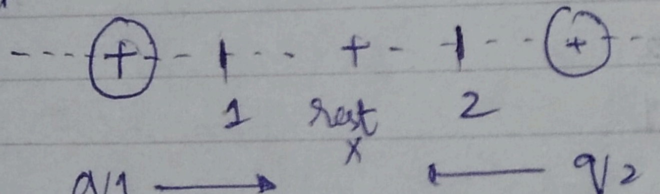


It will go at L.H.S because it's close to R.H.S which is positive so and test charge is also positive so it repel and goes to L.H.S.

* If an unbalanced ~~body~~ force acting on a body it is due to acceleration.

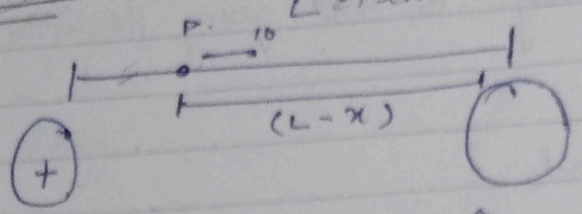
*

charge q_0 → rest
E = 0(rest)



Distance = ?

SP 26.3



$q_1 = 1.5\mu C$ $\quad$ $q_2 = +2.3\mu C$

⇒ from point p to q_1 distance is x.

⇒ Distance b/w point to charge q_2.

⇒ The electric field should be zero = ?

$$E_1 = E_2$$

$$\cancel{\frac{1}{4\pi\varepsilon_0}} \frac{q_1}{x^2} = \cancel{\frac{1}{4\pi\varepsilon_0}} \frac{q_2}{(L-x)^2}$$

$$q_1(L-x)^2 = x^2 q_2$$

$$q_1((L)^2 - 2Lx + x^2) = x^2 q_2$$

$$q_1 L^2 - 2q_1 Lx + q_1 x^2 = x^2 q_2$$

$$q_1 L^2 - x(2q_1 L + q_1 x) = x^2 q_2$$

$$q_1 L^2 - (2q_1 L + q_1 x) = \frac{x^2 q_2}{x}$$

$$\Rightarrow \frac{(L-x)^2}{x^2} = \frac{q_2}{q_1}$$

$$\frac{L-x}{x} = \pm\sqrt{\frac{q_2}{q_1}}$$

$$L/x - \cancel{x}/\cancel{x} = \pm\sqrt{q_2/q_1}$$

Position from q_1 to point p.

to x. Point

$$\frac{L}{x} - 1 = \pm\sqrt{q_2/q_1}$$

$$\frac{L}{x} - 1 = \pm\sqrt{\frac{q_2}{q_1}}$$

$$\frac{L}{x} = 1 \pm \sqrt{q_2/q_1}.$$

$$x = \frac{L}{1 \pm \sqrt{\frac{q_2}{q_1}}}$$

$\boxed{x = 5.8\,cm}$ or $\boxed{x = -54.5\,cm.}$

discard coz of (−).

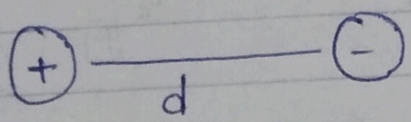
Conclusion:- At a distance of 5.8 cm from q_1. The E.Field is zero this implifies that the q_0^+(test).

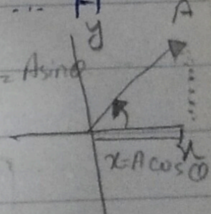
Electric Dipole:- (P) $\boxed{P = q d}$

Two charges separated by some distance having opposite polarity. E.g

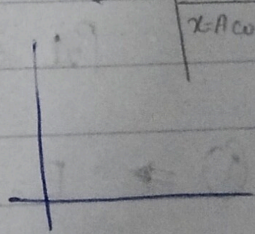
H_2O

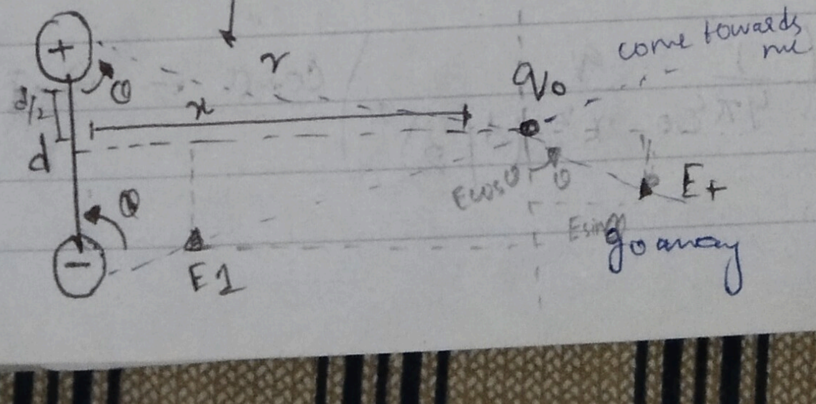
$OH^{-\delta}$ ---- $H^{+\delta}$



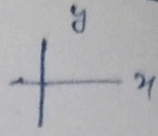


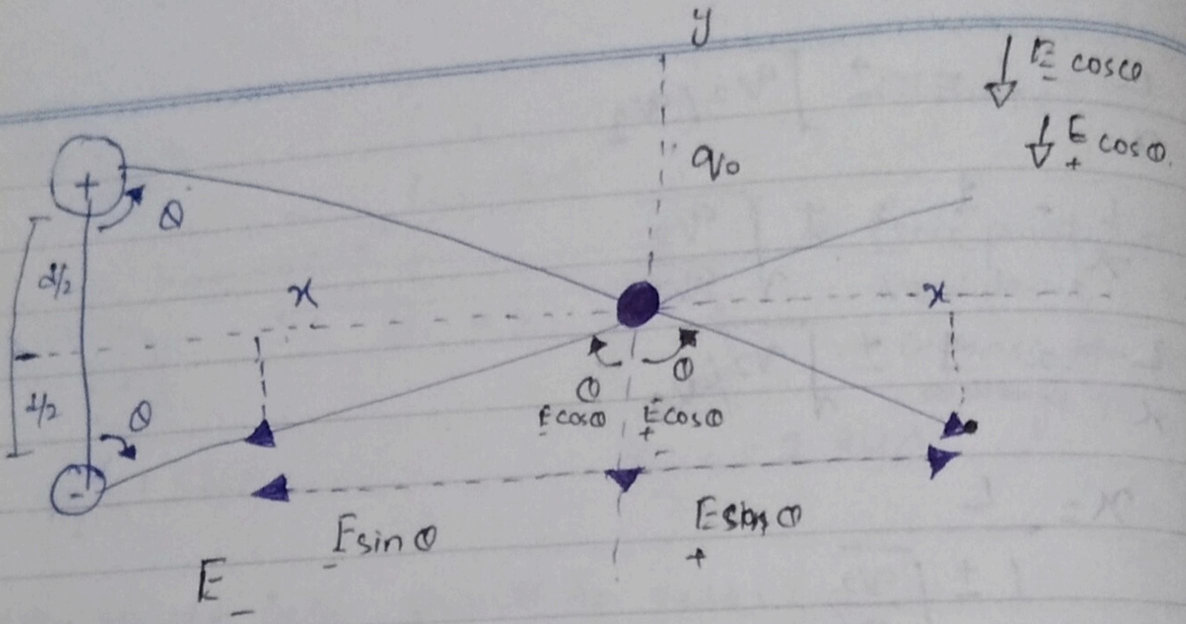
→ perpendicular bisector of the electric dipole.





M





$$\boxed{E_- \sin\theta = E_+ \sin\theta}$$ cancel the effect of each other.

$E = E_+ \cos\theta + E_- \cos\theta$

$E_+ = E_-$ → if this condition is applicable.

than

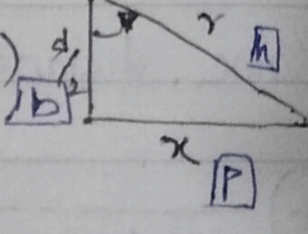
$$\boxed{E = 2E\cos\theta} \quad -(1)$$

$\therefore h^2 = b^2 + p^2$

$r^2 = \left(\frac{d}{2}\right)^2 + x^2$

We know that,

$$E = \frac{1}{4\pi\varepsilon_0}\frac{q}{r^2} = \frac{1}{4\pi\varepsilon_0}\frac{q}{x^2+\left(\frac{d}{2}\right)^2} \rightarrow (2)$$



due to pythagorous theorem

Put eq (2) in (1).

$$① \Rightarrow E = 2\left(\frac{1}{4\pi\varepsilon_0}\frac{q}{x^2+(d/2)^2}\right)\cos\theta \leftarrow (3).$$

$$\because \cos\theta = \frac{b}{h} = \frac{d/2}{r}$$

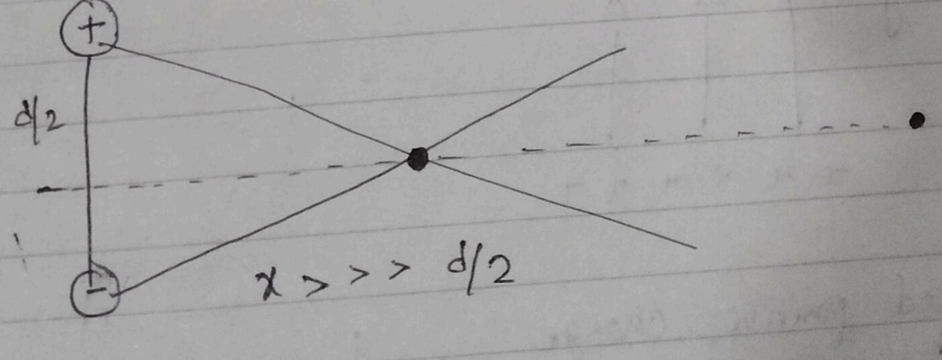
(3) $\Rightarrow E = 2\left(\frac{1}{4\pi\varepsilon_0}\frac{q}{x^2+(d/2)^2}\right)\frac{d/2}{r}$

$$E = \frac{1}{4\pi\varepsilon_0}\frac{q}{\left[x^2+\left(\frac{d}{2}\right)^2\right]}\frac{d}{\left[x^2+\left(\frac{d}{2}\right)^2\right]^{1/2}}$$

$$\boxed{E = \frac{1}{4\pi\varepsilon_0}\frac{p}{\left[x^2+\left(\frac{d}{2}\right)^2\right]^{3/2}}} \rightarrow (A) \qquad \because p = qd$$

Conclusion:-

This is the E. field due to a dipole, at a perpendicular bisector.



$x >>> d/2$

(A) $\rightarrow E = \frac{1}{4\pi\varepsilon_0}\frac{p}{(x^2)^{3/2}}$

Signature of E. dipole is

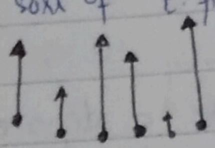
$$E = \frac{1}{4\pi\varepsilon_0}\frac{P}{x^3} \Rightarrow \boxed{E \propto \frac{1}{x^3}}$$

ELECTRIC FIELD PROPERTIES :-

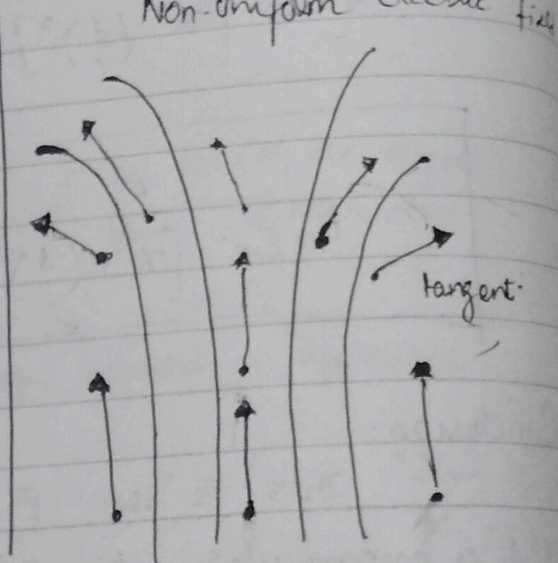
① Uniform Electric Field

No electric field so test charge will Remain at rest.

→ Experiencing force is due to sort of E. field.

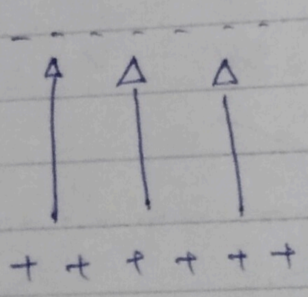


Non-uniform Electric field

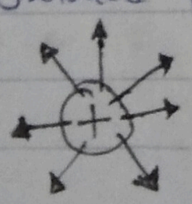


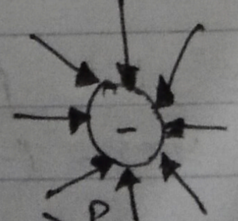
② Electric field lines start from positive and ends on negative.

e.g.:



③ Isolated positive charge





$P_1 > P_2 > P_3$

E↑ E↓ (B/c crossection area of E. Field.

*we have coulomb's law to calculate field so why do we need gauss's law.
⇒ Gauss's law is more accurate then coulomb's law.

20/Sept/2022

Gauss's Law

To calculate force between two charged particles.

Flux:- i) something which is flowing.
ii) From what part it is flowing (Area).

⇒ They generate air lines
⇒ There are alot of air field lines passing through it

Flux = field · area

$$\boxed{\Phi = \vec{F} \cdot \Delta\vec{A}}$$

Alot → Max
less → Min

$$\boxed{\Phi = F\Delta A \cos\theta}$$

Electric field:-

$$\boxed{\Phi_E = \vec{E} \cdot \Delta\vec{A}}$$

1) If flux is passing through a closed surface.
2) If flux is passing through a open surface.

⇒ thickness count of surfaces so having light thickness won't count anything

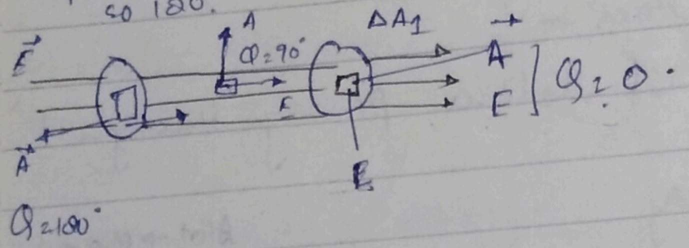
closed surface ⇒ $\phi = 0$

open surface ⇒ $\phi \neq 0$

27.2

Ingredients are Electric field & area & recipe is the dot product.

opposite in direction so 180°



Sol:-

$$\phi_E = E \Delta A$$

$$\Phi_E = \Phi_A + \Phi_B + \Phi_C$$

$$= E\Delta A_A \cos\theta + E\Delta A_B \cos\theta + E\Delta A_C \cos\theta.$$

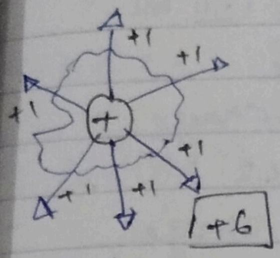
$$= E\Delta A \cos(0) + E\Delta A \cos(180) + E\Delta A \cos(90)$$

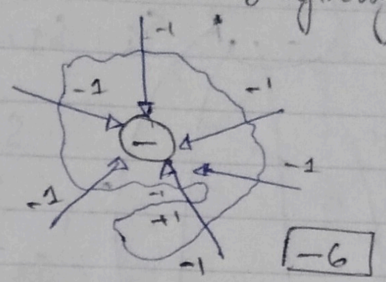
$$= \cancel{E\Delta A} + (-\cancel{E\Delta A}) + 0$$

$$\boxed{\phi_E = 0}$$ (closed surface).

Flux AND FIELD LINES :-

(Imaginary surface).



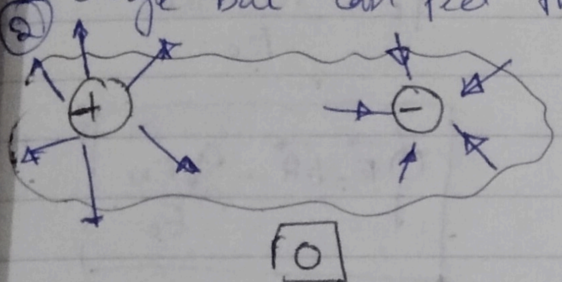


⇒ enter hoga jo −1

⇒ Exit hoga jo +1.

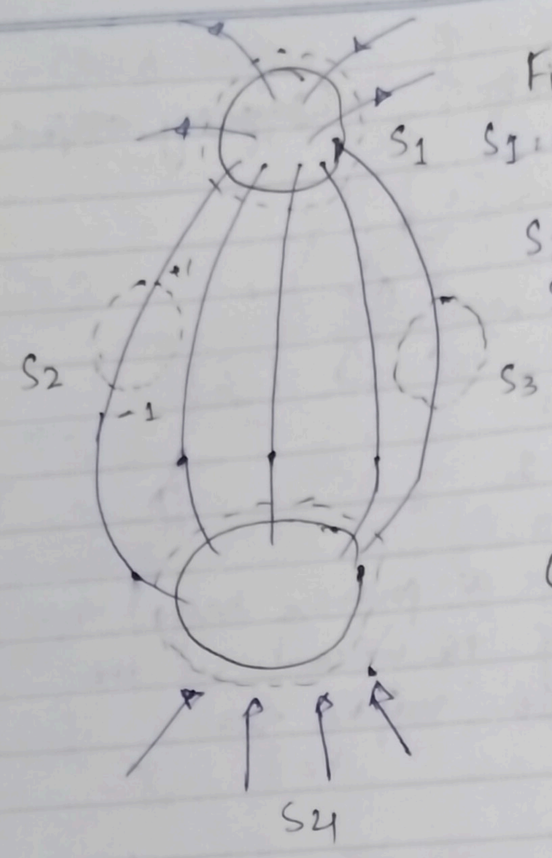
Conclusion:-

1. This implies that we have a positive charge inside the surface because of +6. we can't see the charge but can feel the surface area.

2. 

2. -ve charge

3. In 2 there is no E.F flux shows that .



Find charge (electric)

S_1: enter & leave $\boxed{+q}$ net +ve charge

S_2: no net charge

S_3 = $\boxed{-q}$ net -ve charge

Gauss's law:-

$$\Phi_E = \frac{q_{enclosed}}{\varepsilon_0}$$

$$\boxed{\oint \vec{E} \cdot \Delta \vec{A} = \frac{q_{EN}}{\varepsilon_0}}$$

$\oint$ closed

$\oint = \int$ means integration over closed surface

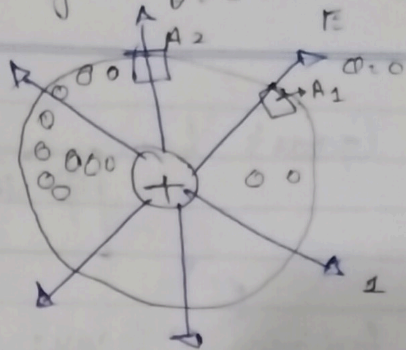
Q1- which one is more fundamental Gauss's law or coulomb's law?

(1) Guass law
(2) Why?

consider a sphere having charge q enclosed.

coulomb's law follow regular symmetry.

Gauss's law follow irregular symmetry. $\Phi = 0$



$$\oint E \cdot \Delta A = q/\varepsilon_0$$

$$E \oint \Delta A = \frac{q}{\varepsilon_0}$$

$$E(4\pi r^2) = \frac{q}{\varepsilon_0}$$

$$\boxed{E = \frac{1}{4\pi\varepsilon_0}\frac{q}{r^2}}$$ Coulomb's law

Gauss's Law is more fundamental because we can drive coulomb's Law from gauss's law.

4-Oct-2022

Gauss's Law:- $\boxed{\oint \vec{E} \cdot d\vec{A} = \frac{q}{\varepsilon_0}}$

Application of Gauss's Law:-

cone dimension}-

$\lambda \Rightarrow \frac{q}{l}$ linear charge density.

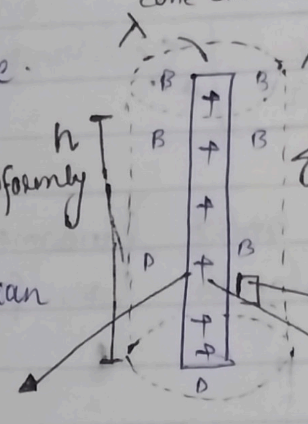
$\sigma \Rightarrow q/A$ surface charge density

$\rho \Rightarrow \frac{q}{V}$ volume charge density

① Infinite line of charge.
$E = ?$

*Charges are distributed uniformly in one direction

Suppose draw a gaussian surface.



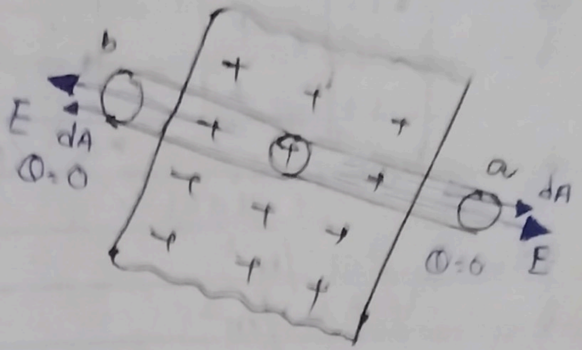
So:- E & A are always ∥ A/c to Gauss Law

$$\oint E \cdot dA = q/\varepsilon_0$$
$$E \oint dA = q/\varepsilon_0$$
$$E(2\pi r h) = q/\varepsilon_0 \text{ (area)}$$
$$\text{if} = \frac{q}{\varepsilon_0 2\pi r h}$$

Conclusion:- $\boxed{E = \lambda / 2\pi r \varepsilon_0}$

This is the formulae for E.F due to the infinite line of charge.
This is the electric field produced

(2) Infinite sheet of charge



A/c to Gauss Law:-

$$\oint E \cdot dA = \frac{q}{\varepsilon_0}$$

$$\oint_a E \cdot dA + \oint_b E \cdot dA = \frac{q}{\varepsilon_0}$$

$$EA + EA = q/\varepsilon_0$$

$$2EA = q/\varepsilon_0$$

$$E = q/2\varepsilon_0 A$$

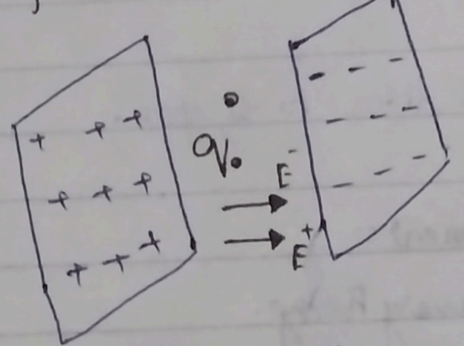
$$\boxed{E = \sigma/2\varepsilon_0}$$

CONCLUSION:-

This is the formula of E. Field Generated by infinite sheet of charge.

Q1- whats the E'F of test charge?

$\sigma_+ = \sigma_- = \sigma$



Q. which one is greater

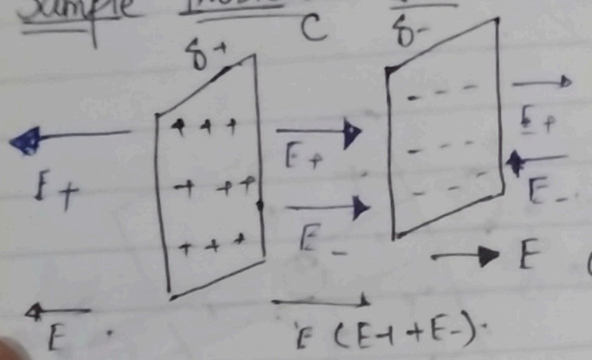
(1) $E = \frac{1}{2}\frac{\sigma}{\varepsilon_0}$ (2) $E = \frac{\sigma}{\varepsilon_0}$

$E = F/q$.

$$\vec{E} = E_+ + E_-$$

$$E = \frac{\sigma_+}{2\varepsilon_0} + \frac{\sigma_-}{2\varepsilon_0} \Rightarrow \boxed{E = \frac{\sigma}{\varepsilon_0}}$$

Sample Problem 27.3 -



⇒ E field produce by +ve charge is radially outward

⇒ E field produce by -ve charge is radially inward

$\sigma_+ = 6.8 \mu C/m^2$

$\sigma_- = -4.3 \mu C/m^2$

$E_C = ?\ ;\ E_L = ?\ ;\ E_R = ?$

$E_+ = \frac{\sigma_+}{2\varepsilon_0} = 3.84 \times 10^5 N/C$

$E_- = \frac{\sigma}{2\varepsilon_0} = 2.43 \times 10^5 N/C$

$E_C = E_+ + E_-$

$E_R = E_+ - E_-$

$E_L = E_+ - E_-$

* Potential Energy varies from system to system.

* Energy is classified into its components.

⇒ Potential Energy is different for everything.

ENERGY :-

① K.E $= \frac{1}{2}mv^2$

② P.E :-

$(P.E)_g = mgh$

$(P.E)_e = \frac{1}{2}Kx^2$

Electric Potential Energy AND Potential

(similarity) :-

Firstly,

(simultaneously inverse square law distance).

$F = \frac{Gm_1m_2}{r^2}$ $\quad F = \frac{1}{4\pi\varepsilon_0}\frac{q_1q_2}{r^2}$

$\Delta U = -W_{ab}$

$= -\int_a^b F.d\vec{r}$

ΔK : Change in K.E

ΔU : Change in P.E

$\Delta K = W_{ab}$

$\Delta U = -W_{ab}$

$G = \times 10^{-11}$

$\Delta U = -\int_a^b \frac{Gm_1m_2}{r^2} d\vec{r}$

$= -Gm_1m_2 \int 1/r^2 \, dr$

$$\boxed{\Delta U = -Gm_1m_2\left(\frac{1}{r_b} - \frac{1}{r_a}\right)}$$

25/oct/2022.

Potential Energy

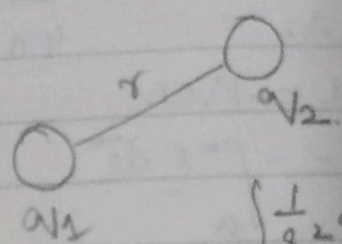
Formula..

$$\Delta U = -\int \vec{F} \cdot d\vec{s} \longrightarrow (1).$$

For electrostatic:-

$$F = \frac{1}{4\pi\varepsilon_0} \frac{q_1 q_2}{r^2} \longrightarrow (2).$$

Put (2) in (1).



(1) ⟹

$$\Delta U = -\int_a^b \frac{1}{4\pi\varepsilon_0} \frac{q_1 q_2}{r^2}\, dr$$

$$= \frac{-q_1 q_2}{4\pi\varepsilon_0} \int_a^b \frac{1}{r^2}\, dr$$

$$\boxed{\Delta U = \frac{1}{4\pi\varepsilon_0} q_1 q_2 \left(\frac{1}{r_b} - \frac{1}{r_a}\right)}$$

$$\int \frac{1}{r^2}\, dr$$

$$\int r^{-2}\, dr$$

$$\left.\frac{r^{-2+1}}{-2+1}\right|_a^b$$

$$\left.\frac{r^{-1}}{-1}\right|_a^b$$

$$\left.\frac{-1}{r}\right|_a^b = \frac{-1}{r_b} + \frac{1}{r_a}$$

* For change in P.E of electrostatic b/w 2 points A & B.

There are certain cases where change in P.E will always remain same.

⇒ when we do work done against the field, we are storing the P.E

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⇒ G.P.E = mgh.

Q. Do we have it? Q. How much do we have it?

* going down from stairs PE is changing into K.E.

$(P.E)_g = mgh$
$= (60)(9.8)(20)$

b — h = 20m
a — ground

⇒ reference point for calculating P.E is

⇒ same mass then its possible that PE stored by them is mostly same.

⇒ heavier ↑ P.E ↑ (more store).

⇒ you have to do some work in storing some P.E

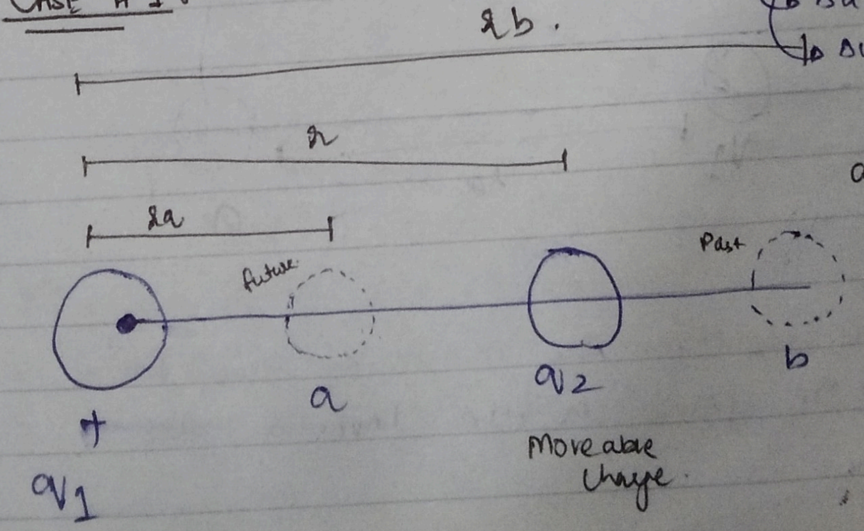
⇒ When we're storing some P.E you're doing some work (physics work). and that work is against the gravitational field. (storing it itself if we are doing against the G.F).

* Towards the G.F so we are losing P.E which we've stored.

CASE #1 :- (Similar charges) (x-along).

b → a = ?
a → b = ?
• ΔU > 0 ; ΔU < 0
• ΔU > 0 ; ΔU < 0
why?

a → b → by own
so P.E ↓



against the E.F :- storing it in

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Imp Question:

Case 2:-

(Disimition Charges) (x-ding)

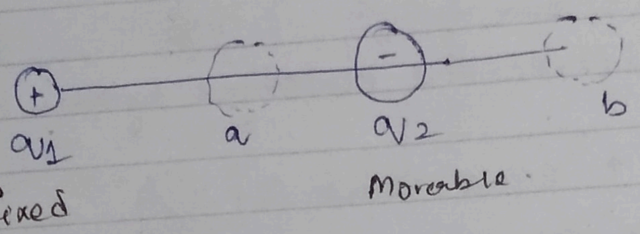
$\Delta K < 0$

$a \to b$; $\Delta U > 0$

$b \to a$; $\Delta U < 0$

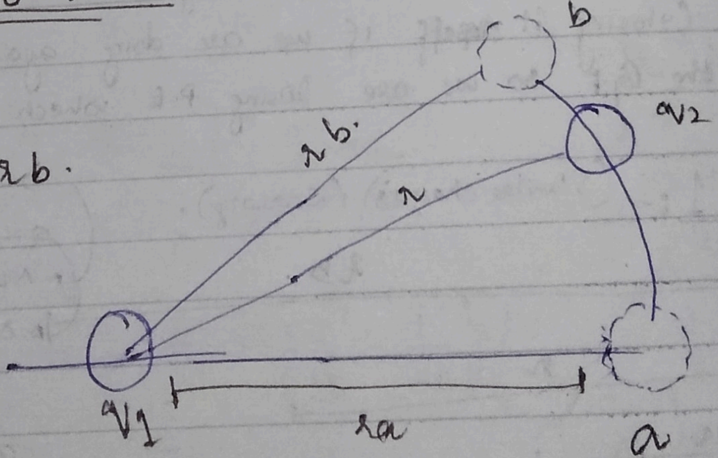
$\Delta K > 0$

* Because having different charges we will not have to apply force from a to b because the fo attraction they will move by themself.



CASE No # III:-

$r = r_a = r_b$.



* nucleons & electrons are moving at some sort of mass
* Radius from point a to b from r are same

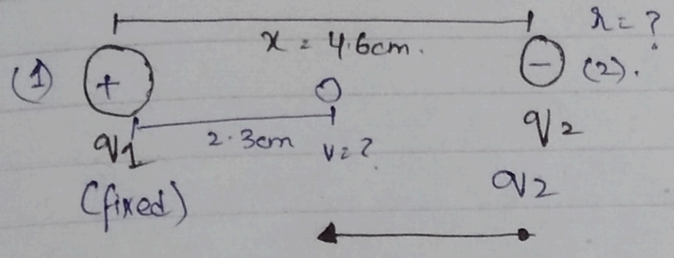
SP 28.2

Data:-

$m_1 = 0.0022\,kg$; $q_1 = 32\mu C$ $\times 10^{-6}$

$m_2 = 0.0039\,kg$; $q_2 = -18\mu C$

$x = 4.6\,cm$



* Calculate the velocity:- ?

Solution:-

Law of conservation of energy.

Before$_{(i)}$ = After (f).

$$U_i + K_i = U_f + K_f$$

$$U_i + 0 = U_f + K_f \qquad K_i = 0$$

$$K_f = U_i - U_f \qquad \because \Delta U = U_f - U_i$$

$$\boxed{K_f = -\Delta U.}$$

$$K_f = \frac{1}{4\pi\varepsilon_0} q_1 q_2 \left(\frac{1}{r_f} - \frac{1}{r_i}\right)$$

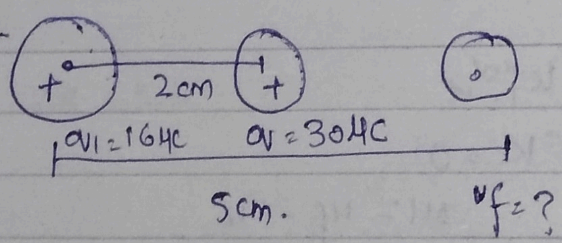
$$K_f = \frac{-1}{4\pi\varepsilon_0}(\;)(\;)\left(\frac{1}{0.023} - \frac{1}{0.046}\right).$$

$$\boxed{K_f = 113 J}$$

$$\frac{1}{2} m_2 v_f^2 = 113 \longrightarrow \boxed{v_f = 240 m/s}$$

From moving point

Q.-



$m_1 = 0.005 kg$

$m_2 = 0.0034 kg$.