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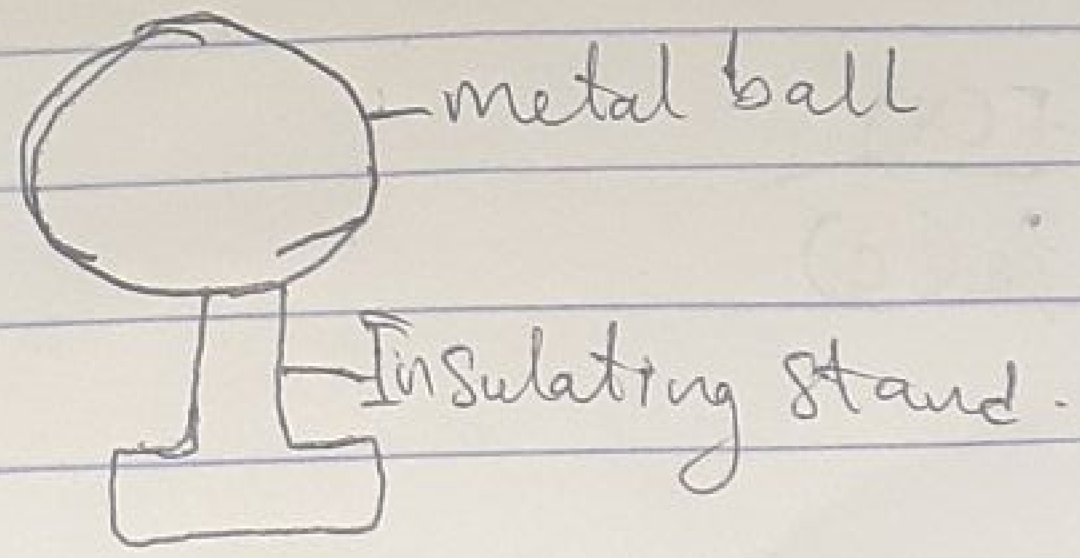
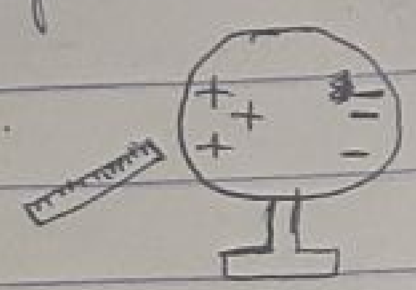
~~Phys~~ PHY102 Assignment

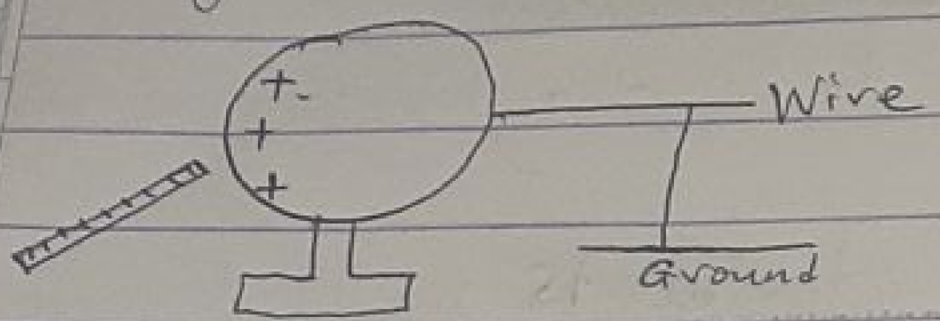
1a) - Firstly the materials to be charged is placed on an ~~...~~ insulating rod.
- Then a negatively charged material is brought near the sphere.
- The sphere is then earthed by connecting it momentarily to the ground by means of a wire.
- The wire is removed followed by the rod. On testing the sphere it will be discovered that it has charged opposite to that of the rod.

- uncharged metal sphere.



~~2a)~~ - Negative charge on the rod repels electrons creating zones of negative and positive inducted charge






The wire lets electron build up (induced negative charge) flow into the ground.

→ Wire is removed ball now has an electron deficient region of positive charge.

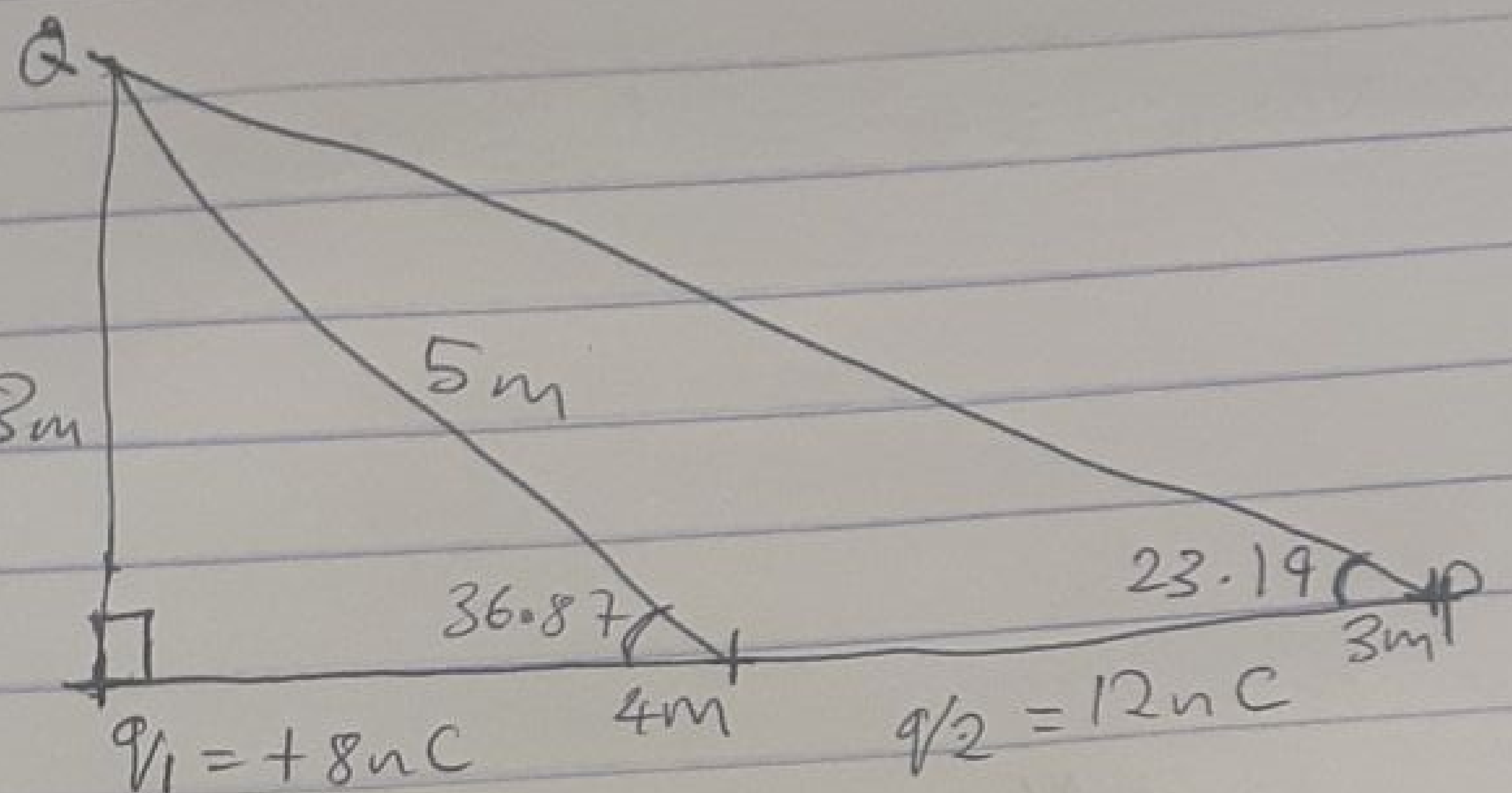
→ negatively charged ground

2a) Electric field: It is a region of space in which electric charge will experience an electric force.

Electric field intensity: It can be defined as the force per unit charge.

$$E = \frac{F(N)}{q_0(C)}$$

b) .




I.) $E_1 = \frac{KQ1}{r^2} = \frac{9\times10^9 \times 8\times10^{-9}}{7^2} = 1.47$

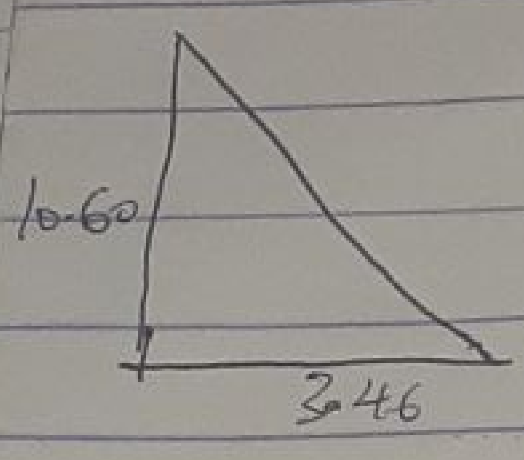
$E_2 = \frac{KQ2}{r^2} = \frac{9\times10^9\times8\times10^{-9}}{3^2} = 12.$

$= 13.47 N/C$

II.) $E_1 = \frac{9\times10^9\times8\times10^{-9}}{9} = 8$

$E_2 = \frac{9\times10^9\times12\times10^{-9}}{5^2} = 4.32$

| $x$ | |
|---|---|
| $8\times\cos(90)$ | $8\times\sin 90$ |
| $=0$ | $8.$ |
| $4.32\times\cos(36.87)$ | $4.32\times\sin(36.87)$ |
| $=3.46$ | $2.60$ |
| $3.46$ | $10.60$ |




$$x = \sqrt{10.6^2 + 3.46^2} = 11.15 \text{ N/C}.$$

3a)

i) Volume charge density

$$\rho = \frac{dQ}{dV} \longrightarrow dQ = \rho\, dV$$

ii) Surface charge density

$$\sigma = \frac{dQ}{dA} \longrightarrow dQ = \sigma\, dA$$

iii) Linear charge density

$$\lambda = \frac{dQ}{dL} \longrightarrow dQ = \lambda\, dL.$$

b i) $dW = F \cdot dL$

$$F = -q_0 E.$$

$$dW = -q_0 E\, dL$$

$$W(A \to B)_{Ag} = -q_0 \int_A^B E\, dL.$$

$$V_B - V_A = \frac{W(A \to B)_{Ag}}{q_0}$$

$$V_B - V_A = -\int_A^B E\, dL.$$

3C.)

$Q_1 = 10\,\mu C$ — 4m — $Q_2 = -2\,\mu C$.

$Q_1 = 10\,NC \quad Q_2 = -2\,NC$

$$V = \frac{1}{4\pi\varepsilon_0}\left[\frac{Q1}{r_1} \times \frac{Q2}{r_2}\right]$$

$$\frac{0}{9\times10^9} = \frac{10\times10^{-6}}{r_1} - \frac{2\times10^{-6}}{r_2}$$

$$2r = 10r_2$$

$$r = 5r_2$$

4a.) Magnetic flux is defined as the strength of the magnetic field which can be represented by line of forces. It is represented by the symbol (I) mathematically given as (I) = B.dA

b.) $M = 9.11\times10^{-31}\,Kg$. $r = 1.4\times10^{-7}\,m$. $B = 3.5\times10^{-1}$ weber/meter$^2$.

Cycloton frequency = angular speed.

$$\omega = \frac{V}{r} = \frac{qB}{m}$$

$$W = \frac{qB}{m} = \frac{1.6\times10^{-19}\times3.5\times10^{-1}}{9\times10^{-31}}$$

$$W = 62222.2222\,T^{-1}$$

c) We were given parameters such as-

i) Mass of the electron $= 9.11 \times 10^{-31}$ kg

ii) A radius of $1.4 \times 10^{-7}$ m.

iii) Magnetic fied of $3.5 \times 10^{-1}$ weber/meter square.

And we were asked to find the cyclotron frequency which is equal or the same thing as angular speed. It is called cyclotron frequency because it is a frequency of an accelerator called cyclotron.

Recall that angular speed is given as $w =$ substituting we have $w = 1.6 \times 10^{-10} \times 3.5 \times 10^{-10} / 9 \times 10^{-31}$.

$= 622222.222 \, T^{-1}$

b) $

5) Biot Savart law is an equation that describes the magnetic field by a current-carrying wire and allows you to calculate its strength at various points ---- And we replace the electric field E with a magnetic field element dB because a moving charge produces a magnetic field not an ~~electhric~~ electric field.

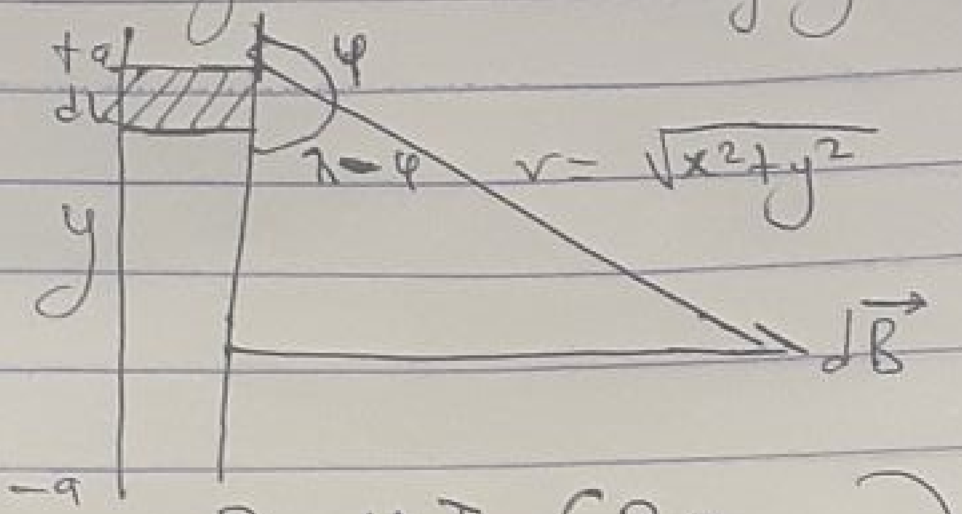
6) ~~Section~~ o

$\infty \quad \infty \quad \infty$

$$B = \frac{\mu_0 I}{4\pi} \int \frac{d\vec{s} \times A}{r^2}$$ — Radical direction, — Distance

$\mu_0 = 4\pi \times 10^{-7}\, T.m/A$

b) Section of a straight current carrying conductor.




$$B = \frac{\mu_0 I}{4\pi x}\left(\frac{2a}{(x^2+a^2)}\right)$$

When the length 2a of the conductor is very great in comparism with distance x from point P, we consider it infinitely long. That is, a is much larger than x.

$$(x^2+a^2)^{1/2} \cong a \text{ as } a \to \infty$$

In a physical situation, we have axial symmetry about y-axis. Thus, at all points in a circle of radius r, around the conductor, the magnitude of B is $B = \frac{\mu_0 I}{2\pi r}$ ----(1)

Equation (1) defines the magnitude of the magnetic field of flux density B near a long straight current carrying conductor.