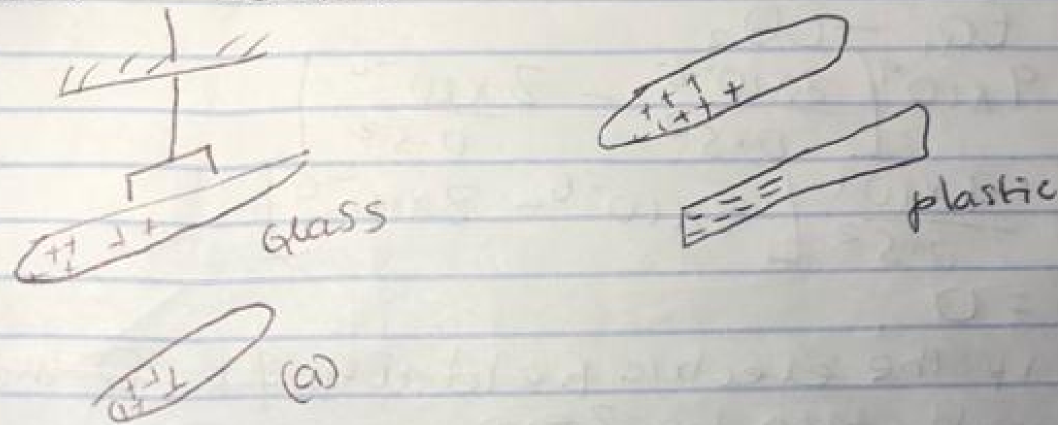
Phy102

1) Question 1

a Negative charge can be produce when we rub a glass rod with a silk clothe. Here a small amount of negative charge moves from the rod to the silk leaving the rod with a small amount of excess positive charge for better understand




b Given

$q_1 + q_2 = 5.0 \times 10^{-5} C$ --- (1)

Electric force $f = 1.0N$

Distance apart $= 2.0$

$$f = \frac{9 \times 10^9 q_1 q_2}{r^2} = \frac{1}{4\pi\varepsilon_0} \frac{q_1 q_2}{r^2}$$

$$q_1 q_2 = \frac{fd^2}{9 \times 10^9} = \frac{10 \times 2^2}{9 \times 10^9} = 4.44 \times 10^{-11} C$$

$$q_1 = \frac{4.44 \times 10^{-4}}{q_2} \quad \text{--- (2)}$$

$$\frac{4.44 \times 10^{-10}}{q_2} + q_2 = 5.0 \times 10^{-5}$$

$$4.44 \times 10^{-10} + q_2^2 = 5.0 \times 10^{-5} q_2$$

$$q_2^2 - 5 \times 10^{-5} q_2 + 4.44 \times 10^{-10} = 0$$

$$q_2 = 3.845 \times 10^{-5} C \text{ or } 1.1545 \times 10^{-5} C$$

Eq(1)

$$q_1 + q_2 = 5.0 \times 10^{-5}$$

$$q_1 = 5.0 \times 10^{-5} - 3.845 \times 10^{-5}$$

$Q_2 = 3.845 \times 10^{-5}$ C

c $d = 0.5$ cm

$Q_1 = Q_2 = 8\mu c$

$\therefore E = EQ_1 - EQ_2$

$= 9 \times 10^9 \left[ \frac{8 \times 10^{-6}}{0.5^2} - \frac{8 \times 10^{-6}}{0.5^2} \right]$

$= \frac{9 \times 10^9}{0.5^2} \left[ 8 \times 10^{-6} - 8 \times 10^{-6} \right]$

$E = 0$

Now if the electric field at q & P = 0 then force will also be zero

Hence $f = 0$

$E = 0$ at point q

Question 2

a Electric field is defined as a field of force surrounding a charged body. The f.

Electric field intensity is defined as the force per unit postive charge of that point

$E = \frac{F}{q}$, where f = electric force - N

q = " charge - C

b Given that

$Q_1 = 8\mu C$

$Q_2 = 12\mu C$

$r_1 = 4m$

$r_2 =$ 3cm

$P = ?$

Equation 3 becomes

$$B = \frac{\mu_0 I x}{4\pi}\left[\frac{y}{x^2(x^2+y^2)^{1/2}}\right]_{-a}^{a}$$

$$B = \frac{\mu_0 I x}{4\pi}\left(\frac{2a}{x^2(x^2+a^2)^{1/2}}\right)$$

when 2a of the conductor is very great in comparsion to its distance $x$ from point P, we consider it long

$$\therefore (x^2+a^2)^{1/2} = a \to \infty$$

$$\therefore B = \frac{\mu_0 I}{2\pi x}$$

Thus, at all points in a circle of radius r

$$B = \frac{\mu_0 I}{2\pi r}$$

magnitude of magnetic field of flux density B near a long, straight current carrying conductor

Question 4

1) magnetic flux is defined as the strength of magnetic field represent by lines of forces. It is usually represented by the symbols $\phi$

B) $$\omega = \frac{v}{r} \cdot \frac{qB}{m}$$

$$= \frac{1.6\times10^{-19} \times 3.5\times10^{-11}}{9.11\times10^{-31}}$$

$$= \frac{5.6\times10^{-28}}{9.11\times10^{-31}}$$

$$= 6.15\times10^{10}\ s^{-1}T^{-1} \text{ or } rad^{-1}s$$

c) 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.

$$E_1 = \frac{Q}{4\pi\epsilon_0 r^2} = \frac{9\times10^9 \times 8\times10^{-6}}{4^2} = 4.5\times10^3\ NC^{-1}$$

$$E_2 = \frac{Q}{4\pi\epsilon_0 r^2} = \frac{9\times10^9 \times 12\times10^{-6}}{3^2} = 12\times10^3\ NC^{-1}$$

$E_p - E_1 + E_2 = 4.5\times10^3 + 12\times10^3 \Rightarrow 16.5\times10^3\ NC^{-1}$

Net charge $= 12 + 8 = 20NC$

$F = qE = 20\times10^{-16} \times 16.5\times10^3$

$= 0.33N$

$$Q = \frac{20\times10^{-6} \times 9\times10^9}{3^2} = 20\times10^3\ NC^{-1}$$

To get the electric charge recall that

$$E = \frac{Q}{4\pi\epsilon_0 r^2} = 9\times10^9 \times \frac{Q}{r^2}$$

$$Q_p = \frac{E\times r^2}{9\times10^9} = \frac{16.5\times10^3 \times 7^2}{9\times10^9}$$

$= 8.98\ NC$

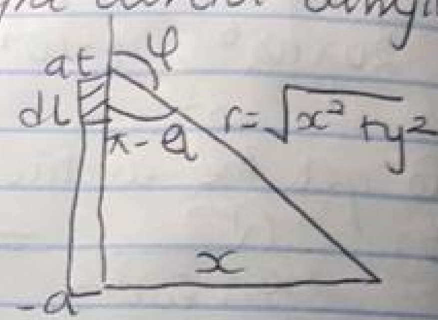
$$E_p = \frac{9\times10^9 \times 89.8\times10^{-6}}{3^2}$$

$E_p = 89.8\ NC^{-1}$

5 Question 5

Biot - Savart law is an equation that describes the magnetic field created by a current - carrying wire, and allow you to calculate its strength at various points.

6 Magnetic field of a straight current carrying conductor




$$B = \frac{\mu_0 I}{4\pi} \int_{-a}^{a} \frac{dl \sin \theta}{r^2}$$

$$\sin(\pi - \theta) = \sin\theta$$

$$\therefore B = \frac{\mu_0 I}{4\pi} \int_{-a}^{a} = dl \frac{(\pi - \theta)}{r^2}$$

from diagram

$$r^2 = x^2 + y^2$$

$$= dl \frac{(\pi - \varphi)}{x^2 + y^2} \quad -(1)$$

But $\sin(\pi - \varphi) = \frac{x}{\sqrt{x^2 + y^2}} = \frac{x}{(x^2 + y^2)^{1/2}}$ --(ii)

putting (ii) into (1)

$$B = \frac{\mu_0 I}{4\pi} \int_{a-}^{a} dl \frac{x}{(x^2 + y^2)(x^2 + y^2)^{1/2}}$$

$$B = \frac{\mu_0 I}{4\pi} \int_{a}^{a} dl \frac{x}{(x^2 + y^2)^{3/2}}$$

recall $dl = dy$

$$B = \frac{\mu_0 I x}{4\pi} \int_{a}^{a} \frac{1}{(x^2 + y^2)^{3/2}} dy \quad ---(3)$$