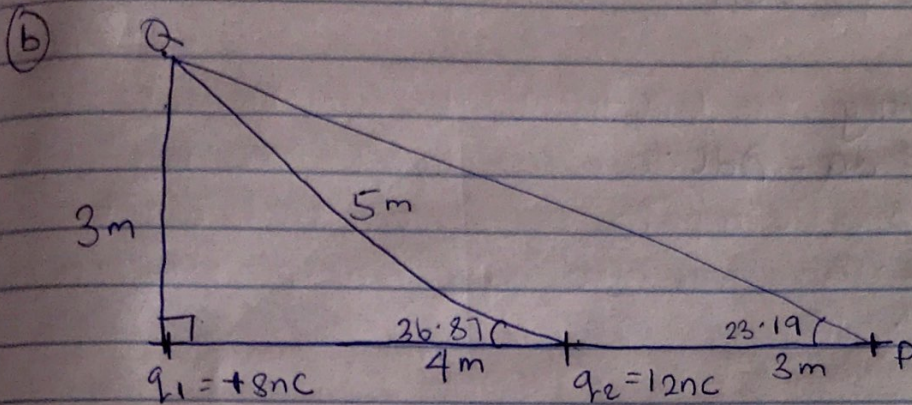


(2a) Electric field : It is a region of space in which an electric charge will experience an electric force.

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

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



$$(i) E_1 = \frac{kQ_1}{r^2} = \frac{9 \times 10^9 \times 8 \times 10^{-9}}{7^2} = 1.47$$

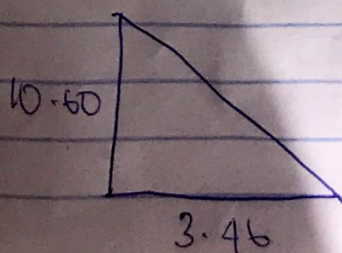
$$E_2 = \frac{kQ_2}{r^2} = \frac{9 \times 10^9 \times 12 \times 10^{-9}}{3^2} = 12$$

$$= 13.47 \text{ N/C}$$

$$(ii) E_1 = \frac{9 \times 10^9 \times 8 \times 10^{-9}}{9} = 8$$

$$E_2 = \frac{9 \times 10^9 \times 12 \times 10^{-9}}{5^2} = 4.32$$

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



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

1

3a)

i) Volume charge density.

$$\rho = \frac{dQ}{dV} \rightarrow dQ = \rho dV.$$

ii) Surface charge density

$$\sigma = \frac{dQ}{dA} \rightarrow dQ = \sigma dA.$$

iii) Linear charge density

$$\lambda = \frac{dQ}{dL} \rightarrow dQ = \lambda dL.$$

3b)

$$dW = F \cdot dL.$$

$$F = -q_0 E.$$

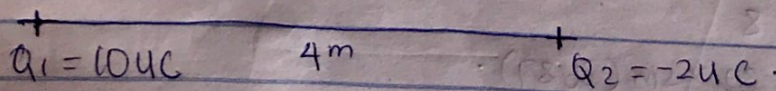
$$dW = -q_0 E dL.$$

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

$$V_B - V_A = \frac{W(A \rightarrow B)_{Ag}}{q_0} \quad \text{it follows the definition.} \quad \equiv$$

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

3c)



$$Q_1 = 10 \mu C \quad Q_2 = -2 \mu C$$
$$V = \frac{1}{4\pi\epsilon_0} \left[\frac{Q_1}{r_1} + \frac{Q_2}{r_2} \right].$$

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

$$2r_1 = 10r_2 \quad ; \quad r_1 = 5r_2$$

Referring to the diagram above, the position along the x-axis where $V = 0$ is 5m from $Q_1 = 10\mu C$ and 1m from $Q_2 = -2\mu C$.

4a) Magnetic Flux is defined as the strength of the magnetic field which can be ~~represented~~^{represented} by line of forces. It is represented by the symbol Φ mathematically given as $\Phi = B \cdot dA$.

b) $m = 9.11 \times 10^{-31} \text{ kg}$, $r = 1.4 \times 10^{-7} \text{ m}$, $B = 3.5 \times 10^{-1} \text{ weber/meter}^2$.
cyclotron Frequency = angular speed

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

$$\omega = \frac{qB}{m} = \frac{1.6 \times 10^{-19} \times 3.5 \times 10^{-1}}{9 \times 10^{-31}}$$

$$\omega = 62222.2222 \text{ T}^{-1}$$

③ We were given parameters such as

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

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

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

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 ~~eyes~~ cyclotron.

Recall that angular speed is given as $\omega =$ substituting we

$$\text{have } \omega = \frac{1.6 \times 10^{-19} \times 3.5 \times 10^{-1}}{9 \times 10^{-31}}$$

$$= 62222.2222 \text{ T}^{-1}$$

change in length, the radius and magnetic field. It can be represented mathematically by $B = \frac{\mu_0 I}{4\pi r^2} dl \times \hat{r}$ where μ_0 is a constant called permeability of free space. The unit of μ_0 is weber/meter square.

$$B = \frac{\mu_0 I}{4\pi} \frac{dl \times \hat{r}}{r^2}$$

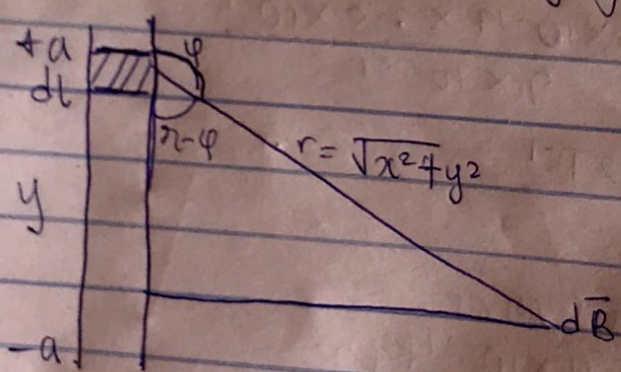
(5) Biot Savart law is an equation that describes the magnetic field created by a current-carrying wire, and allows you to calculate its strength at various points. And we replace the electric field E with a magnetic field element dB because a moving charge produces a magnetic field not an electric field.

$$B = \frac{\mu_0 I}{4\pi} \int \frac{d\vec{s} \times \hat{r}}{r^2}$$

Permeability of free space length of segment Radical direction
Distance

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

(b) Section of a straight current carrying conductor.



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

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

$$B = \frac{\mu_0 I}{2\pi x} \quad \text{as } a \rightarrow \infty$$

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

$$B = \frac{\mu_0 I}{2\pi r} \dots \text{--- (1)}$$

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