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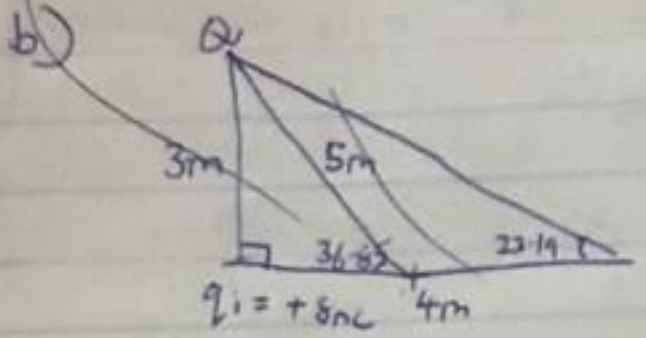
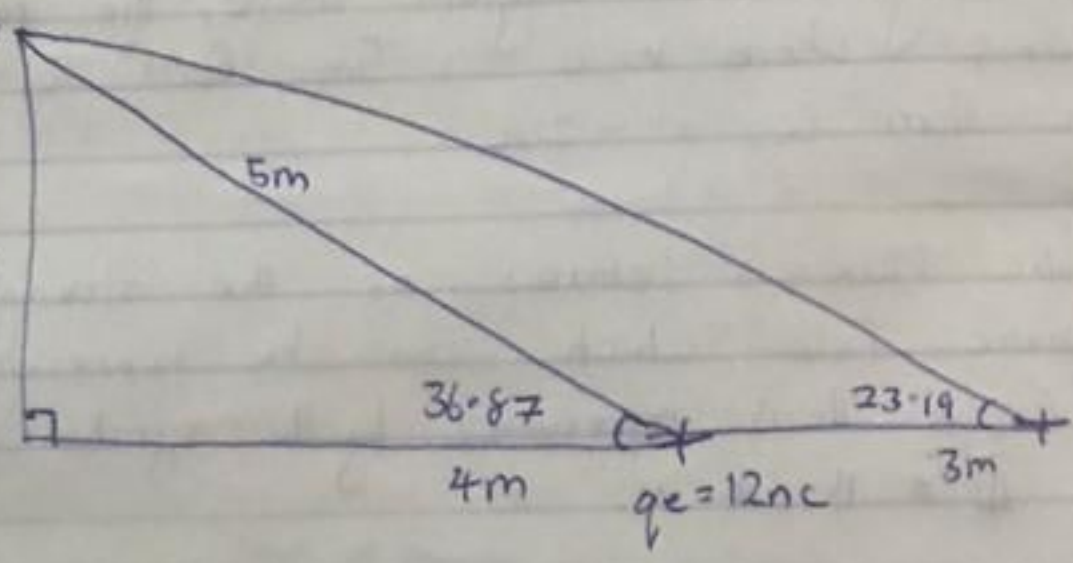
Electrical / Electronics Engineering
19/ENG04/041
PHYSICS 102

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

b)



b)



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

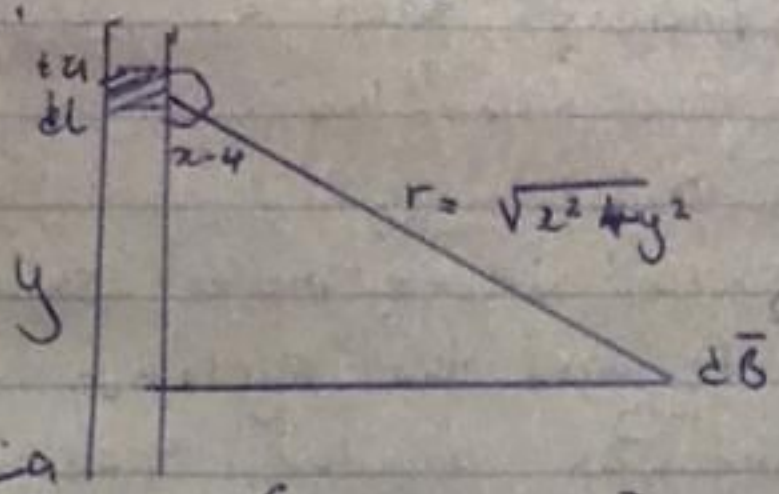
$E_2 = \frac{kQ_2}{r^2} = \frac{9 \times 10^9 \times 8 \times 10^{-9}}{3^2} = 12$

$= 1.47 + 12$
$= 13.47 N/C$

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

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

Eg) Section of a straight current carrying conductor



$$B = \frac{U_0 I}{4\pi x} \left(\frac{2a}{(x^2 + a^2)^{1/2}} \right)$$

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

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

$$B = \frac{U_0 I}{2\pi x}$$

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

$$B = \frac{U_0 I}{2\pi r} \quad \text{---- (1)}$$

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

4) A

4C) We were given parameters such as

i) Mass of the electron = 9.11×10^{-31} kg

ii) A radius of 1.4×10^{-7} m

iii) Magnetic field of 3.5×10^{-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 $w = 1.6 \times 10^{-10} \times 3.5 \times 10^{-1} / 9 \times 10^{-31}$

$= 62222.222\bar{2}^{-1}$

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

Permeability of free space

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

$d\vec{s}$ — length of segment

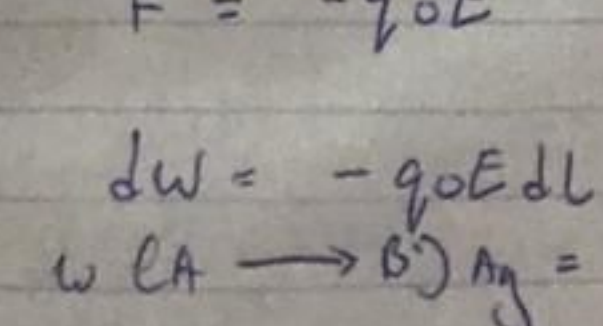
$\hat{r}$ — Radical direction

r^2 — Distance

$\mu_0 = 4.7 \times 10^{-7}$ T·m/A

6)

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



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

3a)

1) Volume Charge density

$$P = \frac{dQ}{dV} \longrightarrow dQ = P\,dv$$

2) Surface Charge density

$$6 = \frac{dQ}{dA} \longrightarrow dQ = 6\,dA$$

3) Linear Charge density

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

b) $dW = F \cdot dL$

$$F = -q_0 E$$

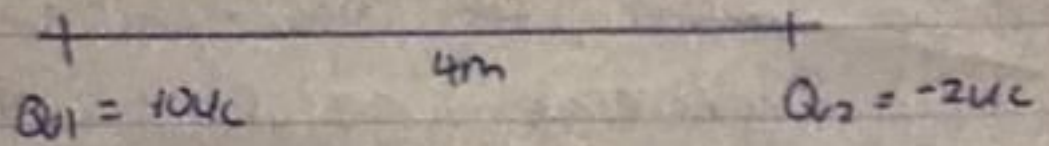
$$dW = -q_0 E\,dL$$

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

$$V_B - V_A = \frac{W(A-B)_{Ag}}{q_0}$$ It allows the definition

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

3c)



$Q_1 = 10\mu C$ $\quad Q_2 = 2\mu C$

$$V = \frac{1}{4\pi\varepsilon_0}\left[\frac{Q_1}{r_1} \times \frac{Q_2}{r_2}\right]$$

$$\frac{0}{d \times 0^4} = \frac{10 \times 10^{-6}}{r_1} - \frac{2 \times 10^{-6}}{r^2}$$

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

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 by line of forces. It is represented by the symbol Φ mathematically given as $\Phi = B \cdot dA$

b) $m = 9.11 \times 10^{-31} kg$ $\quad r = 1.4 \times 10^{-7} m$ $\quad B = 3.5 \times 10^{-1}$ weber/meter^2

cyclotron frequency = angular speed

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

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

$$w = 62222.2222 T^{-1}$$