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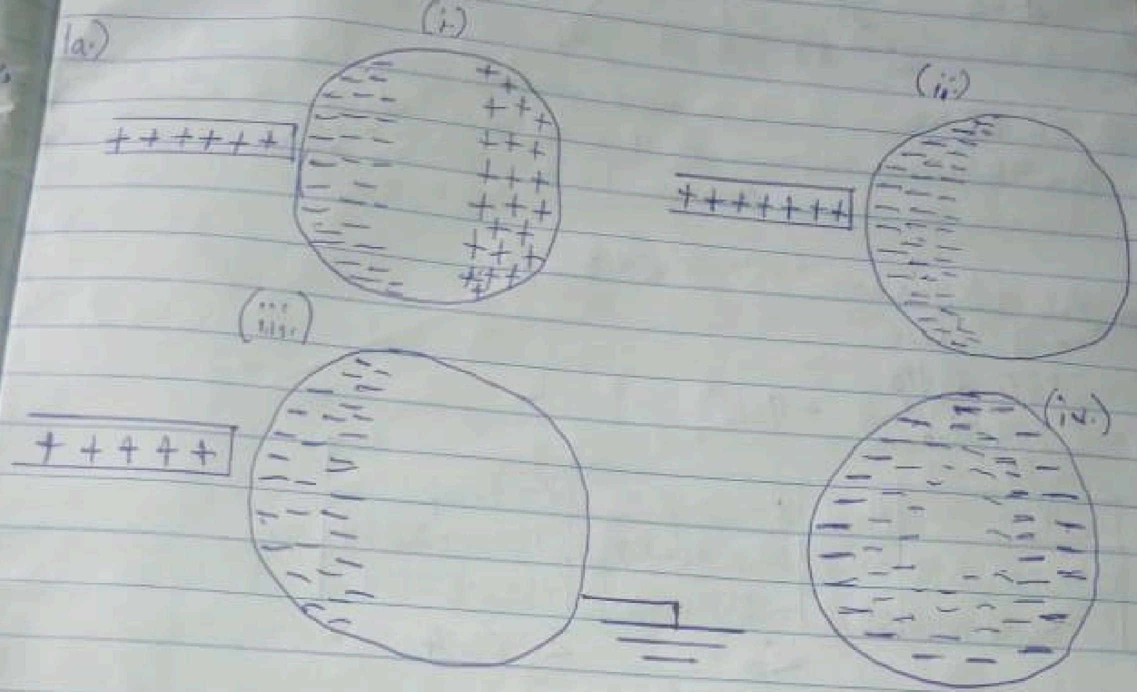
MBBS.
19/MBS01/190.

Phy 102.

1a.)



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

$F = \frac{k q_1 q_2}{r^2} \Rightarrow \frac{Fr^2}{K} = q_1 q_2$ Where $F = 1N$, $r = 2m$, $k = 9 \times 10^9$

$q_1 q_2 = \frac{1 \times 2^2}{9 \times 10^9} = 4.444 \times 10^{-10}$

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

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

$q_1(5.0 \times 10^{-5} - q_1) = 4.444 \times 10^{-10}$

$q_1^2 - (5.0 \times 10^{-5} q_1) + 4.444 \times 10^{-10} = 0$

$$\frac{5.0 \times 10^{-5} + \sqrt{(5.0 \times 10^{-5} - 4(4.444 \times 10^{-10})}}{2}$$

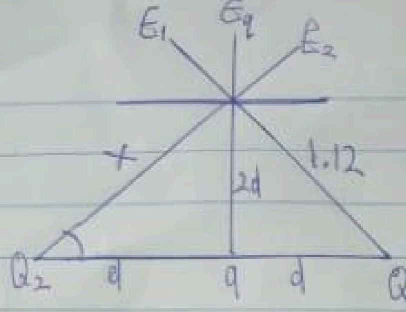
$\boxed{q_1 = 3.84 \times 10^{-5} C}$

$q_2 = 50 \times 10^{-5} - 3.84 \times 10^{-5}$

$\boxed{q_2 = 1.16 \times 10^{-5} C}$

c.)

$d = 0.5$



$x^2 = 1^2 + 0.5^2$

$\sqrt{x^2} = \sqrt{1.25}$

$x = 1.12$

$Q_2 = Q_1 = 8 \times 10^{-6}$

$E_2 = E_1$

$\tan\theta = \frac{opp}{adj}$

$\theta = \tan^{-1}\left(\frac{1}{0.5}\right)$

$\theta = 63.43^\circ$

$E_2 = \frac{Kq_2}{r^2} = \frac{9 \times 10^9 \times 8 \times 10^{-6}}{(1.12)^2} = 57397.95918$

$E_1 = 57397.95918$

$E_q = \frac{Kq}{r^2} = \frac{9 \times 10^9 \times q}{1} = 9 \times 10^9 q$

Vector	Angle	X-Comp	Y-Comp
$E_1 = 57397.95918$	63.4	25700.45785	51322.62339
$E_2 = 57397.95918$	63.4	-25700.45785	51322.62339
		$\Sigma_x = 0$	$\Sigma_y = 102645.2568$

$E_q = \sqrt{(0)^2 + (102645.2568)^2}$

$E_q = 0 + 102645.2568 = 102645.2568$

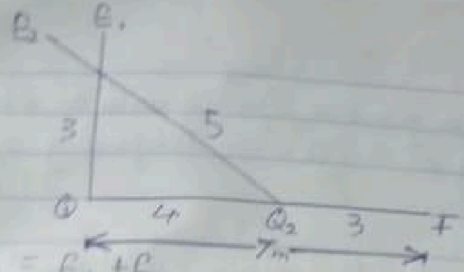
$q = \frac{E_q}{9 \times 10^9} = \frac{102645.2568}{9 \times 10^9}$

$q = 1.14 \times 10^{-5} C$

2a)

- Electric field is a region or space in which an electric charge will experience an electric force
- Electric field intensity can be defined as the force per unit charge

2b)



$\tan\theta = \frac{opp}{adj}$

$\theta = \tan^{-1}\left(\frac{3}{4}\right)$

$\theta = 36.9°$

$E_{net} = E_1 + E_2$

$E_1 = \frac{Kq_1}{r^2} = \frac{9\times10^9 \times 8\times10^{-9}}{7^2} = 1.469\ N/C$

$E_2 = \frac{Kq_2}{r^2} = 9\times10^9 \times 12\times10^{-9} = 12\ N/C$

$E_{net} - 12 + 1.469$

i) $E_{net} = 13.469$ or $13.5\ N/C$

ii) $E_1 = \frac{KQ_1}{r^2} = \frac{9\times10^9 \times 8\times10^{-9}}{3^2} = 8\ N/C$

$E_2 = \frac{KQ_2}{r^2} = \frac{9\times10^9 \times 12\times10^{-7}}{5^2} = 4.32\ N/C$

Vector	Angle	X-Comp	Y-Comp
$E_1 = 8N/C$	90°	0	8
$E_2 = 4.32N/C$	36.9°	−3.45	2.59

$\Sigma_x = -3.45$ $\Sigma_y = 10.59$

$E_{net} = \sqrt{(-3.45)^2 + (10.39)^2}$

$= 11.14\ N/C$

$E_{net} - 11.14\ N/C$

4(a) Magnetic flux is defined as the strength of the magnetic field represented by lines of force.

4(b) $m = 9.11\times10^{-11}\ Kg$, $r = 1.4\times10^{-7}$, $B = 3.5\times10^{-1}$ weber/m^2

$q = -1.6\times10^{-n}$

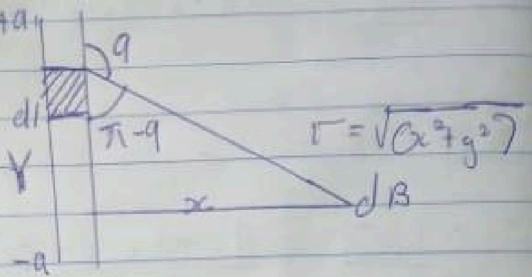
$\omega = \frac{qB}{m} = \frac{-1.6\times10^{-19} \times 3.5\times10^{-1}}{9.11\times10^{-31}}$

$\omega = -6.15\times10^{10}$ rad/s

4(c) The arrow is negative because we are dealing with an electron but the electron is moving at a cyclotron frequency of 6.15×10^{10} rad/s.

5(a) The Biot-Savart law is an equation that describes the magnetic field created by a current-carrying wire and allows you to calculate the strength at various points.

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



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

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

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

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

but $\sin(\pi - a) = \dfrac{x}{\sqrt{x^2+y^2}} = \dfrac{x}{(x^2+y^2)^{\frac{1}{2}}}$ — (2)

substituting (2) into (1)

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

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

Using special integrals,

$$\int \frac{dy}{(x^2+y^2)^{3/2}} = \frac{y}{x^2 \sqrt{(x^2+y^2)}}$$

Equation (3) becomes

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

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

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

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

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