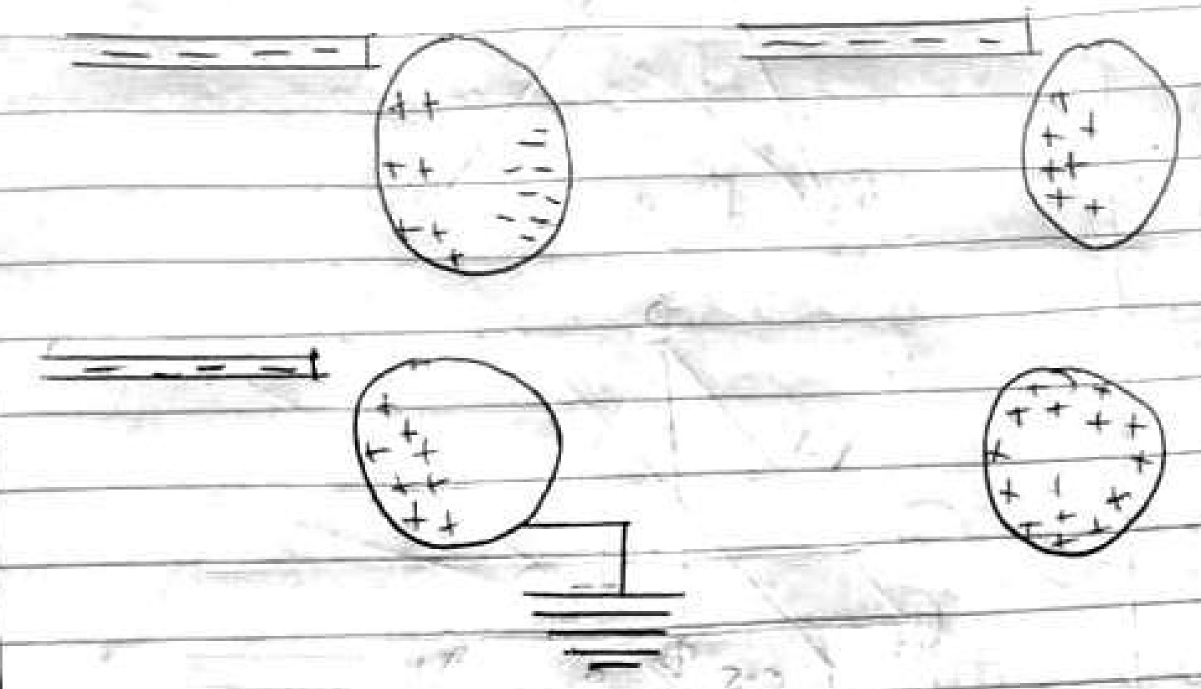
Answers to Physics 102 Assignment.

1a.

1



1b. Solution

$F = 1N$, $\cancel{d=}\, r = 2m$ $\quad Q = 5.0\times10^{-5}C$ $\quad q_1 + q_2 = Q = 5.0\times10^{-5}$

$F = \frac{k q_1 q_2}{r^2}$

$1 = \frac{9\times10^9 \times q_1 q_2}{2^2}$

$\frac{4}{9\times10^9} = \frac{\cancel{9\times10^9}\, q_1 q_2}{\cancel{9\times10^9}}$

$q_1 q_2 = 4.44\times10^{-10}$ --- equ(1).

$q_1 + q_2 = 5.0\times10^{-5}$

$q_1 = 5.0\times10^{-5} - q_2$ --- equ(2).

Put equ(2) into(1).

$q_2\,[5.0\times10^{-5} - q_2] = 4.44\times10^{-10}$

$5.0\times10^{-5} q_2 - q_2^2 = 4.44\times10^{-10}$

$-q_2^2 + 5.0\times10^{-5} q_2 - 4.44\times10^{-10} = 0.$

$q_2 = 3.845\times10^{-5}C$ or $q_2 = 1.155\times10^{-5}C.$

$q_1 = 3.845\times10^{-5}C \quad q_2 = 1.155\times10^{-5}C.$

$E_P = E_{q_1} + E_{q_2} + E_q$

$E_{q_1} = \frac{kq_1}{r_1^2} = \frac{9\times10^9 \times 8\times10^{-6}}{1.1^2} = 59504\ N/C$

$E_{q_2} = \frac{kq_2}{r^2} = \frac{9\times10^9 \times 8\times10^{-6}}{1.1^2} = 59504\ N/C$

$E_q = \frac{kq}{r^2} = \frac{9\times10^9 \times q}{1^2} = 9\times10^9 q\ N/C$

| Vector | angle | x.com | y.com |
|---|---|---|---|
| $E_{q_1} = 59504$ | $63.4°$ | $-59504\cos63.4$ $= -26643\ N/C$ | $59504\sin63.4$ $= 53205\ N/C$ |
| $E_{q_2} = 59504$ | $63.4$ | $59504\cos63.4$ $= 26643$ | $59504\sin63.4$ $= 53205$ |
| $E_q = 9\times10^9 q$ | $90$ | $9\times10^9 q\cos90$ $0$ | $9\times10^9 q\sin90 = 9\times10^9 q$ |
| | | $\Sigma E_{fx} = 0$ | $\Sigma E_{fy} = 106410 + 9\times10^9 q$ |

$E_Q = \sqrt{0^2 + (106410 + 9\times10^9 q)^2}$

$E_Q = 106410 + 9\times10^9 q$

at $E_Q = 0$

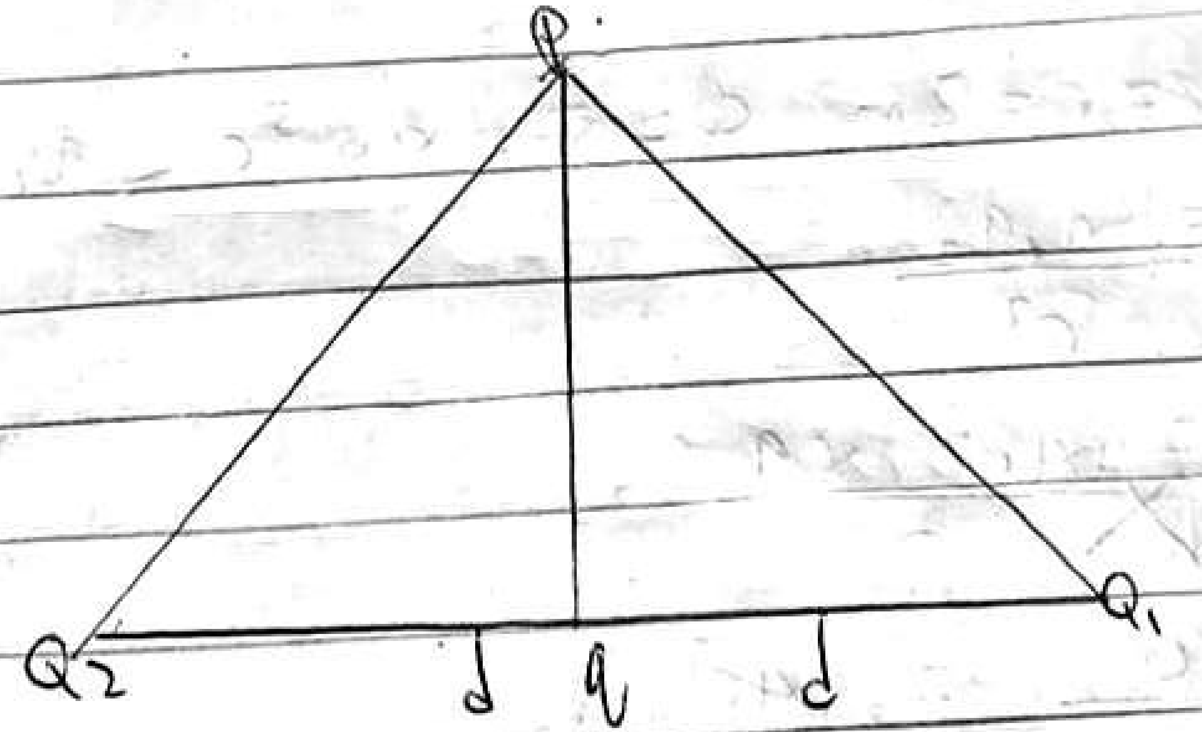
$106410 + 9\times10^9 q = 0$

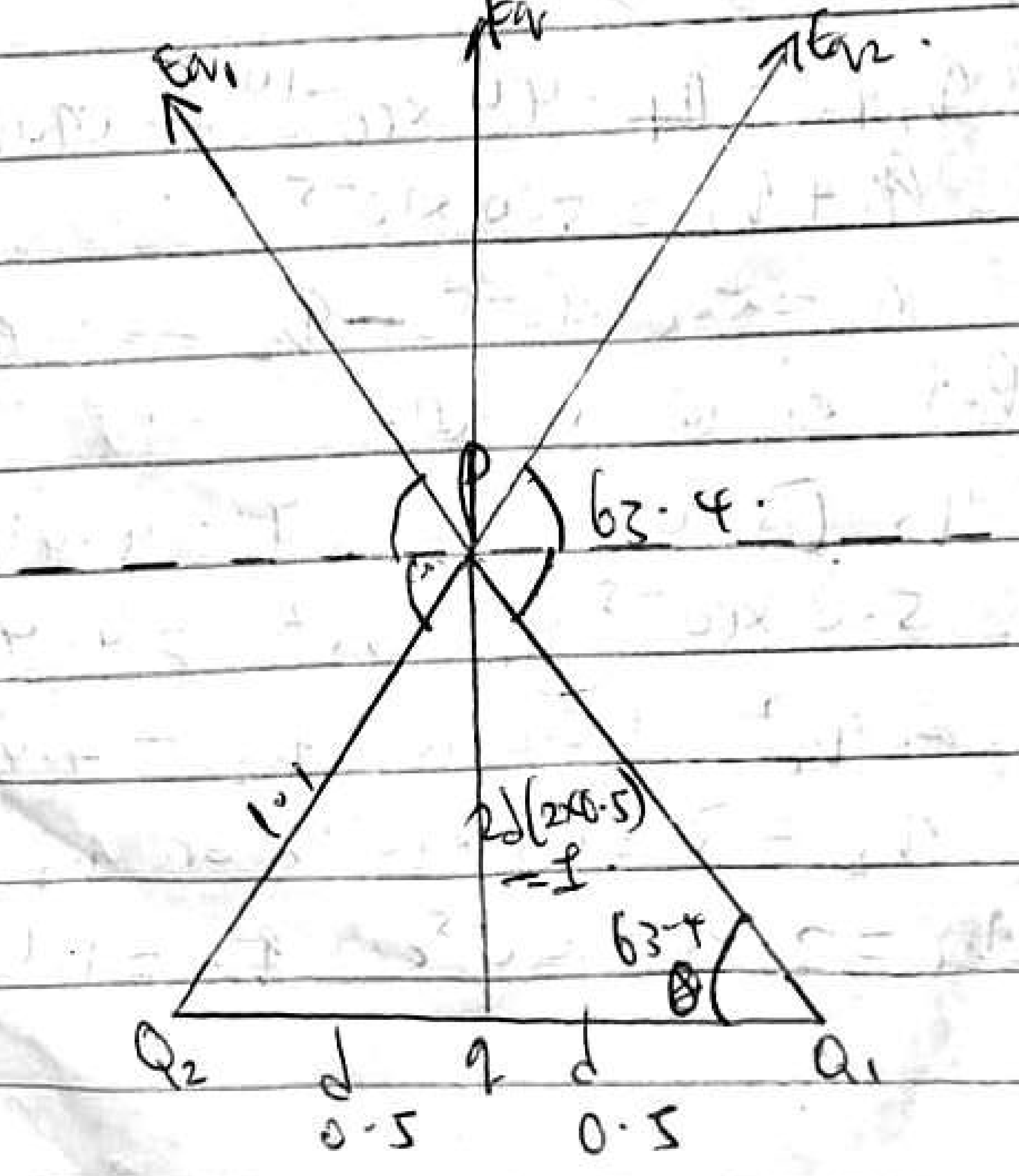
$\frac{\cancel{9\times10^9} q}{\cancel{9\times10^9}} = \frac{-106410}{9\times10^9}$

$q = -1.18\times10^{-5}\ C$

$q \simeq -12\ \mu C$

Ic.



Continuation of No 2.

| Vector | Angle | xcom | ycom |
|---|---|---|---|
| $E_1 = 8N/C$ | $90^\circ$ | $8\cos 90^\circ$ | $8\sin 90^\circ$ |
| | | $= 0$ | $= 8$. |
| $E_2 = 4.32N/C$ | $36.9^\circ$ | $-4.32\cos 36.9$ | $4.32\sin 36.9$ |
| | | $= -3.45$ | $2.59$ |
| | | $E_{fx} = -3.45$ | $E_{fy} = 10.59$ |

110)

$$E_{net_Q} = \sqrt{(-3.45)^2 + (10.59)^2}$$
$$= 11.14 N/C.$$

Section B (No 4 & 5)

No 4a. Magnetic flux is defined as the strength of the magnetic Field represented by lines of force. It is represented by the symbol $\phi$

4b. Solution

$M = 9.11 \times 10^{-31} kg$, $r = 1.4 \times 10^{-7} m$, $B = 3.5 \times 10^{-1} weber/M^2$

$\theta = 90^\circ$, $\omega = ?$ $q = -1.60 \times 10^{-19}$

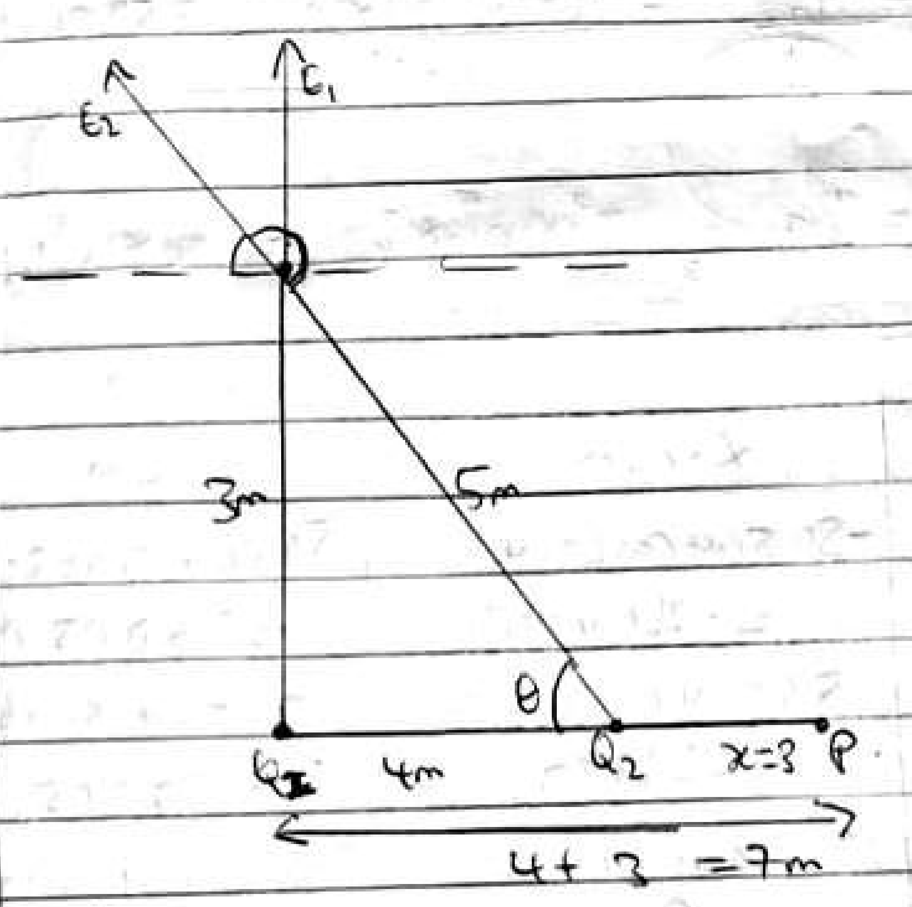
$$W = \frac{qB}{M_e}$$

$$W = \frac{-1.60 \times 10^{-19} \times 3.5 \times 10^{-1}}{9.11 \times 10^{-31}} = -6.15 \times 10^{10} rad/sec$$

4c. Since our cyclotron frequency is negative $-6.15 \times 10^{10}$ rad/sec, it means that the charge particle electron circulates in an/a negative or opposite direction of that angular frequency.

(2a) Electric field: is a region of space in which an electric charge will experience an electric force while Electric field intensity can be defined as the force per unit charge.

(2b). Solution




$E_{net_Q} = E_{Q_1} + E_{Q_2}$

$E_{Q_1} = \frac{kQ_1}{r^2} = \frac{9\times10^9 \times 8\times10^{-9}}{7^2} = 1.469\ N/C$

$E_{Q_2} = \frac{kQ_2}{r^2} = \frac{9\times10^9 \times 12\times10^{-9}}{3^2} = 12\ N/C$

$E_{net\,Q} = 1.469 + 12$
$= 13.469 \simeq \underline{13.5\ N/C}$

(ii). $E_{net_Q} = \vec{E_1} + \vec{E_2}$

$E_1 = \frac{kQ_1}{r^2} = \frac{9\times10^9 \times 8\times10^{-9}}{3^2} = 8\ N/C$

$E_2 = \frac{kQ_2}{r^2} = \frac{9\times10^9 \times 12\times10^{-9}}{5^2} = 4.32\ N/C$

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

(5b). Solution

Applying the Biot-savart law, we find the magnitude of the field $d\vec{B}$

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

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

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

from diagram $r^2 = x^2 + y^2$ (pythagoras theorem)

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

$$\text{But } \sin(\pi - \alpha) = \frac{x}{\sqrt{x^2+y^2}} = \frac{x}{(x^2+y^2)^{1/2}} \quad (xx)$$

Substituting $(xx)$ into $(x)$, we have

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

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

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