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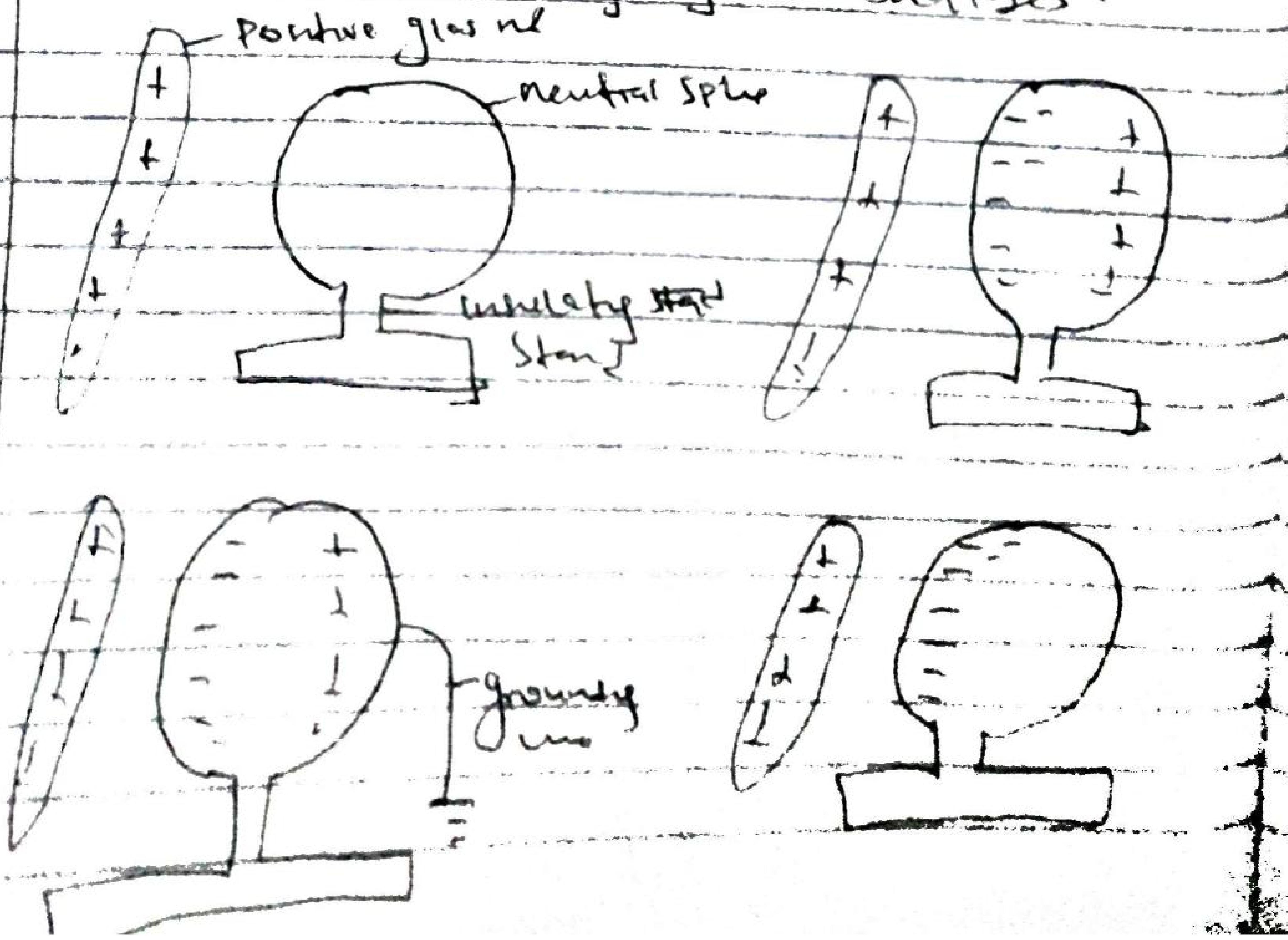
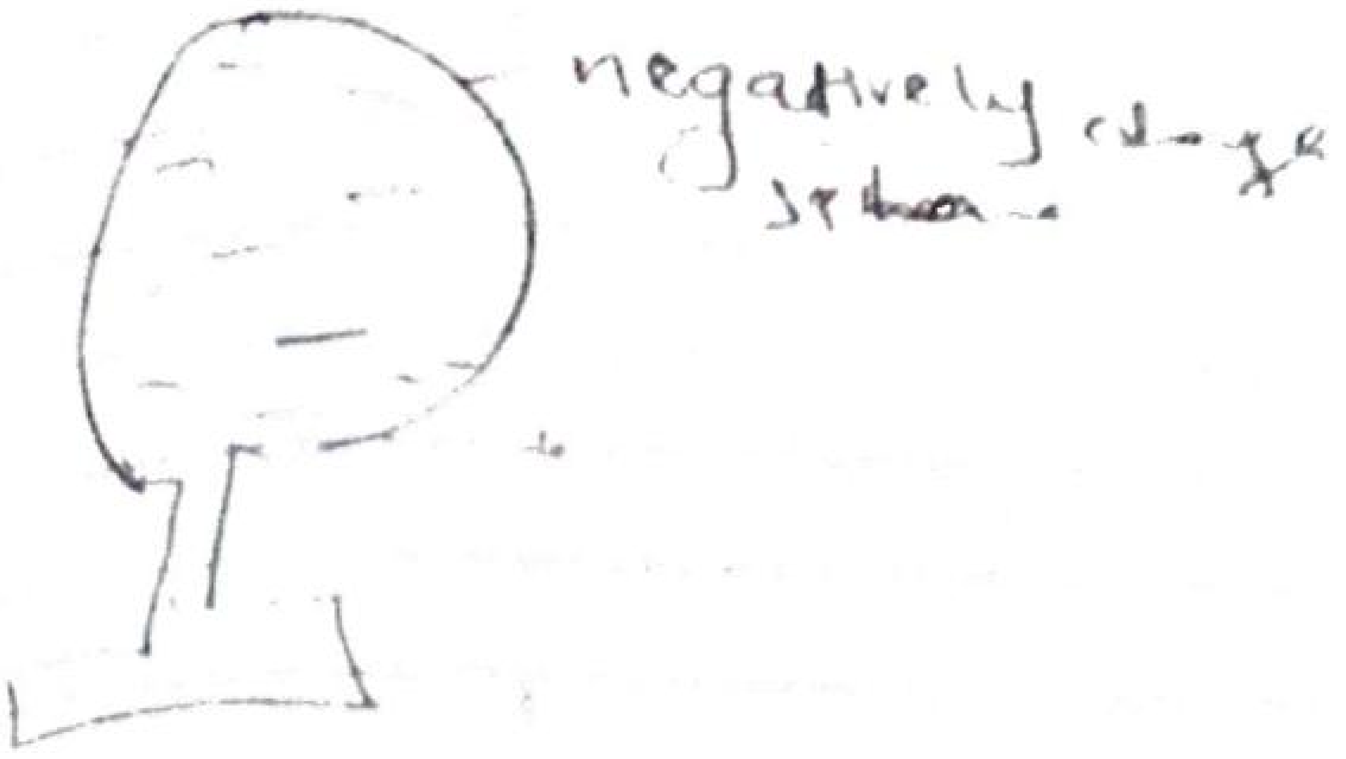
MATRIC NO: 19/MHS01/276
COURSE: PHY 102

1a. A positively charged glass rod is brought near a neutral conducting sphere that is insulated so there is no conducting path.
Repulsive force between the electrons in the rod and those in the sphere take effect it will lead to redistribution of charges in the sphere and the positive charges will move to the end away from the positive glass rod.
The region of sphere closest to the glass rod has a net excess of negative charges and the other end ~~has an excess~~ away from the ~~rod~~ has an excess of ~~neg~~ positive charges
A grounding wire is connected to the sphere and the positive charges from the far end travel to the ground leaving the sphere
The positive glass rod is now removed leaving the sphere with only negative charges.





(4) $F = \frac{K q_1 q_2}{r^2}$ $F = 1N$ $K = 8.99 \times 10^9 \, Nm^2/C^2$

$r = 2m$

$q_1 + q_2 = Q$ $q_1 = ?$

$q_2 = ?$

$q_1 + q_2 = 5.05 \times 10^{-5} C = Q$

$$1 = \frac{8.99 \times 10^9 \times (q_1 \times q_2)}{2^2}$$

$1 \times 4 = 8.99 \times 10^9 \times (q_1 \times q_2)$

$q_1 \times q_2 = \frac{4}{8.99 \times 10^9}$

$q_1 q_2 = 4.45 \times 10^{-10}$ . . . (1)

$q_1 + q_2 = 5.05 \times 10^{-5}$ . . (2)

from (2) $q_1 = 5.05 \times 10^{-5} - q_2$ . . . (3)

subs (3) into eqn (1)

$(5.05 \times 10^{-5} - q_2)(q_2) = 4.45 \times 10^{-10}$

$5.05 \times 10^{-5} q_2 - q_2^2 = 4.45 \times 10^{-10}$

$q_2^2 - 5.05 \times 10^{-5} q_2 + 4.45 \times 10^{-10} = 0$

using quadratic equation formula ...

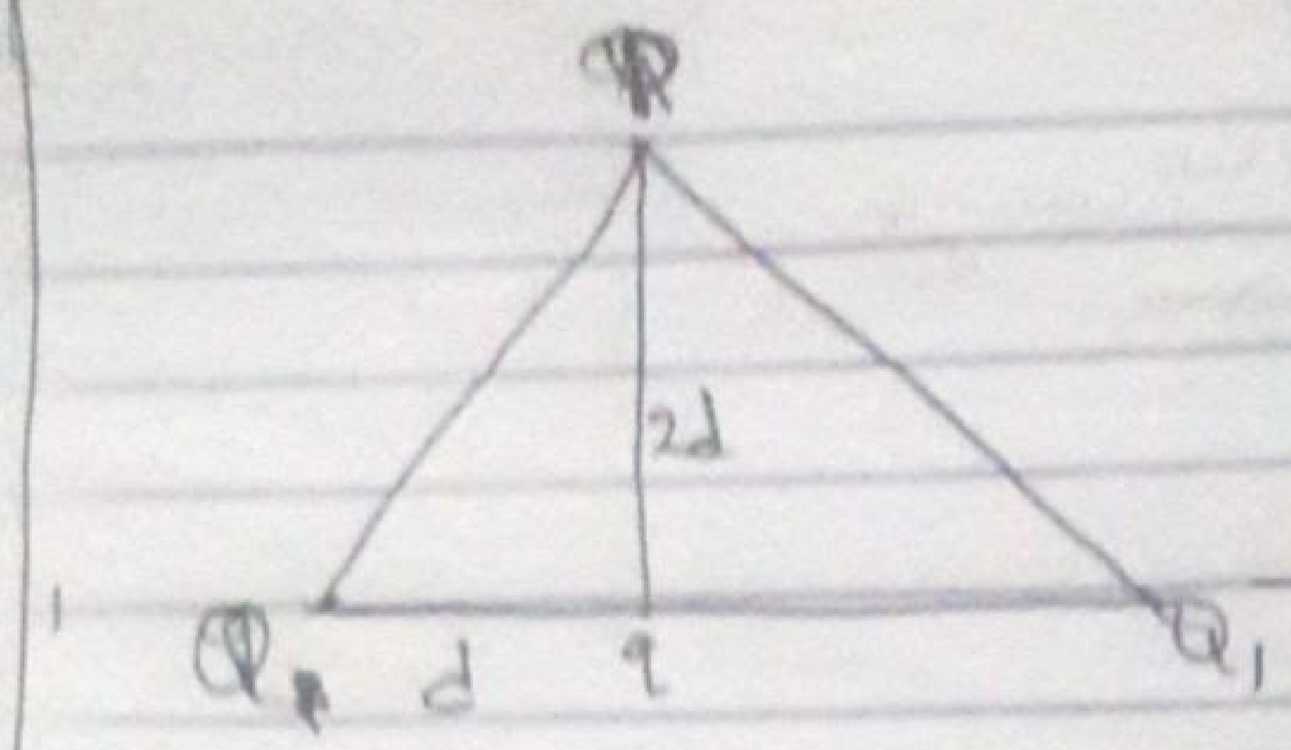
$q_2 = 3.912 \times 10^{-5} C$ or $q_2 = 1.137 \times 10^{-5} C$

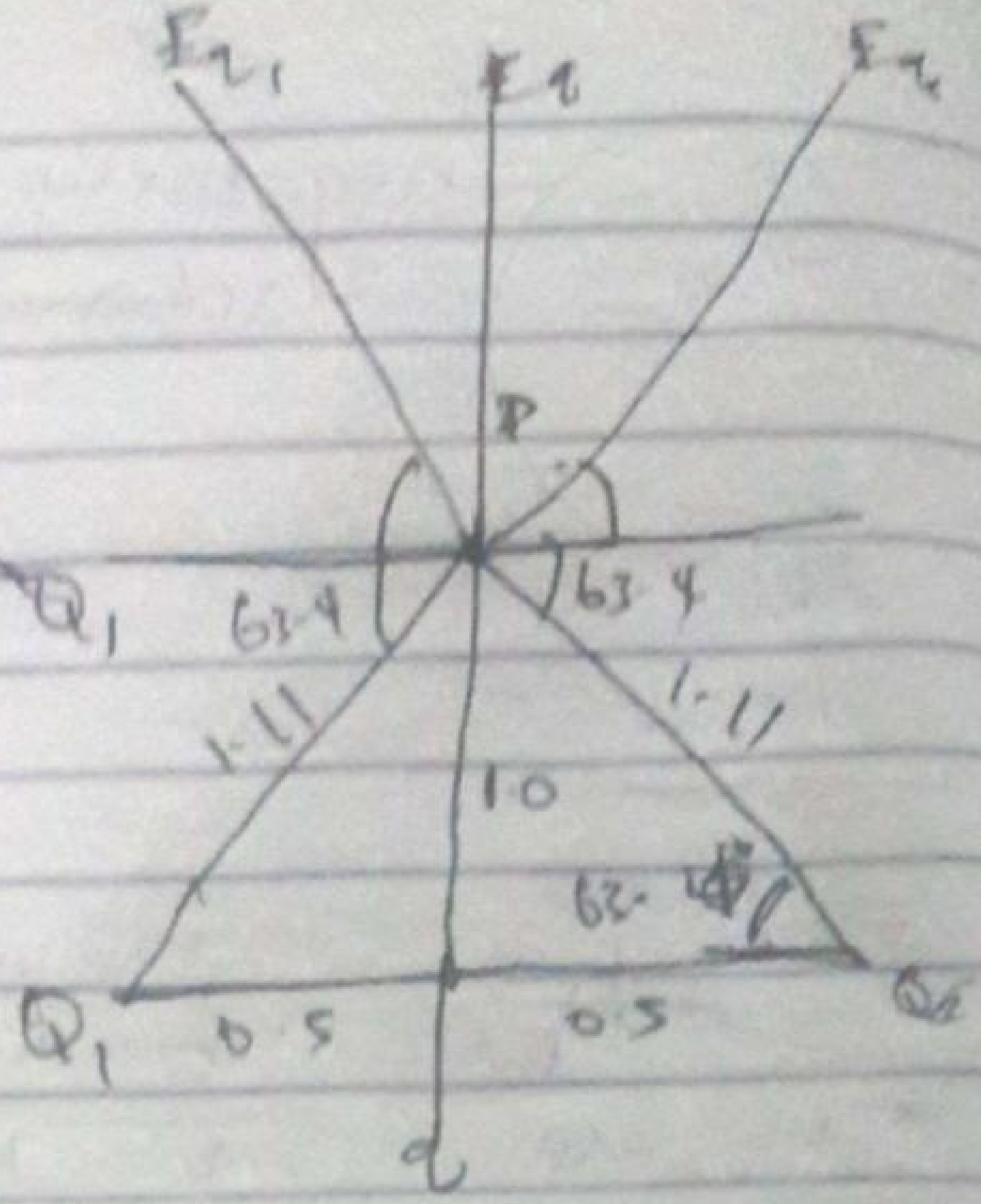
when $q_2 = 3.912 \times 10^{-5} C$ when $q_2 = 1.137 \times 10^{-5} C$

$q_1 = 5.05 \times 10^{-5} - 3.912 \times 10^{-5}$ $q_1 = 5.05 \times 10^{-5} - ($

$q_1 = 1.137 \times 10^{-5} C$ $q_1 = 3.912 \times 10^{-5}$

1c.





$Q_1 = Q_2 = 8\mu C = 8.0\times10^{-6}C$

~~$E_q = \frac{KQ_1}{r} = 8qq$~~

Angle at Q_1 and Q_2 = $\tan\theta = \frac{opp}{adj}$

$\tan\theta = \frac{1.0}{0.5}$

$\theta = \tan^{-1}2 = 63.4°$

Distance of Q_1 and Q_2 to P $= \sqrt{1.0^2 + 0.5^2}$

$= \sqrt{1 + 0.25}$

$= \sqrt{1.25}$

$= 1.11$

~~vecto~~ $E_{q_1} = \frac{Kq_1}{r_1^2} = \frac{8.99\times10^9 \times 8\times10^{-6}}{1.1^2} = 59438.02NC^{-1}$

$E_{q_2} = \frac{Kq_2}{r^2} = \frac{8.99\times10^9\times8\times10^{-6}}{1.1^2} = 59438.02NC^{-1}$

$E_q = \frac{Kq}{r^2} = \frac{8.99\times10^9\times q}{1^2} = 8.99\times10^9 q\ NC^{-1}$

Vector	angle	x	Y
$E_{q_1} = 59438.02$	63.4°	$-59438.02\cos63.4$ $= -26613.9$	$59438.02\sin63.4$ $= 53146.75$
$E_{q_2} = 59438.02$	63.4°	$59438.02\cos63.4$ $= 26613.9$	$59438.02\sin63.4$ $= 53146.75$
$E_q = 8.99\times10^9 q$	90	$8.99\times10^9\cos90$ $= 0$	$8.99\times10^9 q\sin90$ $= 8.99\times10^9$
		Σfx 0	$106293.5 + 8.99\times10^9$

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$E_Q = \sqrt{0^2 + (106293.5 + 8.99\times10^9 q)^2}$

$E_Q = 106293.5 + 8.99\times10^9 q$

at $R = 0$ $E_q = 0$

$106293.5 + 8.99\times10^9 q = 0$

$8.99\times10^9 q = -106293.5$

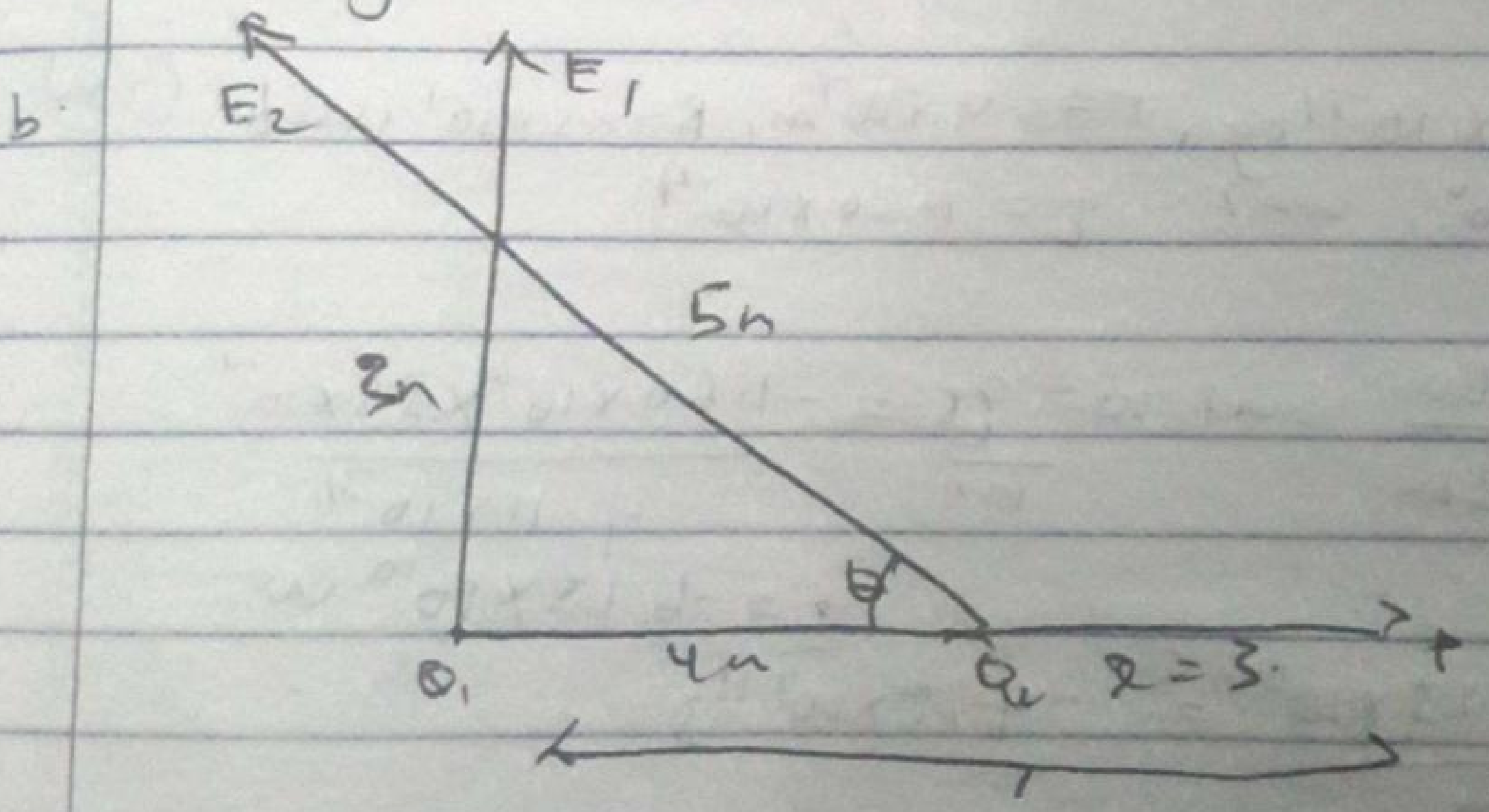
$q = \frac{-106293.5}{8.99\times10^9}$

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

$q = -11.8\ NC$

29\. Electric field is a region of space in which electric charge will experience an electric force while Electric field intensity is the force exerted by a single charge i.e force per unit charge

b.



$E_{net\,Q} = E_{q_1} + E_{q_2}$

$Eq_1 = \frac{KQ_1}{r^2} = \frac{8.99\times10^9\times8\times10^{-9}}{7^2} = 1.467\ NC^{-1}$

$Eq_2 = \frac{KQ_2}{r^2} = \frac{8.99\times10^9\times12\times10^{-9}}{3^2} = 11.98\ NC^{-1}$

$E_{net\,Q} = Eq_1 + Eq_2 = 1.467 + 11.98 = 13.45\ N/C$

(ii) $E_{net\,Q} = \vec{E_1} + \vec{E_2}$ $\therefore F_1 = \frac{KQ_1}{r^2} = \frac{8.99\times10^9\times8\times10^{-9}}{3^2} = ?$

$E_1 = 7.99 NC^{-1}$

$E_2 = \frac{KQ_1}{r^2} = \frac{8.99\times10^9 \times 12\times10^{-9}}{5^2} = 4.3152 NC^{-1}$

Vector	Angle	X axis	Y axis
$E_1 = 7.99$	$90°$	$7.99\cos 90 = 0$	$7.99\sin 90 = 7.99$
$E_2 = 4.32 N/C$	$36.9°$	$-4.32\cos 36.9 = -3.45$	$4.32\sin 36.9 = 2.59$
		$\Sigma F_y = -3.45$	$\Sigma F_x = 10.58$

$$E_{net\,Q} = \sqrt{(-3.45)^2 + (10.58)^2} = 11.14 NC^{-1}$$

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

(b) $m = 9.11\times10^{-31} kg$, $r = 1.4\times10^{7} m$, $B = 3.5\times10^{-1}$ weber/m² (Tesla)
$\theta = 90°$, $\omega = ?$ $q = 1.60\times10^{-19}$
$f = ?$

$f = \frac{\omega}{2\pi}$ but $\omega = \frac{qB}{m} = \frac{-1.60\times10^{-19} \times 3.5\times10^{-1}}{9.11\times10^{-31}} = -6.15\times10^{10}\ \omega$

$f = \frac{-6.15\times10^{10}}{2\pi} = -9.78\times10^{9} Hz$

(c) Since our cyclotron frequency is negative it means the electron circulates in an opposite direction to the angular frequency

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

Solution

Applying 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)

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

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

substituting (2) into (1)

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

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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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