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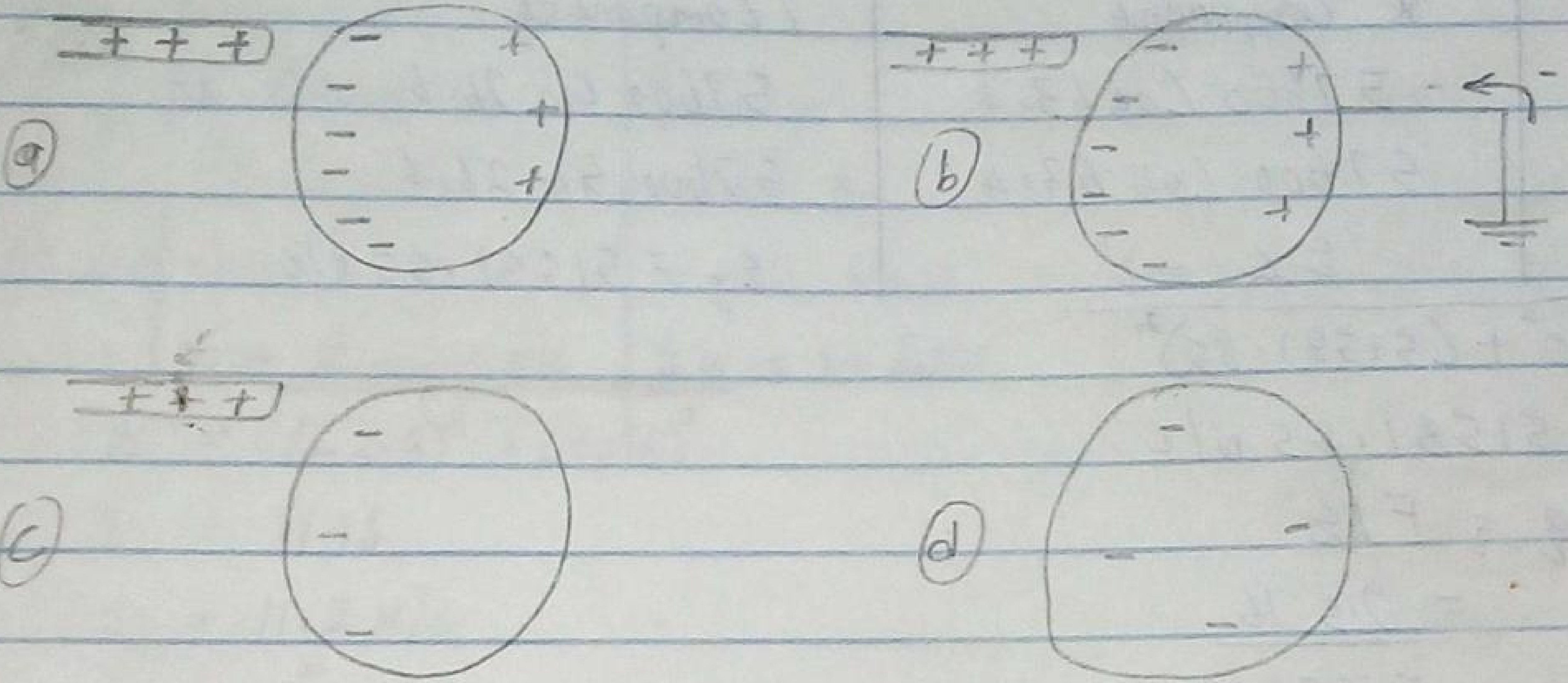
PHY 102 Assignment

(1a) A positively Charged rubber rod is brought near a neutral Conducting sphere, due to the attractive force, the electrons will flow from the ground to the sphere when the sphere is connected to the ground with a wire



(1b)

Given $q_1 + q_2 = 5\times10^{-5}\,C$

$F = \frac{kq_1q_2}{r^2}$ $\qquad q_1 = 5\times10^{-5}\,C - q_2$

$\cancel{q_1q_2 = \frac{Fr^2}{k} = \frac{1\times2^2}{9\times10^9} = \frac{4}{9}\times10^{-9}}$

$1 = \frac{9\times10^9(5\times10^{-5} - q_2)q_2}{2^2}$

$4 = 4.5\times10^5 q_2 - 9\times10^9 q_2^2$

$9\times10^9 q_2^2 - 4.5\times10^5 q_2 + 4 = 0$

Using : $q_2 = -b \pm \sqrt{b^2-4ac}/2a$ $\quad a = 9\times10^9 \quad b = -4.5\times10^5 \quad c = 4$

$q_2 = \frac{4.5\times10^5 \pm \sqrt{(-4.5\times10^5)^2 - 4(9\times10^9\times4)}}{2(9\times10^9)}$

$q_2 = \frac{4.5\times10^5 \pm \sqrt{5.85\times10^{10}}}{1.8\times10^{10}}$

$q_2 = 3.84\times10^{-5}\,C$ OR $q_2 = 1.16\times10^{10}\,C$

1c $F = \frac{kQQ_2}{r^2}$

$F = \frac{9\times10^9 (8\times10^{-6})^2}{1^2} = 0.576N$

$\varepsilon_1 = \frac{kq_1}{r^2} = \frac{9\times10^9 \times 8\times10^{-6}}{\left(\frac{\sqrt{5}}{2}\right)^2}$

$\varepsilon_1 = 57600 N/C$

$\varepsilon_1 = \varepsilon_2$

Vectors	x Component	y Component
ε_1	$-57600 \cos 63.4$	$57600 \sin 26.6$
ε_2	$57600 \cos 63.4$	$57600 \sin 26.6$
	$\varepsilon x = 0$	$\varepsilon_y = 51581.85 N/C$

$\varepsilon = \sqrt{0^2 + (51581.85)^2}$

$\varepsilon = 51581.85 N/C$

$q = F/\varepsilon$

$= \frac{0.576}{51581.85}$

$q = 1.1 \times 10^{-5}$

$q = 11 \times 10^{-6}$

$q = 11 NC$

2a The electric field is a region around a Charge in which it exerts electrostatic force on another Charges. While the streght of electric at any point in space is Called electric field intensity

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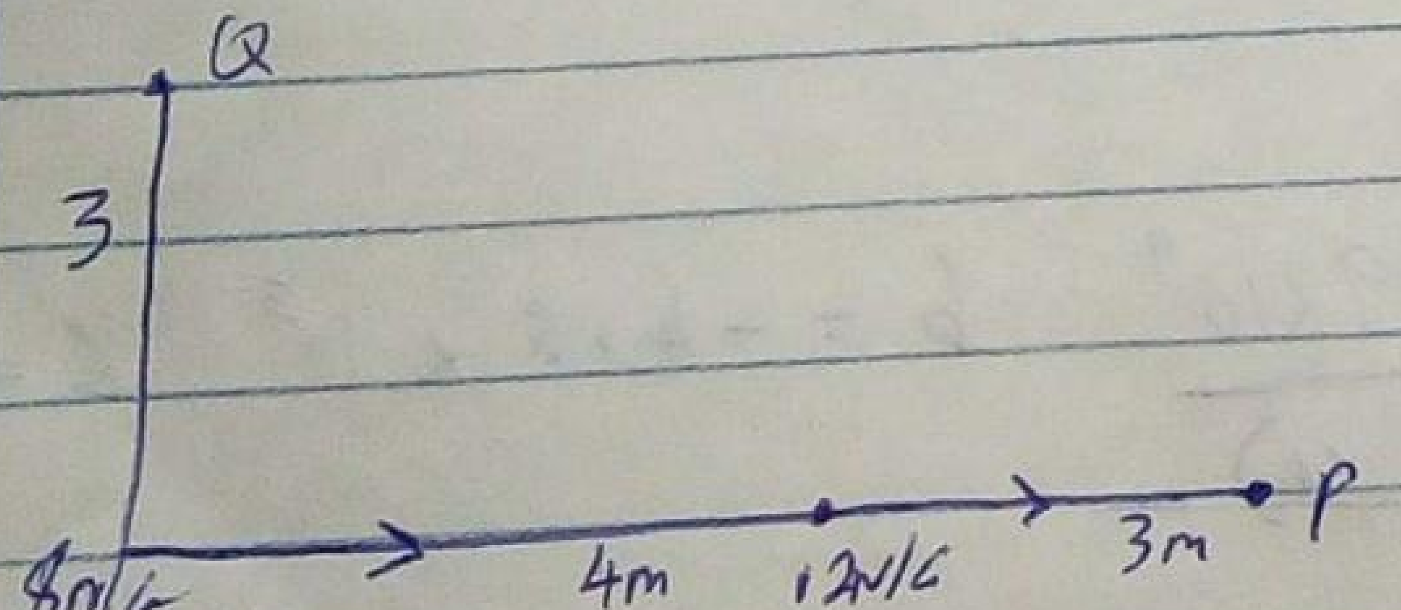
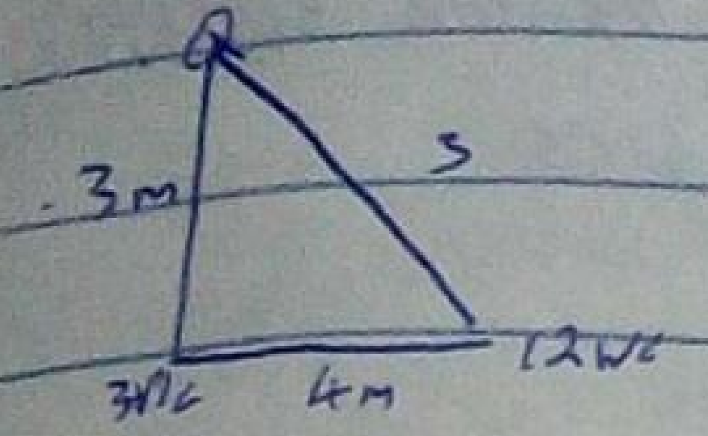


$\varepsilon_1 = \frac{kQ}{r^2} = \frac{9\times10^9 \times 8\times10^{-9}}{(7)^2} = 1.5 N/C$

$\varepsilon_2 = \frac{9\times10^9 \times 12\times10^{-9}}{(3)^2} = 12 N/C$

$E_{net} = 12 + 1.5 = 13.5\ N/C$

ii 

~~$E = 9\times10^9$~~ $E_1 = \dfrac{9\times10^9 \times 8\times10^{-9}}{3^2} = 8\ N/C$

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

Vector	x Comp	y Comp
$E_1 = 8\ N/C$	$8\cos 90^\circ$	$8\sin 90$
$E_2 = 4.32\ N/C$	$-4.32\cos 33$	$4.32\sin 37$
	$E_x = -3.5\ N/C$	$E_y = 10.6\ N/C$

$E = \sqrt{(-3.5)^2 + (10.6)^2}$

$E = 11.16$

$E = 11.2\ N/C$

4a Magnetic flux is a ~~is of the~~ measurement of the total magnetic field which passes through a given area. It is a useful tool for helping describe the effects of the magnetic force on something occupying a given area

4b Cyclotron frequency ~~of~~ $= qB/2\pi m$

$= \dfrac{1.6\times10^{-19} \times 3.5\times10^{-1}}{2\times 22/7 \times 9.11\times10^{-31}}$

$= 9.78\times10^9\ Hz$

4c We got the Cyclotron frequency formula from the formula of a period $(T) = 2\pi m/qB$ and we know the $f = 1/T$. So that means Cyclotron frequency become $qB/2\pi m$ where q is the charge of the electron. B is the magnetic flux, m is the mass and 2π is the constant.

5a The Biot - Savart Law States that it is a Mathematical expression Which illustrates the magnetic field produced by a Stable electric Current in the particular electromagnetism of physics

$$dB = \frac{\mu_0}{4\pi} \frac{I\,dl \times r}{r^2}$$

b ~~The~~ $dB = \frac{\mu_0}{4\pi} \frac{I\,dl \times r}{r^2}$ ... ①

The total magnetic field created at some point by a Current of the finite size is given by integrating equation ①

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

$$B = \frac{\mu_0}{4\pi} \int \frac{I\,dl \sin\theta}{r^2}$$ ... The magnitude of the magnetic field

6a The Strings of an electric guitar make electricity when plucked Under the Strings, there are electricity generating devices Called Pick Each one Consisting of magnets ~~device~~ with hundreds or thousands of Coils of very thin were wrapped around them - The magnets generat a magnetic field around them that passes up through the strings. a result the metal strings becomes magnetized and when they vibra make a very small electric Current flow through the wire pickup Coil. The pickups are hooked up to an electric Current and amplifier which boosts the Current and sends it to a Loudspeak making the guitar sound

6b Using $\varepsilon = N \frac{d\phi_B}{dt}$

$$\phi_B = BA\cos\theta$$

$$\varepsilon = -N\frac{d(BA\cos\theta)}{dt}$$

$$\varepsilon = \frac{N(QB(t_2) - Q_B(t_1))}{t_2 - t_1}$$

$$= 300\left(\frac{0.0314 \times 10}{0.5}\right)$$

$$= 188.4V$$

ii $I = V/\cancel{R} = \frac{188.4}{2}$

$$= 94.2A$$

C Emf $\varepsilon = I \times A = 0.1 \times 8$

$$= 0.8V$$

Using $\cancel{\varepsilon = NA\frac{dQB}{dt}}$ $\varepsilon = N\frac{dQB}{dt}$

$Q_B = BA$ $\therefore \varepsilon = NA\frac{dB}{dt}$

$$0.8 = 75(4 \times 10^{-3})dB/dt$$

$$0.8 = 0.3\frac{dB}{dt}$$

$$\frac{dB}{dt} = \frac{0.8}{0.3} = 2.67\ T/s$$