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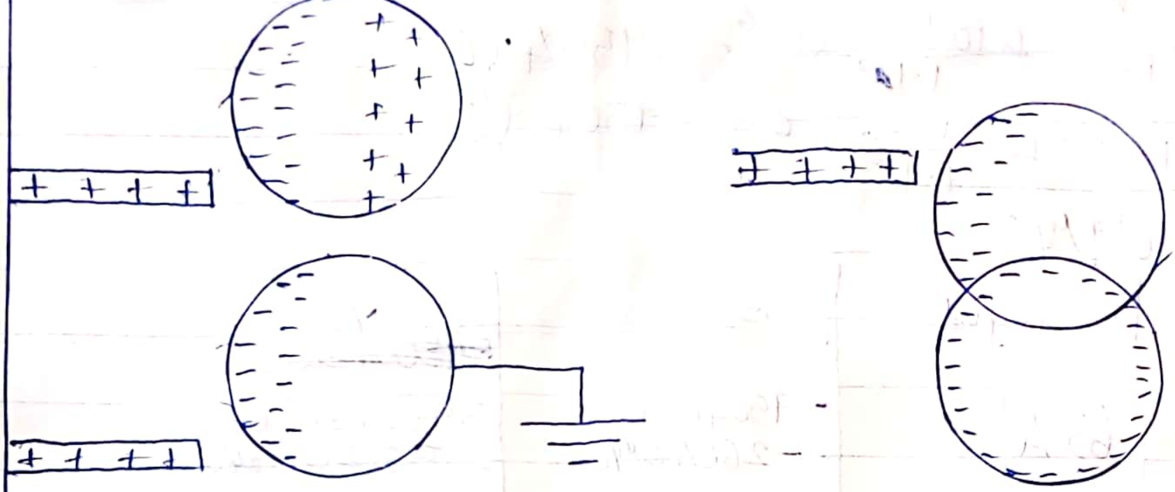
Dept - Computer Engineering
MATRIC NO - 19/Eng02/016
PHYSICS - 102.

1a.



1b $f = 1N$, $d/r = 2m$, $Q = 5.0 \times 10^{-5} C$, $q_1 + q_2 = Q = 5.0 \times 10^{-5}$

$f = kq_1q_2/r^2$

$1 = 9 \times 10^9 \times q_1 q_2 / 2^2$

$4/9 \times 10^{-9} = q_1 q_2$

$q_1 q_2 = 4.44 \times 10^{-10}$ — (i)

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

$q_1 = 5.0 \times 10^{-5} - q_2$ — (ii)

Put (ii) in (i)

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

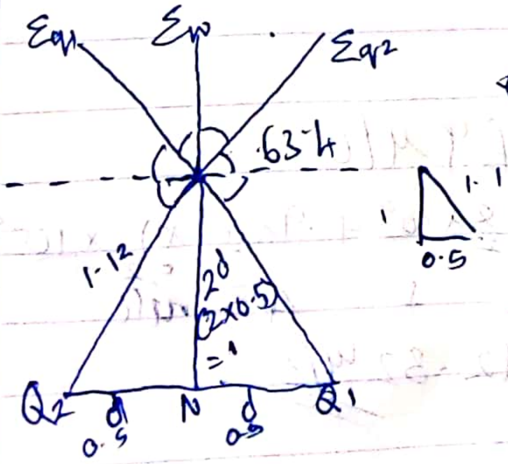
$5.0 \times 10^{-5} q_1 - q_2^2 = 4.44 \times 10^{-10}$

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

$q_2 = 3.845 \times 10^{-5} C$ or $q_2 = 1.155 \times 10^{-5} C$

$\therefore Q_1 = 3.845 \times 10^{-5} C$, $q_2 = 1.155 \times 10^{-5}$
C

1c



$\tan\theta = 1/0.5$

$\theta = 63.4$

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$E_p = E_{q1} + E_{q2} + E_n$

$E_{q1} = kq_1/r^2 = \frac{9\times10^9 \times 8\times10^{-6}}{1.1^2} = 59504\ N/C$

$E_{q2} = kq_2/r^2 = \frac{9\times10^9 \times 8\times10^{-6}}{1.1^2} = 59504\ N/C$

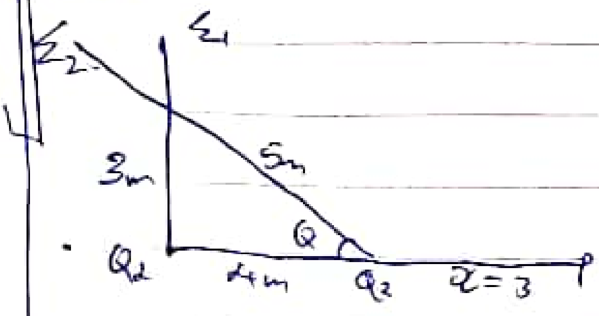
$E_q = 9\times10^9 q\ N/C$

vector	angle	x	Y
59504	63.4°	$-59504\cos 63.4 = -26643\ N/C$	$59504\sin 63 = 53205\ N/C$
59504	63.4°	$59504\cos 63.4 = 26643\ N/C$	$= 53205\ N/C$
$9\times10^9 n$	90°	$9\times10^9\cos 90 = 0$	$9\times10^9\sin 90 = 9\times10^9$
		$\Sigma f_x = 0$	$\Sigma f_y = 106410 + 9\times10^9$

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

$E_p = 106410 + 9\times10^9$

2b)



$E_p = E_{q1} + E_{q2}$

$E_{q1} = kQ/r^2 = \frac{9\times10^9 \times 8\times10^{-9}}{7^2} = 1.469\ N/C$

$E_{q2} = 12\ N/C$

$E_{net} = 1.469 + 12$

$= 13.469 \simeq 13.5\ N/C$

$E_{net} = E_1 + E_2$

$= \frac{9\times10^9 \times 8\times10^9}{2^2} + \frac{9\times10^9 \times 12\times10^{-9}}{5^2}$

$8\ N/C + 4.32\ N/C$

$12.32\ N/C$

2a) Electric field is a region of space where an electric charge experiences an electric force while ELECTRIC FIELD INTENSITY is the force per unit charge

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

4b) $m = 9.11\times10^{-31}\,kg$, $r = 1.4\times10^{-7}\,m$, $B = 3.5\times10^{-1}$

$\theta = 90^\circ$, $w = ?$, $q = 1.60\times10^{-19}\,C$

$w = qB/m_e$

$$w = \frac{-1.60\times10^{-9}\times3.5\times10^{-1}}{9.11\times10^{-31}} = -6.15\times10^{10}\,rad/sec$$

4c) Since our cyclotron frequency is negative -6.15×10^{10} rad/sec, it means that the charged particle electron circulates in a negative or opposite direction at this angular frequency

5a) Biot-Savart law is an equation that describes the magnetic field created by a current-carrying where it allows you to calculate strength at various form

5b) Applying Biot-Savart law we find the magnitude of $d\vec{B}$

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

$\sin[\pi-\phi] = \sin\theta$

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

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

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

But $\sin(\pi-\phi) = \frac{x}{\sqrt{x^2+y^2}} = \frac{x}{(x^2+y^2)^{1/2}}$ — (ii)

Sub (ii) into (i), we have

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

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

Recall, $dl = dy$

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

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

Using special Integral

$$\int \frac{dy}{(x^2+y^2)^{3/2}} = \frac{1}{x^2}\,\frac{y}{(x^2+y^2)^{3/2}}$$

Equation (iii) becomes

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

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

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

When the length 2a of the conductor is very great on comparison to it's distance x from point P we consider it infinity long that is, when a is much than x, $[x^2+a^2]^{1/2} \cong a$, as $a\to\infty$

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

In a physical situation, we have axial symmetry about the y axis, Thus at point in a radius r, around the conductor, the magnitude B is

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