$$\frac{5.0\times10^{-5} \pm \sqrt{2.5\times10^{-9} - 1.78\times10^{-9}}}{2}$$

$$= \frac{5.0\times10^{-5} \pm \sqrt{7.2\times10^{-10}}}{2}$$

$$\frac{5.0\times10^{-5} \pm 2.68\times10^{-5}}{2}$$

$$\frac{5.0\times10^{-5} + 2.68\times10^{-5}}{2} \text{ or } \frac{5.0\times10^{-5} - 2.68\times10^{-5}}{2}$$

$$\frac{2.68\times10^{-5}}{2} \text{ Or } \frac{2.39\times10^{-5}}{2}$$

3.84×10^{-5} Or 1.16×10^{-5}

$q_1 = 3.84\times10^{-5}$ and $q_2 = 1.16\times10^{-3}$ or Vice Versa

(c)

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

b), $\mathcal{E}_1 = \frac{9\times10^{9} \times 8\times10^{-4}}{7^2} = 1.5N/C$

$$\mathcal{E}_2 = \frac{9\times10^{9}\times12\times10^{-4}}{3^2} = 12N/C$$

$$\mathcal{E}_{net} = 12 + 1.5 = 13.5N/C$$

$Q/\mathcal{E}_1 = \frac{9\times10^{4}\times8\times10^{-4}}{3^2} = 8N/C$

$$\mathcal{E}_2 = \frac{9\times10^{4}\times12\times10^{-4}}{5^2} = 4.32N/C$$

$$\frac{9\times10^{9}\times12\times10^{-4}}{25} = 4.32N/C$$

$\mathcal{E}_x = 3.46N/C$ $\mathcal{E}_y = 10.59N/C$

$$\sqrt{(3.46)^2 + (10.59)^2} = 11.14$$

1st $\mathcal{E}_{net} = 13.5N/C$

2nd $\mathcal{E}_{net} = 11.2N/C$

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

$\sin(\pi - \varphi) = \sin\varphi$

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

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

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

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

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

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

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

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

Using special integrals

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

$= \frac{1}{x^2} \frac{y}{(x^2+y^2)^{1/2}}$

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

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

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

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

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

$B = \frac{\mu_0 I}{2\pi R}$.

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

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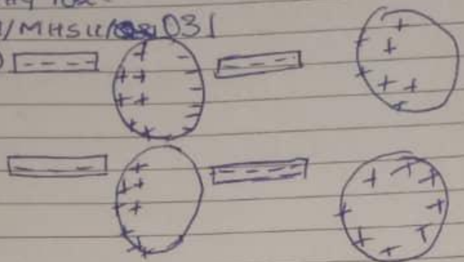
(a)



(b) $f = \frac{kq_1q_2}{(r_{12})^2}$

$K = 9 \times 10^9$

$F = 10N$

$q_1 = ?$

$q_2 = ?$

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

$F = \frac{kq_1q_2}{(r_12)^2}$

$F \times (r_{12})^2 = kq_1q_2$

$q_1q_2 = \frac{F(r_{12})^2}{K}$

$\frac{1 \times (2)^2}{9 \times 10^9}$

$= 4/9 \times 10^9$

$q_1q_2 = 4.44 \times 10^{-10}$

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

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

$q_1q_2 = 4.4 \times 10^{-10}$

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

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

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

using quadratic formula

4.) Magnetic flux? is defined as the strength of the magnetic field which can be represented by line of forces. It is represented by the symbol (ϕ) mathematically given as $\phi = B\,dA$

(b) $m = 9.11 \times 10^{-31}$ kg, $r = 1.4 \times 10^{-7}$ m $B = 3.5 \times 10^{-1}$ weber/meter²

Cyclotron frequency = angular speed

$$\omega = \frac{v}{r} = \frac{qB}{m}$$

$$\omega = \frac{qB}{m} = \frac{1.6 \times 10^{-9} \times 3.5 \times 10^{-1}}{9 \times 10^{-31}}$$

$$\omega = 62222.2222T^{-1}$$

(c) We were given parameter such as

(i) mass of the electron $= 9.11 \times 10^{-31}$ kg

(ii) A radius of 1.4×10^{-7} m

(iii) Magnetic field of 3.5×10^{-1} weber/metersquare

and we were asked to find the cyclotron frequency which is equal or the same thing as angular speed. It is called cyclotron frequency because it is a frequency of an accelerator called cyclotron. Recall that angular speed is given as ω = Substituting we have $\omega = 1.6 \times 10^{n} - 10 \times 3.5 \times 10^{-10} / 9 \times 10^{-31}$

$= 622222.222T^{-1}$

3a) State the Biot-savart law i

The biot-savart law is based on the fo[llowing] observations for the magnetic field $\vec{dB}$ at a point p associated with a length element $\vec{dl}$ at a wire carrying a steady current

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