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~~CHEM 102~~ PHY102

DEPT: MBBS

SECTION A

2. Distinguish between the terms: electric field and electric field intensity

⇒ Electric Field is a vector, a quantity which has both magnitude and a direction. The electric field intensity is the magnitude of the vector.
⇒ The Electric field is a region of space in which an electric charge experiences an electric force while electric field intensity is the force per unit charge.

b $Q_1 = 8\mu C$ $Q_2 = 12\mu C$ $r = 4m$

i Find the net electric field at a point P on the x-axis at $x = 7m$

$$E_1 = \frac{Kq_1}{r^2} = \frac{(9\times10^9)\times(8\times10^{-9})}{7^2} = 1.469387755 \text{ N/C}$$

$$E_2 = \frac{Kq_2}{r^2} \quad \frac{(9\times10^9)\times(12\times10^{-9})}{3^2} = \cancel{12.000\text{ N/C}} \; 12.0 \text{ N/C}$$

Vector	Angle	X-component	Y-components
$E_1 = 1489.387755$ N/C	180°	1.469387755 × cos180	1.489387755 × sin180
$E_2 = 12{,}000$ N/C	180°	12.000 × cos180	12,000 × sin180
		$E_x = -13.469388776$	E_y 0

$$E_{net} = \sqrt{(E_x)^2 + (E_y)^2}$$

$$E_{net} \sqrt{(-13.469388776) + (0)^2}$$

$$E_{net} = 13.469388774$$

$E_{net} \simeq$ ~~13.469 N/C~~

$$E_{net} \simeq 13.5 \text{ N/C}$$

ii the electric field at a point Q on the y axis at y = 3m due to the charges

$E_1 = \frac{kq_1}{r^2} = \frac{(9\times10^9)\times(8\times10^{-9})}{3^2} = \cancel{8000}\ N/C \quad 8\ N/C$

$E_2 = \frac{kq_2}{r^2} = \frac{(9\times10^9)\times(12\times10^{-6})}{5^2} = 4320\ N/C$

Vector	Angle	X comp	Y comp
$E_1 = \cancel{8000}\ 8\ N/C$	90°	$\cancel{8000}\ 8 \times \cos 90$	$\cancel{8000}\ 8.0 \times \sin 90$
$E_2 = 4.320\ N/C$	36.9	$4.320 \times \cos 36.9$	$4.320 \times \sin 36.9$
		$E_x = 3.454633 9725$	$E_y = 10.593881537$

$E_{net} = \sqrt{(E_x)^2 + (E_y)^2}$

$E_{net} = \sqrt{(3.454633 9772)^2 + (10.593881537)^2}$

$= 11.142866525\ N/C$

$\simeq 11.1\ N/C$

3 Volume Charge Density

This is the measure of quantity of charge per unit volume

$\therefore \rho = \frac{dQ}{dV}$

$dQ = \rho . dv$

Surface Charge Density

This is the measure of how much electric charge is accumulated over a surface

$\therefore \sigma = \frac{dQ}{dl}$

$\therefore dQ = \sigma dl$

Linear Charge Density

This is the measure of a quantity of any characteristic value per unit of length. In other words it is the amount of electric charge per unit length).

$\therefore \lambda = \frac{dQ}{dl}$

$\therefore dQ = \lambda dl$

II Electric Potential Difference

This is the workdone per unit charge against electrical forces. when a charge is transported from one point to another.

$dW = F\,dL$

The force is external

$\therefore F = -qE$

$\therefore dW = -qE \cdot dL$

The total workdone in moving the test charge from A to B

$$W(A \rightarrow B)_{Ag} = -q_o \int_A^B E\,dl$$

C $Q_1 = 10\mu C$ $Q_2 = -2\mu C$

$x = 0$ $x = 4m$

$$V = 9\times10^9 \left(\frac{10\times10^{-6}}{r_1} + \frac{-2\times10^{-6}}{r_2} \right)$$

When $V = 0$

$$0 = \frac{90\,000}{r_1} - \frac{18{,}000}{r_2}$$

$$\frac{90{,}000}{r_1} = \frac{18{,}000}{r_2}$$

$$\frac{r_1}{r_2} = \frac{90{,}000}{18{,}000}$$

$$\frac{r_1}{r_2} = \frac{5}{1}$$

$$r_1 = 5 \quad r_2 = 1$$

$\therefore V = 0$ at $x = 5m$

Section B

4. Magnetic flux can be defined as the strength of magnetic field represented by lines of force

b. $M = 9.11 \times 10^{-31}$ kg $\quad B = 3.5 \times 10^{-1}$ T
$r = 1.4 \times 10^{-7}$ m $\quad \omega = ?$

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

$$= \frac{1.6 \times 10^{-19} \times 3.5 \times 10^{-1}}{9.11 \times 10^{-31}}$$

$$= 6.147 \times 10^{10} \text{ rad/s}$$

c Electron move in a circular orbit with a radius of 1.4 x 10^{-7}m with uniform magnetic feild of 3.5 x 10^{-1} tesla and a perpendicular speed of light to the magnetic feild.

The cyclotron frequency of the moving electron can be found by multiplying the charge (1.6 x 10^{-19}) and the magnetic field (3.5 x 10^{-1} T) divided by the ~~its~~ mass of the electron (9.11 x 10^{-31} kg)

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It is a statement in electromagnetism, the magnetic intensity at any point due to a steady ~~movement~~ current in an infinitely long straight wire is directly proportional to the current and inversely proportional to the distance from point to wire.

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

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

b $B = \cancel{\text{4}\pi\varepsilon_0} \frac{\mu_0 I}{4} \int_{-a}^{a} dl \sin\theta$

$\sin(\pi - \varphi) = \sin\cancel{\theta}$

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

From ~~Pytha~~ pythagora's theorem:

$$r^2 = x^2 + y^2$$

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

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

Subtitute equ(ii) into equ(i)

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

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

Recall

$dl = dy$

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

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

Using special integrals

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

Equ(iii) therefore becomes

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

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

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

$$(x^2+a^2)^{1/2} \doteq a, \text{ as, } a \Rightarrow \infty$$

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