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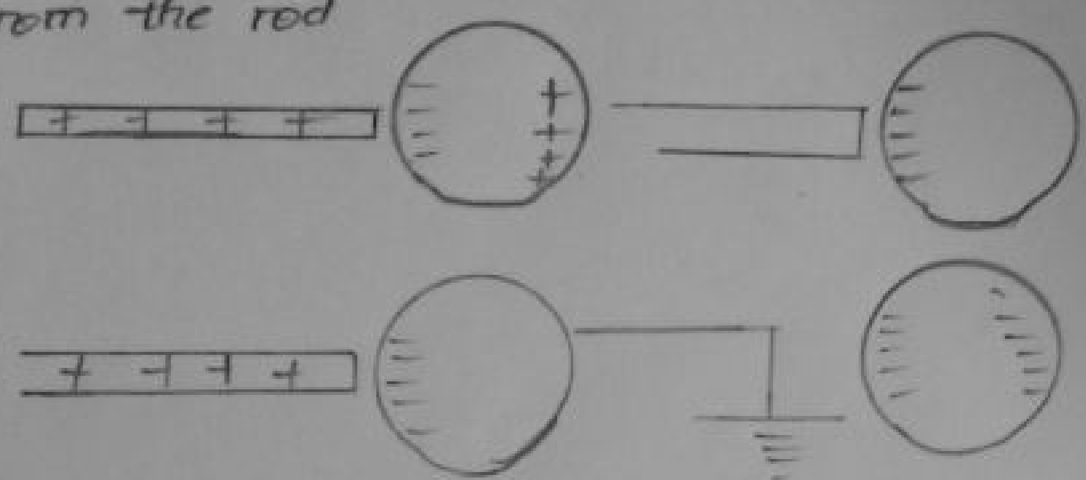
Course: Phy 102
Matric No: 19/MHS02/029

1a charging by induction: it can obtained without touching it by a process called electrostatic induction. consider a positively charged rod brought near a neutral conducting sphere. that. that is insulated so that there is no conducting path. the repulsive force between the protons in the rod and those in the sphere causes a redistribution of charges on the sphere so that some protons move to the scale of the sphere farthest from the rod



b $k = 9 \times 10^9$

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

$f = 1N$

$d = 2m$ calculate the charge on each sphere?

Recall that

$k = 9 \times 10^9$

$$f = \frac{kq_1 q_2}{r^2}$$

$$f = \frac{9 \times 10^9 \times (q_1 q_2 5 \times 10^{-5})}{2^2}$$

$4 = 9 \times 10^9 \times 5 \times 10^5 q + 9 \times 10^9 q_2$

$4 = 4.5 \times 10^5 q_2 + 9 \times 10 q_2$

$9 \times 10^9 q_2 - 4.5 \times 10^5 q_1 + 4 = 0$

$q_2 = 0.006038c$

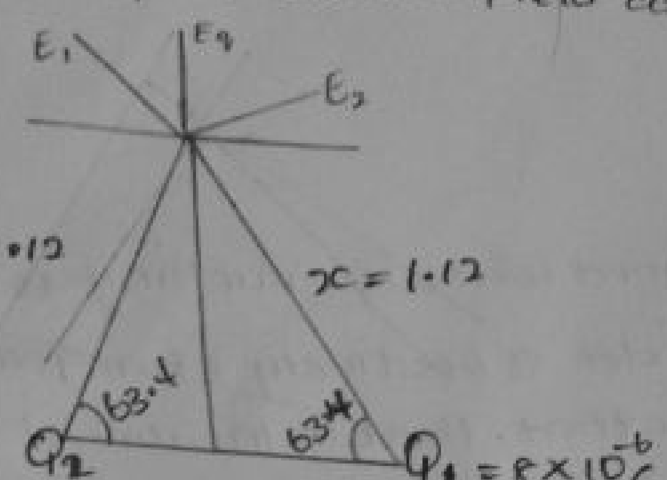
$q_1 = 1.11 \times 10^{-5} c$

$q_2 = 3.8 \times 10^{-5} c$

c

$Q_1 = Q_2 = 8\mu C$, $d = 0.5$

determine Q if electric field at a point P is zero



$E_1 = \frac{Kq_1}{r^2} = \frac{9\times10^9\times8\times10^{-6}}{(1.12)^2} = 5739.795918$

$E_2 = \frac{Kq_1}{r^2} = \frac{9\times10^9\times8\times10^{-6}}{1.12^2} = 5739.795918$

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

$\tan\theta = \frac{opp}{adj} = \frac{1}{0.5}$ $\theta = \tan^{-1}(2)$, $\theta = 63.4$

$x^2 = 1^2 + 0.15$, $\sqrt{x^2} = \sqrt{1.25}$, $x = 1.2$,,

vector	angle°	x - comp	y - comp
$E_1 = 5739.795$	63.4	$E_1 \times \cos\theta - 2570.045$	5,132.262839
$E_2 = 5739.795$	63.4	2570.045	5,132.262839
$E_q = 9\times10^9 q$	90°	$E_q \cos\theta = 0$	$9\times10^9 q$
		$\Sigma x = 0$	$E_y = 10264.52368$.

~~mag~~magnitude $= \sqrt{(\Sigma x)^2 + (\Sigma y)^2}$

$E_q = \sqrt{(0)^2 + (10264.52568}$, $\sin E = 0$

$0 = 9\times10^9 q + 10264.52868$

making q the subject of the formula

$q = \frac{-10204.52568}{9\times10^9}$, $q = 1.140\times10^{-6}$ $\Rightarrow$ $q = 1.14\mu C$,,

3a volume charge density, $P = \frac{dQ}{dV} = PdV$

Surface charge density; $\theta = \frac{dQ}{dA}$ $ndQ = \theta dA$.

Linear charge density $\lambda = \frac{dQ}{dL}$ and $dQ = \lambda dL$

b. Electric potential difference between two parts in an electric field can be defined as the work done per unit charge against electrical forces when a charge is transported from one part to another. It is measured in volt (v) or joules per coulomb (J/c). It is a scalar quantity

Section B

4a magnetic flux is defined as the strength of the magnetic field which can be represented by line of forces. It is ~~pe~~represented by the symbol ϕ. mathematically -> $\phi = BA\cos\theta$.

b. $m = 9 \times 10^{-3}$ kg, $r = 1.4 \times 10^{-7}$m, $B = 3.5 \times 10^{-1}$ weber / meter^2

cyclotron frequency = angular speed. $\omega = \frac{v}{r} = \frac{qB}{m}$

$$\omega = \frac{1.6 \times 10^{-9} \times 3.5 \times 10^{-1}}{9 \times 10^{-3}}, \quad \omega = 622.2r^{-1}$$

c. mass of the electron $= 9.11 \times 10^{-31}$kg.

radius of 1.4×10^{-7}m, magnetic field of 3.5×10^{-1} /m^2

Angular speed -> $\omega = \frac{v}{r} = \frac{qB}{m}$

substituting $\omega = \frac{v}{r} = \frac{qB}{m} = \frac{1.6 \times 10 - 10 \times 3.5 \times 10\text{^}-16}{9.11 \times 10\text{^}-31}$

$$\frac{qB}{m} = \frac{1.6 \times 10^{-11} \times 3.5 \times 10\text{^}-1}{9.11 \times 10\text{^}-31} = 622.22r$$

cycloton frequency = angular speed, cyclotor frequenty is equal to 622.22 having a unit as which is equal to the unit of frequency dimensionally

b. Biot-savart law states that the magnetic field is directly proportionally to the product permeability of free space (μ). the current (I), the charge in length, the radius is inversely proportional the square of radius (r^2). It can be represented mathematically as $dB = \frac{\mu_0}{4\lambda} = \frac{Id.\times r}{r^2}$

μ_0 = constant. Called permeability of free space

$\mu_0 = 4\pi \times 10^{-7}$, $\frac{m}{A}$, the unit of B is w/m^2

magnetic field of a straight current carrying conductor

$$B = \frac{\mu_0 I}{4\pi} \int_{a}^{a} \frac{a I \sin \mu}{r^2}$$

since $(\pi - \mu) = \sin\theta$

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

$r^2 = x^2 + y^2$ (Pythagoras theorem).

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

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

Sub 2 into 1

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

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

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

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

Using special integrals

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

Equation 3 becomes

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

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

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

when the length 2a of the conductor is very great in comparison to its distance x from point P, we consider it infinity long. that is when a much larger than x,

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

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

in a physical situation, we have axial symmetric about the y-axis, thus, at all points in a circle of radius r, around the conductor, the magnitude of B is $B = \frac{\mu_0 I}{2\pi r}$

Equation II defines the magnitude of the magnetic field of flux density B ~~reins~~ as along straight current carrying conductor.