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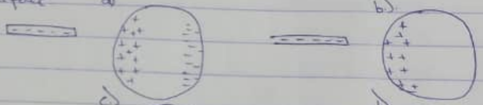
Phy 102.

1a) Consider a negatively charged rubber ~~rub~~ rod brought near a neutron conducting sphere that is insulated so that there is no conducting path to the ground as shown below. The explosive force between the electrons in the rod and those in the sphere causes a redistribution of charges on the sphere so that some of the electrons move to the side of the sphere farthest from the ~~nearest the~~ rod leaving the other region ~~post~~ positively charged. If a grounded wire is connected to the sphere, some of the electrons leave the sphere and travel to the earth. If the wire is then removed, the conducting sphere is left with an excess of induced positive charge. The rubber when removed allows the induced positive charge to remain on the ungrounded sphere making it to become uniformly distributed on its surface.

a) b)



c) d)

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

Using the formula $F_2 = \frac{Kq_2q_1}{r^2}$

$1.0 = \frac{9\times10^9 q_1q_2}{2^2} \Rightarrow 4 = 9\times10^9 \times (5\times10^{-5} - q_2)q_2$.

$4 = 4.5\times10^{-5} q_2 - 9\times10^9 q_2$ Using quadratic formula

$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

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

$q_2 = \frac{-4.5\times10^5 \pm 241867.7}{-18\times10^9}$

$q_2 = 1.156\times10^{-5}C$.

$q_1 = 3.84\times10^{-5}C$

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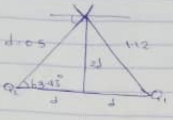
c



$x^2 = 1^2 + 0.5^2$

$\sqrt{x^2} = \sqrt{1.25}$

$x = 1.12$

$Q_2 = Q_1 = 8 \times 10^{-6}$

$\varepsilon_2 = \varepsilon_1$

$\tan\theta = \frac{opp}{adj}$

$\theta = \tan^{-1}(1/0.5)$

$\theta = 63.43°$

$\varepsilon_1 = \frac{kq_2}{r^2} = \frac{9 \times 10^9 \times 8 \times 10^{-6}}{(1.12)^2} = 57397.95918\varepsilon \quad \varepsilon_1 = \varepsilon_2$

$\varepsilon_2 = \frac{kq_2}{r^2} = 9 \times 10^9 \times q = 9 \times 10^9 \varepsilon$

Vector	Angle	X-Component	Y-Component
$\varepsilon_1 = 57397.95918$	63.4	25700.43785	51322.62339.
$\varepsilon_2 = 57397.95918$	63.4	-25700.45785	51322.62339
		$\varepsilon_x = 0$	$\varepsilon_y = 102645.2568$

$\varepsilon_q = \sqrt{(0)^2 + (102645.2568)^2}$

$\varepsilon_q = 0 + 102648.2568 = 102648.2568$

$q = \frac{\varepsilon_q}{9 \times 10^9} = 1.14 \times 10^{-5} C$

1b Magnetic flux is defined as the strength or intensity of the magnetic field represented by lines or forces

b $m = 9.11 \times 10^{-31}$ Kg $\quad r = 1.4 \times 10^{-9} \quad B = 3.5 \times 10^{-1}$ weber/m^2

$\varepsilon = 1.6 \times 10^{-19}$ $\quad$ Using; $\omega = \frac{qB}{m}$

$\omega = \frac{1.6 \times 10^{-19} \times (3.5 \times 10^{-1})}{9.11 \times 10^{-21}}$

$\omega = 6.15 \times 10^{6}$ rad/s

c An electron mass of 9.11×10^{-31} Kg and charge 1.6×10^{-19} C in motion in a magnetic field of 3.5×10^{-1} perpendicular with the field will have an ~~a~~ angular frequency of 6.15×10^{10} rad/s.

2a. Electric field is a region or space where an electric charge will experience an electric force.

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ii) Electric field can be defined as the force per unit charge

i)

$\tan\theta = \frac{opp}{adj}$

$\theta = \tan^{-1}(3/4)$

$\theta = 36.7°$

$E_n = E_1 + E_2$

$E_1 = \frac{kq_1}{r^2} = \frac{9\times10^9 \times 8\times10^{-9}}{9^2} = 1.469\ N/C$

$E_2 = \frac{kq_2}{r^2} = \frac{9\times10^9 \times 12\times10^{-9}}{9^2} = 12\ N/C$

$E_{net} = 1.469 + 12$

$E_{net} = 13.469\ N/C$

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

$E_2 = \frac{kq_2}{r^2} = \frac{9\times10^9 \times 12\times10^{-9}}{5^2} = 4.32\ N/C$

Vector	Angle	x-component	y-component
$E_1 = 8\ N/C$	90	0	8
$E_2 = 4.32\ N/C$	69°	-3.45	2.59
		$E_x = -3.45$	$E_y = 10.59$

$E_{net} = \sqrt{(-3.45)^2 + (10.59)^2}$

$E_{net} = 11.14\ N/C$

The Bio-savart law is an equation that describes the magnetic field created by a current-carrying wire, It allows for the calculation of its strength at various points

$R = \frac{\mu . I}{4\pi}\int_{-a}^{a}\frac{dl \sin a}{r^2}$ $\quad \sin(\pi - a) = \sin\theta$

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

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

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$$B = \frac{M_0 I}{4\pi} \int_{-a}^{a} \frac{dl \sin(\pi - a)}{x^2 + y^2} \quad \dots \text{⑨}$$

$$B = \frac{M_0 T}{4\pi} \int_{-a}^{a} \frac{dl x}{(y^2+x^2)^{3/2}}$$

$$B = \frac{M_0 I_x}{4\pi} \left[\int_{-a}^{a} \frac{dl}{(y^2+x^2)^{1/2}}\right]_{-a}^{a}$$

$$B = \frac{M_0 I}{2 \cancel{4\pi} x} \int_{-a}^{a} \frac{\cancel{2}a}{(a^2+x^2)^{-1/2}}$$

$$B = \frac{M_0 I}{2\pi x} \left[\frac{a}{(a^2+x^2)^{1/2}}\right.$$

~~$B = M_0 I$~~ $(x^2+a^2)^{1/2} \simeq a$

$a >> x$

$$B = \frac{M_0 I}{2\pi x} \quad \frac{a}{(a^2)^{1/2}}$$

$$B = \frac{M_0 I}{2\pi x} \qquad x = r$$

$$B = \frac{M_0 I}{2\pi r}$$

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