OSADEBE ANTOINETTE ADAOBI

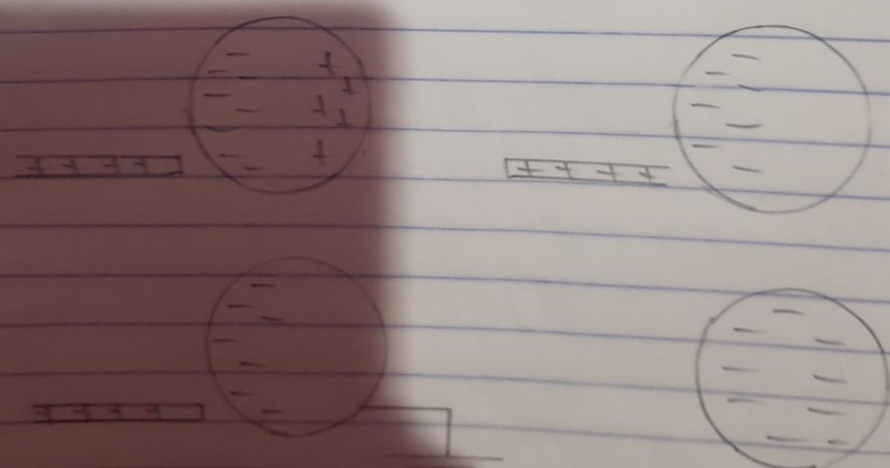
19/MHS01/360

MBBS

PHYICS ASSIGNMENT

Physics Assignment.

1. Charging by induction: A positively charged rubber rod is brought near a neutral (uncharged) conducting sphere that is insulated so that, there is no conducting path to the ground. The repulsive force between the electrons in the rod and those on the sphere, causes a redistribution of charges on the sphere, so that some electrons move to the side of the sphere farthest away from the rod. The region of sphere nearest to the positively charged rod has an excess of negative charge because of the migration of electrons away from this location. If a grounded conducting wire is the connected to the sphere, some of the electrons leave the sphere and travel to the earth. If the wire to the ground is removed, the conducting sphere is left with an excess of induced negative charge. finally, when the rubber ~~rod~~ rod is removed from the vicinity of the sphere, the induced negative charge remains on the ungrounded sphere and becomes uniformly distributed over the surface of the sphere.



b. $F = \frac{kq_1q_2}{r^2}$

$1 = 8 \times 99 \times 10^9 \times (q_1 \times q_2)$

$q_1 + q_2 = 5.0 \times 10^{-5} C,\ F = 1\ r = 2$

$$F = \frac{kq_1q_2}{r^2}$$

$$1 = \frac{9 \times 10^9 \times (q_2 - 5.0 \times 10^{-5})q_2}{4}$$

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

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

$$q_2 = 1.14 \times 10^{-5}$$

$$q_1 = 5.0 \times 10^{-5} - 1.14 \times 10^{-5}$$

$$= 3.86 \times 10^{-5} C$$

$\therefore q_1 = 3.86 \times 10,\ q_2 = 1.14 \times 10^{-5}$

c. $Q = Q_2 = 8\mu C$

$d = 0.5m$

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

$$\theta = \tan^{-1}\frac{1}{0.5}$$

$$\theta = 63.4$$

$$E_1 = \frac{kq_1}{r^2} = \frac{9 \times 10^9 \times 8 \times 10^{-6}}{(1.22)^2} = 5732.79$$

$$E_2 = \frac{kq_2}{r^2} = \frac{9 \times 10^9 \times 8 \times 10^{-6}}{(1.28)^2} = 5739.29$$

$$E_q = \frac{kq}{r^2} = \frac{9 \times 10^9 \times q}{(1)^2} = 9 \times 10^9 q$$

Vector	Angle	x-Comp	y-Comp
5732.79	63.4	25700.14	5132.26
5739.29	63.4	25700.74	5132.26
$9 \times 10^9 q$	90	0	$9 \times 10^9 q$
		0	$E_y = 10264.23659$

Magnitude

$Eq = \sqrt{(0)^2 + (10264 - 2365)^2}$

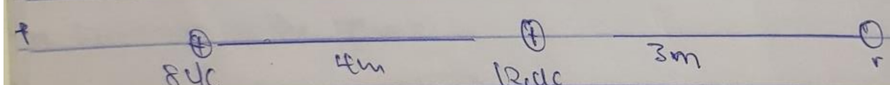
Since $E = 0$

$0 = 9 \times 10^9 q + 10264 - \cancel{28658}$ 52568

$q = 11\mu C$

2. An electric field is a region of space in which an electric charge will experience an electric force, while the electric field strength or electrical field intensity can be defined as the force per unit charge. Mathematically given as $E = \frac{F(N)}{q(C)}$ which is measured in Newton per columb (N/C)

b. $Q = 8\mu C$ $Q_2 = 12\mu C$ $x = 4m$ $k = 9 \times 10^9$, $x = 7m$

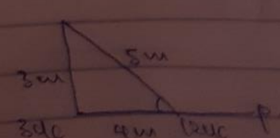


$E_1p = \frac{kq_1p}{r^2} = \frac{9 \times 10^9 \times (8 \times 10^{-9})}{7^2} = 1.469 N/C$

$E_2p = \frac{kq_2p}{r^2} = \frac{9 \times 10^9 \times 12 \times 10^{-9}}{3^2} = 12 N/C$

$E_{net} = 12 + 1.469 = 13.469 N/C$

ii.



$\cos\theta = 4/5$

$\theta = 36.87°$

$E_1q = \frac{kq_1}{r^2} = \frac{9 \times 10^9 \times 8 \times 10^{-9}}{3^2} = 8 N/C$

$E_2q = \frac{kq_2}{r^2} = \frac{9 \times 10^9 \times 12 \times 10^{-9}}{5^2} = 4.32 N/C$

Vector	Angle	x-comp	y-comp
$E_1 q = 8N/C$	90°	$8\cos 90 = 0$	$8\sin 90 = 8$
$E_2 = 4.32N/C$	36.87°	$4.32\cos 36.87 = 3.46$	$4.32\sin 36.87 = 2.59$
		$\Sigma = 3.46N/C$	$\Sigma = 10.59N/C$

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

$$E_{net} = 11.14NC$$

SECTION B

4. A magnetic flux is the strength of magnetic field represented by line of force. It is represented by the symbol ϕ

6. $m = 9.11 \times 10^{-31} kg$

$r = 1.4 \times 10^{-9} m$

$B = 3.5 \times 10^{-1} Wb/m^3$

$q = 1.6 \times 10^{-19} C$

$$v = \frac{qBr}{m}$$

$$v = \frac{1.6 \times 10^{-19} \times 3.5 \times 10^{-1} \times 1.4 \times 10^{-7}}{9.11 \times 10^{-31}}$$

$v = 8.61 \times 10^{3} m/s$

Angular speed = cyclotron frequency

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

$$= \frac{1.6 \times 10^{-19} \times 3.5 \times 10^{-1}}{9.11 \times 10^{-13}} = 6.15 \times 10^{10} rads$$

c. The charge particle circulates at the angular frequency or speed at 6.15×10^{10} rads in the type of accelerator called cyclotron, therefore, the angular speed is also seen as cyclotron frequency.

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

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

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 (* * *) therefore becomes

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

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

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

When the length $2a$ of the conductor is very great in comparision to it's distance x from P, we consider it infinitely long. that is, when a is much larger than x.

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

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

At all points on a circle of radius r, around the conductor, the magnitude of B is $\quad B = \frac{\mu_0 I}{2\pi r}$