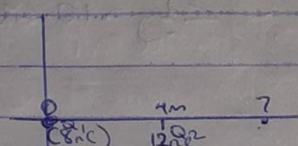
AMIESIMAKA I. Hannah 19/MHS01/090

2a An electric field is a region or space where an electric charge experiences an electric force while an electric field intensity is the force per unit charge ie the strength of the field.

bi

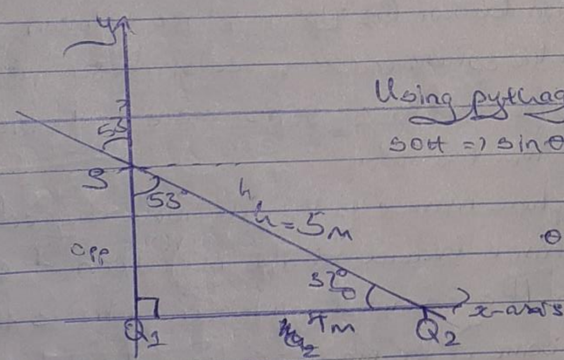


$$E_1 = \frac{KQ_1}{r^2} = \frac{(9\times10^9)\times(8\times10^{-9})}{7^2} = 1.47\,N/C$$

$$E_2 = \frac{KQ_2}{r^2} = \frac{(9\times10^9)\times(12\times10^{-9})}{3^2} = 12\,N/C$$

$$E_{net} = E_1 + E_2$$
$$= 1.47\,N/C + 12\,N/C = 13.47\,N/C.$$

ii



Using pythagoras, h = 5m

$SOH \Rightarrow \sin\theta = \frac{3}{5}$

$\theta = \sin^{-1}(3/5)$

$$E_1 = \frac{KQ_1}{r^2} = \frac{(9\times10^9)(8\times10^{-9})}{3^2} = 8\,N/C$$

$$E_2 = \frac{KQ_2}{r^2} = \frac{(9\times10^9)([illegible]\times10^{-9})}{5^2} = 4.32\,N/C$$

19/MH801/090

VECTOR	ANGLE	X-COMPONENT	Y-COMPONENT.
$E_1 = 8N/C$	$90°$	$8\cos 90° = 0$	$8\sin 90 = +8$
$E_2 = 4.32N/C$	$37°$	$4.32 \times \cos 37 = -3.45$	$4.32 \times \sin 37° = +2.6$
		$\Sigma E_x = -3.45N/C$	$\Sigma E_y = 10.6N/C.$

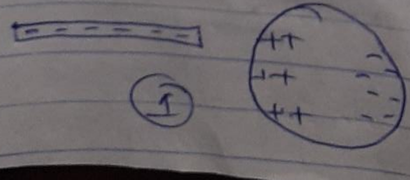
RESULTANT E.

$$E = \sqrt{\Sigma ex^2 + \Sigma ey^2}$$
$$= \sqrt{(-3.45)^2 + (10.6)^2}$$
$$= \sqrt{124.263}$$
$$= \underline{11.15N/C}$$

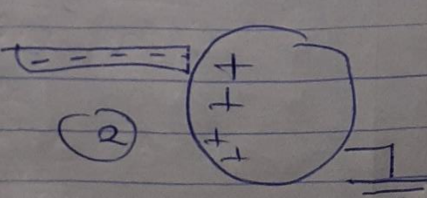
1a Consider a negatively charged rubber rod brought near an uncharged conducting sphere that's insulated so that there is no conducting path to the ground as shown below. The explosive force between the electrons in the rod and those in the sphere causes a redistribution of charges on the sphere so that some of the electrons move to the side of the sphere farthest away from the rod.

The region of the sphere nearest to the relatively charged rod does an excess of positive charge because of the migration of electrons away from this location. If a grounded conducting wire is then connected to the sphere, some of the electrons leave the sphere and travel to the earth. If the wire to be ground is then removed, the conducting sphere is left with an excess of induced positive charge.

Finally, when the rubber rod is removed from the viandity of the sphere, the induced positive charge remains on the ungrounded sphere and became uniformly distributed over the surface of the surface

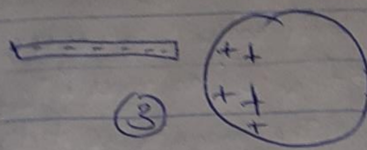


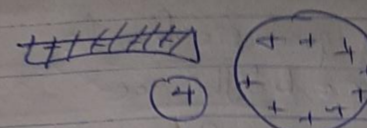
1



2

19/PH480/090.


(3)


(4)

c) $E_{Q_2} = \frac{kQ_2}{r^2} = \frac{(9\times10^9)(8\times10^{-6})}{(d\sqrt{5})^2} = 57600 N/C$

$E_q = \frac{kq}{r^2} = \frac{9\times10^9 \times q}{(2d)^2} = \frac{9\times10^9 q}{1^2} = 9\times10^9 q$ N/C

Vector	θ	X component	Y-component
$E_1 = 57600 N/C$	63.43°	$57600\times\cos 63.43 = -25764$	$57600\times\sin 63.43 = +51516.8$
$E_2 = 57600 N/C$	63.43°	$57600\times\cos 63.43 = +25764$	$57600\times\sin 63.43 = +51516.8$
$E_q = 9\times10^9 q$ N/C	90°	$9\times10^9 q \cos 90 = 0$	$9\times10^9 q \times \sin 90 = 9\times10^9 q$
		$\Sigma E_x = 0$	$\Sigma E_y = 103033.6 + 9\times10^9 q$

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

but E_{net} at point $P = 0$

$0 = \sqrt{0^2 + (103033.6 + 9\times10^9)^2}$

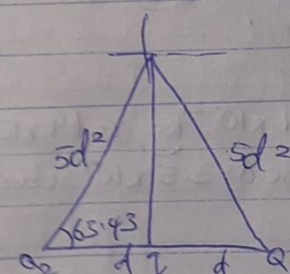
$0 = 103033.6 + 9\times10^9 q$

$q = \frac{-103033.6}{9\times10^9}$

$q = -1.148178\times10^{-5}$

$q = -11.4\times10^{-6}$

$q = -11.4 N/C$



$\sqrt{2d^2 + d^2} = d\sqrt{5}$

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

$F = \frac{kq_1q_2}{r^2}$, $1.0 = \frac{9\times10^9 q_1 q_2}{2^2}$

$4 = 9\times10^9 \times (5\times10^{-5} - q_2) q_2$

$4 = 4.5\times10^{-5} q_2 - 9\times10^9 q_2^2$

$-9\times10^9 q_2^2 + 4.5\times10^5 q_2 - 4 = 0$

19/9H301/020

Using quadratic formula,

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

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

$q_2 = \frac{4.5\times10^{-5} \pm \sqrt{5.8\times10^{10}}}{-18\times10^{7}}$

$q_2 = \frac{45\times10^{-5} \pm 241867.7}{-18\times10^{-7}}$

$q_2 = 1.156\times10^{-5}$ or $3.84\times10^{-5}C$

$q_1 = 1.15\times10^{-5}C$

$q_2 = 3.84\times10^{-5}C$.

4) The magnetic flux is defined as the strength of a magnetic field represented by lines of force, It's usually represented by the symbol Φ.

b) $M_e = 9.11\times10^{-21}kg$, $r = 1.4\times10^{-7}m$, $\theta = 90°$

magnetic field $= 3.5\times10^{-1}$ weber

$w = \frac{qB}{m}$

$w = \frac{1.6\times10^{-19}(3.5\times10^{-1})}{9.11\times10^{-21}}$

$w = 6.115\times10^{10}$ rad/s.

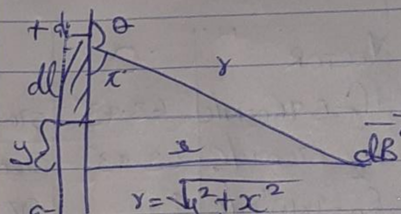
c) An electron of mass $9.11\times10^{-31}kg$ and charge $1.6\times10^{-19}C$ in motion in a magnetic field of 3.5×10^{-1} Tesla perpendicular with the field will have an angular frequency of 6.15×10^{10} rad/s.

5a) The vector $\vec{dB}$ is $\perp$ to $d\hat{l}$ (which points in the direction of the current)

and to the unit vector $\hat{r}$ directed from $d\hat{l}$ toward P.

ii) The magnitude of $\vec{dB}$ is inversely proportional to r^2 where c is the dist. from $d\hat{l}$ to P.

iii) The magnitude of $\vec{dB}$ is proportional to the current I and to the magnitude of the length element $d\vec{l}$



$r = \sqrt{y^2 + x^2}$

$B = \frac{N_0 I}{4\pi}\int_{-a}^{a}\frac{dl\sin\theta}{r^2}$

$B = \frac{N_0 I}{4\pi}\int_{-a}^{a}\frac{dl\, x}{(y^2+x^2)(y^2+x^2)^{1/2}}$

$B = \frac{N_0 I}{4\pi}\int_{-a}^{a}\frac{dl\, x}{(y^2+x^2)^{3/2}}$

$B = \frac{N_0 I x}{4\pi}\int_{-a}^{a}\frac{dl}{(y^2+x^2)^{-1/2}}\Big|_{-a}^{a}$

$B = \frac{N_0 I}{4\pi x}\left[\frac{2a}{(a^2+x^2)^{1/2}}\right]$

$B = \frac{N_0 I}{2\pi x}\left[\frac{a}{(a^2+x^2)^{1/2}}\right]$

$(x^2+a^2)^{1/2} \simeq a$

$a >> x$

$B = \frac{N_0 I}{2\pi x}\frac{a}{(a^2)^{1/2}}$

$B = \frac{N_0 I}{2\pi x}$ $x = r$

$B = \frac{N_0 I}{2\pi r}$ //