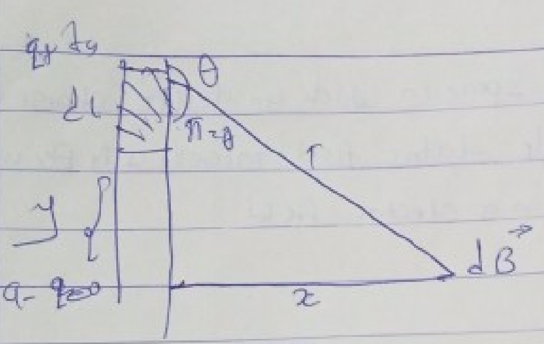


$r = \sqrt{y^2+x^2}$

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

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

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

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

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

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

$$a \gg x$$

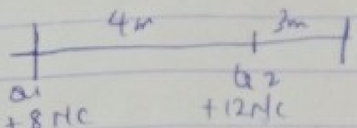
$$B = \frac{\mu_0 I}{2\pi x} = \frac{a}{(a^2)^{1/2}}$$

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

$$B = \frac{\mu_0 I}{2\pi r}$$

charge experienced by a charge in a electric field

b)

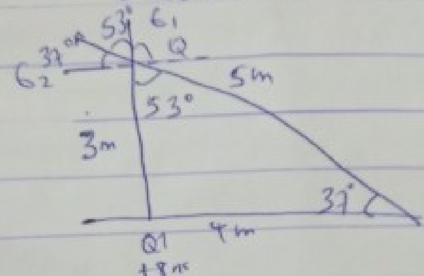


$$E_1 = \frac{kQ_1}{r^2} = \frac{(9\times10^9)(8\times10^{-9})}{7^2} = 1.47\ N/C$$

$$E_2 = \frac{kQ_2}{r^2} = \frac{(9\times10^9)\times(12\times10^{-9})}{3^2} = 12\ N/C$$

$$E_{net} = 1.474 + 12 = 13.47\ N/C$$

ii)



$$E_1 = \frac{kQ_1}{r^2} = \frac{(9\times10^9\times8\times10^{-9})}{3^2} = 8\times10^{18}\ N/C = 8\ N/C$$

$$E_2 = \frac{kQ_2}{r^2} = \frac{(9\times10^9)\times(12\times10^{-9})}{5^2} = 4.32\times10^{18}\ N/C = 4.32\ N/C$$

Vector	Angle	x-Component	y-Component
$E_1 = 8\ N/C$	90°	$8\cos 90° = 0°$	$8\sin 90 = +8°$
$E_2 = 4.32\ N/C$	37°	$4.32\cos 37° = 3.45$	$4.32\sin 37° = +2.6°$
		$\Sigma E_x = 3.45\ N/C$	$\Sigma E_y = 10.6\ N/C$

The resultant E

$$E = \sqrt{\Sigma E_x^2 + \Sigma E_y^2} = \sqrt{(-3.345)^2 + (10.6)^2}$$

$$= \sqrt{124.283}$$

Question 5

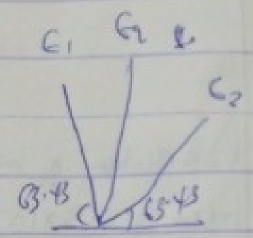
a) The Biot-Savart law is base on the following observations for the magnetic field $d\vec{B}$ at a point P associated with a length element dL of a wire carrying a steady current.

1) The vector dB is perpendicular to dL (which points in the direction of the current) and to the unit vector $\hat{r}$ directed from dL toward P

2) The magnitude of dB is inversely proportional to r^{-2}, where r is the distance from dl to P

3) The magnitude of $d\vec{B}$ is proportional to the current I and to the magnitude of the length element dL

4) The magnitude of $d\vec{B}$ is proportional to, where θ is the angle between $\hat{r}$ and dl. These observations are summarized in the mathematical expression known as Biot-Savart law.



$d = 0.5$

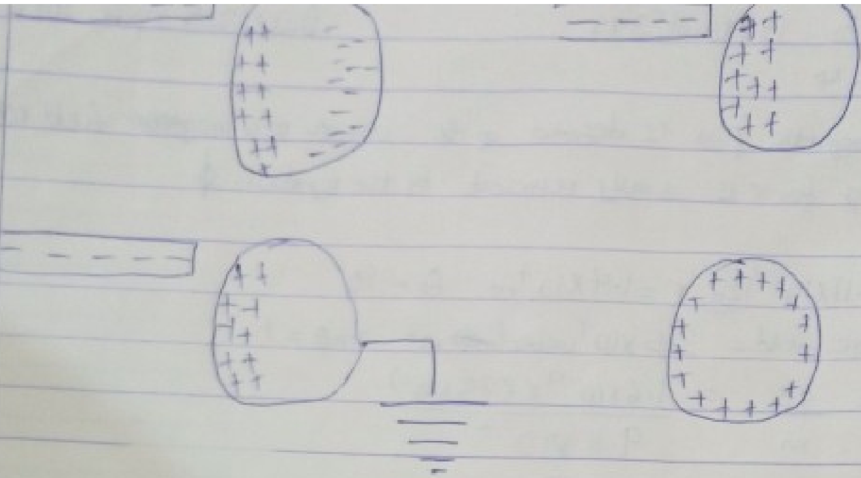
$\theta = 2d/d$

$= 63.43°$

$\frac{9\times10^9\times(8\times10^{-9})}{(d\sqrt5)^2}$

$\times 8\times10^{-1} = 57600\ N/C$

$(\sqrt{\ }/2)^2$



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

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

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

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

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

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

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

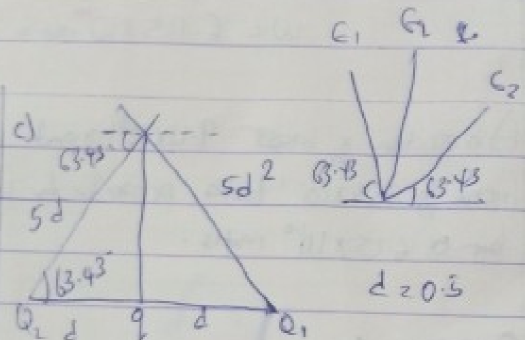
$q_2 = \frac{4.5\times10^5 \pm \sqrt{5.8\times10^{10}}}{-18\times10^9}$

$q_2 = \frac{-4.5\times10^5 \pm 241867.7}{1.8\times10^9}$

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

$q_1 = 1.156\times10^{-5}C$

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

c) 

$\sqrt{5d^2 4d^2} = d\sqrt{5}$, $\tan\theta = 2d/d$

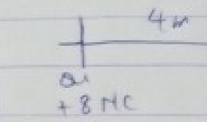
$\tan^{-1}(2) = 63.43°$

$E_1 = \frac{kQ_1}{r_1^2} = \frac{9\times10^9 \times (8\times10^{-6})}{(d\sqrt{5})^2}$

$= \frac{9\times10^9 \times 8\times10^{-6}}{(\sqrt{5}/2)^2} = 57600 N/C$

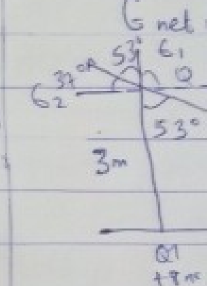
Question 2

a An electric fie...
experience an...
charge unexpe...

b) 

$E_1 = \frac{kQ_1}{r^2}$

$E_2 = \frac{kQ_2}{r^2}$

ii 

$E_1 = \frac{kQ_1}{r^2} = ($...

$E_2 = \frac{kQ_2}{r^2} =$ ...

Vector	Angle
$E_1 = 8 N/C$	90°
$E_2 = 432 N/C$	37°

The resultant E...

$E = \sqrt{Ex^2 + E}$...

$= \sqrt{124.263}$...

Matric No 19/14HS01/399 Date: 20th April, 2020.

Question 4

a The magnetic flux is defined as the strength of a magnetic field represented by lines of force is usually represent by the symbol ϕ

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b $M_e = 9.11 \times 10^{-21}$ kg, $r = 1.4 \times 10^{-7}$ m, $\theta = 90°$

magnetic field $= 3.5 \times 10^{-1}$ weber/meter m², $\sin\theta = 1$

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

$w = 6.115 \times 10^{10}$ radia

c An electron of mass 9.11×10^{31} kg and charge 1.6×10^{-19} c in a motion in a magnetic field of 3.5×10^{-1} tesla perpendicular with the field will have an angular frequency by of 6.15×10^{10} radis.

Question 1

Consider a negatively charged rubber rod brought near a neutral (uncharged) conducting sphere that is in no conducting path to ground as shown below. The repulsive force between the electrons in the rod and those in 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 ~~nearest the negatively charged rod~~ The region of the sphere nearest the negatively charged rod has an excess of positive charge because of the migration of electrons 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 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 vicinity of the sphere the induced positive charge remains on the ungrounded sphere and becomes uniformly distributed over the surface of the sphere.