NAME: **OLULEYE olumuyiwa olusola**

DEPT: **medicine and surgery**

MAT NO.:19\MHS**01/339**

COURSE CODE: PHY 1O2

COVID-19 ASSINGMENT.

COVID-19- ASS

Name : OLULEYE OLUMUYIWA OLUSOLA ~~MATRIC NO: 19/MHS01/339~~

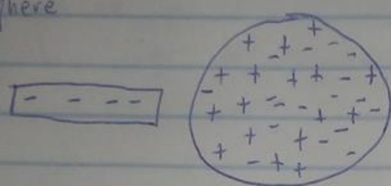
MATRIC NO: 19/MHS01/339

COLLEGE: MHS

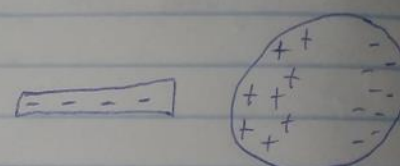
DEPT : Medicine and surgery

SECTION A

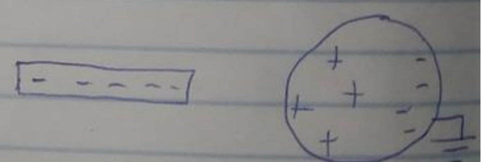
1) a) A negatively charged rod is brought near a neutrally charged sphere



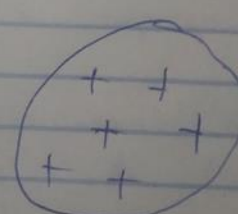
Due to attraction and repulsion the +-tive charges attract to the rod while the negative charges go to the other end



Then a grounded conducting wire is connected to the sphere. Some electrons leave ~~th~~ through the wire.



Then the rod is removed from the vicinity of the sphere and the positive charges are distributed uniformly. The ~~shep~~ sphere becomes positively charged



b

1b

let $q_1 = x$ and $q_2 = y$

~~$1Q\,1 = 9\times10^9$~~

1 B

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

$F = 1.0\,N \quad r = 2.0\,m \quad k = 9\times10^9$

$q_2 = 5.0\times10^{-5} - q_1$

let $q_2 = y$ and $q_1 = x$

$$F = \frac{k\,x\,y}{r^2}$$

$$1 = \frac{9\times10^9 \times x \times [5.0\times10^{-5} - x]}{2^2}$$

$$1 = \frac{9\times10^9 \times x\,5.0\times10^{-5} - x^2}{4}$$

$$\frac{4}{9\times10^9} = \frac{5.0\times10^{-5}x - x^2}{1}$$

$$4\times10^{-10} = 5.0\times10^{-5}x - x^2$$

$$x^2 - 5.0\times10^{-3}x + 4\times10^{-10} = 0$$

Using quadratic Eqn

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

$q_2 = 3.89 \times 10^{-5}\,C$

1C $Q_1 = Q_2 = 8\mu C$

$d = 0.5m$

determine Q if electric field at a point P is zero

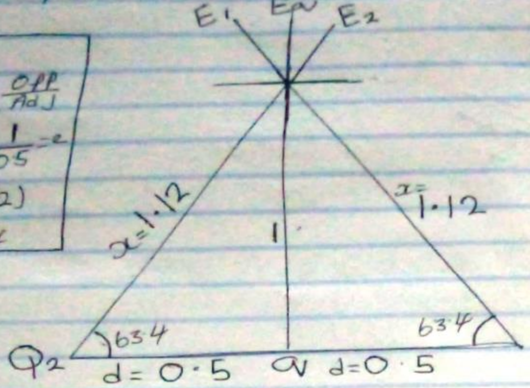
~~θ~~

$Tan\theta = \frac{Opp}{Adj}$

$Tan\theta = \frac{1}{0.5} = 2$

$\theta = Tan^{-1}(2)$

$\theta = 63.4$



$Q_1 = 8\times10^{-6}\,C$

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

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

$x = \sqrt{1.25}$

$x = 1.12$

$$E_1 = \frac{kQ_1}{r_1^2} = \frac{9\times10^9 \times 8\times10^{-6}}{(1.12)^2} = 5739.795918$$

$$E_2 = \frac{kQ_1}{r^2} = \frac{9\times10^9 \times 8\times10^{-6}}{1.12^2} = 5739.795918$$

$$E_Q = \frac{kQ}{r^2} = \frac{9\times10^9 \times Q}{1} = 9\times10^9 Q$$

Vector	angle	x-comp	y-comp
$E_1 = 5739.795918$	63.4° $E_1 =$	$E_1 \times \cos\theta$ -2570.045785	~~$E_1 \times \sin\theta$~~ 5132.262839
$E_2 = 5739.795918$	63.4°	2570.045785	5132.262839
$E_Q = 9\times10^9 Q$	90°	$E_Q \cos\theta = 0$ $\Sigma x = 0$	$9\times10^9 Q$ $\Sigma y =$ 10264.52568

1c.continued

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

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

since $E_q = 0$

$0 = 9\times10^9 q + 10264.52568$

making q subject of formulae

$$q = -\frac{10264.52568}{9\times10^9}$$

$q = 1.140502853 \times 10^{-6}$

$\simeq q = 11.4\mu C$

3a.

(i) Volume charge density, $\boldsymbol{\rho} = \frac{\boldsymbol{dQ}}{\boldsymbol{dV}} \rightarrow \boldsymbol{dQ} = \boldsymbol{\rho dV}$

(ii) Surface charge density, $\boldsymbol{\sigma} = \frac{\boldsymbol{dQ}}{\boldsymbol{dA}} \rightarrow \boldsymbol{dQ} = \boldsymbol{\sigma dA}$

(iii) Linear charge density, $\boldsymbol{\lambda} = \frac{\boldsymbol{dQ}}{\boldsymbol{dL}} \rightarrow \boldsymbol{dQ} = \boldsymbol{\lambda dL}$

3b. ELECTRIC POTENTIAL DIFFERENCE

The electric potential difference between two points in an electric field can be defined as the work done per unit charge against electrical forces when a charge is transported from one point to the other. It is measured in Volt (v) or Joules per Coulomb (J/C). Electric potential difference is a scalar quantity.

Consider the diagram above, suppose a test charge q_o is moved from point A to point B along an arbitrary path inside an electric field E. The electric field E exerts a force $F = q_oE$ on the charge as shown in fig 3.1. To move the test charge from A to B at constant velocity, an external force of $F = -q_oE$ must act on the charge. Therefore, the elemental work done dW is given as:

$$dW = F.dL \quad \ldots \quad (1)$$

But

$$F = -q_0E \quad \ldots \quad (2)$$

Substituting equation (2) in (1) yields

$dW = -q_0EdL$ ... (3)W-q_0EdL ... (3)

Then total work done in moving the test charge from A to B is:

$$W(A \rightarrow B)_{Ag} = -q_0 \int_A^B EdL \quad \ldots \quad (4)$$

From the definition of electric potential difference, it follows that:

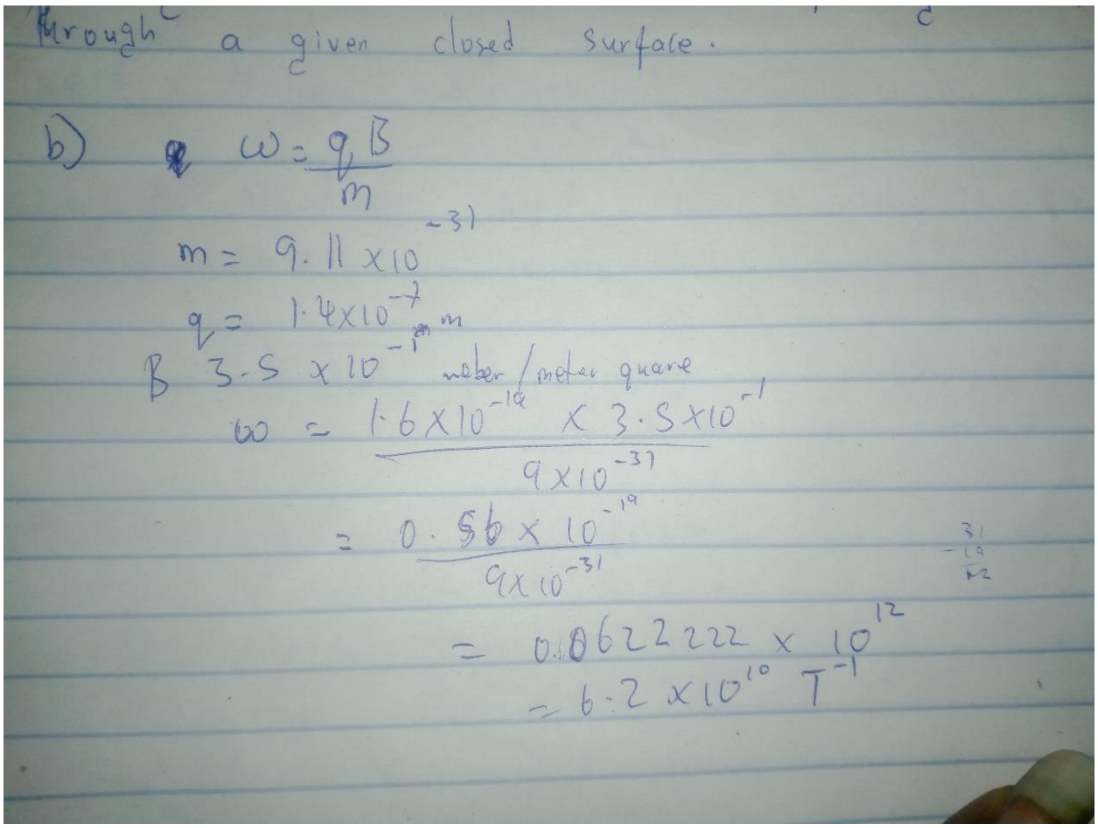
$V_B - V_A = \frac{W(A \rightarrow B)_{Ag}}{q_0}$ ... (5) Putting equation (4) in (5) yields

$$V_B - V_A = -\int_A^B EdL \quad \ldots \quad (6)$$

SECTION B.

4a. magnetic flux is the number of magnetic field that passae through a given closed surface.

4b.



through a given closed surface.

b) $\omega = \frac{qB}{m}$

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

$q = 1.4 \times 10^{-7}$ m

B 3.5×10^{-1} weber/meter quare

$\omega = \frac{1.6 \times 10^{-19} \times 3.5 \times 10^{-1}}{9 \times 10^{-31}}$

$= \frac{0.56 \times 10^{-19}}{9 \times 10^{-31}}$

$= 0.0622222 \times 10^{12}$

$= 6.2 \times 10^{10}\ T^{-1}$

$31 - 19 = 12$

4c.

Recall that angular speed is given as $\omega = \frac{v}{r} = \frac{qB}{m}$

Substituting we have

$\frac{qB}{m} = \frac{1.6\times10^{-19}x3.5x10\hat{}-1}{9.11x10\hat{}-31}$=62222222222.22222T^{-1}

since cyclotron frequency is equal to angular speed the cyclotron frequency is equal to =6.2 x 1010, having a unit as 1\T which is equal to the unit of frequency dimensionally.

5b.Biot-savart law states that the magnetic field is directly proportional to the product permeability of free space(μ),the current(I),the change in length, the radius and inversely proportional to square of radius (r^2). It can be represented mathematically by

$$d\vec{B} = \frac{\mu_o}{4\pi}\frac{I\,d\vec{l}\times\hat{r}}{r^2}$$

where μ_o is a constant called Permeability of free space.

$$\mu_o = 4\pi \times 10^{-7}\,T.\frac{m}{A}$$

The unit of $\vec{B}$ is weber\metre square

5b. Magnetic Field of a Straight Current Carrying Conductor

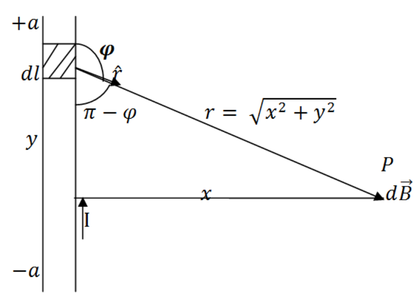


Fig 1: A section of a Straight Current Carrying Conductor

Applying the Biot-Savart law, we find the magnitude of the field $d\vec{B}$

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

$$\sin(\pi - \varphi) = \sin\theta$$

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

From diagram, $r^2 = x^2 + y^2$ $(Pythagoras\ theorem)$

$$B = \frac{\mu_o I}{4\pi}\int_{-a}^{a}\frac{dl\sin(\pi-\varphi)}{x^2 + y^2} \quad \ldots \quad (*)$$

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

Substituting $(**)$ into $(*)$, we have

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

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

Recall $dl = dy$

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

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

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

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

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

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

When the length $2a$ of the conductor is very great in comparison to its distance x from point P, we consider it infinitely long. That is, when a is much largerthan x,

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

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

In a physical situation, we have axial symmetry about the y- axis. Thus, at all points in a circle of radius r, around the conductor, the magnitude of B is

$$B = \frac{\mu_o I}{2\pi r} \qquad \ldots \qquad (\#)$$

Equation $(\#)$ defines the magnitude of the magnetic field of flux density B near a long, straight current carrying conductor.