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MATRIC NUMBER:19/ENG03/003

PHYSICS 102 CORONA VIRUS HOLIDAY ASSIGNMENT

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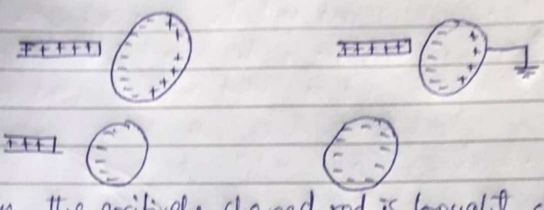
1 a)



When the positively charged rod is brought close to the sphere, the negative charges ~~move~~ in the sphere move to the direction the rod is placed. The sphere is then connected to an earth (neutral) element and the positive charges of the sphere are allowed to flow out of it. By the time the rod is removed, the negative charges in the sphere distribute themselves on the sphere's surface and the sphere is now negatively charged.

b) $F = \frac{Kq_1q_2}{r^2}$

$1 = \frac{9\times10^9 q_1q_2}{4}$

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

$\therefore 4 = 9\times10^9 q_1(5\times10^{-5} - q_1)$

$\frac{4}{9\times10^9} = 5\times10^{-5}q_1 - q_1^2$

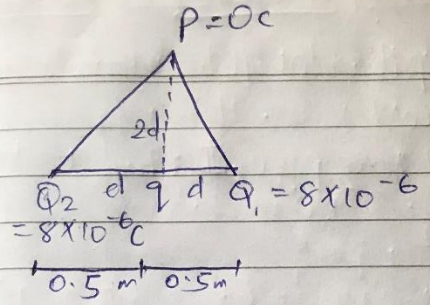
$q_1^2 - 5\times10^{-5}q_1 + 4.44\times10^{-10} = 0$

Using quadratic formular, $q_1 = 1.15\times10^{-5}C$ or $3.85\times10^{-5}C$

if $q_1 = 1.15\times10^{-5}C$, $q_2 = 3.85\times10^{-5}C$ and if $q_1 = 3.85\times10^{-5}C$, $q_2 = 1.15\times10^{-5}$

$\therefore$ the two charges q_1 and q_2 are $1.15\times10^{-5}C$ and $3.85\times10^{-5}C$

c)



$$F_{Q_1Q_2} = \frac{KQ_1Q_2}{r^2} = \frac{9\times10^{-9}\times(8\times10^{-6})^2}{1^2} = 0.576N$$

$$F_{Q_1q} = F_{Q_2q} = \tfrac{1}{2}F_{Q_1Q_2} = 0.288$$

$$\therefore 0.288 = \frac{9\times10^{9}\times 8\times10^{-6}\times q}{0.5^2}$$

$$q = \frac{0.288\times0.5^2}{9\times10^{9}\times8\times10^{-6}} = \underline{1\times10^{-6}}\,C$$

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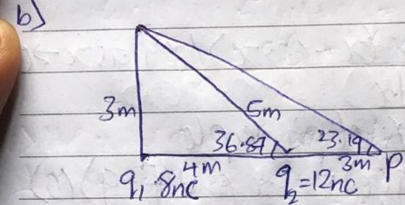
(2) a) Electric field is a region of space in which an electric charge will experience an electric force

Electric field intensity is the force per unit charge $E = F(N)/q$

b)



i) $E_1 = \frac{KQ_1}{r^2} = \frac{9\times10^9 \times 8\times10^{-9}}{7^2} = 1.47$

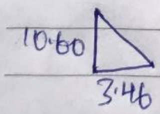
$E_2 = \frac{KQ_2}{r^2} = \frac{9\times10^9 \times 12\times10^{-9}}{3^2} = 12$

$E = E_1 + E_2 = 13.47\,N/C$

ii) $E_1 = \frac{9\times10^9 \times 8\times10^{-9}}{9} = 8$

$E_2 = \frac{9\times10^9 \times 12\times10^{-9}}{25} = 4.32$

x	y
$8\times\cos(90) = 0$	$8\times\sin 90 = 8$
$4.32\times\cos(36.87) = 3.46$	$4.32\times\sin(36.87) = 2.60$
3.46	10.60



$E = \sqrt{10.6^2 + 3.46^2} = 11.15\,N/C$

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lectric charge

ge $E = F(N)/q_0(C)$

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3) a) i) volume charge density $\rho = \frac{dQ}{dv} \rightarrow dQ = \rho dv$

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

iii) Linear charge density $\lambda = \frac{dQ}{dl} \Rightarrow dQ = \lambda dl$

b) $dW = F \cdot dl$

$F = -q_0 \bar{E}$

$dW = -q_0 \bar{E} dl$

$W(A \rightarrow B)_{Ag} = -q_0 \int_A^B \bar{E} dl$

$V_B - V_A = \frac{W(A \rightarrow B)_{Ag}}{q_0}$ it follows the definition

$V_B - V_A = -\int_A^B \bar{E} dl$

Electric potential difference between two points in an electric field can be defined as the work done per unit charge against electric forces when a charge is transported from one point to the other. It is a vector quantity measured in volts or Jouls per Columb (J/C)

c) $Q_1 = 10\mu C$ ——— 4m ——— $Q_2 = -2\mu C$

$V = \frac{1}{4\pi\varepsilon_0}\left[\frac{Q_1}{r_1} + \frac{Q_2}{r_2}\right]$

$\frac{0}{9\times10^9} = \frac{10\times10^{-6}}{r_1} - \frac{2\times10^{-6}}{r_2}$

$2r_1 = 10r_2$; $r_1 = 5r_2$

Refering to the diagram above, the position along the x-axis where $V = 0$ is 5m from $Q_1 = 10\mu C$ and 1m from $Q_2 = -2\mu C$

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4 a) Magnetic flux is defined as the strength of the magnetic field which can be represented by line of forces. It is represented by the symbol Φ mathematically given as $\Phi = B.dA$

b) $m = 9.11 \times 10^{-31}$ Kg $r = 1.4 \times 10^{-7}$ m $B = 3.5 \times 10^{-1}$ weber/meter^2

Cyclotron frequency = angular speed

$$\omega = \frac{v}{r} = \frac{qB}{m} = \frac{1.6 \times 10^{-19} \times 3.5 \times 10^{-1}}{9 \times 10^{-31}} = 62222.2222T^{-1}$$

c) We were given parameters such as

i) mass of the electron $= 9.11 \times 10^{-3}$ Kg

ii) A radius of 1.4×10^{-7} m

iii) magnetic field of 3.5×10^{-1} weber/meters square and we were asked to find the cyclotron frequency which is equal or the same thing as angular speed. It is called cyclotron. Recall that angular speed is given as ω = substituting we have

$$\omega = \frac{1.6 \times 10^{-19} \times 3.5 \times 10^{-10}}{9 \times 10^{-31}} = 622222.222T^{-1}$$

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(5) Biot Savart law is an equation that describes the magnetic field as by a current-carrying wire, and allows you to calculate its strength at various points... ~~And~~ And we replace the electric field E with a magnetic field element dB because a moving charge produces a magnetic field not an electric field

Permeability of free space — Length of segment

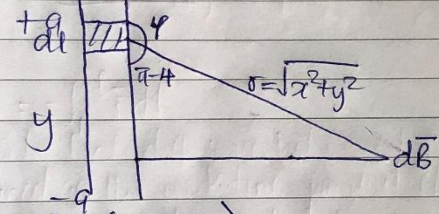
$$B = \frac{\mu_0 I}{4\pi}\int \frac{d\vec{s}\times\hat{r}}{r^2}$$

— radical direction

— Distance

$\mu_0 = 4\pi\times10^{-7}$ T.m/A

b) section of a straight current carrying conductor



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

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

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

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

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

$$B=\frac{\mu_0 I}{2\pi r} \quad \text{—(1)}$$

Equation (1) defines the magnitude of the magnetic field of flux density B near a long, straight current carrying conductor.