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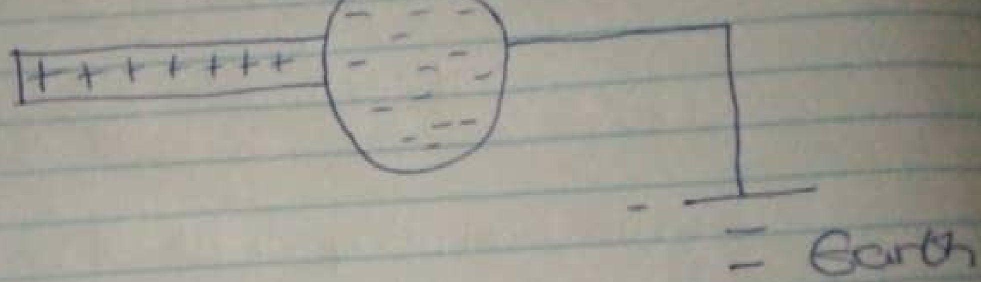
19/mhs01/428
Medicine and Surgery
Phy 102

1a)



~~From the earth the~~ In charging a metal sphere negatively by induction, by bringing a positively charged rod near it. In this case the electrons will flow from the ground to the sphere when the sphere is connected to the ground with wire.

b) Combined charge = 5.0×10^{-5} C
force = 1.0N
r = 2.0m

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

$$1.0N = \frac{9 \times 10^9 \times q_1 \times q_2}{(2.0m)^2}$$

3) i) Volume charge density

$$\rho = \frac{dQ}{dv} \longrightarrow dQ = \rho dv$$

ii) Surface charge density

$$\sigma = \frac{dQ}{dA} \longrightarrow dQ = \sigma dA$$

iii) linear charge density

$$\lambda = \frac{dQ}{dL} \longrightarrow dQ = \lambda dL$$

b) Electric potential difference

~~$dw = F.dt$~~ $F = q_0 E$

$$dw = F.dL \quad - (1)$$

$$F = -q_0 E \quad - (2)$$

Sub eqn (2) into (1)

$$dw = -q_0 E dL \quad - (3)$$

then total work done in moving test charge =

$$W(A \longrightarrow B)_{Ag} = -q_0 \int_A^B E dL \quad - (4)$$

From definition of electric potential diff.

$$V_B - V_A = \frac{W(A \longrightarrow B)_{Ag}}{q_0}$$

Electric potential diff. is the work

$1.\ ON = \frac{9\times10^{9} + 5.0\times10^{-5}}{4} q_1 q_2$

$4 = 9\times10^{9} + 5.0\times10^{-5} q_1 q_2$

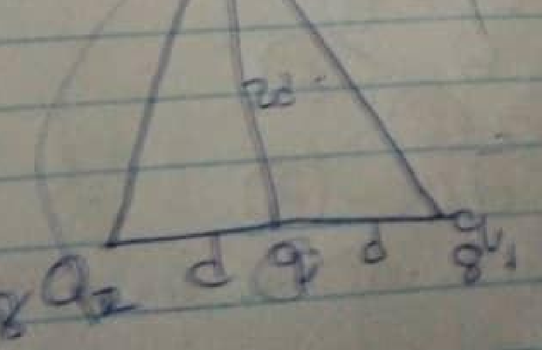
$4 - 9\times10^{9} = 5.0\times10^{-5} q_1 q_2$

$= \frac{-8999}{5.0\times10^{-5}} = \frac{5.0\times10^{-5} q_1 q_2}{5.0\times10^{-5}}$

$= -1799$

$q_1 = 1.11\times10^{-5}C$ and $q_2 = 3.89\times10^{-5}C$.

c)



4a) Magnetic flux ~~is what gene can~~ be defined as what generates the field around a magnetic material. The SI unit is weber (Wb)

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

$r = 1.4 \times 10^{-7}$

$B = 3.5 \times 10^{-1}$

$\omega = ?$

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

$\omega = \frac{1.60 \times 10^{-19} \times 3.5 \times 10^{-1} wb}{9.11 \times 10^{-31}}$

$\omega = 6.147 \times 10^{10} rad/S$,,

C) It shows that the angular speed (angular frequency) is equal 6.147 $\times 10^{10}$ rad/S.

5) Biot - Savart law states that It is a mathematical expression which illustrates the magnetic field produced by a Stable electric current in the particular electromagnetism of physics.

done per unit charge ... forces when a charge is ... field to another.

--2)

$2 + 0.5 + 8 + 10 + 9 = 10 + 8 + 0.5 + 9.99$

$= 20.5 + 9 = 28.49 + 9$

$20.5 - 28.49 = 9 - 9$

-7.99

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

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

$$\int \frac{dy}{(x^2+y^2)^{3/2}} = \frac{1}{x^2} \frac{y}{(x^2+y^2)^{1/2}}$$

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

$$B = \frac{\mu_0 I}{2\pi x} = \frac{\mu_0 I}{2\pi r_{\perp}} \quad Q.E.D.$$

∴ Position along x-axis is 1m where V = 0

$$V = k\left[\frac{Q_1}{r_1} + \frac{Q_2}{r_2}\right]$$

$$0 = \left[\frac{10\times10^{-6}}{4-x} + \frac{-2\times10^{-6}}{x}\right]$$

$$\frac{2\times10^{-6}}{x} = \frac{10\times10^{-6}}{4-x}$$

$$[4-x][2\times10^{-6}] = 10\times10^{-6}x$$

$$8\times10^{-6} - 2\times10^{-6}x = 10\times10^{-6}x$$

$$8\times10^{-6} = 10\times10^{-6}x + 2\times10^{-6}x$$

$$8\times10^{-6} = 12\times10^{-6}x$$

$$x = \frac{8\times10^{-6}}{12\times10^{-6}}$$

$$x = 0.67m$$

∴ position of V = 0 is 0.67m

3b) Electric potential difference due to single point charge

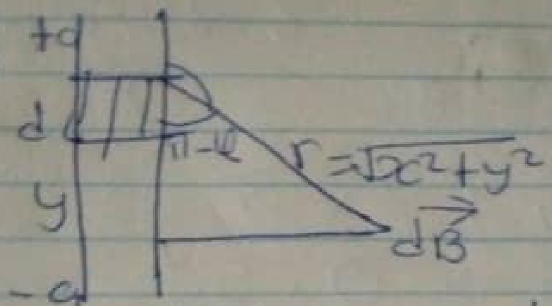
$$V_B - V_A = \frac{Q}{4\pi\varepsilon_0}\left[\frac{1}{r_B} - \frac{1}{r_A}\right]$$

due to several point

$$V_B = \frac{1}{4\pi\varepsilon_0}\left[\frac{Q}{r}\right]\left[\frac{Q}{r_2}\right]$$

V = Electric potential
Q = Point charge
r = distance of q.

5 b)



Applying Biot savart law, magnetic field :-

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

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

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

From the diagram $r^2 = x^2 + y^2$

$$B = \frac{\mu_0 I}{4\pi}\int_{-a}^{a} \frac{dl \sin(\pi - \theta)}{x^2 + y^2} \quad \text{— (1)}$$

Sub $\sin(\pi - \theta) = \frac{x}{\sqrt{x^2+y^2}} = \frac{x}{(x^2+y^2)^{1/2}}$ — (2)

Sub (2) into (1)

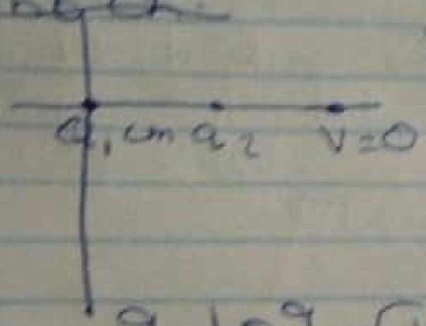
$$B = \frac{\mu_0 I}{4\pi}\int_{-a}^{a} dl \frac{x}{(x^2+y^2)(x^2+y^2)^{1/2}}$$

done per unit charge against electrical forces when a charge is transported from one field to another.

c) $Q_1 = 10\,\mu C$ $Q_2 = -2\,\mu C$ $x = 0$ & $x = 1$

$V = 0$

Point ch.



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

$\frac{1}{4\pi\varepsilon_0} = 9\times10^9 = k$

$V_p = 9\times10^9 \times \left[\frac{10\times10^{-6}}{4+x} + \frac{-2\times10^{-6}}{x}\right]$

$0 = 9\times10^9 \times \left[\frac{10\times10^{-6}}{4+x} + \frac{-2\times10^{-6}}{x}\right]$

$0 = \frac{10\times10^{-6}}{4+x} + \frac{-2\times10^{-6}}{x} = \frac{10\times10^{-6}}{4+x} = \frac{2\times10^{-6}}{x}$

$10\times10^{-6}x = (4+x)(2\times10^{-6})$

$10\times10^{-6}x = 8\times10^{-6} + 2\times10^{-6}x$

$8\times10^{-6} = 10\times10^{-6}x - 2\times10^{-6}x$

$8\times10^{-6} = 8\times10^{-6}x$

$x = \frac{8\times10^{-6}}{8\times10^{-6}}$ $x = 1$