19/MHS01/422 PHY 102 ASSIGNMENT

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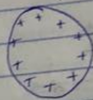
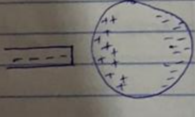
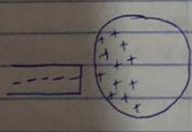
1a Charging by induction: A negatively charged inductor rod is brought near a neutral conducting sphere that is insulated so that there is no conducting path to the ground as shown below. The repulsive force between the electrons in the rod and those in the sphere causes a redistribution of charges in the sphere farthest away from the rod. A grounded conducting wire is constructed to the sphere and some electrons leave the sphere and it is left with excess of induced positive charge. When the rubber rod is removed from the vicinity of the sphere, the induced positive charges remain in the ungrounded sphere and becomes uniformly distributed over the surface of the sphere.







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

$F = 1, \; r = 2$

$F = \frac{k q_1 q_2}{r^2}$

$1 = \frac{9 \times 10^9 \times (q_2 - 5.0 \times 10^{-5}) \times q_1}{4}$

$4.44 \times 10^{-10} \times (q_2 - 5.0 \times 10^{-5}) q^2$

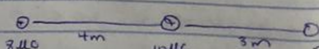
$4.44 \times 10^{-10} = q_2^2 - 5.0 \times 10^{-5} q^2$

$q_2 = 1.14 \times 10^{-5}$

2 a) The electric field is a region around a charge in which it exerts electrostatic force on another charge(s). While the strength of electric field at any point in space is called electric field intensity, it depends upon the distance between the two charges.

b. $Q_1 = 8\mu C$, $Q_2 = 12\mu C$, $x = 4m$, $K = 9 \times 10^9$

i. $x = 7m$



$E_{1p} = \frac{k q_1 P}{r^2} = \frac{9 \times 10^9 \times (8 \times 10^{-9})}{7^2} = 1.469

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

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

At all points in a circle of radius r, around the conductor, the magnitude of B is

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

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$E_{2P} = \frac{Kq_2P}{r^2} = \frac{9\times10^9 \times 12\times10^{-9}}{3^2} = 12N/C$

$E_{net} = 12 + 1.469$

$= 13.469N/C$

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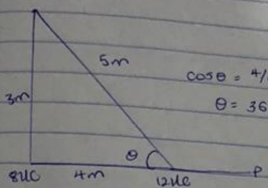

$\cos\theta = 4/5$

$\theta = 36.87°$

$E_{1q} = \frac{Kq_1}{r^2} = \frac{9\times10^9 \times 8\times10^{-7}}{3^2} = 8N/C$

$E_{2q} = \frac{Kq_2}{r^2} = \frac{9\times10^9 \times 12\times10^{-9}}{5^2} = 4.32N/C$

Vector	Angle	x-comp	y-comp
$E_{q} = 8N/C$	90°	8cos 90 = 0	8sin90 = 8
$E_{2q} = 4.32N/C$	36.87°	4.32cos36.87 = 3.46	4.32sin36 = 87
		E = 3.46 N/C	E = 10.59N/C

$E_{net} = \sqrt{(3.46)^2 + (10.59)^2}$

$E_{net} = 11.14 uC$

Magnetic flux through a surface is the surface integral of the normal component of the magnetic field flux density passing through that surface. i.e Magnetic flux is what generates the field around a magnetic material.

$M = 9.11 \times 10^{-31} Kg$

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

$B = 3.5 \times 10^{-1} m^2$

Cyclotron frequency = Angular speed

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

$= \frac{1.6\times10^{-19} \times 3.5\times10^{-1}}{9.11\times10^{-3}}$

$= 6.15 \times 10^{10}$ rads

c. The charged particle circhulates at the angular frequency or angular speed at 6.15×10^{10} rads in the type of accelerator called cyclotron, therefore, the angular speed is also seen as cyclotron frequency.

5a. The Biot-Savart law is an equation describing the magnetic field generated by a constant electric current. It relates the magnetic field to the magnitude, direction, length and proximity of the electric current.

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

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

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

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