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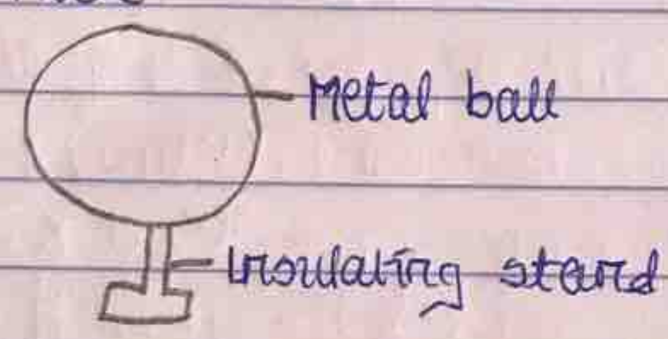
19/Eng 05/018
Mechatronics Engineering
PHY 102

1a) - Firstly the material to be charged is placed on an insulating rod
- Then a negatively charged material is brought near the sphere
- The sphere is then ~~heated by~~ earthed by connecting it momentarily to the ground by means of a wire
- The wire is removed followed by the rod (on testing the sphere, it will be discovered that it has charges opposite to that of the rod.

- Uncharged Metal sphere




- Negative charge on the rod repels electrons creating zones of negative and positive induced charge

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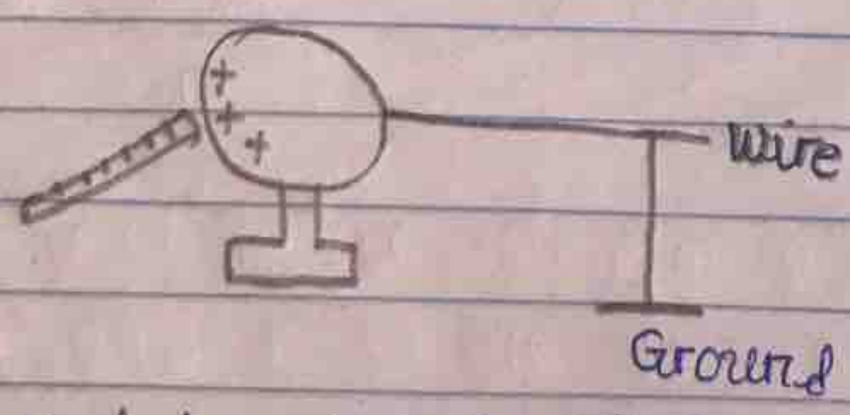
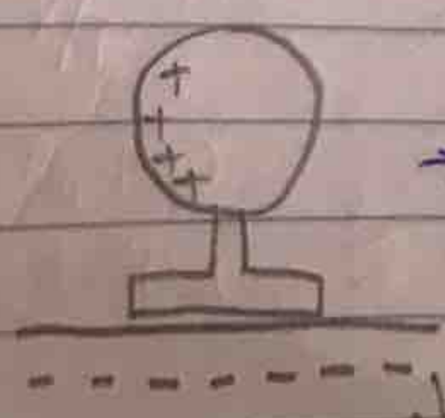



The wire lets electron build up (induced negative charge) flow into the ground



→ Wire is removed ball now has an electron deficient region of positive charge.

Negatively charged ground

~~3(i) net electric field~~

~~3a(i) Volume charge density - It is the measurement of how much electric charge is accumulated over a surface. It is calculated as the charge per unit surface area~~

3a(i) Volume charge density - it is the quantity of charge per unit volume measured in Coulombs per cubic meter ($Cm^{-3}$) at any point in a volume. 2b

(ii) Surface charge density - It is a measure of how much electric charge is accumulated over a surface. It is calculated as the charge per unit surface area

(iii) Linear charge density - it is the quantity of charge per unit length in Coulomb's per meter ($Cm^{-1}$) at any point on a line charge distribution.

b) Electric Potential difference - It is the value of potential obtained when the potential at a point is subtracted from the potential at another point.

$$V_a = V_a - V_b$$

$$V_a = \frac{kq_a}{r}$$

$$V_b = \frac{kq_b}{r}$$

$q_a$ is the value of electric charge at "a", $q_b$, the value of an electric charge at "b" and r is the separation between "0" and the charge at potential

$kq/r$

$V = 2x = 10(4+x)$

$2x = 40 + 10x$, $-8x = 40$, $x = -5m$

a) Magnetic flux can be defined as the total magnetic field which passes through a particular area

b) $C = qB/M$ , $q = 9.11 \times 10^{-31}$ kg , $B = 3.5 \times 10^{-1}$ weber/meter square
$M = 1.4 \times 10^{-7}$ m

$$C = \frac{9.11 \times 10^{-31} \times 3.5 \times 10^{-1}}{1.4 \times 10^{-7}}$$

$$C = \frac{3.19 \times 10^{-31}}{1.4 \times 10^{-7}}$$

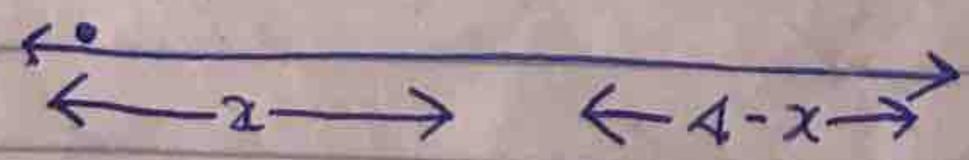
$$C = 2.28 \times 10^{-38}$$

c) Cyclotron frequency is the frequency of a charged particle moving perpendicular to the direction of a uniform magnetic field B.

2) Electric field can be defined as the area around a charged particle or object within which a force would be exerted on other charged particles or objects.

Electric field intensity can be defined as force per coloumbs on a small charge place at that point which does not disturb the field.

$$\mathcal{E} = F/q$$



$0 = 40 - x - 2x$

$0 = 40 - 3x$

$3x = 40$

$x = 40/3$ , $x = 13.3$ . Which is not between the points

2b

1b) $5.0 \times 10^{-5} C = Q$

$F = 1.0N$

$d = 2.0m$

$k = 8.9 \times 10^{9}$

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

make $q_2$ the subject of formula

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

$F = \frac{k q_1 q_2}{d^2}$ , $1.0 = \frac{(8.9 \times 10^{9}) \times q_1 (5.0 \times 10^{-5} - q_1)}{2^2}$

$q_1 (5.0 \times 10^{-5} - q_1) + 0.44 \times 10^{-9} = 0$

$5.0 \times 10^{-5} q_1 - q_1^2 + 0.44 \times 10^{-9} = 0$

$q_1^2 - 5 \times 10^{-5} q_1 + 0.44 \times 10^{-9} = 0$

Using quadratic formula

$q_1 = \frac{\pm\sqrt{(5 \times 10^{-5})^2 - 4(0.44 \times 10^{-9})}}{2}$

$q_1 = 3.84 \times 10^{-5} C$

$q_2 = (5.00 \times 10^{-5}) - (3.84 \times 10^{-5}) C$

$q_2 = \cancel{1.6}\ 1.16 \times 10^{-5} C$