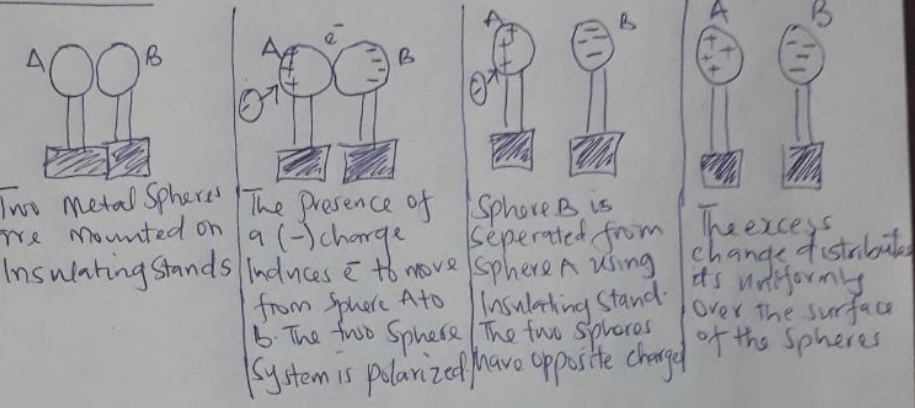
OKPODU JESSICA
18/ENG07/010 – CARRYOVER
PETROLEUM ENGINEERING
PHY 102

Question 19



Two Metal Spheres are mounted on Insulating Stands

The presence of a (−) charge Induces e⁻ to move from Sphere A to B. The two Sphere System is polarized

Sphere B is seperated from Sphere A using Insulating Stand. The two Spheres have opposite charge

The excess charge distributes its uniformly over the surface of the Spheres

A negatively charged rubber rod brought near a Uncharged Conducing Sphere that is insulated so that there is no Conducting path to earth. The repulsive force between the electrons move to the side of the sphere farther away from the rod. The region of the Sphere nearest the negatively charged rod has an excess of positive charge because of the movement of electrons.

When the rubber rod is removed from the Sphere, the Induced Positive charge remains on the Ungrounded Sphere and becomes Uniformly distributed over the Surface of the Sphere.

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Question 1b

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

$|q_1| = |q_2|$

$\therefore F = \frac{k q_1 q_2}{r^2} = 1N$

$q_1 q_2 = (1.0N)\frac{r^2}{k}$

$= (1.0N)(2.0m)^2 8.99 \times 10^9 N.m^2 C^2$

$= 4.449 \times 10^{-10} C^2$

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

$q_1 q_2 = 4.449 \times 10^{-10}$

$q_1(5.0 \times 10^{-5} - q_1) = 4.449 \times 10^{10}$

$(5.0 \times 10^{-5} q_1 - q_1^2) = 4.449 \times 10^{10}$

$q_1^2 - (5.0 \times 10^{-5} C) q_1 + 4.449 \times 10^{-10}$

Using quadratic formula

$q_1 = \frac{(5 \times 10^{-5}) \pm \sqrt{(5 \times 10^{-5})^2 - 4(4.449 \times 10^{-10})}}{2}$

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

$\therefore \rightarrow q_2 = 1.16 \times 10^{-5} C$

Question 1c

$$\overrightarrow{E_y}(q_2) = \overrightarrow{E_y}(q_3) = \frac{q}{4\pi\varepsilon_0 r^2}\cos\theta = \frac{(9\times10^9 Nm^2C^{-2})(1\times10^{-6}C)\cos 60^\circ}{(0.5m)^2}$$

$$= (1.95\times10^3 NC^{-1}$$

$$F = q_1 \cdot (\overrightarrow{E_y}(q_2) + \overrightarrow{E_y}(q_3) = (2\times10^{-6}C)\cdot 2\cdot(1.95\times10^3)$$

$$= 7.8\times10^{-3}N$$

Question 2a

Electric Field

An electric field is a region of space in which an electric charge will experience an electric force.

Electric Field Intensity

This can be defined as the force per unit charge. It is measured in Newton per coulomb. The direction of the electric field intensity at a point in space is the same as the direction of the force a positive test charge would experience.

Question 5a

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.

Question 5b

For a long straight wire where I is the current, r is the distance to the wire and the constant $= 4\pi \times 10^{-7}$ Tm/A is the permeability of free space

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

$$\oint B \cdot dl = \mu_0 \iint J \cdot ds = \mu_0 I$$