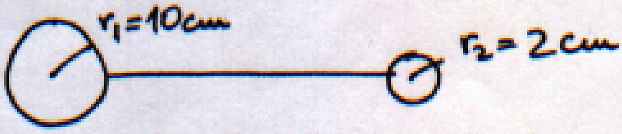
PHYS 142, EXAM 1 NAME: ______________________ SECTION: ________

(10) 1. Two conducting spheres of radii 10cm and 2cm are connected with a thin copper wire. (a) If I put a charge of 60nC on one of the spheres, what will happen to the charge? (b) What can you say about the electric potential in this system? (c) After things have settled, what will be the net charge (q_1) on the larger sphere?



a) $Q = 60nC$

The charge will be distributed on both spheres. (2)

It will go to the surface. (1)

b) Electric potential is the same on both spheres and the wire, because the system is a "single" conductor. (2)

$$V_1 = V_2 = V$$

c) $V_1 = k\frac{q_1}{r_1}$ – potential on a sphere (at surface an inside)

(1) $V_2 = k\frac{q_2}{r_2}$

Can derive this by considering the sphere with charge q as a point charge q at the center of the sphere. Then calculate the potential (due to the point charge) at a distance r (radius) from the center.

$\Rightarrow k\frac{q_1}{r_1} = k\frac{q_2}{r_2}$ (1) ratio

$q_2 = Q - q_1$ (Q = total charge)

$$\frac{q_1}{r_1} = \frac{Q}{r_2} - \frac{q_1}{r_2}$$

$$q_1\left(\frac{1}{r_1} + \frac{1}{r_2}\right) = \frac{Q}{r_2}$$

$$q_1 = \frac{Q}{r_2\left(\frac{1}{r_1} + \frac{1}{r_2}\right)}$$

equation (2)

$$\boxed{q_1 = \frac{Q}{\left(\frac{r_2}{r_1} + 1\right)}}$$

$$q_1 = \frac{60nC}{\left(\frac{2cm}{10cm} + 1\right)} = \frac{60nC}{\left(\frac{1}{5} + \frac{5}{5}\right)}$$

$$q_1 = \frac{5}{6} \cdot 60nC$$

value (1) $\boxed{q_1 = 50nC}$

$\varepsilon_0 = 8.85 \times 10^{-12}\ C^2/(Nm^2)$ $e = 1.6 \times 10^{-19}\ C$ $m_e = 9.1 \times 10^{-31}\ kg$