Quiz 3

1. Derive the Charge on a hollow Conducting Sphere of Diameter 3.75cm held at a given Potential V_0. (Note: For an Isolated Charged Sphere $C = 4\pi\epsilon_0 R$) (5pt)

$$Q = CV$$

$$Q = 4\pi\epsilon_0 R \, V_0 \quad \bullet$$

2. For the torsion balance, write down the relationship between the exerted force and the angle of rotation. (5pt)

$$T = k\theta = FL \qquad so$$

$$F = \frac{k\theta}{L}$$

3. Two conducting hollow balls of diameter 3.75 cm are both initially charged by a bias voltage of +5000 V. When they are brought to a center-to-center distance of 10.0 cm, what is the electrostatic force between them? (5pt)

From (1) $\quad Q = 4\pi\epsilon_0 R \, V_0$

So $\quad F = k\dfrac{q_1 q_2}{r^2} \qquad q_1 = q_2 = Q \qquad\qquad F = \dfrac{kQ^2}{r^2}$

$$F = \frac{k(4\pi\epsilon_0 R)^2 V_0^2}{r^2}$$

4. For the two conducting balls as described in Problem 3, when one ball is attached to a torsion balance, the wire is twisted by a torsional angle of 1°. Assuming the length of the lever arm as 10.0 cm, find the torsion constant of the wire. Show the calculation. (5pt)

$$F = \frac{k\theta}{L} \qquad so \rightarrow k = \frac{FL}{\theta} \qquad\qquad \text{when } F \text{ is from (3)}$$

$$so \qquad k = \frac{k16\pi^2\epsilon_0^2 R^2 V_0^2 L}{r^2 \theta}$$

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