PHYSICS 211
Quiz I
TIME: 90 minutes

November 9, 2010

DO NOT OPEN THIS EXAM BEFORE YOU ARE TOLD TO BEGIN

NAME_____

ID Number _____

Useful information
$\varepsilon_0=8.85\text{x}10^{-12}\ C^2/N.m^2$.

Grading

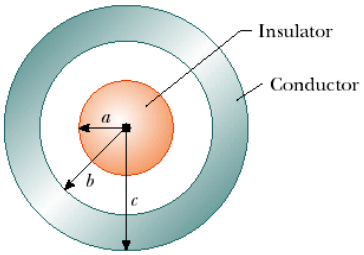
Problem 1	
Problem 2	
TOTAL	

☐ Check if solution is continued on the back.

Problem 1 (65%)

1. Gauss's Law and Capacitance

A solid, insulating sphere of radius a has a uniform charge density ρ and a total charge Q. Concentric with this sphere is an uncharged, conducting hollow sphere whose inner and outer radii are b and c, as shown in the Figure below.



(a) (10) Find the magnitude of the electric field in the region $r < a$

(b) (10) Show that the magnitude of the electric field in the region $a < r < b$ is $E = \rho a^3 / 3\varepsilon_0 r^2$

(c) (5) Find the magnitude of the electric field in the region $b < r < c$

Score:_____

☐ Check if solution is continued on the back.

(d) (10) Find the magnitude of the electric field in the region $r > c$

(e) (15) Determine the induced charge per unit area on the inner and outer surfaces of the hollow sphere.

(f) (10) Determine the potential difference between a and a position r such that $a < r < b$

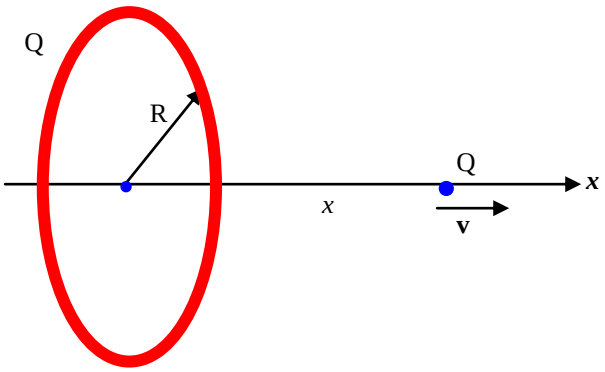
(g) (5) Compare the electric field inside this capacitor to the one produced by two parallel plates.

Score:_____

☐ Check if solution is continued on the back.

2. **(35) Electrostatic acceleration**

We want to accelerate a particle, with charge Q and mass M, just by putting it close to a ring biased to Q and held fixed. The charge is initially put at the center of the ring.



(a) **(10)** Determine the expression of the electric potential at a point on the axis of the ring at a position x from the center.

(b) **(5)** Deduce the electric potential at the center of the ring.

(c) **(5)** Find the potential energy of the particle at the initial and final positions.

Score:_____

☐ Check if solution is continued on the back.

(d) **(10)** Assume that the charge has a mass M, show that the ultimate speed of the point charge is

$$v = \left(\frac{2k_e Q^2}{MR} \right)^{1/2}$$

(e) (5) the ring is now put horizontally, determine the Q needed so as the charge will remain in equilibrium at an elevation equal to x_0

Score:_____

☐ Check if solution is continued on the back.

SCRATCH PAPER

Nothing on this page will be graded

Score:_____

☐ Check if solution is continued on the back.