EXAM II Physics 208

Name.....Section Number.....

USEFUL INFORMATION

For two point particles

$$\vec{F} = \frac{1}{4\pi\epsilon_0}\frac{q_1 q_2}{r^2}\hat{r}$$

$$\frac{d\vec{r}}{dt} = \frac{dx}{dt}\vec{i}_x + \frac{dy}{dt}\vec{i}_y = \frac{dr}{dt}\vec{i}_r + r\frac{d\theta}{dt}\vec{i}_\theta$$

$$V(\vec{r}_2) - V(\vec{r}_1) = -\int_{\vec{r}_1}^{\vec{r}_2} \vec{E}\cdot d\vec{r}$$

$$C = \frac{Q}{V} \qquad R = \rho\frac{l}{A}$$

$$\oint \vec{E}\cdot d\vec{S} = \frac{Q_{inside}}{\epsilon_0}$$

$$V = iR \qquad \vec{E} = \rho\vec{j}$$

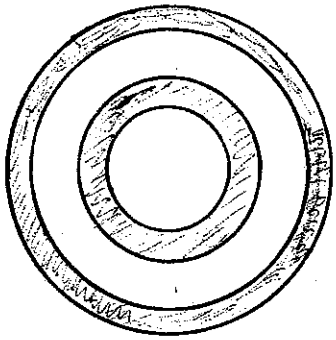
1.

2.

3.

4.

1. (25 points)A conducting spherical shell has inner radius A and thickness T. There is a larger concentic spherical conducting shell with inner radius B and thickness T. The inner shell is given a charge Q.



a. Find the charge per unit area everywhere.

b. Find the electric potential difference between a point on the inside surface of the inner shell and a point on the outside surface of the outer shell.

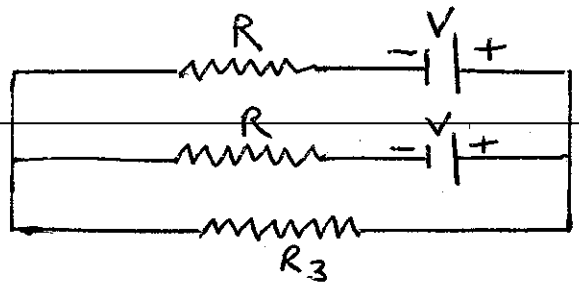
c. What is the capacitance of this system?

2. (25 points)A very, very long insulating cylinder of radius A and length L has a charge Q uniformly spread throughout its volume. For the two questions that follow consider only points very far from the ends so that the cylinder can be assumed to be infinitely long.

a. Find the electric field as a function of r, the distance from the axis of the cylinder, for all values of r.

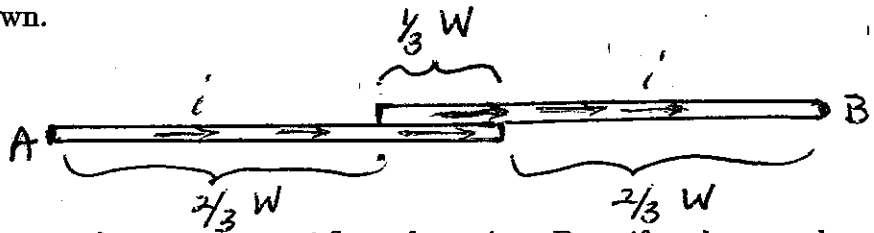
b. Find the difference in the electric potential between a point on the axis, at the center of the cylinder, and a point b a distance 5A from the axis of the cylinder.

3. (25 points)In the circuit below, R, and R_3 and V are known. Find the current in the resistor R_3.



If one of the resistors, R, is replaced by a capacitor, capacitance C, find the current in R_3 and the charges on C.

4. It is necessary to connect two points A and B so that a current will flow. There are two identical wires available that are too short. They have length W, cross-sectional area A, and are made of material with resistivity ρ. They are soldered together as shown.



Assume a known current i flows from A to B, uniformly spread over the cross-section of the wires, as indicated.

a. What is the current density vector at all points in the wires?

b. What is the difference in the electrical potential between the points A and B?

c. What is the resistance between the points A and B?