EXAM II Physics 208 2011

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.....

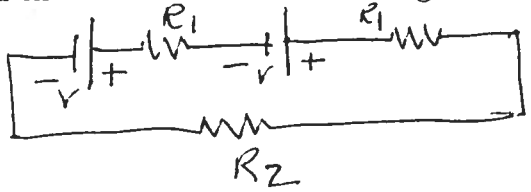
2.....

3.....

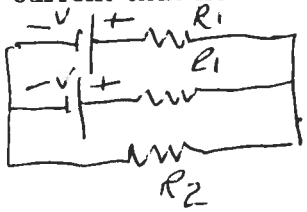
4.....

1. (25 points)In the circuits below, R_1, R_2, C and V are known.

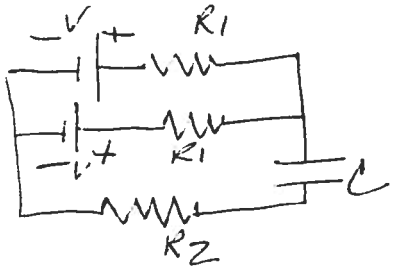
a. Find the current that flows through R_2.



b. Find the current that flows through R_2.



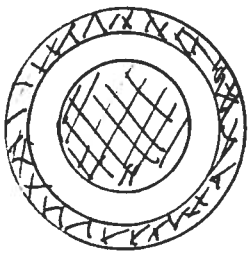
c. Find the current that flows through R_2 and the charge on the bottom plate of the capacitor.



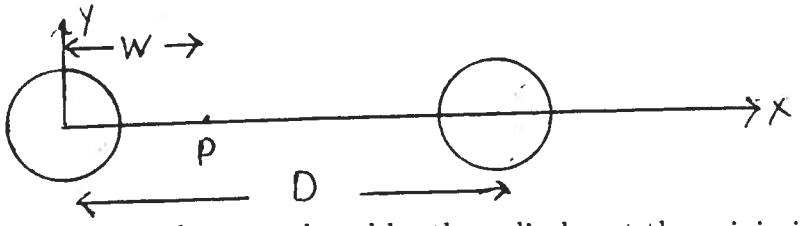
2. (25 points)A sphere of radius H has an amount of charge Q uniformly spread throughout its volume.

a. Find the difference in the electric potential between a point $\frac{H}{3}$ from the center and a point a distance $3H$ from the center.

b. Find this difference in electrical potential if a spherical conducting shell of thickness T and inner radius $2H$ is placed around the sphere of radius H.



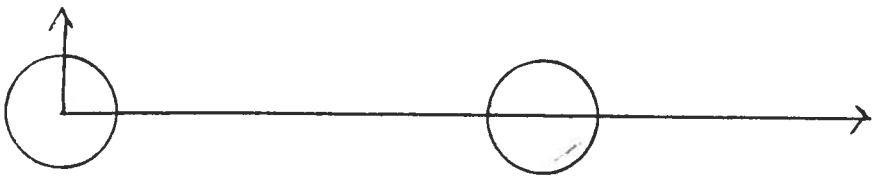
3. (25 points)Two very, very long, identical insulating cylinders of radius H and length L each have charge Q uniformly spread throughout their volumes. They are located with their centers along the x axis as shown. For the two questions that follow consider only points very far from the ends so that the cylinders can be assumed to be infinitely long.



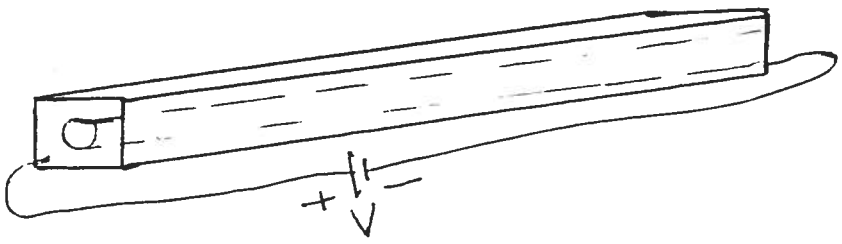
a. Find the electric field everywhere produced by the cylinder at the origin if the second cylinder is not present.

b. Find the total electric field at the point P when both cylinders of charge are present.

c. Indicate on the figure below all points where a charged particle with charge q would not have a force acting on it due to the cylinders. (No algebra please, just qualitatively determine the location of these points.)



4. (25 points)A wire of length L and has a rectangular cross section with height H and width W. The wire has a hole all the way through it of area a. The wire is made of material with constant resistivity ρ_1. A battery with a known voltage is applied across the ends of the wire.



a. What is the electric field inside the material and what current will flow through the wire?

b. If the hole is totally filled with a material that has resistivity ρ_2 what will be the electric field everywhere inside the wire and what current will flow through the wire?