EXAM II Physics 208

MAKE UP SPRING 08

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

USEFUL INFORMATION

For two point particles

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

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

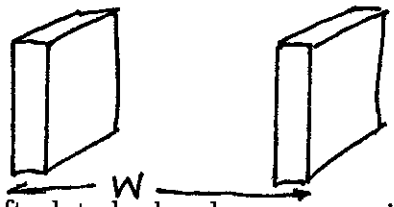
$$V(\vec{r}_2) - V(\vec{r}_1) = -\int_{\vec{r}_1}^{\vec{r}_2} \vec{E}\cdot d\vec{r}$$

$$C = \frac{Q}{V} = \frac{A\epsilon_0}{d} \qquad R = \rho\frac{l}{A}$$

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

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

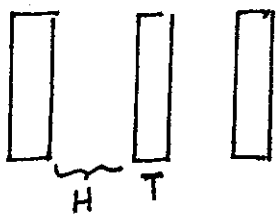
1. (25 points) Two parallel conducting plates, each with very large area A and thickness T are shown below.



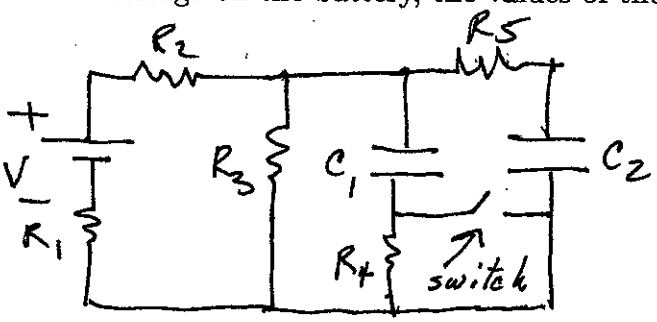
a. If the left plate had a charge per unit area σ find the electric field everywhere between the plates.

b. Derive the expression for the capacitance of this system.

c. If a third conducting plate were placed between them in the position shown, find the electic potential difference between the original two plates.



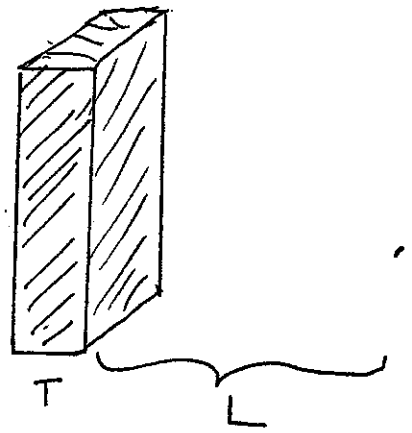
2. (25 points) In the circuit below assume the switch has been open for a long time. The voltage on the battery, the values of the resistors and capacitors are all known.



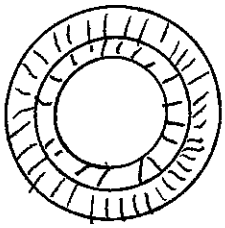
a. Find all currents and the charges on the capacitor plates.

b. If the switch is now closed, find all currents and the charges on the capacitor plates after a long time, i.e. in the steady state.

3. (25 points)There is a very large slab of insulating material that has thickness T and has a uniform charge per unit volume ρ. Consider the area to be infinite. Find the difference in the electric potential between a point right at the middle of the slab and a point L away from one the edges, i.e. $V(L + \frac{T}{2}) - V(0)$.



4. Consider two, concentric spherical shells as shown below. The smaller one is made of material that has resistivity ρ_1 and the larger one has resistivity ρ_2. You are **given** that a current i flows from the inner surface to the outer surface.



inner radius A
thickness T_1 smaller,
thickness T_2 larger.

a. What is the current density vector as a function of r, the distance from the center of the spheres? (Assume $\vec{J}$ is not a function of angle.)

b. What will be the voltage difference between the inner and the outer surfaces?

c. What will be the charge per unit area on the surface where the two spheres are in contact?