Physics 208

Exam II

March 24, 2009

Family Name: _____

First Name: _____

Student ID Number: _____

Your Section Number: _____

USEFUL INFORMATION

For two point particles, $\vec{F} = \frac{1}{4\pi\epsilon_0}\frac{q_1 q_2}{r^2}\hat{r}$

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

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

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

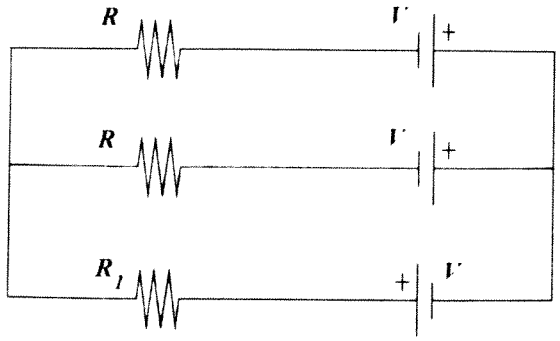
$$\oint \vec{E}\cdot d\vec{S} = \frac{Q_{\text{inside}}}{\epsilon_0}$$

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

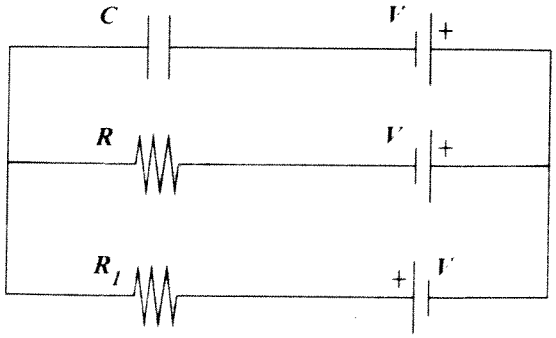
Do not write below

Prob. 1	Prob. 2	Prob. 3	Prob. 4	Total

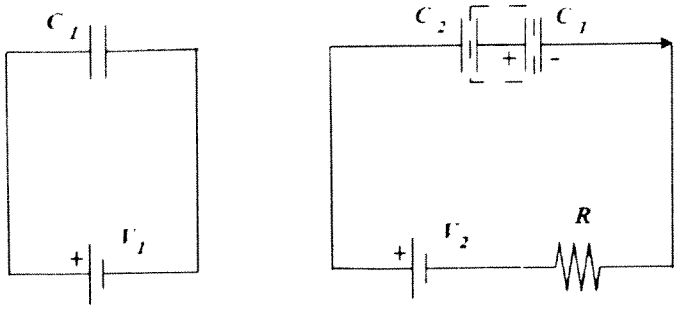
[1] (25 points) In the circuit below, R, R_1, and V are known. Find the current in the resistor R_1. You must define all symbols and clearly state what laws you are using.



If one of the resistors, R, is replaced by a capacitor, capacitance C, find the current in R_1 and the charges on C.



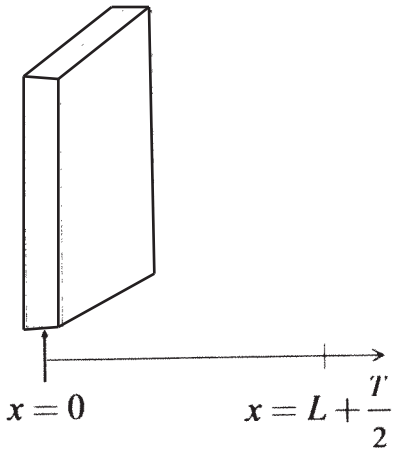
[2] (25 points) The capacitor C_1 is connected to a battery as shown. After being charged it is connected to the capacitor C_2 and the resistor R and a second battery as shown.



(a) When all charges come to rest, what will be the charge inside the box indicated by the dashed lines in the figure?

(b) When all charges come to rest, what will be the charge on the left plate of the capacitor C_2?

[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.

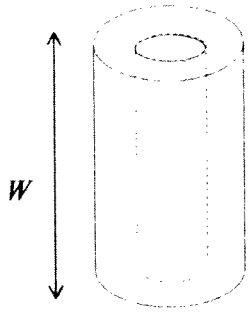


(a) Find the electric field everywhere.

(b) 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] (25 points) A cylindrical shell is made of material with constant resistivity ρ. The shell has inner radius a and outer radius b. Somehow a constant current i is made to flow radially out from the inner surface to the outer. The length of the cylindrical shell is W.

(a) Find the current density vector everywhere inside the shell.



(b) Find the difference in the electrical potential between the inner and outer surface of the shell.

(c) Find the resistance of this shell.