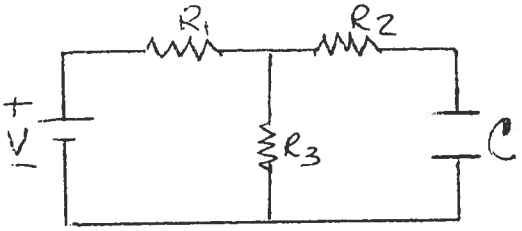
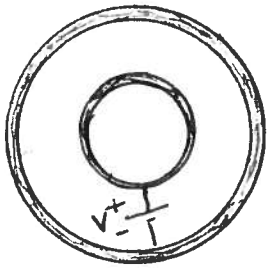
1. (25 points)In the circuit below, R_1, R_2, R_3, and V are known. A, the area of the plates and d, the distance between the plates, are known and $C = \frac{A\epsilon_0}{d}$. Find the magnitude and direction of all currents and the charge on each of the plates of the capacitor. You must clearly indicate what you are doing or you will receive no credit!



If the largest electric field that can exist between the plates of the capacitor is E_{max} without the capacitor burning up, what is the biggest battery you could put in this circuit?

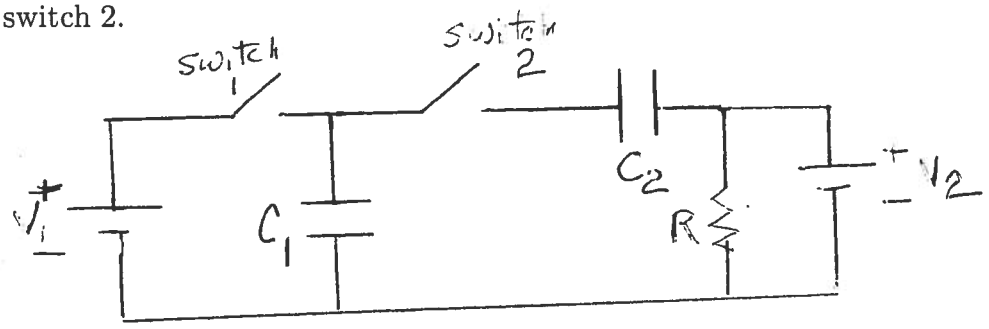
2. (25 points)A conducting spherical shell has inner radius A and thickness T. There is a larger concentric spherical conducting shell with inner radius B and thickness T. A battery of known voltage V is connected from the outer surface of the inner sphere to the inner surface of the outer sphere.



a. Indicate on the figure above the location of any charges once the steady state, i.e. equilibrium, has been reached.

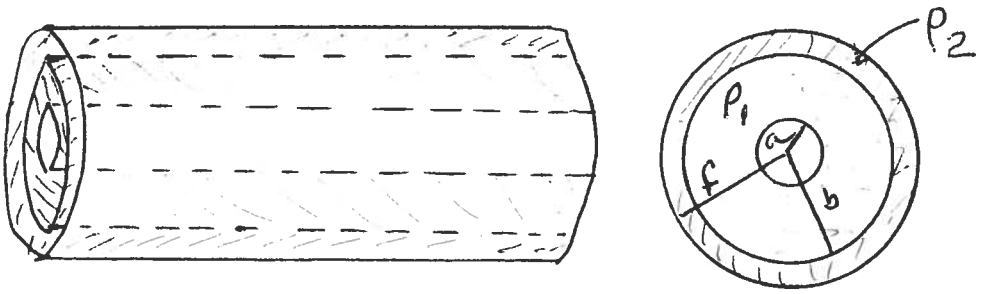
b. Find the amounts of all charge located in or on the two spheres.

3. (25 points)The capacitor C_1 is connected to a battery as shown by having switch 1 closed and switch 2 open. After being charged it is connected to the capacitor C_2 and the resistor R and a second battery, voltage V_2, by opening switch 1 and closing switch 2.



In the steady state, find the magnitude and direction of all currents and determine the charge on each of the plates of each capacitor with switch 1 open and switch 2 closed. You must clearly define all symbols and clearly indicate what you are doing or you will receive no credit!

4. (25 points)A cylindrical shell is made of material with constant resistivity ρ_1. The shell has inner radius a and outer radius b. It is surrounded by another cylindrical shell with inner radius b and outer radius f and constant resistivity ρ_2. Somehow a known, constant current i is made to flow radially out from the inner surface to the outer. The length of the cylindrical shells is W.



a. Find the electric field at a point r_1 where $a < r_1 < b$.

b. Find the electric field at a point r_2 where $b < r_2 < f$.

c. What would the voltage of a battery have to be to cause this current to flow as shown below.