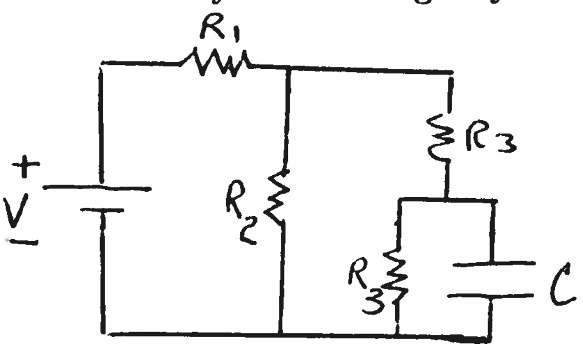
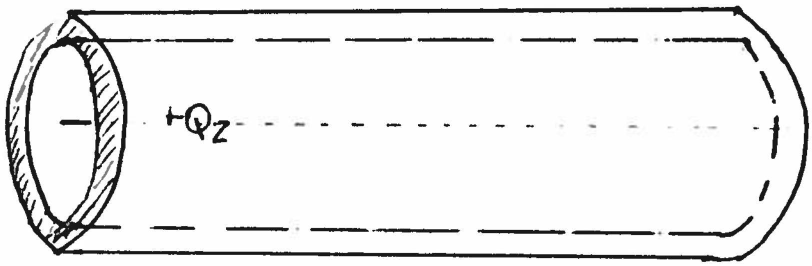
1. (25 points)In the circuit below, all the $R's$, V, and C are known. Obtain enough equations so that you could find the charge on the capacitor if the circuit was put together a long time ago. You must clearly indicate what you are doing or you will receive no credit!



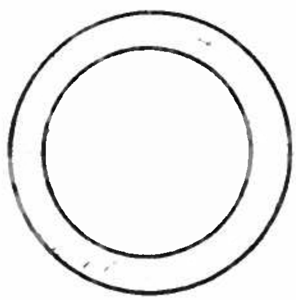
Solve for the charge on the capacitor for the special case where $R_1 = 0$.

2. (25 points)A very, very long, hollow conducting cylinder has inner radius A, outer radius B and length L. It is given a charge Q_1. Along the axis of the cylinder is a very, very long line of length L, with charge, Q_2. Both Q_1 and Q_2 are positive. For this problem consider only points very far from the ends so that the cylinder can be assumed to be infinitely long.



Find the difference in the electric potential between a point $\frac{A}{2}$ from the axis and a point a distance 5B from the axis of the cylinder.

3. (25 points)A spherical shell with inner radius A and outer radius B which has a uniform charge density, i.e. charge per unit volume, ρ_0. Find the electric field everywhere.

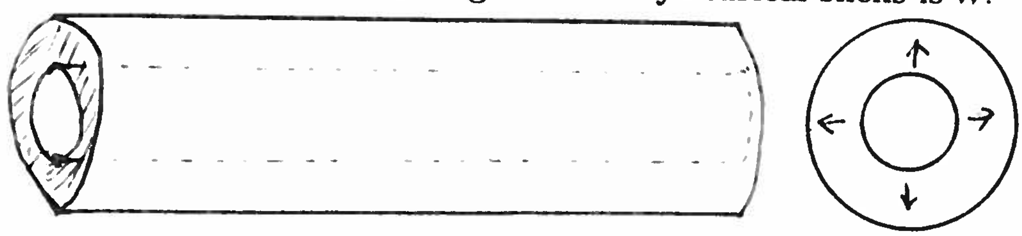


If instead suppose there was a nonuniform charge density that depends on the distance from the center. That charge density is given by

$$\rho(r) = \rho_0(\frac{r^2}{B^2}).$$

What will be the electric field everywhere?

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 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 a distance r from the axis of the cylindrical shell where $A < r < B$.

b. Find the resistance, R, of this shell to the flow of current.

c. What would be the resistance if instead of being constant the resistivity was a function of r given by $\rho(r) = \rho_0 \frac{r}{B}$.