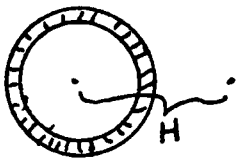
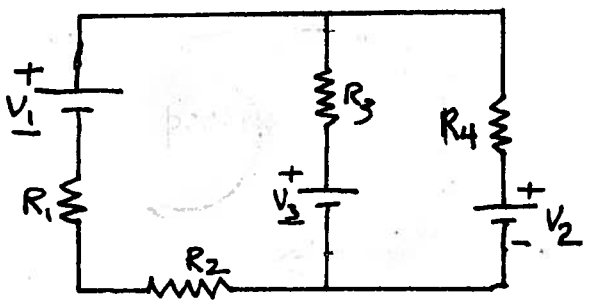
1. (25 points)A spherical shell has inner radius A and thickness T. It has a charge Q which is uniformly spread thoughout the shell.



Find the electric potential difference between the center of the shell and a point outside the shell, a distance H from the center.

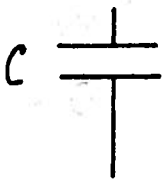
2. (25 points)In the circuit below, R_1, R_2, R_3, R_4, V_1, V_2 and V_3 are known.



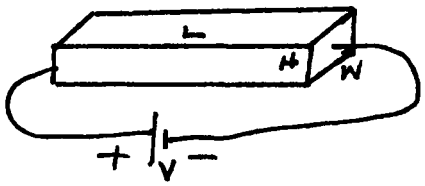
a. If no current flows through the resistor R_3, what current flows through R_2? Call this current i_1.

b. In terms of i_1 and the other quantities, what would V_3 have to be for there to be no current in R_3?

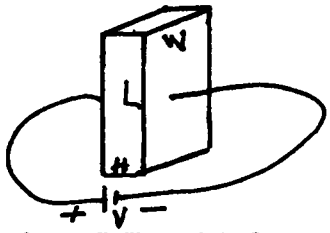
c. If the battery V_3 was replaced by a capacitor, capacitance C, what would be the charges on the capacitor plates?



3. (25 points) A rectangular block of material with resistivity ρ has dimensions L by H by W. If a battery is connected across the block as shown a certain current flows through the block.

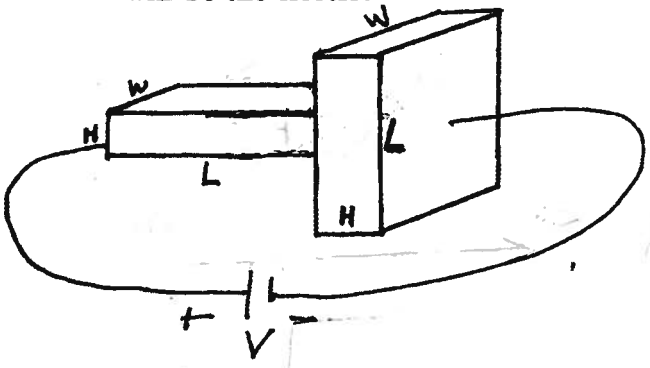


If the battery is instead connected as shown below, four times as much current flows through the block.



a. What can you conclude about L,H and W?

b. If the two blocks are connected together as shown and connected to the battery, what will be the electric field in each block?



c. What charge would reside on the rectangular surface, H by W, where the two blocks are joined?

4. (25 points)A very, very long, hollow conducting cylinder has inner radius A and thickness T. There is a second hollow cylinder with inner radius B and thickness T. Both cylinders have the same length L and have the same axis. The inner cylinder is given a charge Q. For this problem consider only points very far from the ends so that the cylinders can be assumed to be infinitely long.

a. Find the positions of all charges when equilibrium (electrostatics) is reached.

b. Find the electric potential difference between a point on the inside surface of the inner cylinder and a point on the outside surface of the outer cylinder.

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