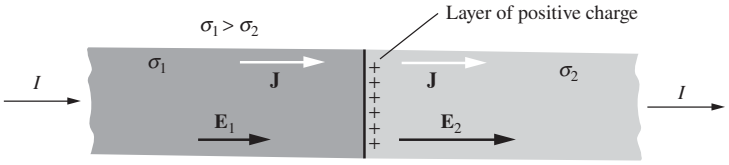
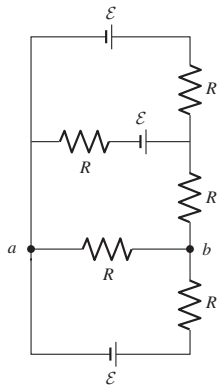
PHY102 : Assignment 5

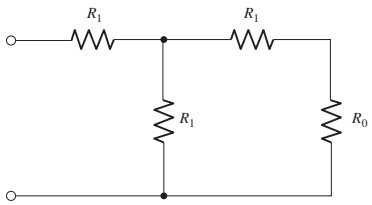
1. (P&M 4.2) Show that the total amount of charge at the junction of two materials as shown, is $I\epsilon_0(1/\sigma_1 - 1/\sigma_2)$, where I is the current flowing through the junction and σ_1 and σ_2 are the conductivities of the two conductors.



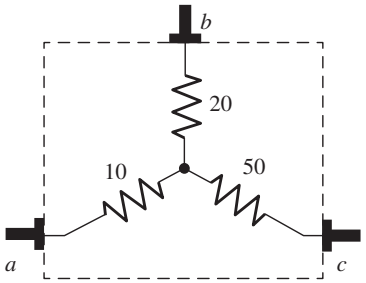
2. (P&M 4.12) What is the potential difference between points a and b in the circuit shown in Fig. ?



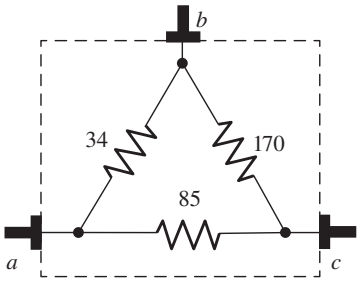
3. (P&M 4.29) In the circuit, if R_0 is given, what value must R_1 have in order that the input resistance between the terminals should be equal to R_0 ?



4. (P&M 4.31) A black box with three terminals, a, b, c contains nothing but three resistors and connecting wire. Measuring the resistance between pairs of terminals, we find $R_{ab} = 30$ ohms, $R_{ac} = 60$ ohms and $R_{bc} = 70$ ohms. Show that the contents of the box could be either configuration as shown in figure. Is there any other possibility ? Are the two boxes completely equivalent, or is there an external measurement that would distinguish between them ?



or



5. (P&M 4.35) A cube has a resistor R along each edge. Find the equivalent resistance between two nodes that correspond to:

   - diagonally opposite corners of the cube;
   - diagonally opposite corners of a face;
   - adjacent corners.

   You do not need to solve a number of simultaneous equations; instead use symmetry arguments. Hint: If two vertices are at the same potential, they can be collapsed to one point without changing the equivalent resistance between the two given nodes.