Homework 10

Symmetry considerations.

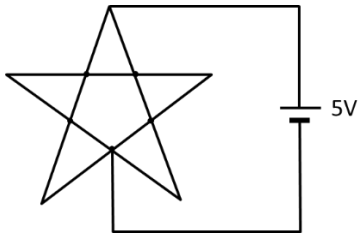
Last class we learned how one can use symmetry considerations to calculate the equivalent resistor of a resistor network in case of the element connections are neither parallel nor series. The point of connection of 2 or more elements of the network we will call a network (or circuit) ***node***.

1. We agreed on if we have two or more equivalent (symmetrical) nodes of the network, they have same potential and, if they are connected with a real wire the current in this wire is zero and you can just cut it off without change in the equivalent resistance.
2. We also agreed on if two or more nodes of the circuit have same potential, you can connect them with a wire of merge them in one node. This will not change the equivalent resistance as well.

The hardest part is to locate the equivalent nodes. Sometimes it is not that hard, especially if the network is drawn in a symmetrical manner. But we have to remember that as long as the shape of ideal wires does not affect the network performance, you can "deform" them as you want and the network performance will remain the same. So, even the network looks non-symmetrical for a first glance it may still have equivalent nodes.

Below are two problems which can be elegantly solved using symmetry considerations.

1. Find total current which flows through the star (see Figure below). Each short segment of the star has a resistance of 2 Ohm. The wires connecting the star and the battery are ideal.



2. Find total current flowing through the construction made of three connected metal circles. The resistance of each of the short arcs connecting the nodes is 2 Ohm. The wires connecting the construction with the battery are ideal.