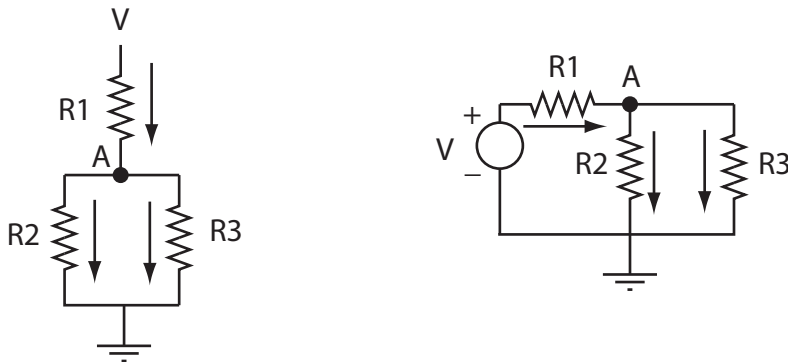


ME 333 Introduction to Mechatronics
 Assignment 1
 Due in class, Tuesday January 8

You studied basic linear circuits in EA3, and perhaps other courses, but for some of you it may have been a while. We do not spend much time reviewing linear circuits in ME 333, but we certainly need to understand them. This assignment is to make sure you are ready at the beginning of ME 333. You may use any resource to help you solve these problems, such as the mechatronics wiki at <http://hades.mech.northwestern.edu/wiki/index.php/Category:Electronics> or any other book or online resource. Whatever your method, you should be able to solve problems like the ones below when you arrive on the first day of class. You should know Kirchhoff's current law (current into a node = current out), Kirchhoff's voltage law (voltage around a closed loop is zero), and the constitutive laws of resistors, capacitors, and inductors. **Be sure to answer all questions, and show your work!**

1. You should recognize that the two circuits below are identical, just drawn slightly differently. The circle is a voltage source of V volts. When I ask you the voltage at a point, it is in reference to ground (GND), which is 0 volts by definition.

In terms of V , $R1$, $R2$, and $R3$, what is the voltage at A? What is the current through $R1$, $R2$, and $R3$? (Note, current is "positive" if it is flowing in the direction of the arrows shown, and "negative" otherwise.) How much power is provided by the voltage source? How much power is dissipated by resistor $R2$?



2. Assume the capacitor is initially discharged (0 volts across it), and both switches, which are initially open, are closed at time $t = 0$.

Just after the switches are closed, what is the current through each resistor? What is the rate of charging of the capacitor, in volts per second?

After the circuit reaches steady state, what is the voltage across the capacitor? How much energy has it stored? In steady state, is the 3V battery being charged or discharged, and at what rate (how much power is being provided or dissipated/stored)? How about the 5V battery? Give units for all your answers (amps, volts, watts, joules). Optional: approximately plot, by hand, the voltage across the capacitor as a function of time, starting at $t = 0$.

