Duke University
Department of Physics

Physics 271 Spring Term 2017

WUN2K FOR LECTURE 2

These are notes summarizing the main concepts you need to understand and be able to apply.

More on DC Circuits

- Voltage divider: this is a common circuit arrangement, in which you are looking for a potential difference V_2 across one (say R_2) of two resistors (or resistor networks) R_1 and R_2 in series, and you know the potential difference V across both. V_2 is given by $V_2 = \frac{R_2}{R_1+R_2}V$.
- Terminology:
  - A circuit **element** is a resistance (impedance, more generally) or an EMF.
  - A **node** (or junction) is where three or more wires join.
  - A **branch** goes between two adjacent nodes.
- Kirchoff's Laws: these are extremely useful for solving circuits even in cases where one cannot divide the circuit into sub-networks. They are based on fundamental physics principles.
  1. Rule 1 (Kirchoff's Current Law): the sum of currents entering any point is equal to the sum of currents leaving the point, $\sum_i I_i = 0$ (or equivalently $\sum I_{\text{in}} = \sum I_{\text{out}}$). This rule is most interesting when applied at nodes. This rule is based on *conservation of charge*.
  2. Rule 2 (Kirchoff's Voltage Law): the sum of potential differences around a closed loop must be zero, $\sum_i V_i = 0$. This rule is based on *conservation of energy*.

In the "branch method" of applying Kirchoff's Laws, you assign a real physical current to each branch and follow the how-to: http://www.phy.duke.edu/∼schol/phy271/syllabus/kirchoff_howto.pdf. In the "loop method", you assign "fake" currents to loops in the diagrams and then write the sum of loop currents in each branch as you step around the loop (most of the same how-to applies). The loop method is usually algebraically easier, but you have to remember to make sure you have converted loop currents to real currents appropriately.