Voltage, Power, Resistance, Current, Energy, and KVL

1) A portable electric drill produces 1.2 hp at full load. This is 85% of the electrical power provided by the 9.6-V battery pack. What is the current flow? How much power goes into waste heat?

2) Three resistors – 1.0, 5.0, and 15.0 Ω - are connected in series to a 75-V ideal DC voltage source.
   a. Draw the circuit diagram.
   b. Determine the equivalent circuit resistance.
   c. Calculate the line current
   d. Find the voltage drop across each resistor.
   e. Compute the power consumed by each resistor.

3) Find the current, I, in the following circuits. Assume I is positive current (i.e. the flow of holes, not electrons).

4) What power is delivered to each individual resistor in problem #3?

5) You are designing a flashlight. The bulb you are using may be considered a 2.0 Ω resistor. What battery voltage is required to provide 1 W of power to the bulb? How many D-size batteries will this require?

Smallest Integer # of batteries, for P = 1W

Your Toolbox
- Ohm's Law
- Kirchoff's Voltage Law (KVL)
- Kirchoff's Current Law (KCL)
- P = V * I
- We = \int Pdt (energy)
A heating element used to heat water in an electric hot water heater may be thought of as a resistor. If the resistor is connected to a 120 V wall outlet, 

\[ R = ? \]

1. What value should the resistor have if it must deliver 1,000,000 J of energy in 5 minutes? [Hint: use Ohm’s law and the power equation to derive an expression to relate power, voltage, and resistance. Solve this expression for resistance.]

\[ 1 \text{ kW} = 1000 \text{ Joules/sec} \]

\[ 1 \text{ kWh} = 3.6 \times 10^6 \text{ Joules} \]

b. What current will flow in this circuit?

\[ 1 \text{ kWh} = 3600 \times 10^3 \text{ Joules per sec} \]

10 Christmas lights are connected in series and plugged into a 120 V wall outlet. Each light is identical and can be thought of as a resistor. [Hint: All circuit components connected in series have the same current flowing through them. All circuit components connected in parallel have the same voltage across their terminals.]

a. What should the value of this resistance be if the total string is to dissipate 50 W?

b. How much power is dissipated in each resistor?

c. How much current flows in each resistor?

8) For the circuit shown:

a. Determine the value of the resistor R2

b. Calculate the voltage drop across each resistor.