Circuit Construction Kit – Sample problems solved

$\Delta V = iR$ Equivalent resistance: Series $R_e = R_1 + R_2$ Parallel $1/R_e = 1/R_1 + 1/R_2$

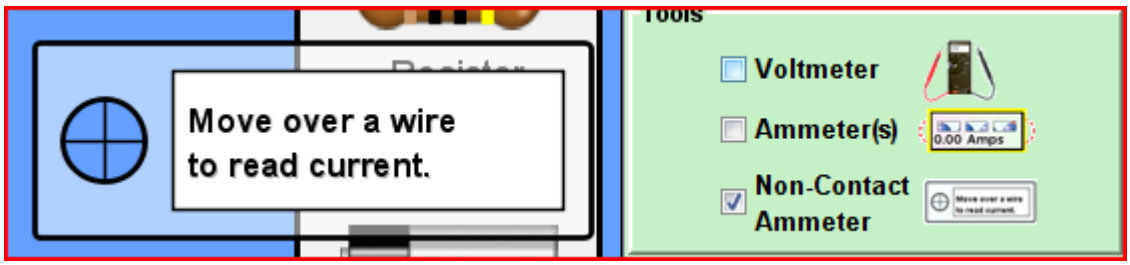
$P = E/t$ $P = iV$ $P = V^2/R$ Cost = rate x energy 1^{st} digit/2^{nd} digit/# of zeros

General

Circuit construction kit enables the modeling of simple circuits. There are a variety of tools and circuit parts which are assembled by drag and drop. Parts have snap on fits where if a part is moved near another part, they connect, like magnets might. This is convenient for making solid connections, but can results in accidental connections too. To delete a resistor part, left click on the part and press delete.

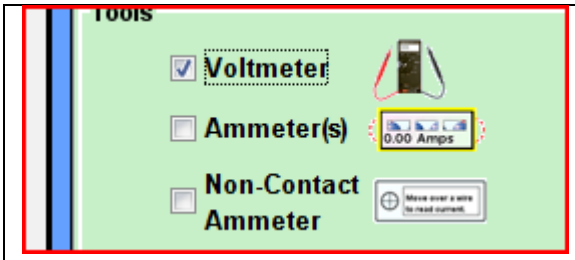
Measuring current:

Check the Non-contact Ammeter box. An ammeter measures amps (current), hence the name. To use it, line up the cross hairs over any current carrying wire and the amount of current will appear. This tool, unfortunately is computer fiction. The real ammeter you will use will need to be inserted into a circuit.



Measuring voltage:

Check the voltmeter box. A volt meter appears.



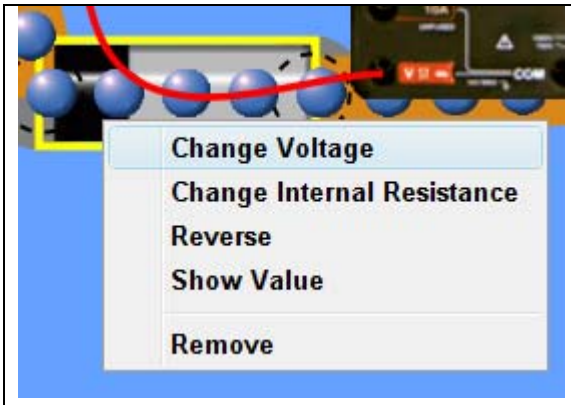
Volt meters measure voltage across resistors and batteries. Place the tip of the red lead (lead rhymes with deed) in the middle of the more positive wire and the tip of the black lead on the other side of resistor (or battery). The voltage drop will read out in the voltmeter's display. If you're confused about which is positive and which is negative, notice two things: First, if you reverse it, you will still get the right value, only it will be negative.

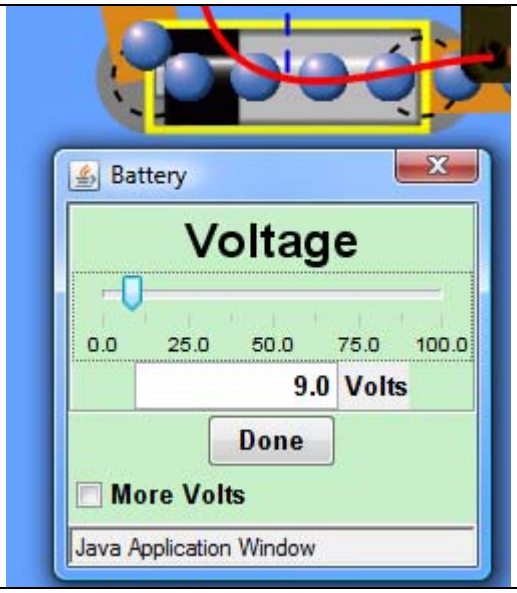
Second, the blue dots are electrons, they leave the negative end of the battery (repelled) and head toward the positive end of the battery (attracted). Electrons are flowing out of the more positive end of the resistor.

The picture below shows the correct placement of two leads across a resistor where the voltage drop is 4.5 V. Can you guess which way the electrons are flowing for the voltage to be positive? The electrons are flowing left (attracted toward the more positive red lead is another way to think about it)

Changing battery voltage/resistor resistance

Right click on the battery and click on "Change Voltage". A text box appears. Use the edit box to directly entered the desired voltage. To exceed the normal voltage max, check the more volts box. Resistor values (ohms) change the same way (right click on the resistor you want to change, etc.)





Finding equivalent resistance

Two or more resistors can be combined mathematically or by using this model to find their equivalent resistance. To find the equivalent resistance measure the total voltage drop, using a volt meter, and total current using an ammeter either entering or leaving the battery. Ohm's law can then be used to solve for R_e using the measured values for V and i.

Finding power consumed by a resistor

Power consumed by a resistor is found using one of two equations:

$P = iV$ $P = V^2/R$

They both work the same and will give you the same value. I could show you how one leads to the other doing a proof with Ohm's law, but it's late and I'm tired and be honest, you don't really care to see it, so we'll skip it. Ask me in class if you're interested in seeing the proof. After overcoming my initial shock and skepticism that you really want to see a proof, I'll happily show you.

Anyway, power is measured in watts, current in amps, voltage in volts and resistance in ohms.

To find total power of a circuit with multiple resistors, just add the individual power consumed by each resistor.

Cost to operate a circuit

To find the cost of a circuit, find the power in watts. Convert power to energy in kW-hrs using $E = P\ t$ (t in hours) and King Henry or the definition of kilo (kilo means the same thing as thousand, they're interchangeable; ie 30 thousand and 30 kilo are the same as are 175.2 thousand and 175.2 kilo. Finally, multiply the cost per kW-hr by the number of kW-hrs to find the total cost.

…."Make Sense"?