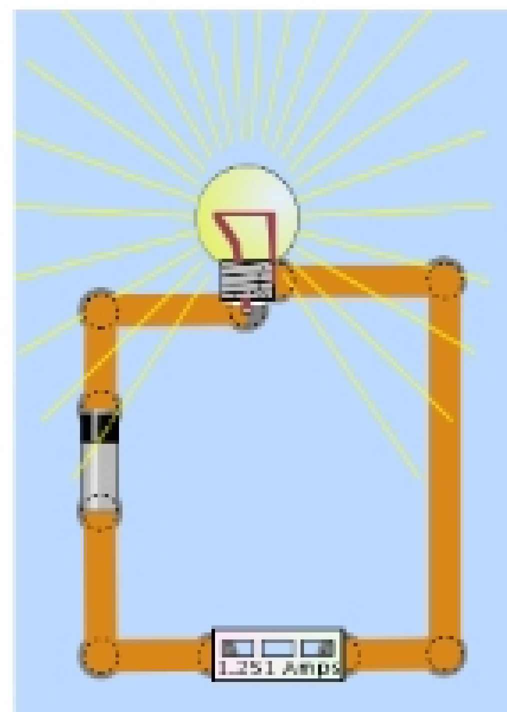
Lab: DC Circuits II

INTRODUCTION:

This week we will continue with DC circuits, but now with an emphasis on current rather than voltage. Of course, in order to fully understand any circuit, you need to take into account both voltage and current. Additionally, we will be using a computer simulation called the *Circuit Construction Kit* (CCK) instead of real wires, bulbs, and resistors. The goals of this lab are to complete our understanding of how voltage, current, and resistance relate to each other in circuits, and to learn how to use an ammeter to measure current directly.

PRECAUTIONS & NOTES:

To measure how much current is flowing through a circuit, the current needs to flow **through** the ammeter. Recall that when we measured voltage differences, we attached the voltmeter in parallel with whatever we were measuring. To measure current, the ammeter needs to be placed in **series** with the element (resistor, bulb, battery) that we are measuring (see figure at right).

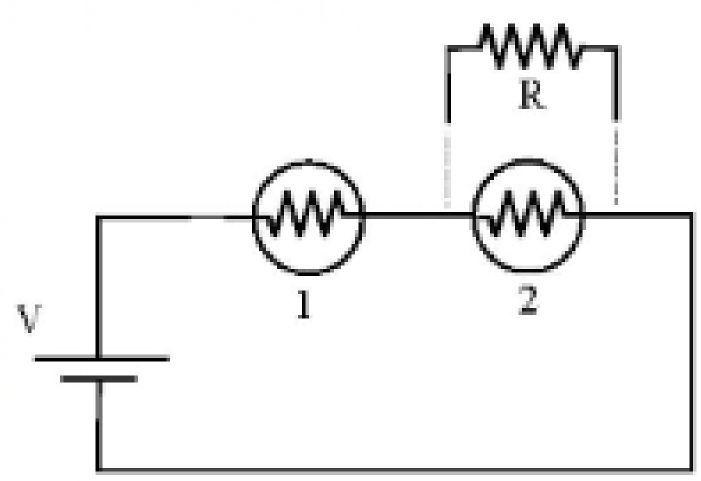


Ammeter configured to measure current.

PART I: MEASURING CURRENT DIRECTLY WITH THE AMMETER

Drag and drop one 2 Ω resistor into the work area (if you right click on a resistor, you can change its resistance) and two light bulbs into your work area.

Construct the circuit shown on the right, consisting of two light bulbs (with the same resistance) in series with a battery. (The resistor R will be added later). Increase the voltage across the battery to 20 V (right click on the battery to change its voltage).



Predict what will happen to the **current** *flowing from the battery* when you place a (R = 2 Ω) resistor in parallel with bulb #2 as shown in the schematic. Explain your reasoning.

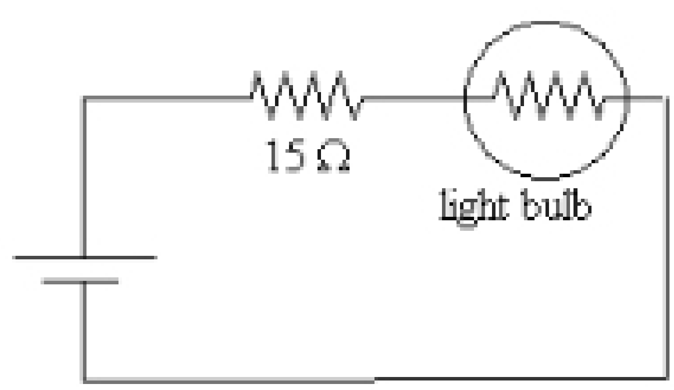
Measure the voltage difference across the battery, then put the ammeter in the circuit so that you can measure the current flowing from the battery. Measure and record the battery voltage difference and current here.

Add in the R = 2 Ω resistor, and describe what happens and why. Were your predictions correct?

PART II: COMPUTING THE RESISTANCE OF A LIGHT BULB

Build a circuit consisting of a battery in series with a 15 Ω resistor and one light bulb (see diagram below).

Circuit Schematic



Set the voltage difference across the battery to 30 V. Using the voltmeter with needle probes, measure the voltage difference $\mathbf{V_{BATT}}$ across the battery, the voltage difference $\mathbf{V_R}$ across the 15 Ω resistor, and the voltage difference $\mathbf{V_{BULB}}$ across the light bulb. Using the known resistance of the resistor, compute the current $\mathbf{I_R}$ flowing though the resistor.

Now set up the ammeter to directly measure the current $\mathbf{I_R}$ flowing though the resistor. Does this value match the calculated $\mathbf{I_R}$ from the previous step?

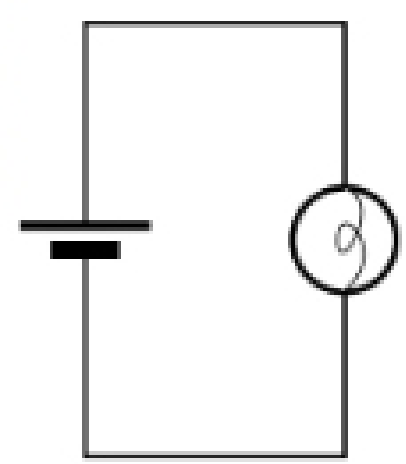
How is the current flowing though the light bulb (I_B) related to the current flowing through the resistor (I_R)? What is the relationship between the three measured voltage differences V_R, V_{BULB}, and V_{BATT}?

From these measurements, compute R_{BULB}.

Using the measurements and calculations from this section, how much power is dissipated in the 15 Ω resistor? How much power is dissipated in the light bulb?

PART III: 2 BULBS IN SERIES

Construct the circuit shown at right, containing a single light bulb. Set the battery voltage to 20 V. Using the voltmeter and the needle probes, measure the voltage difference across the light bulb. Then use the ammeter to measure the current flowing out of the battery. Record your results.



Predict what will happen if a second bulb is added in series with the first bulb, as shown at right. Will the bulb brightness change? Will the current flowing through the first bulb change? Will the current coming out of the battery change? Will the voltage difference across the first bulb change? How will the power change (for each bulb and in total) if at all? Clearly explain your reasoning.