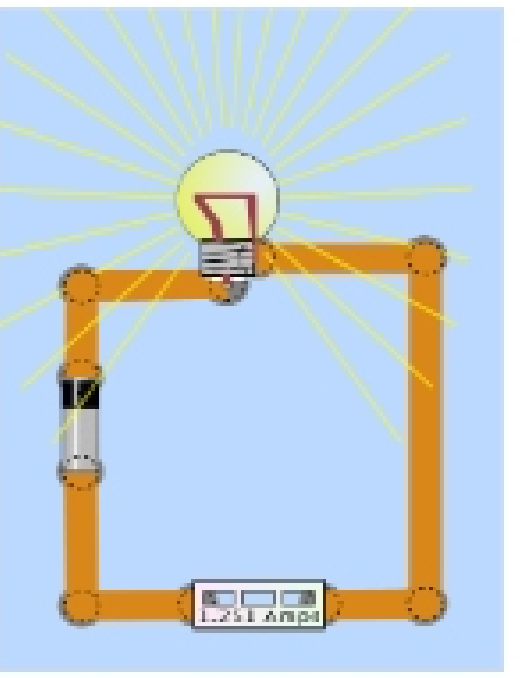
Lab: DC Circuits III

INTRODUCTION:

This week we will continue with DC circuits. In order to fully understand any circuit, you need to take into account both voltage and current. We will again be using the computer simulation *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.



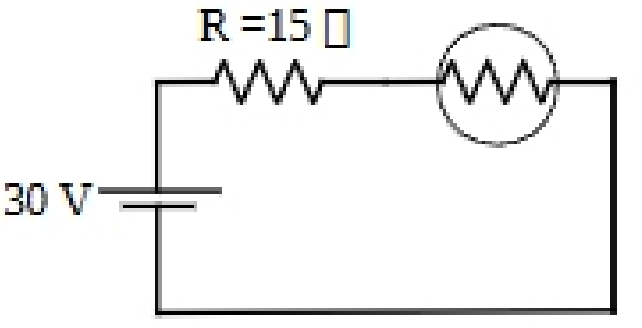
Ammeter configured to measure current.

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.

PART I: COMPUTING THE RESISTANCE OF A LIGHT BULB

Build a circuit consisting of a 30 V battery in series with a 15 Ω resistor and one light bulb. (Right-click on the battery to set its voltage. Right-clicking on the resistor to set its resistance.)



Using the voltmeter with needle probes, measure the voltage difference V_{BATT} across the battery, the voltage difference V_R across the 15 Ω resistor, and the voltage difference V_{BULB} across the light bulb. Using Ohm's Law and the known resistance of the resistor, compute the current I_R flowing though the resistor.

Now set up the ammeter to directly measure the current I_R flowing though the resistor. Does this value match the calculated 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}.

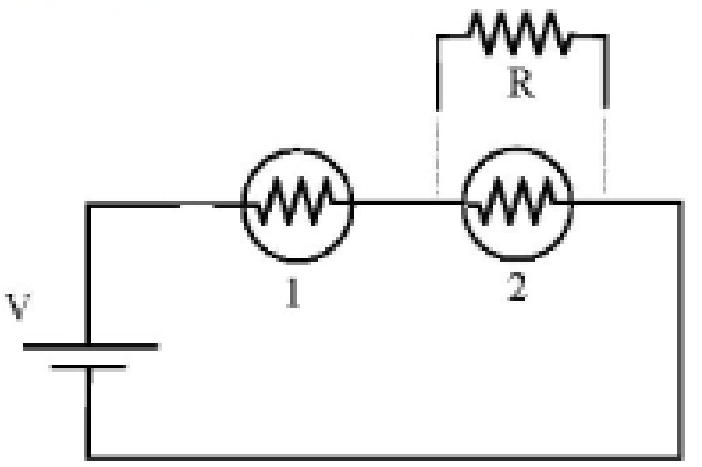
Using the measurements and calculations from this section, how much power is dissipated in the 15 Ω resistor? How much power is dissipated in the light bulb?

PART II: ADDING A RESISTOR IN SERIES

Drag and drop two light bulbs and a R=2 Ω resistor onto the stage.

Construct the circuit shown on the right, consisting of two identical light bulbs in series with a 20V battery. (The R=2 Ω resistor will be added later.)

Measure the voltage difference across the battery, then put the ammeter in the circuit so that you can measure the current flowing through the battery. Measure and record the battery voltage V_{batt} and current I_{batt}.

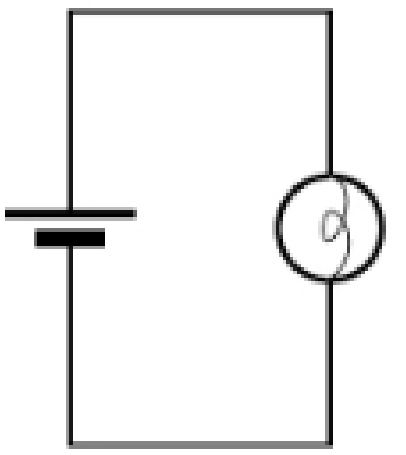


Predict what will happen to the current I_{batt} flowing through the battery when you place the R = 2 Ω resistor in parallel with bulb 2 as shown. Will the battery current increase, decrease, or remain constant? Explain your reasoning.

Now add in the R = 2 Ω resistor, and describe what happens. Was your prediction correct? What happens to the brightness of bulb 1 and why? What happens to the brightness of bulb 2 and why?

PART III: 2 BULBS IN SERIES

Construct the circuit shown at right, containing a single light bulb. Set the battery voltage to 20 V. With the voltmeter, measure the voltage difference across the light bulb. Then use the ammeter to measure the current. 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 brightness of the 1st bulb change? Will the current change? Will the voltage across the first bulb change? How will the power from the battery change, if at all? Clearly explain your reasoning.