

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Period: **B**

Graded problems are worth 2 points each. This assignment is graded out of  $\infty$  points.

### To Do During Class:

**Note: you can put two batteries together in series (end to end) and call it just one battery, if you like. Use up to 3 batteries in a row to get the bulbs to light up... some of the batteries we have are pretty close to dead. (Sorry.)**

Using the materials available, **build** and draw a circuit diagram of circuits 1 through 3.

- 1) A series circuit consisting of a battery, 2 bulbs, and a switch.
- 2) A series circuit consisting of a battery, resistor, bulb, and switch.
- 3) A series circuit consisting of a battery, bulb, and switch.
- 4) Circuits #2 and #3 above are similar. In which circuit was the bulb brighter when the switch was closed? Explain why there was a difference in brightness.
- 5) Take a look at the light box (device we used to show light colors and the potentiometers). Draw a circuit diagram for the circuits in the light box.
- 6) Using the materials available, make any series circuit you like (please do not string more than three batteries end to end: it may blow out the bulbs). Sketch the circuit diagram for the circuit you built.
- 7) Do the same thing as #6, but this time, create a parallel circuit.

### To Do During Class or at Home:

- 8) A series circuit consists of 2 bulbs and a battery: bulb 1 has a resistance of  $3 \Omega$ , bulb 2 has a resistance of  $4.5 \Omega$ . The current in the circuit is  $18 \text{ A}$ .
  - a. What is the total resistance in the circuit?
  - b. How much voltage does the battery provide (the total voltage)?
  - c. What are the voltage drops across each of the bulbs?
- 9) A series circuit contains three resistors: resistor 1 has  $3.75 \Omega$  of resistance, resistor 2 has  $5.0 \Omega$  of resistance, and resistor 3 has  $1.55 \Omega$  of resistance. There are  $1.25 \text{ A}$  of current flowing in the circuit. Calculate the voltage drop across each resistor as well as the total voltage of the circuit.
- 10) A series circuit contains bulbs. The voltage drop across the first bulb is  $3.5 \text{ V}$  and the resistance is  $7.0 \Omega$ . The resistance of the second bulb is  $5.5 \Omega$ .
  - a. What is the voltage drop across the second bulb?
  - b. How much current is flowing through the circuit?
- 11) Over the weekend, open up a simple electronic device (like a toaster... a cell phone is pretty complicated) and try to sketch the circuit diagram of the device.
- 12) If you find, online, a circuit diagram drawing program, please try it out and let me know about it!

## Selected Answers

- 8) A series circuit consists of 2 bulbs and a battery: bulb 1 has a resistance of  $3\ \Omega$ , bulb 2 has a resistance of  $4.5\ \Omega$ . The current in the circuit is  $18\ \text{A}$ .

- a. What is the total resistance in the circuit?

$$3\ \Omega + 4.5\ \Omega = 7.5\ \Omega$$

- b. How much voltage does the battery provide (the total voltage).

$$I = 18\ \text{A}$$

$$R = 7.5\ \Omega$$

Use the total resistance here  
because the battery is the source  
of all the voltage in the circuit.

$$V = IR$$

$$V = 18\ \text{A} \times 7.5\ \Omega = 135\ \text{V}$$

$$V = 18\ \text{A} \times 7.5\ \Omega = 135\ \text{V}$$

- c. What are the voltage drops across each of the bulbs?

For each bulb, the method is the same:  $V_{\text{bulb}} = I \times R_{\text{bulb}}$ .

$$\text{Bulb \#1: } V_{\text{bulb1}} = 18\ \text{A} \times 3\ \Omega = 54\ \text{V}$$

$$\text{Bulb \#2: } V_{\text{bulb2}} = 18\ \text{A} \times 4.5\ \Omega = 81\ \text{V}$$

Use Kirchhoff's law to double check:

$$V_{\text{total}} = V_{\text{bulb1}} + V_{\text{bulb2}}$$

$$135\ \text{V} = 54\ \text{V} + 81\ \text{V}$$

This equation is true, so our confidence in our work is greater.

- 9) A series circuit contains three resistors: resistor 1 has  $3.75\ \Omega$  of resistance, resistor 2 has  $5.0\ \Omega$  of resistance, and resistor 3 has  $1.55\ \Omega$  of resistance. There are  $1.25\ \text{A}$  of current flowing in the circuit. Calculate the voltage drop across each resistor as well as the total voltage of the circuit.

Repeat this for each resistor: work for resistor 1 only is shown.

$$V_{\text{drop}} = I \times R_{\text{device}}$$

$$V_{\text{drop}} = 1.25\ \text{A} \times 3.75\ \Omega = 4.6875\ \text{V} \text{ (or } 4.69\ \text{V if using sig figs)}$$

To find the total Voltage, either add together all of the voltage drops (use Kirchhoff's Law) OR find the total resistance and multiply the total resistance by the current. In either case, the answer should be the same (or within rounding error margin).

- 10) A series circuit contains bulbs. The voltage drop across the first bulb is  $3.5\ \text{V}$  and the resistance is  $7.0\ \Omega$ . The resistance of the second bulb is  $5.5\ \Omega$ .

- a. What is the voltage drop across the second bulb?

You know that the current is the same for each bulb.

$$I = \frac{V_{\text{bulb1}}}{R_{\text{bulb1}}}$$

$$I = \frac{V_{\text{bulb2}}}{R_{\text{bulb2}}}$$

So, we can just set these values equal to each other and use a proportion to solve this:

$$\frac{V_{\text{bulb1}}}{R_{\text{bulb1}}} = \frac{V_{\text{bulb2}}}{R_{\text{bulb2}}}$$

$$\frac{3.5\ \text{V}}{7.0\ \Omega} = \frac{x}{5.5\ \Omega}$$

$$x = \frac{5.5\ \Omega \times 3.5\ \text{V}}{7.0\ \Omega} = 2.75\ \text{V}$$

(or  $2.8\ \text{V}$  if using sig figs.)

- b. How much current is flowing through the circuit?  $\frac{3.5\ \text{V}}{7.0\ \Omega} = 0.5\ \text{A}$