PHY103-Parallel and Series Circuits

NAME_____ PARTNER(s) _____

The goal of this lab is to learn to build some simple series and parallel circuits and make measurements of the circuits using a multimeter. You should have on your table: several resistors, connecting wires, a voltage source (to use in place of a battery) and a multimeter to make measurements of your circuit. Some of you may have experience building a measuring simple circuits; for those of you that don't, expect to consult your instructor frequently as you go through the lab.

Current, Voltage and Resistance:

In lecture, we've learned about three concepts in simple circuits.
The CURRENT, ***i***, at a place in the circuit refers to how many electrons flow past that point every second. It is measured in Amps.

The VOLTAGE of a battery is how much "Oomph" the battery has to get current flowing – the higher the battery's voltage, the stronger its ability to get current flowing in a circuit.

The RESISTANCE of a circuit, measured in Ohms, is how much blockage there is in the circuit that resists the flow of current. Adding more devices such a lightbulbs to a circuit generally (but not always) adds more resistance.

In simple circuits these three quantities are related by Ohm's Law V=iR where V is the voltage of the battery, i is the current through the battery, and R is the total resistance of the whole circuit.

Experiment 0: Meet the Multi-meter:

Your multi-meter has many functions. It can be used an ammeter (measuring current through the meter) or a voltmeter (measuring voltage difference between the two points that the leads are touching. First, we'll use it to measure resistance. Turn the selection dial to select a measurement of resistance (probably the symbol Ω). If you have a choice between many settings, start with the coarsest or least sensitive scale. We have many "identical" resistors to use in building our first circuits, and we're going to check the resistance of them. Make sure you plug the probes into the proper holes in the meter (we usually plug the black probe into "common" for any measurement, the red should go in the appropriate hole for a resistance measurement). Connect the two wires to either end of the resistor. Write down the resistance of that resistor here _____. Make sure you understand what units are being reported and (as is always good practice with a meter) start on a coarse scale and slowly increase the sensitivity (make the "range" smaller) until you are at the most sensitive usable

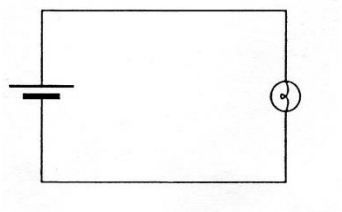
scale for your measurement. Again, consult your instructor if unclear. ***You shouldn't trust the numbers that the meters display too far-sometimes the meters have been damaged and don't work correctly and other times you may be using them wrong because there's some subtlety of how they work . Throughout the lab, if a meter's reading doesn't seem correct try another one, think, and/or chat with your instructor.***

Check two other "identical" resistors – they should have the same colored bands on the side- and record the values here _____ , _____. As you may have found, these "identical" resistors are not very identical, but they should be "similar"- if all three aren't within 10% of each other, consult your instructor. Take the average value of the 3 resistors you measured, then round to the nearest 5Ω, and record it here as R_{main} – we're going to use this type of resistor many times, so before you go further, double check your value for rough agreement with other groups or your instructor.

R_{main} = _____ Ω

Experiment 1: Simple Series and Parallel Circuits

Turn the voltage source to 5Volts (consult your instructor if you aren't sure how to turn it on, or how to build a circuit like the one diagrammed below and set up circuit 1 below with an R_{main} resistor. This circuit diagram indicates a battery (the two short parallel) and a resistor (the circle with the squiggly line through it) connected in parallel by wires.



Circuit 1

1) For a basic 1-resistor circuit, we've learned Ohm's Law in class ***V=iR***, where ***R*** is the resistance of the resistor (in Ohms), ***V*** is the voltage of the source (in volts) and ***i*** is the current in Amps. Using this equation, what value do you expect for the current, ***i***, through the resistor in this circuit?

2) Measure the current through the resistor using one of your multi-meters as an ammeter. *To make a current measurement you need to insert your ammeter into the circuit, set it to measure DC amps, and choose the appropriate hole for your red wire. Always start on the highest current (10A or 20A setting (there's a hole just for that one!), and if the current reads low enough, you can reduce the setting (for example, if on the 20A setting the current reads less*

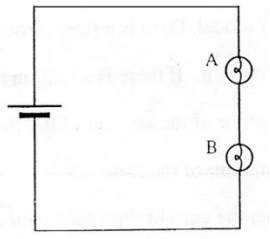
than 2A, you can change to the 2A setting if you have one). **If you aren't sure, check with the instructor before turning the power on!** Take some time to understand what the units of the number being reported are- this is not always obvious! Record your current measurement (with units!) here.

3) Finally, measure the voltage drop across the resistor, setting one of your meters up as a voltmeter, by turning the knob to "Volts" *Voltage measurements on a circuit are easy-no disconnecting of wires in needed! to measure the voltage difference between any two points in a circuit, touch the two probes directly to exposed metal at those points.* Record the voltage drop here (with units)…

You should notice that there are two meters on the voltage source, one that measures the voltage of the source and another that measures the current through the source. The values displayed there should correspond closely with the measurements you have made in questions 2) and 3). If not, please consult your instructor – we're going to use these measurements on the source itself for most of the rest of this lab.

Leaving the source voltage at 5 volts and assuming all resistors have the value R_{main}, quickly predict for the Figures above the current that would flow through…

Now construct circuit 2 - a circuit with two identical resistors in series.



4) Record the Voltage and Current measurements on the source meters here:

Voltage:V = _____. Current i = _____ Amps.

5) Now use V=iR to solve for the total resistance R of circuit 2

R (circuit 2) = _____ ohms

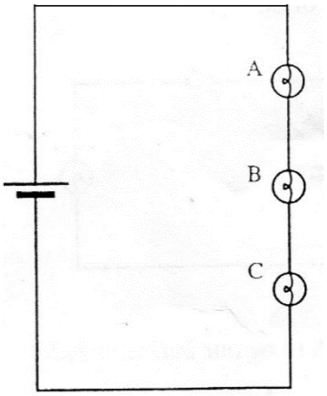
6) Which of these rules seem to fit what you have observed in circuits 1 and 2 ? (circle one)

--When we add more resistors in series, the total resistance of the circuit does not change

--When we add more resistors in series, the total resistance of the circuit is the sum of the resistance of all the resistors.

What evidence do you have for the choice you made?

Now add one more resistor in series to build the circuit below



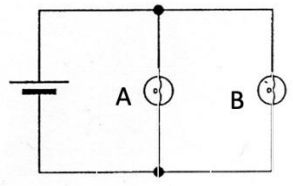
7) Keeping the voltage source at V= 5 volts, record the current here: i=_____

8) And use V=iR to calculate the total resistance R = _____

9) Does your rule from question 6) still apply? Answer yes or no and discuss your evidence.

PARALLEL CIRCUITS

Now you'll construct a circuit with two resistors in PARALLEL :



This may be tricky to build-again, please consult your instructor if you are not sure how to build the circuit.

10) With the source voltage still set a 5 Volts, record the current through the battery in this circuit

Current i = _____

11) And use V=iR to deduce the total resistance of this circuit

Total resistance R = _____

12) Which of these rules is true for adding resistors in parallel (circle one)?

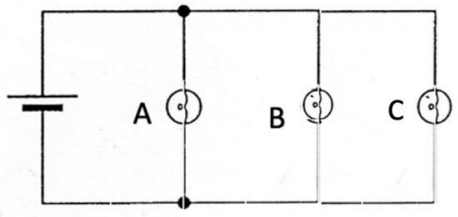
Adding an identical 2nd resistor in parallel doesn't change the total resistance of a circuit

Adding an identical 2nd resistor in parallel doubles the total resistance of a circuit

Adding an identical 2nd resistor in parallel cuts the total circuit resistance by ½.

13) Predict what will happen to the total current in the source when you add a third resistor in parallel.

14) Add a third resistor in parallel, and record what happens to the source current-was your prediction in 13) correct?



15)Finally, set up your multimeter to measure the current through resistor A. While you are monitoring this current, disconnect and reconnect resistors B and C. How does the current through A change when the other two resistors are removed and added to the circuit?

16). Electrical devices in your house are wired in parallel, not in series. What does your in 15) tell you about why this is a good idea?

QUICK OPINION SURVEY:

You have done two labs this semester (including today) using real equipment and the rest of your labs have been simulations. Please rate your level of agreement with the following statements.

1). I found the labs with real equipment more enjoyable

Strongly agree Agree No preference Disagree Strongly Disagree

2) I think that the labs with real equipment help me understand the material better than the simulated labs

Strongly agree Agree No preference Disagree Strongly Disagree