

Basic Circuits and Ohm's Law

Name: _____

Part 1: Measuring Voltage and Resistance

Voltage

Measure the voltage coming out of the 5V supply of the Arduino.

Record it here: _____

Resistance

You will use a multimeter to measure the resistance of the 3 resistors at your lab table. Fill in the table below by answering the 3 questions:

1. State the color combination for the resistor you are analyzing.
2. State the color code value of each resistor +/- the tolerance. (i.e. 1000+/-100Ω)
3. What is the measured value of the resistor?
4. Does the measured value fall within the stated tolerance? (yes/no)

Color	1st Digit	2nd Digit	Muliplier	Tolerance
Black	0	0	10^0	
Brown	1	1	10^1	
Red	2	2	10^2	
Orange	3	3	10^3	
Yellow	4	4	10^4	
Green	5	5	10^5	
Blue	6	6	10^6	
Violet	7	7	10^7	
Grey	8	8	10^8	
White	9	9	10^9	
Gold				5%
Silver				10%
None				20%

1. Color combination

2. Color code value +/- tolerance

3. Measured value

4. Yes/No

R_A _____

200 Ω

R_B _____

330 Ω

R_C _____

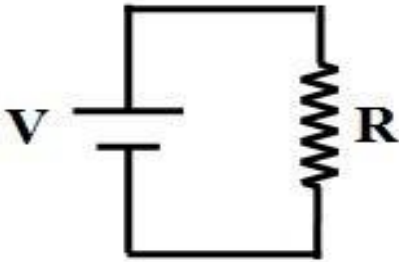
470 Ω

Part 2: Current measurement, Ohm's Law: $V=IR$

- Remember that a voltmeter is connected in parallel (across) one or more components of the circuit, and an ammeter (measuring current) is connected in series (becomes a component in the circuit).
- Always remove (or disconnect) a resistor from the circuit to measure its resistance!

Construct the following circuit on the breadboard. Use the **200 Ω** resistor.

Measure and record the value of the voltage and the value of the resistor.



V= _____

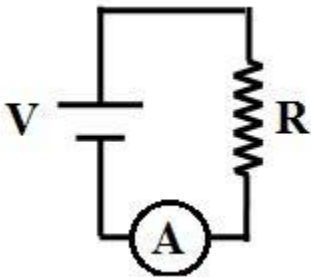
R= _____

Calculate the current in the circuit. Express it in mA.

I (calc) = _____

Show your work in the space below.

Connect the multimeter into the circuit as an ammeter and measure the current.



I (measured) _____

Compare the calculated value to the measured value. Are they close enough to believe $V = IR$ is true?

*****Before moving on:** Select the **330Ω** resistor for this next section. Record the (**measured**) resistance:

R= _____

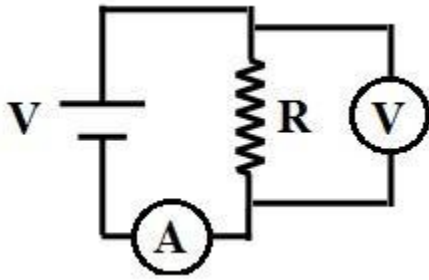
Using your new resistor, build the same simple circuit as before. Add the voltmeter to the circuit and measure the voltage **across** the resistor. Then, using the correct method, measure the **current** in the circuit.

V

= _____

I

= _____



What would you **expect** to happen to **the current** as you **change the voltage** in the above circuit ($R = \text{constant}$), according to Ohm's law? Explain why you think so.

Change the voltage supply to the Arduino's 3V. Measure and record the new values for V and I.

V = _____ I = _____

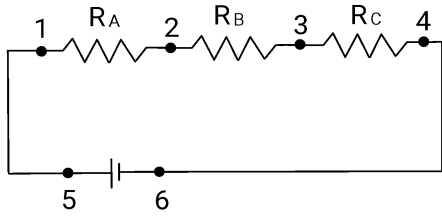
Change the voltage supply to a 9V battery. Measure and record the new values for V and I.

V = _____ I = _____

Graph your voltage and current data for the three different scenarios (5V, 3V, 9V) on the chart below. What is the result, and how does it confirm Ohm's Law ($V = IR$) with respect to the equation for a line: $y = mx + b$. What part of your graph will be the indicator of resistance? Check the slope of the line with Alison's spreadsheet.

Part 3: Series resistance circuit

Build the circuit shown below on a breadboard. Use the 9V battery as your voltage source. **Measure** and record the value of the voltage, and copy the measured values of your 3 resistors from the first page.



V= _____

R_A= _____

R_B= _____

R_C= _____

Calculate the equivalent resistance for your circuit

R_{eq}= _____ (calc)

Measure the equivalent resistance.

R_{eq}= _____ (meas)

Where will you place the multimeter probes to measure this?

Calculate the value of the current, I, in your circuit.

I= _____

What do you expect to be true about the sum of the voltages: V_A + V_B + V_C ? (V_A is the voltage across R_A, etc.)

Calculate, then measure, V_A, V_B, V_C, and V_{PS}. (V_{PS} is the power supply voltage, measured at pts (1,4) or (5,6). Show your work below.

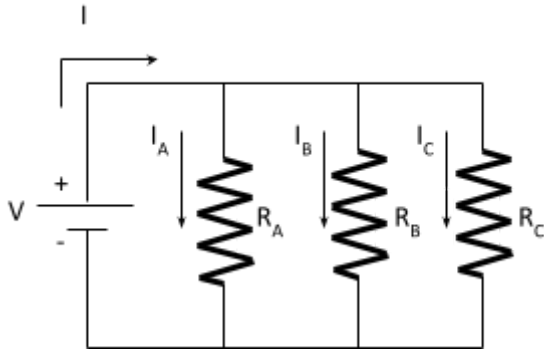
	<u>Calculated value</u>	<u>Measured value</u>
V _A	_____	_____
V _B	_____	_____
V _C	_____	_____
V _{PS}	_____	_____

Compare your measurements to your predictions.

Part 4: Parallel resistance circuit

Build the circuit shown below. Keep using the 9V battery. Copy your measured total voltage value from earlier here:

$$V = \underline{\hspace{2cm}}$$



Calculate the equivalent resistance of the entire circuit. Show your work.

$$R_{eq} = \underline{\hspace{2cm}} \text{ (calc)}$$

Measure the equivalent resistance. Where will you place the multimeter leads?

$$R_{eq} = \underline{\hspace{2cm}} \text{ (meas)}$$

What do you expect to be true about V_A , V_B , and V_C ? (V_A is the voltage across R_A , etc)

Measure and record V_A , V_B , and V_C .

$$V_A = \underline{\hspace{2cm}}$$

$$V_B = \underline{\hspace{2cm}}$$

$$V_C = \underline{\hspace{2cm}}$$

Compare your measurements to your prediction.

Calculate, then measure, the currents **I**, **I_A**, **I_B**, and **I_C** and fill in the table below. Show your work in the margins and empty space below.

<u>Calculated values</u>	<u>Measured values</u>
I _____	_____
I_A _____	_____
I_B _____	_____
I_C _____	_____

Does the total current $I = I_A + I_B + I_C$?