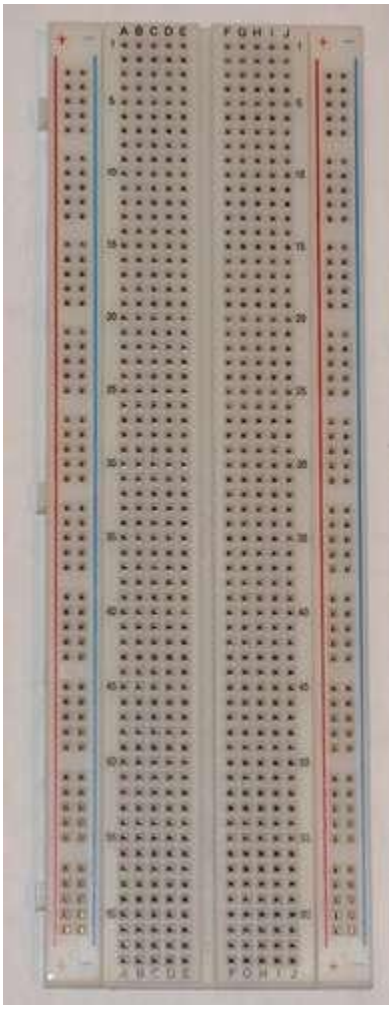
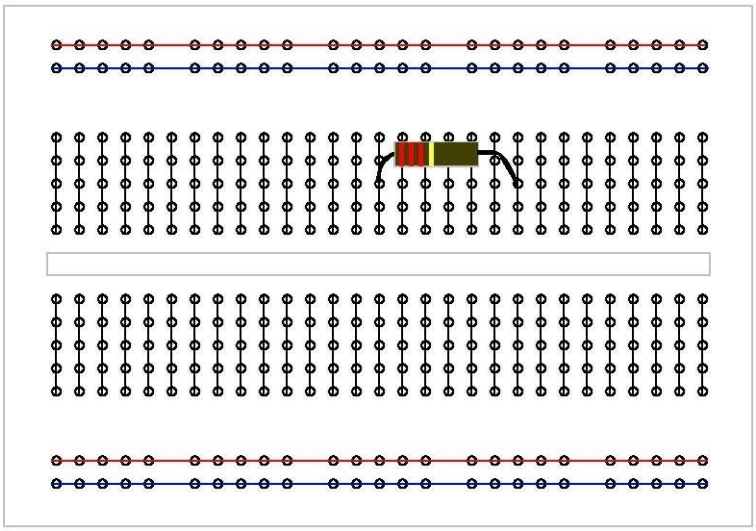
Intro to Circuits Lab #1

Anatomy of a Breadboard:

The "breadboard" is where you will be assembling your circuits. The breadboard is composed of rows and columns of metal clips. These clips are housed in a plastic covering with holes that allow for pin connections.



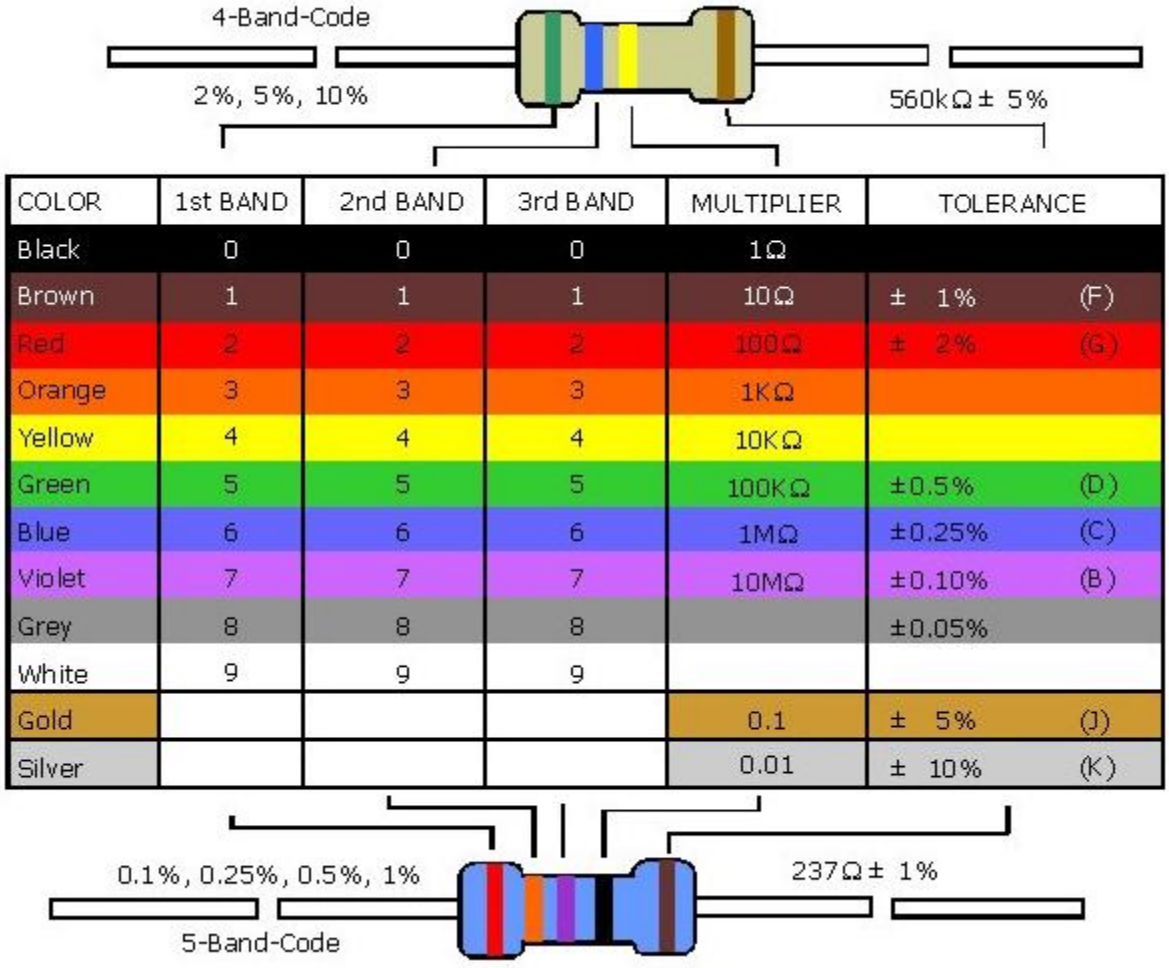


Basic Circuit Components

Resistors – A resistor is an electronic component that "resists" electric current by producing a voltage drop between its terminals. The value of the resistance is equal to the voltage drop across the resistor divided by the current through the resistor. This is also known as Ohm's Law, given by:

$$R = \frac{V}{I}$$

Usually, resistors are color-coded to represent their value and tolerance. The first two bands are a numerical value, the third band is a power of ten multiplier and the fourth band indicates the tolerance within which the actual resistance is given.



COLOR	1st BAND	2nd BAND	3rd BAND	MULTIPLIER	TOLERANCE
Black	0	0	0	1Ω	
Brown	1	1	1	10Ω	± 1% (F)
Red	2	2	2	100Ω	± 2% (G)
Orange	3	3	3	1KΩ	
Yellow	4	4	4	10KΩ	
Green	5	5	5	100KΩ	±0.5% (D)
Blue	6	6	6	1MΩ	±0.25% (C)
Violet	7	7	7	10MΩ	±0.10% (B)
Grey	8	8	8		±0.05%
White	9	9	9		
Gold				0.1	± 5% (J)
Silver				0.01	± 10% (K)

For example, a resistor with color code **red, violet, yellow gold** is a resistor with a value of 270k Ω and a 5% tolerance. Thus the actual value of the resistor is between 256.5kΩ and 283.5kΩ. More expensive resistors have lower tolerance.

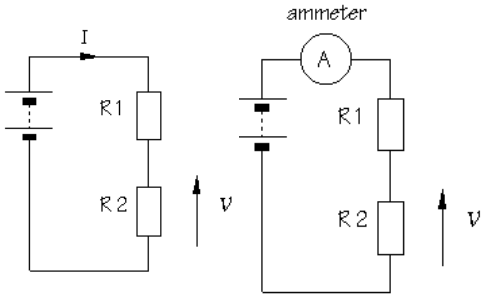
Making Measurements

Multimeters:

A multimeter is a device that is able to measure current (ammeter), potential difference between two locations (voltmeter), and resistance (ohmmeter) amongst other things.

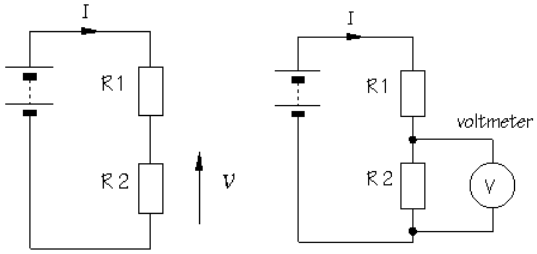
The purpose for which you are using the multimeter (i.e to measure current, voltage, or resistance) dictates the method in which you connect it to the rest of your circuit.

Ammeter



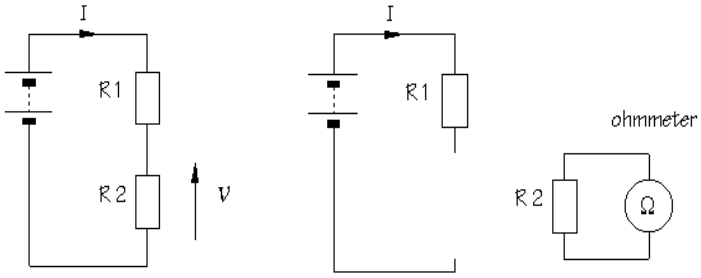
To measure current, the multimeter should be connected *in series* with the rest of the components in your circuit. This allows the current flowing through the circuit to pass through the ammeter as well. However, meters should not alter the behavior of the circuit whose current they are measuring, and thus, to avoid causing a voltage drop across them, ammeter should have *very low* resistance.

Voltmeter

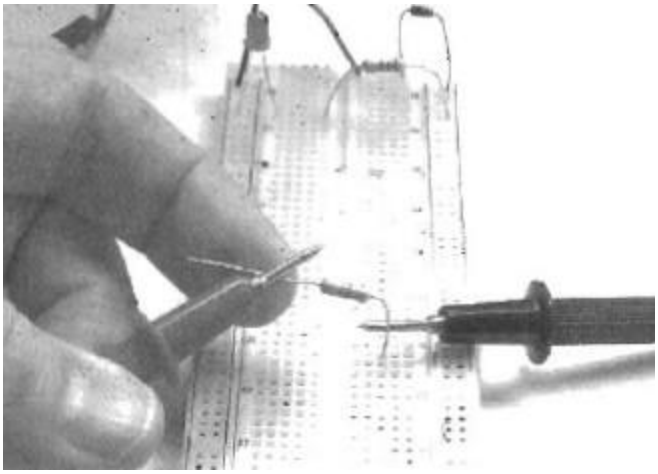


In order to measure voltage across a given component in your circuit, the voltmeter is connected *in parallel* to that component. Because the voltmeter provides a parallel pathway, it should pass as little current as possible, so as not to short circuit the component across which it is measuring. That being said, a voltmeter should have *very high* resistance.

Ohmmeter

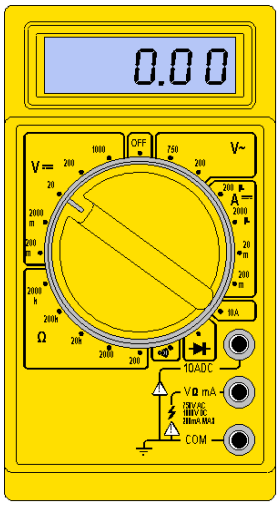


Unlike ammeters and voltmeters, ohmmeters cannot function if the circuit is connected to a power supply. In order to measure the resistance of a given circuit component, it must be *removed* from the circuit and probed independently. The ohmmeter then passes a small current through the circuit component of interest and subsequently measures the voltage produced, and using principles based on Ohm's law, displays the resistance of the component. Probing a powered circuit with an ohmmeter will likely damage the meter.



You should not hold the both sides of the wire or component while you are testing the resistance, because your skin will conduct electricity and the DMM will be measuring your resistance mixed with the component's.

Place one end of the component into your solderless breadboard and hold the probe tightly against it. You can press the other probe against the top of the component with your other finger.



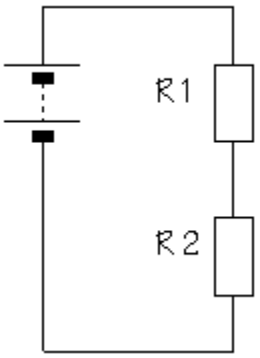
Generally multimeters have a central knob with various positions to which it can be rotated. Where you position the knob will be dependent on the purpose for which you will use it. If you circuit is operating from a constant voltage source such as a battery, current flow will always be in the same direction, and thus it is referred to as "direct current" or DC. V⎓ In this case, you could set the meter to 10V DC, and with this the maximum voltage that can be measured at this setting is 10V. If you know that the measurement you will be making is in the millivolt range, then you will achieve more accuracy if you set the multimeter to make measurements in the 10V to 100mV range. If the current you have flowing through the circuit periodically switches direction from positive to negative, then you are dealing with an "alternating current" or AC power supply, and you should adjust your multimeter knob to take AC measurements. V~

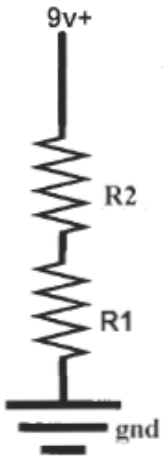
Procedures:

1. Pick 3 different resistors.
2. Write down the value of resistors using the colour code.
3. Measure the resistance of the resistors using DMM (digital multimeter). Fill the table.

	Colours	Resistor value using colour code	DMM value
1			
2			
3			

4. Measure your skin's resistance by holding a probe in each hand. It will bounce around, but try to take an average. Record the measurements for every group member.
   _____Ohms
   _____Ohms.
   Did you know that this can be used as a crude lie detector? A person sweats when they get anxious. Have a friend hold the probes. Then ask them an embarrassing question. Watch the resistance go down for a moment. Wire the following circuit.

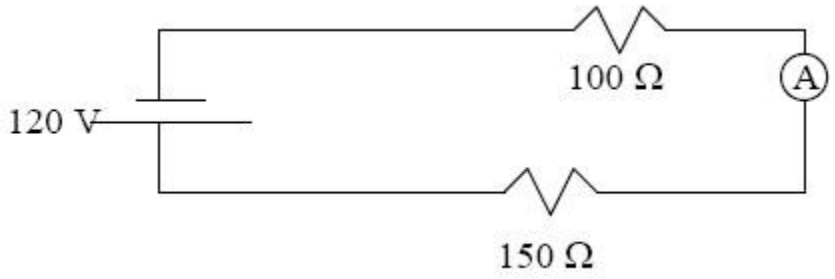




5. What are the resistances $\mathbf{R_1}$, $\mathbf{R_2}$, and $\mathbf{R_{tot}}$.
6. What is the current through the resistor R_1: $\mathbf{I_1}$? What is the total current?
7. Wire the circuit with LED and variable resistor (potentiometer). Change resistance. Draw the circuit diagram. Show the circuit to your teacher.
8. Wire the circuit with piezo buzzer. Use rated voltage source from breadboard. .

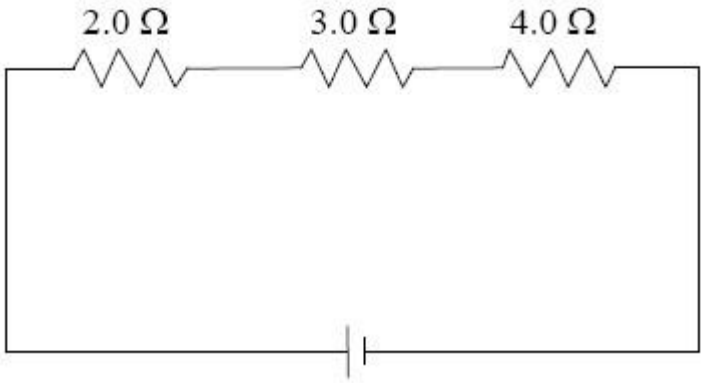
Answer the following questions:

1. Find the current as well as the voltage across each resistor.



2. Three known resistances are connected in series to the terminals of a power source. The potential difference at the terminals of the 3.0 Ω resistance is 12 V.

    a. What is the potential difference of the power source?
    b. What is the voltage drop across the 4.0 Ω resistor?
    c. What is the voltage drop across the 2.0 Ω resistor?



3. Which of the following circuits may be used to determine the value of the resistor? Draw all circuits that apply in your report.