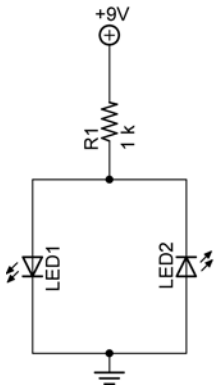
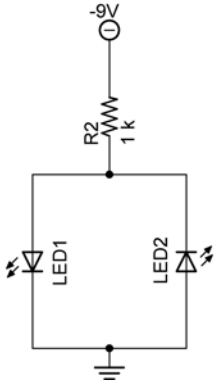
Cornerstone Electronics Technology and Robotics Week 8
Chapter 3, Introduction to Basic Electrical Circuit Materials Continued

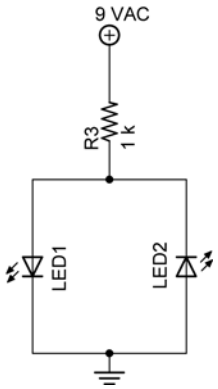
- Administration:
  - Prayer
  - Turn in quiz
- Review LED's:
  - Wire the following circuits on your breadboards:



Circuit A



Circuit B



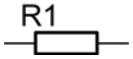
Circuit C

Note in the table below which LED or LED's light in each circuit

Circuit	LED 1	LED 2
A	on or off	on or off
B	on or off	on or off
C	on or off	on or off

Now substitute a tri-colored LED for the LED's in the above circuits.

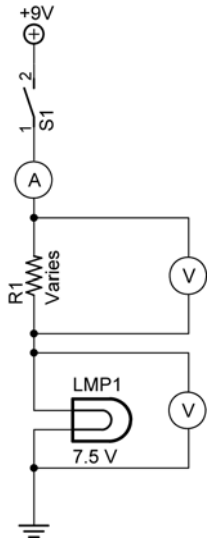
- Electricity and Electronics, **Section 3.5**, Resistors:
  - Types:
    - Fixed:
      - Symbols:



- Carbon composite resistor
- Thin film resistor
- Film resistors
- Chip resistors
    - SIP - Single In-line Package
    - DIP - Dual In-line Package
- Wire wound resistors are used where the resistor has to dissipate a lot of heat.

▪ Adjustable resistor:
- Symbol:

o General Function of Resistors:
- ▪ Resistors resist the flow of electrons through an electrical circuit. They convert electrical energy into mechanical energy (heat).
- ▪ Students assemble the circuit below on their breadboard using 1, 10, 22, 47, 68, and 100 ohm resistors, an ammeter, two voltmeters, and a 7.5 v light bulb. Note the brightness variation, the currents, and voltage drops in each case.



Circuit D

Voltage Drops for Circuit D					
Circuit	**R1 Value**	**Current**	**Voltage R1**	**VoltageLMP1**	**Voltage Total**
1					
2					
3					
4					
5					
6					

        - Resistors are used to:
            - Provide a voltage drop
            - Provide a current limit
            - Dissipate (converting) electrical energy
            - Some electrical components have resistance that varies with temperature or light. They serve as sensors used in various applications.
- A larger value in ohms represents a larger resistance.
- Resistor Failure:
    - Open circuit
    - Changed in value
    - They never go short circuit.
- Physical characteristics:
    - Different resistance values are created by mixing or doping different impurities with the carbon.
    - Electrical current running through a resistor causes it to become heated. Resistors have a wattage rating. The higher this rating the more heat they can dissipate. The wattage in a resistor is the maximum amount of heat energy it can safely dissipate without damage.
    - Demonstration using a 150 ohm ½ watt and ¼ watt resistors with various currents from a robust power supply. Note how the heat from the resistors varies. Verify the value of the resistor as the voltage increases.
    - Resistors carrying large currents must be physically large so the heat can radiate quickly to the surrounding air.
    - Demonstration using a small (1/4 watt) and a larger (10 watt) resistor, both having a resistance of 10 ohms. The current through each resistor will be the same. Note the variation in heat given off by the two resistors.

- Potentiometers: A **potentiometer** is a type of variable (adjustable) resistor that is used in circuits having low power. They are used to divide voltage and they come with three terminals.
    - Symbol:

R1

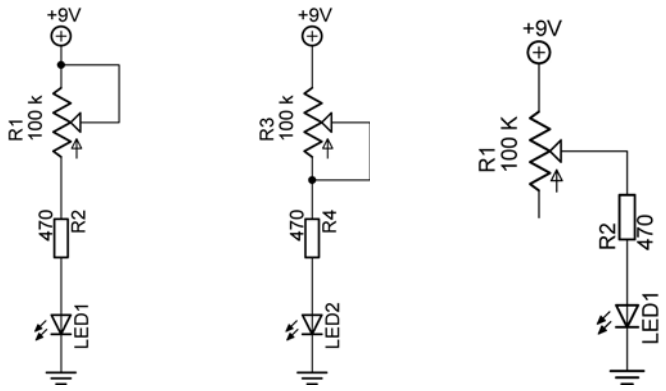
    - Values printed on a potentiometer are the maximum value.
    - Designed to turn tens of thousands of times.
    - Samples

- **Tripots** (trimmer potentiometers or trimmers):
  - Small potentiometers without knobs.
  - Wear out after as little as one hundred turns.
  - Demonstrate single vs. multi-turn tripots
  - Values
    - The third digit is the number of zeros to add to the end of the first two digits. For example, a tripot labeled 221 has a value of 220 ohms; a tripot labeled 123 has a value of 12,000 ohms.
    - Tripot sample values:
      - 1.
      - 2.
      - 3.
      - 4.
      - 5.
      - 6.
      - 7.
- Testing potentiometers:
  - Test for maximum resistance with an ohm meter, (the outside leads) and compare with value printer on the side of the potentiometer.
  - Turn tripot dial and also switch leads
  - Using two DMM's, connect the test wiper (center) lead to the two outside leads and observe the resistances of each meter as you change the value of the potentiometer.

o **SEE pg 9, 10, Marine Institute Electrotechnology 1100**

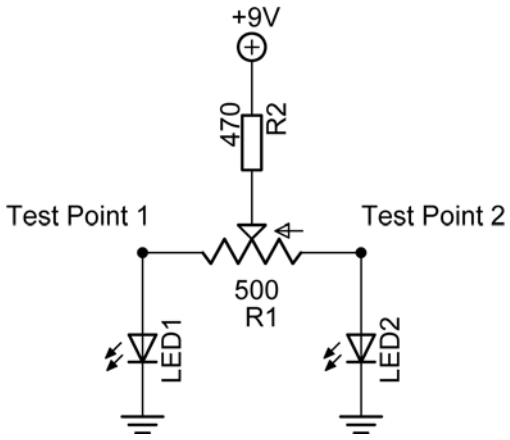
o Variable brightness LED circuit:

- Wire each circuit below and compare the results.



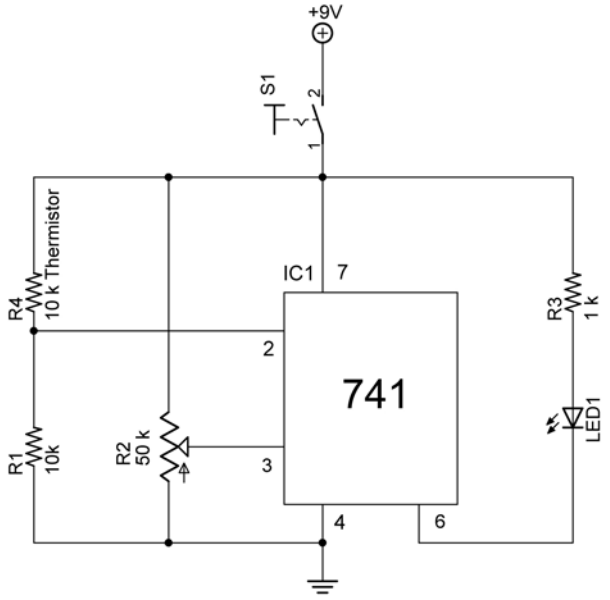
- What is the purpose of the 470 ohm resistor?

- Brightness balancing circuit:



Note: The test points will be used in future lessons.

- Thermistor:
  - Resistor that are designed to change in value when heated
  - They are used in temperature measuring circuits.
  - Students graph temperature vs. resistance for 10 k and 1 k thermistors.
  - Thermistor Circuit:



Temperature Switch

Switch pins 2 and 3 so the LED will light as the temperature decreases.

- Resistor Color Code:

Color Value Bands for Resistors and Capacitors			
Color	**First Band**	**Second Band**	**Third Band**
Silver	-	-	x1/100
Gold	-	-	x1/10
Black	0	0	x1
Brown	1	1	x10
Red	2	2	x100
Orange	3	3	x1,000
Yellow	4	4	x10,000
Green	5	5	x100,000
Blue	6	6	x1,000,000
Violet	7	7	-
Gray	8	8	-
White	9	9	-

Resistor Tolerance Bands	
Color	**Tolerance**
None	20%
Silver	10%
Gold	5%
Red	2%
Brown	1%

- Tolerance Calculations:
  - 470 Ω resistor with a 10% tolerance:
    - The range of resistance is from 470 ohms minus 47 ohms (-10%) to 470 ohms plus 47 ohms (+10%). Therefore the range is from 423 to 517 ohms.

- Suggested homework, Student Activity Sheets 3-2, 3-3.