Electronics Review 1
Cornerstone Electronics Technology and Robotics II Week 1

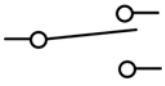
- **Administration:**
  - Prayer
  - Welcome back
  - Review Quiz 1
- **Review:**
  - Reading meters:
    - When a current or voltage value is unknown, begin with the highest meter range.
    - An ammeter must always be connected in series (in line) with a circuit component.
    - Voltmeters are always connected in parallel with the component (across the component).
    - When measuring resistance, disconnect the resistor from the circuit. Also make sure power is off to the circuit.
  - Ohm's Law:

    V = I x R where:

    V = voltage in volts,
    I = current in amperes, and
    R = resistance in ohms
  - Switches:
    - SPST switch example and symbol:

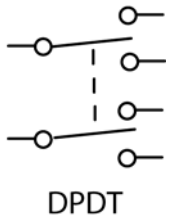
SPST

    - SPDT switch example and symbol:

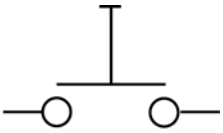


SPDT

- DPDT switch example and symbol:



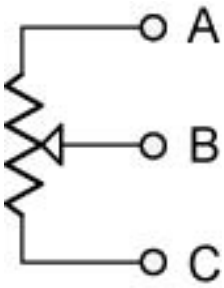
- Momentary switches:



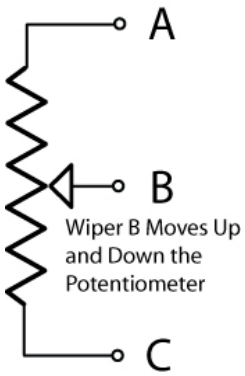
Normally Closed (NC) Normally Open (NO)

- Show samples

o Potentiometer: a 3 -Terminal Variable Resistor
  - 100 Watt sample
  - Potentiometer Symbol:



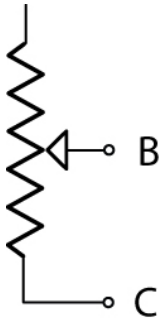
- Function:



Potentiometer

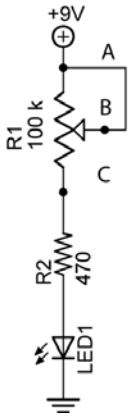
- The resistance between points A and C (R_{AC}) is constant. It is the resistance rating of the potentiometer.
- As wiper B moves up and down the potentiometer, resistances R_{AB} and R_{BC} vary, but $R_{AB} + R_{BC}$ will equal R_{AC}.
- Set up an experiment to verify the last point.

o Rheostat: A 2 -Terminal Variable Resistor
  - Symbol:

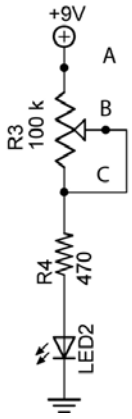


Rheostat

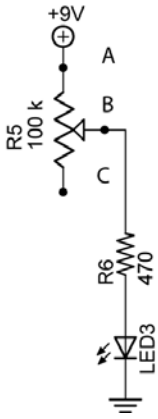
- Potentiometer Wired as a Rheostat:



Circuit A



Circuit B



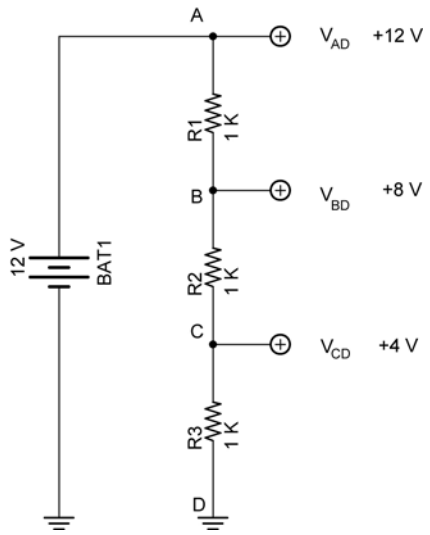
Circuit C

  - In the Circuits A and B above, a potentiometer is used as a rheostat.
  - In Circuit A above, R_{AB} is always 0 Ohms and R_{BC} varies from 0 – 100K Ohms.
  - In Circuit B, R_{BC} is always 0 Ohms and R_{AB} varies from 0 – 100K Ohms.
  - In Circuit C, R_{AB} varies from 0 – 100K Ohms and R_{BC} does not exist since there is no connection to C.
  - What is the purpose of the 470 ohm resistor?

o Review Summary Sheet of Series and Parallel Circuits
  - See: http://www.cornerstonerobotics.org/curriculum/lessons_year1/ER%20Week13a,%20Series%20Parallel%20Summary.pdf

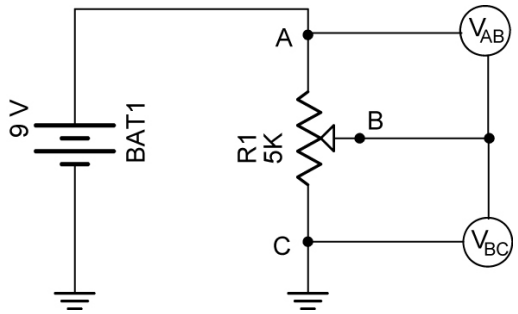
o Parallel Resistors:
  - Perform Review 1 Lab 1 – Voltage Drop in a Parallel Circuit

- Voltage Dividers:
  - Series resistors can be used to divide a voltage into smaller voltages. For example, the following series resistors divide a 12 volt source into 12 volts, 8 volts, and 4 volts using the same value for each resistor. Notice that we are not measuring voltages across each resistor, but voltages from a point, e.g. B to the ground point D (V_{BD}). (The voltage drop across each individual resistor is 4 volts.)



Example of a Voltage Divider

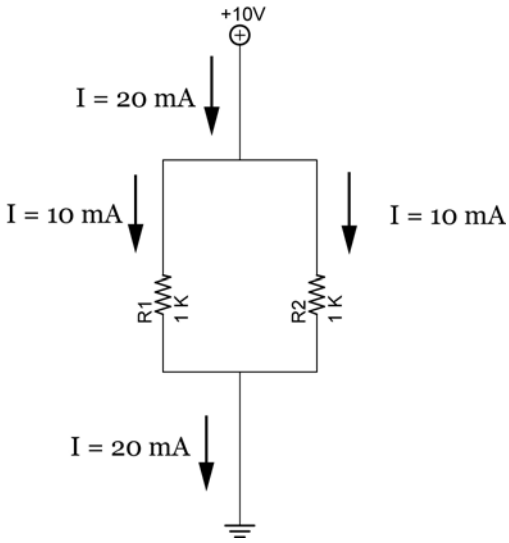
  - Potentiometers can be used as voltage dividers. In the circuit below, the sum of the voltmeter measurements V_{AB} and V_{BC} equals the source voltage V_{AC}.



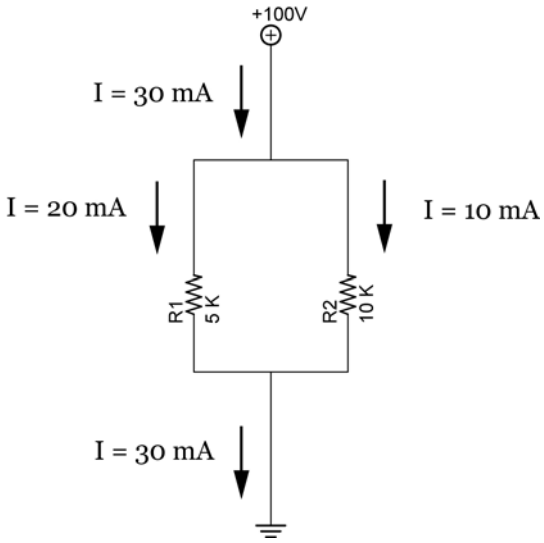
Potentiometer as a Voltage Divider

  - Voltage dividers may be used in resistive sensor circuits
  - Perform Review 1 Lab 2 – Potentiometers.

- Kirchhoff's Current Law: The sum of the currents into a junction is equal to the sum of the currents leaving that junction.
  - Parallel circuits act as current dividers.



Example 1



Example 2

- **14" Band Saw:**
  - Safety Rules:
    - See copy from the manual.
  - Operation:
    - See copy from the manual.
- **Project for the Year:**
  - Each student will design and build his own mobile autonomous robotics car. The car must be equipped to:
    - Use dc motors as the drive system
    - Have sufficient room on a breadboard for a LCD (Liquid Crystal Display), PIC microcontroller(s), H-bridge, and other supporting electronics
    - Mount several different sensors that will be studied this year
- **Practice Circuit:**
  - Perform Review 1 Lab 3 – Touch Switch.

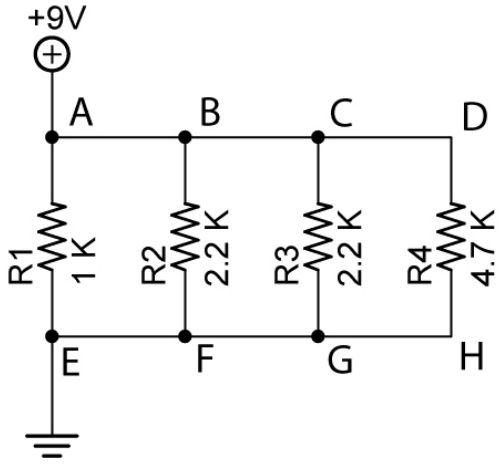
Cornerstone Electronics Technology and Robotics II Week 1
Electronics Review 1 Lab 1 – Voltage Drop in a Parallel Circuit

- **Purpose:** The purpose of this lab is to experimentally verify that the voltage drops across parallel resistors are equal.

- **Apparatus and Materials:**

  - 1 – Solderless Breadboard with 9 V Power Supply
  - 1 – Digital Multimeter
  - 1 – 1 K Ohm Resistor
  - 2 – 2.2 K Ohm Resistors
  - 1 – 4.7 K Ohm Resistor

- **Procedure:**
  - Wire the following circuit
  - Measure and record V_{AE}, V_{BF}, V_{CG}, and V_{DH}.



- **Results:**

Points	Voltage Drop
A - E	
B - F	
C - G	
D - H	

- **Conclusions:**
  - How do the voltage drops V_{AE}, V_{BF}, V_{CG}, and V_{DH} mathematically relate to each other?

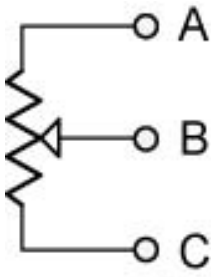
Cornerstone Electronics Technology and Robotics II Week 1
Electronics Review 1 Lab 2 – Potentiometers

- **Purpose:** The purpose of this lab is have the student measure tripot values and to help the student understand the function of a potentiometer as a variable resistor.

- **Apparatus and Materials:**

  - 1 – Digital Multimeter
  - 1 – 5 K Ohm Potentiometer

- **Procedure:**
  - Testing potentiometers:
    - Test and record the maximum resistance of the potentiometer with a DMM, and compare with value printed on the side of the potentiometer.
    - Turn the potentiometer shaft and then flip the DMM leads. How does the maximum resistance value of the potentiometer react? Record your results.
    - Using the DMM, measure and record the resistance R_{AB}, R_{BC}, and R_{AC} at three different positions of the potentiometer. Before changing each position, apply +5v to Point A and ground to Point C, then measure and record V_{AB}, V_{BC}, and V_{AC}.



- **Results:**

  - Maximum resistance of the potentiometer:

    Maximum resistance = _____ohms

    Printed value of the potentiometer = _____ ohms

    Resistance when potentiometer shaft turned = _____ohms

    Resistance when DMM leads reversed = _____ohms

- Testing potentiometers:

Potentiometer Test 1			
	Position 1 (Ohms)		**Position 1 (Volts)**
R_{AB}		V_{AB}	
R_{BC}		V_{BC}	
$R_{AB} + R_{BC}$		$V_{AB} + V_{BC}$	
R_{AC}		V_{AC}	

Potentiometer Test 2			
	Position 2 (Ohms)		**Position 2 (Volts)**
R_{AB}		V_{AB}	
R_{BC}		V_{BC}	
$R_{AB} + R_{BC}$		$V_{AB} + V_{BC}$	
R_{AC}		V_{AC}	

Potentiometer Test 3			
	Position 3 (Ohms)		**Position 3 (Volts)**
R_{AB}		V_{AB}	
R_{BC}		V_{BC}	
$R_{AB} + R_{BC}$		$V_{AB} + V_{BC}$	
R_{AC}		V_{AC}	

- **Conclusions:**
  - In the potentiometer test, mathematically relate R_{AC} to R_{AB} and R_{BC}.

  - How does V_{AC} relate to $V_{AB} + V_{BC}$?

Cornerstone Electronics Technology and Robotics II Week 1
Electronics Review 1 Lab 3 – Touch Switch

- **Purpose:** The purpose of this lab is to reacquaint the student with wiring a circuit on a breadboard.

- **Apparatus and Materials:**

  - 1 – 555 Timer
  - 1 – 10M Ω Resistor
  - 1 – 100K Ω Resistor
  - 1 – 1K Ω Resistor
  - 1 – 0.01 uF Capacitor
  - 1 – 4.7uF, 10uF, 22uF, 47uF, and 100uF Capacitors
  - 1 – LED

- **Procedure:**
  - Wire the touch switch circuit on your breadboard.
  - Use a 4.7 uF capacitor for C2 to begin, and then substitute the 10 uF, 22 uF, 47 uF, and 100 uF in its place.
  - Use the normal jumpers as your touch leads.