Instrumentation Lab

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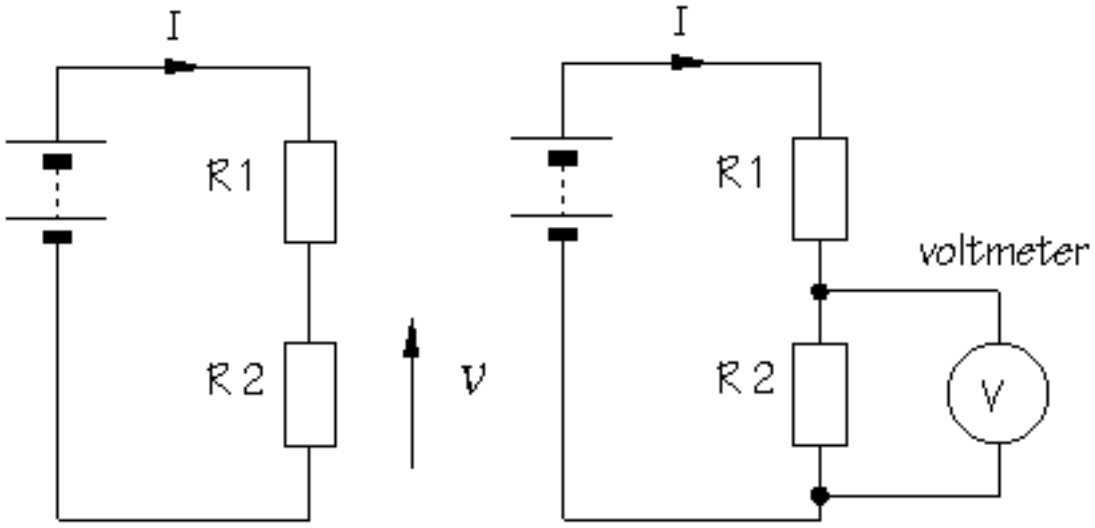
This lab is to give students practice using the bench instruments such as the power supply, multimeter, function generator, and oscilloscope. These tools are widely used in the field of engineering. A power supply is a device that provides power such as a voltage or current source. A multimeter is a measuring instrument. It can measure current, voltage, and resistance. A function generator is an electronic instrument that generates various waveforms such as sine wave, square wave, pulse trains, and sawtooth. The amplitude, DC offset, frequency, and others are adjustable. The oscilloscope is basically a graph-displaying device. It draws a graph of an electrical signal. In most applications, the graph shows how signals change over time. The vertical (Y) axis represents voltage. The horizontal (X) axis represents time. For all of the instruments, the red probe is positive and the black probe is negative (usually for grounding). Grounding is necessary for safety. To ground means to connect it to an electricaly neutral reference point.

Part A: Using the power supply and multimeter

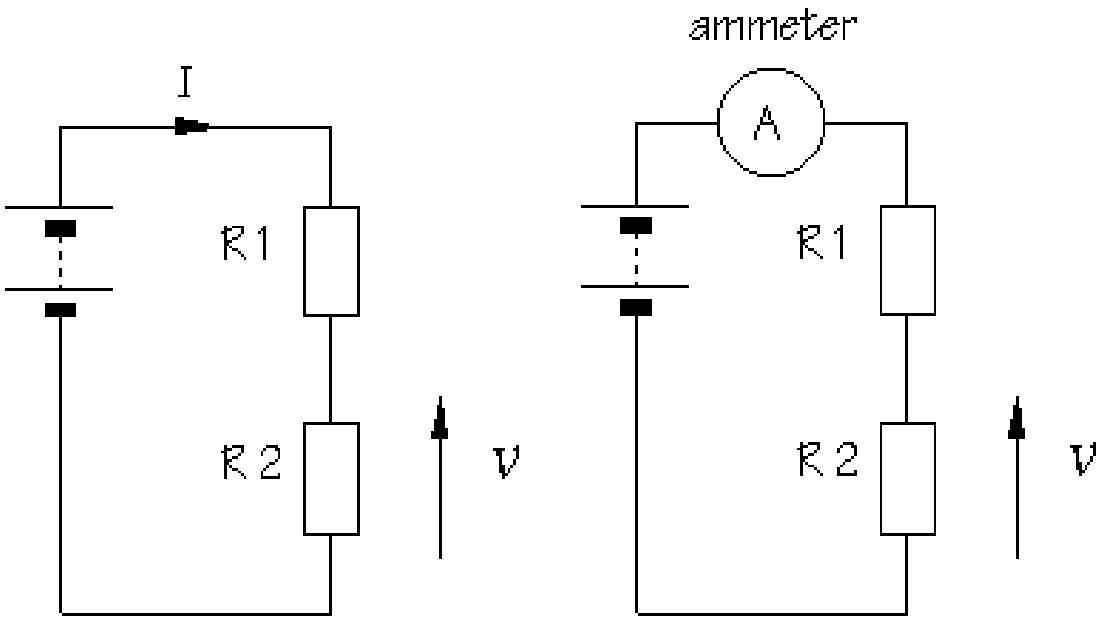
1. Measuring voltage

   Connect the power supply to the multimeter. For the multimeter to measure potentail different (voltage), the circuit is not changed. The multimeter is connected in parallel. To get a voltage source, the power supply should have the current knob fully clockwise. The voltage knob should be fully counter-clockwise. Once the probes are connected, turn the voltage knob clockwise to increase the voltage. Adjust up to 30V. Make sure the red probe to the multimeter is connected to the voltage plug on the multimeter. The multimeter knob needs to be changed to DC voltage. To measure voltage, connect the red probe of the power supply to the red probe from the multimeter. The black probe from the power supply should be connected to the black probe from the multimeter.

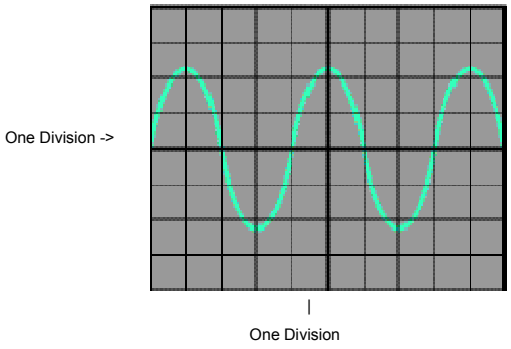


2. Measuring current

For the multimeter to measure current, the circuit must be broken to allow the multimeter to be connected in series. For the power supply, the voltage knob should be fully clockwise. The current knob should be fully counter-clockwise. Once the probes are connected, turn the current knob clockwise. Adjust up to 5A. Change the red probe on the multimeter to the 10A plug and change the knob to 10A. Keep the red probe from the power supply connected to the red probe from the multimeter. Keep the black probe from the power supply connected to the black probe from the multimeter.



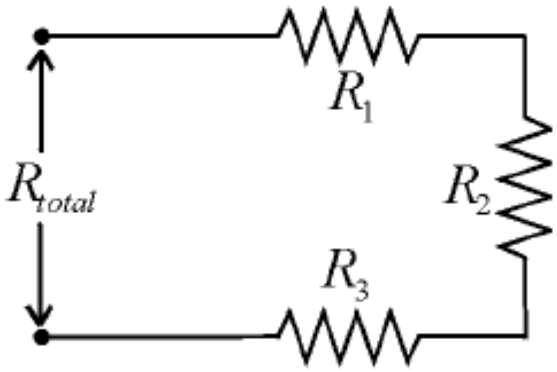
Part B: Using the function generator and oscilloscope



Connect the function generator to the oscilloscope. To do this, connect the red probe from the function generator to the push button clip from the oscilloscope. You can connect the black probe to the alligator clip from the oscilloscope. Make sure the “Output” button is pressed on the function generator. Use different waveforms such as a sine, square, ramp, and pulse wave. Change the frequency and amplitude. With the oscilloscope, change the time/division and

voltage/division by using the scales knob. Also, move the waveform up and down with the vertical position knob. Try moving it left and right with the horizontal position knob. With the cursors from the cursor button on the oscilloscope, scroll across the waveform to check the values. Measure the frequency and amplitude using the measure button on the oscilloscope.

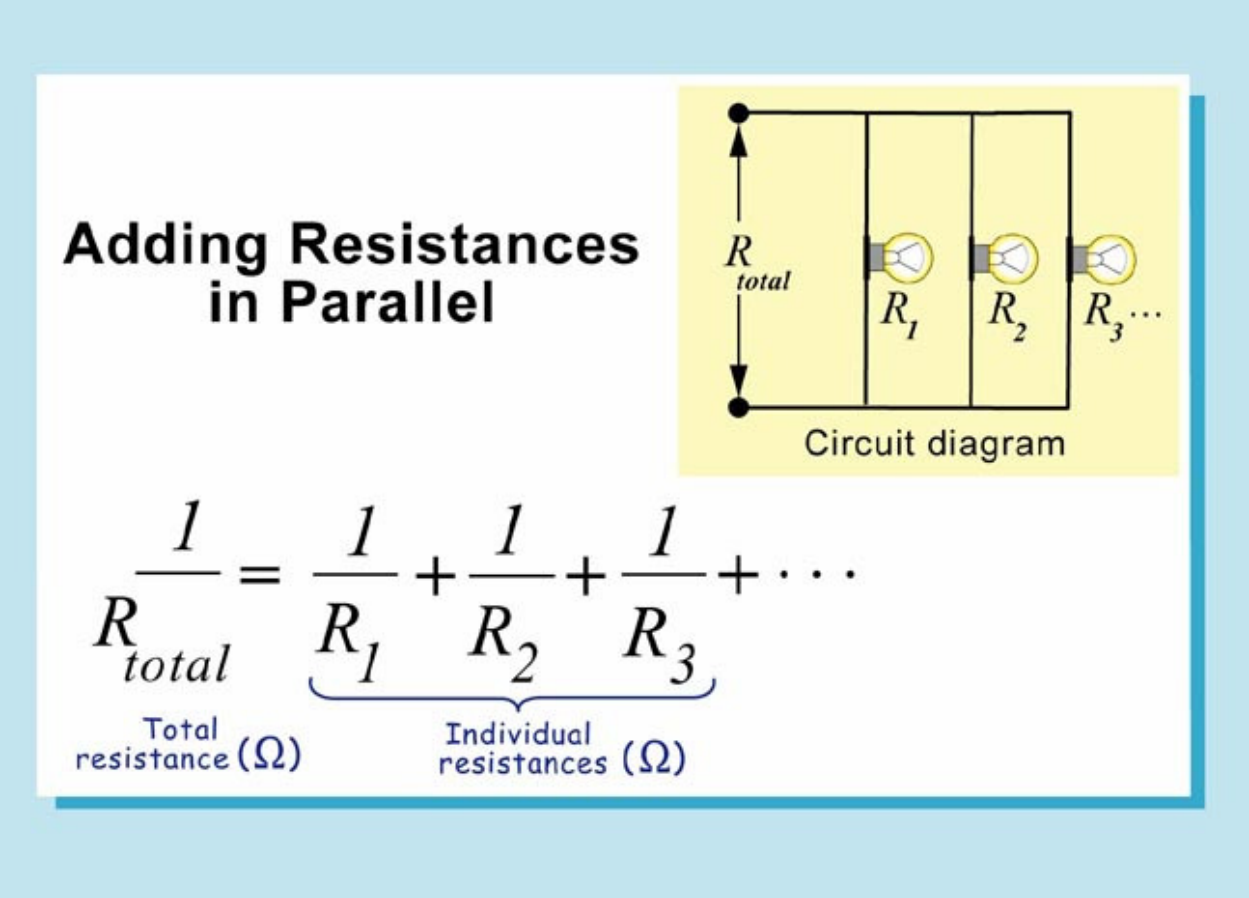
Part C: Using the multimeter for electrical components



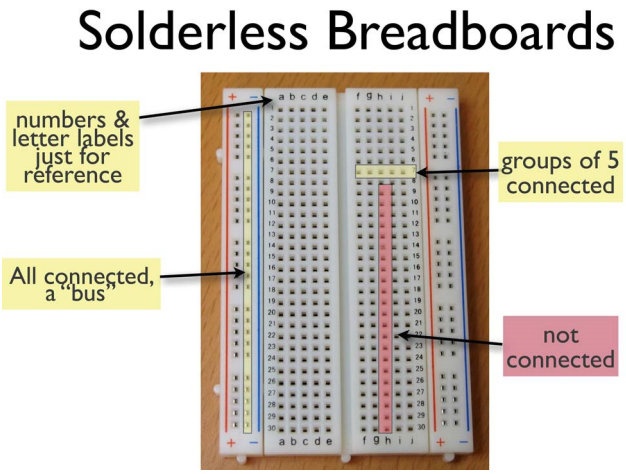
Circuit diagram

$$R_{total} = R_1 + R_2 + R_3 \ldots$$

Each resistance in a series circuit adds to the total resistance of the circuit. The same applies for voltages.



Use the multimeter to measure the voltages of different batteries by themselves and in series. Use D cell batteries and up to 4 in series. Use the multimeter to measure the resistance of different resistors by themselves, in series, and in parallel.



Put the resistors on a breadboard. Use the power supply and resistors together. Again, put the resistors on a breadboard and connect the power supply with wires on the breadboard. Measure the voltage across the resistors.