Name:_____ Lab Partner: _____

Survey of Physics

Lab 13: Ohm's Law and Electric Power

Purpose:

In this exercise, you will use a digital multimeter in three modes: as a voltmeter, an ammeter and as an ohmmeter. You will make measurements to determine resistance using Ohm's Law, and compare the results to resistance measured directly by an ohmmeter. You will also calculate power produced in simple circuits.

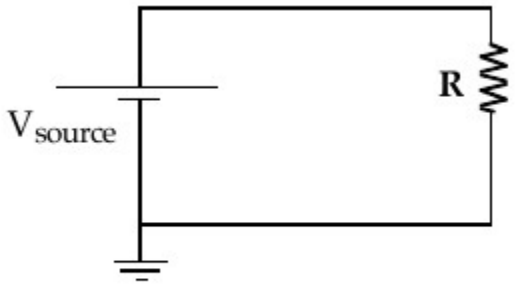
Equipment:

It is important to understand the differences in function and operation of a multimeter when used as a voltmeter, ammeter or ohmmeter.

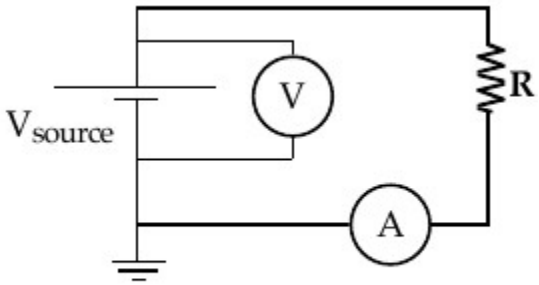
Voltmeter: A digital multimeter, when configured and operated as a voltmeter, will be connected to two points in a circuit. The voltmeter will display the voltage drop V. Ideally zero current should flow through the voltmeter, so that the circuit behaves exactly as it did before the voltmeter was connected.

Ammeter: Current is measured by having the electric charge flow through the multimeter, configured as an ammeter. Ideally the ammeter should have zero resistance (the opposite of a voltmeter). The ammeter must be placed in series in the circuit: you must physically disconnect the circuit where you wish to measure current, and insert the ammeter into the space created. If you connect an ammeter in parallel, like a voltmeter, you will short out the component in parallel with the ammeter.

Ohmmeter: An ohmmeter will apply a voltage to a circuit element and measure the resulting current, calculating resistance. Be sure to remove a resistor from the circuit before measuring resistance with an ohmmeter. If the circuit element is still in a circuit with a voltage source, the multimeter can be damaged.



Basic circuit



With meters

Procedure

Part A: Ohm's Law

1. Obtain the box of three resistors, a power supply, two multimeters and several wires. Assemble the single-resistor circuit shown using resistor R1. Source voltage may be set to approximately 10 V. Measure and record the exact voltage and current. Repeat for R2 and R3, completing the table below. In the last column, use Ohm's Law to calculate the resistance.

Resistor	Voltage V (V)	Current I (A)	$R = \frac{V}{I}$
R1			
R2			
R3			

2. Measure the resistance of each resistor directly using an ohmmeter. Remember to disconnect the resistor from the voltage source when measuring resistance with an ohmmeter. Record the resistances. If they are not very close to your results above, determine why not.

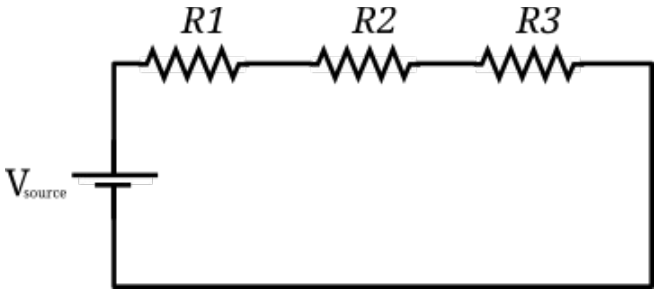
Resistor	Resistance R (Ω)
R1	
R2	
R3	

3. Use the equation $P = IV$ to calculate how much power is lost in each resistor when connected to 10V.

Resistor	Power P (W)
R1	
R2	
R3	

Part B: Series Resistance

4. Assemble the circuit shown at the right, using 10V for the source.



5. Measure the voltage across each resistor individually, and the current through each resistor. Record your answers below.

Resistor	Voltage V (V)	Current I (A)
R1		
R2		
R3		

6. How do the currents through each resistor compare?

7. How does the sum of the three voltages compare to the source voltage?

Part C: Body Resistance

8. Use an ohmmeter to find your resistance, from one hand to the other (hold one wire lead from the ohmmeter in each hand).

   Dry hands

   Wet hands

9. Use Ohm's Law to find the current that flows through you if you touch the positive and negative terminals of a 12 V car battery with wet hands (one hand on each terminal).

10. Is this enough current to feel?
    (The smallest current felt as a slight tingling sensation is about 1 mA = 0.001 Amp.)