Name _____ Group #_____ Date _____
Partners _____

Electrical Measurements

Experimental Objective
The objective of this experiment is to become familiar with some of the electrical instruments. You will gain experience by wiring a simple electrical circuit and drawing its circuit diagram. You will learn the correct use of a digital multimeter as an ohmmeter, voltmeter and ammeter.

Theory
Current, *I*, is the flow of charge, measured in amps.

Voltage, *V*, is the difference in electrical potential between two points, measured in volts.

Resistance is the ratio of voltage across to the current flowing through it, measured in ohms, Ω.

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

Wires are conductors with very low resistance designed to carry the current from one object to another.

Resistors are objects with a moderately high resistance made of carbon films. Resistors are color coded to indicate the magnitude.

A circuit diagram is a diagram that represents the electrical circuit using internationally accepted symbols. The diagram represents the electrical connections of the circuit, but not necessarily the bench layout of each item.

A series connection consists of two or more components that are connected end to end with one another and the same current flows through each component.

A parallel connection consists of components connected so that one end of all the components are connected together and the other ends are connected together such that the same voltage is applied across each component.

Multimeters are used to measure current, voltage and resistance. The meters used in our lab will give you a digital reading and since they use a battery should always be turned *off* when not in use. The black connecting lead should always be connected to the common (COM, ground) socket.

Name _____ Group #_____ Date _____
Partners _____

Equipment

Digital Multimeter	Various Resistors
Leads	Low Voltage Power Supply
AC/DC Electronics Lab Board	

Safety

Do not turn *On* the power supply until the instructor has checked your circuit. This will prevent damage to the equipment and also will prevent any harm to you. Also, turn *off* the power supply before touching or changing the circuit.

PART 1: Resistance Measurement

Use the digital multimeter (DMM) as an ohmmeter to measure the resistance of various resistors.

1. Select a resistor and record its set of colors in Data Table #1.
2. Determine the coded value and tolerance of the resistor using the "Resistor Color Codes" Table. Record in Data Table #1.
3. Use the multimeter to measure the resistance of the resistor. Connect the Black Lead in the common (COM) socket; connect the Red Lead in the VΩ socket. Use alligator clips to connect the other end of the leads to the resistor.
4. Draw a circuit diagram below Data Table #1.
5. Set the knob in the DMM to an appropriate scale in ohms (Ω) to measure the resistance. Start with a scale close to the coded value you obtained in step #2.
6. Record the measured resistance values in Data Table #1.
7. Repeat steps #1 - #6 for the remaining resistors.

PART 2: Current and Voltage Measurement

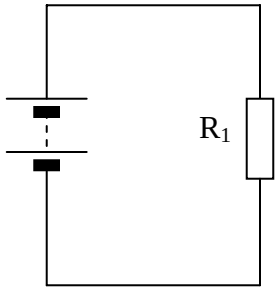
Use the DMM to measure current and voltage in a circuit.

A. DMM as an Ammeter.

To measure current you must break the circuit and connect the DMM across the break so that the current flowing in the circuit passes through the ammeter; this is a series connection. The red lead needs to be connected to the point where current enters the DMM and the black lead to the point where it exits. To set the DMM to measure DC current turn the knob to the DCA segment and to a number that corresponds roughly to the current that you anticipate.

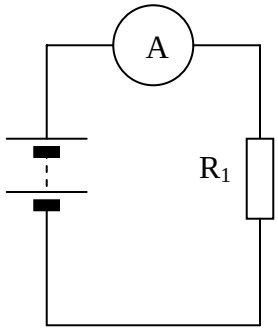
Name _____ Group #_____ Date _____
Partners _____

1. Set up a simple circuit as shown below by connecting the power supply across the ends of one of the resistors.



2. Break the circuit and connect the ammeter in series at the place where the current will be measured.

ammeter



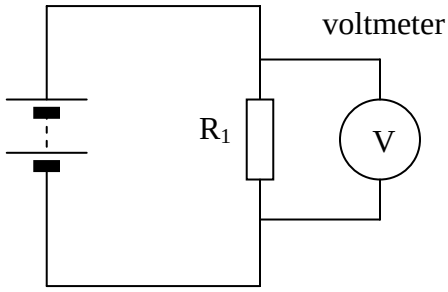
3. Connect the Black Lead to the common (COM) socket and its other end to the negative in the power supply.
4. Connect the Red Lead to the mA socket and its other end to the resistor.
5. Draw a circuit diagram below Data Table #2.
6. Set the DMM to read at its highest setting. If you have a large current but use a low setting you can blow the fuse in the DMM. Once the power is turned on, you can increase the sensitivity of the ammeter by changing the knob to a lower range.
7. **Do not turn *On* the power supply until the instructor has inspected your circuit.**
8. Turn *On* the power supply and adjust as follows: *Current Adjust* to halfway up and *Voltage Adjust* slowly to a few volts, (approx. 1.5 volts).
9. Record the current measured in Data Table #2. Do not exceed a current value of 0.5A.
10. Turn the power supply *Off*.

Name _____ Group #_____ Date _____
Partners _____

B. DMM as a Voltmeter.

To measure voltage across a circuit component the DMM is connected across the component (i.e. resistor). The red lead needs to be connected to the positive side of a component (i.e. the positive side of a battery/power supply) and the black lead to the negative side. If you connect it the wrong way then the meter reading will have a negative sign in front of the digits.

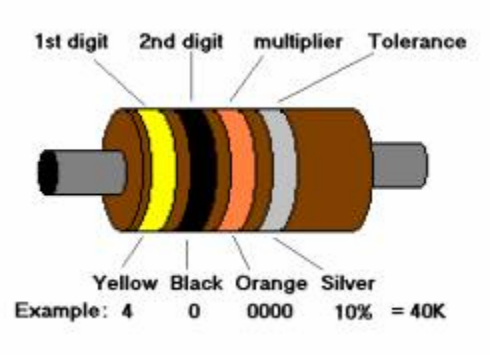
1. Set up a simple circuit as shown below by connecting the power supply across the ends of one of the resistors.



2. Connect the DMM across the resistor; this is a parallel connection. Connect the Black Lead to the common (COM) socket, clip the other end of the black lead to the end of the resistor that is connected to the negative side of the power supply. Connect the Red Lead to the VΩ socket, clip the other end of the red lead to the end of the resistor that is connected to the positive terminal of the power supply.
3. Draw a circuit diagram of this circuit below Data Table #2.
4. Set the knob on the DMM to the DCA scale to read a maximum of 20V.
5. **Do not turn *On* the power supply until the instructor has inspected your circuit.**
6. Turn *On* the power supply.
7. Record the voltage measured in Data Table #2. Turn the power supply *Off*.
8. Repeat steps #1 - #7 for the other resistors.

Name _____ Group #_____ Date _____
Partners _____

Resistor Color Codes



Color	1st Digit	2nd Digit	Multiplier	Tolerance
Black	0	0	x1	
Brown	1	1	x10	
Red	2	2	x100	± 2 %
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		
Gold				± 5 %
Silver				± 10 %
None				± 20 %

Name _____ Group #_____ Date _____
Partners _____

Lab Report

Calculations and Results:

PART 1: Resistance Measurement

Data Table #1: Resistance

	Coded Resistance	Tolerance Value	Measured Resistance	Within Tolerance (Y/N)
1				
2				
3				
4				

1. Compare the measured resistance with the coded resistance for each resistor and indicate if the resistor is within tolerance.

Circuit Diagram:

Name _____ Group #_____ Date _____
Partners _____

PART 2: Current and Voltage Measurement

Data Table #2: Current and Voltage

Resistance (Ω)	Current (amps)	Voltage (volts)	Voltage/Resistance (amps)	% Error

1. Enter the resistance measured in Part I for each resistor.
2. Calculate the current, this is given by the ratio of Voltage/Resistance.
3. Compare the calculated values of the current with the measured values of the current and calculate its percent error.
4. Draw a circuit diagram including the voltmeter and ammeter.