PE
3

Real Power and Kirchhoff's Voltage Law

A Practical Exercise Name:_____ Section: _____

I. Purpose.

1. Review the correct use of the DMM for measuring DC voltages and DC currents in DC series circuits.
2. Review the application of Ohm's Law in DC series circuits.
3. Review the use of color codes for determining the value of a fixed resistor.
4. Review the correct use of the DMM for measuring resistance.
5. Introduce the construction of a DC series circuit on a quad board from a circuit schematic diagram.
6. Introduce the application of Kirchhoff's Voltage Law in the analysis of a DC series circuit.
7. Review the calculation of calculate power supplied and dissipated in a DC series circuit.
8. Introduce the calculation of total resistance of multiple resistive elements connected in series.

II. Equipment.

Agilent 34401A Digital Multimeter (DMM)
Agilent E3620A Dual DC Power Supply
Quad Board and Test Leads
560-Ω resistor
220-Ω resistor

III. Preparation.

Review procedures from the *EE Studio Lab Quick Reference Guide* for measuring resistance, voltage, and current.

IV. Lab Procedure.

You must **read** and complete each step.

Step One: DC Series Circuit:

☐ On a QUAD board construct the DC series circuit in Figure 1.

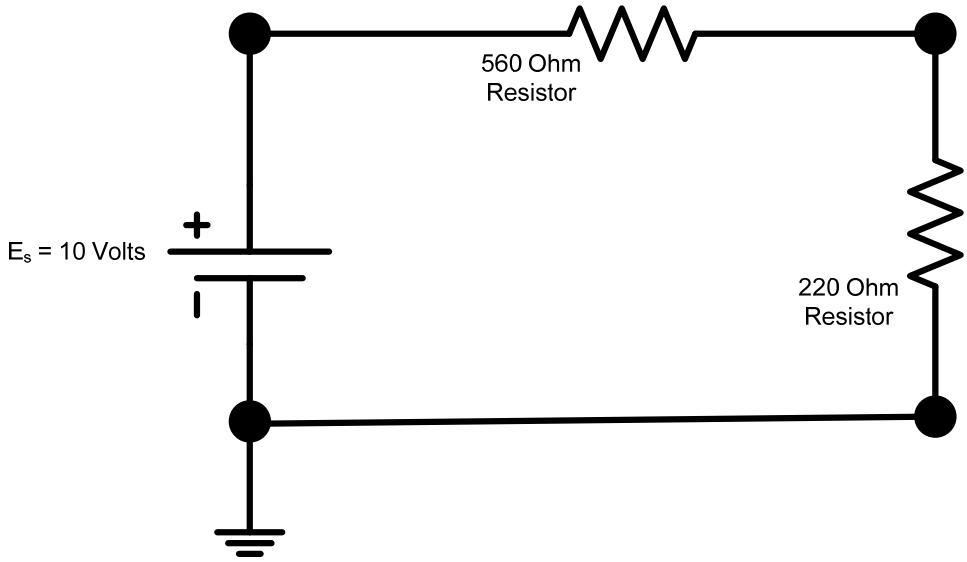

Figure 1

Step Two: Measure DC current.

For this part we will measure the DC current in two different places in the DC series circuit (Figure 1) that we constructed. Remember the current that you wish to measure must pass through the DMM. To measure this current, you will "open" the circuit and insert the DMM. You cannot measure current by placing the DMM "across" components in the circuit.

- ☐ Turn off the Dual DC Power Supply
- ☐ For the purpose of using the DMM to measure the DC current in the circuit, "open" the circuit between the "+" side of the Dual DC power supply and the 560-Ω resistor, and insert the DMM.
- ☐ Turn on the Dual DC Power Supply.
- ☐ Record the DC current on the table below.
- ☐ Turn off the Dual DC Power Supply.
- ☐ Remove the DMM from the circuit and reconnect the circuit on shown in figure 1.
- ☐ "Open" the circuit between the 560-Ω resistor and the 220-Ω resistor, and insert the DMM to measure the DC current.
- ☐ Turn on the Dual DC Power Supply.
- ☐ Record the DC current in the following table.

DC current between …	Measured Values
"+" side of DC power supply and 560-Ω resistor	
560-Ω resistor and 220-Ω resistor	

Are the measured DC current values the same? _____

Why? _____

_____

☐ Turn off the Dual DC Power Supply.

☐ Remove the DMM from the circuit and reconnect the circuit on shown in Figure 1.

Step Three: Conventional DC current direction and DC voltage polarity.

☐ Using your results from above, indicate on Figure 2 the direction of the conventional source current "I_s".

☐ Also on Figure 2, indicate the polarity of the voltages across the 560-Ω resistor and the 220-Ω resistor.

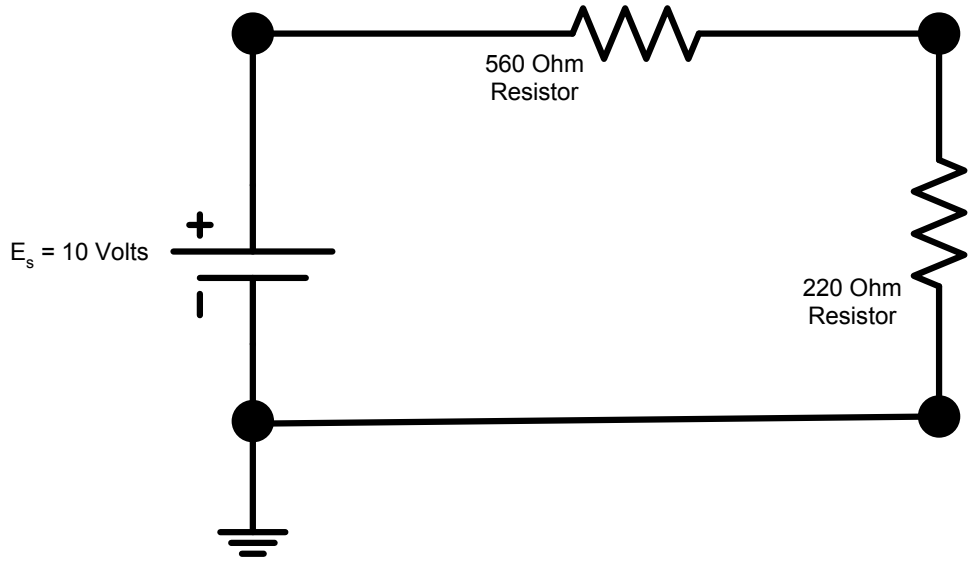

Figure 2

Step Four: Predict DC voltage values using Ohm's Law.

☐ Complete the following table using your measured DC current value, the measured values of the resistors, and Ohm's Law.

	Predicted DC Voltages across…
560-Ω resistor	
220-Ω resistor	

Step Five: Measure DC voltages.

For this part we will measure the DC voltages across the 560 Ω resistor and the 220 Ω resistor. We will also measure the resistance of each resistor. Ensure that your circuit has a complete "closed" loop to travel as shown in Figure 1, and remember to measure voltage we must place the DMM leads across the component(s) whose voltage we wish to measure.

- ☐ Turn off the Dual DC Power Supply.
- ☐ Set the DMM to measure DC voltage and place the DMM across the 560-Ω resistor.
- ☐ Turn on the Dual DC Power Supply.
- ☐ Record the measured value on the table below.
- ☐ Repeat the previous steps for the 220-Ω resistor.
- ☐ Remove/isolate the 560-Ω resistor from the circuit.
- ☐ Measure the resistance of the 560-Ω resistor.
- ☐ Place the 560-Ω resistor back in the circuit and record the measured value in the table below.
- ☐ Repeat the previous three steps for the 220-Ω resistor.

	Measured DC Voltages across each resistor	**Measured Resistance**
560-Ω resistor		
220-Ω resistor		

Are your measured DC voltage values the same as your predicted DC voltage values? _____

What are possible causes for the differences between the measured and predicted values?

_____

_____

Step Six: Verify Kirchhoff's Voltage Law.

☐ On Figure 3, label the DC voltage polarities and the measured DC voltage values of the DC voltage source, the 560-Ω resistor and the 220-Ω resistor.

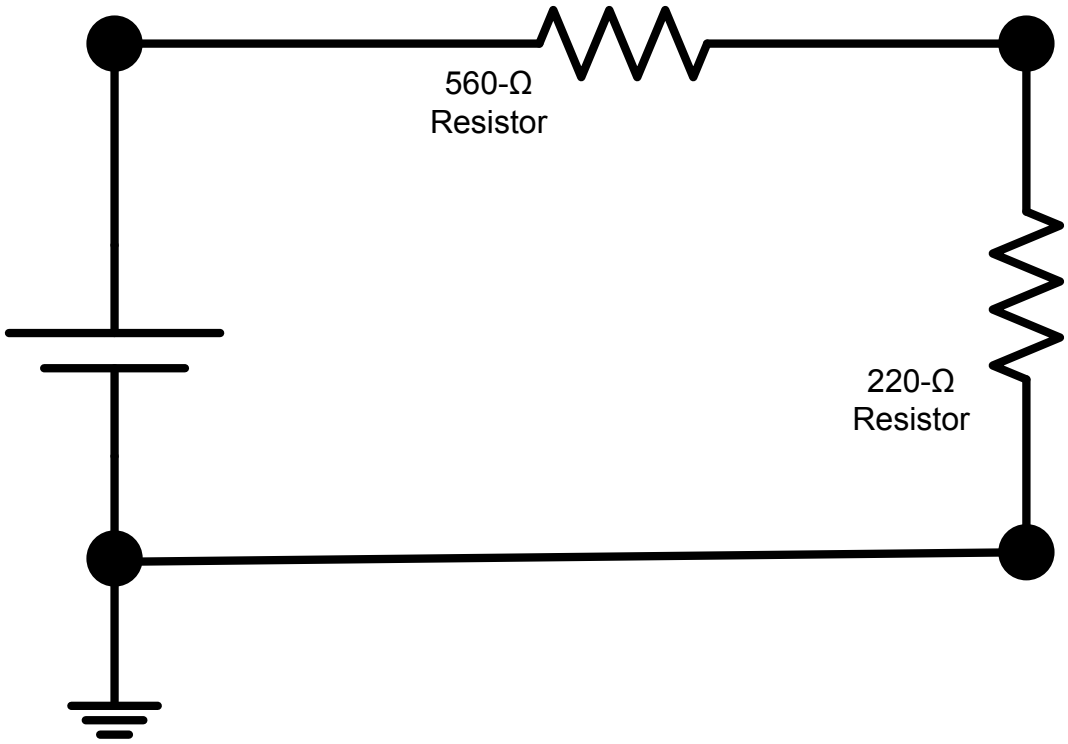

Figure 3

☐ Verify Kirchhoff's Voltage Law in this closed loop DC series circuit.

$$\Sigma\ E_{gains} = \Sigma\ V_{drops}$$

$$\Sigma\ \_\_\_\_\_ = \Sigma \_\_\_\_\_$$

Is the sum of your DC voltaig gains equal to the sum of your DC voltage drops? _____

What are possible causes for the differences?

_____

_____

Step Seven: Compute the real power (**P = I V, P = I^2 R,** and **P = V^2 / R**).

☐ Using your measured current and voltage values and indicated resistor values, compute the power supplied by the DC power source and the power dissipated by the 560-Ω and the 220-Ω resistors.

	Power (watts)
DC Power Supply	
560-Ω resistor	
220-Ω resistor	

Does the total power supplied equal the total power dissipated by the resistors? _____

If yes, what is the efficiency of this circuit? If no, what is the power lost?

_____

_____