ECET102/CPET101 Electrical Circuits
Lab 5 Series Resistor Lab
By
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Required Devices & Equipment:

Resistors: 330Ω, 1kΩ, 3.3kΩ, 1MΩ, and a 10kΩ Potentiometer
Power Supply
Digital Multimeter (DMM)

Note that beginning with this lab each lab team must have the following to construct the circuits: Circuit Board/Breadboard with wire, wire strippers and cutters, and small needle-nose pliers and a scientific/engineering calculator.

Objectives:

1. Apply principals to series resistor measurements
2. Apply a simple equivalent circuit using a potentiometer (variable resistor)
3. Verify Kirchoff's Voltage Law
4. Calculate and measure the effect of a very large and a small resistor in series.
5. Calculate and measure the effect of an open circuit

General Information:

Resistors in series add and can be considered as a single equivalent resistor. Figure 1a shows three 1kΩ resistors in series. If you measure the resistance between points A and B in Figure 1a, you will get 3kΩ. So these three resistors can be considered as if they were a single equivalent resistor of value 3kΩ as shown in Figure 1b. All current and voltage measurements will be the same for the equivalent resistor as for the 3 real resistors.

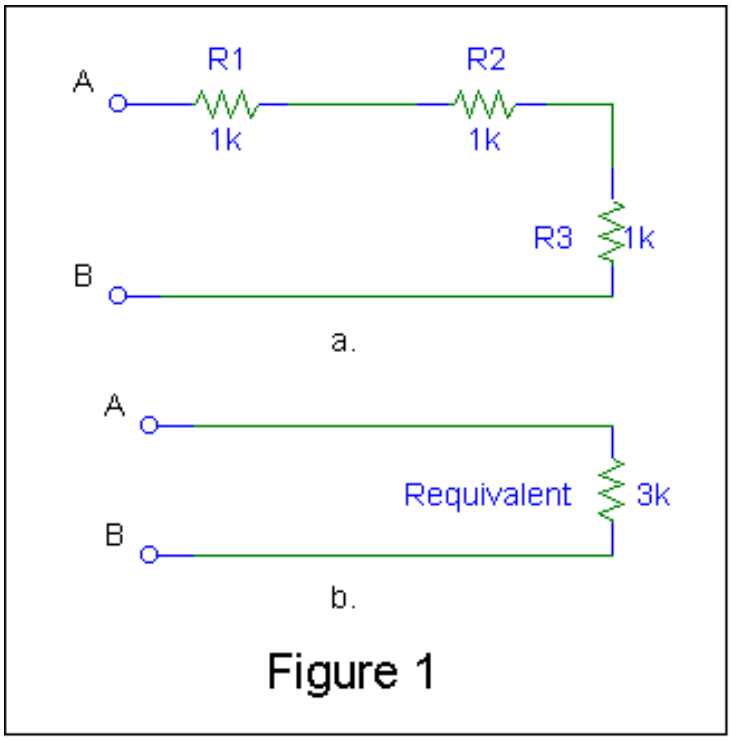

Figure 1

There are normally 3 connections on a potentiometer (variable resistor). The resistance between the two end connections is the entire resistance of the potentiometer. The resistance between one end connector and the center connector can be varied by turning the knob (or other rotary device) on the potentiometer.

A simple form of Kirchoff's voltage law (KVL) for a series circuit states that the battery voltage (if there is only one battery in a circuit) equals the sum of the voltages across all of the resistors.

$$V_{Battery} = V_{R1} + V_{R2} + V_{R3} + \text{etc.}$$

Procedure:

Part 1: An equivalent circuit.

a. Use the DMM to measure the resistance of the 3 resistors, whose nominal values are shown below (and in Figure 2a) and write the values below:

R_{330} = _____

R_{1k} = _____

$R_{3.3k}$ = _____

b. Connect these 3 resistors in series to a 10-volt power supply as shown in Figure 2a. Measure the voltage of the power supply with the DMM and write the value below:

V_1 = _____

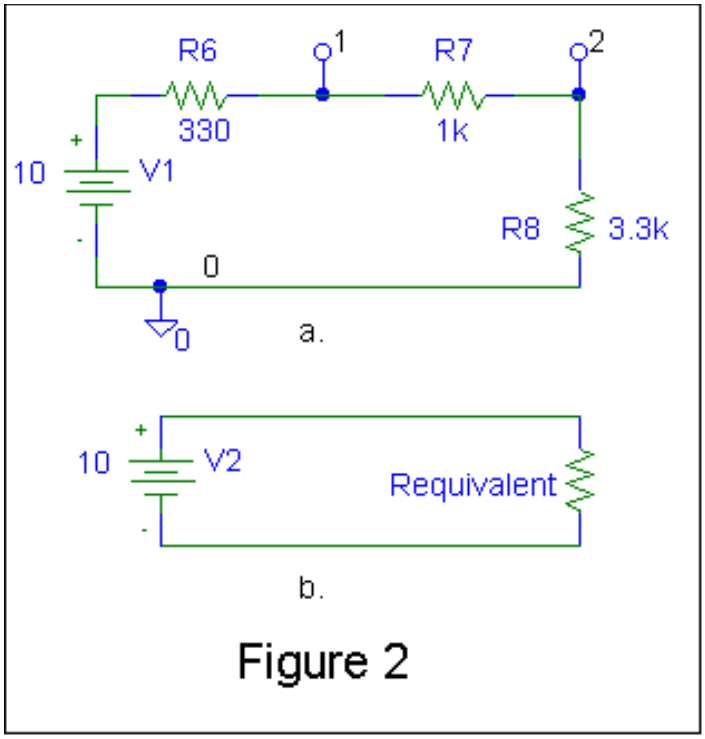

Figure 2

c. Calculate and measure the voltages from Node 1 to node 0 (ground/common) and from Node 1 to node 2 and write the values below. Calculate and measure the current in the circuit of Figure 2a using the DMM and write the values below. Explain differences.

Calculated: V_{10} = _____ V_{12} = _____ $I_{circuit}$ = _____

Measured: V_{10} = _____ V_{12} = _____ $I_{circuit}$ = _____

d. Add the actual, measured value of the 3 resistors and write the value below.

R_{Total} = _____ = $R_{Equivalent}$

e. Set the resistance of a 10kΩ potentiometer (between one end connection and the center connection) to the value of R_{Total} shown above. Then, build the circuit of Figure 2a, using the potentiometer as the resistor. Measure the current in the circuit and write the value below:

$I_{circuit}$ = _____

f. Should the values of the current measured in part 1c and in part 1e be the same?

g. Explain any difference between part 1c and part 1e.

h. Measure the voltage across each resistor and write the values below:

V_{330} = _____ V_{1k} = _____ $V_{3.3k}$ = _____

Explain how this verifies Kirchoff's Voltage Law (KVL).

_____

Part 2: Large resistances and Open Circuits

a. Construct the circuit shown in Figure 3a. Calculate and measure the voltage across the 1 MegΩ resistor (the voltage from node 1 in the figure to ground/common and write the values below:

Calculated:

V_{1Meg} = _____

Measured:

V_{1Meg} = _____

b. Calculate and measure the current in the circuit of Figure 3a and write the values below:

Calculated:

I = _____

Measured:

I = _____

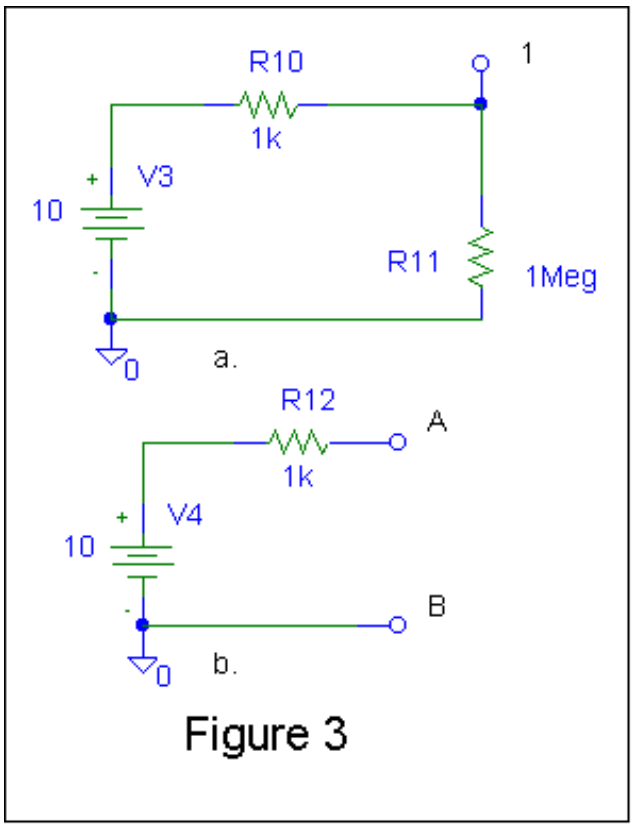

Figure 3

c. Take the 1 MegΩ resistor out of the circuit so that there is an OPEN CIRCUIT between points A and B in Figure 3b. Calculate and measure the voltage between points A and B and write the values below:

Calculated:

V_{AB} = _____

Measured:

V_{AB} = _____

d. What is the current in the circuit of Figure 3b? Explain

e. An open circuit is equivalent to a VERY large resistance (in the electrical field we say infinite (∞) resistance). Calculate the voltage at node 1 in Figure 3a and the current in the circuit if the 1MΩ resistor is replaced with a 10MΩ resistor and write the values below.

V_{10Meg} = _____

I_{10Meg} = _____

How close is this to an open circuit?

Part 3: Problems

a. Find the value of the unknown resistance in Figure 4a and write the value below:

R = _____

b. Find the value of the voltage in Figure 4b and write the value below:

V = _____

c. Find the value of the current in Figure 4c and write the value below:

I = _____

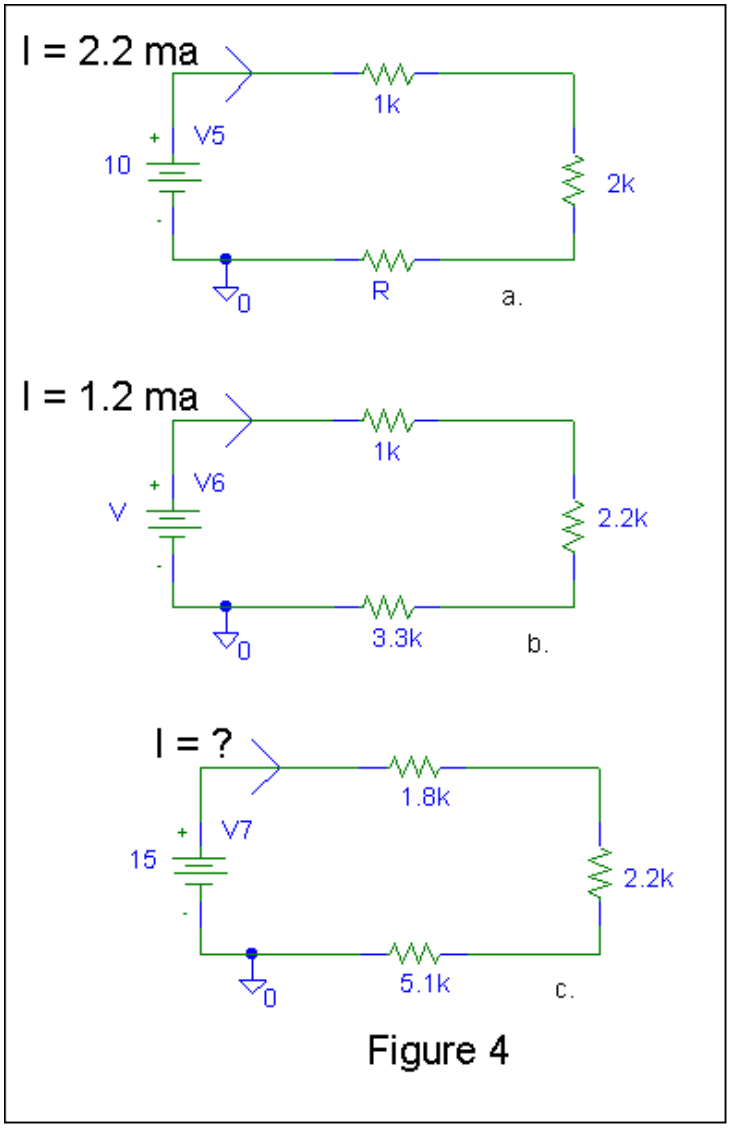

Figure 4