Proportionality and Superposition

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Purpose:

Verify the Proportionality and Superposition theorems.

Equipment Required:

- 1 - Agilent 34401A Digital Multimeter
- 1 - Agilent E3631A Power Supply
- 1 - Protoboard
- 1 - 4.7 kΩ 1/4W Resistor
- 4 - 10 kΩ 1/4W Resistors
- 1 - 27 kΩ 1/4W Resistor

Prelab:

Read sects. 3-1 and 3-2 in the text.* In this exercise proportionality and superposition are examined by applying them to circuits built in the lab.

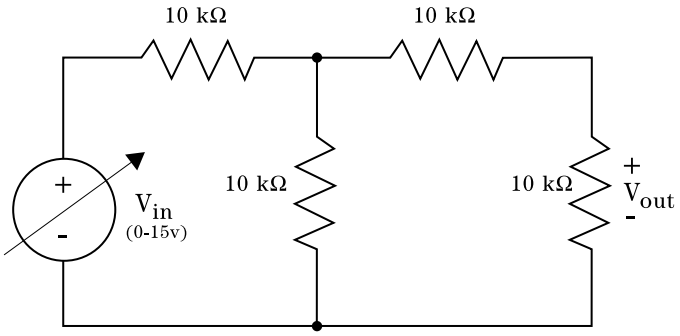

Figure 1

1. Proportionality

For the circuit of Fig. 1, compute the proportionality constant K that relates the input voltage to the output voltage, ($V_{out} = KV_{in}$). Use a CCA program to generate a plot of the response (V_{out}) of this circuit for a V_{in} sweep from 0 to 15 V. Tape the printed CCA results into your journal.

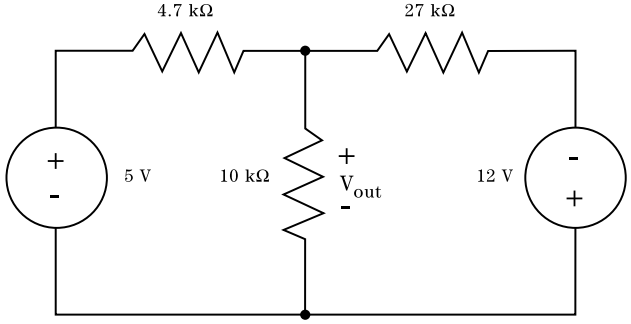

Figure 2

2. Superposition

Use superposition to analyze the circuit of Fig. 2. Compute and record the voltages V_{5V} and V_{12V} as shown in Figs. 3 and 4. Then compute V_{out} across the 10-kΩ resistor for the complete circuit of Fig 2.

Procedure:

1. Verify the proportionality theorem

a. In your journal, prepare a table with three columns, the first labeled V_{in}, the second V_{out}, and the third will be the calculated scalar K. Construct the circuit of Fig. 1.

b. At four different input voltages of your choice, accurately measure V_{in} and V_{out}. For each point, calculate and record K.

c. On the CCA plot produced in the Prelab, plot these four actual points on the graph and connect them with a best-fit line.

2. Verify the superposition theorem

a. Construct the circuit of Fig. 3. Measure the voltage across the 10-kΩ resistor. Be sure to turn the power off whenever you move wires in the circuit. Record these values.

b. Construct the circuit of Fig. 4. Measure the voltage across the 10-kΩ resistor. Record these values.

c. Now construct the circuit of Fig. 2. Measure the voltage across the 10-kΩ resistor. Record these values.

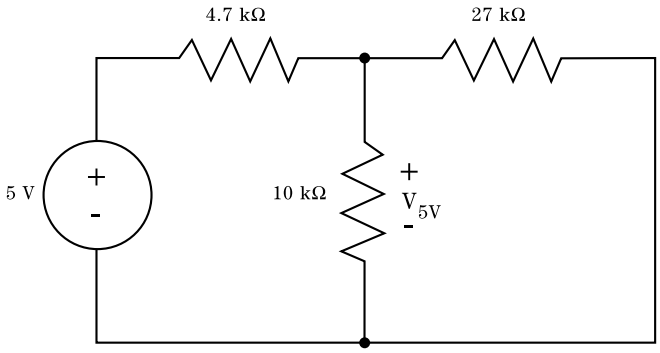

Figure 3

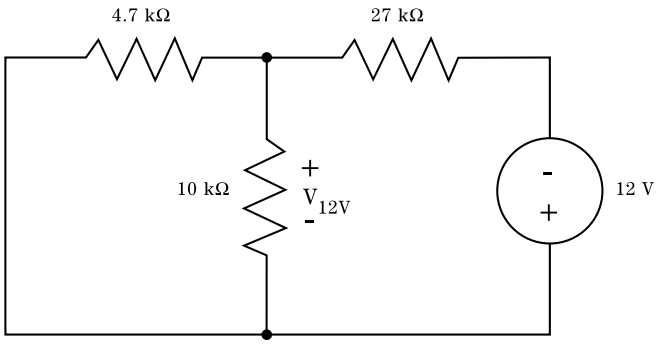

Figure 4

Conclusion

For the circuit of Fig. 1, how did the measurements made in the lab compare with the predicted output calculated using proportionality? Explain any differences.

For each of the three circuits you built for the superposition portion of this exercise, how well did the calculated and measured outputs compare? Explain any differences.

* Roland E. Thomas and Albert J. Rosa, The Analysis and Design of Linear Circuits, Prentice Hall, (New Jersey, 1994)