

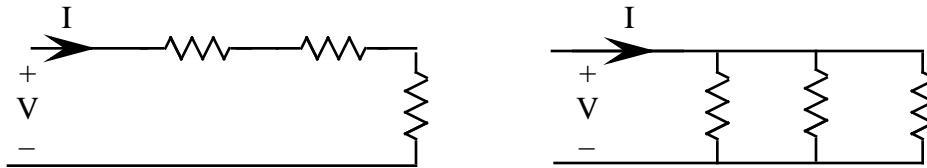
ECE 109 - SERIES AND PARALLEL - INVESTIGATION 13 VOLTAGE AND CURRENT GAINS

SUMMER 2007

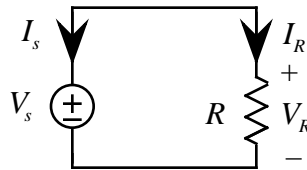
A.P. FELZER

To do "well" on this investigation you must not only get the right answers but must also do neat, complete and concise writeups that make obvious what each problem is, how you're solving the problem and what your answer is. You also need to include drawings of all circuits as well as appropriate graphs and tables.

In the Investigation on equivalent resistance we showed that V is proportional to I in series and parallel circuits like the following



The objective of this Investigation is to generalize on these results and show that all voltages and currents in series and parallel circuits are proportional to the source just like in the following single resistor circuit

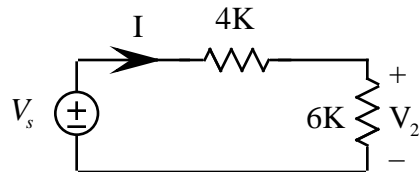


in which all voltages and currents are proportional to V_s as follows

$$V_R = V_s \quad I_R = \frac{1}{R} V_s \quad I_s = -I_R = -\frac{1}{R} V_s$$

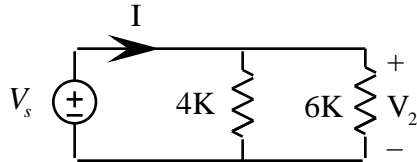
Be sure to take a look at the **Computer Demos** on Series and Parallel Resistor Circuits.

1. For the following series circuit



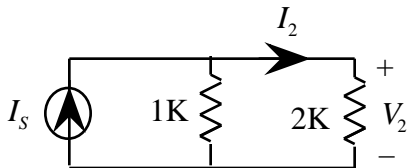
- a. Find and sketch I as a function of V_s
- b. Find and sketch V_2 as a function of V_s
- c. Describe your two graphs

2. For the following parallel circuit

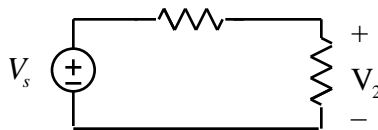


- Find and sketch I as a function of V_s
- Find and sketch V_2 as a function of V_s
- Describe your two graphs

3. Now for a parallel circuit with a current source as follows



- Find and sketch I_2 as a function of I_s
 - Find and sketch V_2 as a function of I_s
 - Describe your two graphs
4. The first three problems illustrated the fact that voltages and currents in resistor circuits are proportional to the source. We now illustrate how this observation can be useful. Suppose that $V_2 = 0.4V_s$ in the following circuit

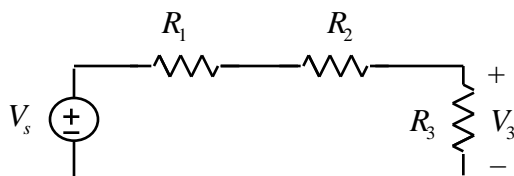


Then

$$G = 0.4 = \frac{V_2}{V_s}$$

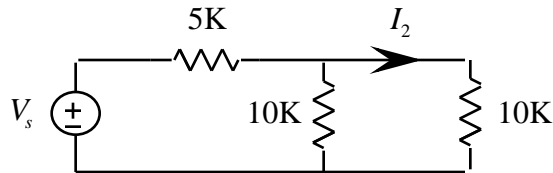
is defined to be the **gain G** of the circuit. **Memorize** the definition of gain. Then find V_2 when

- $V_s = 2$ volts
 - $V_s = 4$ volts
 - $V_s = -4$ volts
5. When are gains useful
6. Given the following series circuit

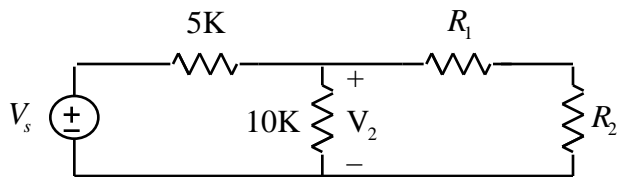


- a. Show that $G_3 = \frac{V_3}{V_s} < 1$
- b. Generalize on your result in part (a)

7. Find $G = \frac{I_2}{V_s}$ in the following circuit. Hint - make use of equivalent circuits

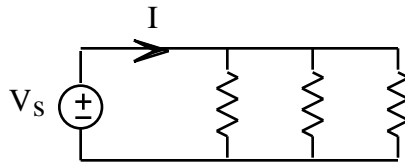


8. Find the gain $G = \frac{V_2}{V_s}$ in the following circuit



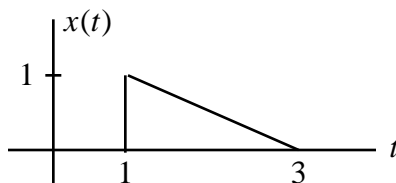
if the equivalent resistance of R_1 and R_2 is $R_{EQ} = 10K$. Be sure to draw the equivalent circuit

9. What will happen to the current I flowing through the voltage source in the following circuit as more parallel resistors are added. Justify



10. Given two resistors R_1 and R_2 with $R_1 > R_2$
 - a. Which resistor will have the larger power when they're in parallel. Justify
 - b. Which resistor will have the larger power when they're in series. Justify

11. Math Review: Given $x(t)$ as follows



- a. Sketch $y_1(t) = x(t+1)$
- b. Sketch $y_2(t) = x(t-1)$