

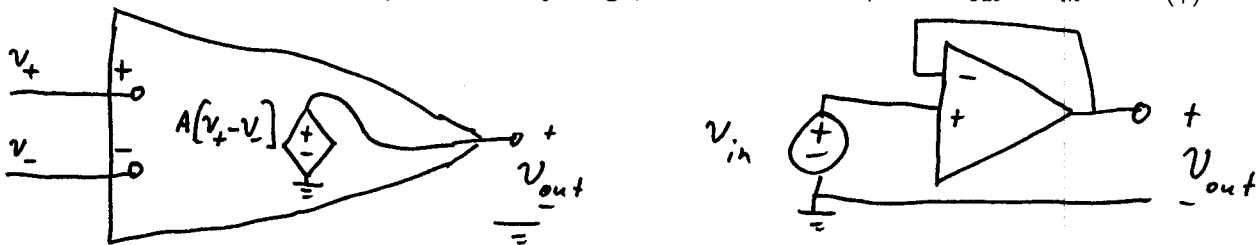
ELEC 105: Op Amp Problems for Homework #5

Date Assigned: Monday, February 23, 2004

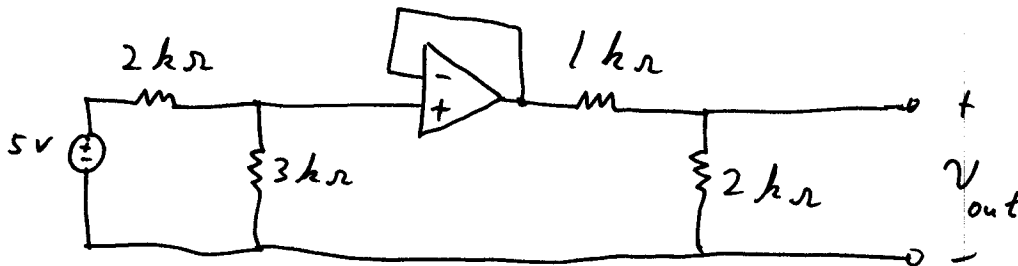
Date Due: Friday, February 27, 2004

Problems: Please work on the following problems.

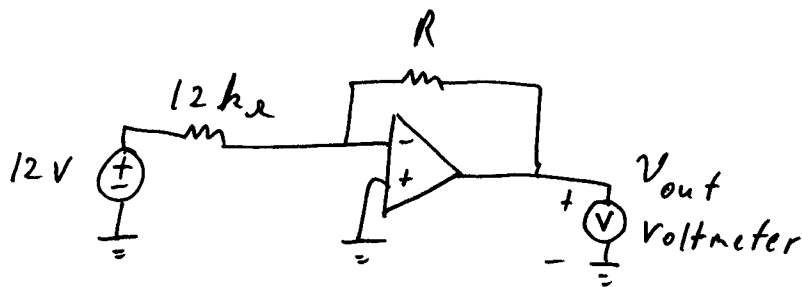
- Using the op amp model $v_{out} = A[v_{(+)} - v_{(-)}]$ shown below, show that the "buffer" operates according to $v_{out} = \frac{A}{1+A}v_{in}$. Note that the buffer is connected so that $v_{(-)} = v_{out}$. Briefly explain why if A is very large, such as $A = 10^5$, then $v_{out} \approx v_{in}$ and $v_{(+)} \approx v_{(-)}$.



- Find v_{out} in the circuit below. (Hint: Look for voltage dividers and the buffer circuit!)



- Design an op amp circuit such that the output voltage is one-fourth the input voltage, i.e. $v_{out} = 0.25v_{in}$. Hint: You may need more than one op amp.
- Consider the electronic ohmmeter shown on the back of this page. To use the ohmmeter, an unknown resistance R is connected as shown, and then the value of R is obtained by measuring the voltage v_{out} and then computing $R = -1000 \times v_{out}$.



- Since v_{out} is always within the range -10 volts to +10 volts, what is the maximum value of R that can be measured with this circuit?
- How can the circuit be modified in order to measure resistance values up to 100 k Ω ? Explain the reasoning behind your modification, and explain how the value of R is computed from v_{out} in your circuit.

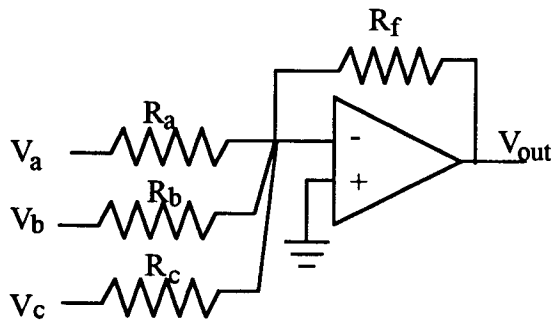
5. Please do the following problem.

Puzzle 6.4.3: Assume that you need to measure an average temperature in a heated space. You have three identical temperature sensors. Each sensor produces a voltage proportional to temperature such that:

$$\text{Sensor Voltage} = .01 * \text{Temperature in degrees Celsius}$$

Assume that you have three voltages, V_a , V_b , and V_c . You want to take the average of these three voltages in order to compute the average temperature inside the heated space.

This circuit has been suggested as a possibility for computing the average.



- Find an analytical expression for V_{out} in terms of the input voltages and the four resistors.
- Determine if a proper choice of resistors will let you use this as an averager. If you can, then find some appropriate values for the resistors.

Puzzle 6.4.4: Design a circuit that will produce a signal that is the difference of two signals. You may need more than one operational amplifier.