MASSACHVSETTS INSTITVTE OF TECHNOLOGY
Department of Electrical Engineering and Computer Science

6.002 – Electronic Circuits
Fall 2001

Problem Set 10

Issued: November 8, 2001 Due: November 16, 2001

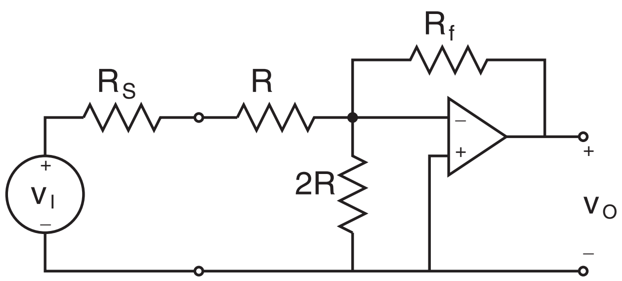
Readings:

- Agarwal & Lang Sections 16.2 to 16.5.
- Agarwal & Lang Example 107, Chapter 8 for Thursday, November 15.

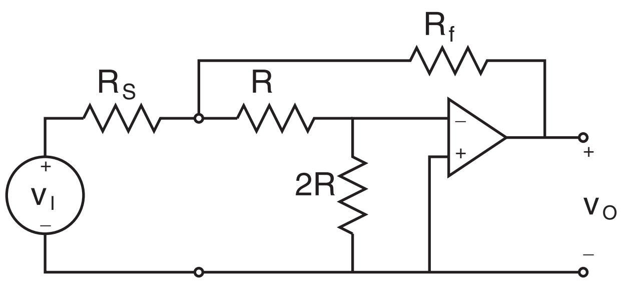
Problems:

NOTE: In all problems, consider the op-amp gain to be infinite.

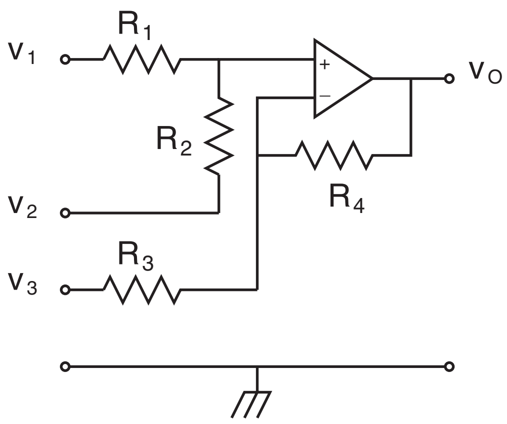
1. (a) Find the expected gain v_O/v_I for the circuit shown below.



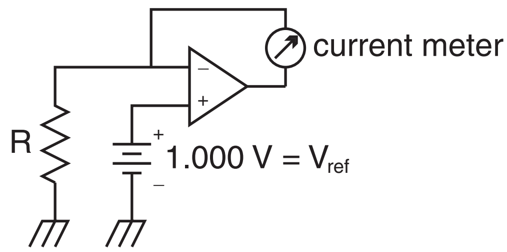
(b) A mistake was made in the construction of the circuit in part (a) and the feedback resistor R_f was wired to the wrong point as shown below. What is the gain of this incorrectly wired circuit? Compare this gain with that of the intended design of part (a).



2. Express the value of the output voltage v_O in terms of the three input voltages v_1, v_2 and v_3, and the resistors R_1, R_2, R_3 and R_4, for the circuit shown below.

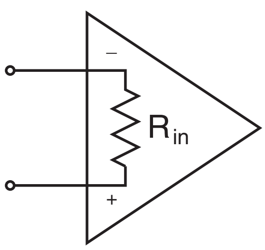


3. The circuit shown below is proposed to measure the resistance value of a resistor R. A reference voltage source of $1.000V$ is included. However, the voltage source requires that essentially no current be drawn from it to maintain its accurate value; namely, $1.000V$ is the open circuit value. A current measurement meter is placed in the feedback loop of the op-amp.

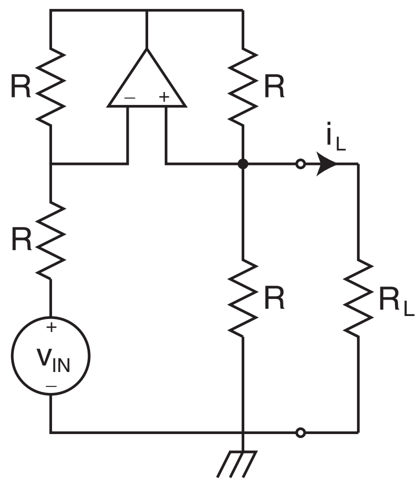


(a) Assuming the op-amp is ideal, how is the current in the meter related to the resistance R?

(b) Assume the op-amp is non-ideal and has an effective large input resistance R_{in} as shown below. How is the meter current now related to R and V_{ref}? How much current is drawn from V_{ref} assuming the voltage remains at $1.000V$?



4. Refer to the circuit shown below.



(a) Assume the op-amp is operating in its active region. Write an expression for the load current, i_L, in terms of v_{IN}, where R and R_L are resistances.

(b) Under what conditions of v_{IN} is the op-amp no longer in the active region? Assume there is no power limit at the op-amp output and $\pm V_S = \pm 15V$.