EE 40

Homework #5

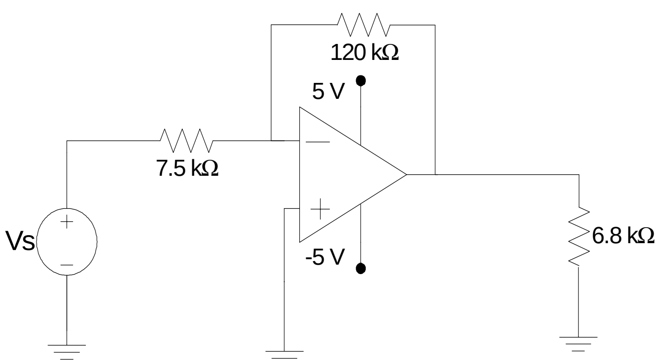
Due October 18, 2002

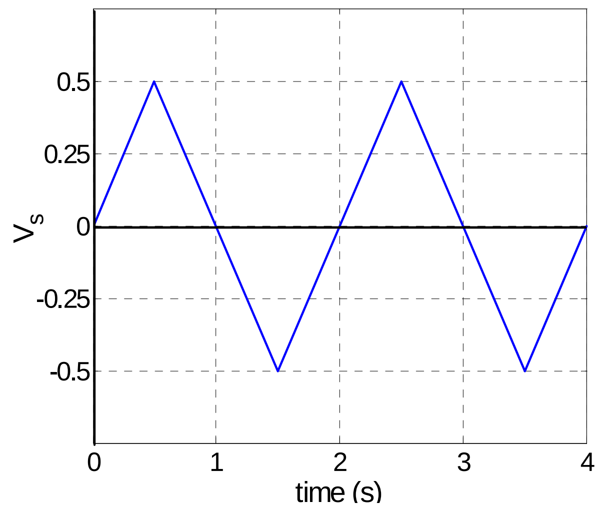
Nearly all problems taken from *Electric Circuits* by Nilsson and Riedel

Notation: The extra connections coming out of the amplifier indicate the "rails".

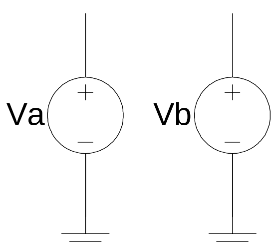
Problem 1:

For the time-varying input voltage V_S and ideal operational amplifier circuit below, sketch V_O as a function of time.





Problem 2:



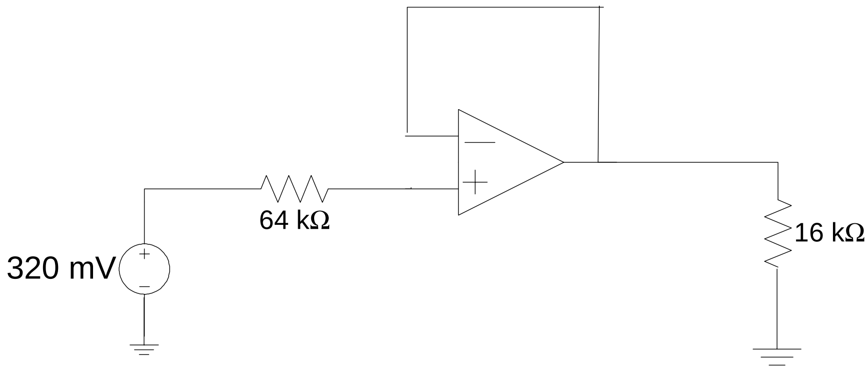
Given two input voltages Va and Vb, which cannot be detached from ground, design an ideal operational amplifier circuit which has the average of Va and Vb as its output voltage. Assume that the amplifier will always be operating in its linear region (i.e., ignore the rail voltages).

Problem 3:

Assume that the ideal operational amplifier on the next page is operating in its linear region (i.e., ignore the rail voltages).

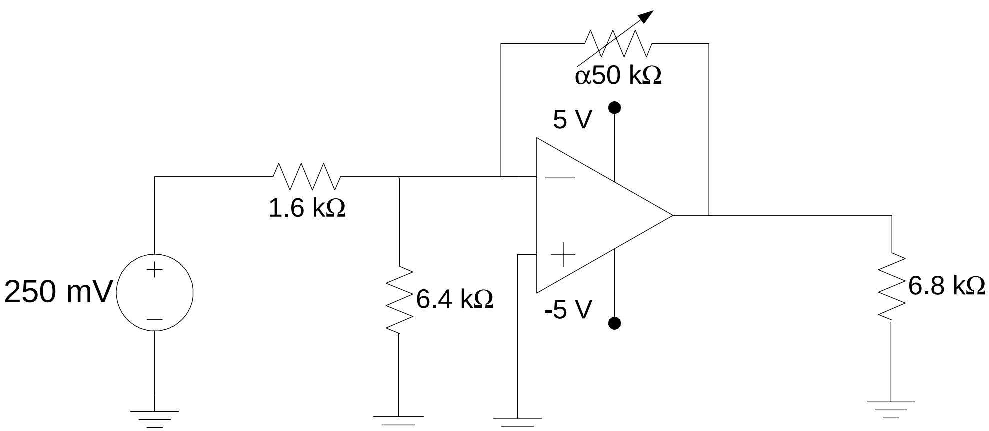
a) Calculate the power delivered to the 16 kΩ resistor.
b) Repeat part a) with the amplifier removed from the circuit; that is, with the 16 kΩ resistor connected in series with the voltage source and the 64 kΩ resistor.
c) Find the ratio of the power found in part (a) to that found in part (b).

Problem 3 continued:

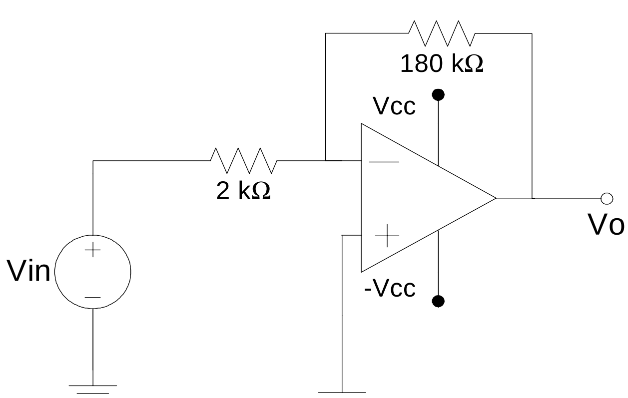


Problem 4:

Consider the operational amplifier circuit below, with the variable (max 50 kΩ) resistor in the feedback path. Will the amplifier operate in its linear region for all α between 0 and 1? If not, for what range of α does the amplifier operate linearly (i.e., not hit the rails)?



Problem 5:



The inverting amplifier in the circuit at left has an input resistance R_i of 500 kΩ, an output resistance R_o of 5 kΩ, and an open loop gain A of 250,000. Assume that the amplifier is operating in its linear region (i.e., ignore the rails).

a) Calculate the voltage gain V_o/V_{in}.
b) Repeat part a) using the ideal op-amp model.