Homework #11

Operational Amplifiers – *100 points*

DUE @ Beginning of Class: Tuesday, December 5

1) E-Book, problem 9.2 (12 points)

2) E-Book, problem 9.6 (10 points)

3) E-Book, problem 9.7 (14 points)

4) E-Book, problem 9.19 (14 points)

5) E-Book, problem 9.25 (20 points)

6) E-Book, problem D9.35 (10 points)

7) E-Book, problem D9.60 (20 points)

1) E-Book, problem 9.2 (12 points)

9.2 The op-amp in the circuit shown in Figure P9.2 is ideal except it has a finite open-loop gain. (a) If $A_{od} = 10^4$ and $v_O = -2\,\text{V}$, determine v_I. (b) If $v_I = 2\,\text{V}$ and $v_O = 1\,\text{V}$, determine A_{od}.

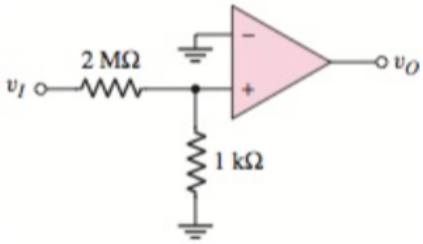


Figure P9.2

2) E-Book, problem 9.6 (10 points)

9.6 Assume the op-amps in Figure P9.6 are ideal. Find the voltage gain $A_v = v_O/v_I$ and the input resistance R_i of each circuit.

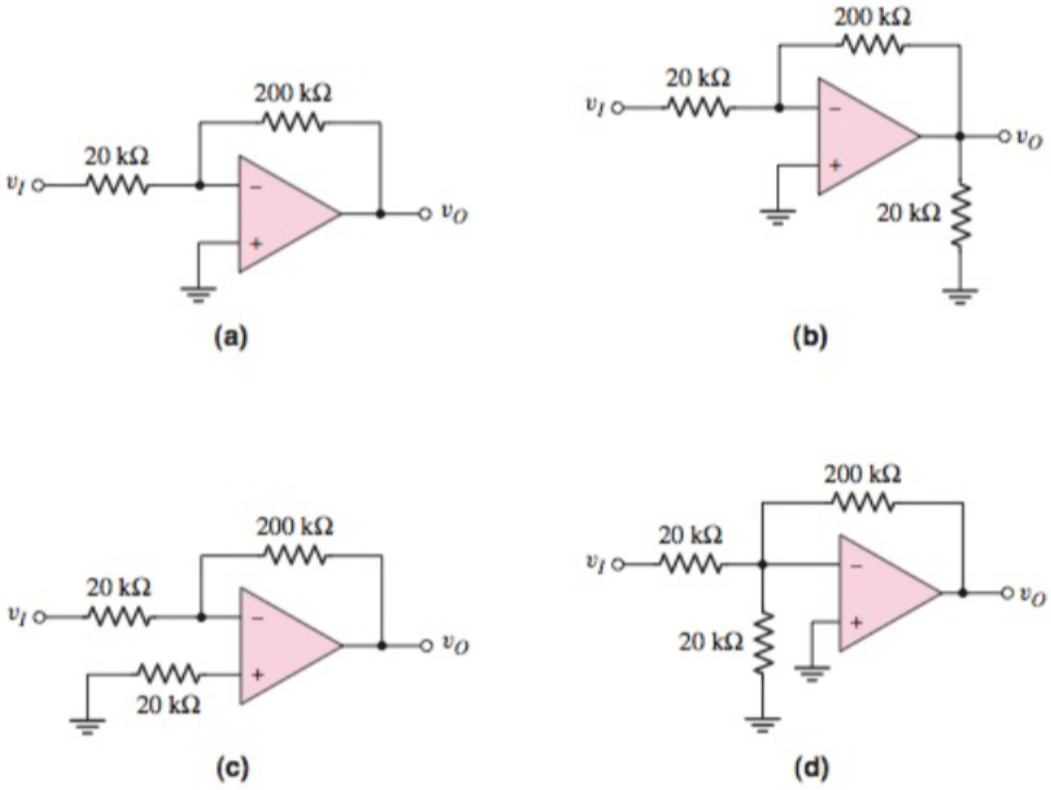


Figure P9.6

3) E-Book, problem 9.7 (14 points)

9.7 Consider an ideal inverting op-amp with $R_2 = 100\,\text{k}\Omega$ and $R_1 = 10\,\text{k}\Omega$. (a) Determine the ideal voltage gain and input resistance R_i. (b) Repeat part (a) for a second $100\,\text{k}\Omega$ resistor connected in parallel with R_2. (c) Repeat part (a) for a second $10\,\text{k}\Omega$ resistance connected in series with R_1.

4) E-Book, problem 9.19 (14 points)

9.19 Consider the circuit shown in Figure P9.19. (a) Determine the ideal output voltage v_O if $v_I = -0.40$ V. (b) Determine the actual output voltage if the open-loop gain of the op-amp is $A_{od} = 5 \times 10^3$. (c) Determine the required value of A_{od} in order that the actual voltage gain be within 0.2 percent of the ideal value.

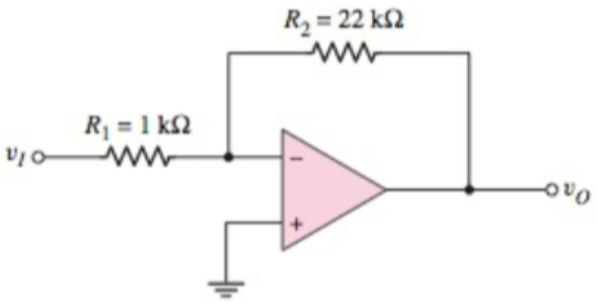


Figure P9.19

5) E-Book, problem 9.25 (20 points)

9.25 For the op-amp circuit shown in Figure P9.25, determine the gain $A_v = v_O/v_I$. Compare this result to the gain of the circuit shown in Figure 9.12, assuming all resistor values are equal.

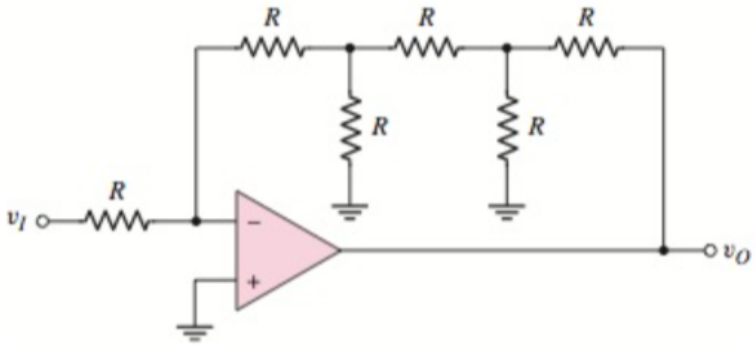


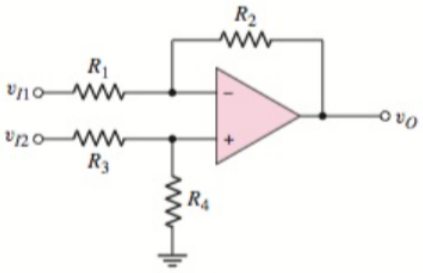
Figure P9.25

6) E-Book, problem D9.35 (10 points)

D9.35 (a) Design an ideal summing op-amp circuit to provide an output voltage of $v_O = -2\,[(v_{I1}/4) + 2v_{I2} + v_{I3}]$. The largest resistor value is to be 250 kΩ. (b) Using the results of part (a), determine the range in output voltage and the maximum current in R_F if the input voltages are in the ranges $-2 \le v_{I1} \le +2$ V, $0 \le v_{I2} \le 0.5$ V, and $-1 \le v_{I3} \le 0$ V.

7) E-Book, problem D9.60 (20 points)

D9.60 Consider the op-amp difference amplifier in Figure 9.24(a). Let $R_1 = R_3$ and $R_2 = R_4$. A load resistor $R_L = 10\,\text{k}\Omega$ is connected from the output terminal to ground. (a) Design the circuit such that the difference voltage gain is $A_d = 15$ and the minimum difference input resistance is 30 kΩ. (b) If the load current is $i_L = 0.25\,\text{mA}$, what is the differential input voltage $(v_{I2} - v_{I1})$? (c) If $v_{I1} = 1.5\,\text{V}$ and $v_{I2} = 1.2\,\text{V}$, determine i_L. (d) If $i_L = 0.5\,\text{mA}$ when $v_{I2} = 2.0\,\text{V}$, determine v_{I1}.



(a)