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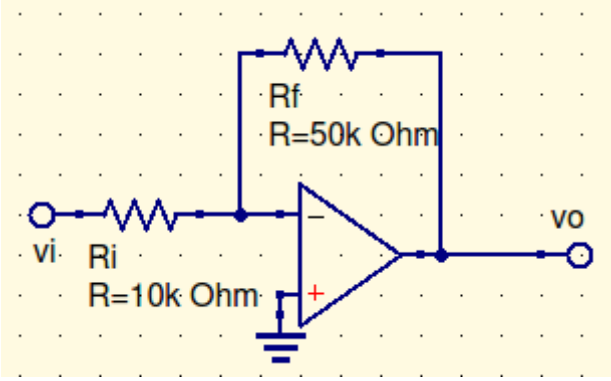
Homework 1: Due 1/20/2020

Chapter 2

1. Consider the circuit of Figure P2-1 with $R_i = 10k\Omega$ and $R_f = 50k\Omega$



1. Determine the closed-loop voltage gain.

$$A_{CL} = \frac{V_o}{V_i} = \frac{R_f}{R_i} = -5 \tag{1}$$

2. Determine the input impedance of the circuit.

$$r_i = R_i = 10k\Omega \tag{2}$$

3. Determine the ideal output impedance of the circuit.

$$r_o = 0\Omega \tag{3}$$

4. Determine the peak input voltage v_i (peak) for which linear operation is possible.

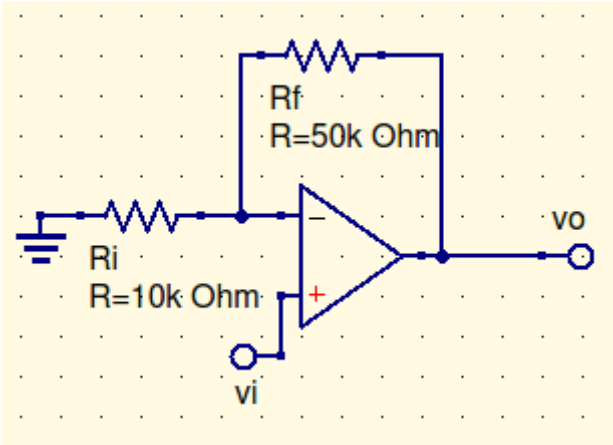
$$V_{ipk} = \frac{V_{sat}}{|A_{CL}|} = (\frac{13}{5}) or (2\frac{3}{5}) \tag{4}$$

5. Determine the output voltage for each of the following values for the following input voltages.

$$V_o = A_{CL} v_i \tag{5}$$

v_i **(V)**	v_o **(V)**
0	0
-1	5
2	-10
-3	15
4	-20

3. Consider the circuit of Figure P2-3 with $R_i = 10k\Omega$ and $R_f = 50k\Omega$



1. Determine the closed-loop voltage gain.

$$A_{CL} = \frac{V_o}{V_i} = \frac{R_f + R_i}{R_i} = \frac{6}{5} \tag{6}$$

2. Determine the input impedance of the circuit.

$$r_i = R_i = 10k\Omega \tag{7}$$

3. Determine the ideal output impedance of the circuit.

$$r_o = 0\Omega \tag{8}$$

4. Determine the peak input voltage v_i (peak) for which linear operation is possible.

$$V_{ipk} = \frac{V_{sat}}{|A_{CL}|} = (\frac{13(5)}{6}) or (10\frac{5}{6}) \tag{9}$$

5. Determine the output voltage for each of the following values for the following input voltages.

$$V_o = A_{CL} v_i \tag{10}$$

v_i **(V)**	v_o **(V)**
0	0
-1	$\frac{-6}{5}$
2	$\frac{12}{5}$
-3	$\frac{-18}{5}$
4	$\frac{24}{5}$

5. For the circuit of Problem 2-1 with $v_i = -2V$, assume an external load of $R_L = 2k\Omega$ is connected to the output. Determine the total op-amp output current.

$$\begin{aligned} ACL &= -10 \\ v_i &= 2V \\ v_0 &= -20V \\ \frac{V}{R} &= I \\ \frac{20V}{2k\Omega} &= I = \frac{1}{100} A = 10mA \end{aligned} \tag{11}$$