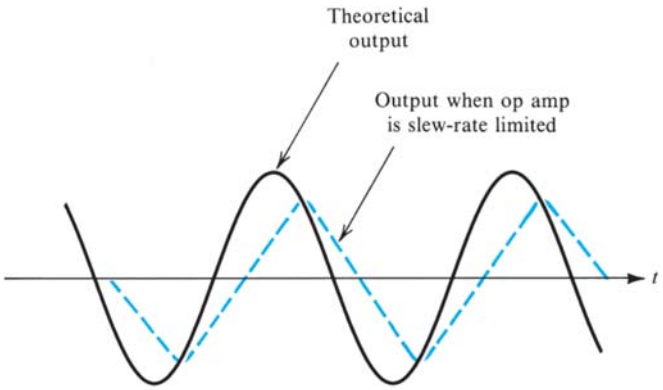
Full-Power Bandwidth and Effect of Slew-Rate limiting on output sinusoidal waveforms:

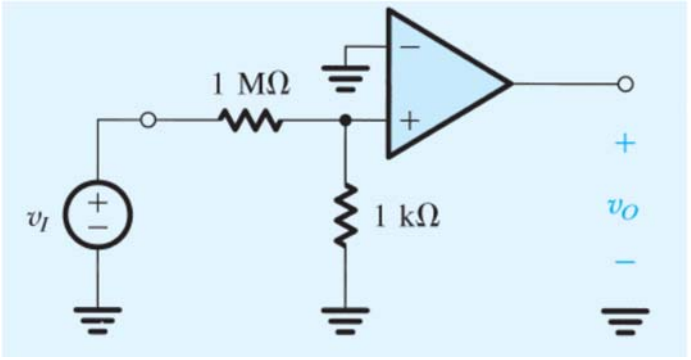
Op-amp slew-rate limiting can cause nonlinear distortion in sinusoidal waveforms. Consider once more the unity-gain follower with a sine-wave input given by:



Zero crossing detector (ZCD) is a voltage comparator that switches the output between +Vsat and –Vsat (Vsat: Saturation voltage almost equal to 14V) when the input crosses zero reference voltage.

2.30 An op amp has a rated output voltage of ±10 V and a slew rate of 1 V/μs. What is its full-power bandwidth? If an input sinusoid with frequency $f = 5f_M$ is applied to a unity-gain follower constructed using this op amp, what is the maximum possible amplitude that can be accommodated at the output without incurring SR distortion?

2.2 The circuit of Fig. P2.2 uses an op amp that is ideal except for having a finite gain A. Measurements indicate $v_O = 4.0$ V when $v_I = 1.0$ V. What is the op-amp gain A?



2.4 A set of experiments is run on an op amp that is ideal except for having a finite gain A. The results are tabulated below. Are the results consistent? If not, are they reasonable, in view of the possibility of experimental error? What do they show the gain to be? Using this value, predict values of the measurements that were accidentally omitted (the blank entries).

Experiment #	v_1	v_2	v_O
1	0.00	0.00	0.00
2	1.00	1.00	0.00
3		1.00	1.00
4	1.00	1.10	10.1
5	2.01	2.00	−0.99
6	1.99	2.00	1.00
7	5.10		−5.10

2.10 You are provided with an ideal op amp and three 10-kΩ resistors. Using series and parallel resistor combinations, how many different inverting-amplifier circuit topologies are possible? What is the largest (noninfinite) available voltage gain magnitude? What is the smallest (nonzero) available gain magnitude? What are the input resistances in these two cases?

2.32 The circuit in Fig. P2.32 utilizes an ideal op amp.

(a) Find I_1, I_2, I_3, I_L, and V_x.
(b) If V_O is not to be lower than -13 V, find the maximum allowed value for R_L.
(c) If R_L is varied in the range 100 Ω to 1 kΩ, what is the corresponding change in I_L and in V_O?

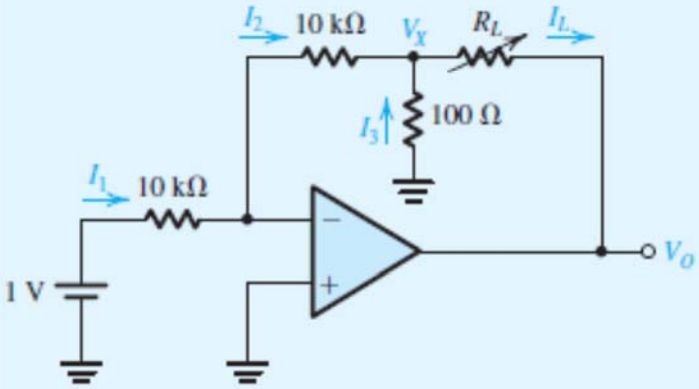
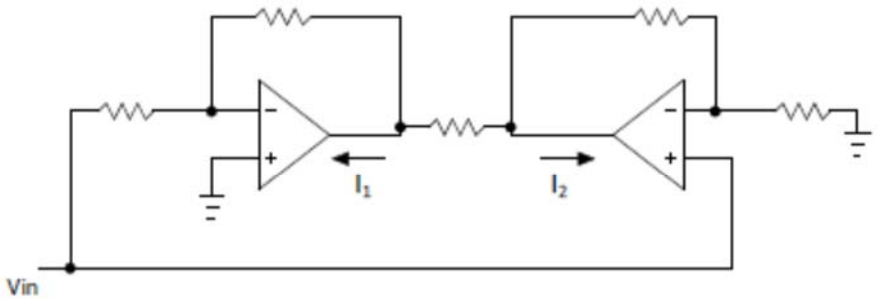


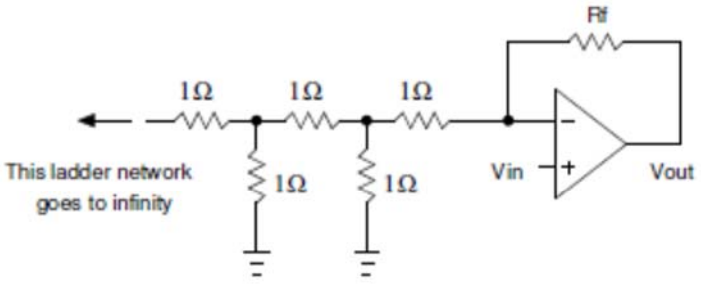
Figure P2.32

Homework Hints:

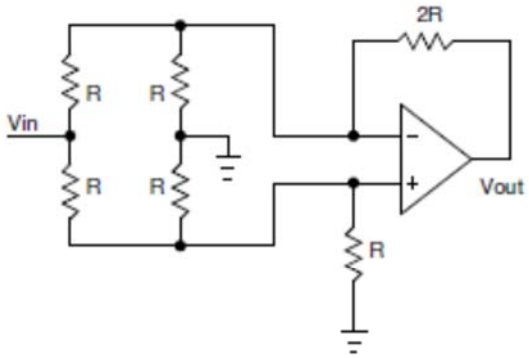
1) For the circuit shown below, determine the currents I_1 and I_2. V_{in} is 1V and all resistors are 1kΩ.



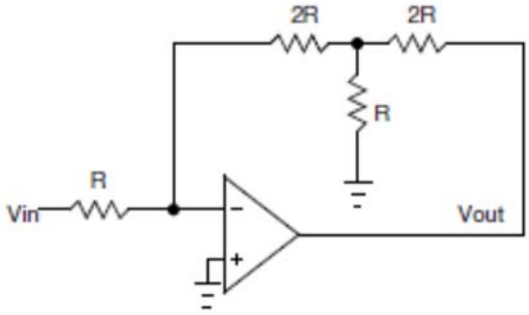
2) For what value of R_f, the gain of this circuit will be 2?



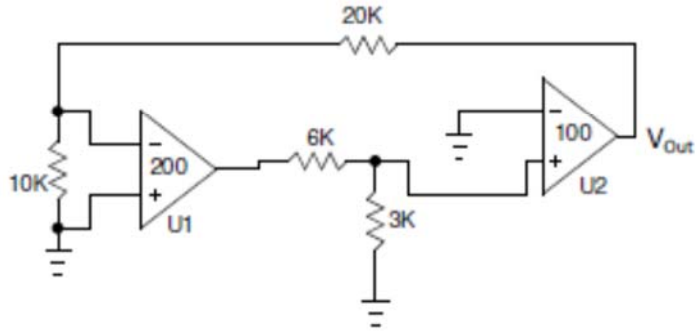
3) Determine an expression for V_{out}. Use thevenin's theorem to find the equivalent input(s) to solve this problem.



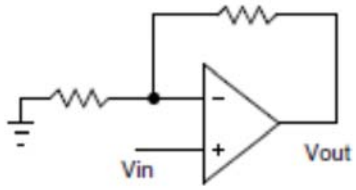
4) The Opamp used in this circuit has a finite bias current, I_B. For the closed loop amplifier configuration shown below, what will be the output voltage if V_{in} is 0? If you were to compensate the output DC offset voltage resulting due to I_B, what compensation resistor value will you choose and where will you connect that?

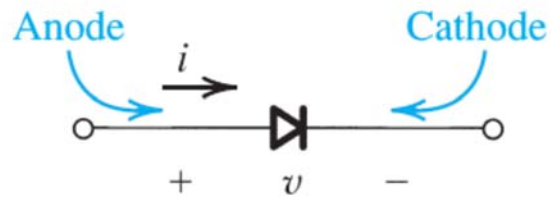


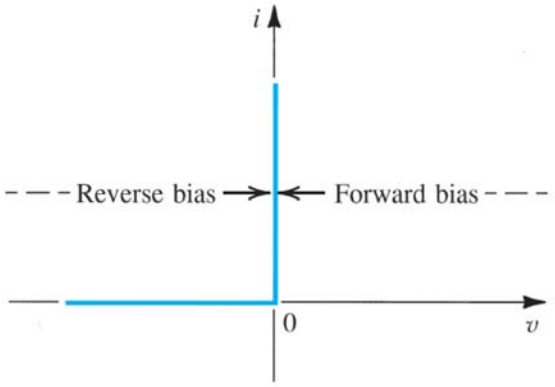
5) Opamp U1 has a 4mV input offset voltage and an internal gain of 200. Opamp U2 has an internal gain of 100. Determine V_{out}.

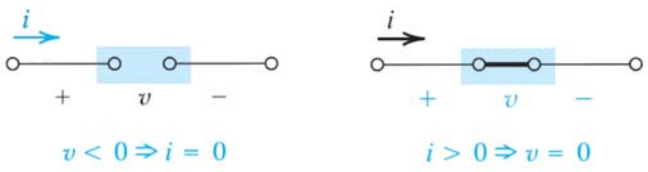


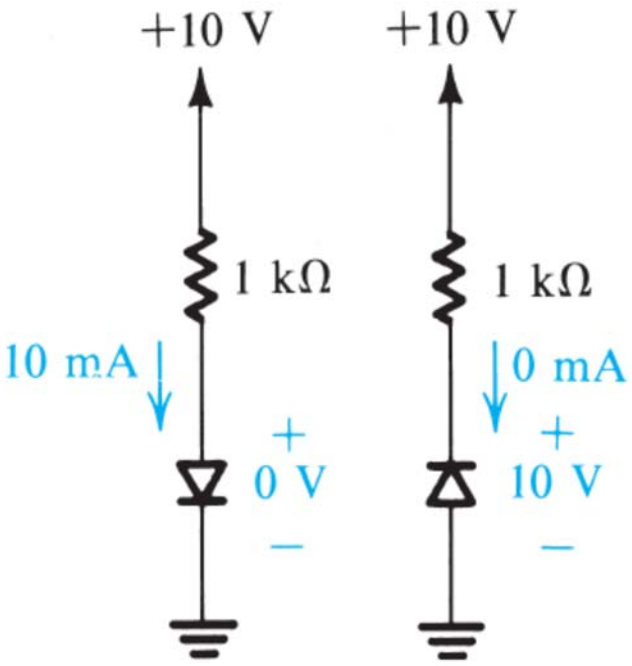
6) Derive an expression for the gain of the circuit shown below. The resistor values are RΩ and the Opamp has a finite internal gain of A.




Anode
Cathode
i
+
v
–


i
Reverse bias
Forward bias
0
v


i
+
v
–
v < 0 ⇒ i = 0
i
+
v
–
i > 0 ⇒ v = 0


+10 V
1 kΩ
10 mA
+
0 V
–
+10 V
1 kΩ
0 mA
+
10 V
–

Simple Application: The Rectifier: