The purpose of this problem is to examine the effects of closed-loop bandwidth and slew-rate limitations on the output response. Use the op-amp from problem C.8 connected as a unity-gain amplifier (feedback from output to (-) input) for all parts. Results from previous homeworks can be used without re-derivation.

a) With a load capacitor, $C_L = 100\text{pF}$, placed between the output and ground, calculate the maximum initial slope of the output voltage in $V/\mu s$ for a step input due to the following limitations:

- $SR^+$: Slew-Rate limitation for positive changes in the output voltage.
- $SR^-$: Slew-Rate limitation for negative changes in the output voltage.
- $(BW)_{CL}$: limitation from bandwidth (or time-constant) specified as a function of step amplitude, $V_{step}$.

b) Find the maximum step amplitude, $V_{step}$, so that the step response is not slew-rate limited for both positive and negative step inputs. Again use a load capacitance of $C_L = 100\text{pF}$.

c) For a sine-wave input, $V_M \sin(2\pi f_o t)$, find the maximum frequency $f_o$ for undistorted, unattenuated output with $V_M = 2V$ and $V_M = 0.01V$. Assume a load capacitance, $C_L = 0$.

d) Perform Spice3 simulations for the following:

- Pulse input for $V_{step} = 2V$ and $V_{step} = 0.01V$. Perform both steps with and without the load capacitor, $C_L = 100\text{pF}$. Label the initial slope and the cause of the limitation for each step type, and explain any stability effects of the load capacitor.
- Confirm the results of part c) using sine wave inputs, again assuming $C_L = 0$. 

©1999 R. Zane, University of Colorado, Boulder