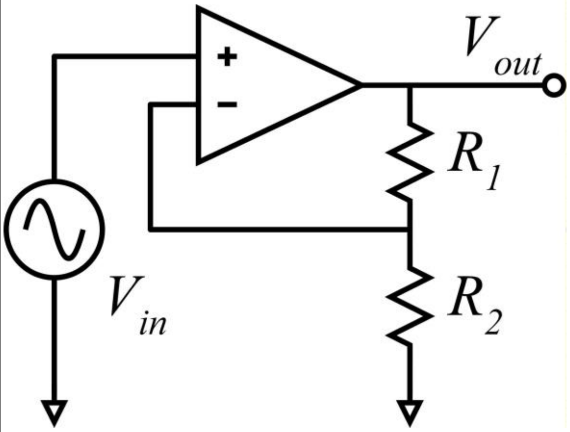
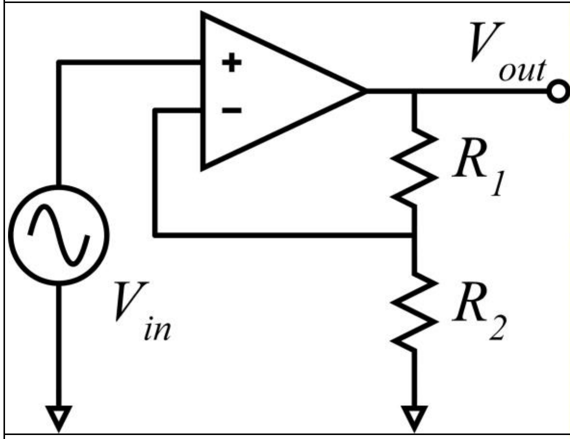
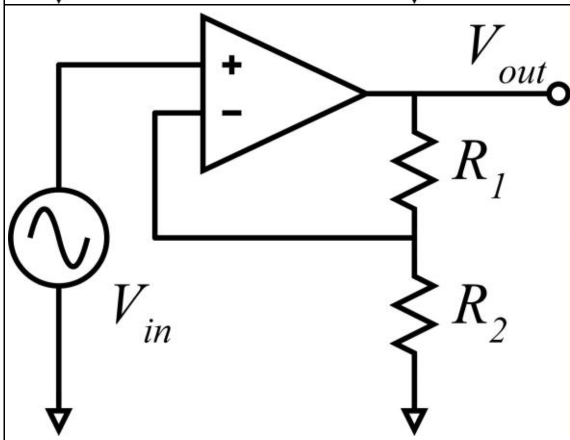
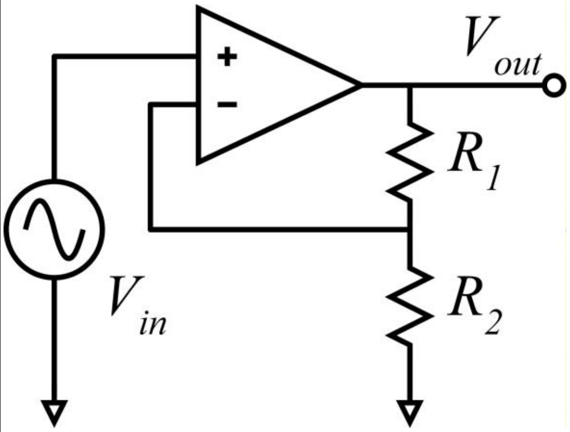
ECE137B Problem set #6,

	Problem 1 a) The operational amplifier has infinite input impedance, zero output impedance, infinite common-mode rejection ratio, and a differential gain of A_{diff}=10,000. R_1=9kOhm, R_2=1kOhm. Find the gain V_{out}/V_{in}. (b) Now suppose that the op-amp has a differential input impedance of 100 kOhm. Find the closed-loop input impedance c) The differential amplifier has an output impedance of 10 Ohm (but infinited input impedance). Find the closed-loop output impedance.
	Problem 2 The operational amplifier has zero output impedance, infinite common-mode rejection ratio, and a differential gain of A_{diff}=10,000. R_1=9kOhm, R_2=1kOhm. The amplifier's differential input is only 90 Ohms. Find the gain V_{out}/V_{in}. Hint: this requires use of the relationship $A_{cl} = A_{\infty}\frac{T}{1+T}$
	Problem 3. Feedback amplifier stability analysis by the Bode method. The operational amplifier has a differential gain of 10^6 at DC. Its differential gain has three poles, one at 10 Hz, and two at 5 MHz. The amplifier is otherwise ideal (infinite input impedance, zero output impedance, infinite CMRR). We will consider 2 cases: a) R1=0 and R2=1kOhm b) R1=9kOhm and R2=1kOhm. In each of cases a), and b) do the following: •Draw Bode plots (Magnitude and phase) of Ad(f) and ß(f) •Find the loop bandwidth and estimate from this the bandwidth of Vout/Vgen. •Find the gain margin and the phase margin of the feedback loop. Is the amplifier stable ?



Problem 4
Stability analysis: the Root Locus
The operational amplifier has a differential gain of 10^6 at DC. Its differential gain has **two** significant poles, one at 10 Hz, and one at 1 MHz The amplifier is otherwise ideal (zero output impedance, infinite input impedance, infinite CMRR). Consider 2 cases: a) R1=0 and R2=1kOhm b) R1=9kOhm and R2=1kOhm. In each of cases a), and b) do the following:
Solve mathematically for Vout(s)/Vgen(s)
Find the natural frequency, the damped frequency, and the damping factor
Draw to scale the location of the poles of Vout(s)/Vgen(s) on the S-plane.
Graph the (amplitude) of Vout(jf)/Vgen(jf)
Graph the step response of the amplifier Vout(t) given Vin(t)=1V*U(t)