

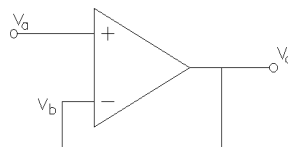




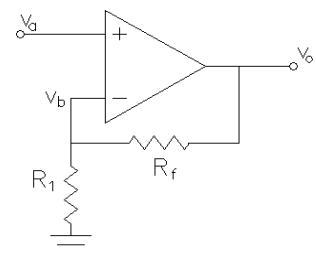
7. Design a differentiator using an op-amp, a resistor, and an inductor. You do not need to show parts values, but you need to show that the circuit will differentiate by showing a derivation similar to the ones in my handout.
8. Design a comparator whose output will be high (about 8 or 9 V) when the input is greater than 5 V and whose output will be low (about 1 V or so) when the input is less than 5 V.

**Answers**

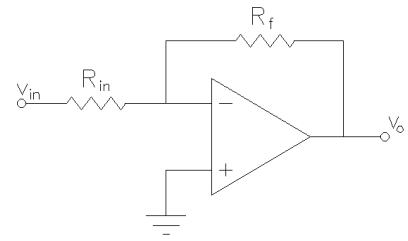
- 1.) Draw a voltage follower.



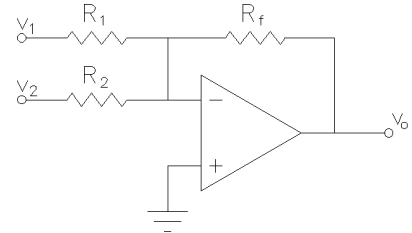
- 2.) Draw a noninverting amplifier. Choose an  $R_1$  and an  $R_f$  which is 11 times bigger than  $R_1$ . Say  $R_1 = 10 \text{ k}\Omega$  and  $R_f = 110 \text{ k}\Omega$ .



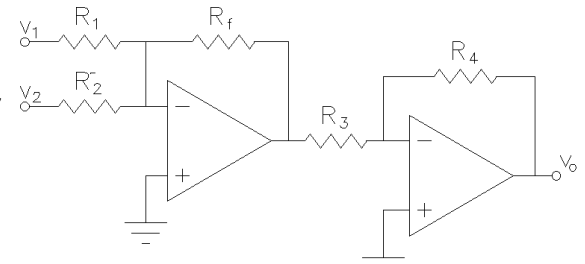
- 3.) Draw an inverting amplifier.  $R_{in} = 10\text{ k}\Omega$ ,  $R_f = 250\text{ k}\Omega$ .



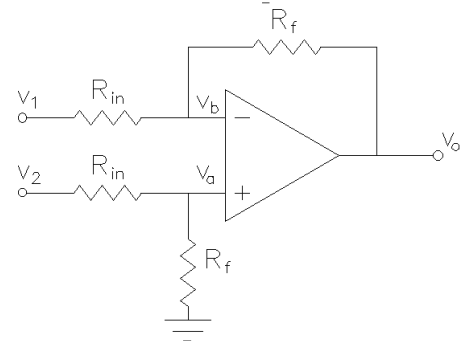
- 4.) Draw a two-input summer. Choose a value for  $R_f$ . Choose a value for  $R_1$  which is  $R_f/10$  and a value for  $R_2$  which is  $R_f/4$ . Say  $100\text{ k}\Omega$ ,  $10\text{ k}\Omega$  and  $25\text{ k}\Omega$ .



- 5.) Redraw the same circuit as problem 4, only now follow it with an inverting amp with a gain of 1. Say  $R_3 = R_4 = 10\text{ k}\Omega$  for the second op-amp.



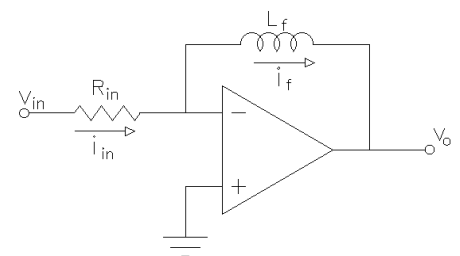
- 6.) Draw a differential amplifier. Choose an  $R_{in}$  value. Make  $R_f$  12 times bigger than  $R_{in}$ . Say  $R_{in} = 10\text{ k}\Omega$  and  $R_f = 120\text{ k}\Omega$ .



- 7.) Design a differentiator using an op-amp, a resistor, and an inductor. You do not need to show parts values, but you need to show that the circuit will differentiate by showing a derivation similar to the ones in my handout.

$$i_{in} = \frac{v_{in}}{R_{in}} = i_L = -\frac{1}{L} \int v_o dt$$

$$v_o = -\frac{L}{R_{in}} \frac{dv_{in}}{dt}$$



- 8.) Just choose the two resistor values to be equal, so the voltage at the inverting input pin will be 5 V. Now, anytime the voltage on the noninverting pin is above 5 V the output will be high ( $\sim 8\text{ V}$ ) and anytime the voltage on the noninverting pin is below 5 V the output will be low ( $\sim 2\text{ V}$ ).

