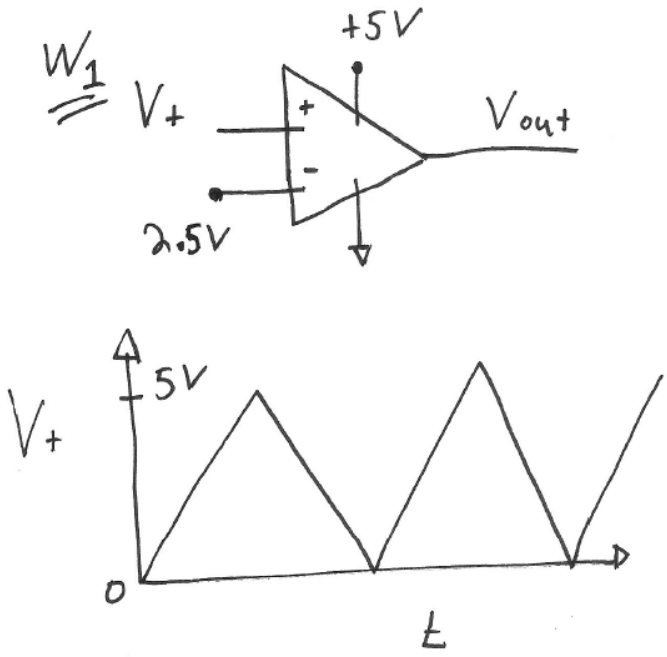
Problem set: Op-amps

Open loop

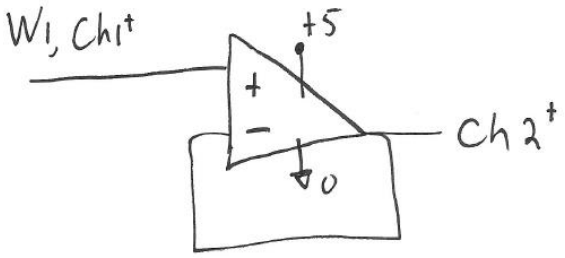
Let's first explore the open-loop behavior of the op-amp. Create the circuit below. Set V- to 2.5 V and connect V+ to the waveform 1 output from the analog discovery. Monitor V+ with Ch1 input and monitor the output of the op-amp with Ch2. Set the waveform output on V+ to be a triangle wave with 2.5 V center and an amplitude of 2.5 V (Shown schematically). Watch Vout as a function of time. On the scope, you can put the plot into x-y mode. Using x-y mode, plot Vout as a function of Vin where time is parametric.



See for yourself that you get Figure 5.3 and 5.4 in book. Create the two plots from this section to turn in for your problem set.

Op-amp follower

One of the simplest and most useful op-amp circuits is called a voltage follower, described in section 5.3 of the book. The circuit consists of simply wiring the op-amp's output to the negative input as shown below.



Create a sine wave input on W1 as 2.5V centered with 1 V amplitude. Monitor the op-amp output with Ch2.

- Set the frequency to 1 kHz. Does the follower work as advertised? You don't need a figure to turn in.

- Increase the frequency. At some point the follower will not operate fast enough to keep up with the input. At what frequency (approximately) do you notice a significant different between output and input?

- Set the input frequency back to 1 kHz. Set the input to be centered at 0 V and leave the amplitude at 1 V. Why does this circuit not work?

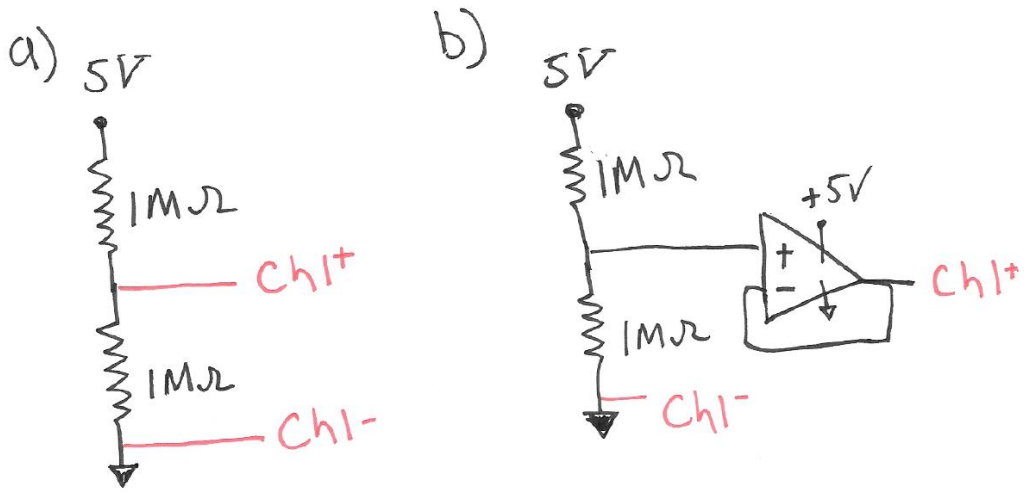
- Set the center of the input back to 2.5 with 1 V amplitude. Change the input to be a square wave. How long does it take (approximately) for the output to catch up to the change in the input? You will need to zoom in the time scale.

- Just for fun, switch the circuit such that the feedback is to the positive input and the input from the waveform goes to the negative input. Confirm that this circuit does not work as a follower. No need to turn anything in, just confirm that it doesn't work.

Follower as a buffer

This follower circuit is useful since the input to the op amp draws no current, the follower can be added between components of a system in order to isolate the components from each other. A simple example is found in the difference between the two circuits shown in figure 1a and 1b.

Test the measurement of a simple voltage divider as shown in Figure 1 and see the difference between the circuit Figure 1a and 1b. You should find that the measurement in b is in agreement with the ideal measurement.



Report the value of Vout for circuits a and b.