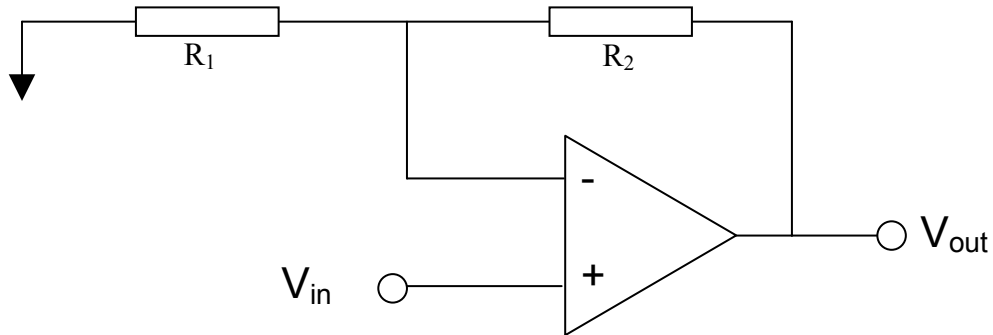


Assignment #2

I forgot to mention in class that the value of capacitors used in op-amp circuits typically range in value from 1 pF (10^{-12} F) up to 100 μ F (10^{-4} F). If you use a capacitor that affects the gain of your output in any of your op-amps, you should restrict your values of C to the range specified above.

1. Pictured below is a buffer amplifier with a gain (also known as a non-inverting amplifier).



Show that the output voltage is related to the input voltage by the following equation.

$$V_{out} = V_{in} \left(\frac{R_2}{R_1} + 1 \right)$$

2. Draw a circuit that will produce the following output.

$$-V_{out} = 4.0V_i + 1000I_i$$

3. An Ion Selective Electrode (ISE) with an internal reference electrode produces a voltage of 1.0V. What must be the input resistance of the voltmeter used to measure this voltage if the loading error is not to exceed 0.1%? The output resistance of a typical ISE is 20 M Ω .
4. Build an operational amplifier circuit that will produce a linear voltage ramp output that starts at -0.15 V and increases (makes more positive) the output voltage at a rate of 10 mV/s. Use only one 1.5 V battery as the voltage source. This can be done using only two op-amps.