Electronic Devices and Circuits I - EE2CJ4
Lab #1

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Experiment

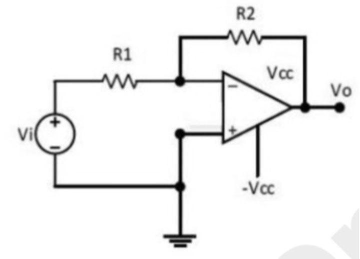
Given the values...

$R_1 = 10k\Omega$

$R_2 = 47k\Omega$

$V_{cc} = 5V$

$V_{ee} =- 5V$



$We\ can\ determine\ the\ voltage\ gain,\ A_0 = \frac{V_o}{V_i}\ by\ performing\ nodal\ analysis\ at\ V_p...$

$Since\ we\ have\ an\ ideal\ diode,\ we\ know\ V_p = V_n = 0v\ and\ i^+ = i^- = 0A$

$$\frac{V_n - V_i}{R_1} = \frac{V_o - V_n}{R_2} \Rightarrow \frac{-V_i}{R_1} = \frac{V_o}{R_2} \Rightarrow \frac{V_o}{V_i} =- \frac{R_2}{R_1} = \frac{-47}{10} =- 4.7V$$

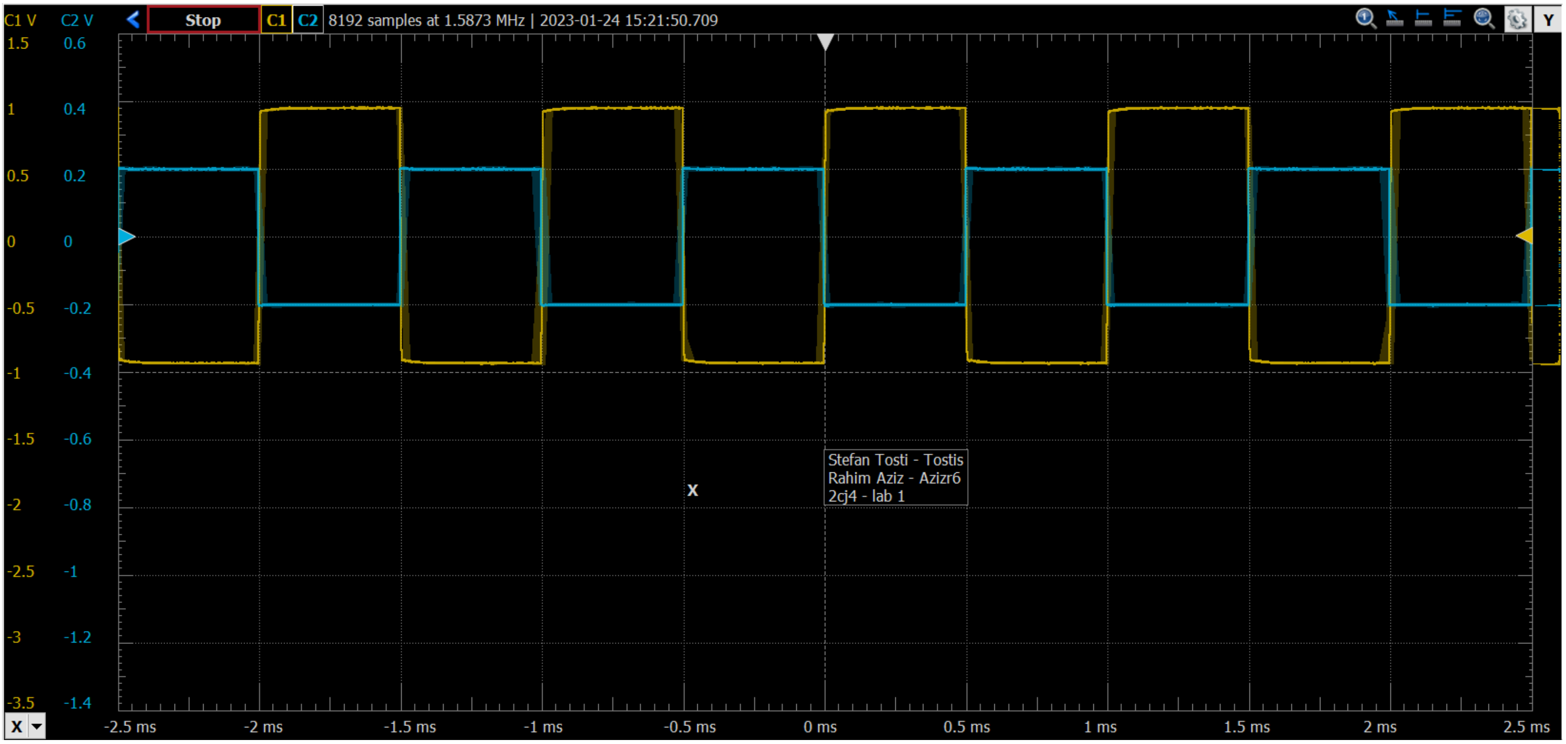
$To\ determine\ the\ saturation\ regions,\ we\ use\ the\ fact\ that\ \frac{V_{ee}}{A_v} < V_i < \frac{V_{cc}}{A_v}...$

$$\frac{V_{ee}}{A_v} < V_i < \frac{V_{cc}}{A_v} \Rightarrow \frac{-5}{-4.7} < V_i < \frac{5}{-4.7} \Rightarrow -\frac{50}{47} < V_i < \frac{50}{47}$$

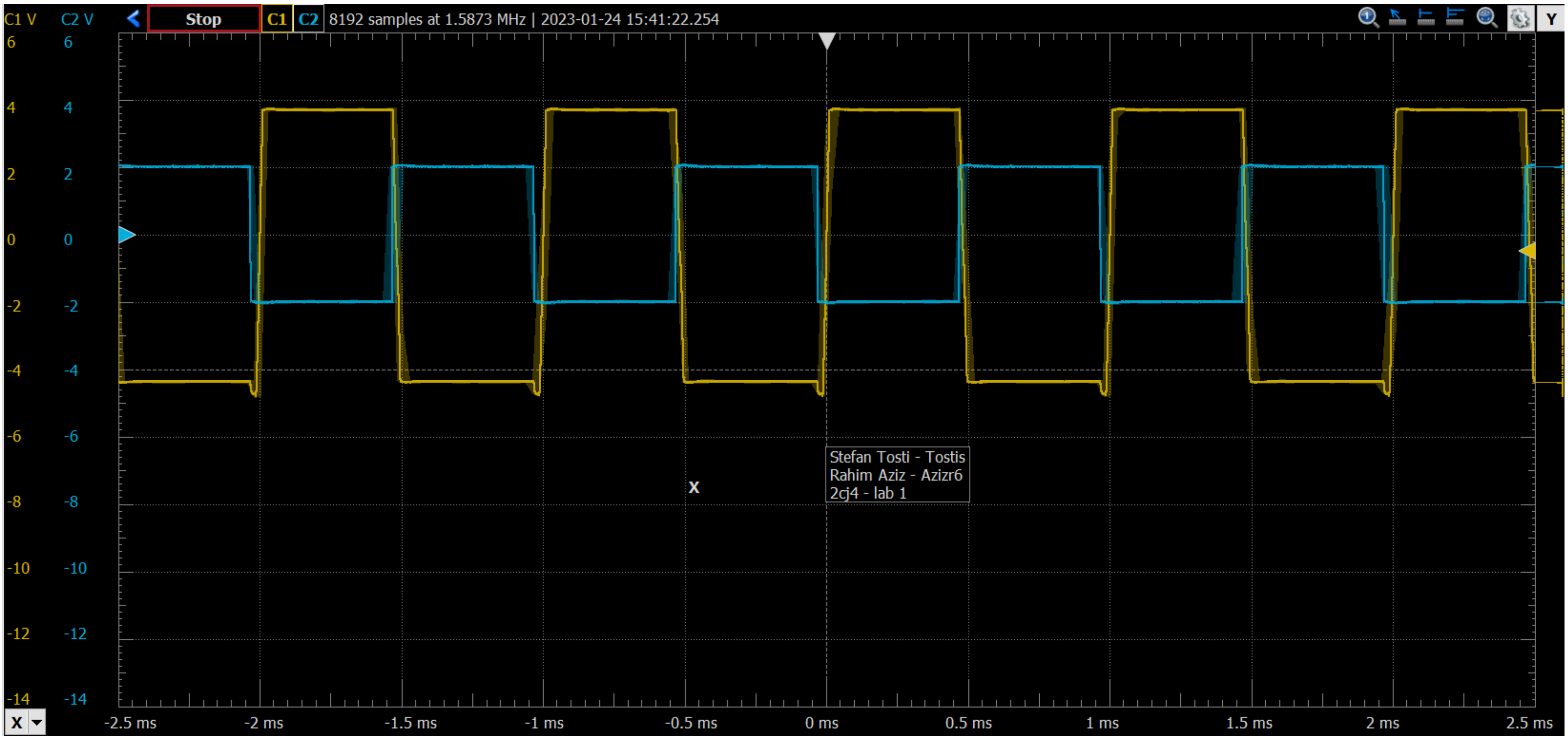
$Which\ lets\ us\ conclude\ that\ when\ we\ are\ within\ the\ above\ stated\ region,\ V_o = -4.7V_i$

Exercise I

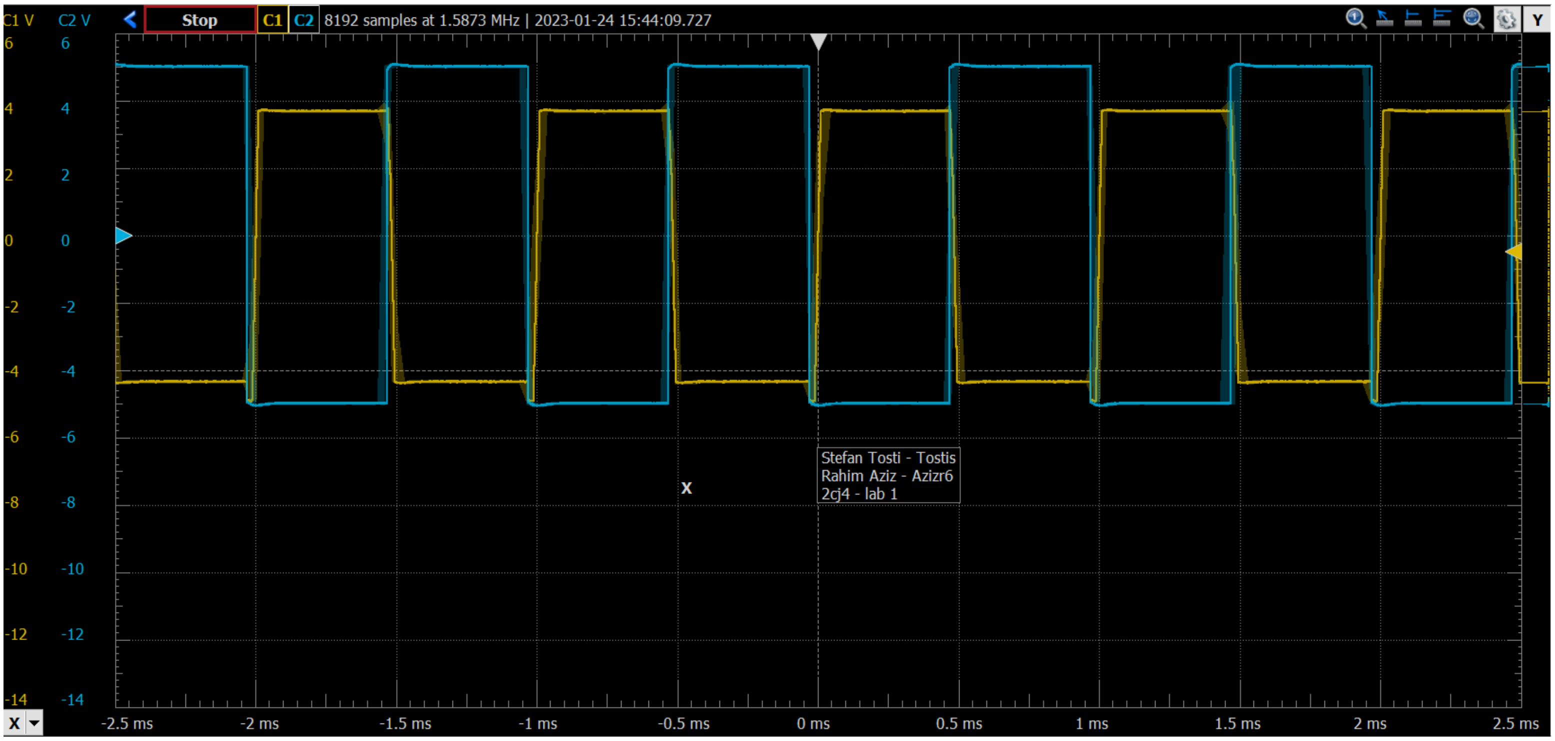
a.) 200 mv square wave...



b.) 2V square wave…



c.) 5V square wave…

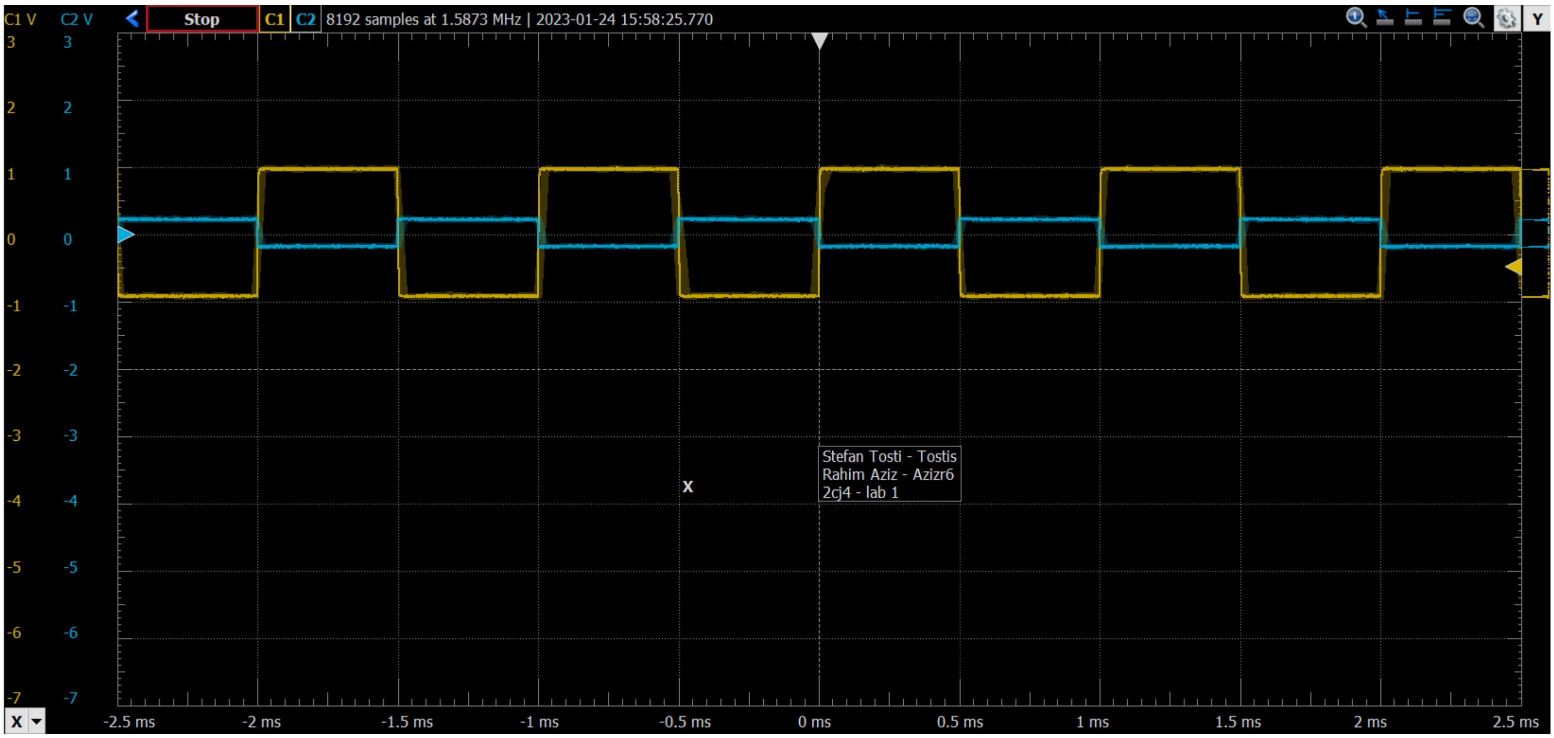


Exercise II

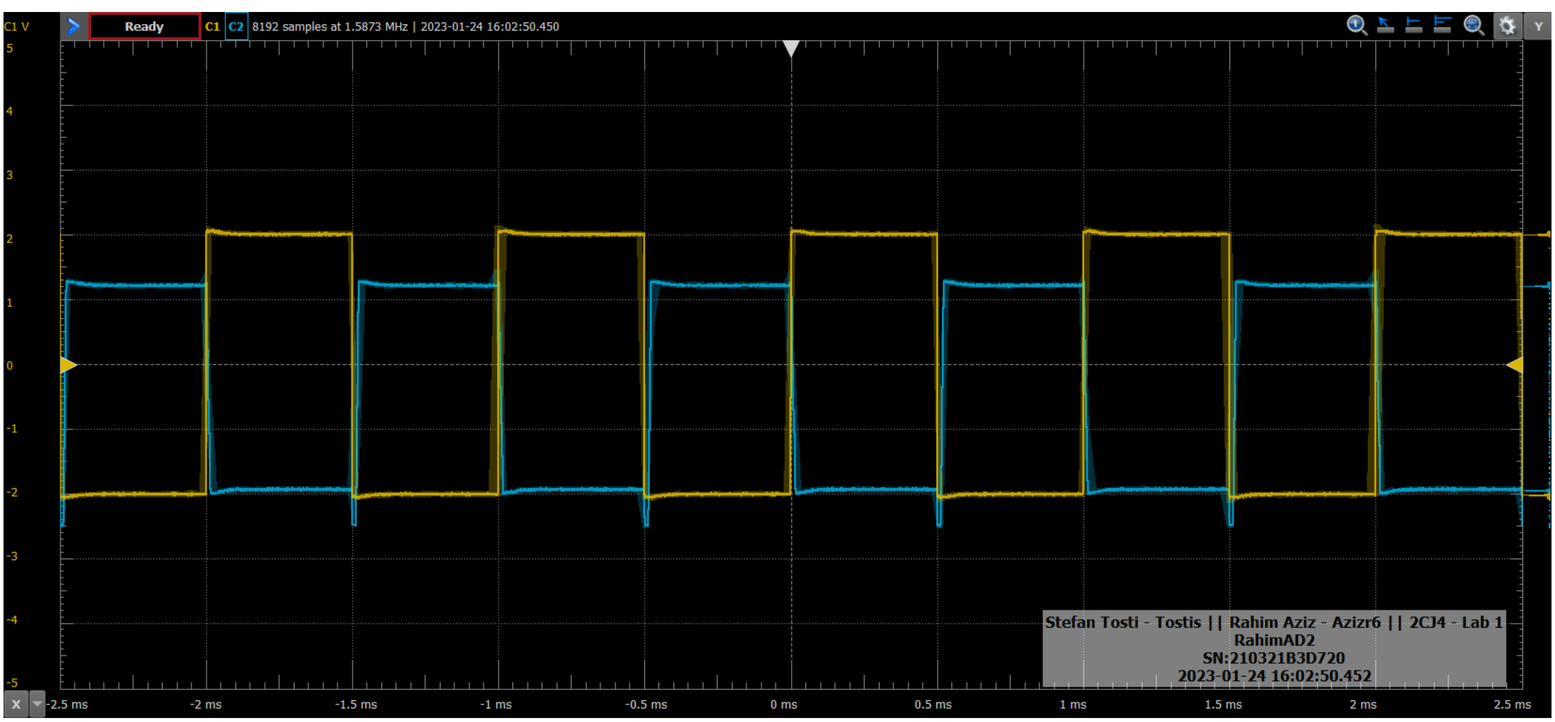
We used the 200mV graph as our reference, we can calculate our experimental voltage gain with $A_o = \frac{V_o}{V_i} = \frac{-0.929V}{0.213V} = -4.36$ this experimental value is close to our theoretical value of -4.7 but slightly less. This is due to the fact that we are dealing with non-ideal op-amps. Non-ideal op-amps do not have infinite gain but have a limited gain using a resistor of the size (10^6). Additionally non-ideal op-amps do draw a very small amount of operating current. Due to these facts, we expect our experimental gain to be slightly lower than the theoretical gain .

Exercise III

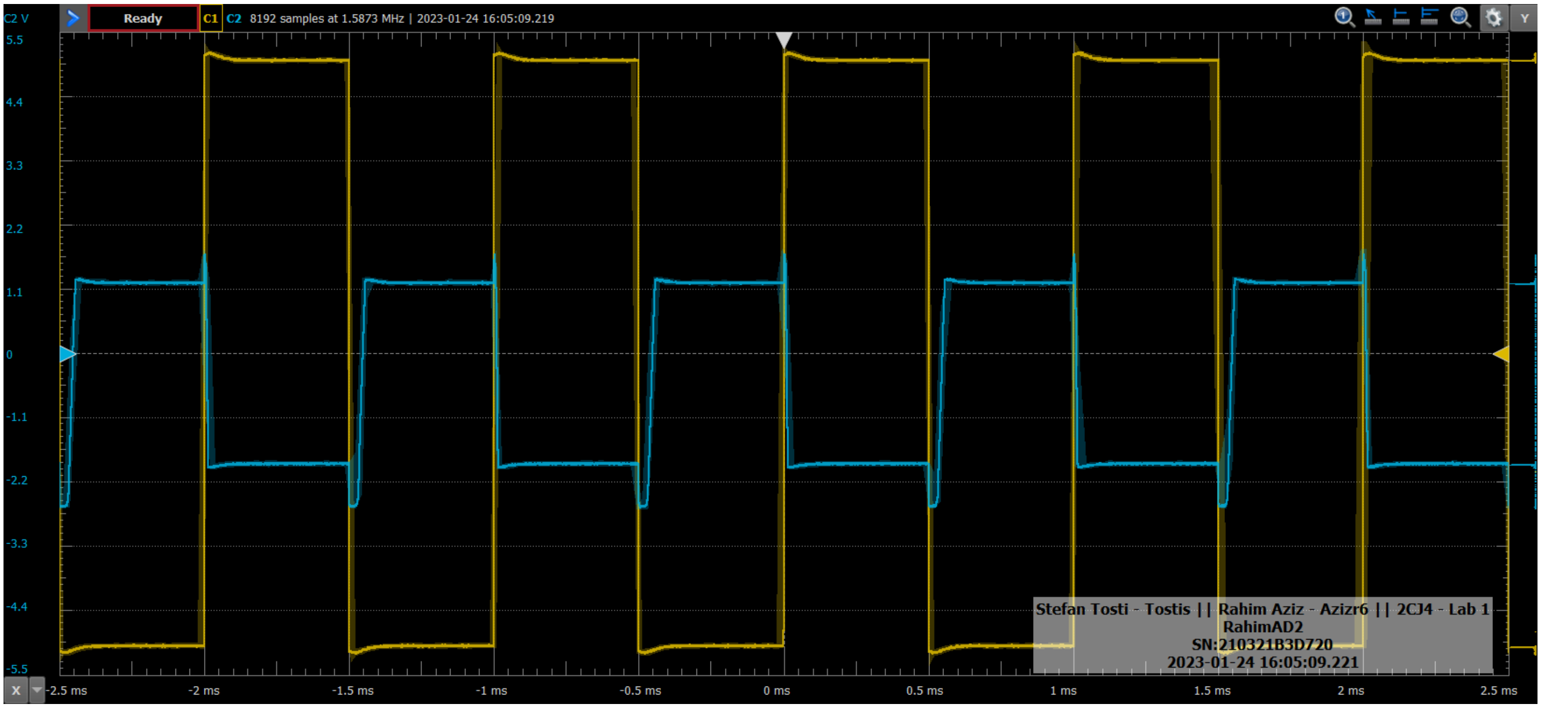
a.) 200 mV square wave, 2.5V saturation



b.) 2 V square wave, 2.5V saturation



c.) 5 V square wave, 2.5V saturation



We used the 200mV graph as our reference, we can calculate our experimental voltage gain with $A_o = \frac{V_o}{V_i} = \frac{-0.932V}{0.204V} = -4.56V$ this experimental value is extremely close to our theoretical value of -4.7V. This is due to the fact that we are dealing with non-ideal op-amps. Non-ideal op-amps do not have infinite gain but have a limited gain using a resistor of the size (10^6). Additionally non-ideal op-amps do draw a very small amount of operating current. Due to these facts, we expect our experimental gain to be slightly lower than the theoretical gain. When comparing the gain for Vcc=2.5V and Vcc=5V we expect the same results because the gain is dependent on the feedback resistors and the input resistors which we haven't changed. Additionally we noticed for the 2.5V graph its peak to peak voltage had a slight offset and was not perfectly symmetrical across the x-axis. This goes back to the fact that we are using non-ideal op-amps. Non-ideal op-amps have a slight bias current which causes a small DC offset voltage at the output. Furthermore, other factors such as frequency and the internal components of the op-amp are another reason for our graph not reaching full saturation