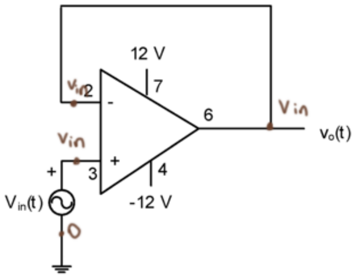
EXPERIMENT 4 ONLINE VERSION
BASIC APPLICATIONS OF OPERATIONAL AMPLIFIERS

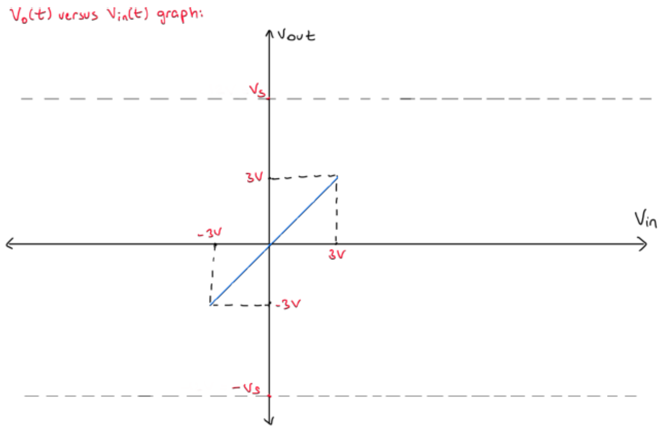
Preliminary Work:

1)

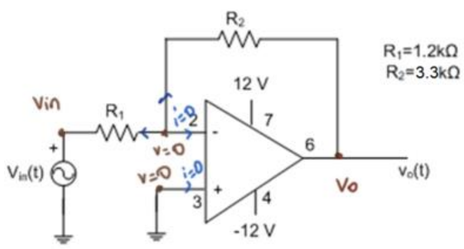
a.



$V_{in} = V_{out}$



b.

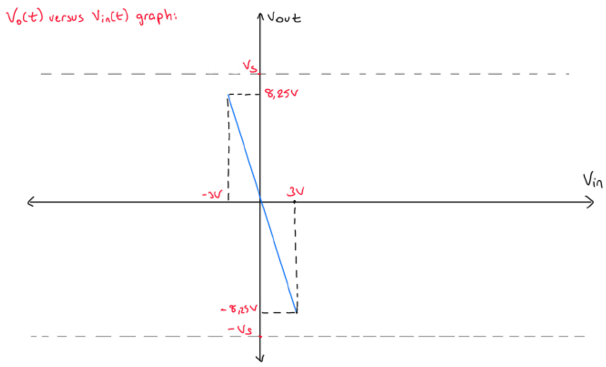


R_1=1.2kΩ
R_2=3.3kΩ

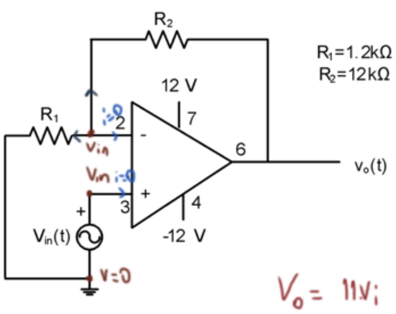
$$\frac{0-V_{in}}{R_1} + \frac{0-V_o}{R_2} = 0$$

$$V_o = -V_i \; \frac{R_2 (3.3)}{R_1 (1.2)}$$

$$V_o = -2{,}75 V_i$$



c.

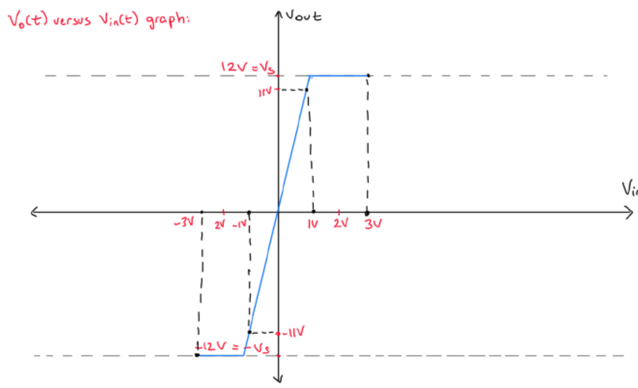


R_1=1.2kΩ
R_2=12kΩ

$$\frac{V_{in}-0}{R_1} + \frac{V_{in}-V_o}{R_2} = 0$$

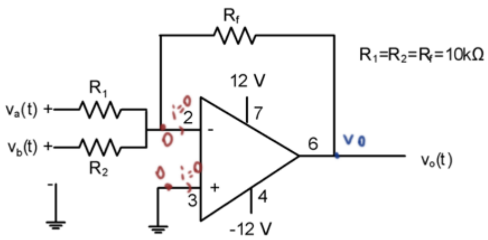
$$V_o = V_i \left(\frac{R_2 + R_1}{R_1} \right)$$

$$V_o = 11 V_i \qquad \left(\frac{12+1{,}2}{1{,}2} \right)$$



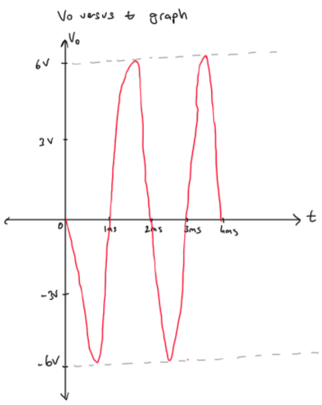
2)

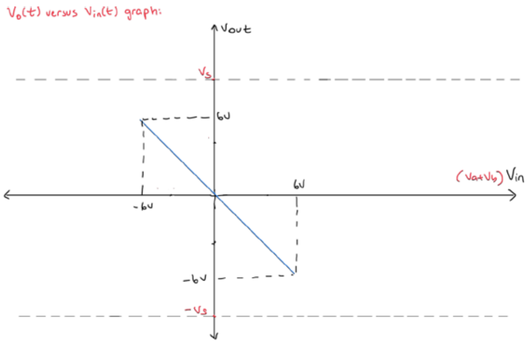
a. Summation of the inputs



$$\frac{0-V_a}{R_1}+\frac{0-V_b}{R_2}+\frac{0-V_o}{R_f}=0$$

$$V_o=-(V_a+V_b)$$





b. Subtraction of the inputs

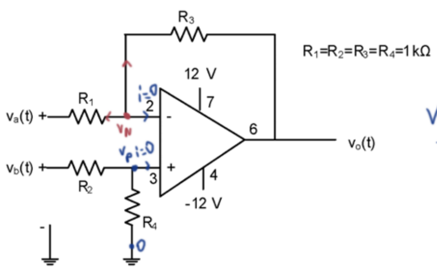


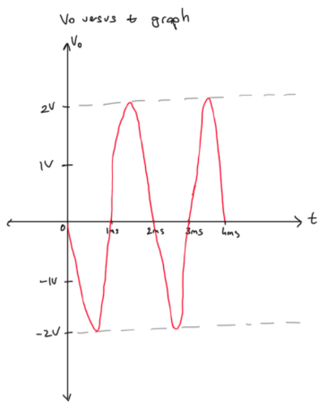
Figure 8

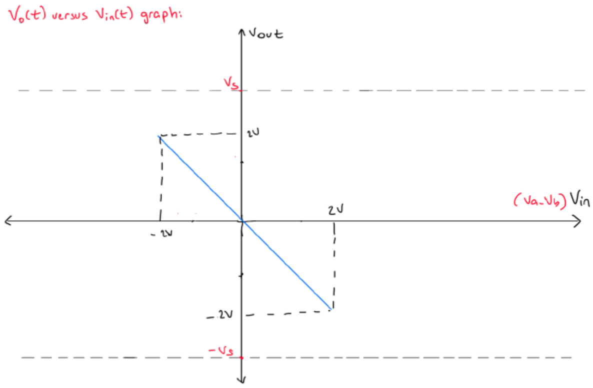
$$\frac{V_p-V_b}{R_2}+\frac{V_p}{R_4}=0$$

$$V_p=\frac{V_b}{2}=V_N$$

$$\frac{\frac{V_b}{2}-V_a}{R_1}+\frac{\frac{V_b}{2}-V_o}{R_3}=0$$

$$V_o=V_b-V_a$$





3)

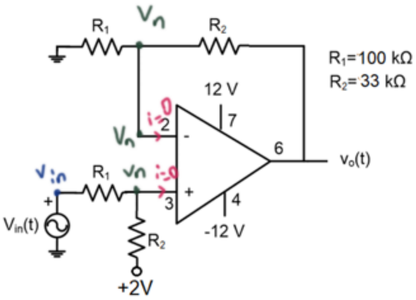


Figure 9

$$\frac{V_n - 0}{R_1} + \frac{V_n - V_o}{R_2} = 0 \qquad V_n = \frac{100 V_o}{133}$$

$$\frac{V_n - V_{in}}{R_1} + \frac{V_n - 2}{R_2} = 0 \qquad V_n = \frac{33 V_{in} + 200}{133}$$

$$\frac{100 V_o}{133} = \frac{33 V_{in} + 200}{133}$$

$$V_o = 0{,}33 V_{in} + 2$$

EXPERIMENT 4
REPORT SHEET

Full Name: Derya Tınmaz
Date: 12.12.20
Experimental Work:
1)
a)

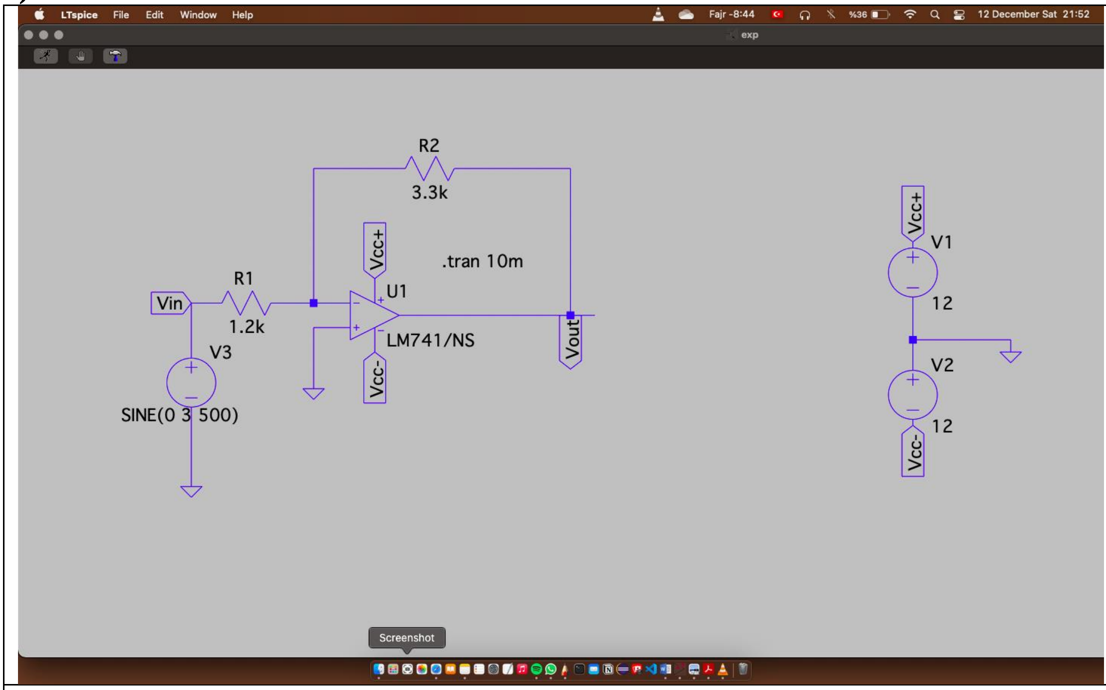


Figure 1: The function of the circuit is inverting the input voltage (-2.75 times greater) to output voltage and the figure corresponds to Figure 5 in the experiment worksheet.

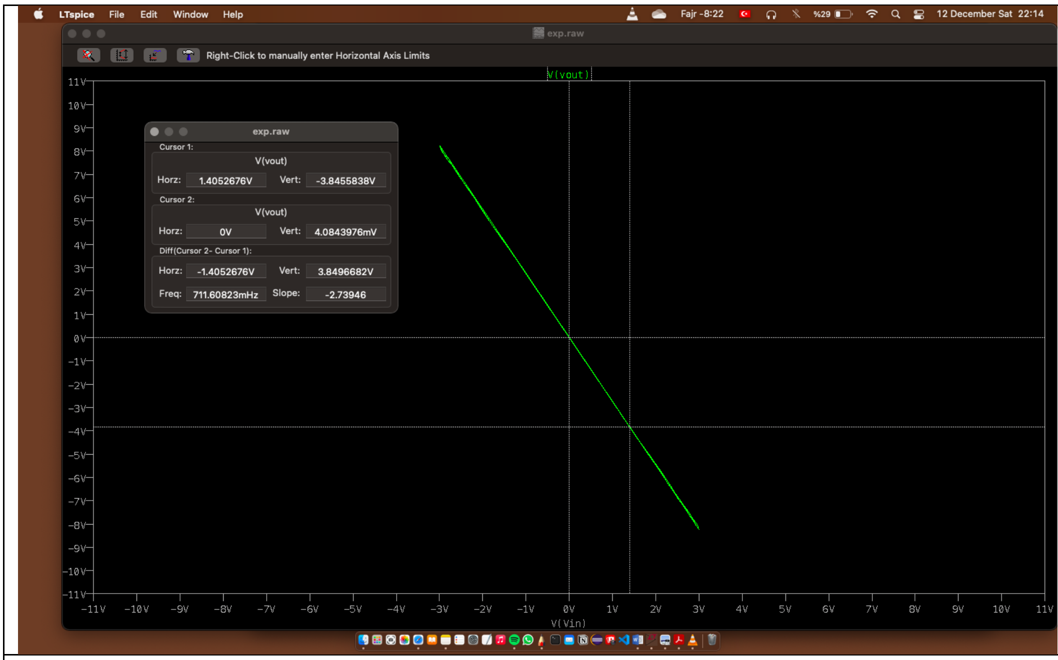


Figure 2: -2.74 times of input voltage is seen on the output voltage. Since max input voltage is |-3V|, the max output voltage is |-8.22V|. The experimental gain(Vout/Vin=-2.74) and the theoretical value(-2.75) are almost same, little differences due to negative feedback (due to non-ideal op amp) and floating-point precision.

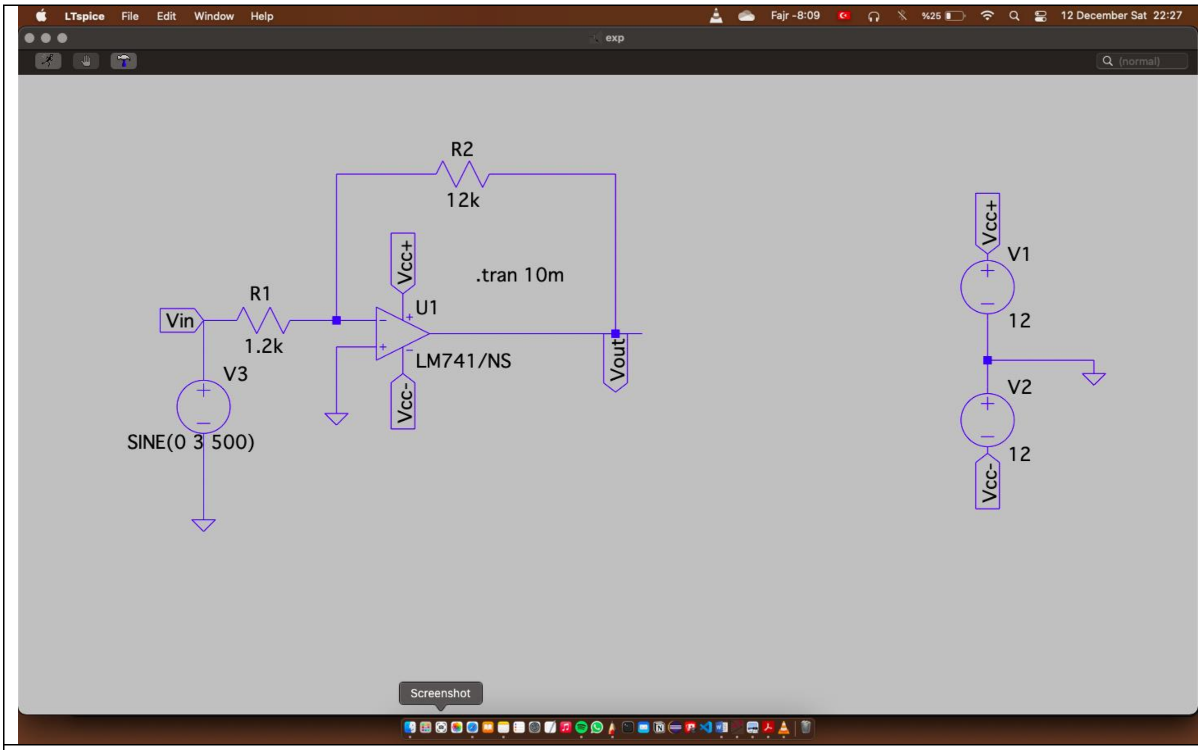


Figure 3: The function of the circuit is inverting the input voltage (-10 times greater) to output voltage and the figure corresponds to Figure 10 in the experiment worksheet.

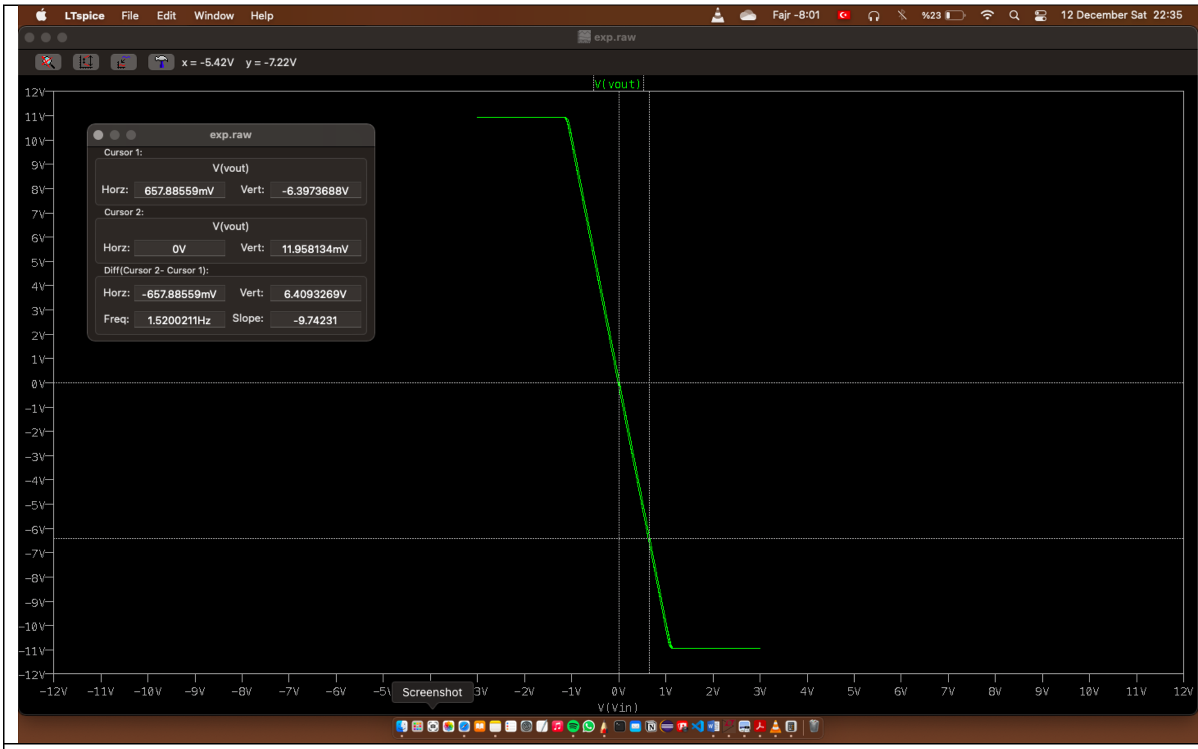


Figure 4: -9.74 times of input voltage is seen on the output voltage. After some point around |Vin|>1v, the circuit reaches its saturation point. Therefore, we see 11V Vout. The experimental gain(-9.74) and the theoretical value(-10) are almost same, little differences due to negative feedback (due to non-ideal op amp) and floating-point precision.

Comments: The results are same as expected, just little differences.

b)

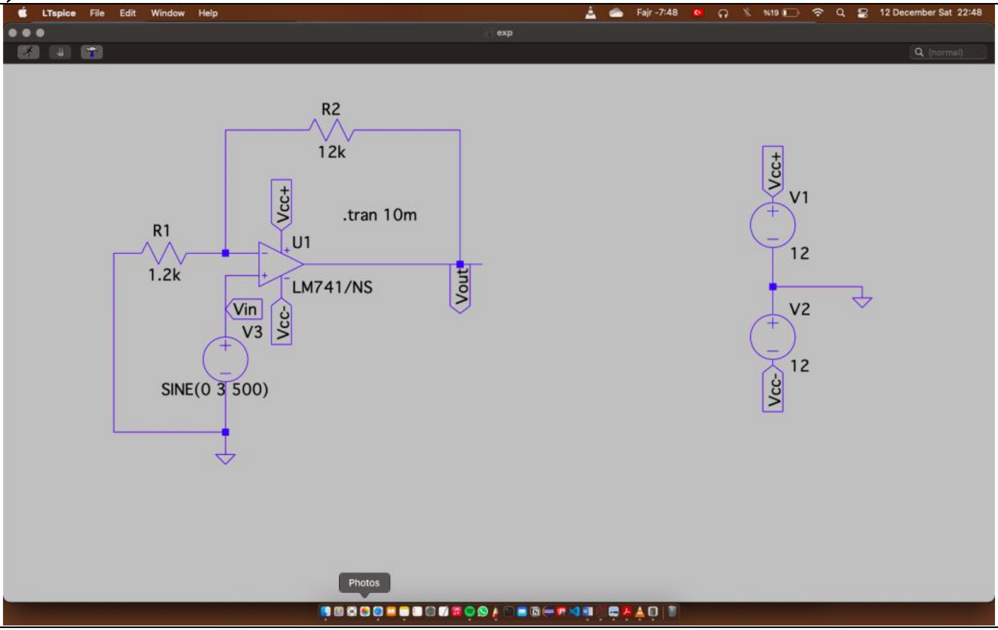


Figure 5: The function of the circuit is non-inverting the input voltage (11 times greater) to output voltage and the figure corresponds to Figure 6 in the experiment worksheet.

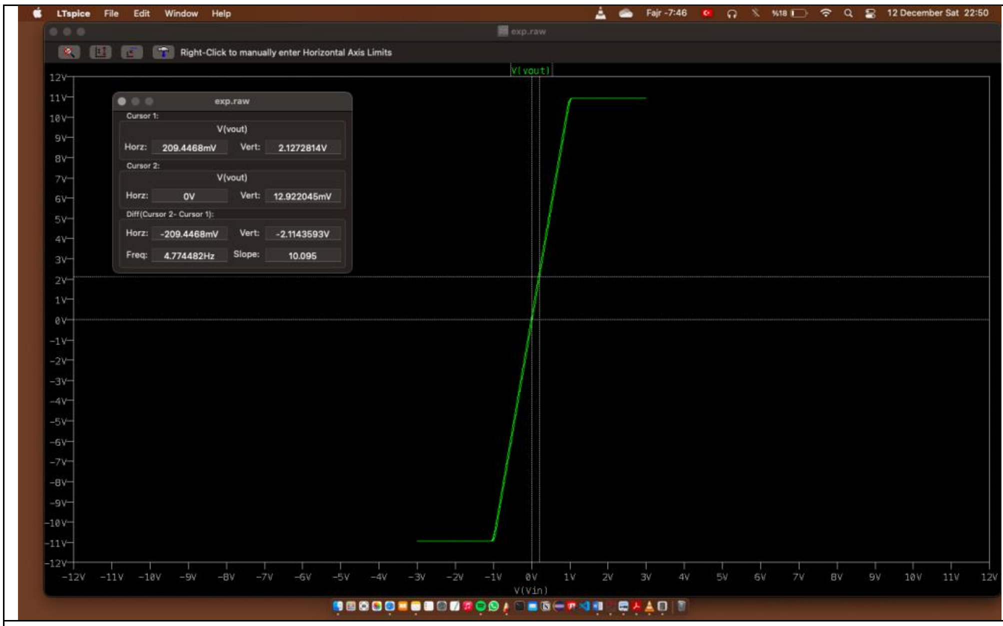


Figure 6: 10 times of input voltage is seen on the output voltage. After some point around |Vin|>1v, the circuit reaches its saturation point. Therefore, we see 11V Vout. The experimental gain(10) and the theoretical value(11) are almost same, little differences due to negative feedback (due to non-ideal op amp) and floating-point precision.

Comments: The results are same as expected, just little differences.

2)

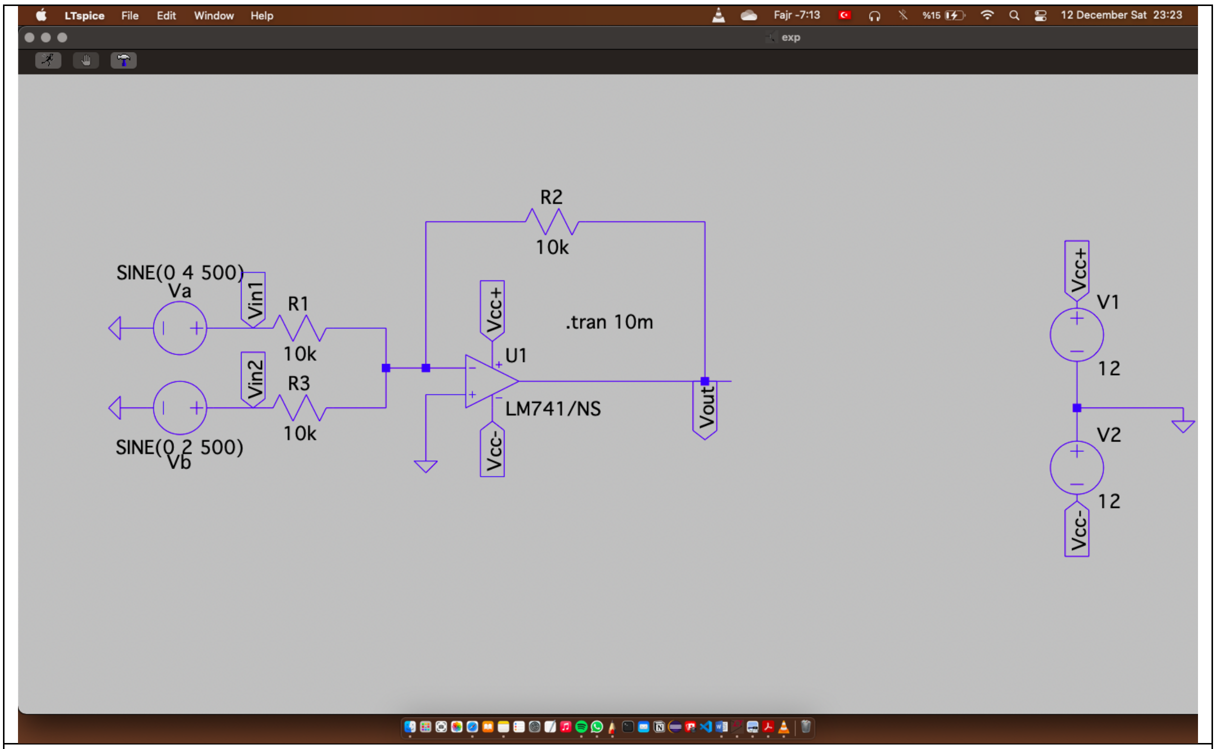


Figure 7: The function of the circuit is summing the input voltages and the figure corresponds to Figure 7 in the experiment worksheet.

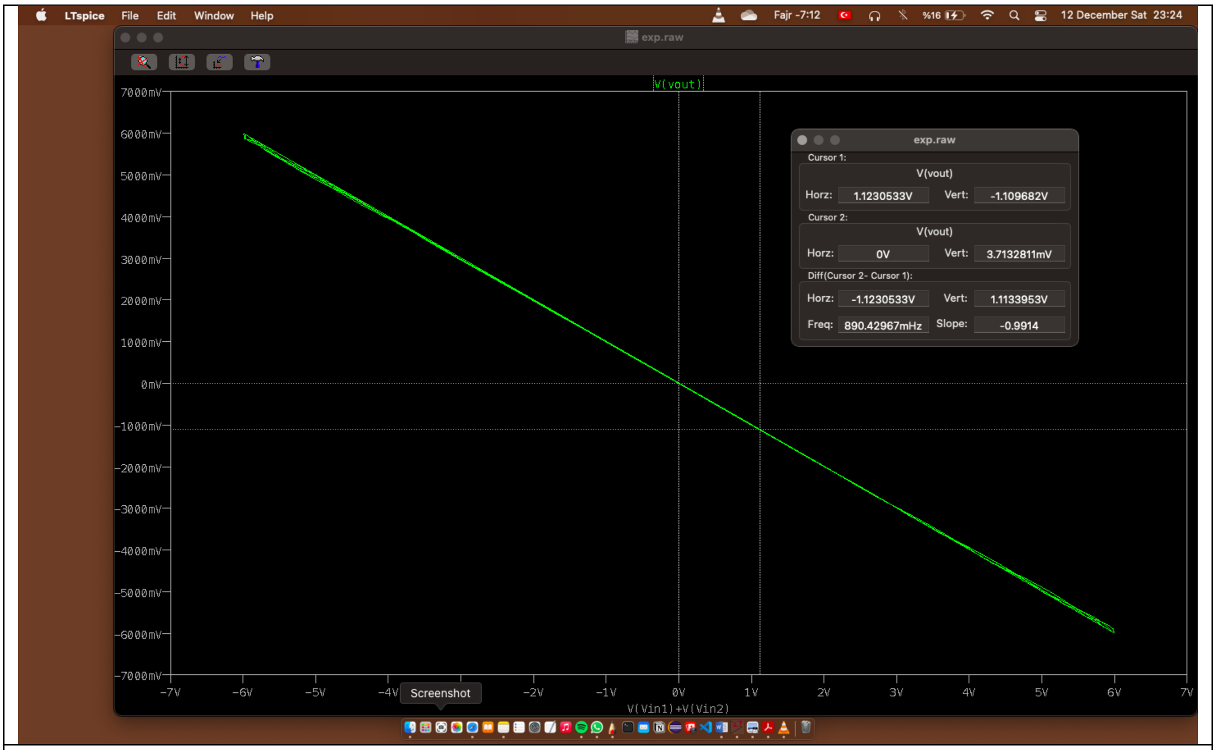


Figure 8: Given two input voltages summation (with negative sign) is seen on the output voltage. Since max of Va is 4, max of Vb is 2, the output voltage does not reach the saturation point. (Little differences due to negative feedback (due to non-ideal op amp) and floating-point precision.)

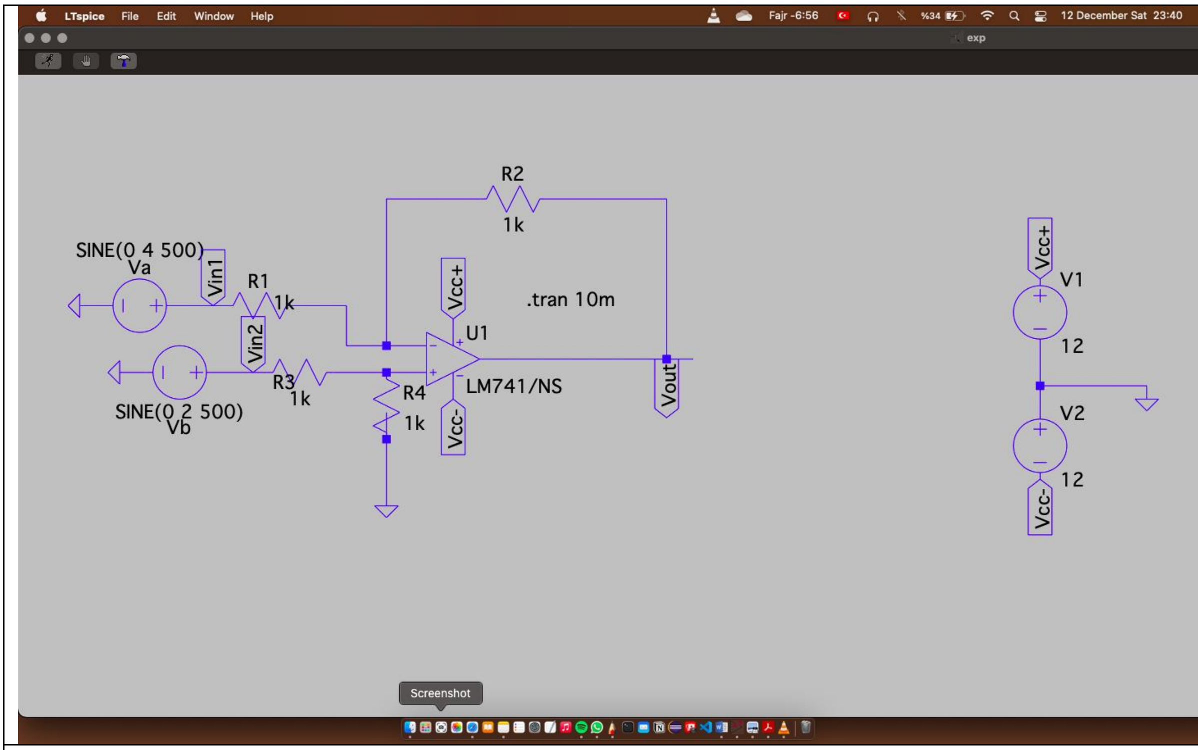


Figure 9: The function of the circuit is subtraction of the input voltages and the figure corresponds to Figure 8 in the experiment worksheet.

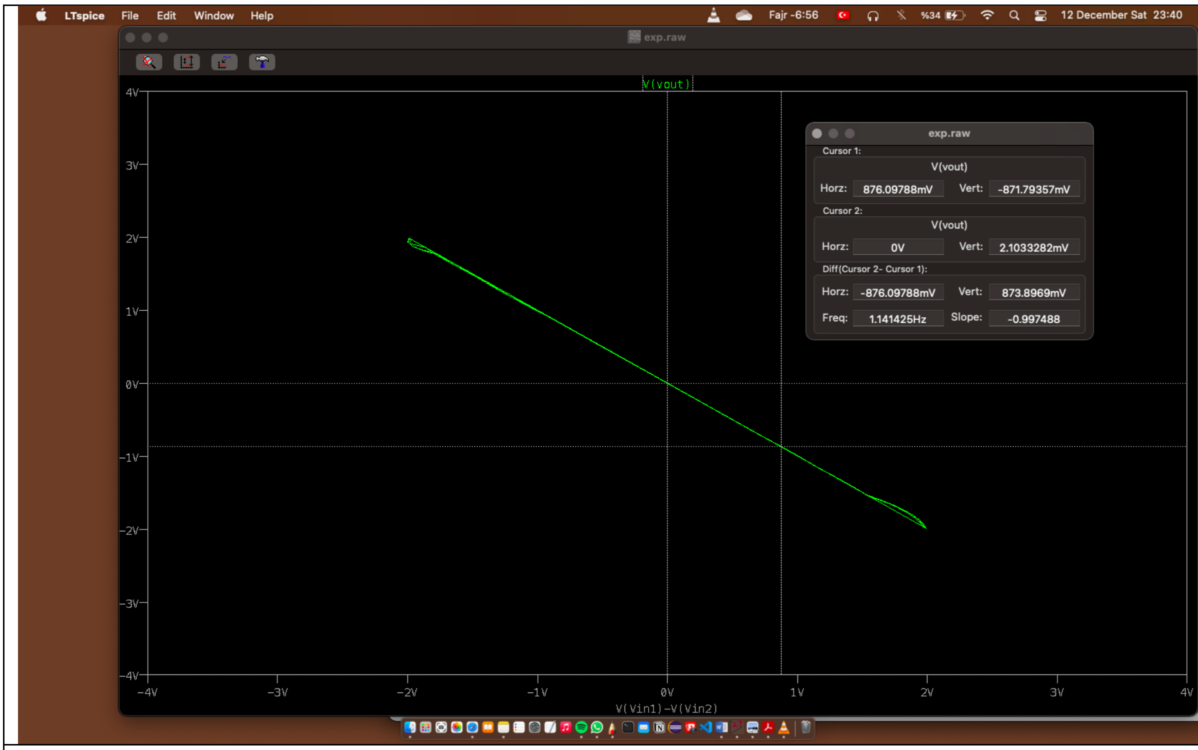


Figure 10: Given two input voltages subtraction (with negative sign -(Va-Vb)) is seen on the output voltage. Since max of Va is 4, max of Vb is 2, the output voltage does not reach the saturation point. (Little differences due to negative feedback (due to non-ideal op amp) and floating-point precision.)

Comments: The results are same as expected, just little differences.

3)

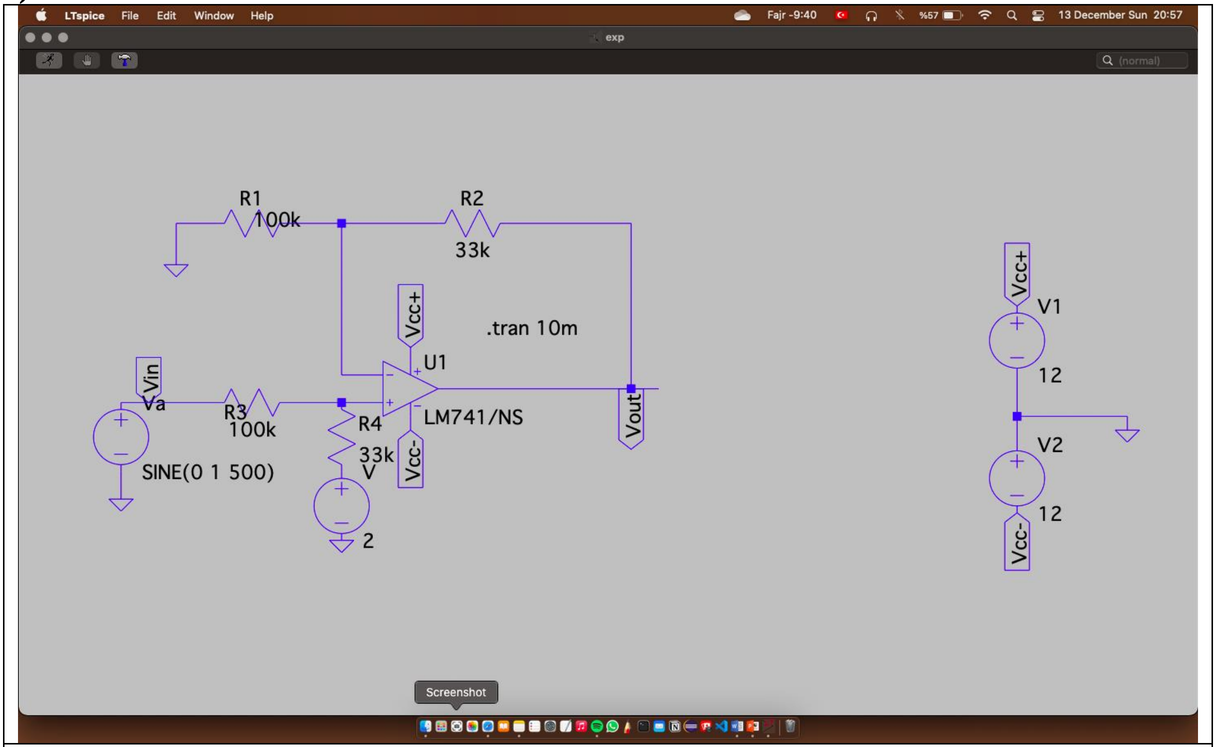


Figure 11: The function of the circuit is non-inverting (multiplying by 0.33 and adding 2 to the input voltage) and the figure corresponds to Figure 9 in the experiment worksheet.

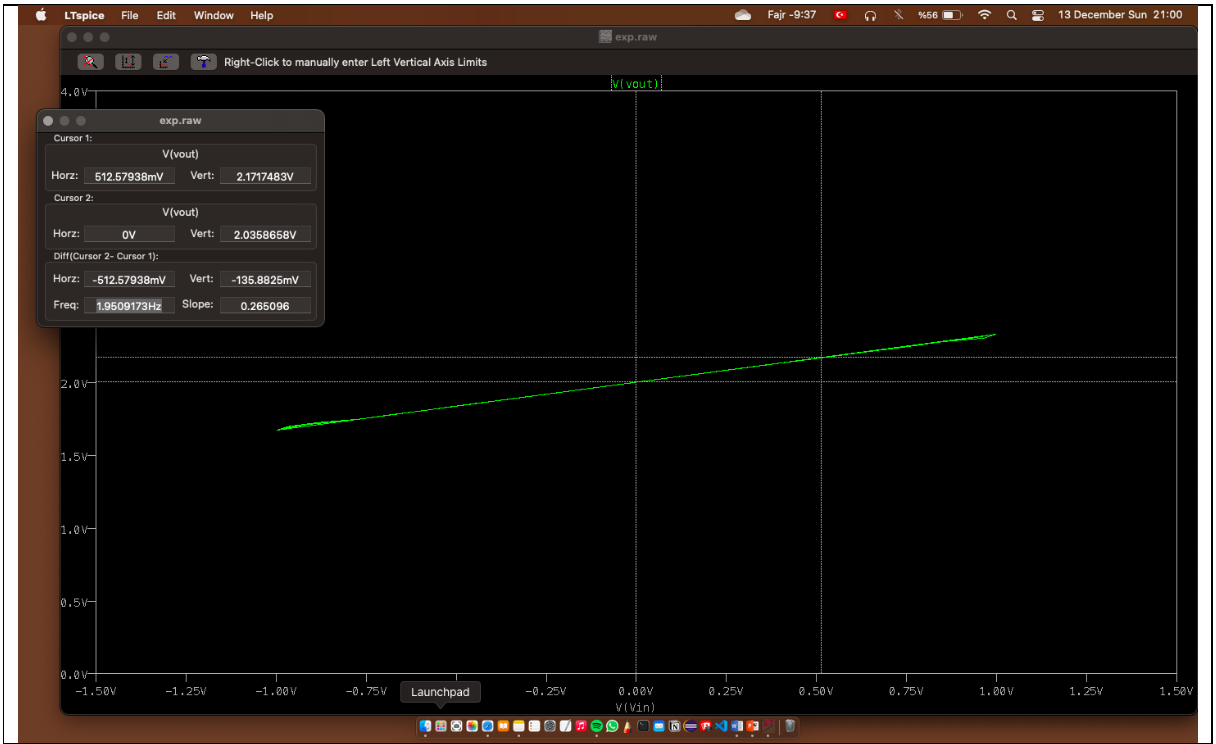


Figure 12: The input voltages is multiplied by 0.33 and added 2, seen on the output voltage. The shape of the output waveform with respect to the input wave is linear. Since max of Vin is 1, the output voltage does not reach the saturation point. (Little differences due to negative feedback (due to non-ideal op amp) and floating-point precision.)

Comments: The results are same as expected, just little differences.

4) Conclusions:

1. Why do the outputs saturate?

Because the output voltage is limited to the supply voltage. When this limit is reaced or being trying to exceeded, the output satures.

2. What may happen if the inputs are not grounded correctly?

The output will not be what we are expecting. After some value, output is saturated always.