

Pre-Lab 3:

Second Order Circuit

Name: Wan-Yu Liao

ECEN 325 Section 514

TA: Mandela

Date: September 20, 2019

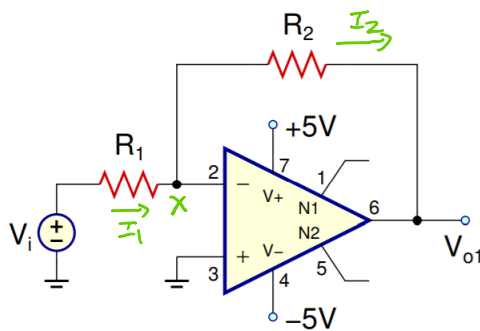
Calculation

1. Read the data sheet for the UA741 opamp and write down the typical values of the following parameters:

| | | | |
|--------------------|--------------------------|-----------------------|------|
| Supply Voltage: | 5V to 15V -5V to -15V | Power Consumption: | 50mW |
| Input Resistance: | 2MΩ | Input Offset Voltage: | 1mV |
| Output Resistance: | 75Ω | Input Offset Current: | 20nA |
| Voltage Gain: | 106dB | Bandwidth: | 1MHz |
| Slew Rate: | 0.5V/μs | | |

2. Derive the voltage gains

Circuit A

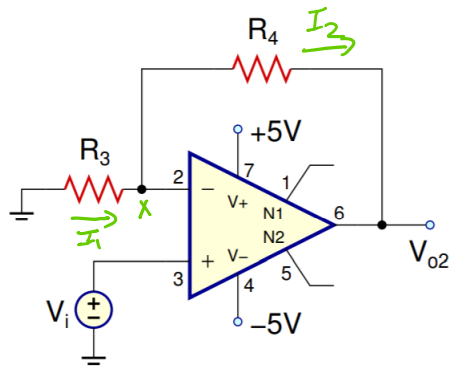


$$V_x = 0 \quad I_1 = I_2$$

$$\frac{V_i - V_x}{R_1} = \frac{V_x - V_{o1}}{R_2}$$

$$\boxed{\frac{V_{o1}}{V_i} = -\frac{R_2}{R_1}}$$

Circuit B

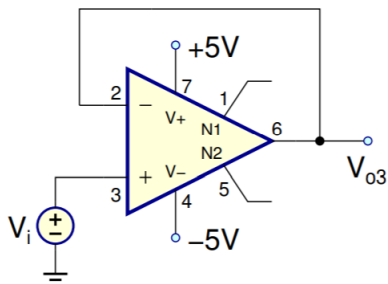


$$V_x = V_i$$

$$\frac{0 - V_x}{R_3} = \frac{V_x - V_{o2}}{R_4}$$

$$\frac{V_{o2}}{V_i} = 1 + \frac{R_4}{R_3}$$

Circuit C



$$V_{o3} = V_i$$

$$\frac{V_{o3}}{V_i} = 1$$

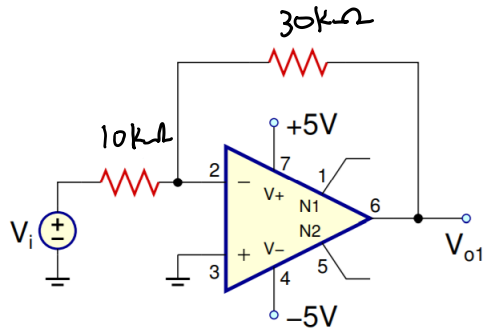
3. If $R_1 = R_3 = 10\text{k}\Omega$, find R_2 and R_4 such that $V_{o1}/V_i = -3$ and $V_{o2}/V_i = 6$.

$$\frac{V_{o1}}{V_i} = -\frac{R_2}{R_1} \Rightarrow -3 = -\frac{R_2}{10\text{k}} \Rightarrow R_2 = 30\text{k}\Omega$$

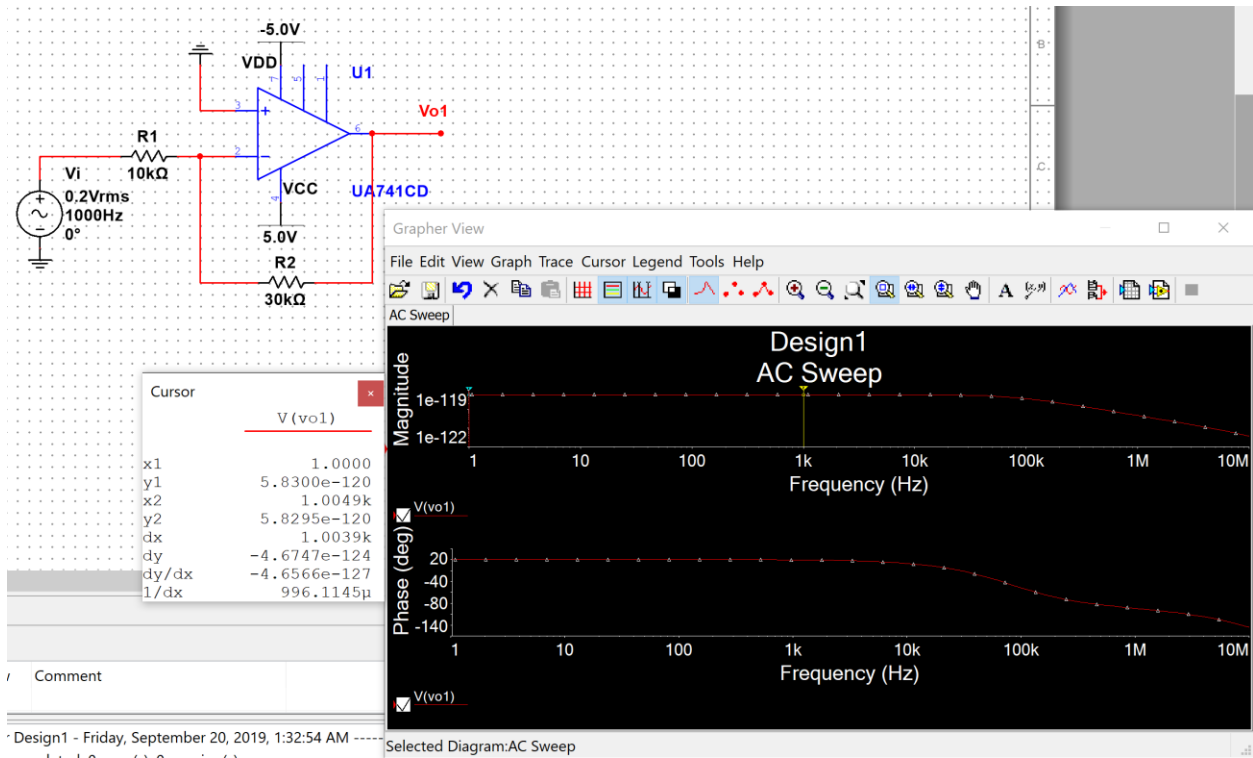
$$\frac{V_{o2}}{V_i} = 1 + \frac{R_4}{R_3} \Rightarrow 6 = 1 + \frac{R_4}{10\text{k}} \Rightarrow R_4 = 50\text{k}\Omega$$

Simulations

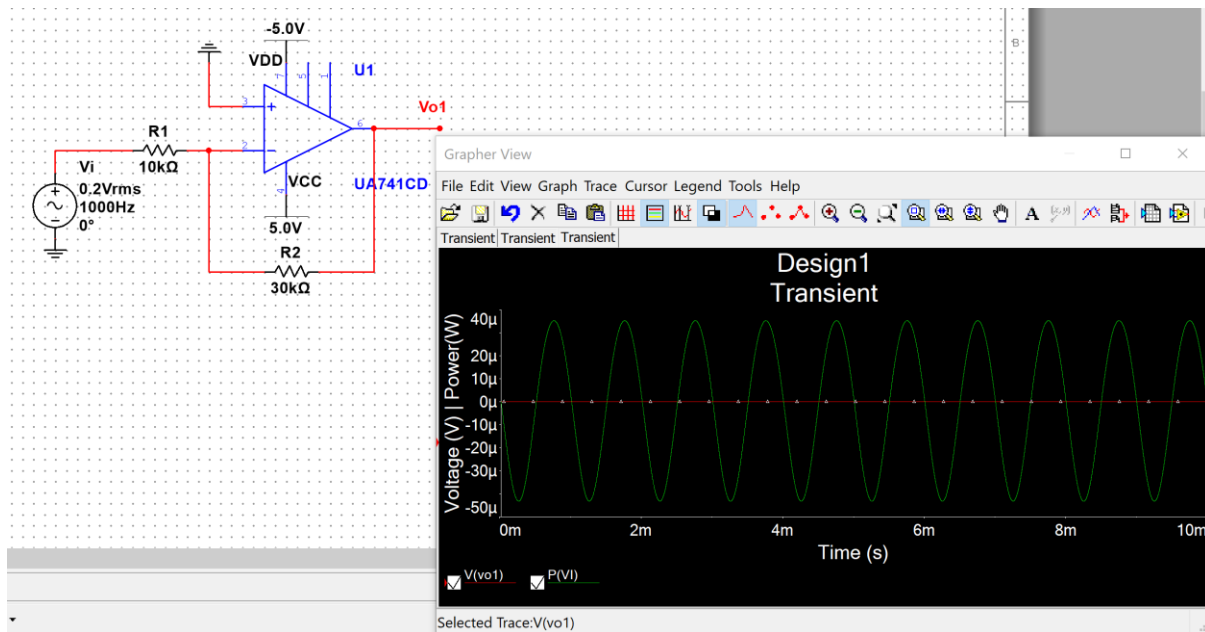
Circuit A



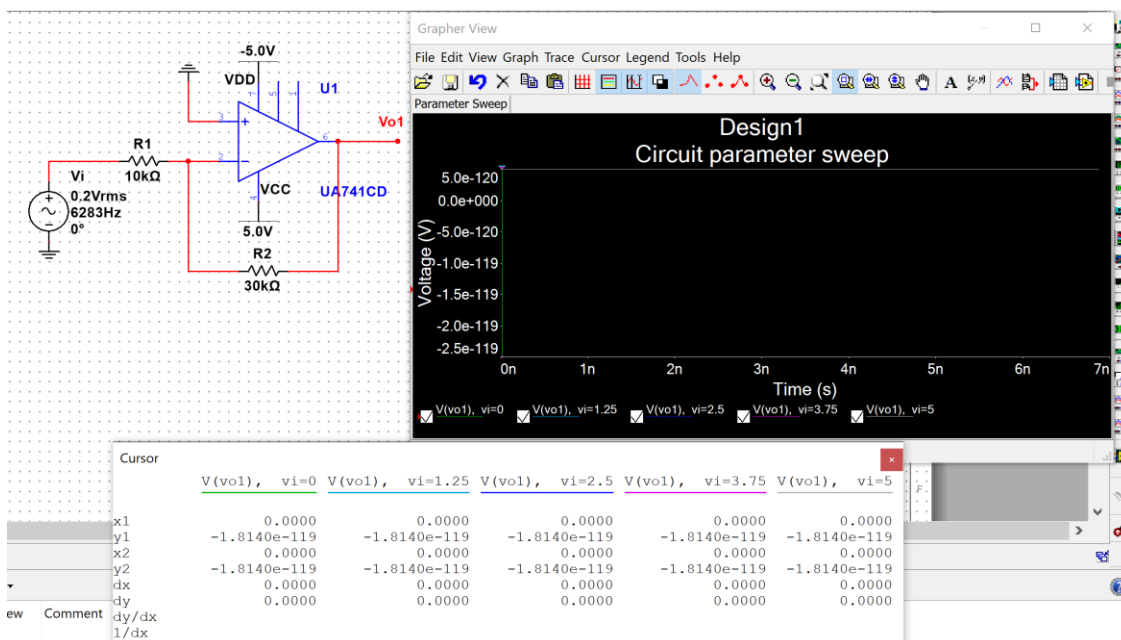
(a)



(b)

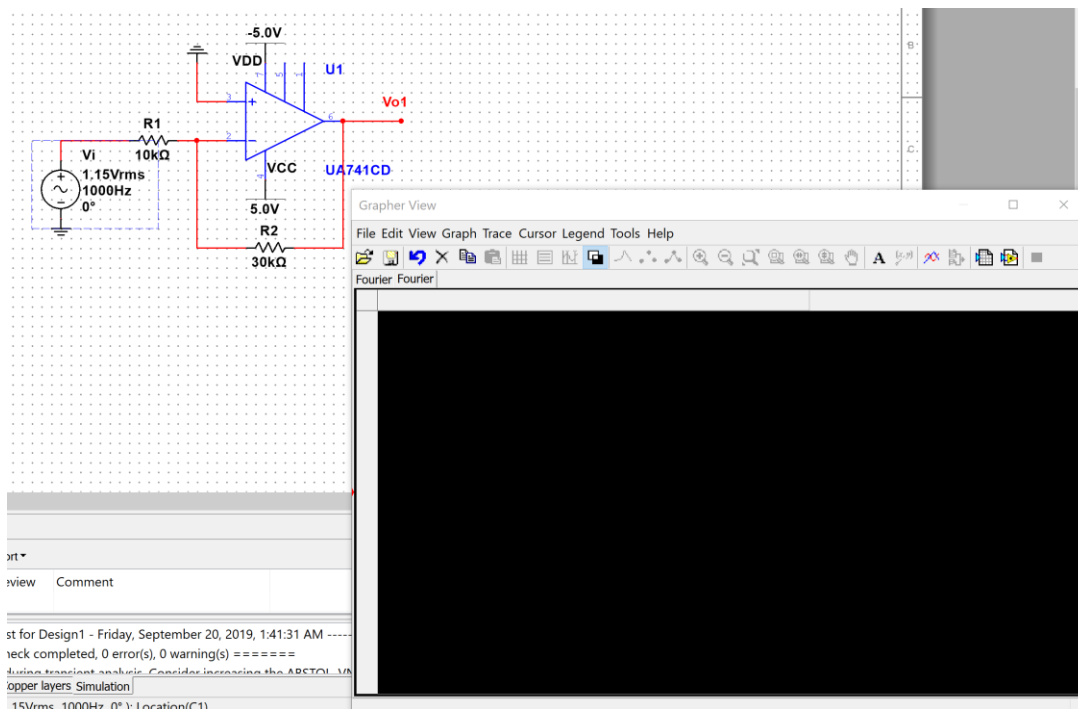


(c)



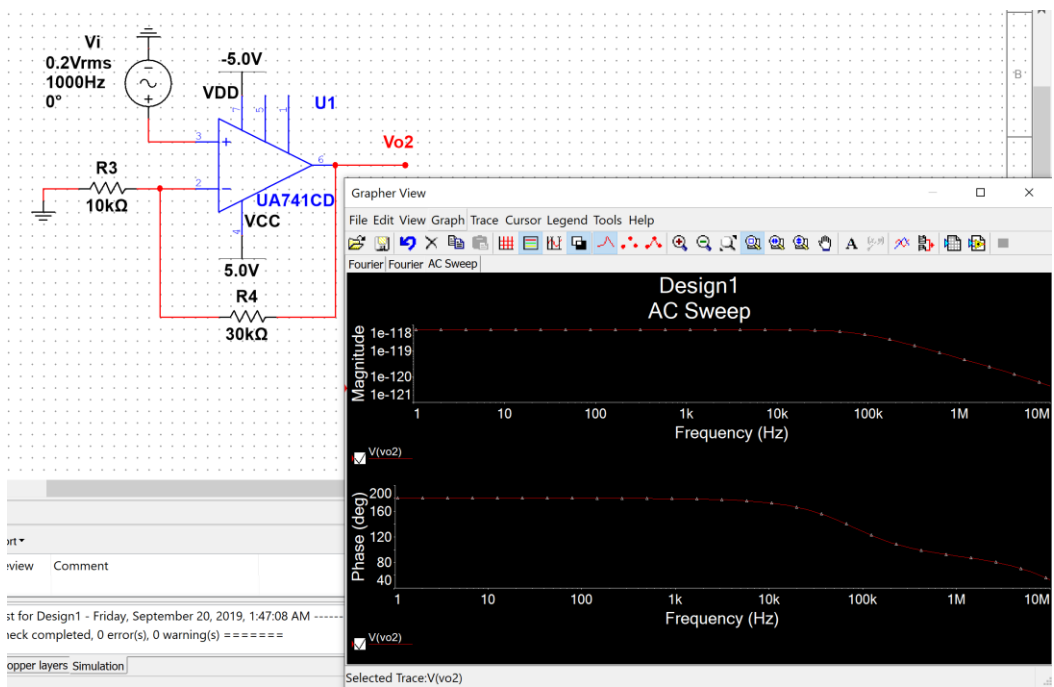
(d)

Since I couldn't tell the V_{max} from the graph above. I searched online and used 1.15V as the V_{max} for this circuit. Still couldn't figure out why there is nothing on the graph.

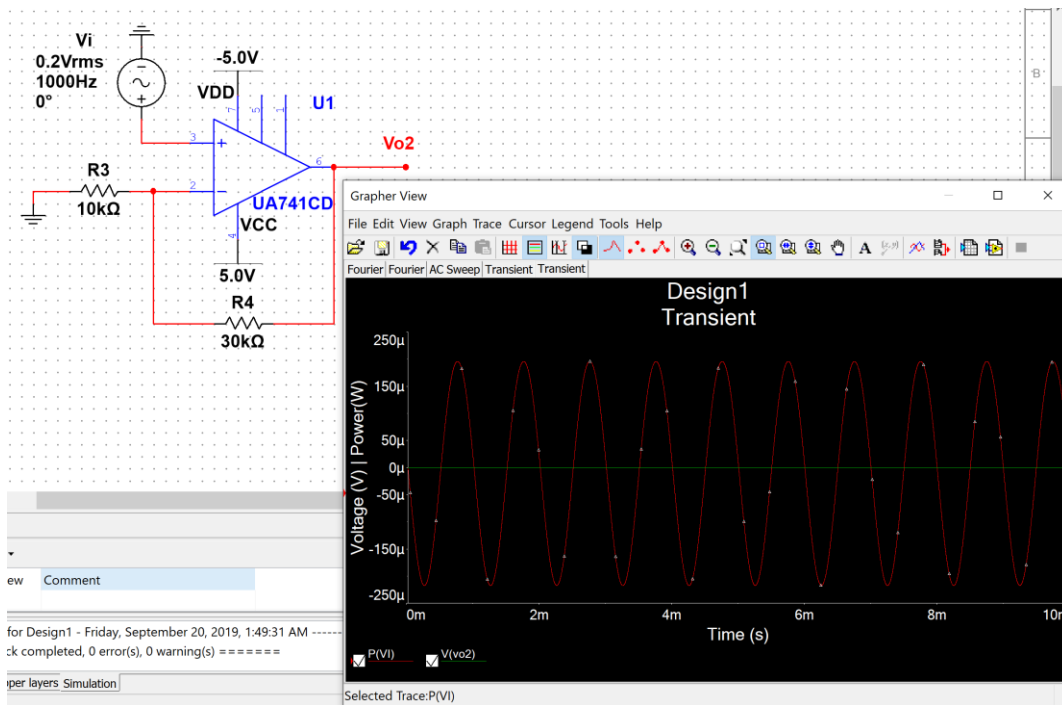


Circuit B

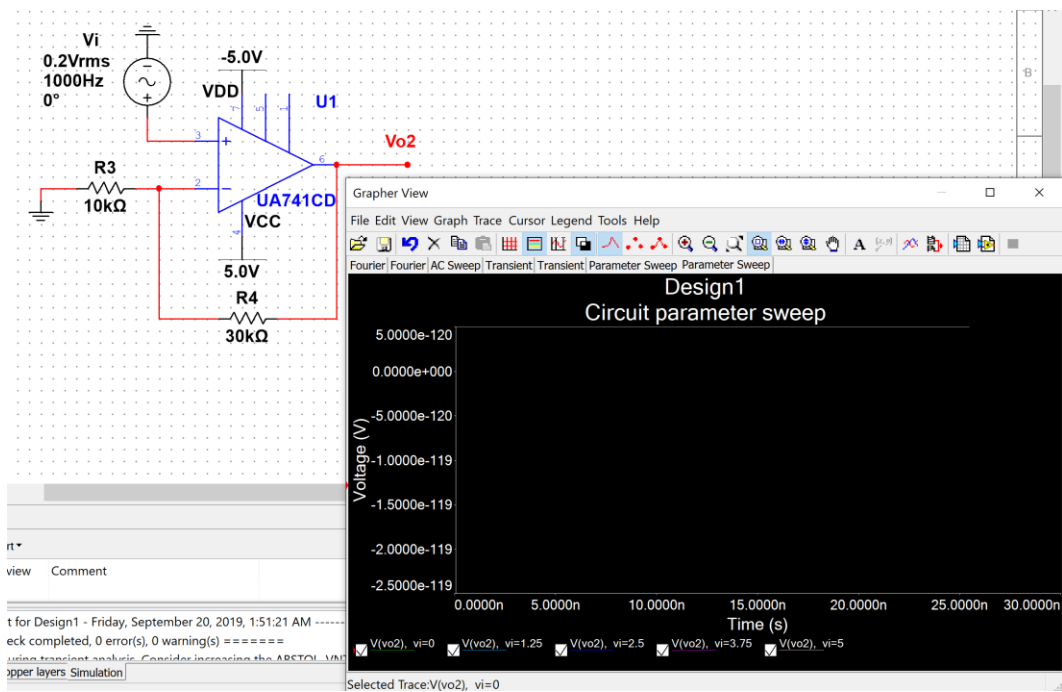
(a)



(b)

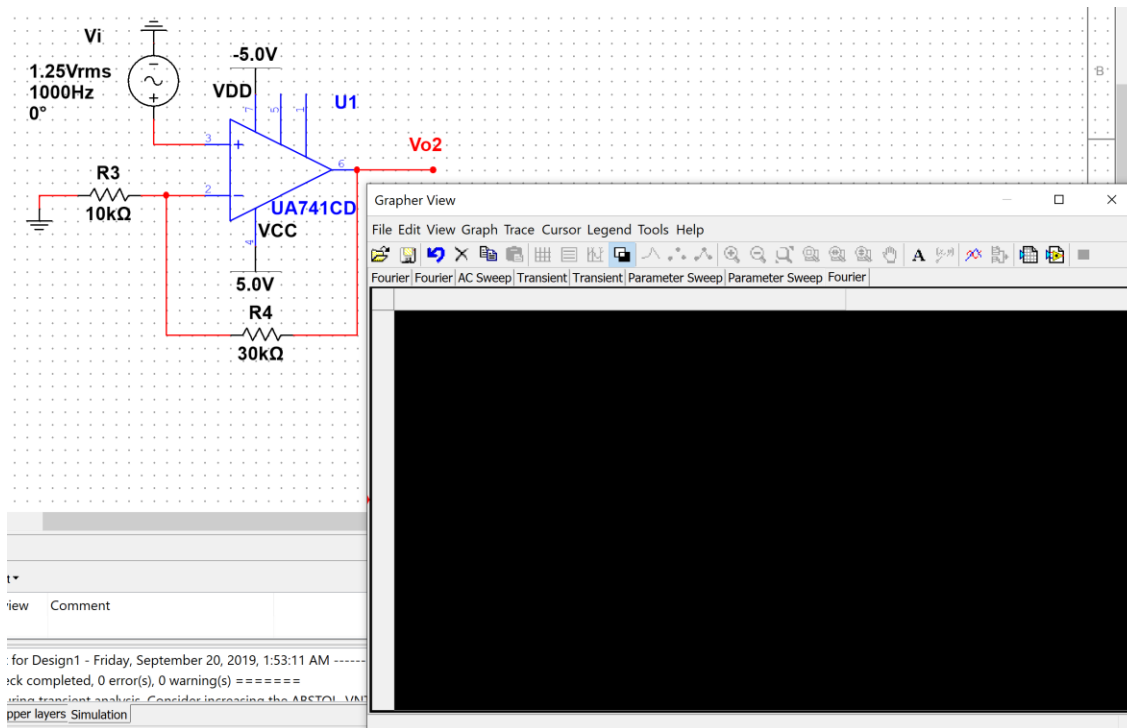


(c)



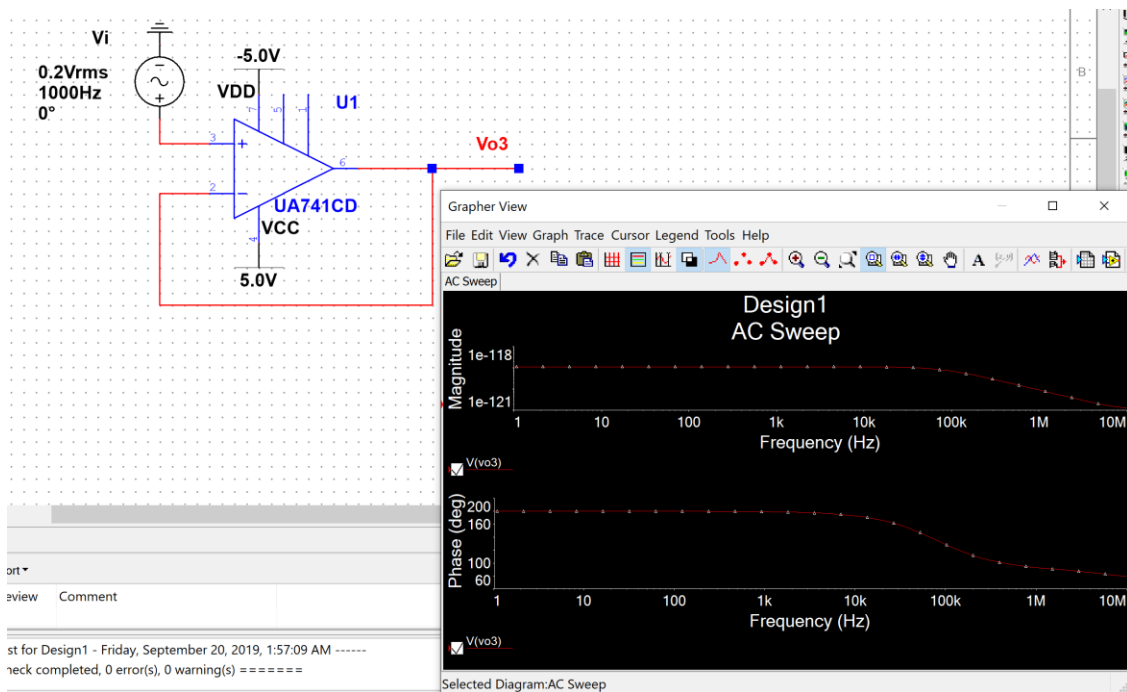
(d)

Since I couldn't tell the V_{max} from the graph above. I searched online and used 1.25V as the V_{max} for this circuit. Still couldn't figure out why there is nothing on the graph.

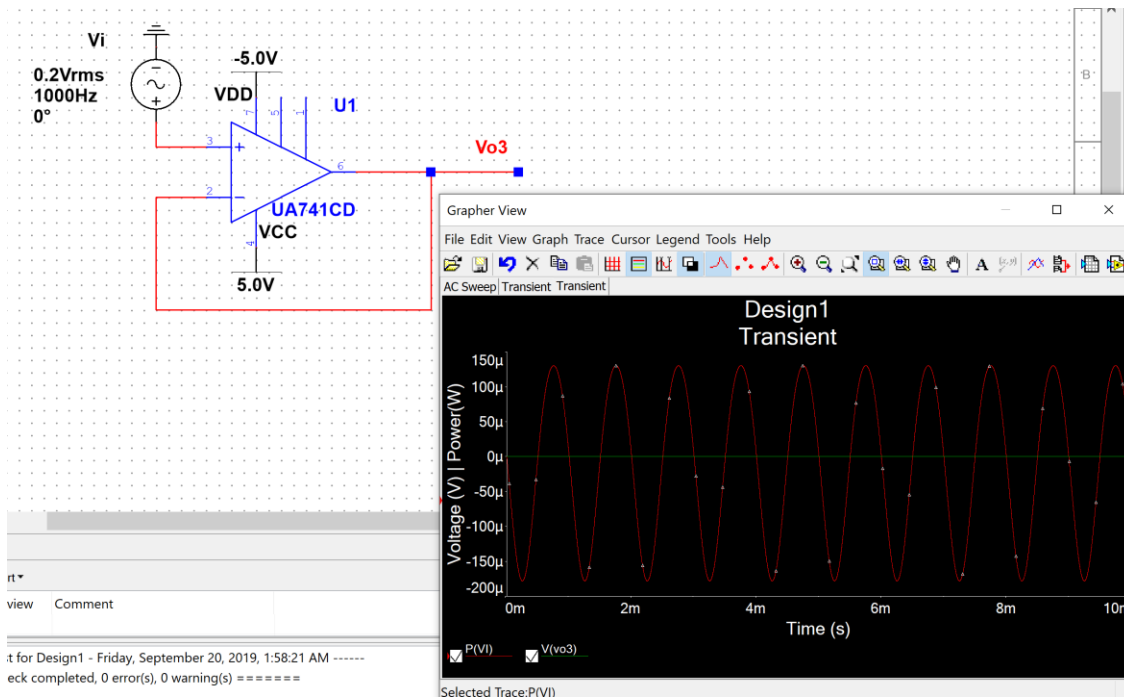


Circuit C

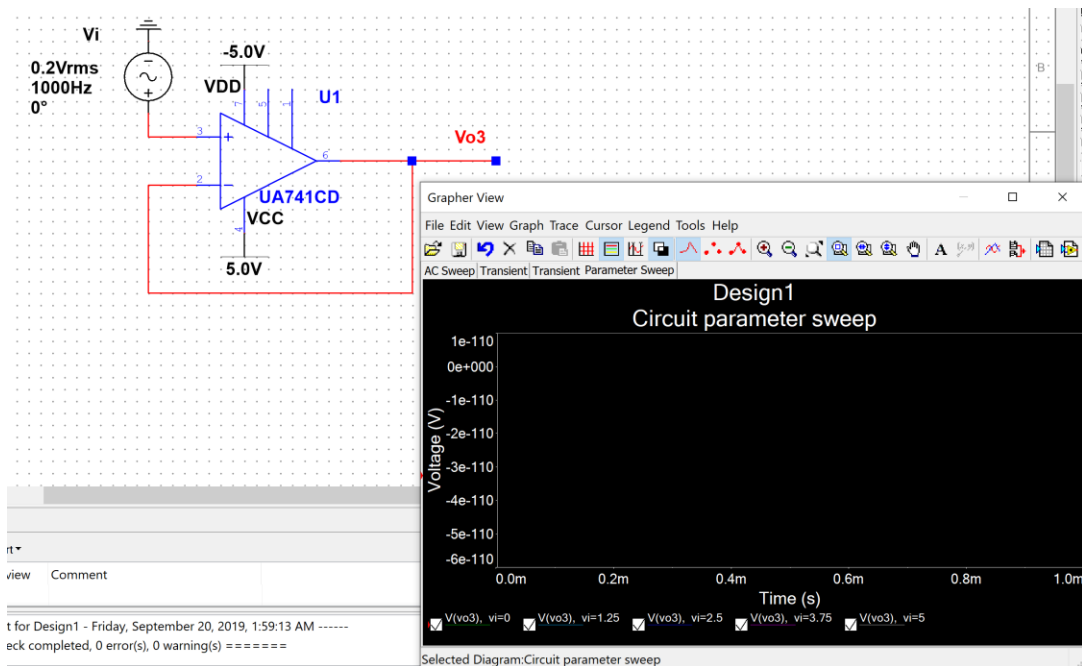
(a)



(b)



(c)



(d)

Since I couldn't tell the V_{max} from the graph above. I searched online and used 1V as the V_{max} for this circuit. Still couldn't figure out why there is nothing on the graph.

