Faculty of Engineering and Technology
Department of Electrical and Computer Engineering

ENEE 2103

CIRCUITS AND ELECTRONICS LABORATORY

Experiment #9, Pre-Lab #5

"Multistage Amplifier and Frequency Response"

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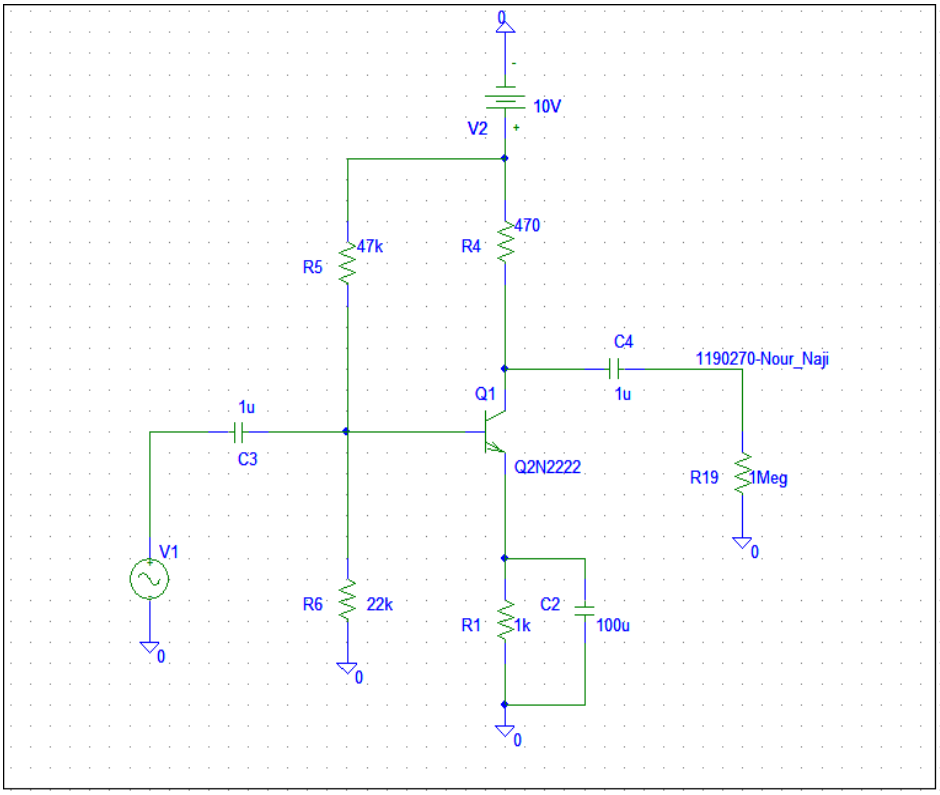
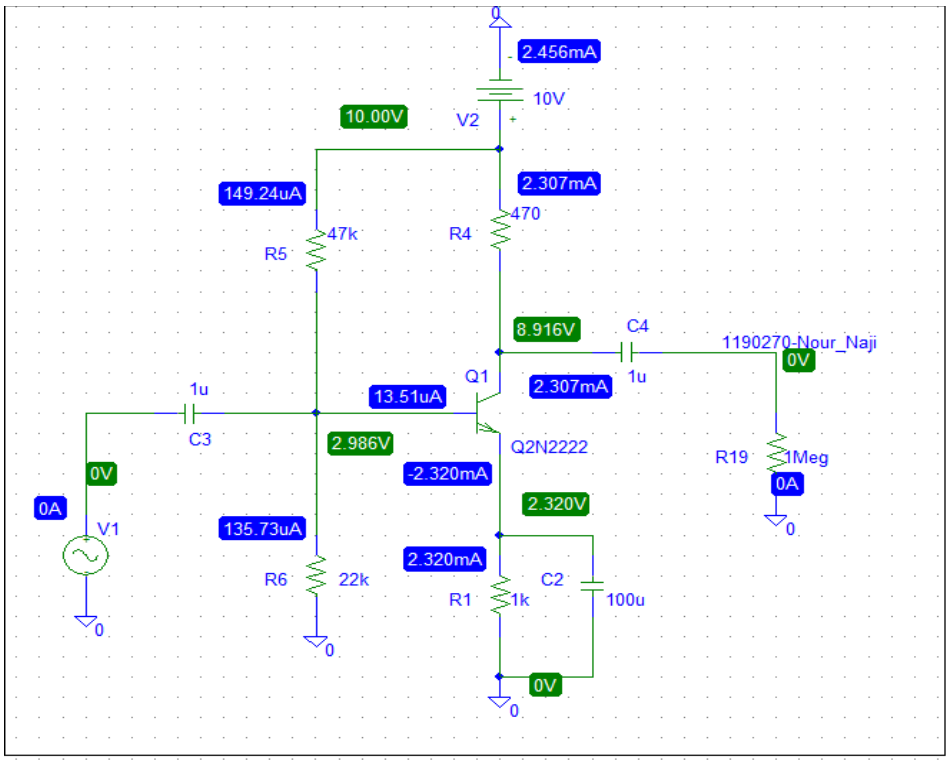
1. First Amplifier stage

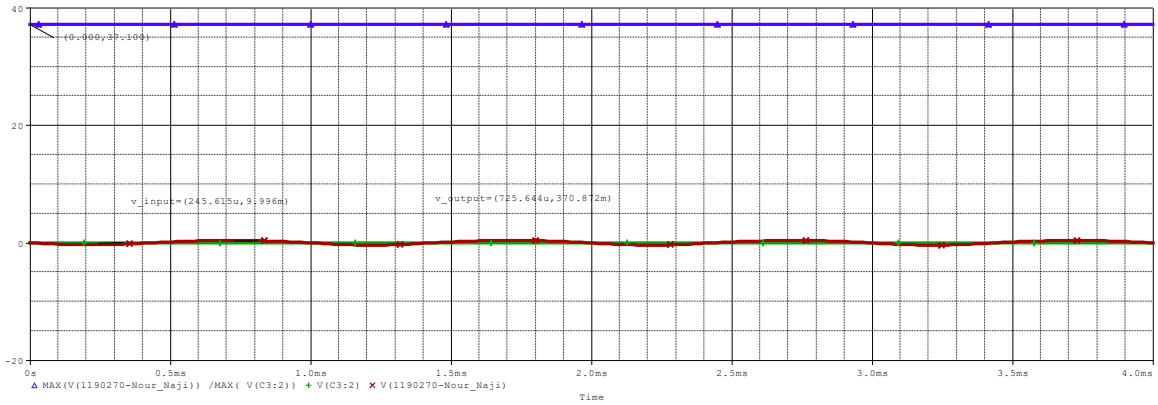


❖ DC bias and measure V_B, VC, V_E, IC and I_B:



- $V_B = 2.986$ v
- $V_C = 8.916$ v
- $V_E = 2.32$ v
- $I_C = 2.307$ mA
- $I_B = 13.51$ µA

❖ Transient analysis with a sine wave with frequency = 1 kHz and peak =10 mV:

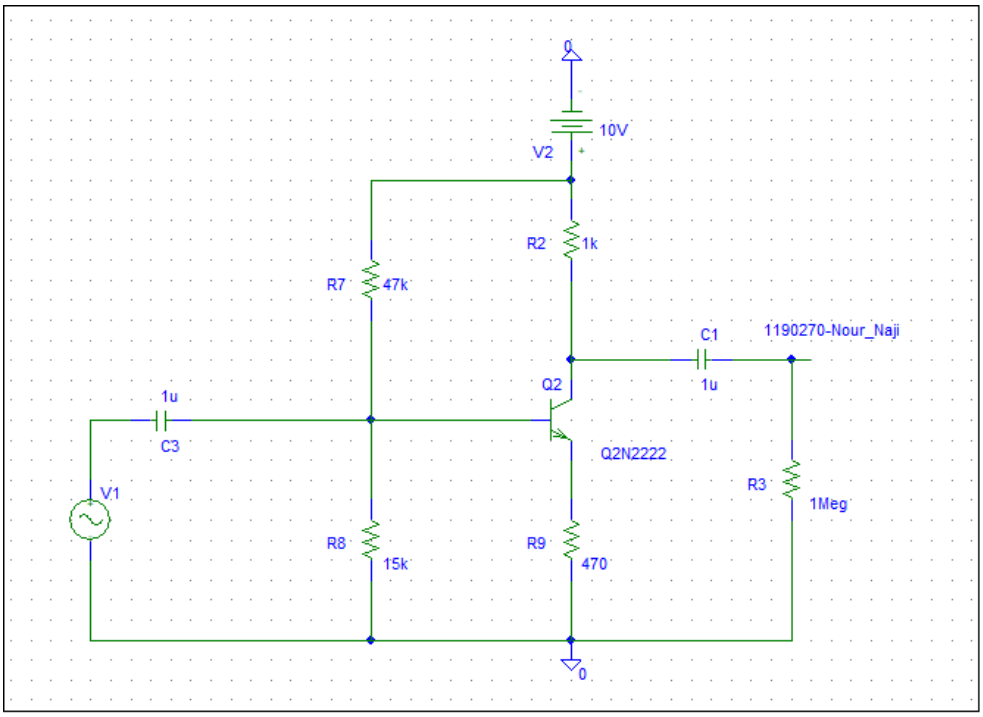


❖ Question:

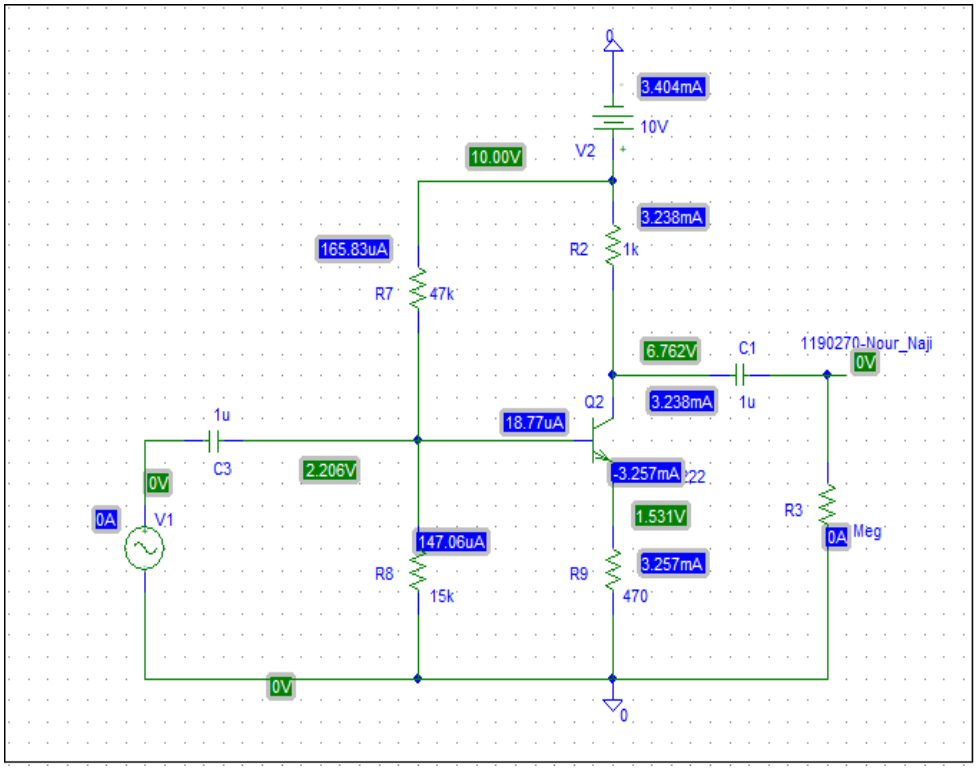
What is the gain of the amplifier first stage?

➢ Voltage Gain Av = $\frac{Vout}{Vin}$ = 37.100

2. Second Amplifier stage

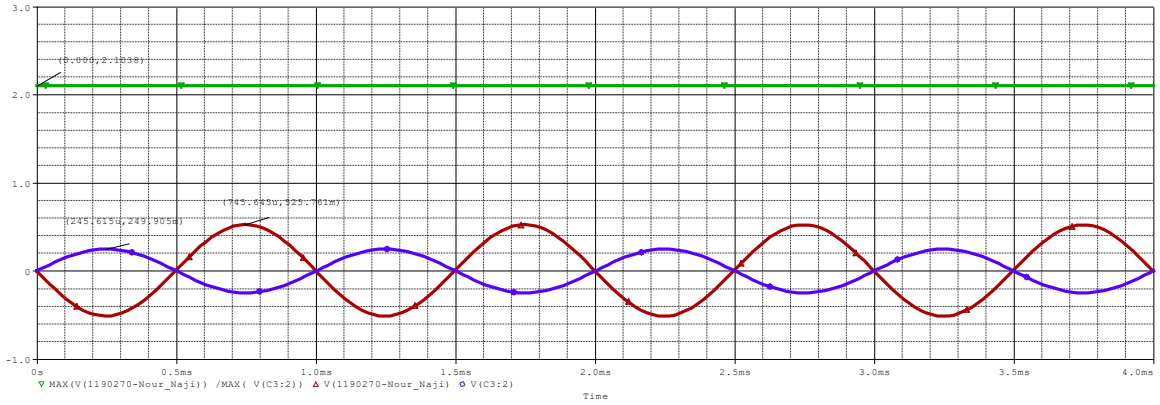


❖ DC bias and measure V_B, VC, V_E, IC and I_B:



- $V_B = 2.206$ v
- $V_C = 6.762$ v
- $V_E = 1.531$ v
- $I_C = 3.238$ mA
- $I_B = 18.77$ µA

❖ Transient analysis with a sine wave with frequency = 1 kHz and peak =250 mV:

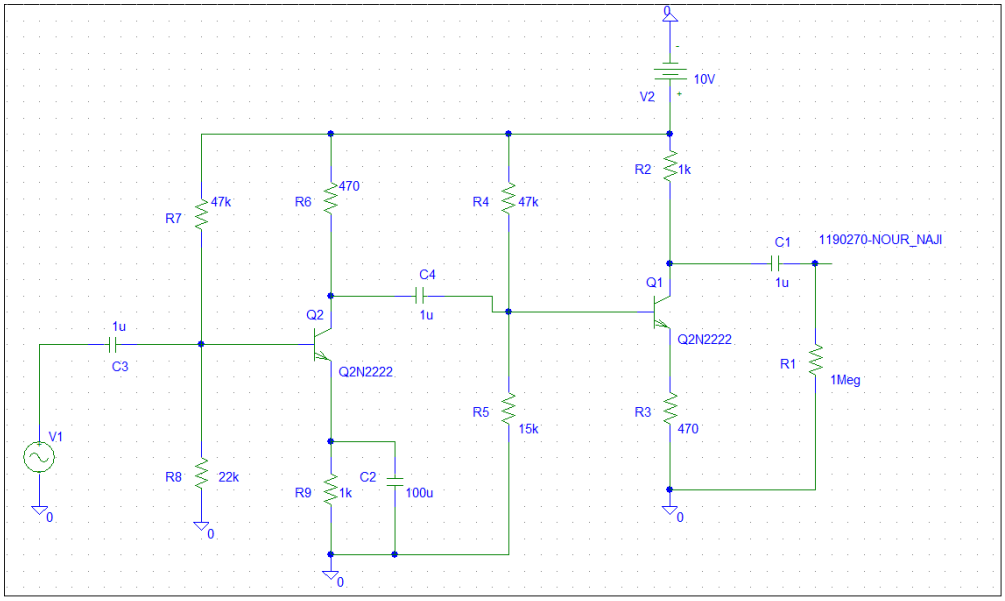


❖ Question:

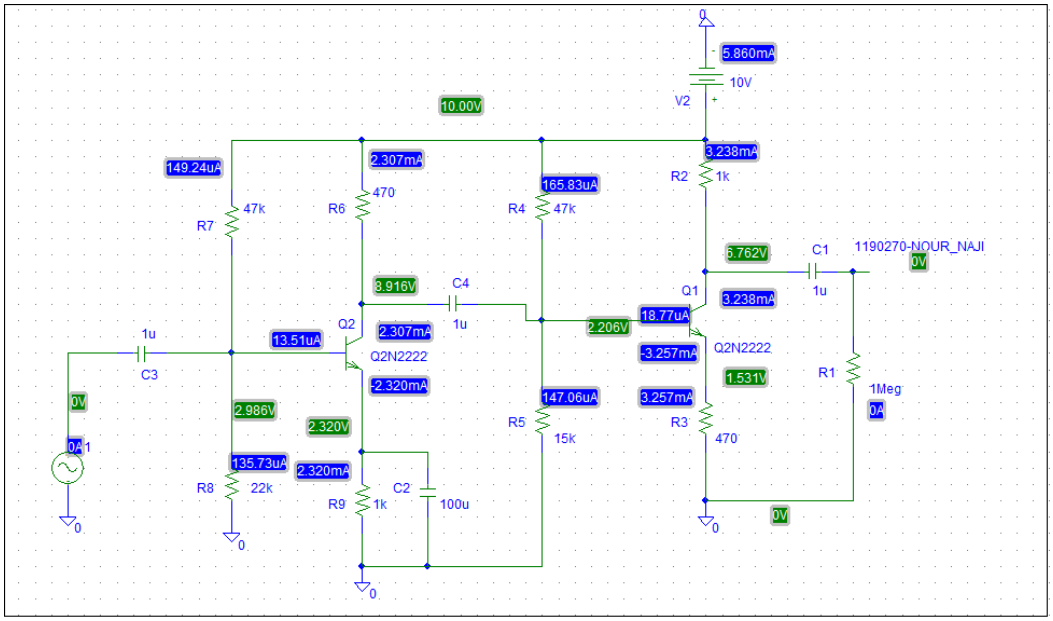
What is the gain of the amplifier first stage?

➢ Voltage Gain Av = $\frac{Vout}{Vin}$ = 2.1038

3. Connect the two stages together:

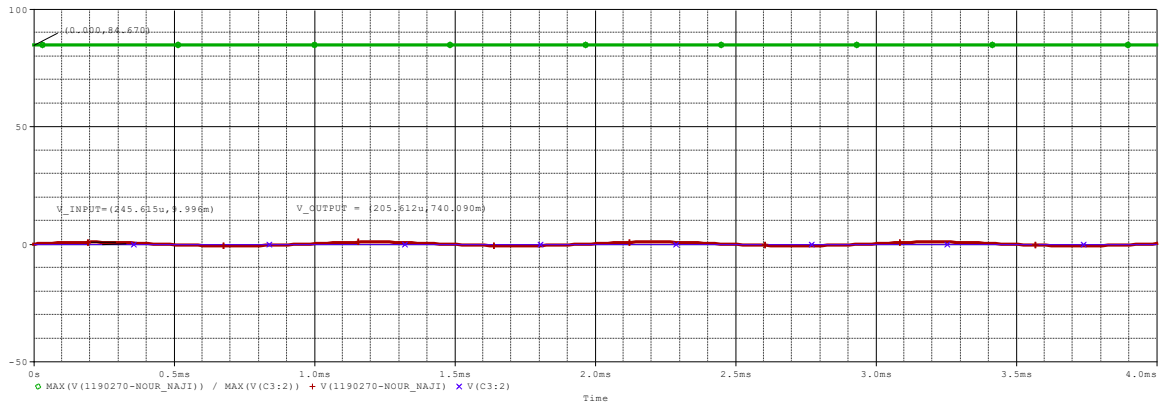


❖ DC bias and measure V_{B1},V_{C1}, V_{E1},I_{C1} and I_{B1} for first amplifier stage, V_{B2}, V_{C2},V_{E2},I_{C2} and I_{B2} for second amplifier stage:



- $V_{B2} = 2.986$ v $V_{B1} = 2.206$ v
- $V_{C2} = 8.916$ v $V_{C1} = 6.762$ v
- $V_{E2} = 2.320$ v $V_{E1} = 1.531$ v
- $I_{C2} = 2.307$ mA $I_{C1} = 3.238$ mA
- $I_{B2} = 13.51$ µA $I_{B1} = 18.77$ µA

❖ Transient analysis with Vi(t) replaced by a sine wave with frequency = 1kHz and peak =10 mV:



❖ Question:

What is the gain of the amplifier first stage?

➢ Voltage Gain Av = $\frac{Vout}{Vin}$ = 84.670

4. Compare the dc bias voltages and currents obtained in 1,2 and 3:

- DC bias and V_B, V_C, V_E, I_C and I_B obtained in A:
  - $V_B = 2.986$ v
  - $V_C = 8.916$ v
  - $V_E = 2.32$ v
  - $I_C = 2.307$ mA
  - $I_B = 13.51$ µA

- DC bias and measure V_B, V_C, V_E, I_C and I_B obtained in B:
  - $V_B = 2.206$ v
  - $V_C = 6.762$ v
  - $V_E = 1.531$ v
  - $I_C = 3.238$ mA
  - $I_B = 18.77$ µA

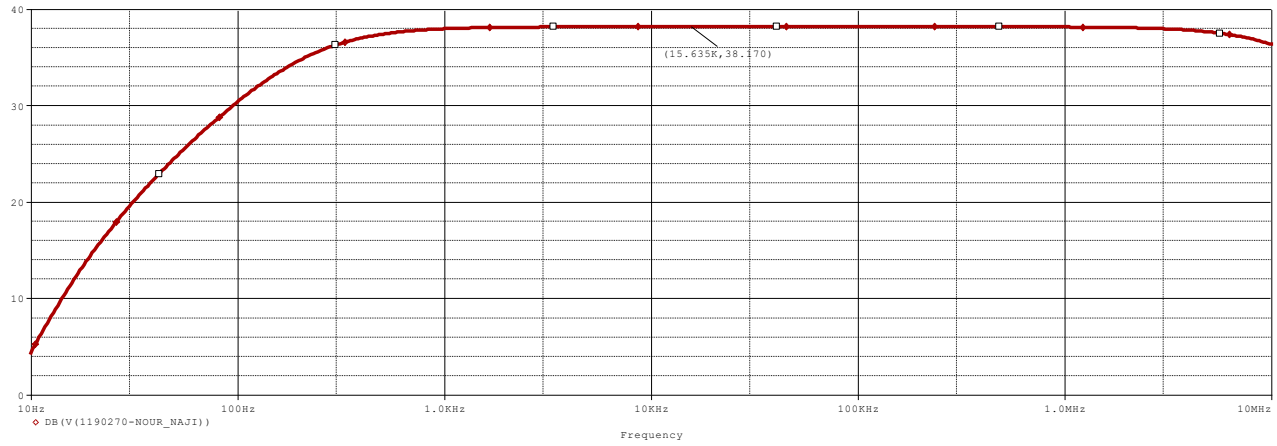
- DC bias and measure V_{B1}, V_{C1}, V_{E1}, I_{C1} and IB1 for first amplifier stage, V_{B2}, V_{C2}, V_{E2}, I_{C2} and I_{B2} for second amplifier stage:
  - $V_{B1} = 2.986$ v $V_{B2} = 2.206$ v
  - $V_{C1} = 8.916$ v $V_{C2} = 6.762$ v
  - $V_{E1} = 2.32$ v $V_{E2} = 1.531$ v
  - $I_{C1} = 2.307$ Ma $I_{C2} = 3.238$ mA
  - $I_{B1} = 13.51$ µA $I_{B2} = 18.77$ µA

5. Compare Av (obtained in 3) with product Av1*Av2 (obtained in 1 and 2):

- Voltage Gain $A_{v1} = \frac{Vout}{Vin}$ = 37.100
- Voltage Gain $A_{v2} = \frac{Vout}{Vin}$ = 2.1038
- Voltage Gain Av = $\frac{Vout}{Vin}$ = 84.670
- $A_{v1} * A_{v2}$ = 37.100 * 2.1038 = 78.05 v

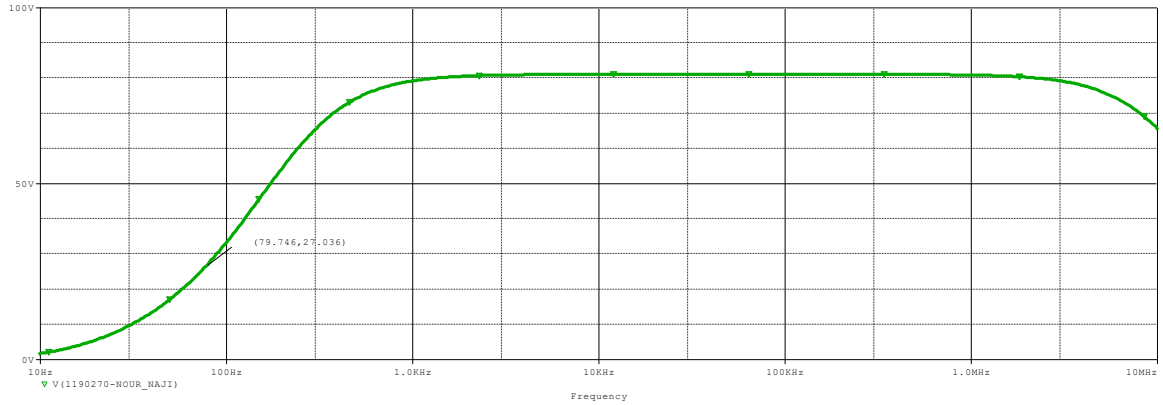
✓ As can be shown, Av = $\frac{Vout}{Vin}$ is the same as the result of the product of A_{v1} and A_{v2}, but with simple loading effect.

6. For the two stage Amplifier, perform ac sweep and show the frequency response in dB for frequency range 10Hz-10MHz



7. Based on F, estimate F_L and f_H (the cutoff frequencies at low and high frequencies)

- Log 38.170 = 1.5817 v
- $\frac{Av}{\sqrt{2}} = \frac{38.170}{\sqrt{2}} = 27$



- So the cut-off frequency = 79.746