Ryerson University

Department of Electrical, Computer, & Biomedical Engineering
Faculty of Engineering & Architectural Science

Course Title:	ELE302 Electric Networks
Course Number:	ELE302
Semester/Year (e.g.F2016)	F2024

Instructor:	S. Jassar

Assignment/Lab Number:	3
Assignment/Lab Title:	Freqvency Response and Bode Plots postlab

Submission Date:	
Due Date:	

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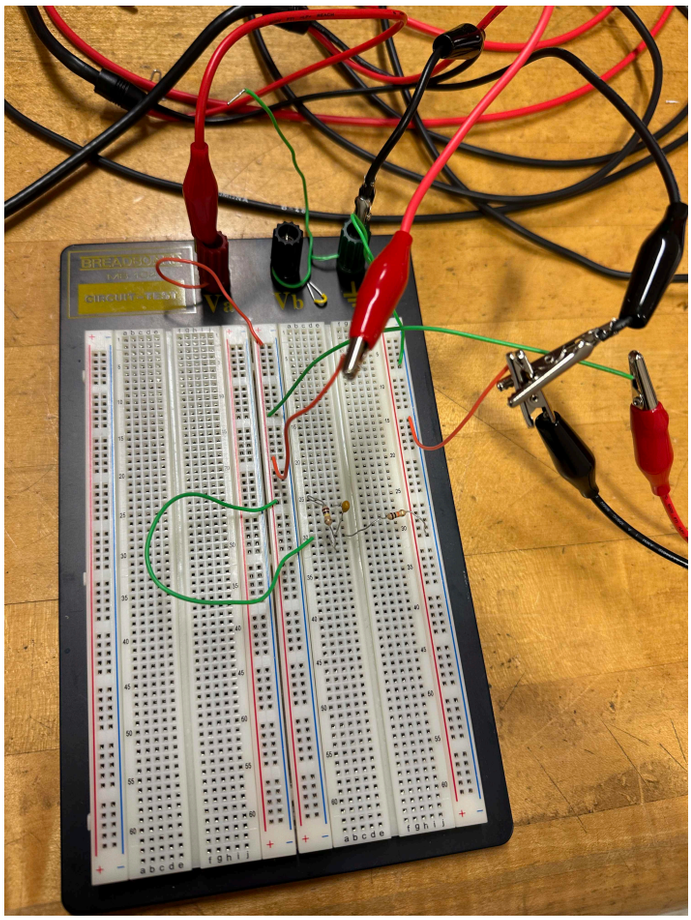
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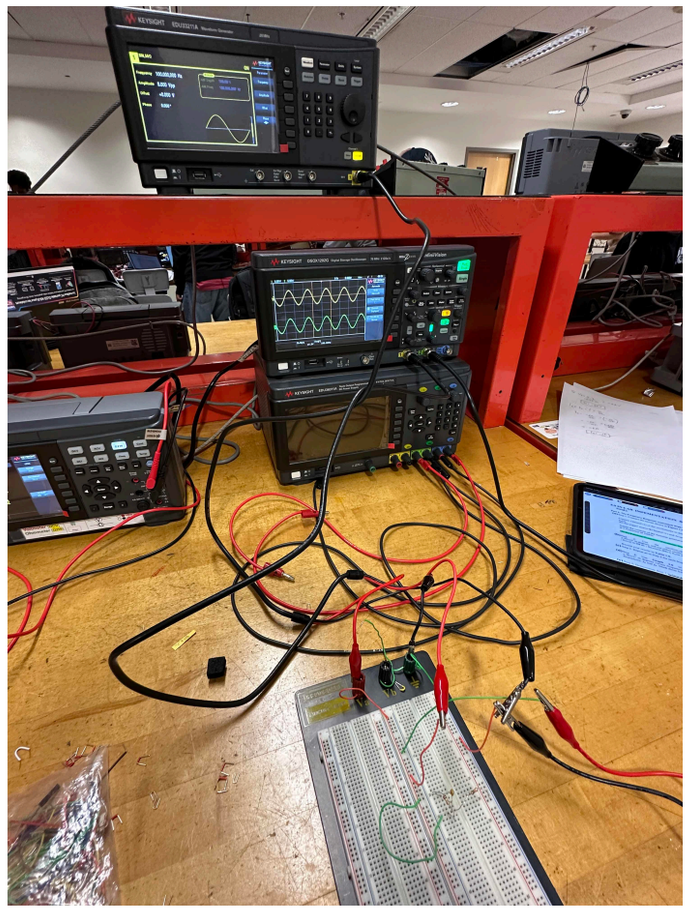
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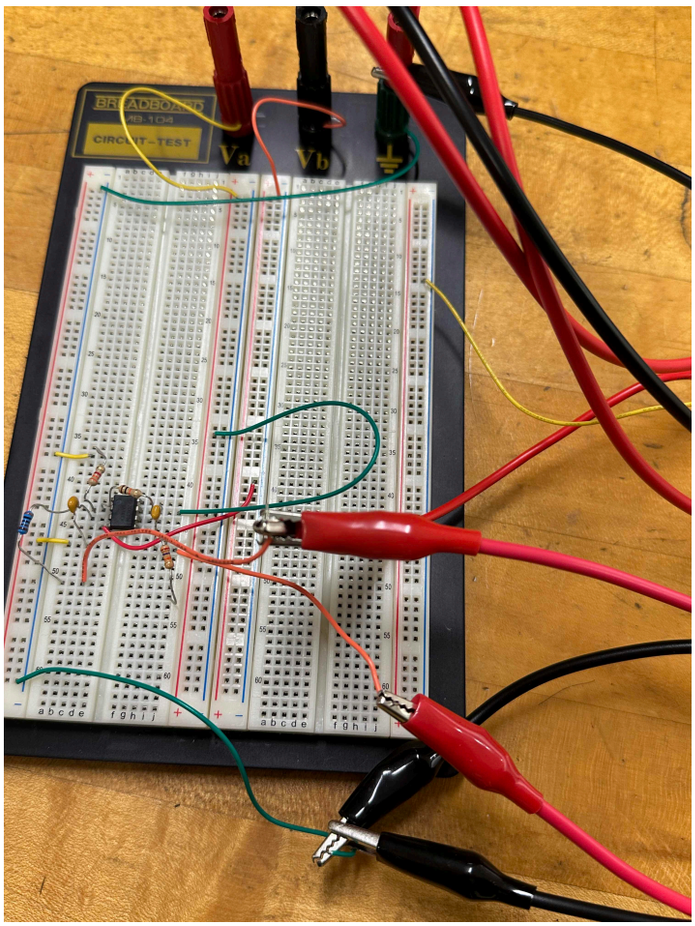
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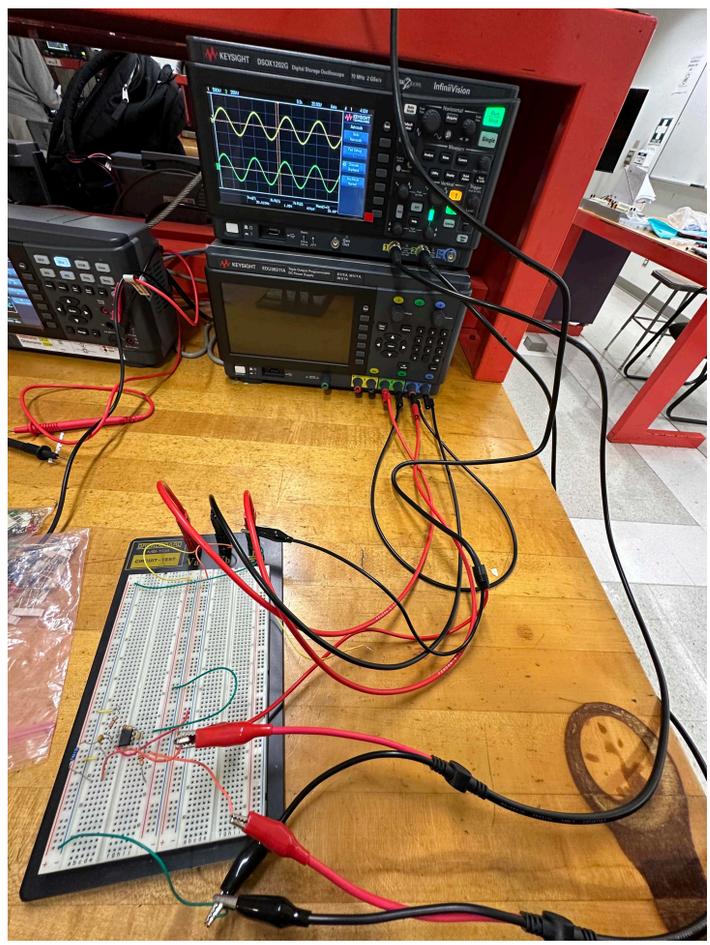
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5.0 IN-LAB IMPEMENTATION & MEASUREMENTS (5 marks in total):

Part I: The Frequency Response Associated With [One Pole-One Zero] Transfer Function

(a) Step 1: Connect the circuit shown in **Figure 1.0.**

Connect Channel (1) of the oscilloscope to display $v_i(t)$ and Channel (2) of the oscilloscope to display $v_o(t)$.
Set the trigger source→Channel (1) and Acquire Mode→Averaging.

Adjust the controls of the function generator to provide a **sinusoidal** input voltage $v_i(t)$ of **5V (peak)** at a frequency of 100Hz.

On the Function Generator: Waveform: Sine wave, Amplitude: 5 V_{PP}, Frequency: 100 Hz

(b) Step 2: Use the oscilloscope displays to measure the phase angle $\angle H(\omega)^o$ in degrees, and use either oscilloscope or DMM to measure V_i and V_o. Evaluate the magnitude $|H(\omega)|$ in dB as: $|H(\omega)|(\text{in dB}) = [V_o(\text{in dB}) - V_i(\text{in dB})]$.

Record your results in **Table 1.0.**

(c) Step 3: Repeat as in Step 2 for each frequency setting in **Table 1.0.**

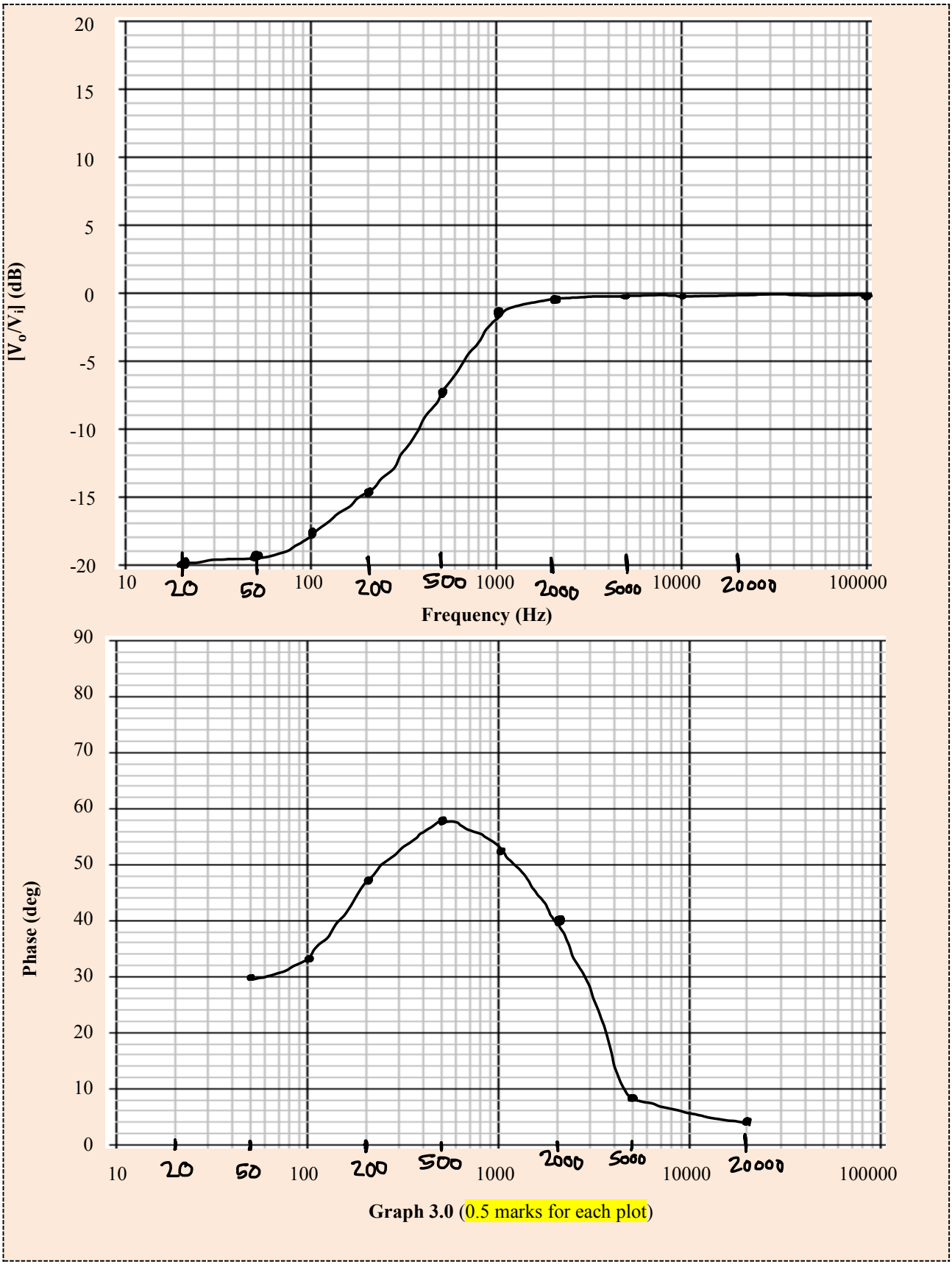
(d) Step 4: Use **Graph 3.0** to plot the magnitude $|H(\omega)|$ in dB and phase $\angle H(\omega)^o$ in degrees versus frequency in Hz. Use your plot to determine the locations of the corner frequencies: f_Z and f_P. Mark these frequencies on **Graph 3.0.**

(e) Step 5: Demonstrate Step 1 to Step 4 to your TA. (1 mark)

Table 1.0 (0.5 marks)

Vo - Vi

Frequency (Hz)	$\|V_o\|$ (dB)	$\|V_i\|$ (dB)	$\|H(\omega)\|$ (dB)	$\angle H(\omega)$ (degrees)
20	-7.57	13.171	-20.746	28.7
50	-6.76	13.17	-19.93	30.5
100	-4.87	13.17	-18.04	33.4
200	-1.086	13.17	-14.256	47.6
500	5.277	13.17	-7.893	58.9
1K	9.355	13.13	-3.775	52.4
2K	11.737	13.12	-1.38	40.6
10K	13.0	13.12	-0.119	9.21
20K	13.065	13.12	-0.0549	6.43
50K	13.08	13.12	-0.0399	3.21
100K	13.127	13.12	-0.007	0.51



Graph 3.0 (0.5 marks for each plot)

Part II: The Frequency Response Associated with [Two Poles-One Zero] Transfer Function

(f) Step 6: Connect the circuit shown in **Figure 2.0.** Connect Channel (1) of the oscilloscope to display $v_i(t)$ and Channel (2) of the oscilloscope to display $v_o(t)$; set the trigger source→Channel (1). Adjust the controls of the function generator to provide a **sinusoidal** input voltage $v_i(t)$ of **0.5V (peak)** at a frequency of 100Hz.

On the Function Generator: Waveform: Sine wave, Amplitude: 0.5 VPP, Frequency: 100 Hz

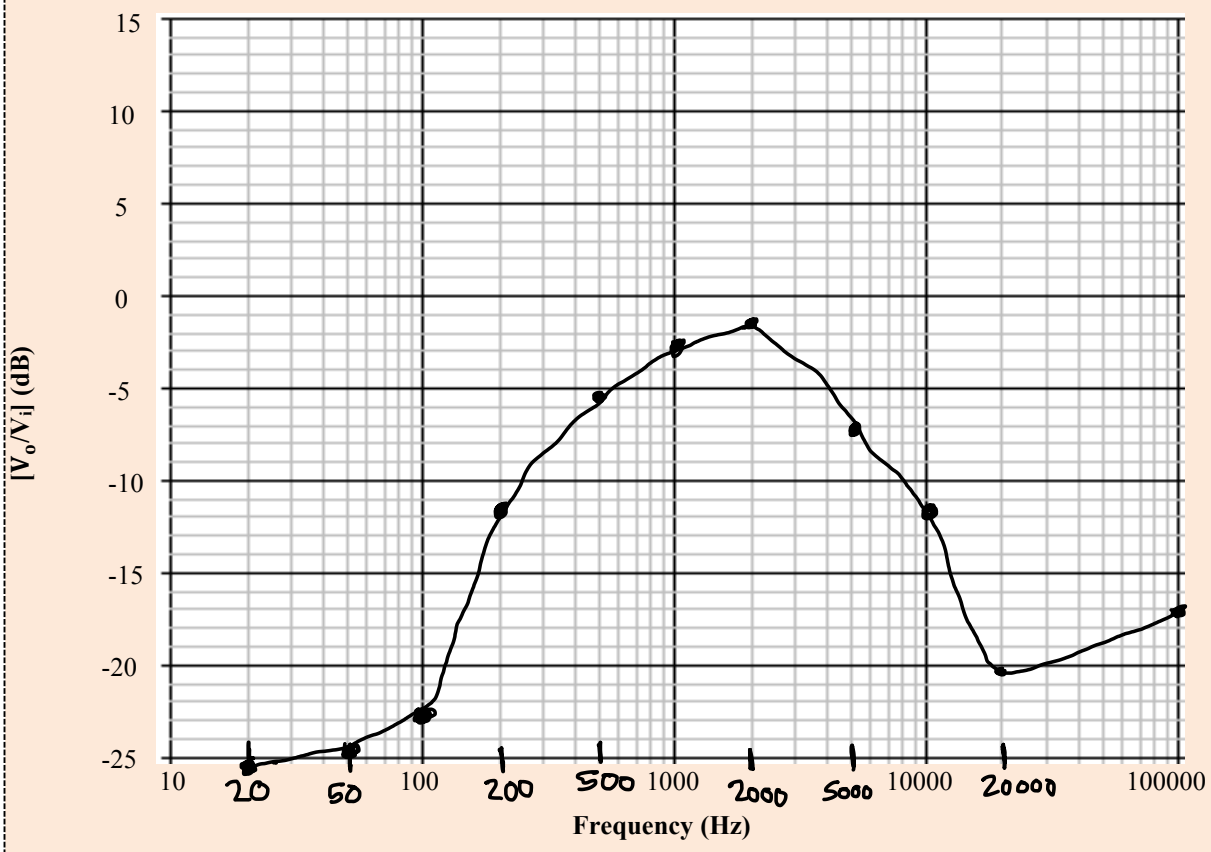
(g) Step 7: Repeat the measurements as in Step 2 and Step 3, and record your results in **Table 2.0.**

(h) Step 8: Use **Graph 4.0** to plot the magnitude $|H(\omega)|$ in dB and phase $\angle H(\omega)$ in degrees versus frequency in Hz. Use your plots to determine the locations of the corner frequencies: f_{P1} and f_{P2}. Mark these frequencies on **Graph 4.0.**

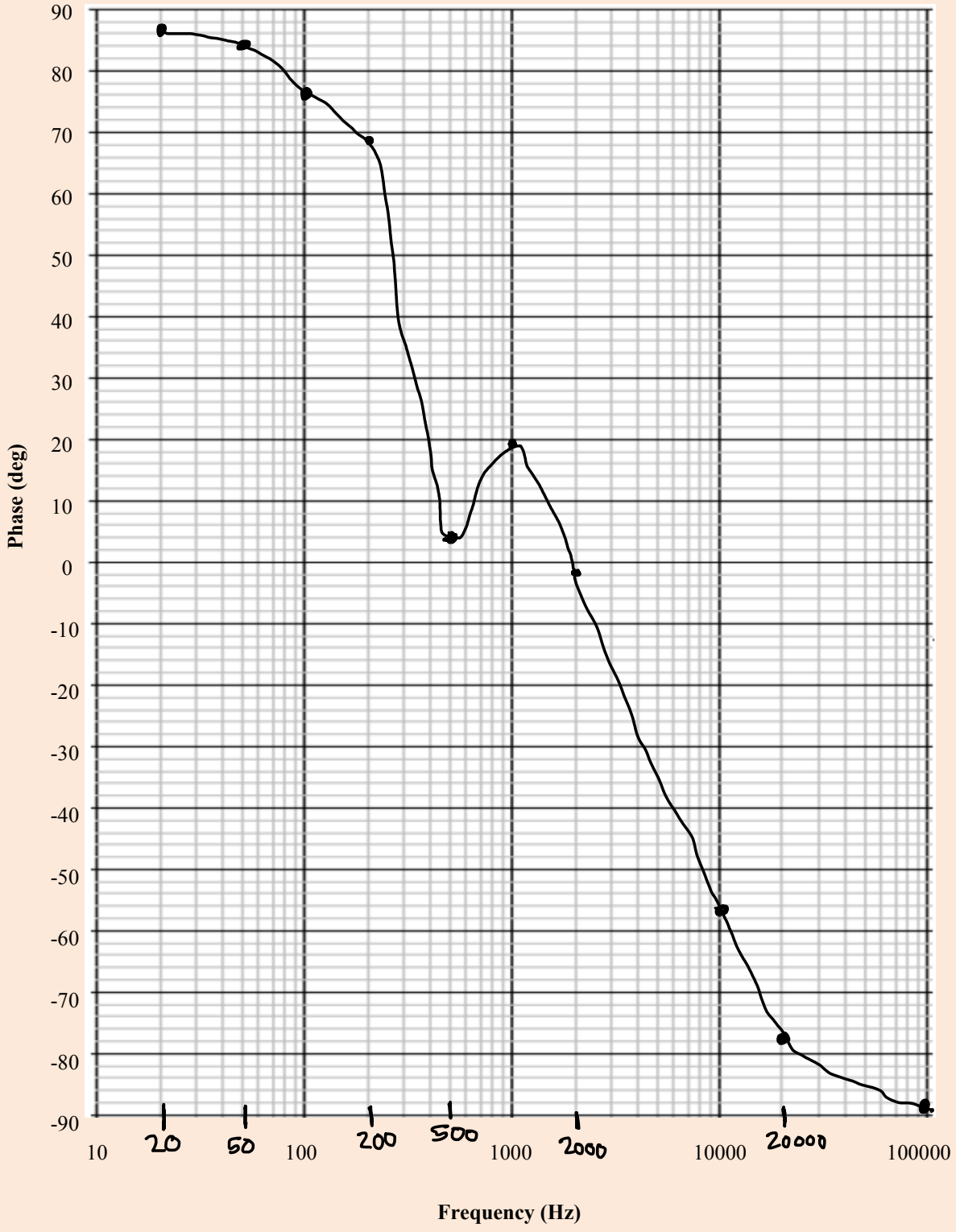
(i) Step 9: Demonstrate Step 6 to Step 8 to your TA. (1 mark)

Table 2.0 (0.5 marks)

Frequency (Hz)	$\|V_o\|$ (dB)	$\|V_i\|$ (dB)	$\|H(\omega)\|$ (dB)	$\angle H(\omega)$ (degrees)
20	−24.742	−6.8	−31.542	87.5°
50	−16.565	−6.8	−23.365	85.64°
100	−10.665	−6.8	−17.465	77.65°
200	−5.023	−6.8	−11.823	69.39°
500	1.072	−6.8	−5.728	4.46°
1K	3.571	−6.8	−3.289	19.65°
2K	4.247	−6.8	−2.553	−2.25°
10K	−0.576	−6.8	−7.376	−59.04°
20K	−5.56	−6.8	−12.36	−79°
50K	−13.485	−6.8	−20.285	−97.24°
100K	−10.11	−6.8	−17.41	−96.32



Graph 4.0 ***Gain*** (0.5 marks)



Graph 4.0 ***Phase*** (0.5 marks)

6.0POST-LAB QUESTIONS (2 marks in total, 2/3 marks for each question):

(1) By considering all the asymptotic & measured plots, answer the following:
   a) At which frequencies does the asymptotic plot yield the maximum error? What would you do to minimize this error?
   b) At what frequency range does the error become negligible?

a) The frequency with max error is 500Hz. As the numbers are increasing it goes from steady increase and jumps near 0. For instance, at 200Hz it was -6.44 then at 500Hz it become -0.213Hz. I would add a few extra points in between to keep a steady increase.

b) The error becomes negligible after 1K to look. This is where it becomes Steady increase

(2) What is the maximum rate of attenuation of | H(ω)| in dB/decade for your plots on in **Graph 3.0**?

$m = \frac{y_2 - y_1}{x_2 - x_2}$ m = slope of line

$m = \frac{28.9 - 5}{\log 100 - \log 20}$

$= 34.2$

∴ The max rate of attenuation will be 34.2

(3) By considering your plots on **Graph 4.0,** answer the following:

a) What is the maximum rate of attenuation of | H(ω)| in dB/decade?

b) Suppose that the 2.7kΩ resistor and the 0.01μF capacitor at the input part of the circuit in **Figure 2.0** were interchanged, what effect would this have on the frequency-response characteristics?

a) $m = \frac{y_2 - y_1}{x_2 - x_1}$

$= \frac{77.4 - 87.4}{\log 100 - \log 20}$

$= -14.3$

∴ The max rate of attenuation of graph 4.0 will be -14.3

b) If the capacitor and resistor were switched this will result into an extra zero in the transfer function

This is due to the fact that the capacitor is now directly connected to the input voltage.