Lab Experiment #3
Frequency Response

Group Members

	Student Name		Student ID #	Pre-Lab Mark (out of 30)	Lab Demo and performance (out of 70)	Total Lab Mark
	Surname	First Name				
Student 1						
Student 2						
Student 3						

TA Signature:

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Common Emitter Amplifier

Goal: The goal of this lab is to construct a common emitter amplifier and determine its frequency response

Prelab Work

1) For the common emitter amplifier shown in Figure 1, find all the low frequency poles. Assume that $\beta = 100$.

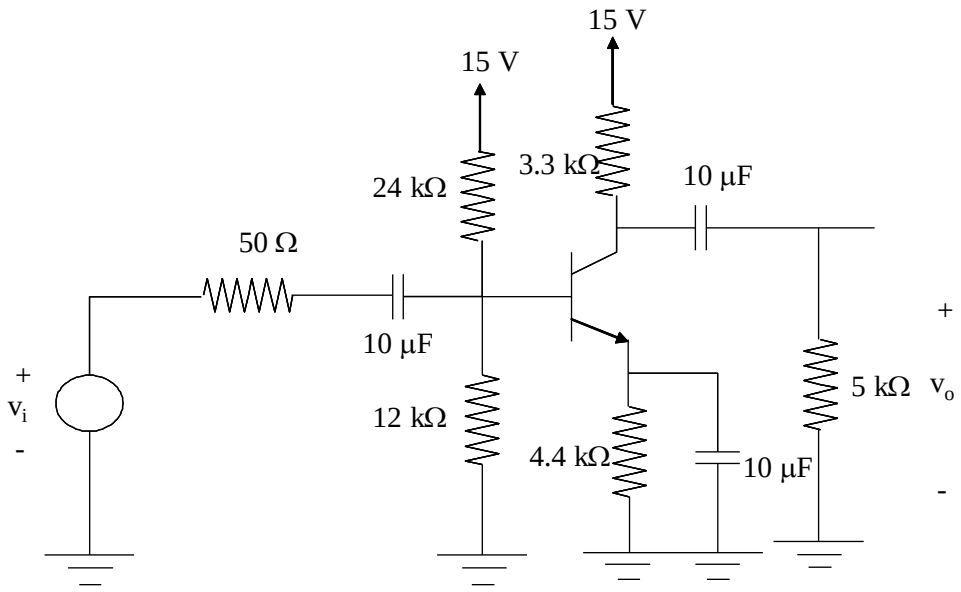


Fig. 1 Common Emitter Amplifier

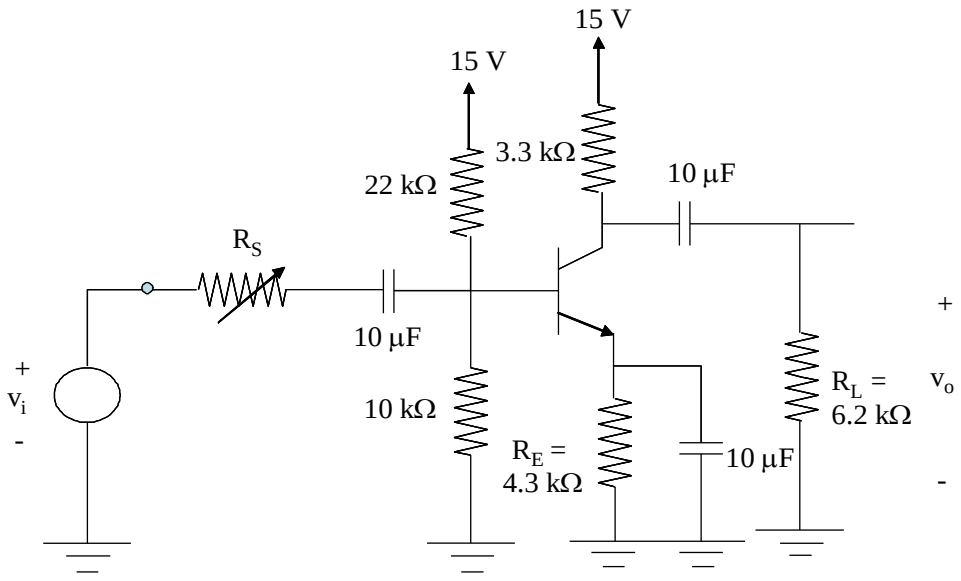
2) Find the midband gain of the circuit in Figure 1.

3) Find f_H if $f_T = 700$ MHz and $C_\mu = 3$ pF.

Procedure

Part 1 Low Frequency Response and Midband Gain

1) Measure the β of a 2N3904 transistor and then construct the circuit in Figure 2. Measure the DC voltages in the transistor's collector, emitter and base. What is the maximum p-p output signal you may expect? Use a variable resistance (R_S) at the output of the signal generator and treat this as the source resistance.



2) Using a 5 kHz sine wave with amplitude of 50 mV as the input, vary R_S until the amplitude of v_{be} is less than 10 mV. Record this value of R_S.

3) Measure the amplitude of v_o and note the phase difference between v_o and v_i. Calculate v_o/v_i. This is the midband gain of the amplifier (A_m). Compare to the theoretical value. Assume that r_x=0 and $r_o = \infty$.

4) Change R_E from 4.3 to 6.2 kΩ. Measure the DC voltages in the transistor's collector, emitter and base. What is the maximum p-p output signal you may expect this time? What is the new midband gain? How does R_E affect the midband gain of the circuit?

5) Return R_E to its original value of 4.3 kΩ. Lower the frequency of the input in steps of 1 KHz and record $|v_o|/|v_i|$ for each frequency. Use smaller steps (e.g. 200 KHz) when the gain starts to decrease. Continue decreasing the frequency until $|v_o|/|v_i| \leq |A_m|$. The 3dB frequency is the frequency where $|v_o|/|v_i|$ $= 0.707|A_m|$. At what frequency does this occur (use the graphs sheet given on the next page)?

6) Replace the load resistance R_L with a 10 kΩ resistor and repeat steps (3) and (5) (use the graphs sheet given on the next page).

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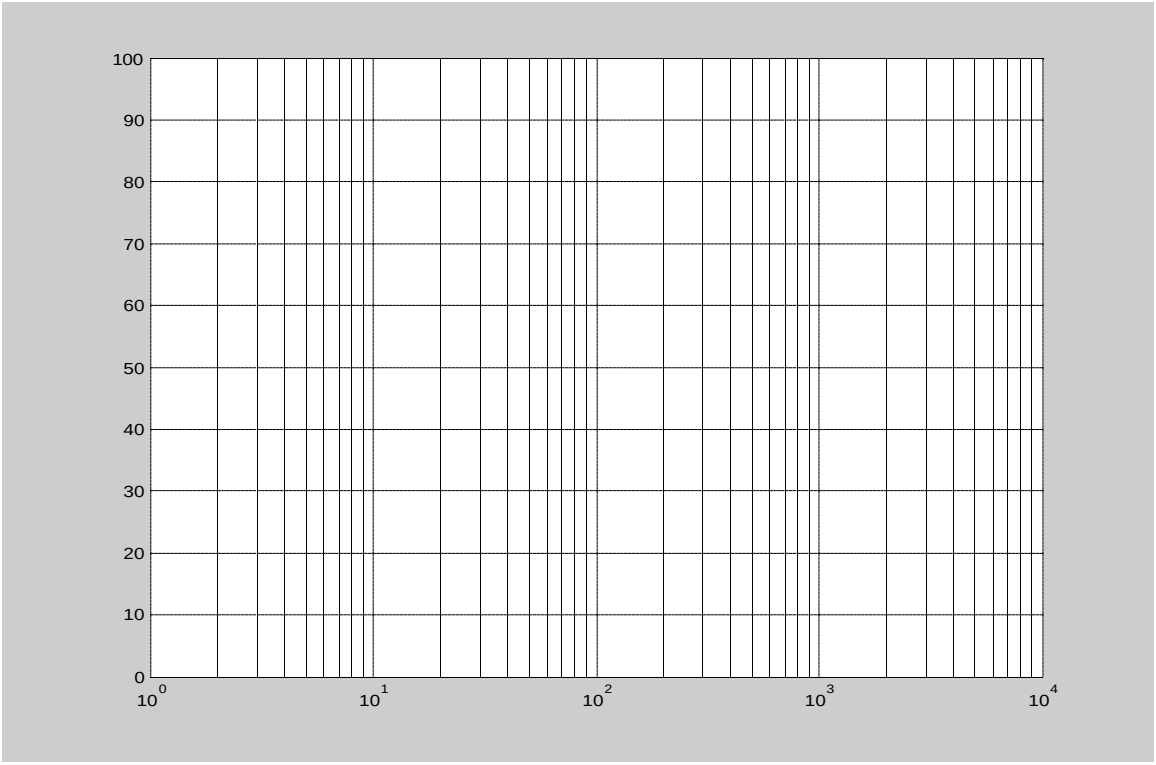
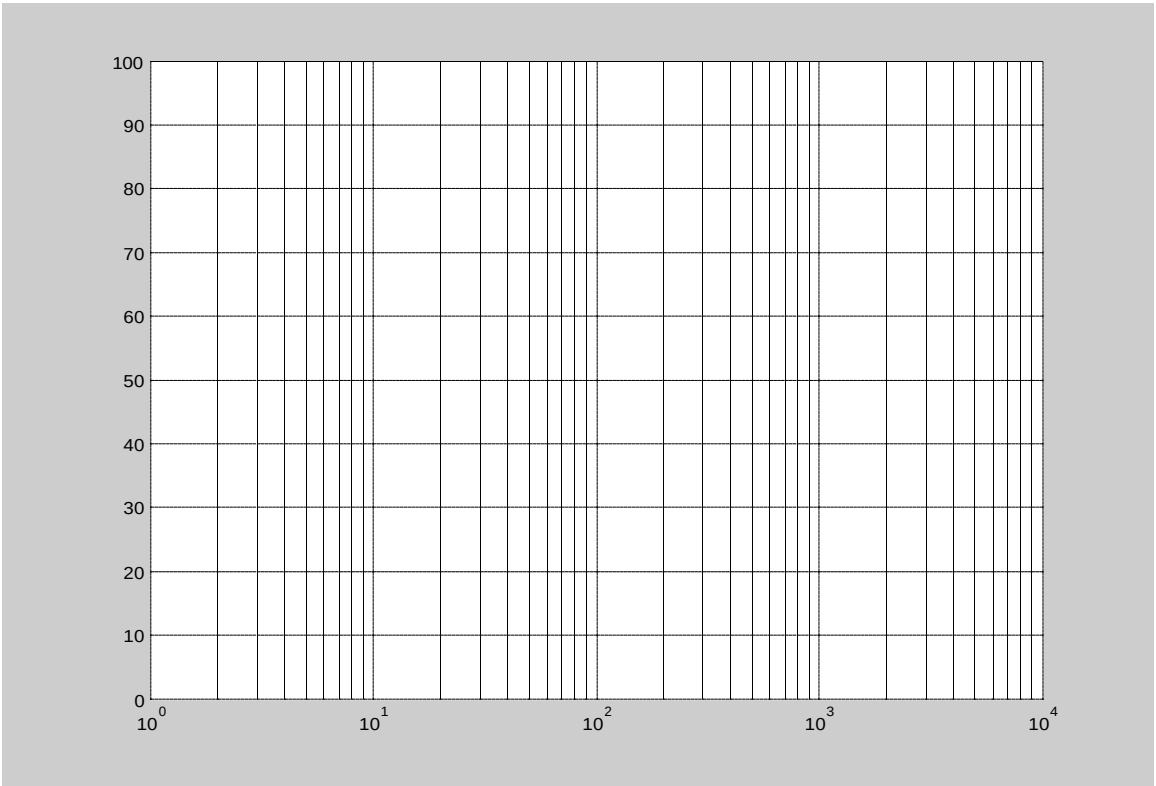




Part 2 High Frequency Response

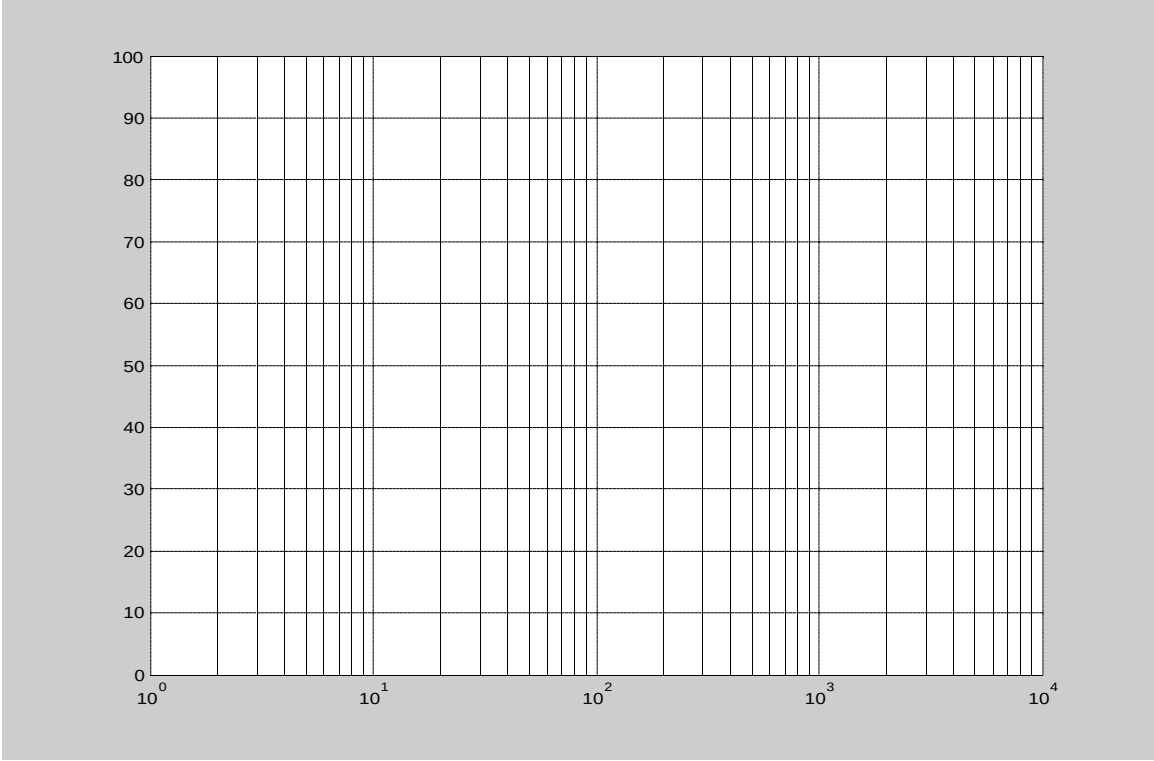
1) Return R_L to its original value of 6.2 kΩ. Measure $|v_o|/|v_i|$ for an input frequency of 50 kHz. How does this value compare to $|A_m|$?

2) Increase the frequency in steps of 25 kHz and measure $|v_o|/|v_i|$. Use smaller steps (e.g. 5 KHz) when the gain starts to decrease. Continue increasing the frequency until $|v_o|/|v_i| \leq 0.5|A_m|$. By graphing |vo|/|vi| (in dB) vs the frequency (log scale), find the upper 3dB frequency (use the graphs sheet given on the next pages).

3) Replace R_L by a 10 kΩ resistor and repeat steps (1) and (2). Draw the magnitude and phase response of your amplifier for R_E = 4.3 kΩ in both cases of loading with R_L = 4.3 kΩ and 10 kΩ (use the graphs sheet given on the next pages).

4) Using the two 3dB frequencies, find the values of C_π and C_μ.

5) Find the unity gain bandwidth (f_T) of the transistor using g_m and the values of C_π and C_μ found in (3).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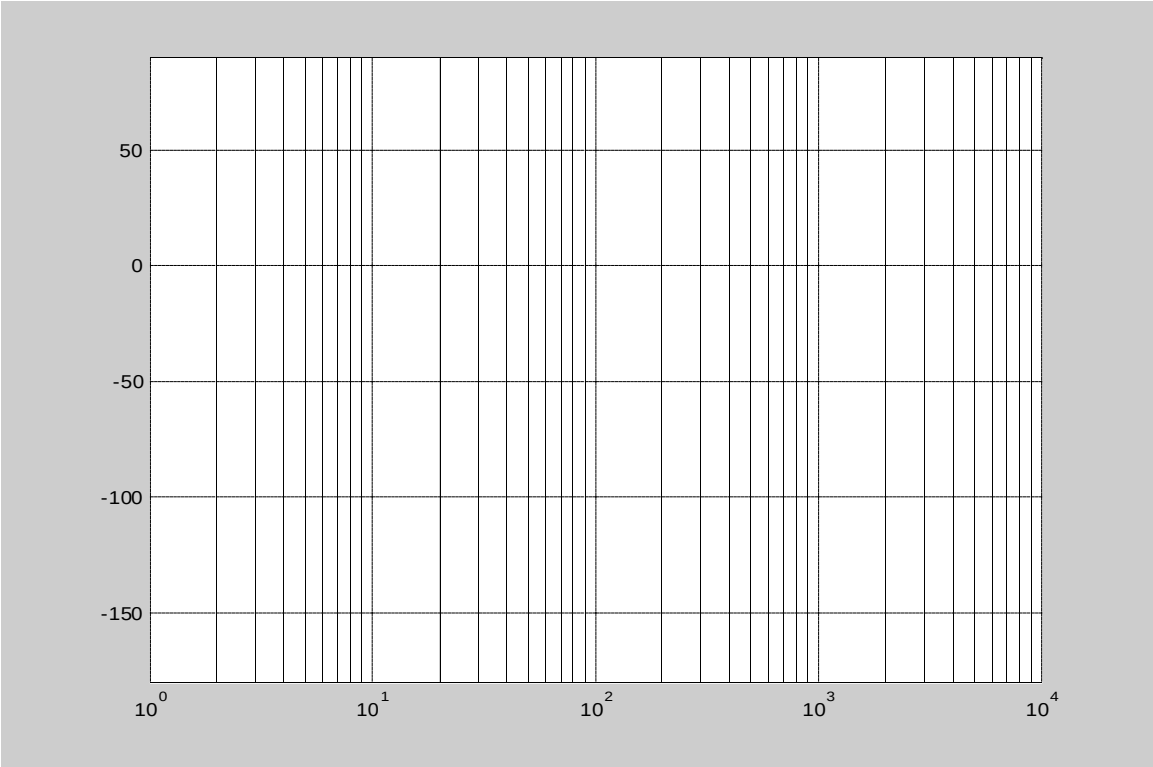
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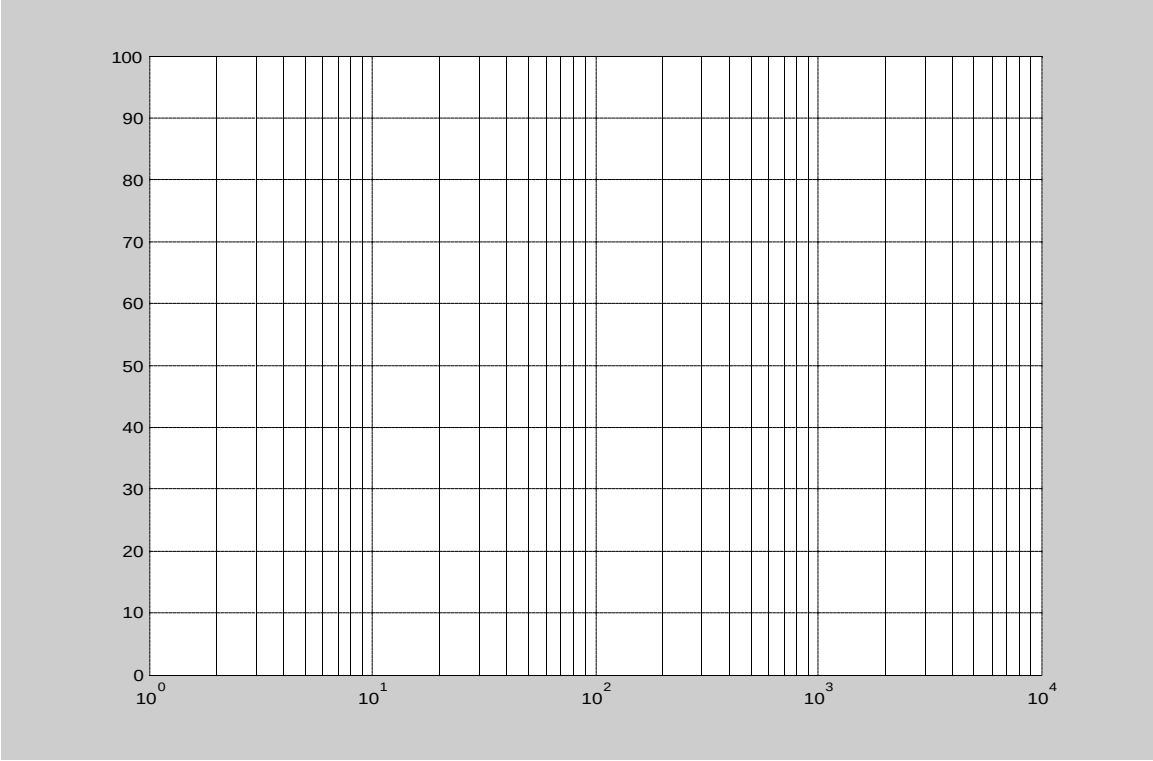
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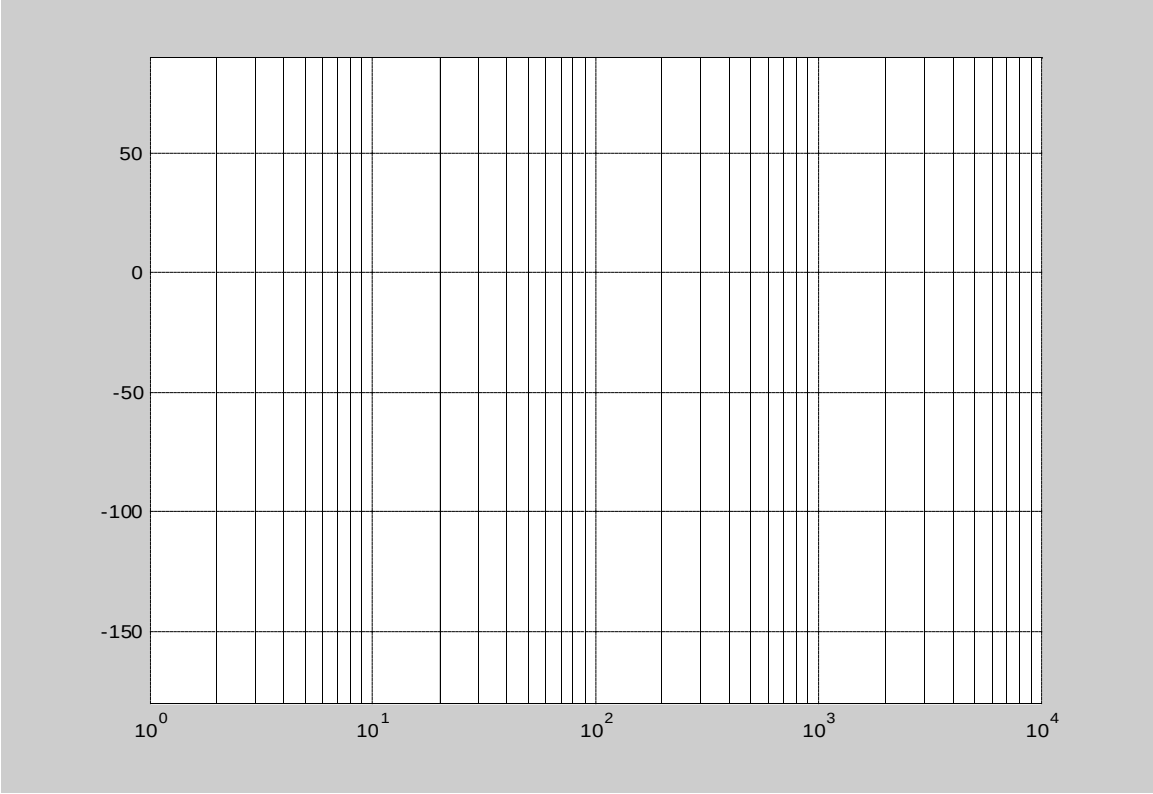
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