

Final
EE40
Fall 2012

NAME: _____ SSID: _____

Instructions

Read all of the instructions and all of the questions before beginning the exam.

There are 6 problems in this exam. The total score is 130 points. Points are given next to each problem to help you allocate time. Do not spend all your time on one problem.

Unless otherwise noted on a particular problem, you must show your work in the space provided, on the back of the exam pages or in the extra pages provided at the back of the exam.

Draw a BOX or a CIRCLE around your answers to each problem.

Be sure to provide units where necessary.

GOOD LUCK!

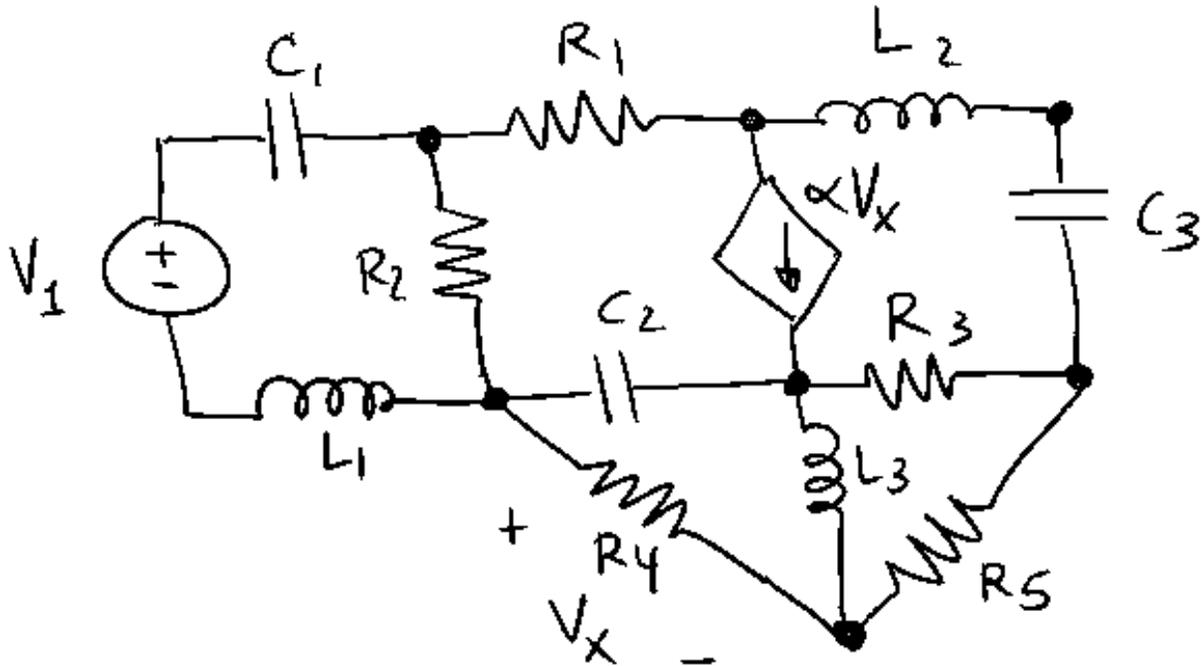
PROBLEM	POINTS	MAX
1	25	
2	30	
3	20	
4	20	
5	20	
6	15	

Belladonna: "Why would anyone want to be with you?"
 Leezar: "I'm not sure really... oh yeah, perhaps because
 I'm rich, I live in a castle and I can do magic."
 -Your Highness

Problem 1

Consider the following circuit:

a) V_1 is a sinusoidal voltage source. Solve for all mesh currents.



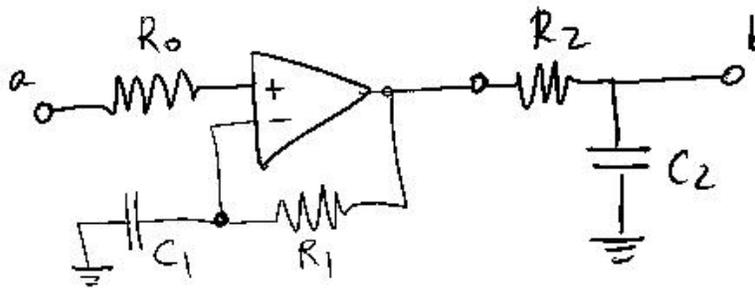
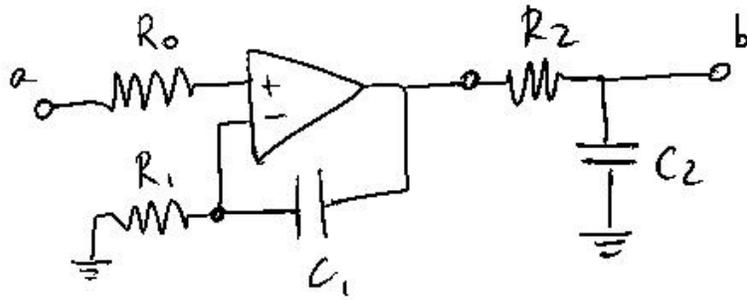
In the box below, provide your answer in this form or **LOSE POINTS**

$$\underline{\quad} i_1 + \underline{\quad} i_2 + \underline{\quad} i_3 + \dots \underline{\quad} i_n = \underline{\quad}$$

Solution:

“In the beginning the Universe was created.
 This has made a lot of people very angry and been widely regarded as a bad move.”
 — Douglas Adams, *The Restaurant at the End of the Universe*

Problem 2 (30 points)

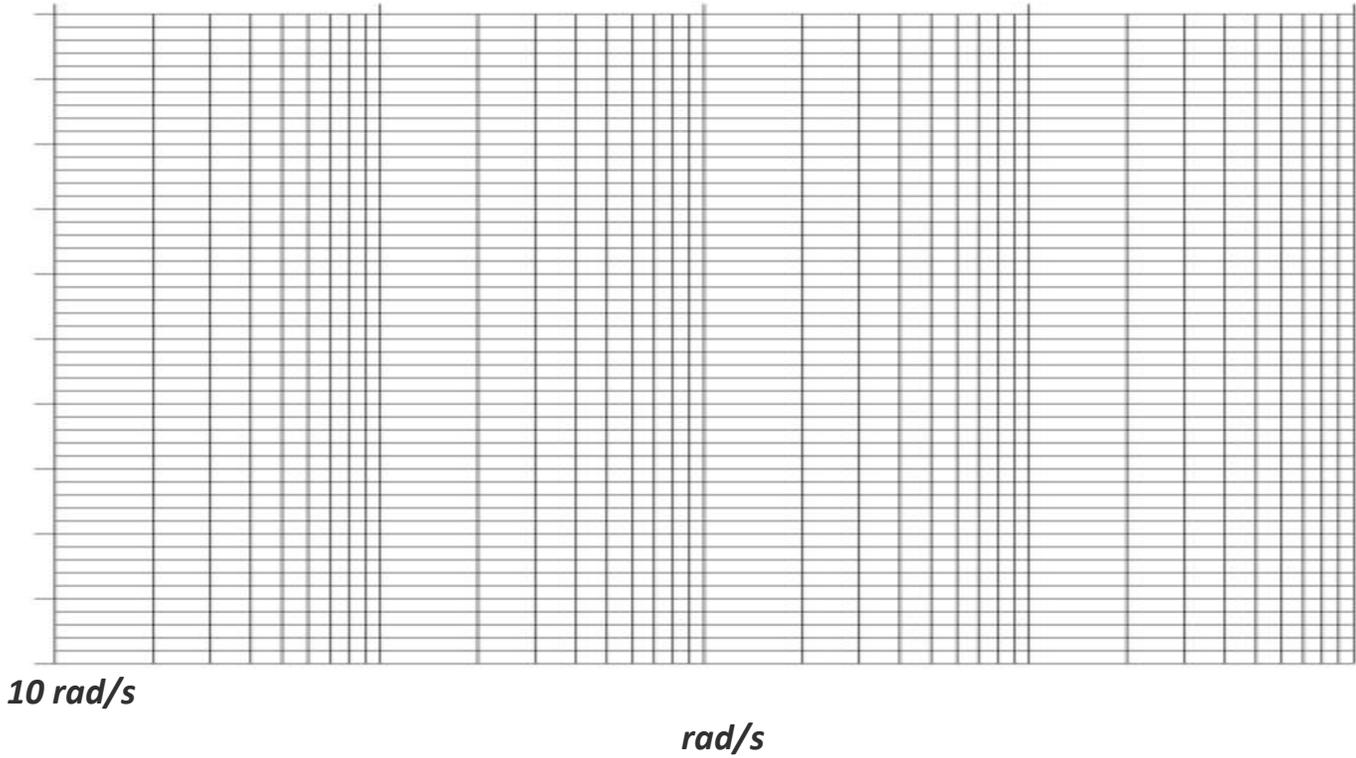


a) Provide **SYMBOLIC** transfer functions for BOTH circuits. (10 points)

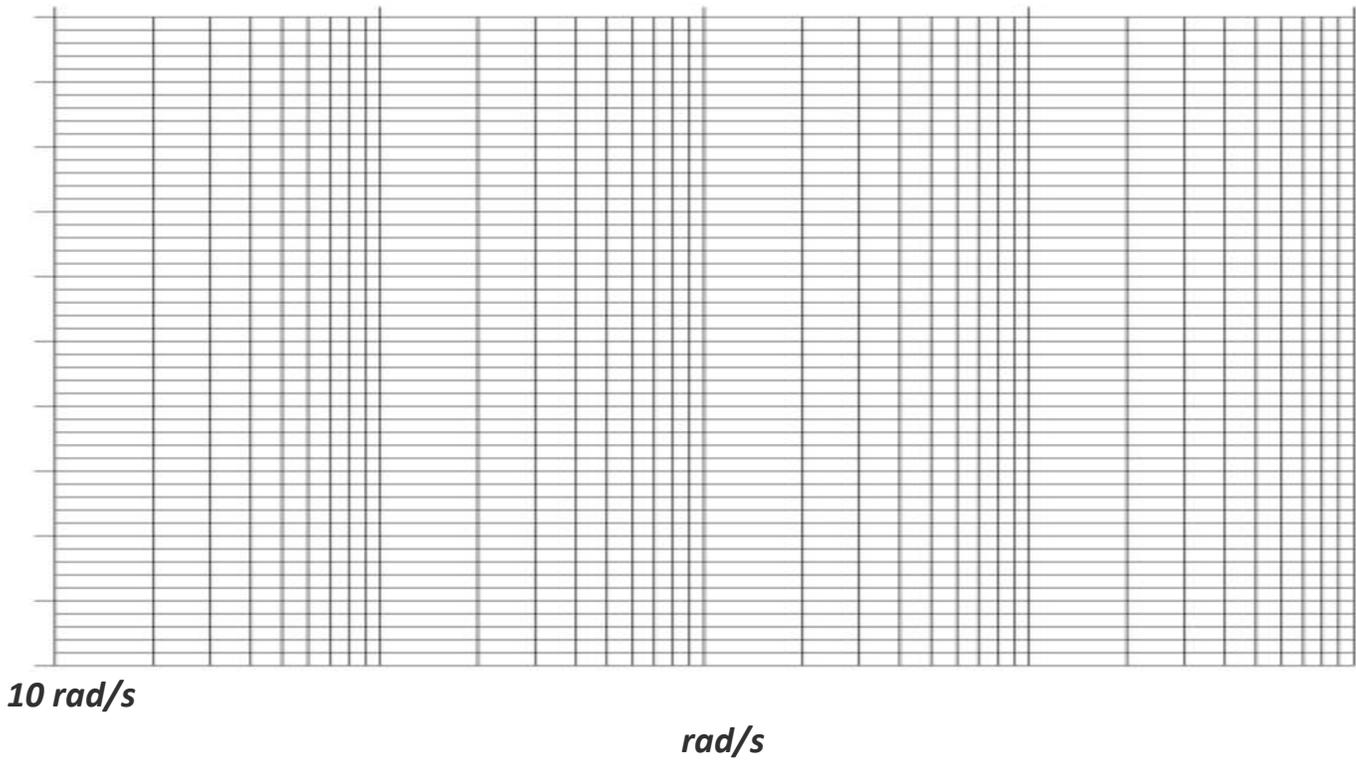
Transfer function for the left circuit:	Transfer function for the right circuit:

b) Provide Bode magnitude and phase plots for both circuits: (20 points: 10 points for each set)
R1 = 10 kΩ, C1 = 10 fF, R2 = 100 kΩ, C2 = 20 fF

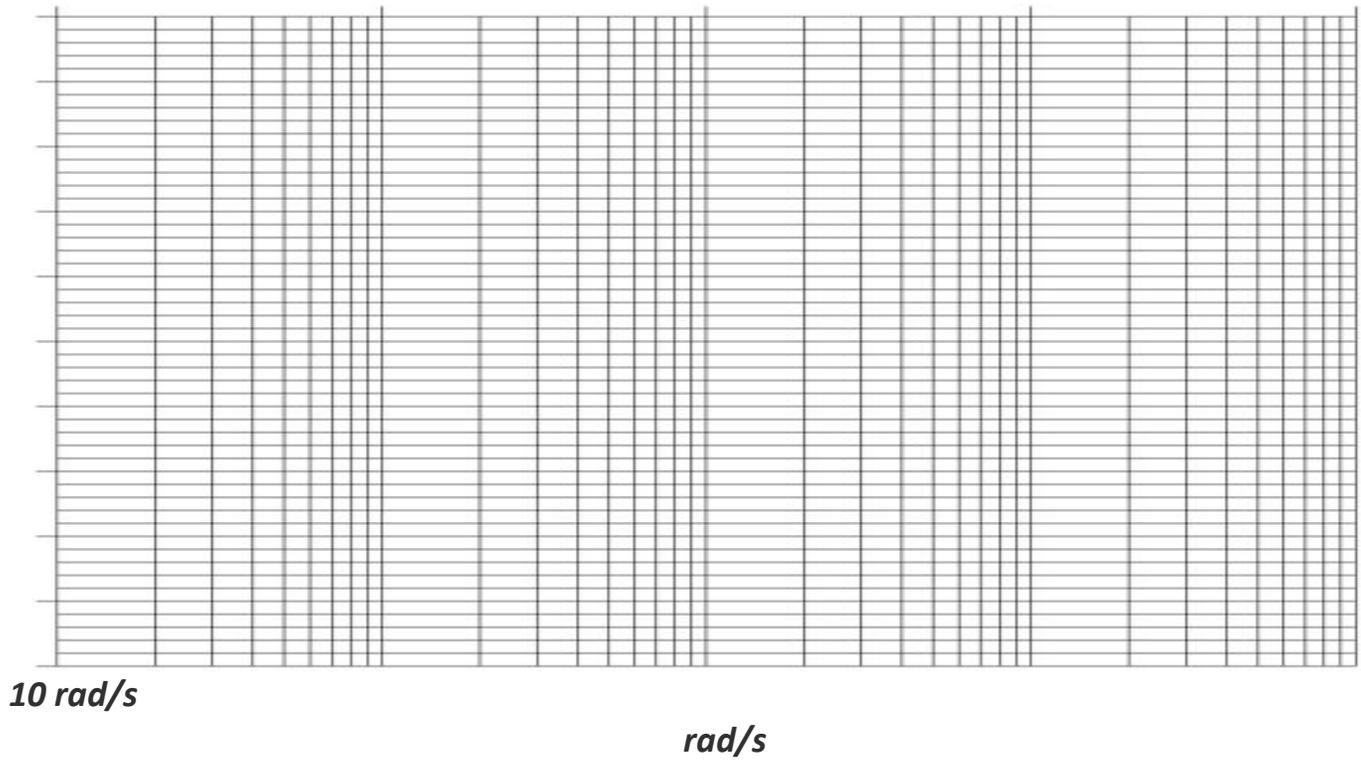
Magnitude Bode plot for left circuit



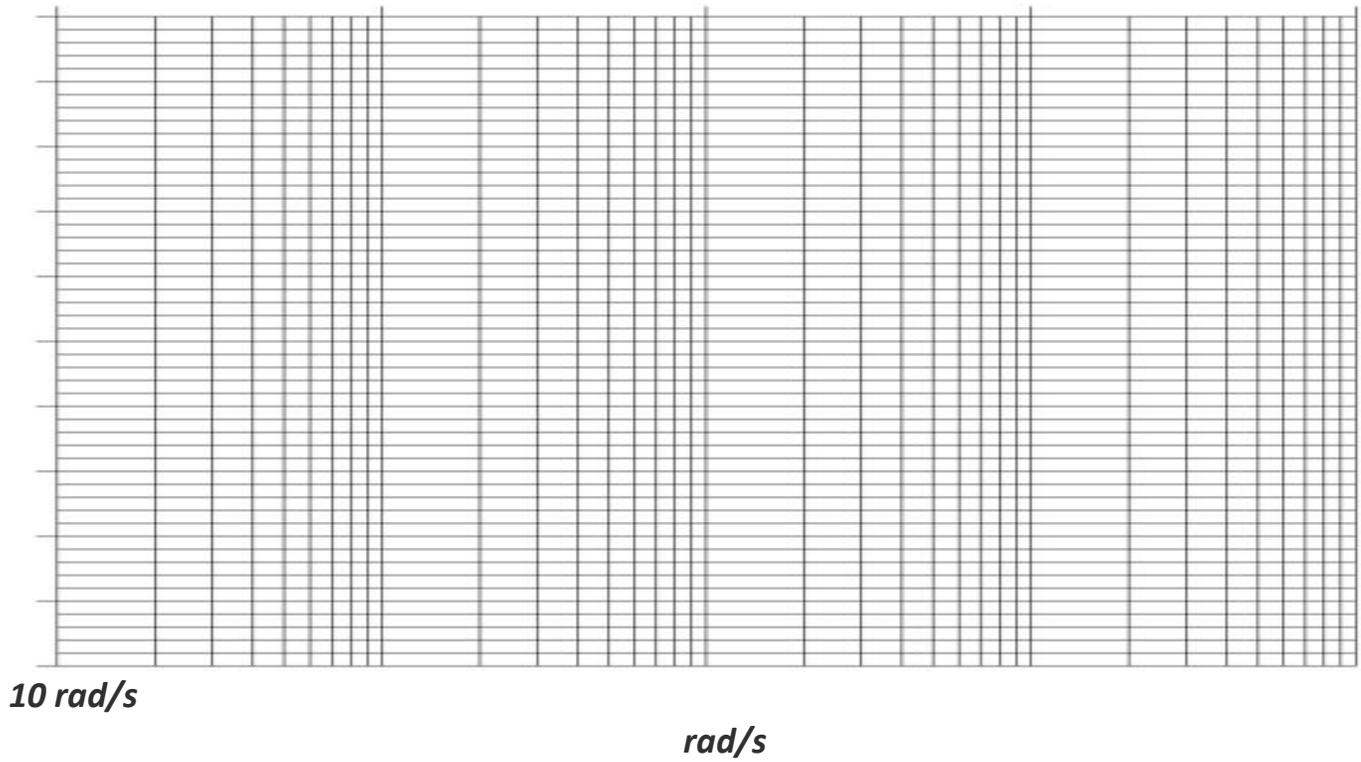
Phase Bode plot for left circuit



Magnitude Bode plot for right circuit



Phase Bode plot for right circuit

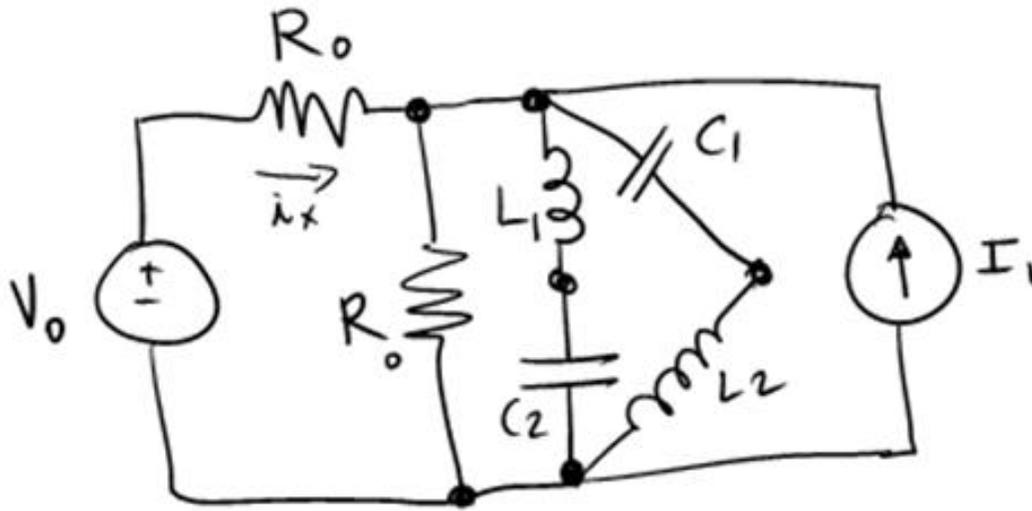


"I love mankind," he said, "but I find to my amazement that the more I love mankind as a whole, the less I love man in particular."

— Fyodor Dostoyevsky, *The Brothers Karamazov*

Problem 3 (20 points)

Consider the circuit below.



$$L_1 = 10 \mu\text{H}, C_1 = 50 \mu\text{F}, L_2 = 2 \mu\text{H}, C_2 = 100 \mu\text{F}$$

$$V_0 = 10\cos(\omega_1 t + \phi_1) \text{ where } \omega_1 = 2\pi(5033 \text{ Hz}) \text{ and } \phi_1 = 0^\circ$$

$$I_1 = 1\cos(\omega_2 t + \phi_2) \text{ where } \omega_2 = 2\pi(15.9 \text{ kHz}) \text{ and } \phi_2 = 30^\circ$$

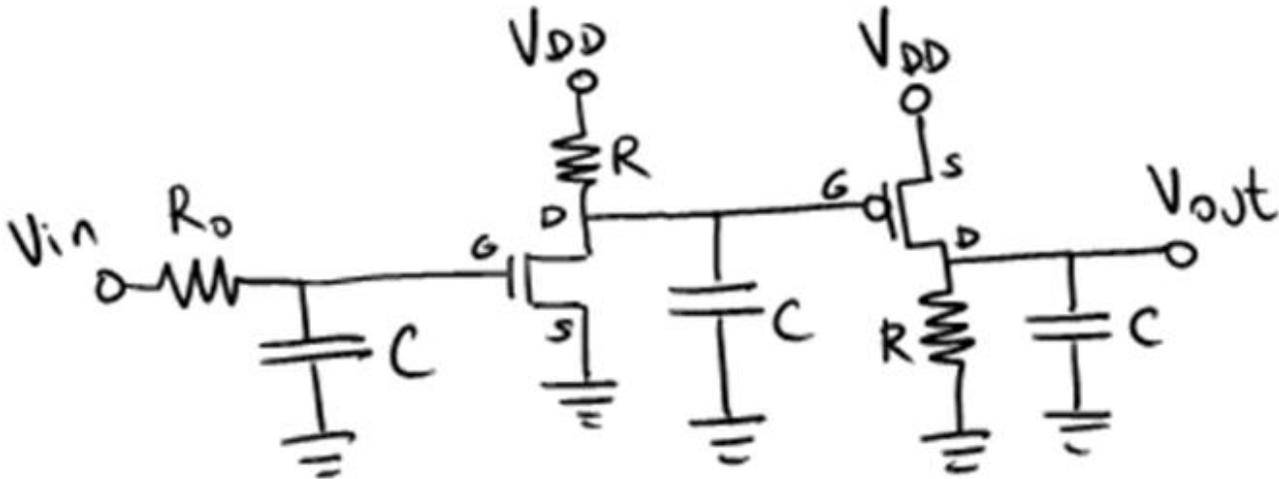
Solve for i_x .

“Wisdom comes to us when it can no longer do any good.”

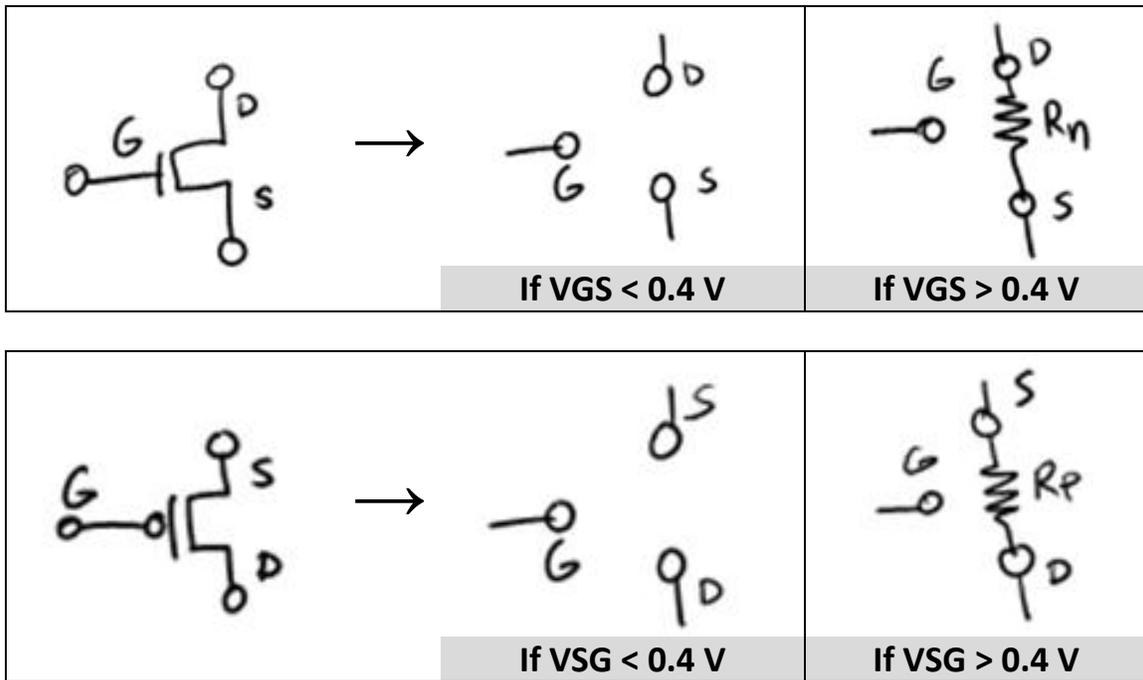
— Gabriel García Márquez, *Love in the Time of Cholera*

Problem 4 (20 points)

Consider the circuit below:



The MOSFETs can be replaced with the following models:



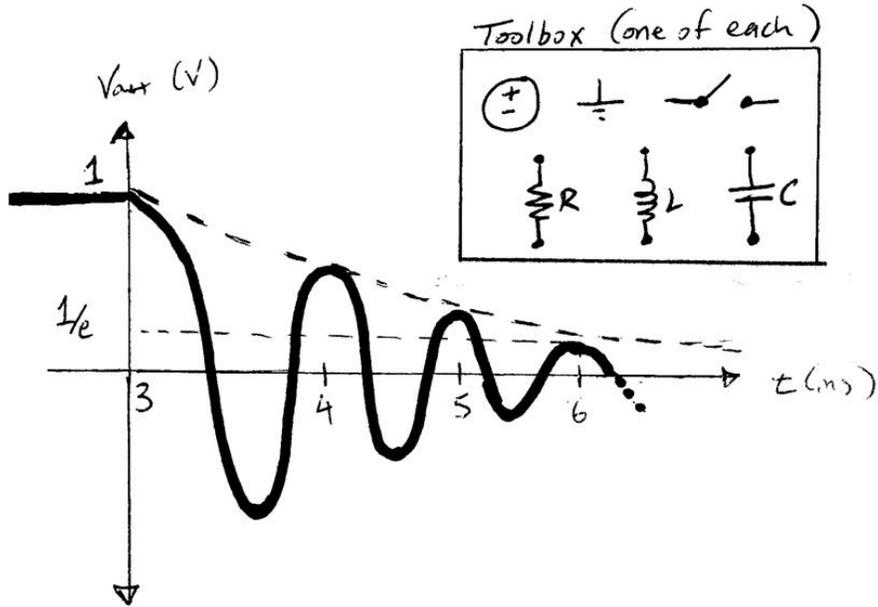
At what t does V_{OUT} reach $V_{DD}/2$ if $V_{IN} = V_{DD}u(t)$?

“Sit, be still, and listen, because you're drunk
and we're at the edge of the roof.”

— Rumi

Problem 5 (20 points)

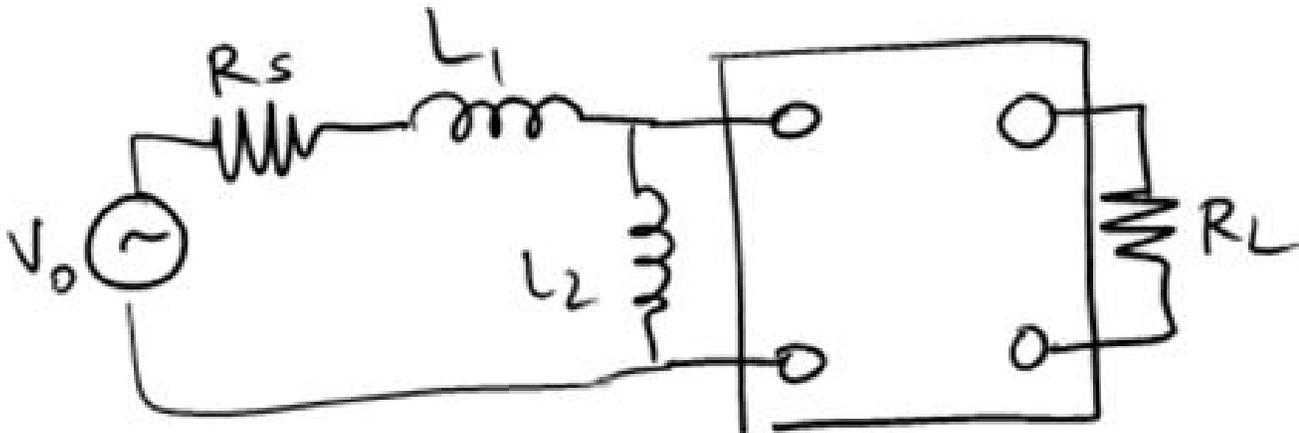
Use the contents of your toolbox to *both construct and operate* a circuit to produce the plot below. You must specify numerical values for each circuit element. Clearly label V_{out} in your circuit.



“For seven and a half million years, Deep Thought computed and calculated, and in the end announced that the answer was in fact 42- and so another, even bigger, computer had to be built to find out what the actual question was.” — Douglas Adams, *The Restaurant at the End of the Universe*

Problem 6 (15 points)

Provide a circuit inside the box such that there's maximum power transfer at $f = 1$ MHz. $L_1 = L_2 = 1 \mu\text{H}$.
 $R_S = 1 \text{ k}\Omega$; $R_L = 1 \text{ k}\Omega$



Scratch

Scratch