Name:_____

Massachusetts Institute of Technology
Department of Nuclear Science and Engineering
Department of Electrical Engineering and Computer Science

22.071/6.071 – Introduction to Electronics, Signals and Measurement
Spring 2006

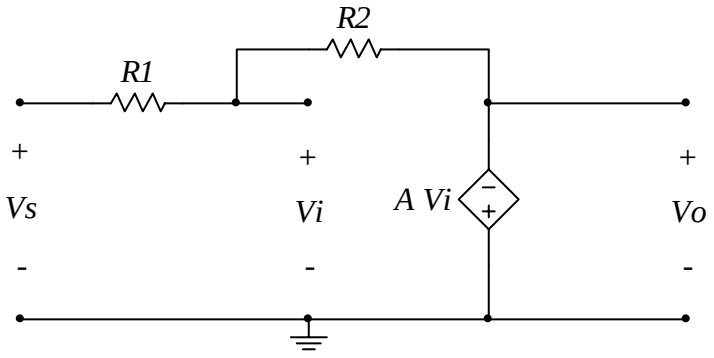
Quiz 2

- Please write your name on each page of the exam in the space provided
- Please verify that there are 11 pages in your exam.
- To the extent possible, do your work for each question within the boundaries of the question or on the back side of the page preceding the question. Extra pages are also provided for computation.
- Note that the total number of points is 100.
- Closed book. No Calculators
- Partial credit adds up so make sure that you show your work.

Name:_____

Problem 1 - (15 points)

What is the gain $\frac{Vo}{Vs}$ for the following circuit



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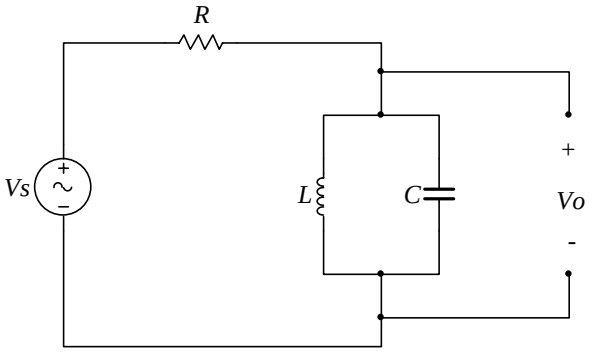
Problem 2 - (15 points)

The circuit below operates in steady state driven by the sinusoidal source *Vs*.



A. Calculate the transfer function $|H(\omega)| = \left|\frac{Vo}{Vs}\right|$

B. Graph $|H(\omega)|$ as a function of frequency and indicate how an increase in R will affect your graph.

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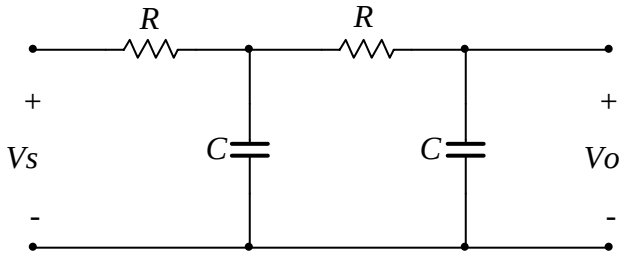
Problem 3 - (15 points)

For the following circuit, the capacitor C is known. The circuit operates under sinusoidal steady state conditions. Determine the value of resistors R so that the phase difference between Vo and Vs is $-\frac{\pi}{2}$. ($\phi_{Vo} - \phi_{Vs} = \frac{\pi}{2}$)



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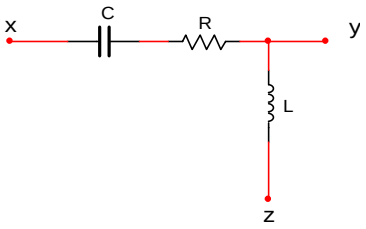
Problem 4 - (10 points)

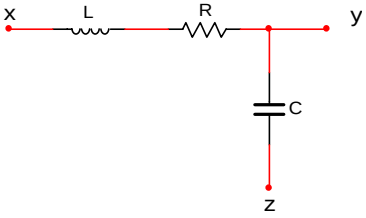
Tau finds a black box with 3 terminals labeled X, Y, Z. Tau, who took 6.071 last year, decides to make resistance measurements across the terminals at DC ($\omega = 0$ Hz) and at high frequency (ω large). She observes the following results:

	Resistance (Ω) at	
Measure resistance across	DC	High-Freq.
X – Y	∞	40
Y – Z	0	∞
X - Z	∞	∞

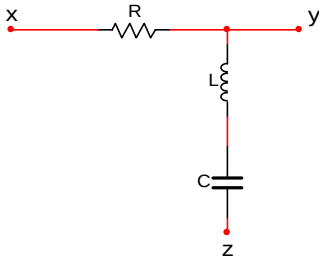
Which of the following equivalent circuits is inside Tau's black box?



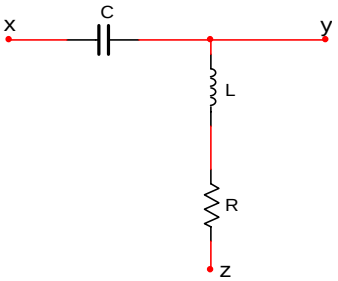
Circuit A



Circuit B



Circuit C

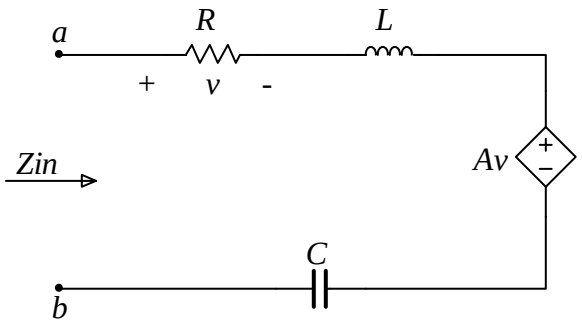


Circuit D

Name:_____

Problem 5 - (15 points)

Find the impedance *Zin* across terminals *a-b* as indicated in the following circuit



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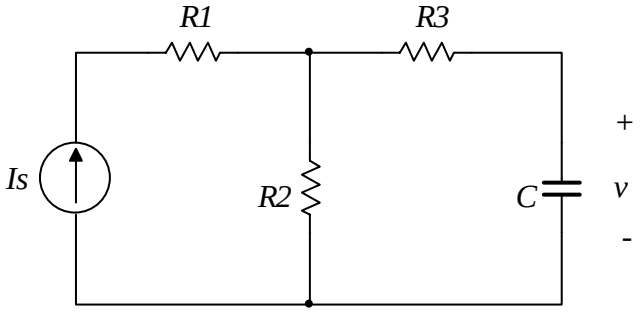
Problem 6 - (15 points)



For the circuit above the current *Is* has the form

$$Is(t) = \begin{cases} I_0 & t > 0 \\ 0 & t < 0 \end{cases}$$

Where $I_0 = \text{constant}$

A. Determine the voltage *v* at $t = 0^+$ and at $t \to \infty$

B. Determine the equivalent resistance seen by the capacitor

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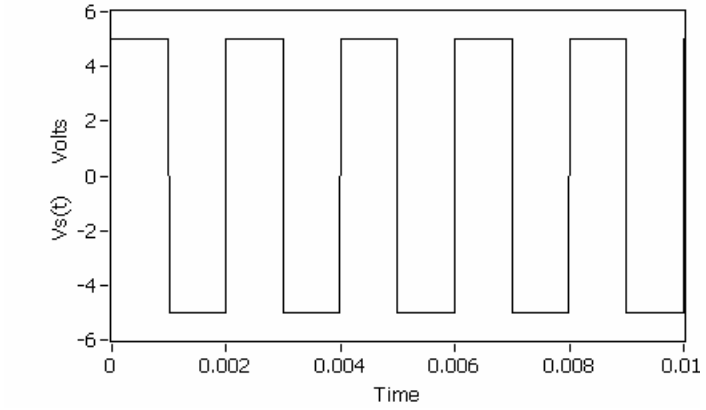
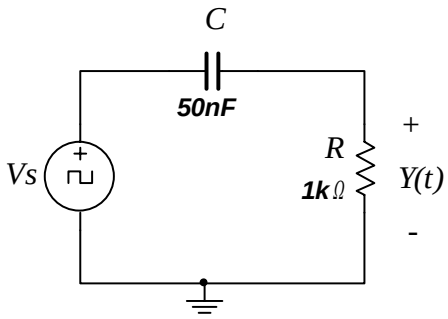
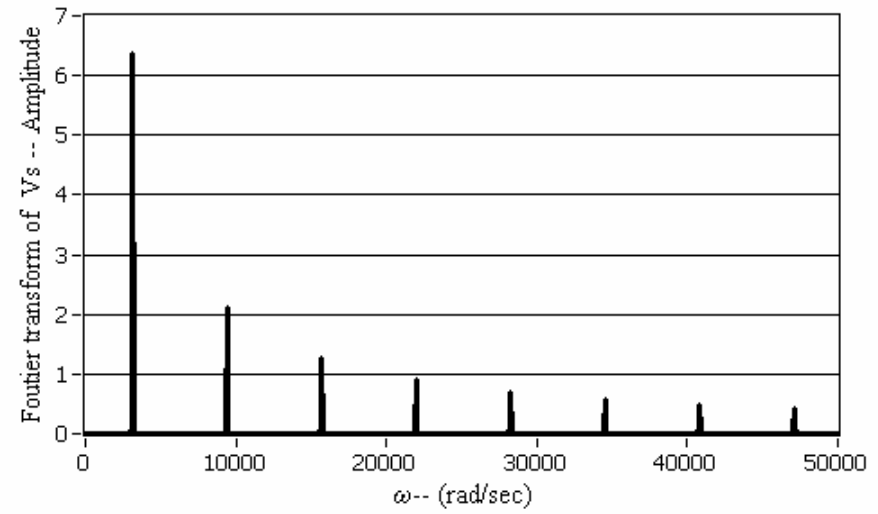
Problem 7 - (15 points)

The signal *Vs(t)* is applied to the circuit as indicated in the schematic below

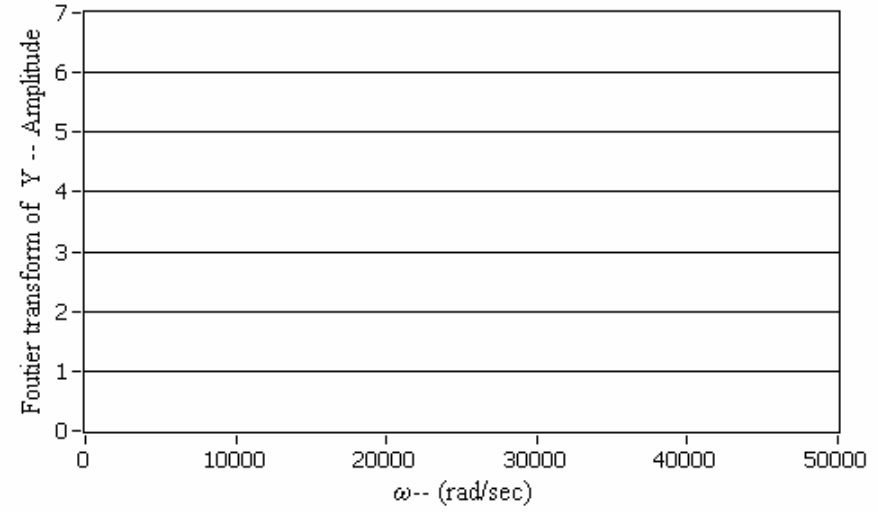




The Fourier transform of the input signal *Vs(t)* is shown below.



The output signal Y(t) is taken across the resistor. Draw the Fourier transform of the signal Y(t) on the following graph.



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Problem	Points
1	
2	
3	
4	
5	
6	
7	
Total	