Name: _____ (please print)

Signature: _____

ECE 2300 – Quiz #6
April 30, 2012

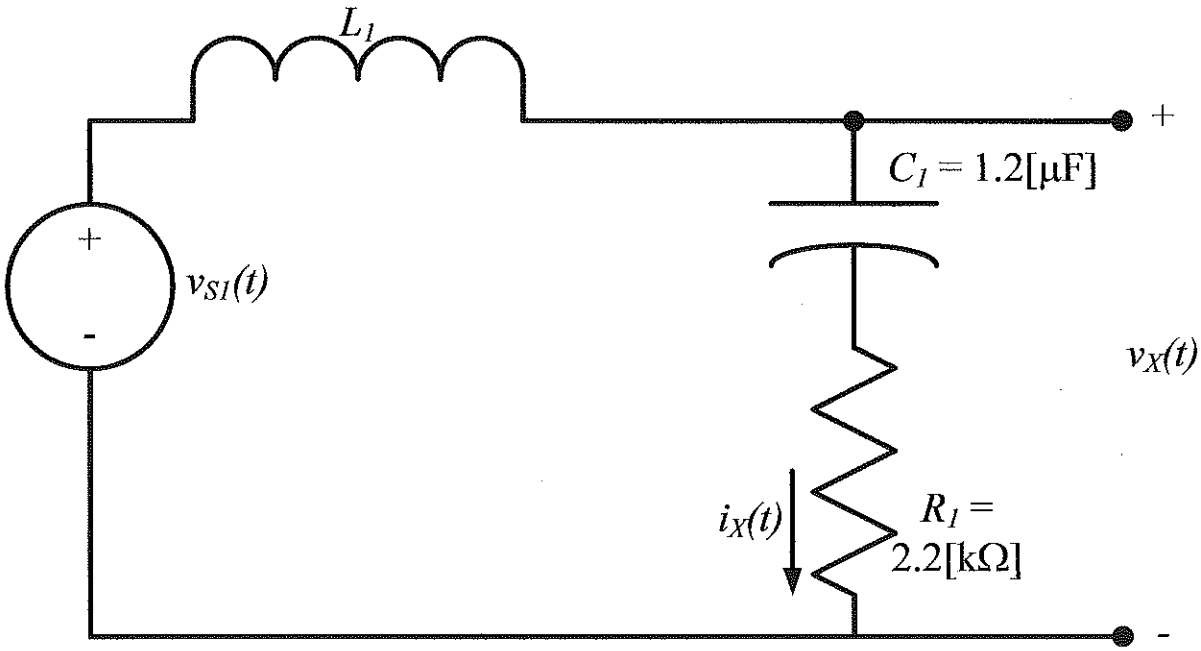
Keep this quiz closed and face up until you are told to begin.

1. This quiz is closed book, closed notes. You may use one 8.5" x 11" crib sheet, or its equivalent.
2. Show all work on these pages. Show all work necessary to complete the problem. A solution without the appropriate work shown will receive no credit. A solution which is not given in a reasonable order will lose credit.
3. It is assumed that your work will begin on the same page as the problem statement. If you choose to begin your work on another page, you must indicate this on the page with the problem statement, with a clear indication of where the work can be found. **If your work continues on to another page, indicate clearly where your work can be found. Failure to indicate this clearly will result in a loss of credit.**
4. Show all units in solutions, intermediate results, and figures. Units in the quiz will be included between square brackets.
5. Do not use red ink. Do not use red pencil.
6. You will have 30 minutes to work on this quiz.

_____/20

Room for extra work

Use the circuit below to solve this problem. All expressions are for the steady state condition. Find a value of the inductance L_1 so that the phase of the voltage $v_X(t)$ will be -23°.



$$v_{S1}(t) = 36\cos\left(560\left[\text{rad}/\text{s}\right]t + 39°\right)[\text{V}].$$

Room for extra work

ECE 2300 -- Quiz #6 – April 30, 2012 – Solution

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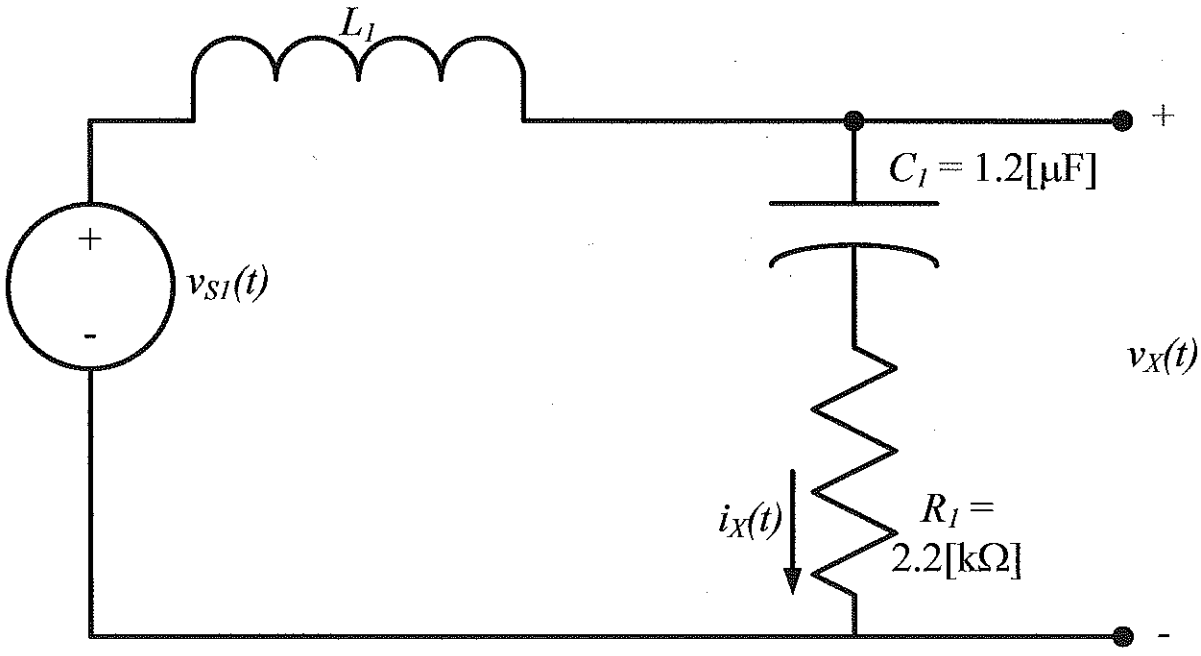

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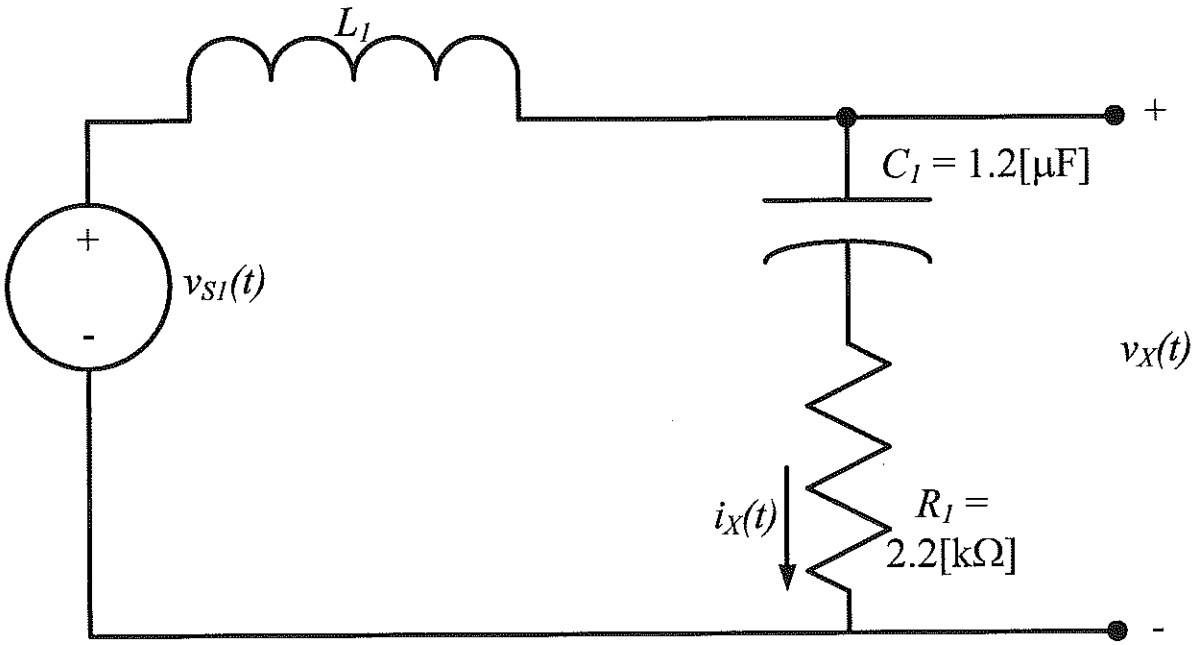

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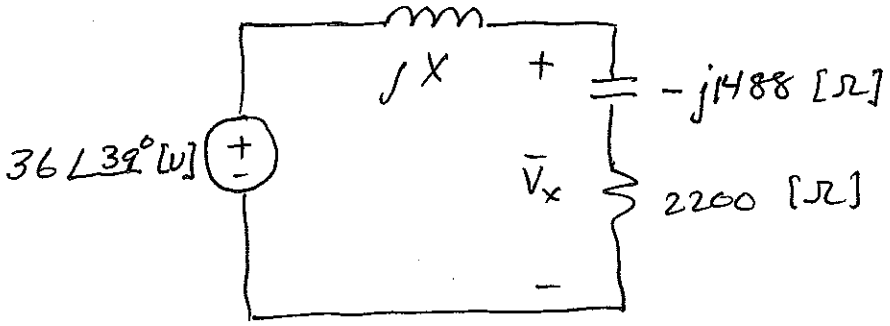
We convert to phasor domain and find the phasor equivalent of $v_x(t)$:

$1/j\omega C_1 = -j1488\ [\Omega]$



$$\bar{V}_x = 36\angle 39° \frac{2200 - j1488}{2200 - j1488 + jX} = 36\angle 39° \frac{2656\angle -34.07°}{2200 - j1488 + jX}$$

We need the angle of $\bar{V}_x$:

$$\angle \bar{V}_x = 39^\circ - 34.07^\circ - \tan^{-1}\frac{X-1488}{2200} = -23^\circ$$

$$\therefore \tan^{-1}\frac{X-1488}{2200} = 27.93^\circ$$

$$\frac{X-1488}{2200} = \tan(27.93^\circ)$$

$$X = \omega L = 2654.3$$

$\omega = 560 \left[\frac{rad}{s}\right]$ $\Rightarrow$ $\underline{\underline{L = 4.74\ [H]}}$

Complex numbers have real and imaginary parts. Here is a case where we can simplify by converting to magnitude and angle, and then recognizing that we only need the angle. Beginning with the equation for $\angle \bar{V}_x$ above, we consider only the angle and ignore magnitude.