

Name: _____ (please print)

Signature: _____

ECE 2300 – Quiz #5
July 17, 2014

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

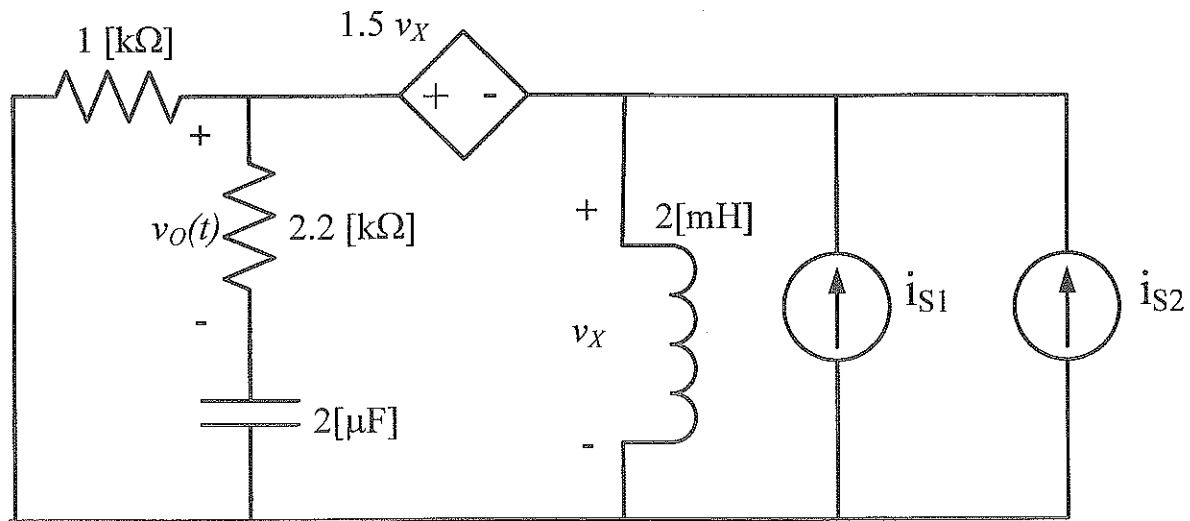
1. This quiz is closed book, closed notes. You may use one 8.5" x 11" crib sheet, or its equivalent.
2. Show all work on these pages. Show all work necessary to complete the problem. A solution without the appropriate work shown will receive no credit. A solution which is not given in a reasonable order will lose credit.
3. Show all units in solutions, intermediate results, and figures. Units in the quiz will be included between square brackets.
4. If the grader has difficulty following your work because it is messy or disorganized, you will lose credit.
5. Do not use red ink. Do not use red pencil.
6. You will have 30 minutes to work on this quiz.

Room for extra work

Find the steady state voltage $v_o(t)$.

$$i_{s1}(t) = 300 \cos(1000t) \text{ [mA]}$$

$$i_{s2}(t) = 500 \sin(2000t + 90^\circ) \text{ [mA]}$$



Room for extra work

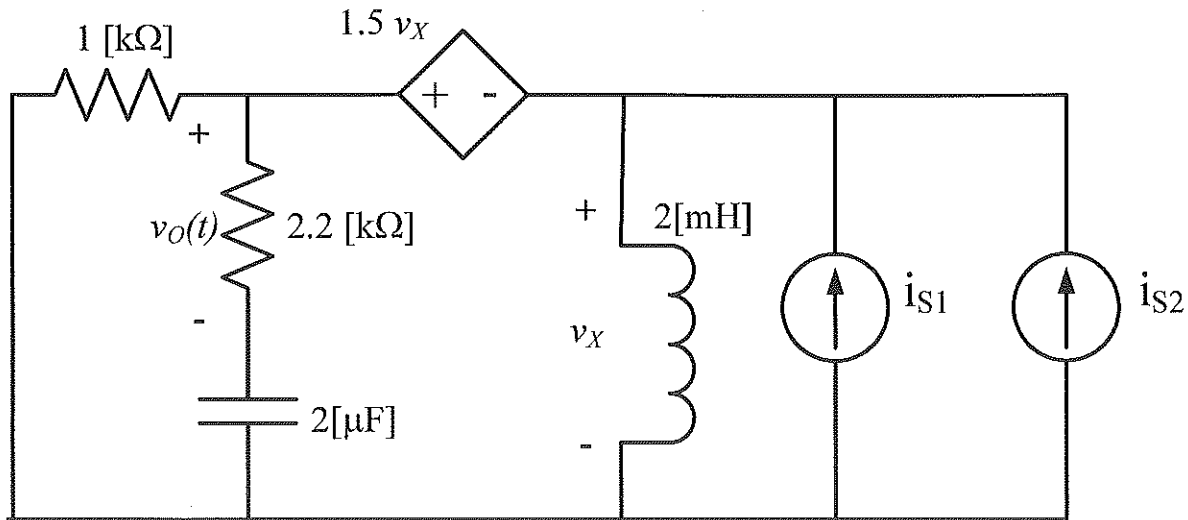
Find the steady state voltage $v_o(t)$.

$$i_{s1}(t) = 300 \cos(1000t) \text{ [mA]}$$

$$i_{s2}(t) = 500 \sin(2000t + 90^\circ) \text{ [mA]}$$

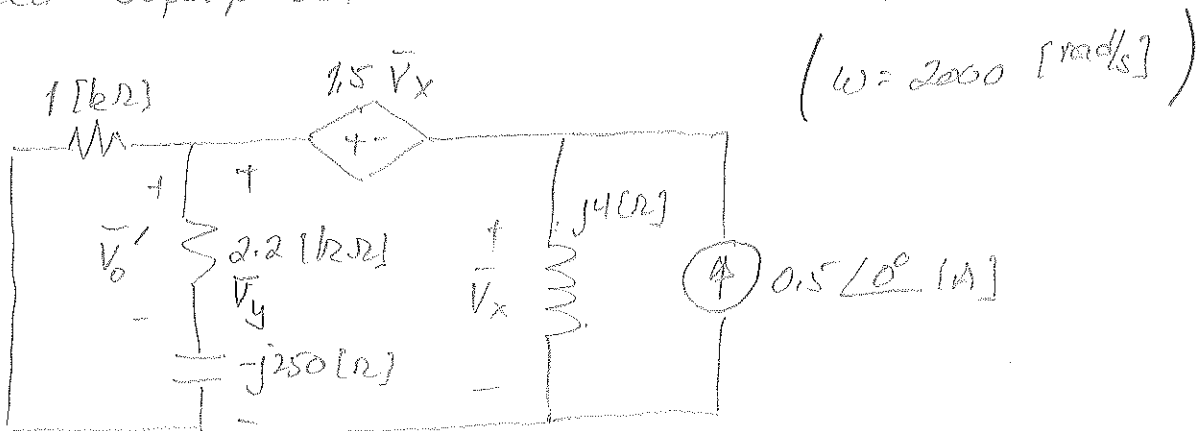
$$\vec{I}_{s1} = 0.3 \angle 0^\circ \text{ [A]} \quad \omega = 1000 \text{ [rad/s]}$$

$$\vec{I}_{s2} = 0.5 \angle 0^\circ \text{ [A]} \quad \omega = 2000 \text{ [rad/s]}$$



Note: $i_{s2} = 0.5 \sin(2000t + 90^\circ) \text{ [A]}$
 $= 0.5 \cos(2000t + 90^\circ - 90^\circ) \text{ [A]} = 0.5 \cos(2000t) \text{ [A]}$

We need superposition here: Deactivating i_{s1} , we have



$$j\omega L = j(2000)(0.002) = j4 \text{ [}\Omega\text{]}$$

$$-j/\omega C = -j/(2000)(2\mu\text{F}) = -j250 \text{ [}\Omega\text{]}$$

Room for extra work

$$\frac{\bar{V}_x}{j^4} - 0.5 \angle 0^\circ + \frac{\bar{V}_y}{1000} + \frac{\bar{V}_y}{2200 - j250} = 0$$

$$\bar{V}_y - \bar{V}_x = 1.5 \bar{V}_x$$

$$\Rightarrow \bar{V}_x = 0.0290 + j2.001 \text{ [V]} = 2.001 \angle 89.2^\circ \text{ [V]}$$

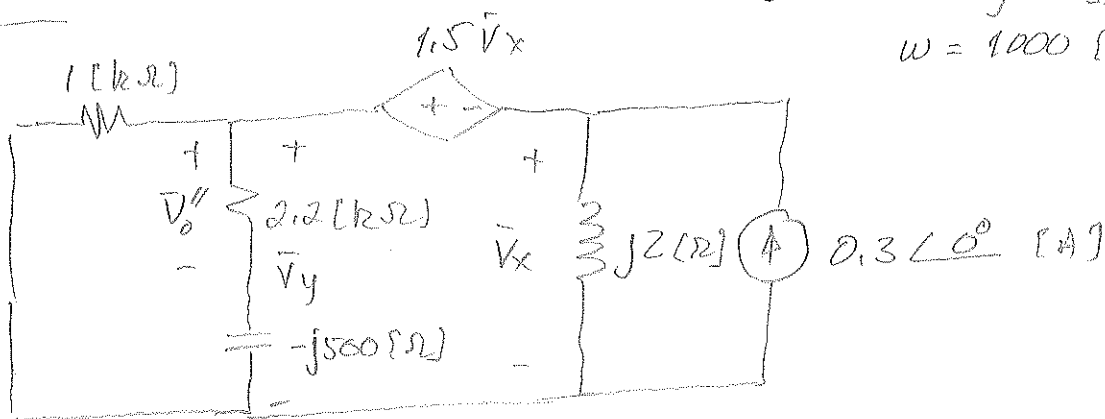
$$\bar{V}_y = 0.0725 + j5.002 \text{ [V]} = 5.002 \angle 89.2^\circ \text{ [V]}$$

$$\bar{V}_0' = \frac{\bar{V}_y}{2200 - j250} \cdot 2200 = -0.4922 + j4.946 \text{ [V]} = 4.97 \angle 95.68^\circ \text{ [V]}$$

$$v_0'(t) = 4.97 \cos(2000t + 95.68^\circ) \text{ [V]}$$

Deactivating i_{s2} , we have...

$$\omega = 1000 \text{ [rad/s]}$$



$$j\omega L = j(1000)(0.002) = j2 \text{ [}\Omega\text{]}$$

$$-j/\omega C = -j/(1000)(2 \times 10^{-6}) = -j500 \text{ [}\Omega\text{]}$$

$$\frac{\bar{V}_x}{j2} - 0.3 \angle 0^\circ + \frac{\bar{V}_y}{1000} + \frac{\bar{V}_y}{2200 + j500} = 0$$

$$\bar{V}_y - \bar{V}_x = 1.5 \bar{V}_x$$

$$\bar{V}_x = 4.3 \times 10^{-3} + j0.600 \text{ [V]} = 6.003 \angle 89.6^\circ \text{ [V]}$$

$$\bar{V}_y = 0.0108 + j1.501 \text{ [V]} = 1.501 \angle 89.6^\circ \text{ [V]}$$

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Room for extra work

$$\vec{V}_0'' = \frac{\vec{V}_y}{2000 - j500} \cdot 2200 = -0.3144 + j1.430 \text{ [V]} = 1.464 \angle 102.4^\circ \text{ [V]}$$

$$\boxed{v_0''(t) = 1.464 \cos(1000t + 102.4^\circ) \text{ [V]}}$$

$$v_0(t) = v_0'(t) + v_0''(t)$$

$$\boxed{v_0(t) = 4.97 \cos(2000t + 95.68^\circ) \text{ [V]} + 1.464 \cos(1000t + 102.4^\circ) \text{ [V]}}$$