ECE204 AC Circuits

Midterm Exam 1
9/28/2010

NAME: Test with answers

- **NO PARTIAL CREDIT WILL BE GIVEN** without a full explanation of the procedure followed to arrive at your solution. Put a box around your solution. **DON'T FORGET UNITS AND CONDITIONS ON VALIDITY.**
- One 8 ½ x11 inch formula sheets (both sides) may be used. Laptops may not be used. Cellphones must be turned-off.
- Time allowed : 50 min.
- You may use both sides of the paper for your answer. Please use the back of the previous page.
- Present all ***phasor*** quantities in ***polar*** form with the angle in degrees and state magnitudes to 3 significant figures.

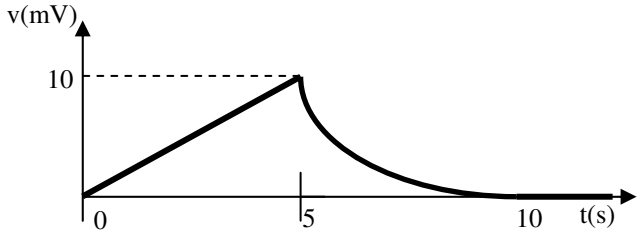
Question #	Possible Points	Awarded Points
1	25	
2	25	
3	25	
4	25	
Total	100	

The voltage across a 2 μF capacitor is plotted in the figure below:

$v(t) = 2t$ mV , for $0 \le t \le 5$ s.

$v(t) = 10e^{-(t-5)}$ mV, for $5 \le t < \infty$.

a) Derive the expression for the current through the capacitor i(t) for $0 \le t < \infty$.



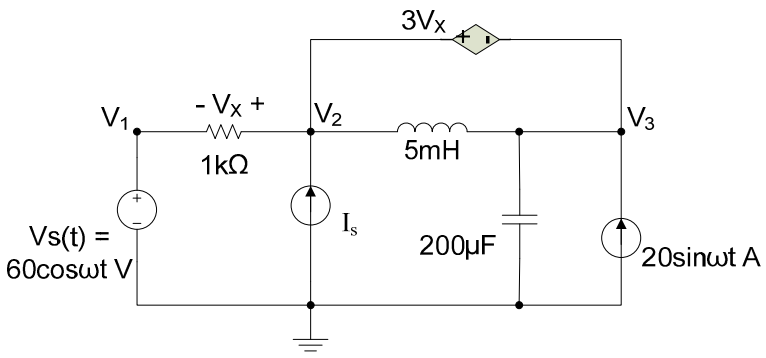
b) Calculate the power dissipated by the capacitor at *t=3s* and at *t=6s*.

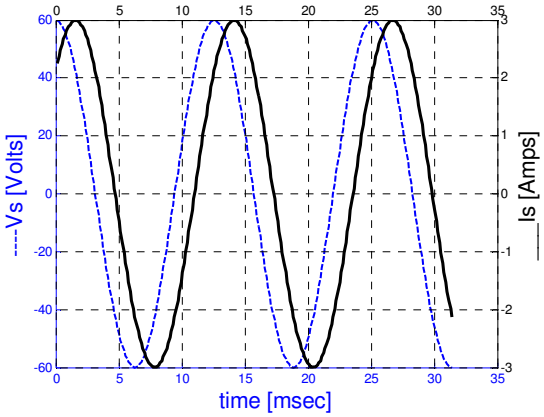
p(3) = 24 pW

c) Calculate the energy stored in the capacitor at *t=3s*.

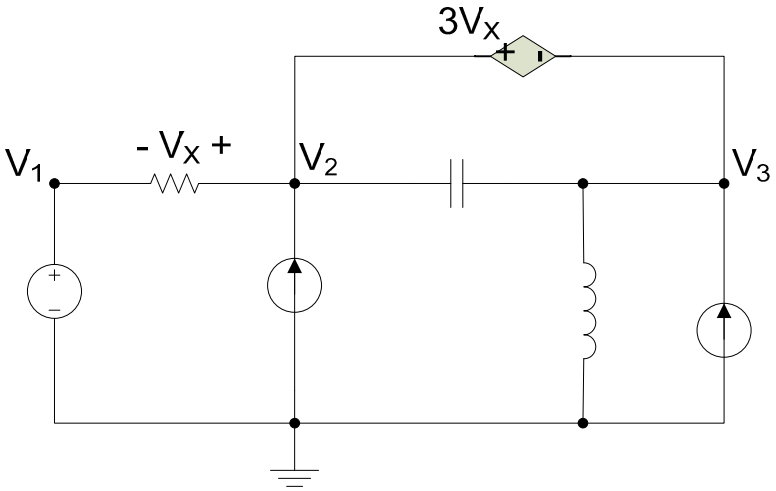
w(3) = 36 pJ

In the circuit shown below, assume that all sources have the same frequency.





a) The current source $\boldsymbol{I_s}$ has a peak-to-peak value of 6A, the period is 12.57 msec, and is shifted 45 degrees to the right with respect to the voltage source as shown in the graph to the right. Use this information to redraw the circuit diagram, expressing sources as phasors, and loads as impedances.



b) Write all the equations necessary to solve for the labeled node-voltages in terms of phasor quantities.

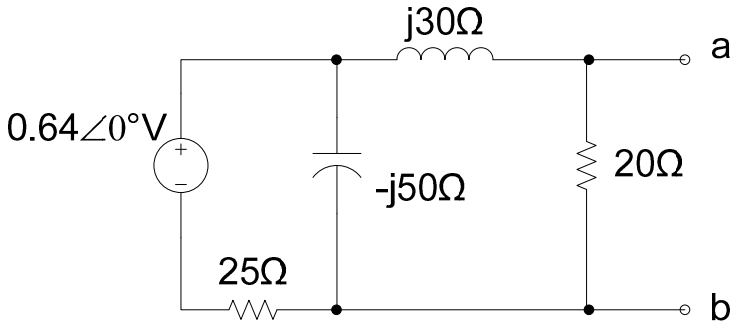
Note f = 79.55 Hz, ω = 499.9 rad/s, $\boldsymbol{I_s} = 3\angle -45^0$ A, $\boldsymbol{I} = 20\angle -90^0$ A

c) Assume the answer to part (b) is the following set of equations (NOTE: this is ***not*** the answer to part (b)). Solve them for all nodal voltages.

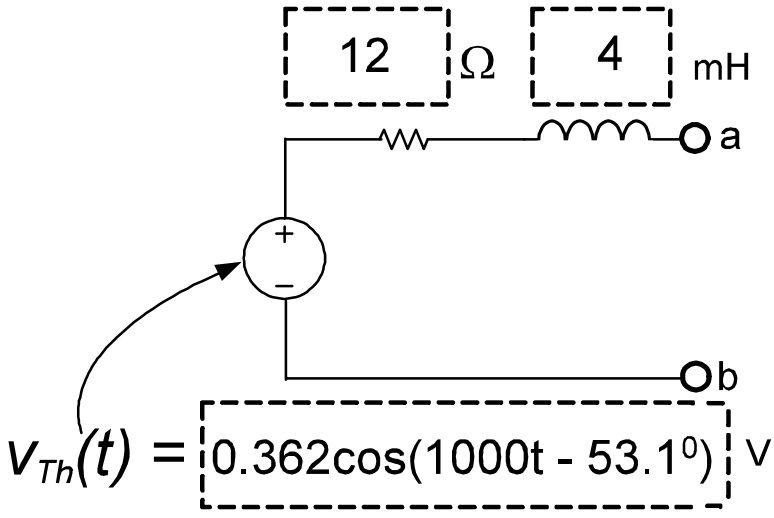
$$\frac{V_2 - 30}{2000} + j20 + \frac{V_3}{j5} - 3\angle -45° = 0$$
$$-V_2 + V_3 - 3V_x = 0$$
$$30 + V_x - V_2 = 0$$

$V_2 = 50.22\angle 3^0$ V, $V_3 = 111.1\angle 5.4^0$ V, $V_x = 20.32\angle 7.4^0$ V,

Find the Thevenin equivalent circuit. Report your answers in the time-domain form assuming the frequency of operation is 1000 r/s. State your analysis methods.

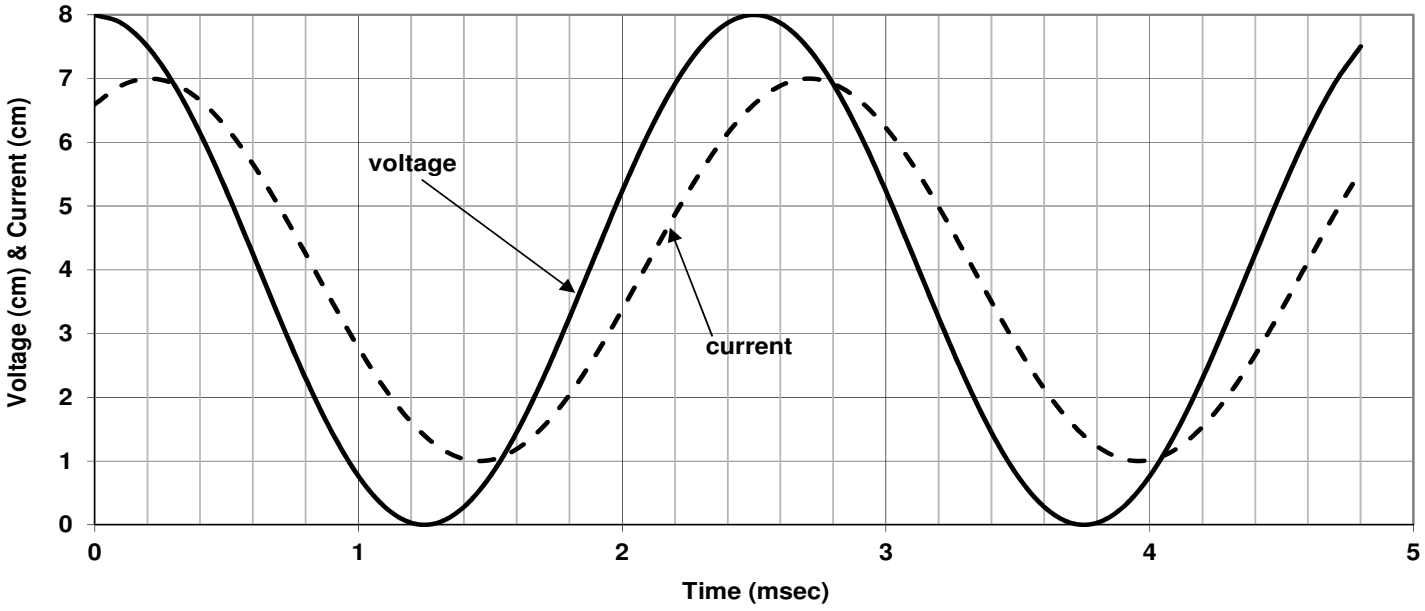


Assume voltage is rms.



A trace from an oscilloscope is shown below. The voltage amplification was set on 20 V/cm, while the current amplification was set on 5 A/cm. Take the voltage as reference and determine:

a) The voltage and current in phasor form.
b) The frequency of the supply in Hz.
c) The power associated with the circuit and the energy (in joules) consumed in three minutes.



$\boldsymbol{V} = 56.57\angle 0^0$ V, $\boldsymbol{I} = 10.61\angle -30^0$ A

f = 400 Hz

P = 519.6 W

W = 93.53 kJ