Desk Copy

ECE 300
Spring Semester, 2006
HW Set #11:

Due: March 30, 2006
wlg

Name wlg
Print (last, first)

Use engineering paper. Work only on one side of the paper. Use this sheet as your cover sheet, placed on top of your work and stapled in the top left-hand corner. Number the problems at the top of the page, in the center of the sheet. **Do neat work. Underline your answers. Show how you got your equations**. **Be sure to show how you got your answers.** Each problem counts 10 points.

9.6 Answers: (a) $i(t)$ leads $v(t)$ by 20^o (b) $v_2(t)$ leads $v_1(t)$ by 170^o (c) $v(t)$ leads $x(t)$ by 9.24^o

9.13 Work (a) and (b): See text for answers.

9.34 $\Omega = 100$ rad/sec

9.43

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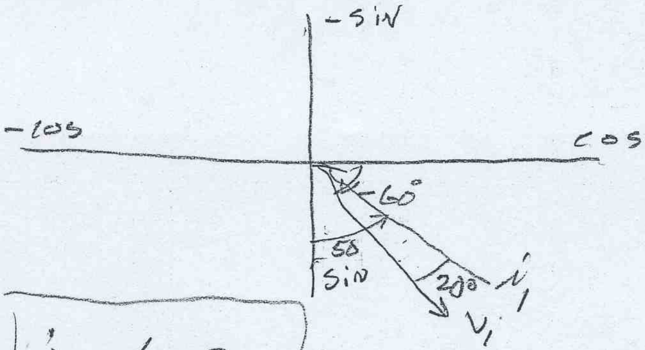
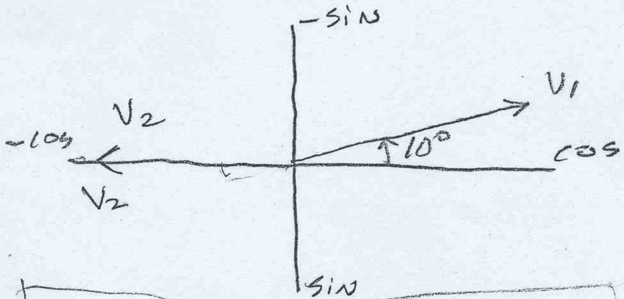
9.6 In the following, determine which signal leads and by how much.

(a) $v_1 = 10\cos(4t - 60^\circ)$
$i = 4\sin(4t + 50^\circ)$



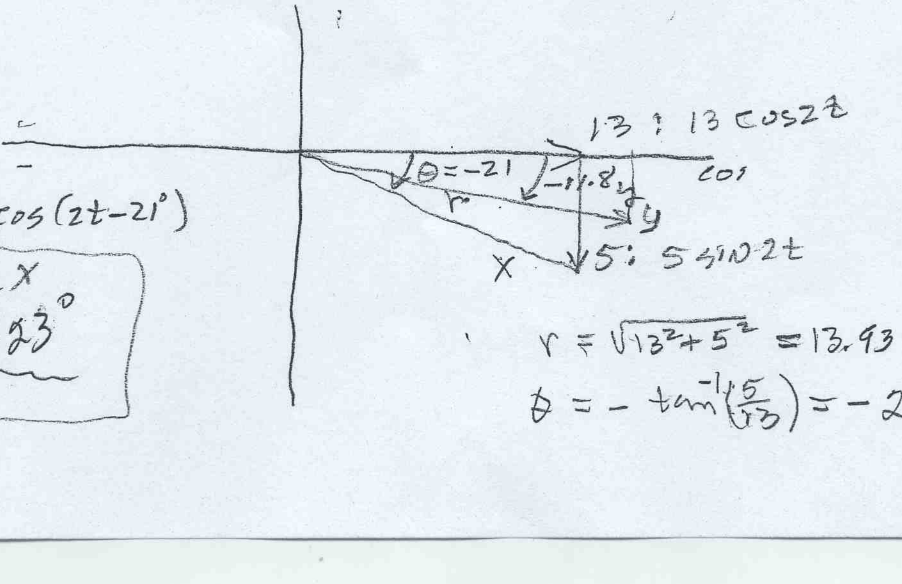
i leads v by 20°

(b) $v_1 = 4\cos(377t + 10^\circ)$ $v_2 = -20\cos 377t$



v_2 leads v_1 by 170°

(c) $x = 13\cos 2t + 5\sin 2t$
$y = 15\cos(2t - 11.8)$



$x = 13.93\cos(2t - 21^\circ)$

y leads x by 9.23°

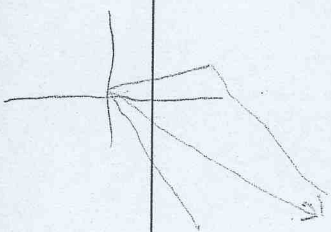
$r = \sqrt{13^2 + 5^2} = 13.93$
$\theta = -\tan^{-1}\left(\frac{5}{13}\right) = -21^\circ$

4.13 Evaluate the following

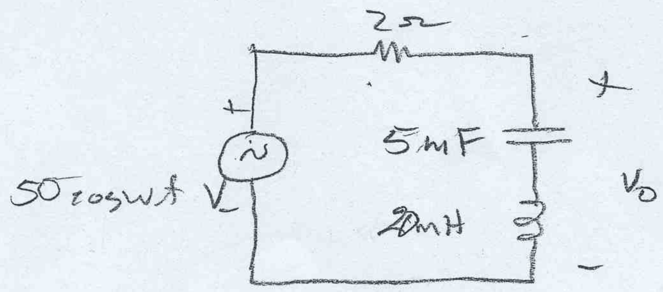
(a) $\dfrac{(2+j3)}{(1-j6)} + \dfrac{(7-j8)}{(-5+j11)}$

$-1.275 + j0.152$

(b) $\dfrac{(5\angle 10)(10\angle -40)}{(4\angle -80)(-6\angle 50^\circ)} = -2.083 + j1.215$



9.34 Given



V_o will be zero when the series impedance of the 5μF capacitor and the 2mH coil is zero. In other words, when

$$j\omega L - \frac{j}{\omega C} = 0$$

OR

$$\omega L = \frac{1}{\omega C}$$

and

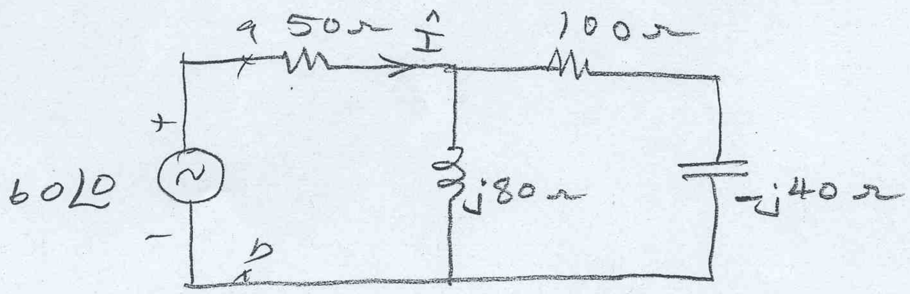
$$\omega = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{20\times10^{-3}\times5\times10^{-3}}}$$

$$\boxed{\omega = \frac{1000}{\sqrt{100}} = 100 \text{ rad/sec}}$$

10×10^{-6}

.000010

9.43 Given the following circuit.



Find $\hat{I}$

$$Z_{ab} = 50 + \frac{(80\angle 90)(100 - j40)}{100 + j80 - j40}$$

$$Z_{ab} = 50 + \frac{((80\angle 90)(100 - j40))}{(100 + j40)}$$

$$= (105.17 + j57.93) = 120.07\angle 28.85\ \Omega$$

$$I = \frac{60\angle 0}{120.07\angle 28.85}$$

$$I = 0.4997\angle -28.85^\circ\ A$$

$$\boxed{I = 499.7\angle -28.85\ mA}$$

Ans: 499.7∠−28.85

$$v_c(t) = \left[V_i + (K_1 + tK_2) e^{-\alpha t} \right] \qquad t \geq 0$$

@ $t = 0^+$ $\quad v_c(0) = 0$, so ...

$$v_c(0^+) = V_i + K_1 + \cancel{K_2(0)}^0 = 0$$

$$= \boxed{V_i = -K_1}$$

$$\frac{dv_c(t)}{dt} = \cancel{V_i}^0 + \left(-\alpha K_1 e^{-\alpha t}\right) + \left(K_2 e^{-\alpha t}\right) + \left(-\alpha t K_2 e^{-\alpha t}\right)$$

$$\frac{dv_c(0^+)}{dt} = (-\alpha K_1) + K_2 + 0 = \frac{V_i}{RC} \qquad \left(\text{note: } i(t) = C\frac{dV_c}{dt}\right)$$

$$= -\alpha(-V_i) + K_2 + 0 = \frac{V_i}{RC}$$

$\alpha = \frac{R}{2L}$ and set $V_i = 1$, thus

$$\Rightarrow \frac{R}{2L}(1) + K_2 = \frac{1}{RC}$$

$$\boxed{K_2 = \frac{1}{RC} - \frac{R}{2L}}$$

(3b)

$\alpha = \omega_0$

$$\frac{R}{2L} = \frac{1}{\sqrt{LC}} \Rightarrow \frac{R^2}{4L^2} = \frac{1}{LC} \Rightarrow R^2 = \frac{4L}{C} \Rightarrow R = \sqrt{\frac{4L}{C}} = 2\sqrt{\frac{L}{C}}$$