Name: Key

Section: 2

EE331 Homework PS7 – fall 2012

Problems from Alexander & Sadiku:

CH 9

- 9.1
- 9.3
- 9.8
- 9.30 (Ans: 2.5*cos(60t+20)mA and 300*cos(60t+110)mA)
- 9.35
- 9.44 (Ans: 960*cos(200t – 7.96) mA)

CH 10

- 10.13 (Remember to use CSOLVE in calculator)

Other Problems:

- Pg. 2 and 3 of this Problem Set

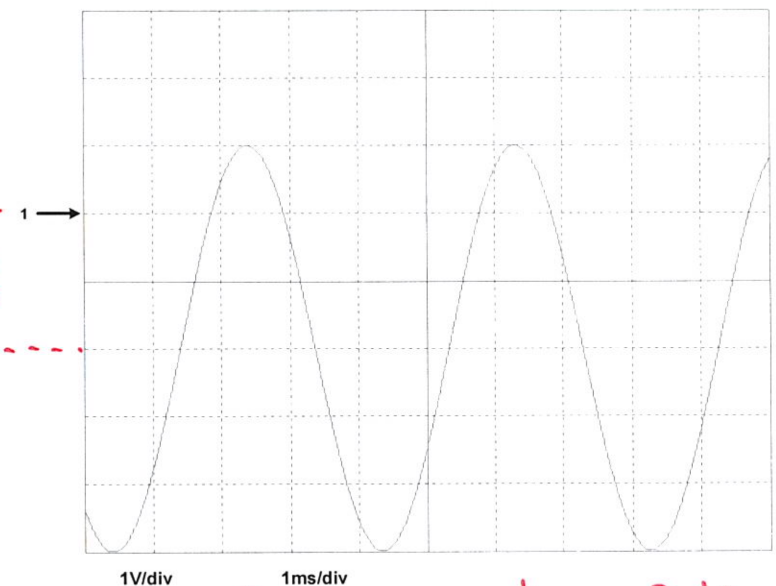
Additional Problems (Instructor Option):

- Any as assigned by instructor

Name: ______________________
Section: ______________________

Given the following scope image where the arrow indicates the ground level for CH1,

$-2V$



Amplitude

$4ms = T \Rightarrow f = 1/T$

a. Determine the DC offset
b. Determine the frequency in Hz
c. What is the RMS value of the sinusoidal part of the signal

a) $\boxed{-2V\ DC}$

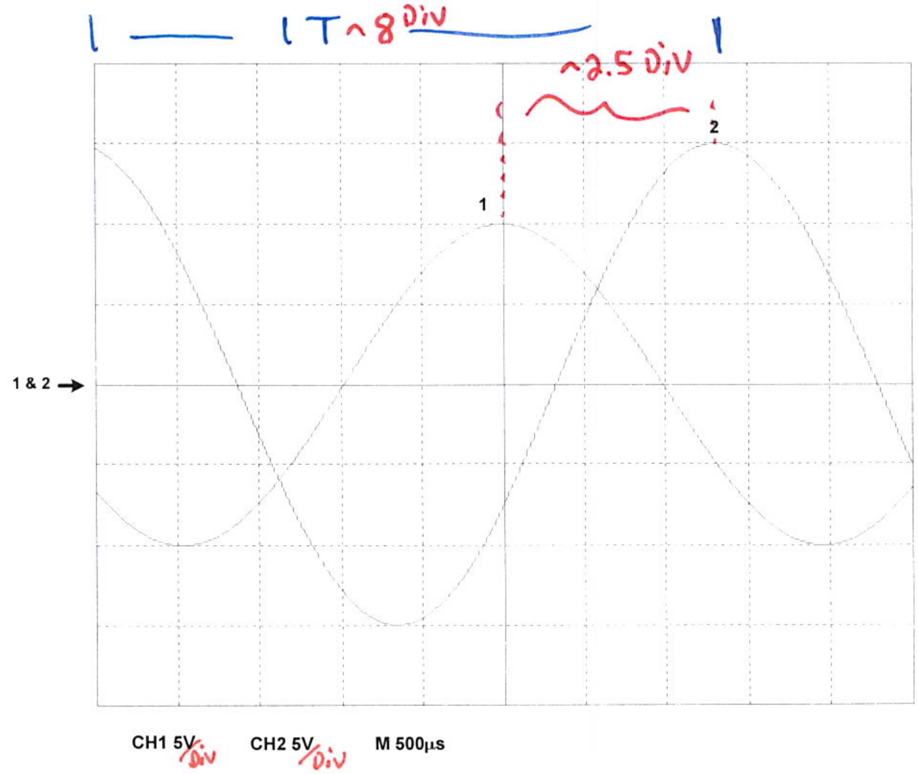
b) $4ms = T \Rightarrow \boxed{f = 1/T = 250\,Hz}$

c) $3V/\sqrt{2} = \boxed{2.12V}$

Name: ______________________

Section: ______________________

Given the following scope image where the arrow indicates the ground level for CH1 & CH2,



a. Which signal leads which and by how many degrees?

b. What is the RMS value of the signal on CH2?

a) 1 leads 2 => $2.5\ \text{Div} \cdot \left(\frac{500\ \mu s}{1\ \text{Div}}\right) = \boxed{1250\ \mu s}$

=> $1T = 8\ \text{Div} = 360°$

$2.5\ \text{Div} / 8\ \text{Div} = \frac{X}{360°}$ => CH1 leads by $\boxed{X \cong 112°}$

b) $V_{rms} = 15V/\sqrt{2} = \boxed{10.6V}$

Chapter 9, Problem 1.

Given the sinusoidal voltage $v(t) = 50\cos(30t+10^{o})$ V, find: (a)the amplitude V_m, (b) the period T, (c) the frequency f, and (d) v(t) at t=10 ms.

a) $\boxed{V_m = 50V}$

b) $\omega = 2\pi f = 2\pi/T \Rightarrow T = \frac{2\pi}{\omega} = \frac{2\pi}{30} = \boxed{0.209 \text{ sec}}$

c) $f = 30/2\pi = \boxed{4.77 \text{ HZ}}$

d) $V(10ms) = 50 \cdot \cos(30_{\frac{rad}{sec}} \cdot 10ms \cdot \frac{360^{o}}{2\pi rad} + 10^{o})V$

$= \boxed{44.5V}$

Chapter 9, Solution 3.

(a) $10\sin(\omega t + 30°) = 10\cos(\omega t + 30° - 90°) = \mathbf{10cos(\omega t - 60°)}$

(b) $-9\sin(8t) = \mathbf{9cos(8t + 90°)}$

(c) $-20\sin(\omega t + 45°) = 20\cos(\omega t + 45° + 90°) = \mathbf{20cos(\omega t + 135°)}$

(a) $10\cos(\omega t - 60°)$, (b) $9\cos(8t + 90°)$, (c) $20\cos(\omega t + 135°)$

Chapter 9, Solution 8.

(a) $$\frac{60\angle 45^\circ}{7.5 - j10} + j2 = \frac{60\angle 45^\circ}{12.5\angle -53.13^\circ} + j2$$
$$= 4.8\angle 98.13^\circ + j2 = -0.6788 + j4.752 + j2$$
$$= \mathbf{-0.6788 + j6.752}$$

(b) $(6-j8)(4+j2) = 24-j32+j12+16 = 40-j20 = 44.72\angle -26.57^\circ$

$$\frac{32\angle -20^\circ}{(6 - j8)(4 + j2)} + \frac{20}{-10 + j24} = \frac{32\angle -20^\circ}{44.72\angle -26.57^\circ} + \frac{20}{26\angle 112.62^\circ}$$

$$= 0.7156\angle 6.57^\circ + 0.7692\angle -112.62^\circ = 0.7109 + j0.08188 - 0.2958 - j0.71$$

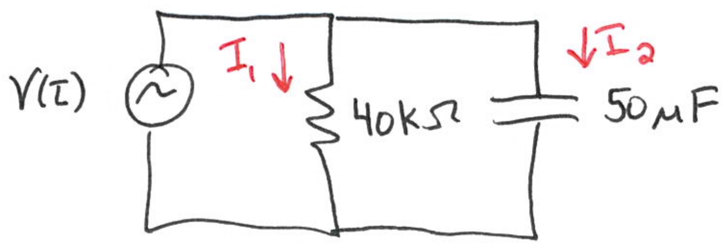
$$= \mathbf{0.4151 - j0.6281}$$

(c) $20 + (16\angle -50^\circ)(13\angle 67.38^\circ) = 20 + 208\angle 17.38^\circ = 20 + 198.5 + j62.13$

$$= \mathbf{218.5 + j62.13}$$

Chapter 9, Problem 30.

If a voltage $v(t) = 100\cos(60t + 20^{o})$ V is applied to a parallel combination of a 40-kΩ resistor and a 50-μF capacitor. Find the steady-state currents through the resistor and capacitor.



General Steps

1) Convert everything to Phasors
2) Solve
3) Convert back to Time Domain

$$I_1 = \frac{\tilde{V}}{R} = \frac{100\angle 20^\circ \text{ V}}{40\text{k}\Omega}$$

$$= 2.5\text{mA}\angle 20^\circ$$

$$\rightarrow \boxed{i_1(t) = 2.5\text{mA}\cos(60t + 20^\circ)}$$

Capacitor Impedance

$$I_2 = \frac{100\angle 20^\circ \text{ V}}{333.3\angle -90^\circ\ \Omega} \leftarrow Z_c = \frac{1}{\omega C j} = \frac{1}{60 \cdot 50\mu\text{F}}\angle -90^\circ = 333.3\angle -90^\circ\ \Omega$$

$$= 300\text{mA}\angle 110^\circ$$

$$\rightarrow \boxed{i_2(t) = 300\text{mA}\cos(60t + 110^\circ)}$$

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or if stay in time Domain

$$\rightarrow i_2(t) = C\, dv_1/dt = -50\mu\text{F} \cdot 100 \cdot 60 \cdot \sin(60t + 20^\circ)$$

$$= -300\text{mA}\sin(60t + 20^\circ)$$

$$= \boxed{300\text{mA}\cos(60t + 110^\circ)}$$

Chapter 9, Problem 35.

Find current i in the circuit of Fig. 9.42, when $v_s(t) = 50\cos 200t$ V.

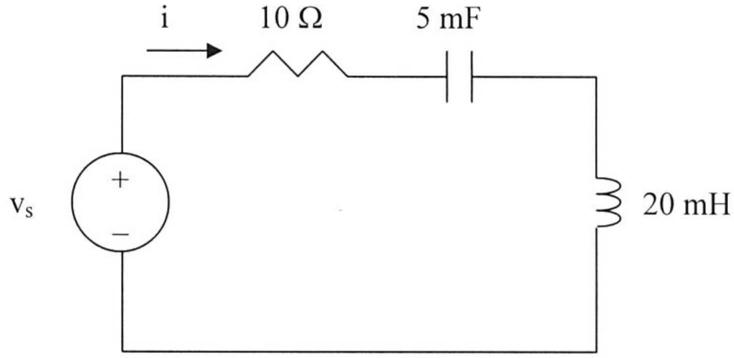


Figure 9.42 For Prob. 9.35.

Convert to Phasor

- $Z_R = 10\Omega\angle 0^\circ$, $Z_C = \frac{1}{\omega C}\angle -90^\circ$, $Z_L = \omega L \angle 90^\circ$

$= 1\Omega\angle 90^\circ$ $\qquad = 4\Omega\angle 90^\circ$

Solve

- $Z_{Total} = Z_R + Z_C + Z_L$

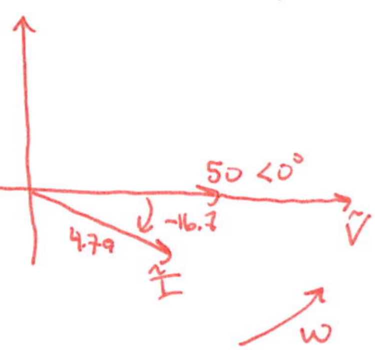
$= 10\Omega - 1\Omega j + 4\Omega j$

$= 10\Omega + 3\Omega j$

$= 10.44\angle 16.7^\circ\ \Omega$ ← (overall Inductive!)

R L

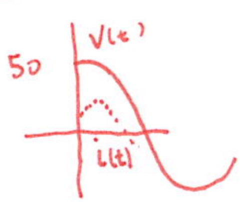
(10 + 3j) Ω



(ELI)

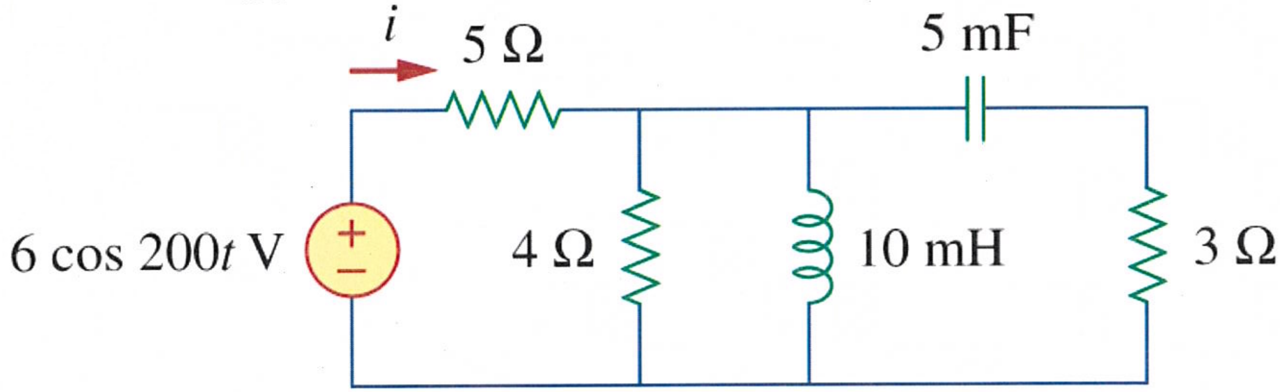
- $I = \frac{V_s}{Z_{TOT}} = \frac{50V\angle 0^\circ}{10.44\angle 16.7^\circ\ \Omega} = 4.79\angle -16.7^\circ A$

Convert to time Domain → $\boxed{i(t) = 4.79\cos(200t - 16.7^\circ)\ A}$



shifted to Right, ∴ Voltage leads current (ELI) ☑

Figure 9.51



Chapter 9, Solution 44.

$\omega = 200$

$$10\text{ mH} \longrightarrow j\omega L = j(200)(10\times10^{-3}) = j2$$

$$5\text{ mF} \longrightarrow \frac{1}{j\omega C} = \frac{1}{j(200)(5\times10^{-3})} = -j$$

$$\mathbf{Y} = \frac{1}{4} + \frac{1}{j2} + \frac{1}{3-j} = 0.25 - j0.5 + \frac{3+j}{10} = 0.55 - j0.4$$

$$\mathbf{Z} = \frac{1}{\mathbf{Y}} = \frac{1}{0.55 - j0.4} = 1.1892 + j0.865$$

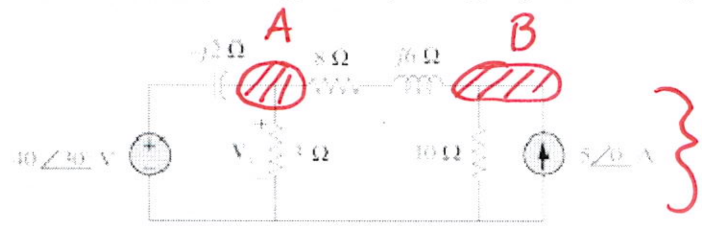
$$\mathbf{I} = \frac{6\angle 0^\circ}{5+\mathbf{Z}} = \frac{6\angle 0^\circ}{6.1892 + j0.865} = 0.96\angle -7.956^\circ$$

Thus,

$$i(t) = \mathbf{960\cos(200t - 7.956^\circ)\ mA}$$

Chapter 10, Problem 13.

Determine $\mathbf{V}_x$ (see Fig. 10.62), using any method of your choice.



Could also Source Transform to get Down to 1 Node

Figure 10.62

$$A: \quad \frac{\hat{V}_A - 40\angle 30^\circ}{-j2} + \frac{\hat{V}_A - 0}{3\angle 0^\circ} + \frac{\hat{V}_A - \hat{V}_B}{8+6j} = 0$$

$$B: \quad \frac{\hat{V}_B - \hat{V}_A}{8+6j} + \frac{\hat{V}_B - 0}{10\angle 0^\circ} + (-5\angle 0^\circ) = 0$$

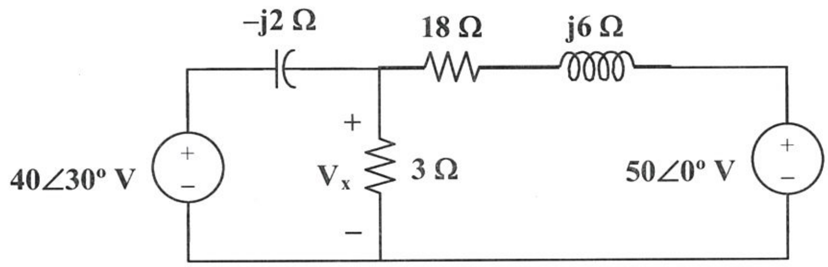
$$\text{CSolve} \Rightarrow \boxed{\hat{V}_A = \hat{V}_x = 29.4\angle 62.9^\circ\, V}$$

$$\hat{V}_B = 40.8\angle 28^\circ\, V$$

OR

Chapter 10, Solution 13.

Nodal analysis is the best approach to use on this problem. We can make our work easier by doing a source transformation on the right hand side of the circuit.



$$\frac{V_X - 40\angle 30^\circ}{-j2} + \frac{V_X}{3} + \frac{V_X - 50}{18 + j6} = 0$$

which leads to V_x = **29.36∠62.88° A**.