Desk Copy

ECE 301
Fall Semester, 2005
Test #4

wlg Version A

Name _____
Print (last, first)

Work the exam on your own engineering paper. Work on one side of your paper only. Attach your work to the back of this exam sheet and staple in the top left hand corner. Each problem counts 20%.

(1) You are given the circuit of Figure 1. Find the phasor current **I.**

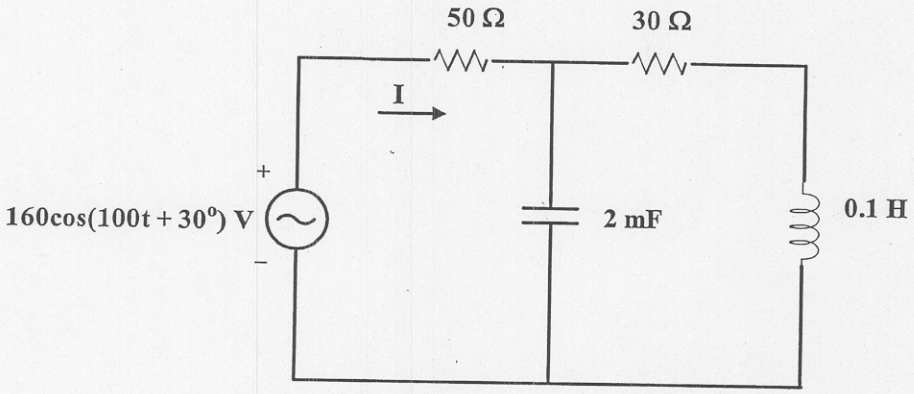


Figure 1: Circuit for problem 1.

(2) You are given the circuit of Figure 2. Find the phasor voltage $\mathbf{V}_1$ using nodal analysis.

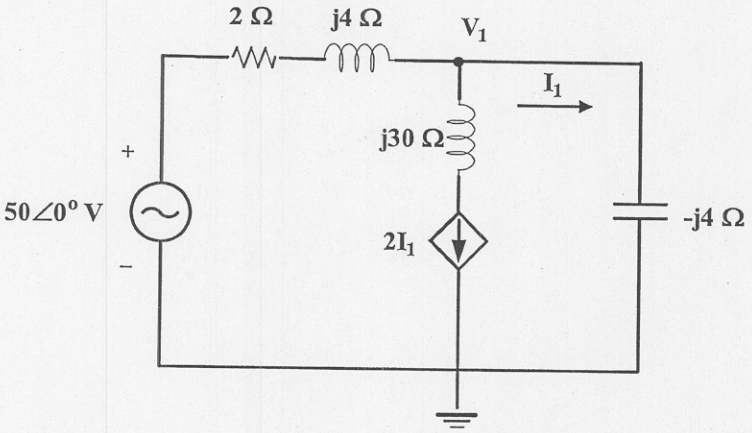


Figure 2: Circuit for problem 2.

(5) You are given the AC circuit shown below.
(a) Determine the complex power supplied by the source.
(b) Determine the power factor.

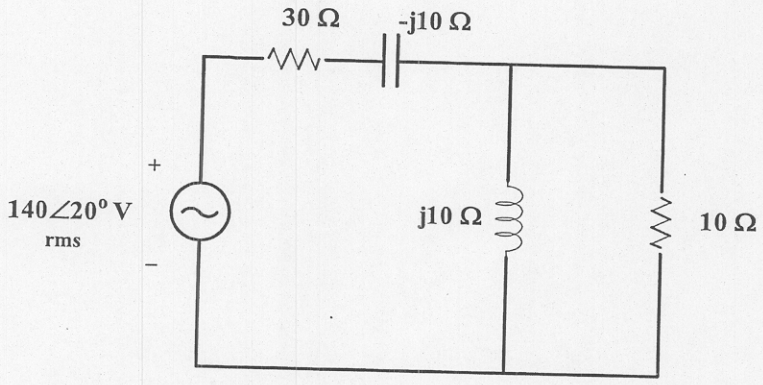


Figure 5: Circuit for problem 5.

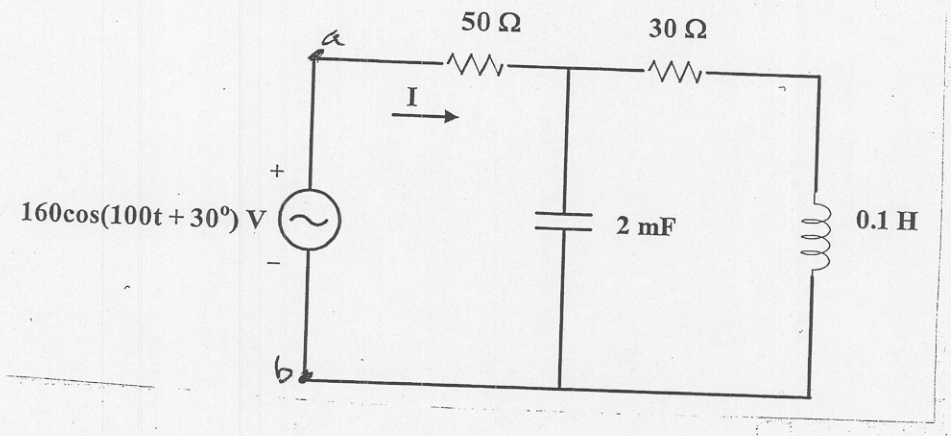
ECE 301

Test 4

F '05

Version A

(1) Find $\hat{I}$.

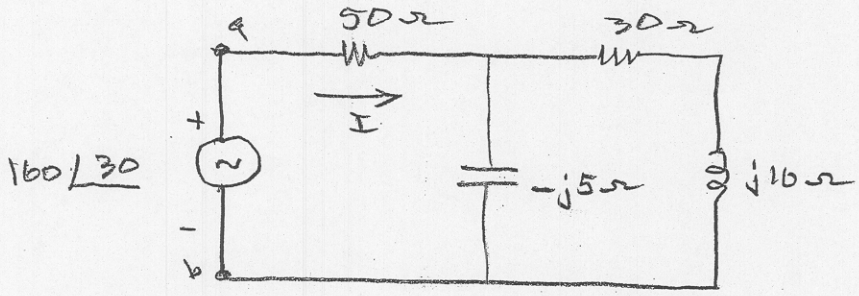


Find X_C and X_L

$$X_C = \frac{1}{\omega C} = \frac{1}{1\times10^{2}\times2\times10^{-3}} = 5$$

$$X_L = \omega L = 1\times10^{2}\times0.1 = 10$$

Phasor Circuit



Find Z_{ab}

$$Z_{ab} = 50 + \frac{(5\angle-90)(30+j10)}{30+j10-j5} = 51.07\angle-5.77$$

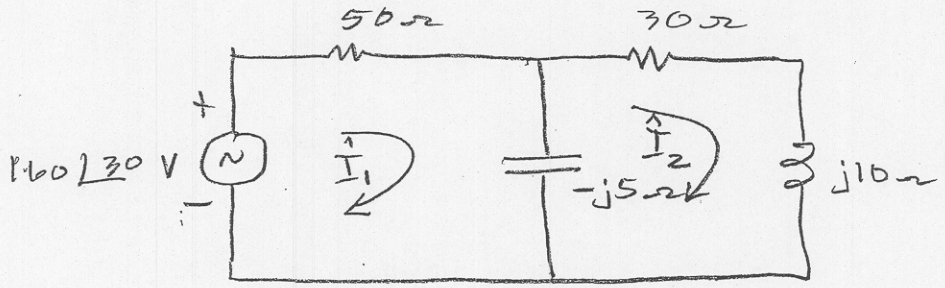
$$\hat{I} = \frac{160\angle30}{51.07\angle-5.77} =$$

$$\hat{I} = 3.13\angle35.8^{\circ}\ A$$

Version A

(1) Alternate Method

From the phasor circuit;

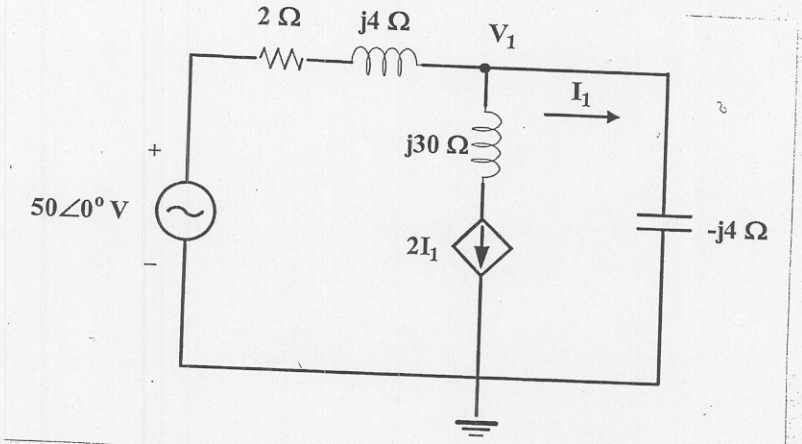


$$\begin{bmatrix} 50-j5 & j5 \\ j5 & 30+j5 \end{bmatrix} \begin{bmatrix} \overset{\uparrow}{I}_1 \\ \overset{\uparrow}{I}_2 \end{bmatrix} = \begin{bmatrix} 160\angle 30 \\ 0 \end{bmatrix}$$

$$\overset{\uparrow}{I}_1 = 2.54 + j1.8 = 3.13\angle 35.8^\circ \text{ A}$$

Version A

(2) Find V_1, nodal analysis



$$\frac{\hat{V}_1 - 50}{2+j4} + \frac{\hat{V}_1}{-j4} + 2\hat{I}_1 = 0$$

but $\hat{I}_1 = \dfrac{V_1}{-j4}$

so,

$$\frac{\hat{V}_1 - 50}{2+j4} + \frac{V_1}{-j4} + \frac{2V_1}{-j4} = 0$$

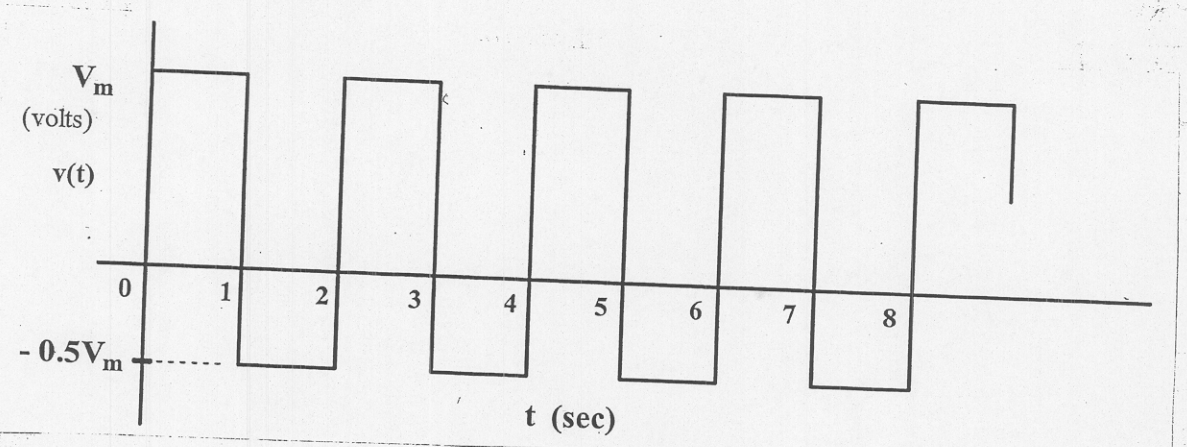
$$(0.1 - j0.2)V_1 + (-5 + j10) + j0.75V_1 = 0$$

$$(.1 - j.2 + j.75)V_1 = 5 - j10$$

$$V_1 = \frac{5 - j10}{0.1 + j0.55} = (-16 - j12)\ V$$

$$\boxed{V_1 = 20\angle -143.1°\ V}$$

(3) Find V_{RMS}



$$V_{rms} = \sqrt{\frac{1}{2}\left[\int_0^1 V_m^2\,dt + \int_1^2 .25V_m^2\,dt\right.}$$

$$= \sqrt{\frac{V_m^2}{2}\left[t\Big|_0^1 + .25t\Big|_1^2\right]}$$

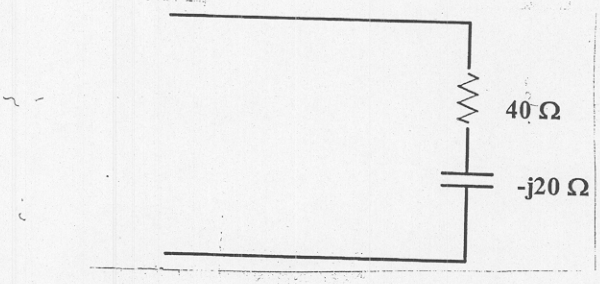
$$= \sqrt{\frac{V_m^2}{2}\left[1 + .5 - .25\right]}$$

$$= \sqrt{\frac{V_m^2}{2} \times 1.25} = V_m\sqrt{\frac{1.25}{2}}$$

$$\boxed{V_{rms} = 0.79\,V_m}$$

(4)

(a) Determine the power factor



$Z = 40 - j20$

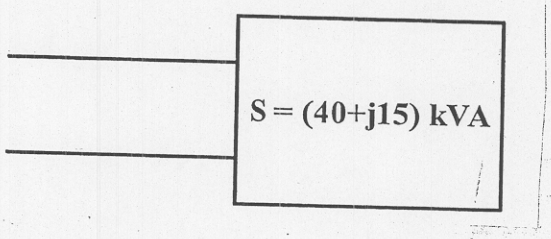
$Z = 44.7 \angle -26.56^\circ \ \Omega$

The angle of Z is the p.f. angle.
If $\angle Z$ is negative, it is a leading p.f.

$p.f. = \cos(-26.56^\circ)$

p.f. = 0.8945 leading

(b) Find the p.f.



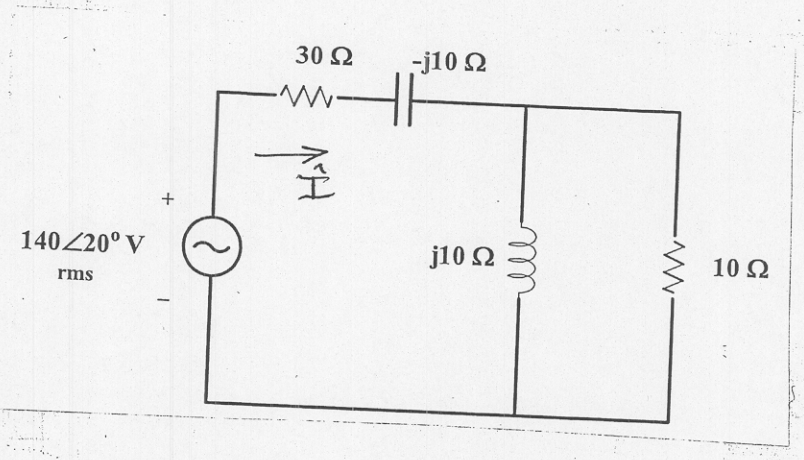
Angle of $\vec{S}$ is the p.f. angle

$\vec{S} = 40 + j15 = 42.7 \angle 20.56^\circ$

p.f. = cos(20.56) = 0.9363 lagging

(5) (a) Determine $\hat{S}$ supplied.

(b) Determine p.f.



Determine Z looking into the circuit.

$$\hat{Z} = (30 - j10) + \frac{(10\angle 90)(10)}{10 + j10}$$

$$Z = 35 - j5$$

$$Z = 35.36\angle -8.13^\circ \Omega$$

$$\hat{S} = \frac{|\hat{V}_{rms}|^2_{source}}{Z^*}$$

$$\hat{S} = \frac{140^2}{35.36\angle 8.13} = 548.73 - j78.39$$

$$\hat{S} = 554.3\angle -8.13 \text{ VA}$$

$$\hat{I} = 3.96\angle 28.1$$

$$\begin{bmatrix} 30 - j10 & -j10 \\ -j10 & 10 + j10 \end{bmatrix} \begin{bmatrix} I \\ I_2 \end{bmatrix} = \begin{bmatrix} 140\angle 20 \\ 0 \end{bmatrix}$$

$$\hat{S} = 140\angle 20 \times 3.96\angle -28.1$$

$$\hat{S} = 554\angle -8.1 \text{ VA}$$

(b) $P.f. = \cos(-8.13) = 0.98995$ leading

P.f. = 0.98995 leading