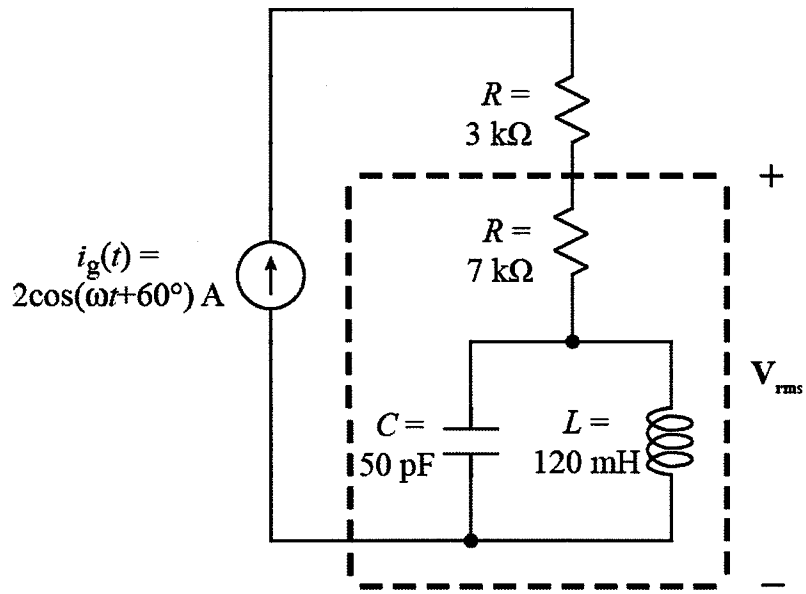
HOMEWORK #7 prob 2 solution

Ex:



a) Calculate $\mathbf{V}_{rms}$. Note: $\omega = 1$ Mr/s.

b) Calculate the complex power, S, for the components inside the box.

soln a) If we convert the current source to rms units, then a calculation of V_{rms} is accomplished by using Ohm's law:

$$\mathbf{V}_{rms} = \mathbf{I}_{rms} \cdot Z_{box}$$

where

$$Z_{box} = R + j\omega L \,||\, \frac{1}{j\omega C}$$

We have

$$j\omega L = j\,1M \cdot 120m\,\Omega = j120k\,\Omega$$

$$\frac{1}{j\omega C} = \frac{1\,\Omega}{j1M \cdot 50p} = -j\,20k\,\Omega$$

$$j\omega L \,||\, \frac{1}{j\omega C} = j20k \cdot 6 \,||\, {-1} = j\,20k\left(\frac{-6}{5}\right)$$
$$= -j\,24k\,\Omega$$

Thus, $Z_{box} = 7k\Omega - j24k\Omega$.

For the current source, the current in rms is the phasor current divided by $\sqrt{2}$:

$$\mathbb{I}_{g\,rms} = \frac{\mathbb{I}_g}{\sqrt{2}} = \frac{2\angle 60^\circ}{\sqrt{2}} = \sqrt{2}\angle 60^\circ A_{rms}$$

Thus, $$V_{rms} = \mathbb{I}_{g\,rms} Z_{box}$$

$$= \sqrt{2}\angle 60^\circ A_{rms} \cdot (7k - j24k)\Omega$$

$$= \sqrt{2}\angle 60^\circ A_{rms} \cdot 25k\Omega\angle -73.7^\circ$$

$$V_{rms} = 25\sqrt{2}\, kV_{rms} \angle -13.7^\circ$$

or $$V_{rms} = 9.6k - j8.1k\ V_{rms}$$

b) It is convenient here to use the following formula for S:

$$S = |\mathbb{I}_{rms}|^2 Z$$

$$= 2^2 A^2 (7k - j24k)\Omega$$

$$S = 28 - j96\ kVA$$

or $S = 100\angle -73.7^\circ\ kVA$