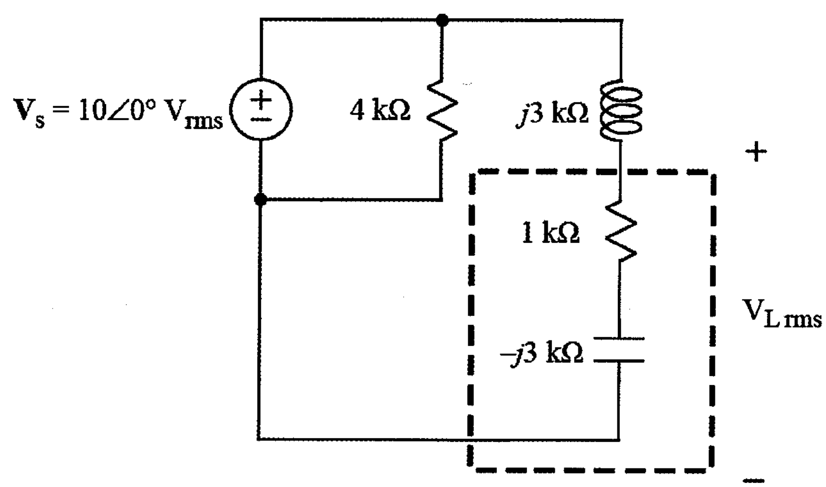
Ex:



a) Calculate the value of rms voltage, $\mathbf{V}_{L\,rms}$, across the dashed box.

b) Calculate the value of the average power, P, dissipated by the circuitry in the dashed box.

sol'n: a) We have two circuits in parallel across V_s — the $4\,k\Omega$ and everything else. These circuits may be solved separately. Thus, the $4\,k\Omega$ may be ignored.

We have a V-divider.

$$V_{L\,rms} = V_s \cdot \frac{1\,k\Omega - j3\,k\Omega}{j3\,k\Omega + 1\,k\Omega - j3\,k\Omega}$$

$$= 10\angle 0^\circ\, V_{rms} \; \frac{1\,k\Omega - j3\,k\Omega}{1\,k\Omega}$$

$$= 10 \cdot (1 - j3)\; V_{rms}$$

$$V_{L\,rms} = 10 - j30 \;\; V_{rms}$$

Note: Since our source is given in rms, the value of $V_{L\,rms}$ will be rms.

b) Complex power is $\mathbb{S} = \mathbb{P} + jQ = \mathbb{V}_{rms} \mathbb{I}^*_{rms}$

Using Ohm's Law, we find $\mathbb{I}_{L\,rms}$ from $\mathbb{V}_{L\,rms}$:

$$\mathbb{I}_{L\,rms} = \frac{\mathbb{V}_{L\,rms}}{Z_{box}} = \frac{\mathbb{V}_{L\,rms}}{1k\Omega - j3k\Omega}$$

$$'' = \frac{10 - j30 \ V_{rms}}{1k\Omega - j3k\Omega}$$

$$\mathbb{I}_{L\,rms} = 10 \ mA_{rms}$$

Since $\mathbb{I}_{L\,rms}$ is real, $\mathbb{I}^*_{L\,rms} = \mathbb{I}_{L\,rms}$.

So $\mathbb{S} = \mathbb{V}_{L\,rms} \mathbb{I}^*_{L\,rms} = (10 - j30) \cdot 10 \ m \ VA$

$$\mathbb{S} = \frac{1}{10} - j\frac{3}{10} \ VA$$

The average power, $\mathbb{P}$, is the real part of $\mathbb{S}$.

$$\mathbb{P} = \frac{1}{10} W$$

Note: The units for $\mathbb{P}$ are Watts, for Q are VAR, and for $\mathbb{S}$ are VA.