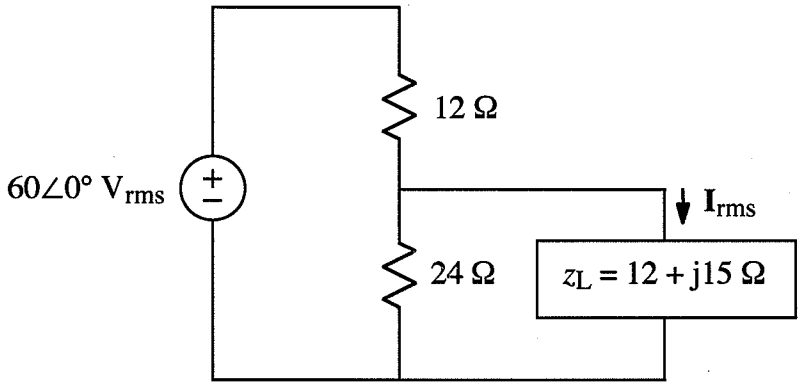
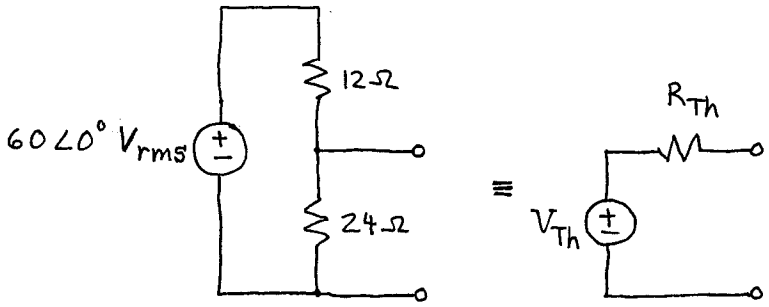
EX:



a) Calculate the value of rms current, $\mathbf{I}_{rms}$, flowing through z_L.

b) Calculate the complex power, S, for z_L. Include appropriate units.

Soln: a) One approach is to use a Thevenin equivalent of the V-src, 12Ω, and 24Ω.



V_{Th} = open-circuit output voltage of original circuit

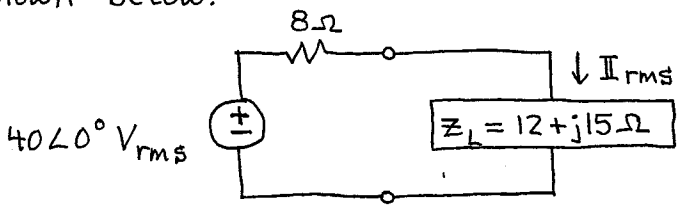
$$= 60\angle 0^\circ\ V_{rms} \cdot \frac{24\ \Omega}{12\ \Omega + 24\ \Omega} \quad \text{(V divider)}$$

$$= 40\angle 0^\circ\ V_{rms}$$

R_{Th} = R seen looking into circuit with V-src turned off, (i.e. $60\angle 0^\circ\ V_{rms}$ becomes wire).

$$R_{Th} = 24\Omega \| 12\Omega = 12\Omega \cdot 2 \| 1 = 12\Omega \cdot \frac{2}{3} = 8\Omega$$

Using the Thevenin equivalent, our circuit is shown below.



From Ohm's law, we find $\mathbb{I}_{rms}$:

$$\mathbb{I}_{rms} = \frac{40\angle 0^\circ V_{rms}}{8\Omega + Z_L} = \frac{40\angle 0^\circ V_{rms}}{8 + 12 + j15\ \Omega}$$

$$= \frac{40\angle 0^\circ V_{rms}}{20 + j15\ \Omega}$$

$$\mathbb{I}_{rms} = \frac{40\angle 0^\circ V_{rms}}{25\angle 36.9^\circ \Omega}$$

Note: $25 = \sqrt{20^2 + 15^2}$, $\quad 36.9^\circ = \tan^{-1}\frac{15}{20}$

$$\mathbb{I}_{rms} = \frac{40}{25}\angle(0^\circ - 36.9^\circ)\ A_{rms}$$

$$\mathbb{I}_{rms} = 1.6\angle -36.9^\circ\ A_{rms}$$

or $\quad 1.28 - j0.96\ A_{rms}$

b) $S = |\mathbb{I}_{rms}|^2 Z_L$

Note: Since we're using $\mathbb{I}_{rms}$, we do not divide by 2.

$S = 1.6^2 \cdot (12 + j15)$ VA

Note: We use VA as the units to indicate that the value represents S (rather than P or Q).

$S = 30.72 + j38.4$ VA

or $49.2 \angle 51.3^\circ$ VA