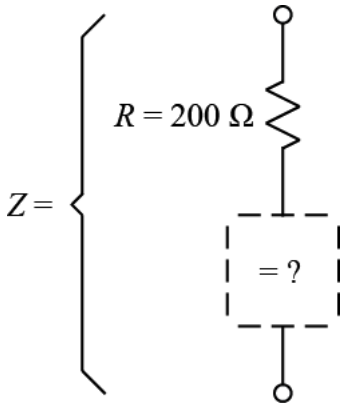
Ex:



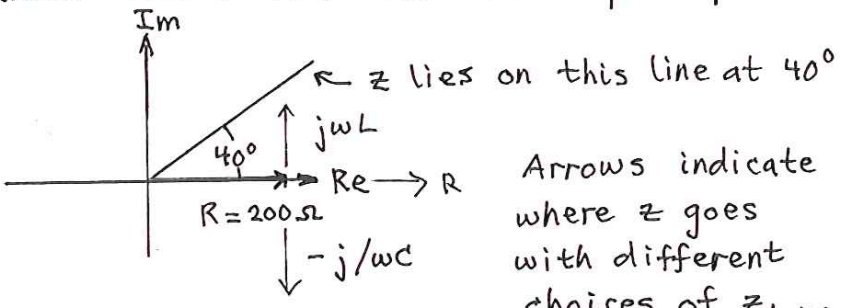
The total impedance of the above circuitry is $Z = |Z|e^{j40°}$. We don't know the magnitude of *Z*, but its phase angle is +40°. *Z* is made of a 200Ω resistor in series with one other part. What is that part? Give the type and value of the part, and draw the combination.

$\omega = 3000$ rad/sec

soln: We can consider the magnitude and phase of $\mathcal{Z}$ in separate Ohm's law equations:

$$|\mathcal{Z}| = \frac{|\mathcal{V}|}{|\mathcal{I}|} \quad \text{and} \quad \angle\mathcal{Z} = \angle\mathcal{V} - \angle\mathcal{I} = 40°$$

Our value for $\mathcal{Z}$ is $\mathcal{Z} = 200\Omega + \mathcal{Z}_{box}$, and we know $\angle\mathcal{Z} = 40°$. In the complex plane:



From the diagram, we see we need jωL, with $\angle R + j\omega L = 40°$.

$$40° = \tan^{-1}\frac{\omega L}{R} \quad \text{or} \quad L = \frac{R}{\omega}\tan 40° = \frac{200}{3k}(0.839) \approx 56\text{mH}$$