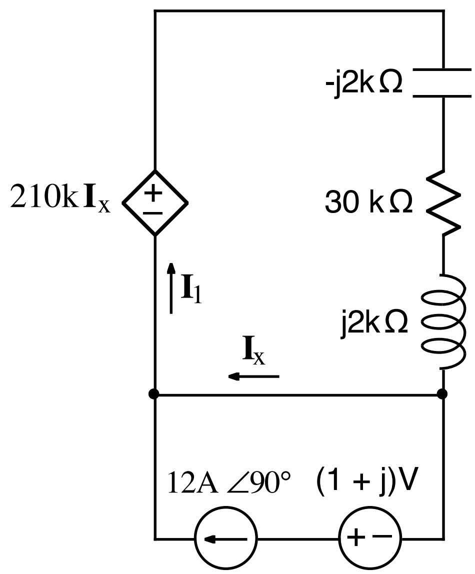
Ex:

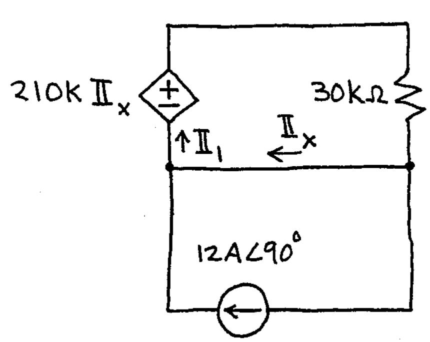


a) A frequency-domain circuit is shown above. Write the value of phasor $\mathbf{I}_1$ in polar form.

b) Given $\omega = 2k$ rad/s, write a numerical time-domain expression for $i_1(t)$, the inverse phasor of $\mathbf{I}_1$.

sol'n: a) We first eliminate unnecessary components:
- The $-j2k\Omega$ and $j2k\Omega$ sum to 0Ω and act like a wire.
- The $(1+j)V$ source is in series with a current source, allowing us to ignore it.

New circuit model:



Using a current summation at the left node, we have one eq'n in two unknowns:

(1) $12A\angle 90° + \mathbb{I}_x = \mathbb{I}_1$

Using a voltage loop around the top half of the circuit, we get a 2nd eq'n in two unknowns:

(2) $\mathbb{I}_1 = \dfrac{210k\,\mathbb{I}_x}{30k\Omega}$

We solve eq'n (1) for $\mathbb{I}_x$:

(1') $\mathbb{I}_x = \mathbb{I}_1 - 12A\angle 90°$

Substituting into (2) gives an eq'n for $\mathbb{I}_1$:

(2') $\mathbb{I}_1 = \dfrac{210k}{30k\Omega}(\mathbb{I}_1 - 12A\angle 90°) = 7(\mathbb{I}_1 - 12A\angle 90°)$

(2'') $6\mathbb{I}_1 = 12A\angle 90°$

(2''') $\mathbb{I}_1 = 2A\angle 90°$

c) $i_1(t) = P^{-1}[\mathbb{I}_1] = P^{-1}[2A\angle 90°]$

$i_1(t) = 2\cos(\omega t + 90°)A = 2\cos(2kt + 90°)\,A$