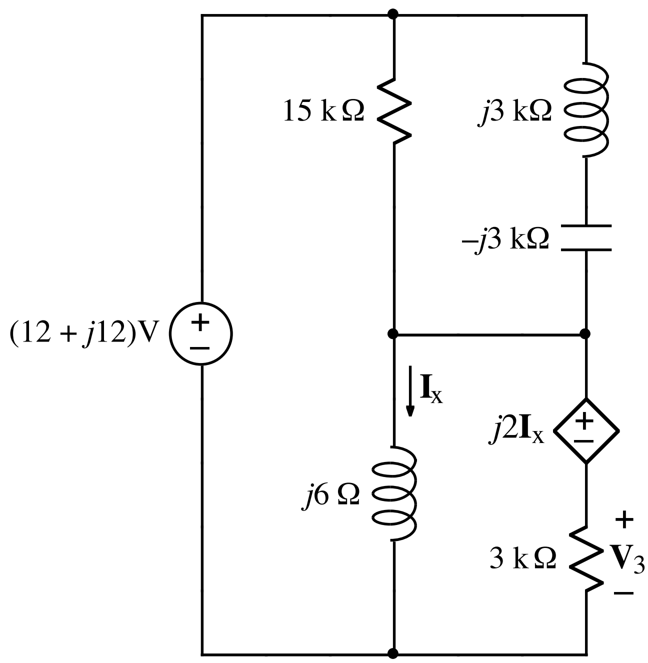
HOMEWORK #18 solution

Ex:



a) A frequency-domain circuit is shown above. Write the value of phasor $\mathbf{V}_3$ in polar form.

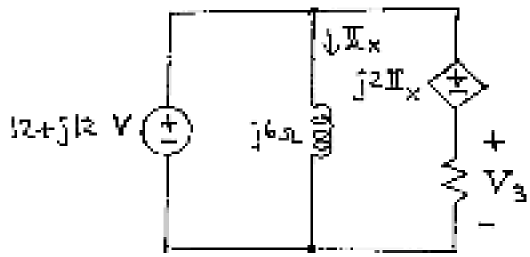
b) Given ω = 37 rad/s, write a numerical time-domain expression for $v_3(t)$, the inverse phasor of $\mathbf{V}_3$.

sol'n: a) The j3kΩ and −j3kΩ sum to 0Ω = wire.

Thus, the 15 kΩ is bypassed by a short and may be ignored.

It also follows that the 12+j12 V is directly across the j6Ω and directly across the j2$\mathbf{I}_x$ source in series with the 3kΩ resistor.

Our circuit model is as follows:



By Ohm's law, $I_x = \dfrac{12+j12\ V}{j6\ \Omega} = \dfrac{2(1+j)}{j}\ A$

or $I_x = -j2(1+j)\,A$

or $I_x = 2 - j2\ \ A$

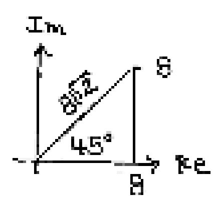
It follows that $j2I_x = j2(2-j2)\,V = 4+j4\ V.$

From a v-loop around the outside of the circuit, we have the following:

$$V_3 = (12+j12)V - (4+j4)V$$

or $V_3 = 8 + j8\ \ V$

or $V_3 = 8\sqrt{2}\angle 45°\ \ V$



b) $v_3(t) = P^{-1}\left[8\sqrt{2}\angle 45° V\right]$, $\omega = 37$ rad/s

$$v_3(t) = 8\sqrt{2}\cos(37t + 45°)\ \ V$$