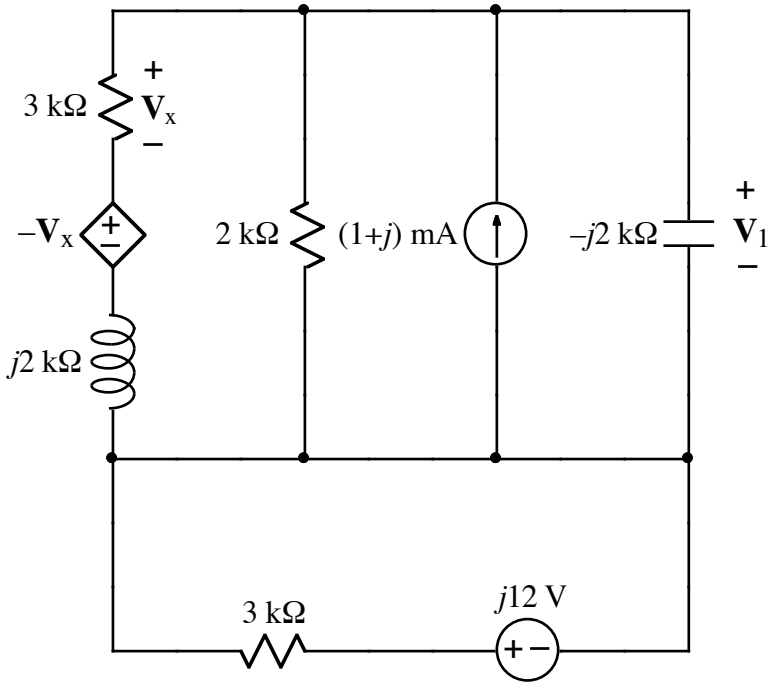
HOMEWORK #18 solution

Ex:



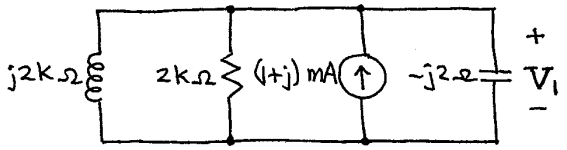
a) A frequency-domain circuit is shown above. Write the value of phasor voltage $\mathbf{V}_1$ in rectangular form.

b) Given ω = 500 rad/s, write a numerical time-domain expression for $v_1(t)$, the inverse phasor of $\mathbf{V}_1$.

sol'n: a) The dependent-source voltage cancels out the voltage across the 3kΩ resistor, yielding the equivalent of a wire, (i.e. 0V).

We may also ignore the bottom part of the circuit, which is shorted out by the middle wire.

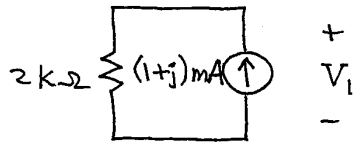
Thus far, we have the following circuit:



Now we observe that the $j2k\Omega$ and $-j2k\Omega$ in parallel are equivalent to an open circuit:

$$j2k\Omega \,\|\, -j2k\Omega = j2k\Omega \cdot 1 \,\|\, -1 = j2k\Omega - \frac{1}{0} = \infty\,\Omega$$

Thus, the L and C disappear:



Now we use Ohm's Law:

$$V_1 = (1+j)\ mA \cdot 2k\Omega = 2+j2\ V$$

b) In polar form, $V_1 = 2\sqrt{2} \angle 45^\circ\ V$

In the time domain, we have

$$v_1(t) = 2\sqrt{2}\cos(500t + 45^\circ)\ V$$

Note: We could also directly take the inverse phasor of $2+j2\ V$:

$$v_1(t) = 2\cos(500t) - 2\sin(500t)\ V$$