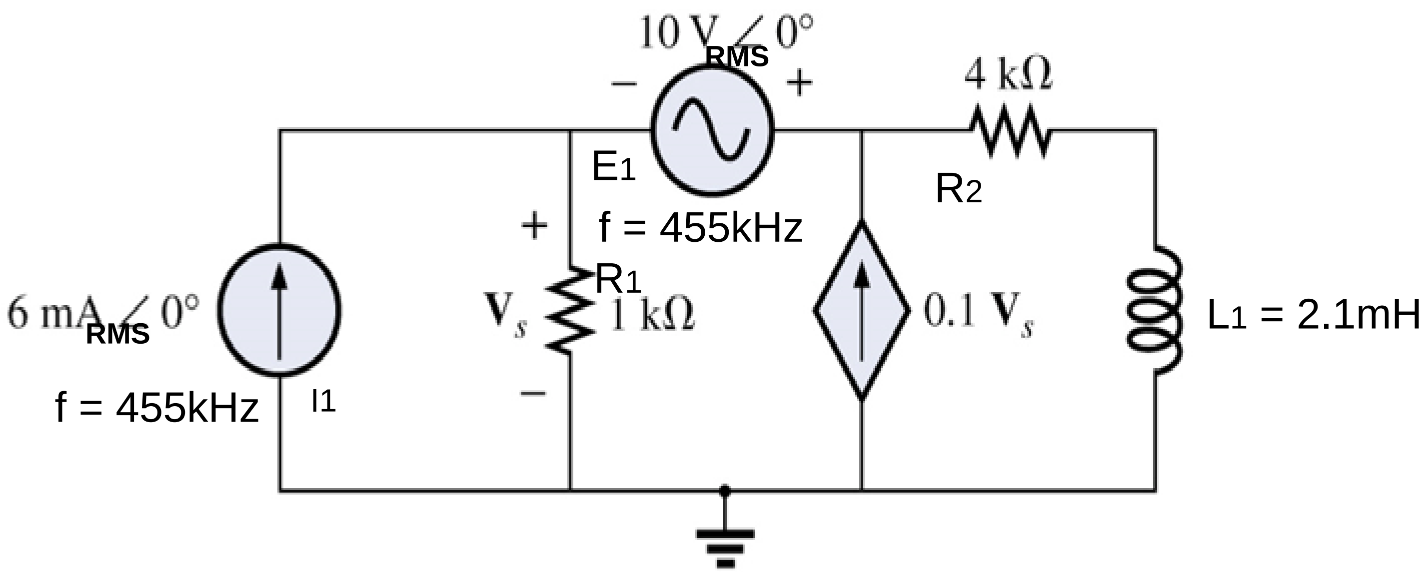
In Class Problem (also a modified homework problem)



Find:
- The current through the inductor

Approach:
- Use Nodal Analysis
- Combine R2 and L1

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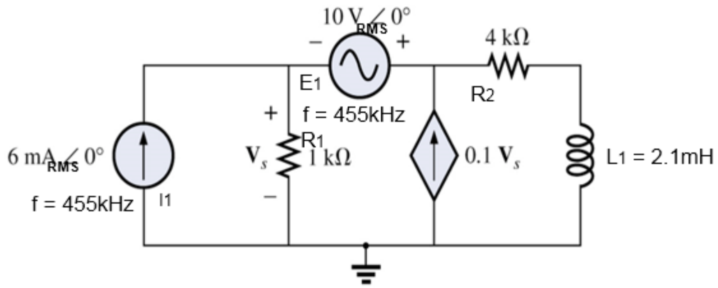
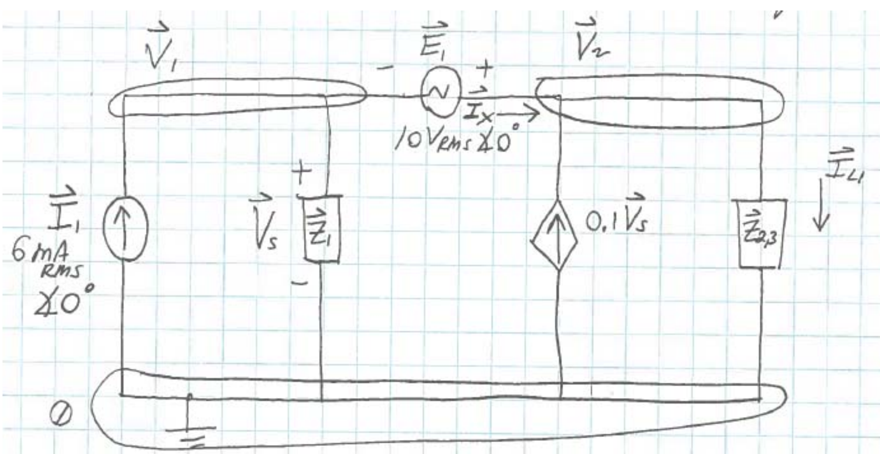


Convert to impedance boxes, label the nodes:



$\vec{Z}_1 = 1000\,\Omega$

$\vec{Z}_{2,3} = (4000 + j6004)\,\Omega$

KCL

$\sum I_{IN} = \sum I_{OUT}$

Replace **E1** w a s/c and write the KCL eq:

$$\vec{I}_1 + 0.1\vec{V}_s = \frac{\vec{V}_1}{\vec{Z}_1} + \frac{\vec{V}_2}{\vec{Z}_{2,3}}$$

But $0.1\vec{V}_s = 0.1\vec{V}_1$

So we have:

$$\frac{\vec{V}_1}{\vec{Z}_1} + \frac{\vec{V}_2}{\vec{Z}_{2,3}} - 0.1\vec{V}_1 = \vec{I}_1$$

$$\left(\frac{1}{\vec{Z}_1} - 0.1\right)\vec{V}_1 + \left(\frac{1}{\vec{Z}_{2,3}}\right)\vec{V}_2 = \vec{I}_1 \quad (1)$$

Writing **E1** in terms of the node voltages:

$$\vec{E}_1 = \vec{V}_2 - \vec{V}_1$$

$$-\vec{V}_1 + \vec{V}_2 = \vec{E}_1 \quad (2)$$

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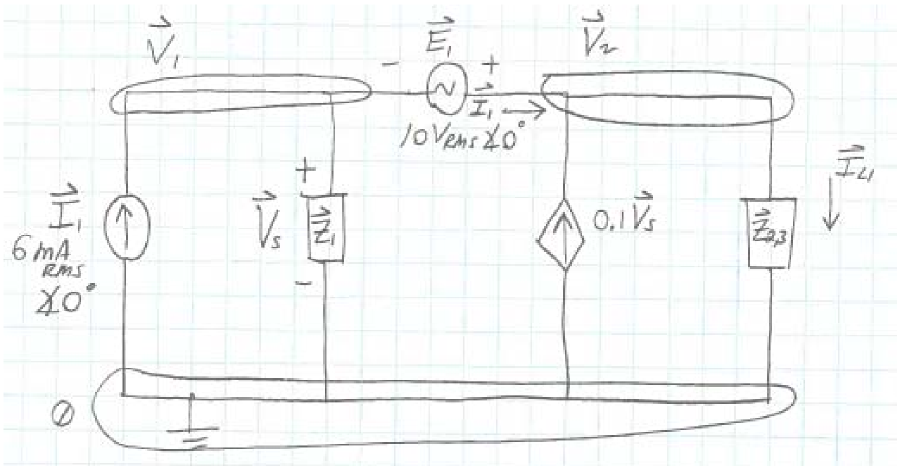

$$\vec{Z}_1 = 1000\,\Omega$$

$$\vec{Z}_{2,3} = (4000 + j\,6004)\,\Omega$$

$$\left(\frac{1}{\vec{Z}_1} - 0.1\right)\vec{V}_1 + \left(\frac{1}{\vec{Z}_{2,3}}\right)\vec{V}_2 = \vec{I}_1 \quad (1)$$

$$-\vec{V}_1 + \vec{V}_2 = \vec{E}_1 \quad (2)$$

Substituting values yields:

$$-99\times10^{-3}\,\vec{V}_1 + 138.6\times10^{-6}\angle -56.33°\,\vec{V}_2 = 6\times10^{-3} \quad (1)$$

$$-\vec{V}_1 + \vec{V}_2 = 10 \quad (2)$$

$$\boxed{\begin{aligned}\vec{V}_1 &= 54.16\,mV_{RMS}\angle -167.6° \\ \vec{V}_2 &= 9.947\,V_{RMS}\angle -66.81\times10^{-3}\,°\end{aligned}}$$

Using the node voltages to find **IL1**:

$$\vec{I}_{L1} = \frac{\vec{V}_2}{\vec{Z}_{2,3}} = \frac{9.947\,V_{RMS}\angle -66.81\times10^{-3}\,°}{(4000 + j\,6004)\,\Omega}$$

$$\boxed{\vec{I}_{L1} = 1.38\,mA_{RMS}\angle -56.4°}$$

One quick check:

$$\vec{E}_1 \overset{?}{=} \vec{V}_2 - \vec{V}_1$$

$$10\,V_{RMS}\angle 0° \overset{?}{=} \left(9.947\,V_{RMS}\angle -66.81\times10^{-3}\,°\right) - \left(54.16\,mV_{RMS}\angle -167.6°\right)$$

$$10\,V_{RMS}\angle 0° \overset{?}{=} 9.99\,V_{RMS}\angle 179\times10^{-6}\,°$$

☺

Easier than MESH on the same problem!