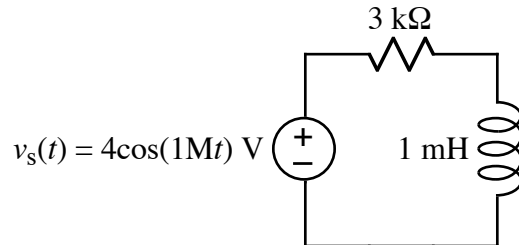
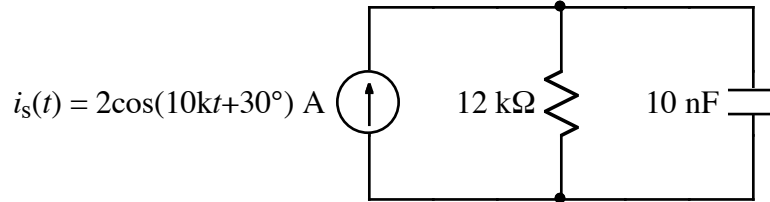


Ex:



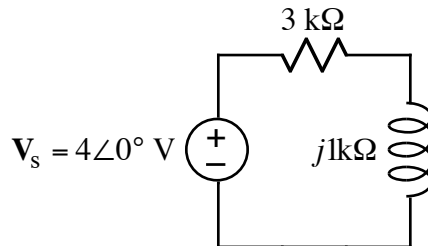
- a) Find time-domain expressions for the waveforms of the voltages across the  $R$  and  $L$  in the above circuit.



- b) Find time-domain expressions for the waveforms of the currents through the  $R$  and  $C$  in the above circuit.

SOL'N: a) First, we transform the circuit to the frequency-domain.

$$j\omega L = j1\text{M} \cdot 1\text{m} \Omega = j1 \text{ k}\Omega$$



Second, we use a voltage-divider formula to find the voltage across the  $R$  and  $L$ .

$$V_R = 4\angle 0^\circ \text{V} \frac{3\text{k}\Omega}{3\text{k}\Omega + j1\text{k}\Omega} = 4\text{V} \frac{3}{3 + j1} = 4\text{V} \frac{3}{3 + j} \frac{3 - j}{3 - j}$$

or

$$V_R = 12\text{V} \frac{3 - j}{10} = 1.2\text{V} \cdot \sqrt{3^2 + 1^2} \angle \tan^{-1}\left(\frac{-1}{3}\right) = 1.2\sqrt{10} \angle -18.4^\circ \text{ V}$$

or

$$\mathbf{V}_R = 3.79\angle -18.4^\circ \text{ V}$$

The calculation for the inductor voltage is similar to the above.

$$\mathbf{V}_L = 4\angle 0^\circ \text{V} \frac{j1\text{k}\Omega}{3\text{k}\Omega + j1\text{k}\Omega} = 4\text{V} \frac{j1}{3 + j1} = 4\text{V} \frac{j}{3 + j} \frac{3 - j}{3 - j}$$

or

$$\mathbf{V}_L = 4\text{V} \frac{1 + j3}{10} = 0.4\text{V} \cdot \sqrt{1^2 + 3^2} \angle \tan^{-1}\left(\frac{3}{1}\right) = 0.4\sqrt{10} \angle 71.6^\circ \text{ V}$$

or

$$\mathbf{V}_L = 1.26 \angle 71.6^\circ \text{ V}$$

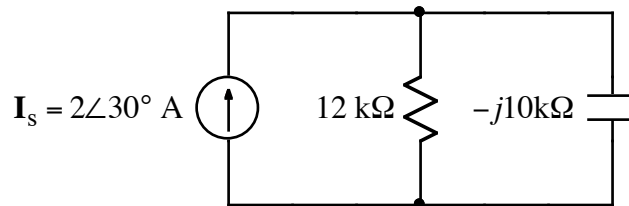
Third, we take the inverse phasor.

$$v_R(t) = 1.2\sqrt{10} \cos(1\text{M}t - 18.4^\circ) \text{ V}$$

$$v_L(t) = 0.4\sqrt{10} \cos(1\text{M}t + 71.6^\circ) \text{ V}$$

b) First, we transform the circuit to the frequency-domain.

$$\frac{1}{j\omega C} = \frac{1}{j10\text{k} \cdot 10\text{n}} \Omega = -j10\text{k}\Omega$$



Second, we use a current-divider formula to find the current through the  $R$  and  $C$ .

$$\mathbf{I}_R = 2\angle 30^\circ \text{A} \frac{-j10\text{k}\Omega}{12\text{k}\Omega - j10\text{k}\Omega} = 2\angle 30^\circ \text{A} \frac{10\angle -90^\circ}{\sqrt{12^2 + 10^2} \angle \tan^{-1}\left(\frac{-10}{12}\right)} \text{ A}$$

or

$$\mathbf{I}_R = \frac{10}{\sqrt{61}} \angle 30^\circ - 90^\circ - \tan^{-1}\left(\frac{-10}{12}\right) \text{ A} = \frac{10}{\sqrt{61}} \angle -20.2^\circ \text{ A}$$

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The calculation for the capacitor current is similar to the above.

$$\mathbf{I}_C = 2\angle 30^\circ \text{ A} \frac{12\text{k}\Omega}{12\text{k}\Omega - j10\text{k}\Omega} = 2\angle 30^\circ \text{ A} \frac{12}{\sqrt{12^2 + 10^2} \angle \tan^{-1}\left(\frac{-10}{12}\right)} \text{ A}$$

or

$$\mathbf{I}_C = \frac{12}{\sqrt{61}} \angle 30^\circ - \tan^{-1}\left(\frac{-10}{12}\right) \text{ A} = \frac{10}{\sqrt{61}} \angle 69.8^\circ \text{ A}$$

Third, we take the inverse phasor.

$$i_R(t) = \frac{10}{\sqrt{61}} \cos(10kt - 20.2^\circ) \text{ A}$$

$$i_C(t) = \frac{12}{\sqrt{61}} \cos(10kt + 69.8^\circ) \text{ A}$$