Chapter 10, Solution 46.

Solve for $v_o(t)$ in the circuit of Fig. 10.91 using the superposition principle.

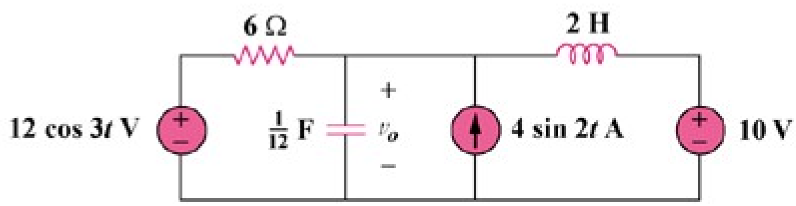
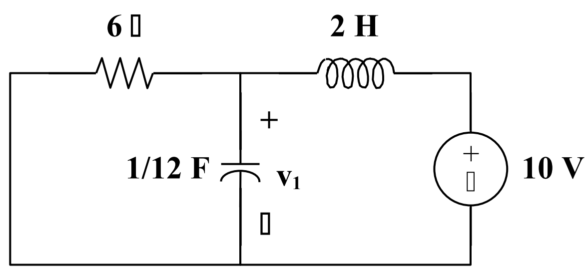


Figure 10.91
For Prob. 10.46.

Solution

Let $v_o = v_1 + v_2 + v_3$, where v_1, v_2, and v_3 are respectively due to the 10-V dc source, the ac



(a)

current source, and the ac voltage source. For v_1 consider the circuit in Fig. (a).

The capacitor is open to dc, while the inductor is a short circuit. Hence,

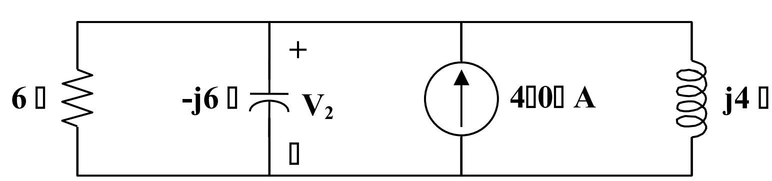
$$v_1 = 10 \text{ V}$$

For v_2, consider the circuit in Fig. (b).

$$\omega = 2$$

$$2 \text{ H} \longrightarrow j\omega L = j4$$

$$\frac{1}{12}\text{F} \longrightarrow \frac{1}{j\omega C} = \frac{1}{j(2)(1/12)} = -j6$$



(b)

Applying nodal analysis,

$$4 = \frac{\mathbf{V}_2}{6} + \frac{\mathbf{V}_2}{-j6} + \frac{\mathbf{V}_2}{j4} = \left(\frac{1}{6} + \frac{j}{6} - \frac{j}{4}\right)\mathbf{V}_2$$

$$\mathbf{V}_2 = \frac{24}{1 - j0.5} = 21.45\angle 26.56°$$

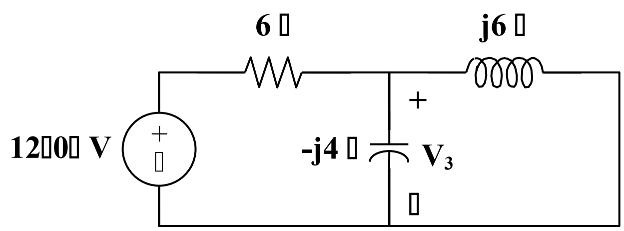
Hence, $$v_2 = 21.45\sin(2t + 26.56°)\ \text{V}$$

For v_3, consider the circuit in Fig. (c).

$$\omega = 3$$

$$2\ \text{H} \longrightarrow j\omega L = j6$$

$$\frac{1}{12}\ \text{F} \longrightarrow \frac{1}{j\omega C} = \frac{1}{j(3)(1/12)} = -j4$$



(c)

At the non-reference node,

$$\frac{12 - \mathbf{V}_3}{6} = \frac{\mathbf{V}_3}{-j4} + \frac{\mathbf{V}_3}{j6}$$

$$\mathbf{V}_3 = \frac{12}{1 + j0.5} = 10.73\angle -26.56°$$

Hence, $$v_3 = 10.73\cos(3t - 26.56°)\ \text{V}$$

Therefore,

v_o = **[10+21.45sin(2t+26.56°)+10.73cos(3t–26.56°)] V**