Chapter 10, Solution 44.

Use superposition principle to obtain v_x in the circuit of Fig. 10.89. Let $v_s = 50 \sin 2t$ V and $i_s = 12 \cos(6t + 10°)$ A.

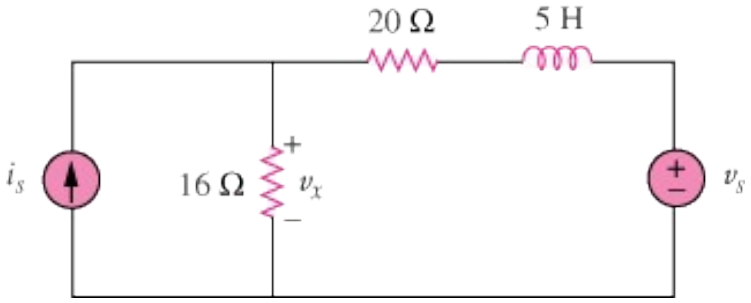


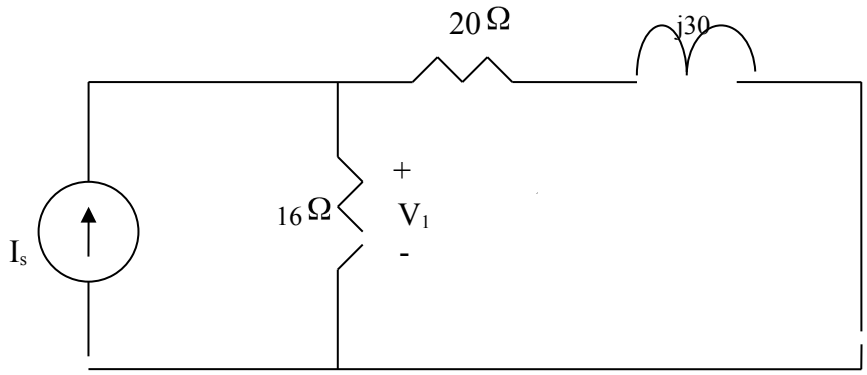
Figure 10.89
For Prob. 10.44.

Solution

Let $v_x = v_1 + v_2$, where v_1 and v_2 are due to the current source and voltage source respectively.

For v_1, $\omega = 6$, $5\,\text{H} \longrightarrow j\omega L = j30$

The frequency-domain circuit is shown below.

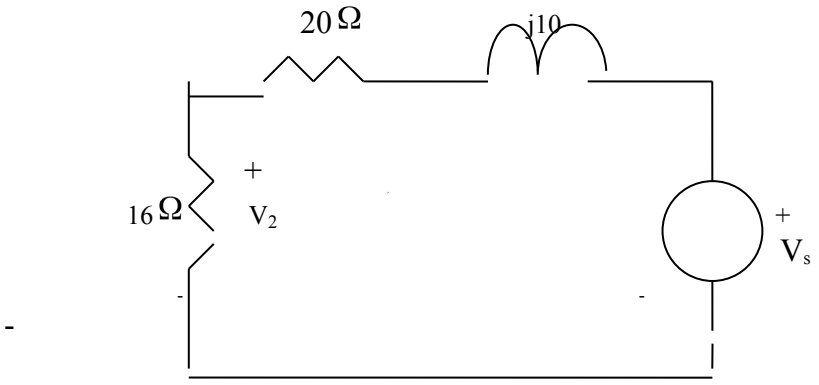


Let $Z = 16 /\!/ (20 + j30) = \dfrac{16(20 + j30)}{36 + j30} = 11.8 + j3.497 = 12.31\angle 16.5^o$

$V_1 = I_s Z = (12\angle 10^o)(12.31\angle 16.5^o) = 147.7\angle 26.5^o \longrightarrow v_1 = 147.7 \cos(6t + 26.5^o)$ V

For v_2, $\omega = 2$, $5\,\text{H} \longrightarrow j\omega L = j10$

The frequency-domain circuit is shown below.



Using voltage division,

$$V_2 = \frac{16}{16 + 20 + j10} V_s = \frac{16(50\angle 0^o)}{36 + j10} = 21.41\angle -15.52^o \longrightarrow v_2 = 21.41\sin(2t - 15.52^o)\,\text{V}$$

Thus,

$$v_x = \mathbf{[147.7\cos(6t+26.5°)+21.41\sin(2t–15.52°)]\ V}$$