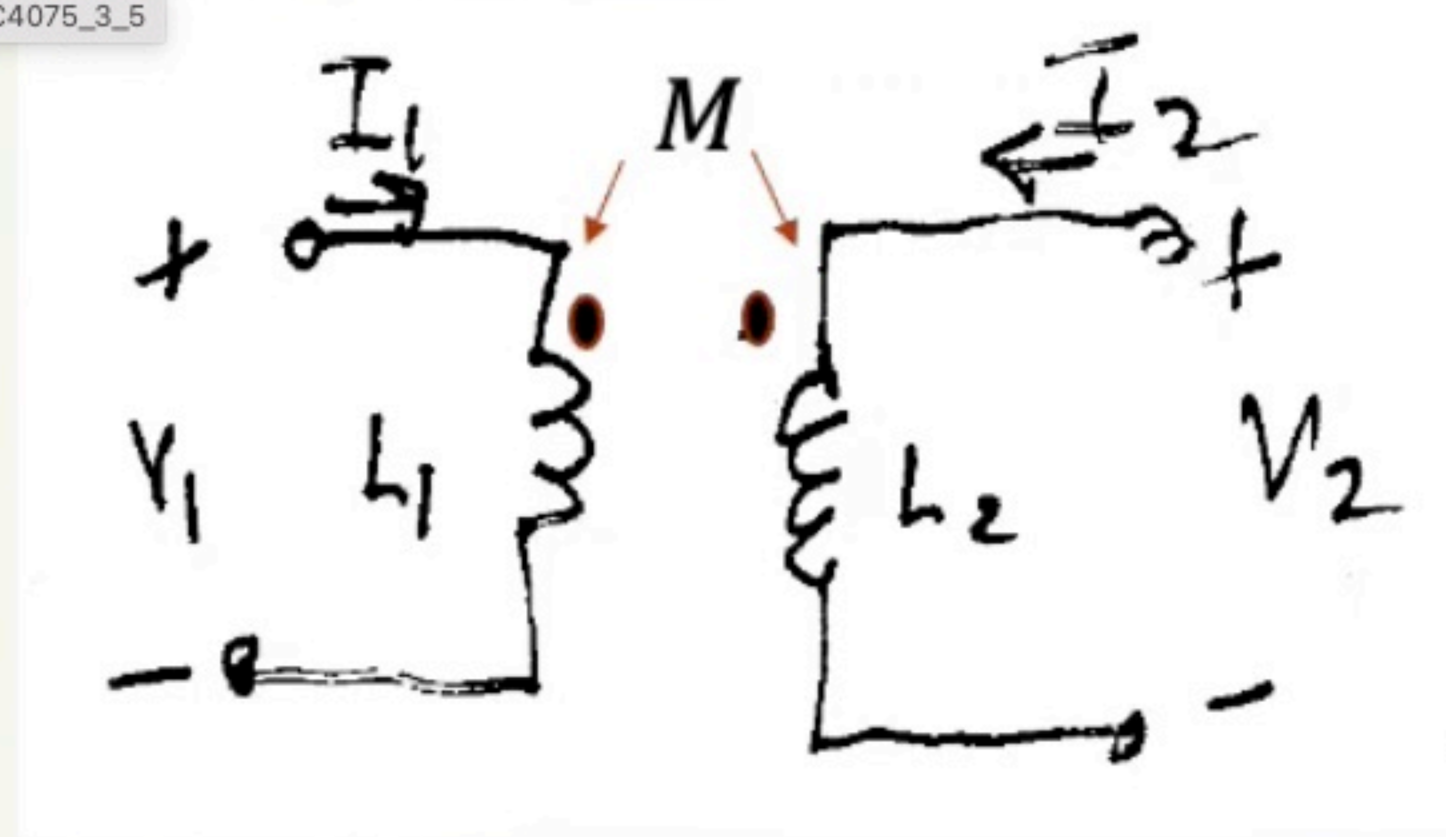
Inductancia mutua

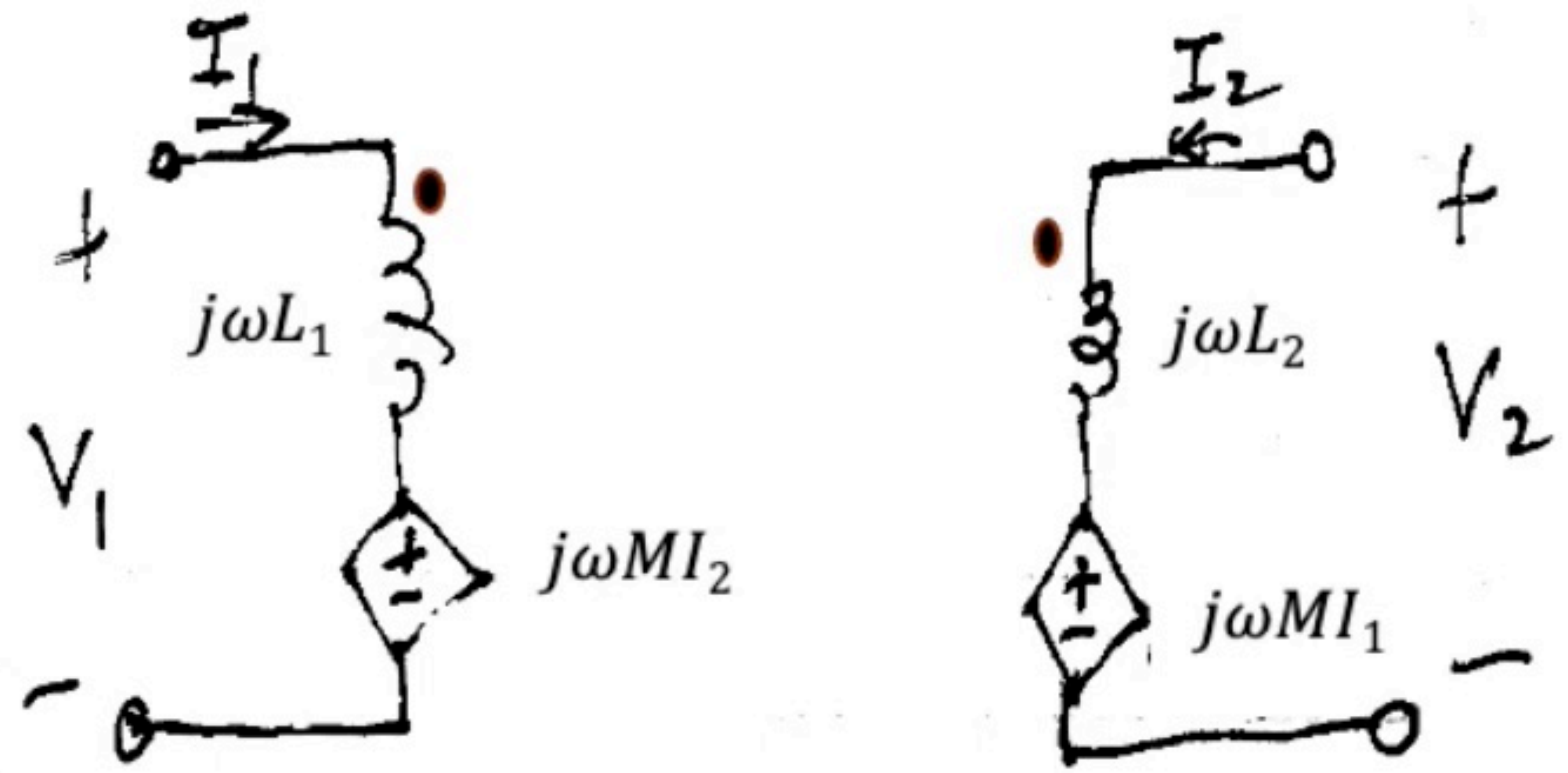
$$V_1 = L_1\frac{dI_1}{dt} + M_{12}\frac{dI_2}{dt}$$

$$V_2 = L_2\frac{dI_2}{dt} + M_{21}\frac{dI_1}{dt}$$

Si $M_{12} \approx M_{21} = M = k\sqrt{L_1L_2}$ $\quad 0 \leq k \leq 1$

Transformacion fasorial de inductores acoplados





$$V_1 = j\omega L_1 I_1 + j\omega M I_2$$

$$V_2 = j\omega L_2 I_2 + j\omega M I_1$$

The input to the circuit shown in Figure 11.9-6*a* is the voltage of the voltage source,

$$v_s(t) = 5.94\cos(3t + 140°)\ \text{V}$$

The output is the voltage across the right-hand coil, $v_o(t)$. Determine the output voltage $v_o(t)$.

enlace

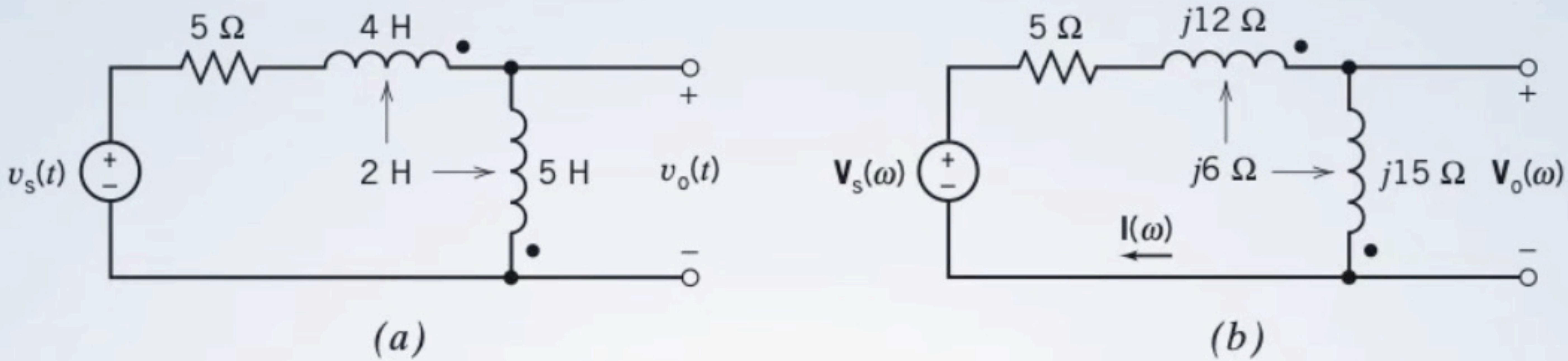


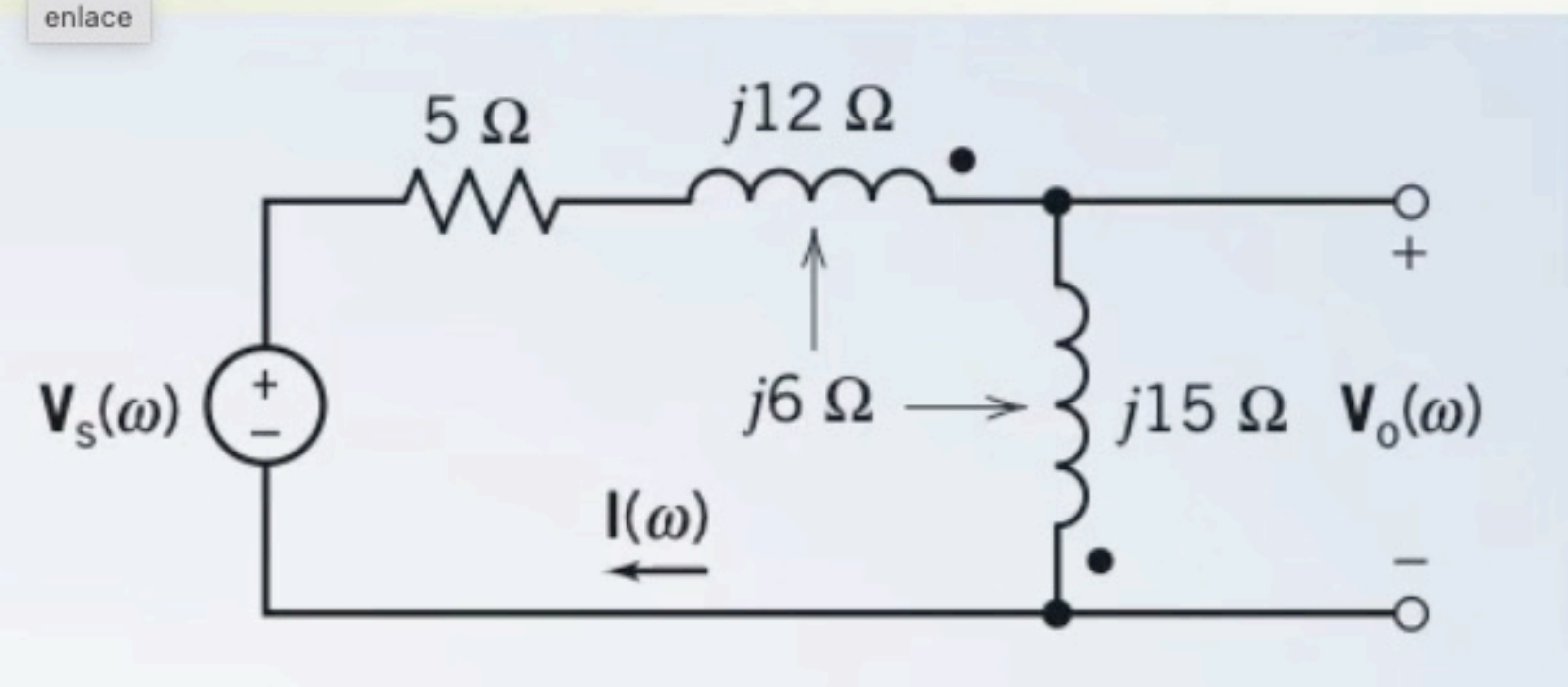
FIGURE 11.9-6 The circuit considered in Example 11.9-2 represented (*a*) in the time domain and (*b*) in the frequency domain.

$$\mathbf{V}_s(\omega) = 5.94\angle 140°\ \text{V}$$

$$\mathbf{I}(\omega) = \frac{5.94\angle 140°}{5 + j(12+6+6+15)} = \frac{5.94\angle 140°}{5+j39} = \frac{5.94\angle 140°}{39.3\angle 83°} = 0.151\angle 57°\ \text{A}$$

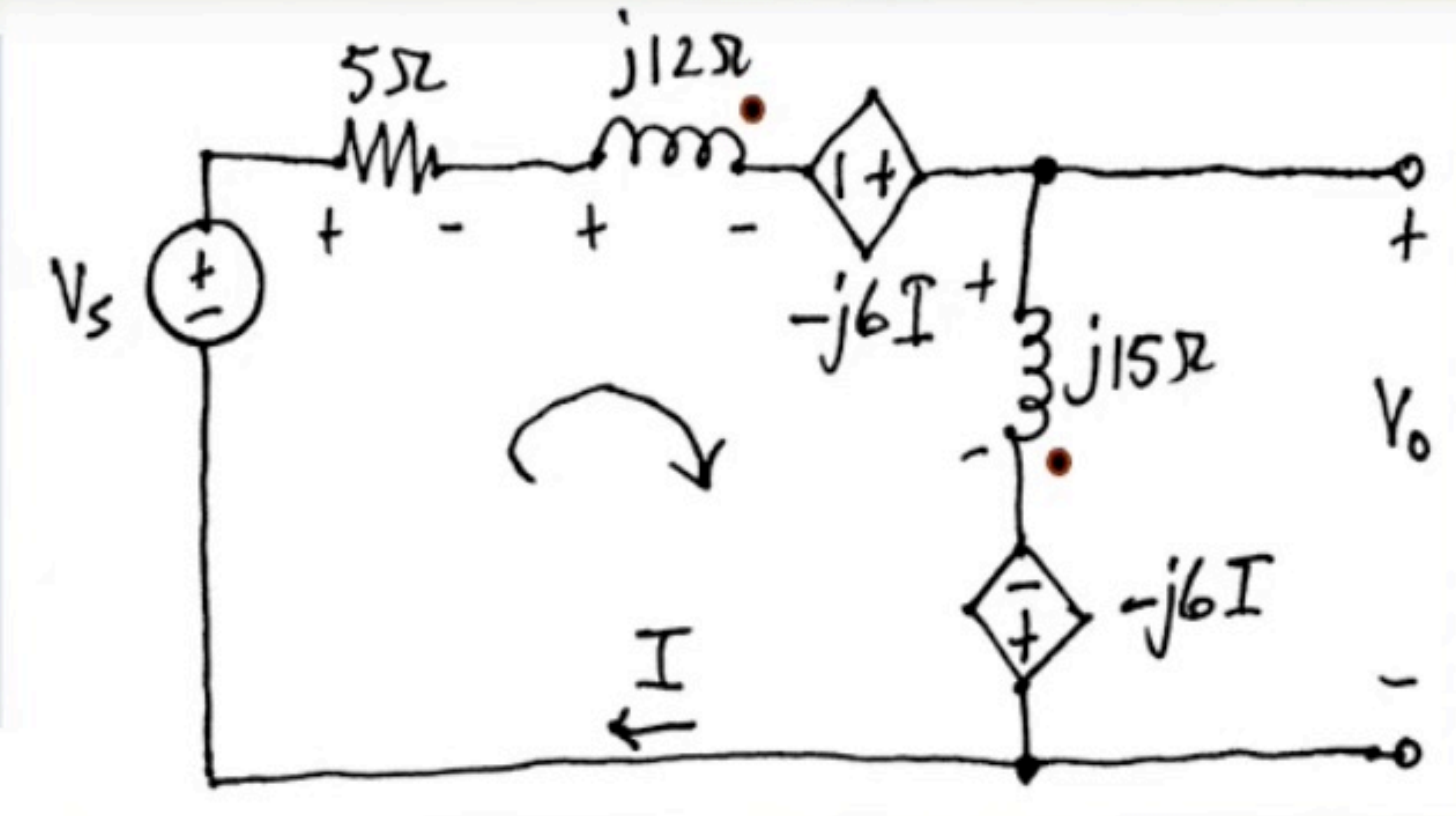
$$\begin{aligned}\mathbf{V}_o(\omega) = j15\,\mathbf{I}(\omega) + j6\,\mathbf{I}(\omega) = j21\,\mathbf{I}(\omega) &= j21(0.151\angle 57°)\\ &= (21\angle 90°)(0.151\angle 57°)\\ &= 3.17\angle 147°\ \text{V}\end{aligned}$$

enlace



(b)

$$\mathbf{V}_s(\omega) = 5.94\angle 140^\circ \text{ V}$$



Por mallas con las fuentes dependientes

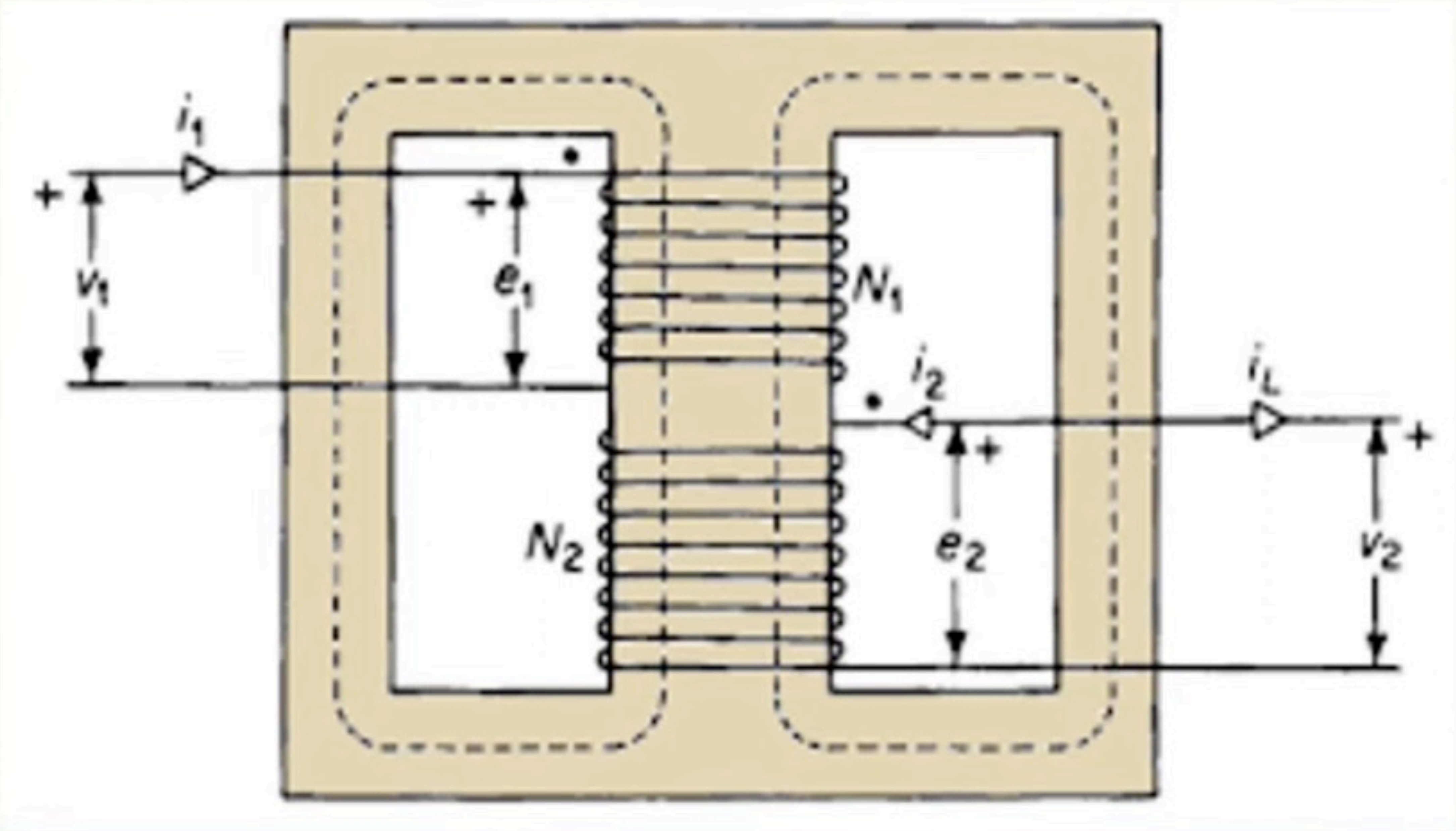
$$V_S - j6I - j6I = (5 + j12 + j15)I$$

$$I = \frac{V_S}{5 + j12 + j15 + j6 + j6} = \frac{5.94\angle 140^\circ}{5 + j39}$$

$$V_o = j15I - (-j6I) = j21I$$

$$v_o(t) = 3.17\cos(3t + 147^\circ)\ V$$

Ideal Transformer



$$v_1 = -N_1 \frac{d\phi}{dt}$$

$$v_2 = -N_2 \frac{d\phi}{dt}$$

$$\frac{v_1}{N_1} = -\frac{d\phi}{dt} = \frac{v_2}{N_2}$$

$$\frac{v_2}{v_1} = \frac{N_2}{N_1} = -\frac{i_1}{i_2} = \frac{i_1}{i_L}$$

$$v_2(t) = \frac{N_2}{N_1} v_1(t)$$

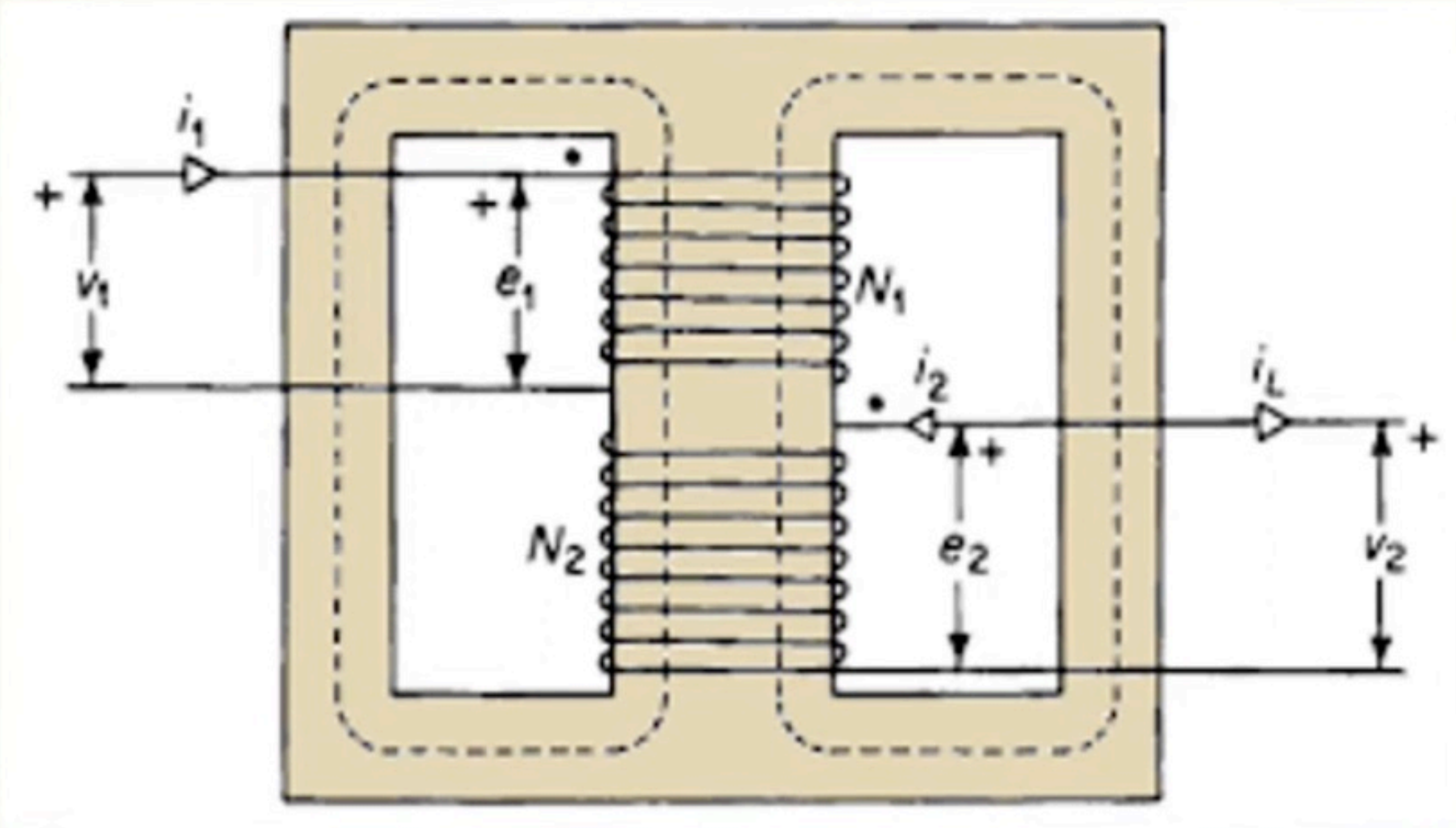
$$p_1(t) = v_1(t) i_1(t)$$

$$i_1(t) = -\frac{N_2}{N_1} i_2(t)$$

$$p_2(t) = -v_2(t) i_2(t) = -\frac{N_2}{N_1} v_1(t) \left[-\frac{N_1}{N_2} i_1(t) \right] = v_1(t) i_1(t)$$

enlace

Ideal Transformer



$$v_1 = -N_1 \frac{d\phi}{dt}$$

$$v_2 = -N_2 \frac{d\phi}{dt}$$

$$\frac{v_1}{N_1} = -\frac{d\phi}{dt} = \frac{v_2}{N_2}$$

$$\frac{v_2}{v_1} = \frac{N_2}{N_1} = -\frac{i_1}{i_2} = \frac{i_1}{i_L}$$

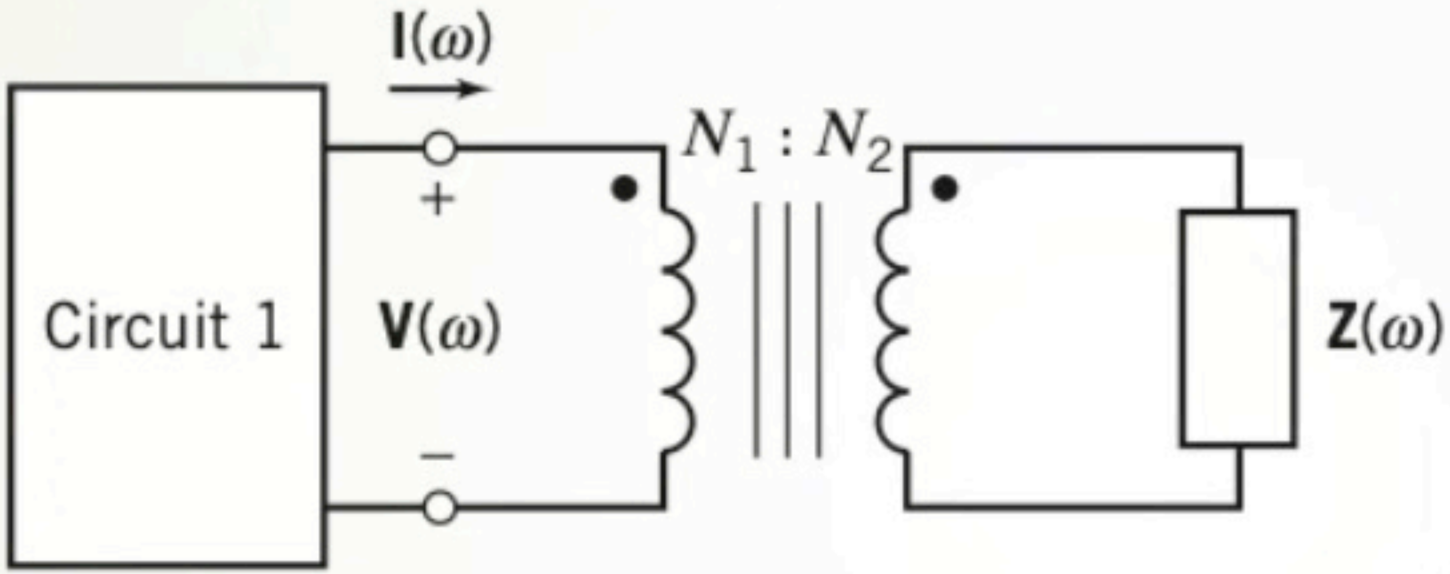
$$v_2(t) = \frac{N_2}{N_1} v_1(t)$$

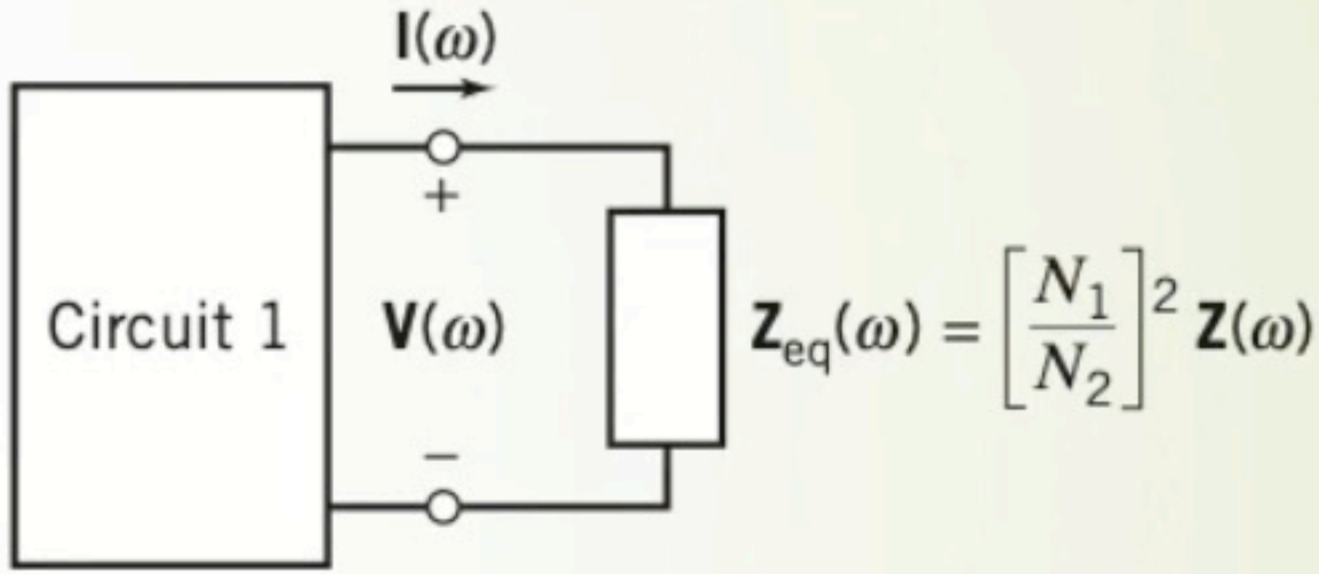
$$p_1(t) = v_1(t) i_1(t)$$

$$i_1(t) = -\frac{N_2}{N_1} i_2(t)$$

$$p_2(t) = -v_2(t) i_2(t) = -\frac{N_2}{N_1} v_1(t) \left[-\frac{N_1}{N_2} i_1(t) \right] = v_1(t) i_1(t)$$

Usando el transformador para impedance matching





$$\mathbf{Z}_{eq}(\omega) = \left(\frac{N_1}{N_2}\right)^2 \mathbf{Z}(\omega) = \frac{1}{n^2}\mathbf{Z}(\omega) = a^2 Z(\omega)$$

Example 13.8

For the ideal transformer circuit of Fig. 13.37, find: (a) the source current $\mathbf{I}_1$, (b) the output voltage $\mathbf{V}_o$, and (c) the complex power supplied by the source.

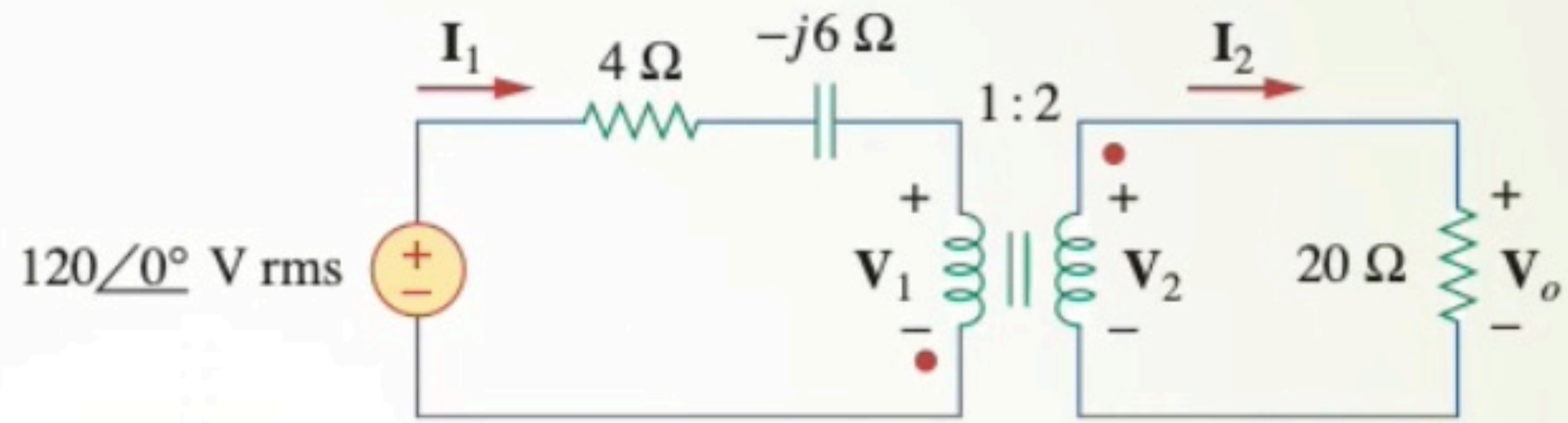
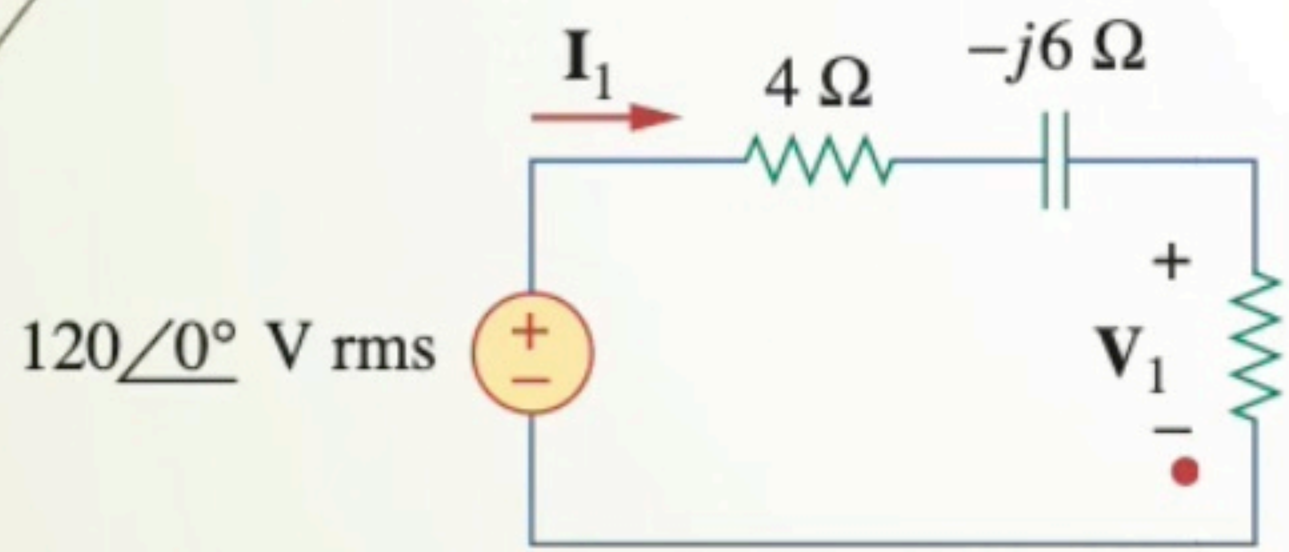


Figure 13.37
For Example 13.8.



$$R_{eq} = \frac{20}{2^2} = 5\ \Omega$$

$$I_1 = \frac{120}{4+5-j6} = 11.09\angle 33.69°\ A$$

$$I_2 = -\frac{1}{2}(11.09\angle 33.69°) = -5.55\angle 33.69°\ A$$

$$V_o = 20I_2 = 110.9\angle -146.31°\ V$$

$$S = 120(11.09\angle -33.69°)$$
$$= 1330.8\angle -33.69°\ \text{VA}$$