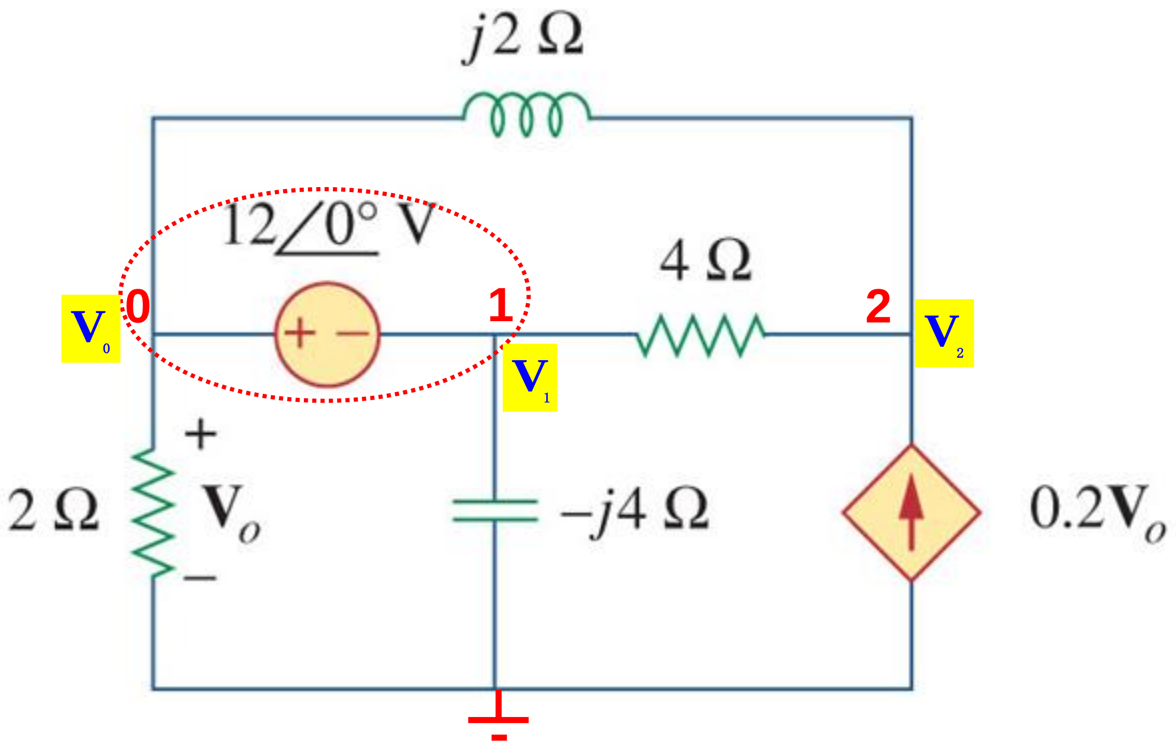
Problem 10.19 P445

Obtain $\mathbf{V}_o$ in Fig. 10.68 using nodal analysis.



Solution:

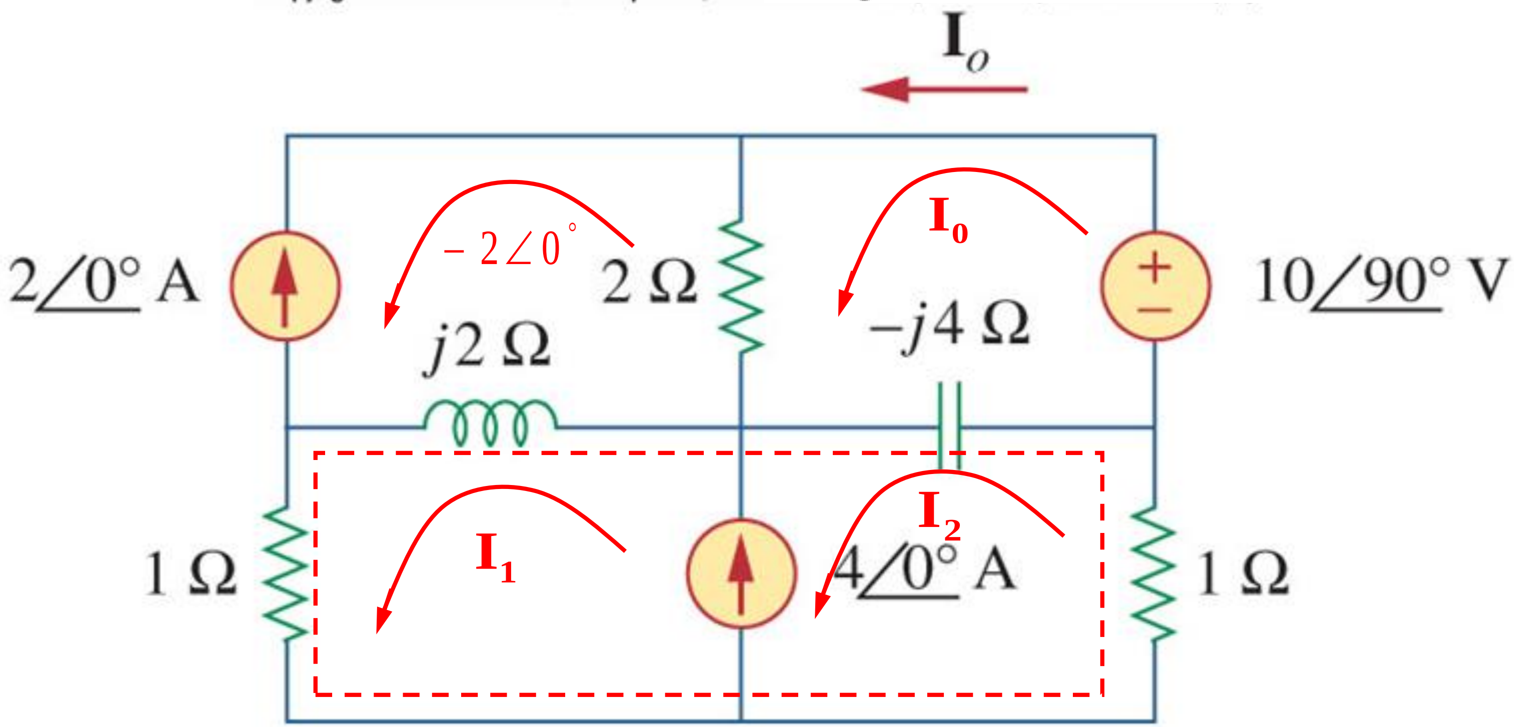
$$V_0 + V_1: \quad \frac{V_0}{2} + \frac{V_0 - V_2}{j2} + \frac{V_1}{-j4} + \frac{V_1 - V_2}{4} = 0$$

$$V_0 - V_1 = 12\angle 0^\circ \qquad \Rightarrow \quad V_0 = 7.68\angle 50^\circ$$

$$V_2: \qquad \frac{V_2 - V_1}{4} + \frac{V_2 - V_0}{j2} = 0.2V_0$$

Problem 10.38 P447

Using mesh analysis, obtain $\mathbf{I}_o$ in the circuit shown in Fig. 10.83.



Solution:

$$\mathrm{I}_0: \quad (2-j4)\mathrm{I}_0 + j4\mathrm{I}_2 - 2(-2\angle 0^\circ) = 10\angle 90^\circ$$

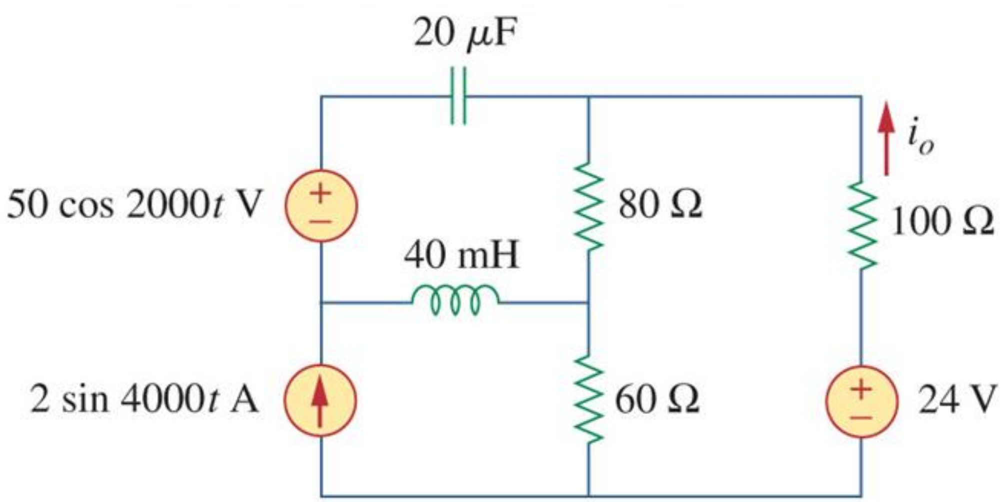
$$\mathrm{I}_1 + \mathrm{I}_2: \quad (1+j2)\mathrm{I}_1 + (1-j4)\mathrm{I}_2 + j4\mathrm{I}_0 - j2(-2\angle 0^\circ) = 0$$

$$\mathrm{I}_1 - \mathrm{I}_2 = 4\angle 0^\circ$$

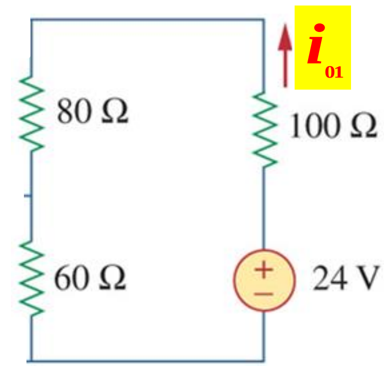
$$\Rightarrow \quad \mathrm{I}_0 = 3.35\angle 174^\circ$$

Problem 10.48 P448

Find i_o in the circuit of Fig. 10.93 using superposition.

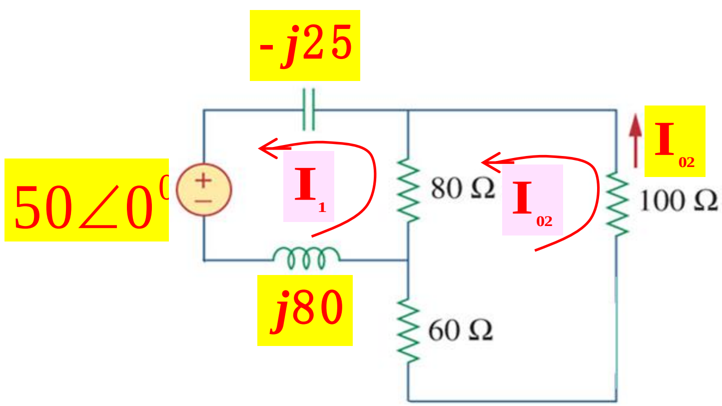


Solution:



24V-source is alone acting:

$$i_{01} = \frac{24}{100+80+60} = 0.1 \text{ A}$$



$50\cos 2000t$-source is alone acting:

$$I_1: \ (j80+80-j25)I_1 - 80I_{02} = -50\angle 0°$$

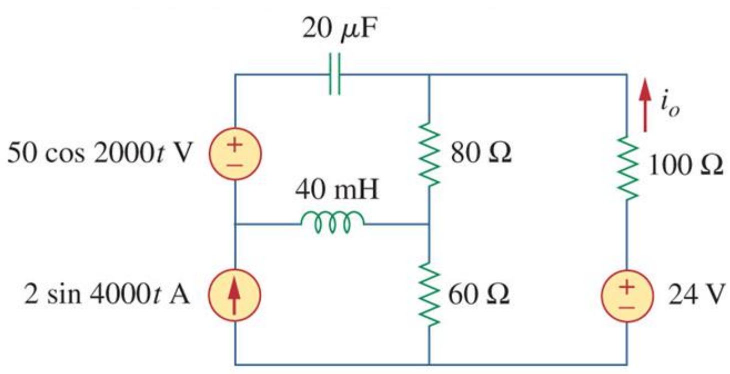
$$I_{02}: \ -80I_1 + (80+60+100)I_{02} = 0$$

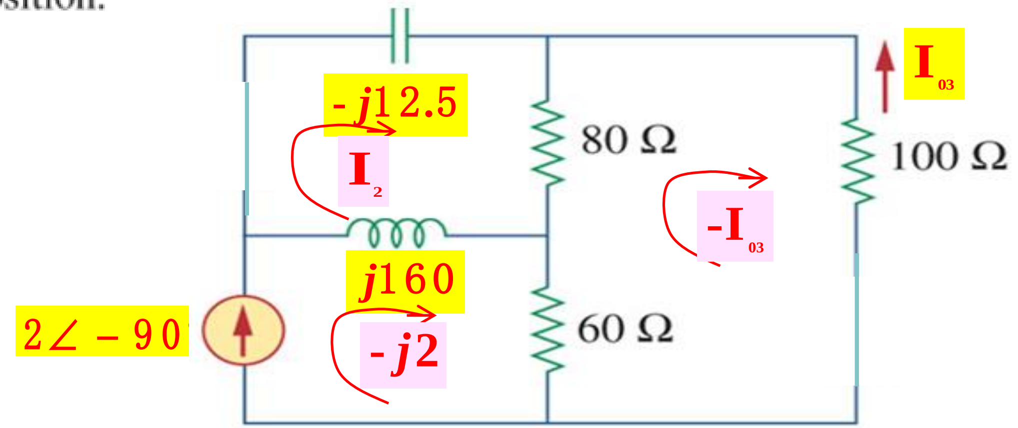
$$\Rightarrow \ I_{02} = 0.22\angle 135°$$

So: $\ i_{02}(t) = 0.22\cos(2000t + 135°)$

Problem 10.48 P448

Find i_o in the circuit of Fig. 10.93 using superposition.





$2\sin 4000t$-source is alone acting:

$$I_2: \ \left(j160+80-j12.5\right)I_2 - j160(-j2) - 80(-I_{03}) = 0$$

$$\text{-}I_{03}: \ -80I_2 + \left(80+60+100\right)(\text{-}I_{03}) - 60(-j2) = 0$$

$$\Rightarrow \quad I_{03} = 1.18\angle 122.5°$$

So: $i_{03}(t) = 1.18\cos(4000t + 122.5°)$

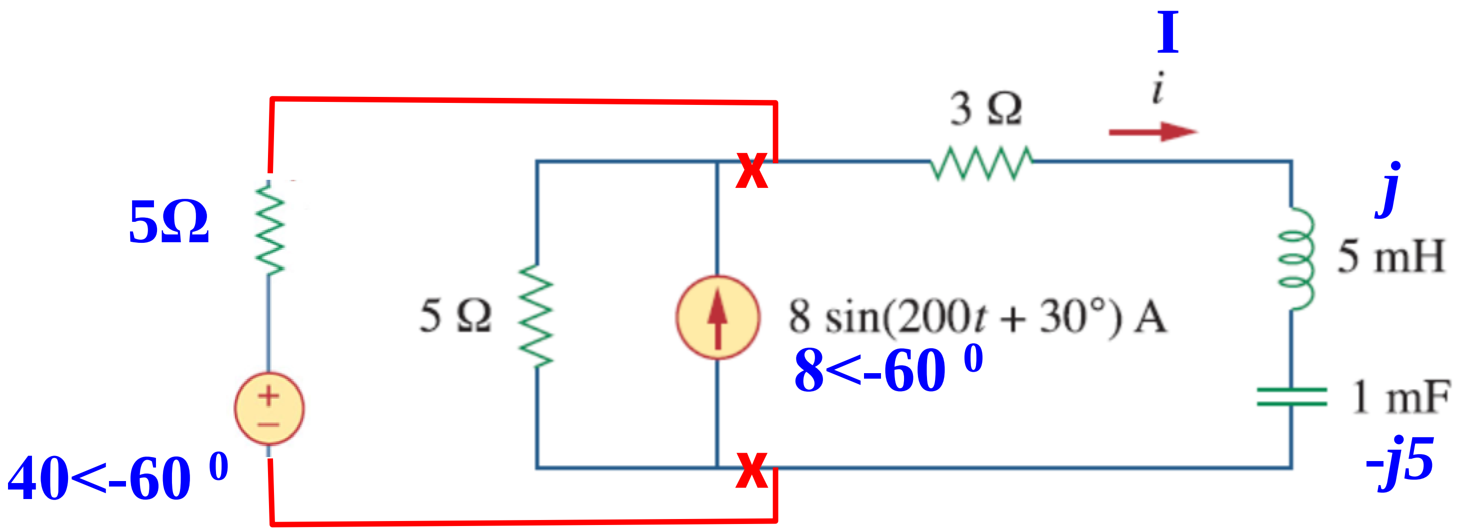
$$= \text{-}1.18\sin(4000t + 32.5°)$$

Then: $i_0 = i_{01} + i_{02}(t) + i_{03}(t)$

$$= 0.1 + 0.22\cos(2000t + 135°)\text{-}1.18\sin(4000t + 32.5°)$$

Problem 10.49 P448

Using source transformation, find i in the circuit of Fig. 10.94.



Solution:

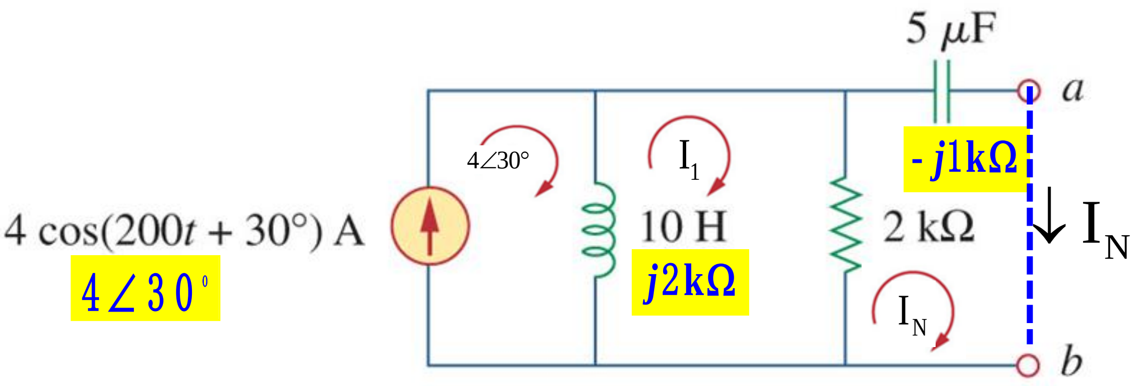
$$I = \frac{40\angle -60^\circ}{5+3+j-j5} = 4.46\angle\text{-}33.5^\circ \text{ A}$$

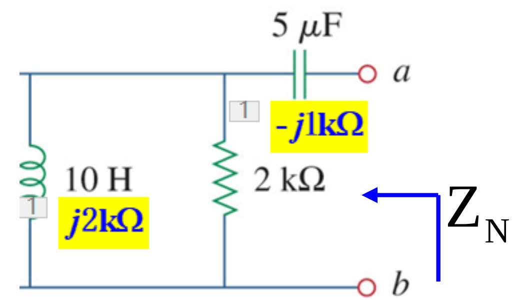
So: $i = 4.46\cos(200t\text{-}33.5^\circ)$

$= 4.46\sin(200t + 56.5^\circ)$

Problem 10.63 P450

Obtain the Norton equivalent of the circuit depicted in Fig. 10.106 at terminals *a*-*b*.





Solution:

For Z_N: $Z_N = -j + j2\|2 = 1\text{ k}\Omega$

For I_N

$$I_1: \quad (2 + j2)I_1 - 2I_N - j2 \times 4\angle 30° = 0$$

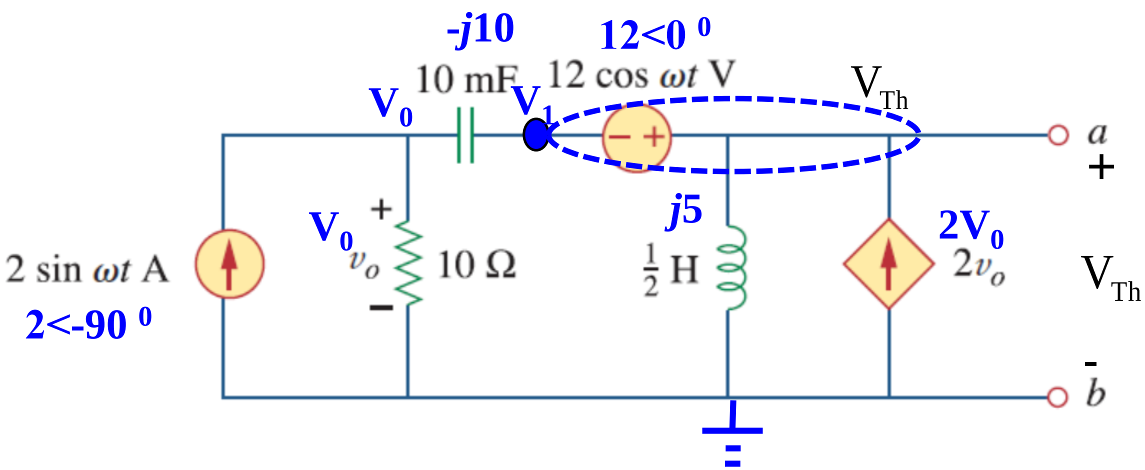
$$I_N: \quad -2I_1 + (2 - j)I_N = 0$$

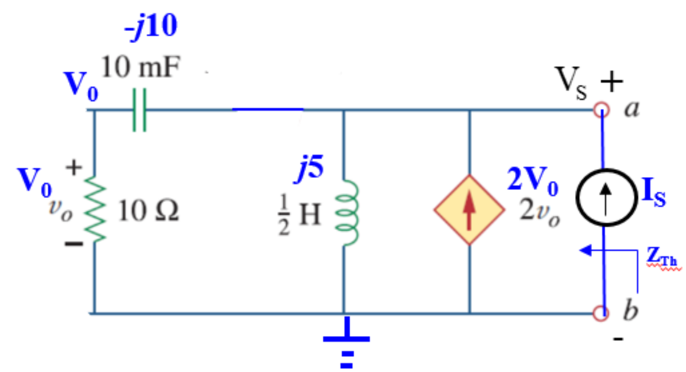
$$\Rightarrow \; I_N = 5.66\angle 75°$$

So: $i_N = 5.66\cos(200t + 75°)$

Problem 10.66 P450

At terminals *a-b*, obtain Thevenin and Norton equivalent circuits for the network depicted in Fig. 10.109. Take $\omega = 10$ rad/s.





Solution:

For V_{Th}:

$$V_0: \left(\frac{1}{10}+\frac{1}{-j10}\right)V_0 - \frac{1}{-j10}V_1 = 2\angle -90°$$

$$V_1 + V_{Th}: \frac{V_1 - V_0}{-j10} + \frac{V_{Th}}{j5} = 2V_0$$

$$V_{Th} - V_1 = 12\angle 0°$$

$$\Rightarrow V_{Th} = 29.79\angle -3.6°$$

For Z_{Th}:

$$\left(\frac{1}{10}+\frac{1}{-j10}\right)V_0 - \frac{1}{-j10}V_S = 0$$

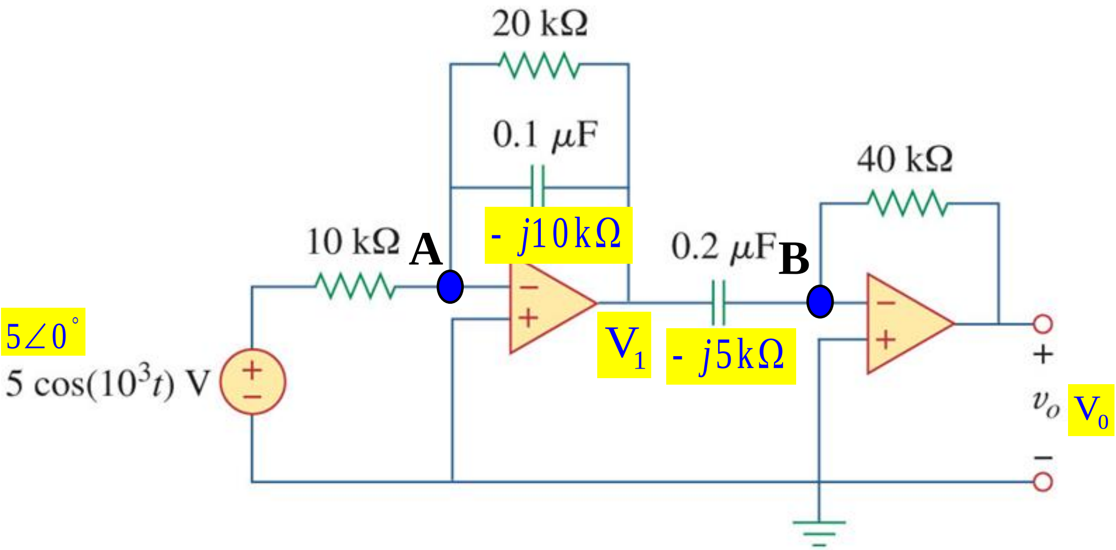
$$-\frac{V_0}{-j10} + \left(\frac{1}{j5}+\frac{1}{-j10}\right)V_S = 2V_0 + I_S$$

$$\Rightarrow Z_{Th} = \frac{V_S}{I_S} = 0.67\angle 130° = Z_N$$

$$I_N = \frac{V_{Th}}{Z_{Th}} = 44.46\angle -134°$$

Problem 10.79 P453

For the op amp circuit in Fig. 10.122, obtain $v_o(t)$.



Solution:

$$\text{A:}\ \frac{5\angle 0^\circ}{10} + \frac{V_1}{-j10} + \frac{V_1}{20} = 0$$

$$\text{B:}\ \frac{V_1}{-j5} + \frac{V_0}{40} = 0$$

$$\Rightarrow\ V_0 = 35.7\angle 27^\circ$$

$$\text{So: } v_0(t) = 35.7\cos(10^3 t + 27^\circ)$$