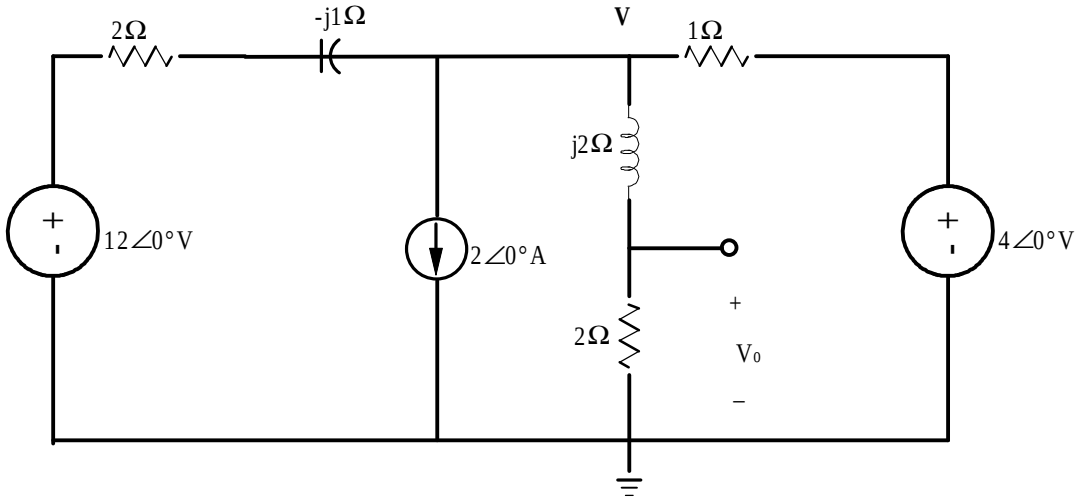
Problem 7.47

Find V_0 in the network shown using nodal analysis.



Suggested Solution

$$V_0 = V\left[\frac{2}{2+j2}\right] = \frac{V}{\sqrt{2}\angle 45^\circ} = \frac{V}{1+j1}$$

$$\frac{12-V}{2-j1} = 2 + \frac{V}{2+j2} + \frac{V-4}{1} = V\left[1+\frac{1}{2+j2}\right] - 2 = V\left[\frac{3+j2}{2+j2}\right] - 2$$

$$12 - V = V\left[\frac{(3+2j)(2-j1)}{2+j2}\right] - 4 + j2 = V\left[\frac{8+j1}{2+j2}\right] - 4 + j2$$

$$16 - j2 = V\left[1+\frac{8+j1}{2+j2}\right] = V\left[\frac{2+j2+8+j1}{2+j2}\right]$$

$$16 - j2 = V\left[\frac{10+j3}{2+j2}\right]$$

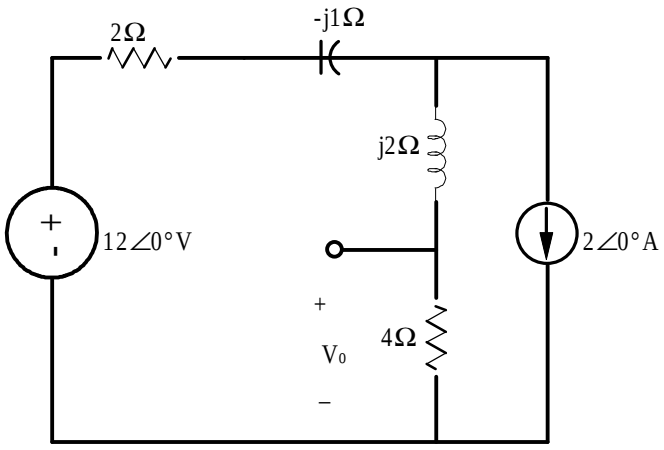
$$V = \frac{4(8-j1)(1+j1)}{(10+j3)}$$

$$V_0 = \frac{V}{1+j1} = \frac{4(8-j1)}{10+j3} = \frac{32.25\angle -7.13^\circ}{10.44\angle 16.70^\circ}$$

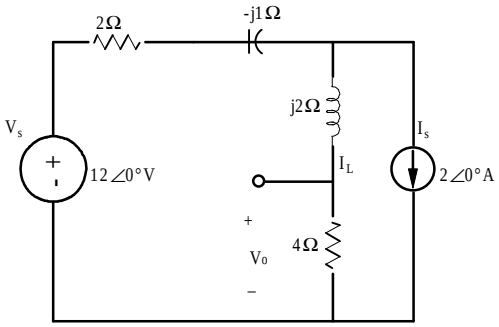
$$V_0 = 3.09\angle -23.83^\circ V$$

Problem 7.58

Using superposition, find V_0 in the circuit shown.



Suggested Solution



For the voltage source

$$V_1 = \frac{4}{4+2+j2-j1}(12\angle 0°) = \frac{48}{6+j1}$$

For the current source

$$I_L = I_S\left[\frac{2-j1}{4+2+j2-j1}\right] = \frac{-4+j2}{6+j1}$$

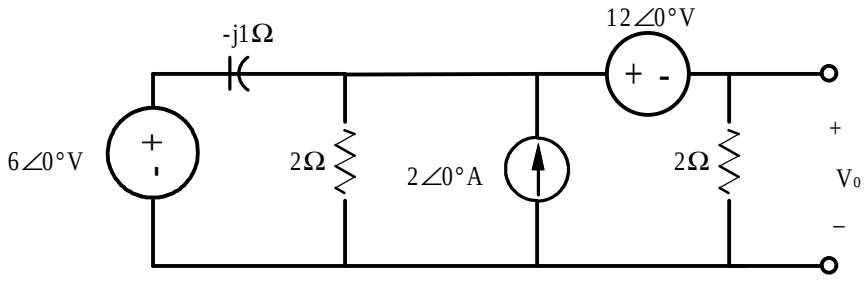
$$V_2 = 4I_L = \frac{-16+j8}{6+j1}$$

Summing

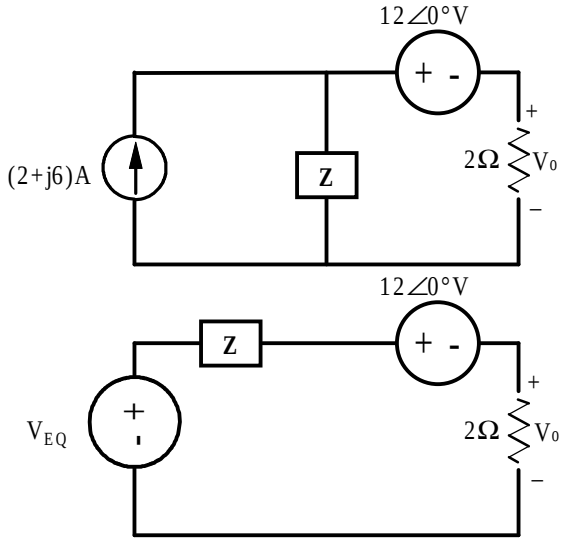
$$V_0 = V_1 + V_2 = \frac{32+j8}{6+j1} = 5.41\angle 4.57° V$$

Problem 7.60

Use source exchange to determine V_0 in the network shown.



Suggested Solution



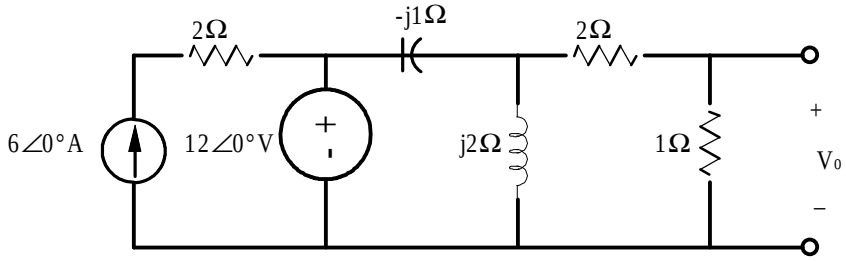
$$Z = 2 \| -j = \frac{-j2}{2-j1} = \frac{2}{1+j2}$$

$$V_{EQ} = (2+j6)(Z_{EQ}) = \frac{2(2+j6)}{1+j2} = 5.66\underline{|8.13°}V = (5.60+j0.80)V$$

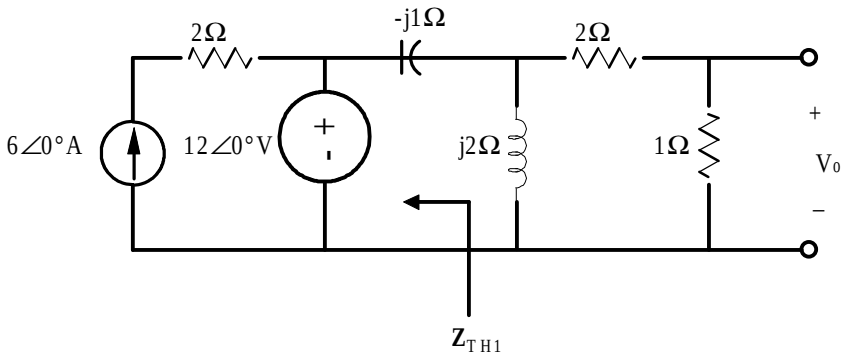
$$V_0 = (V_{EQ} - 12)\left[\frac{2}{2+Z_{EQ}}\right] = (-6.4+j0.8)\left[\frac{4}{3+j2}\right] = 7.16\underline{|139.18°}V$$

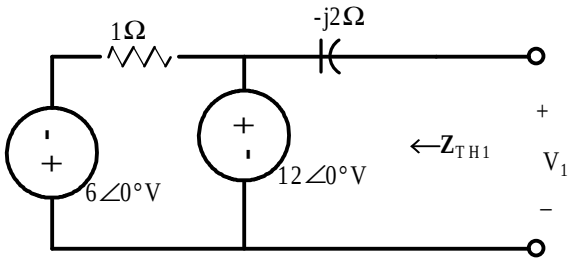
Problem 7.63

Use Thevenin's theorem to find V_0 in the circuit shown.



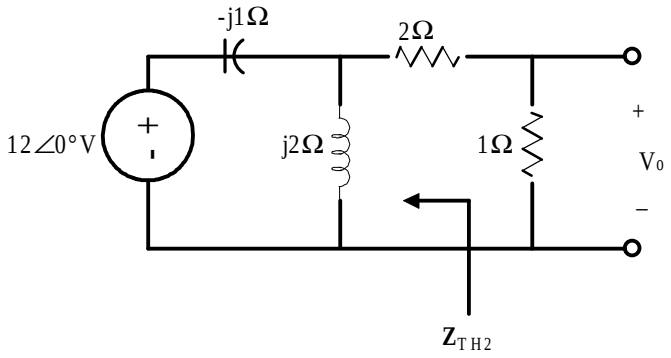
Suggested Solution

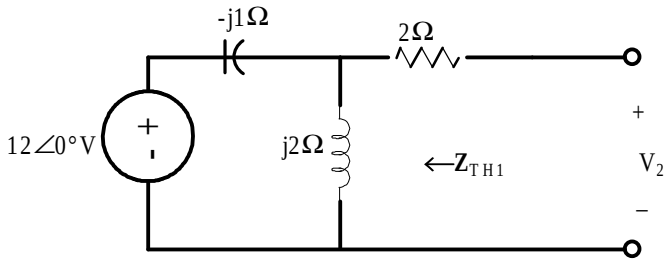




$V_1 = 12\angle 0°V$

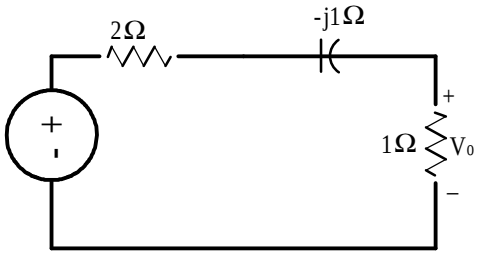
$Z_{TH1} = -j1\Omega$





$V_2 = 24\angle 0°V$

$Z_{TH2} = 2 - j2\Omega$



$V_0 = 6.66\angle 33.69°V$