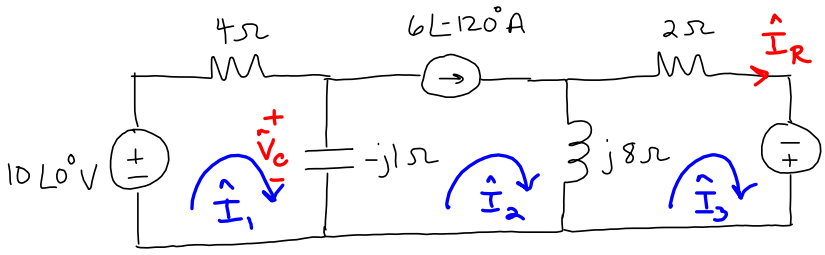


Know

$\hat{I}_2 = 6\angle -120^\circ$ A

$\hat{I}_R = \hat{I}_3$

$\hat{V}_c = -j1(\hat{I}_1 - \hat{I}_2)$

$\omega = 4 \frac{rad}{s}$

$6\angle -120^\circ$

m1: $10\angle 0^\circ - 4\hat{I}_1 - (-j1)(\hat{I}_1 - \hat{I}_2) = 0$

$6\angle -120^\circ$

m3: $-j8(\hat{I}_3 - \hat{I}_2) - 2\hat{I}_3 + 4\angle 45^\circ = 0$

$\hat{I}_1 = 1.37\angle 46.02^\circ$ A

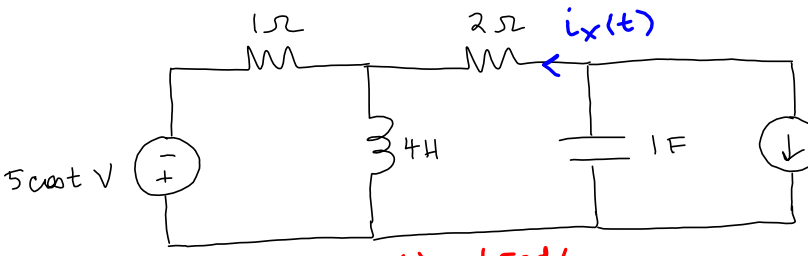
$\hat{I}_3 = 5.96\angle -101.46^\circ$ A

$\hat{I}_R = 5.96\angle -101.46^\circ$ A

$\hat{V}_c = 7.34\angle -32.59^\circ$ V

$i_R(t) = 5.96\cos(4t - 101.46^\circ)$ A

$v_c(t) = 7.34\cos(4t - 32.59^\circ)$ V



Use superposition to find $i_x(t)$

$\omega = 1$ rad/s

Sources

$5\cos t$ V $\longrightarrow$ $5\angle 0^\circ$ V

$8\sin(t+20^\circ)$ A

$8\cos(t+20-90)$

$8\cos(t-70^\circ) \longrightarrow 8\angle -70^\circ$ A

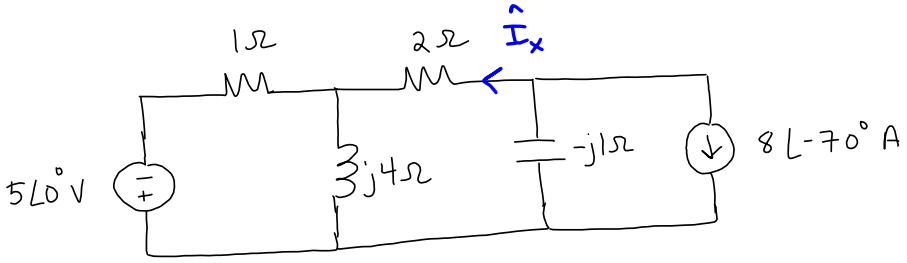
Impedances

$1\Omega \longrightarrow 1\Omega$

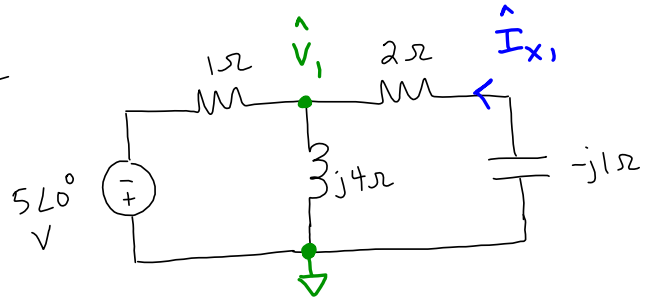
$2\Omega \longrightarrow 2\Omega$

$4H \longrightarrow j\omega L = j(1)(4) = j4\Omega$

$1F \longrightarrow \frac{-j}{\omega C} = \frac{-j}{(1)(1)} = -j1\Omega$



$5\angle 0^\circ$ V ON



Know

$$\hat{I}_{x_1} = \frac{0 - \hat{V}_1}{2 - j1}$$

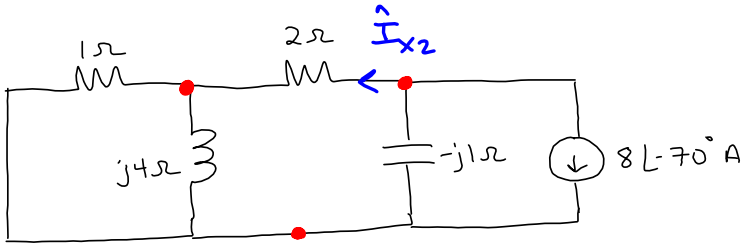
$$\frac{\hat{V}_1 + 5\angle 0}{1} + \frac{\hat{V}_1}{j4} + \frac{\hat{V}_1}{2-j1} = 0$$

$$\hat{V}_1\left(1 + \frac{1}{j4} + \frac{1}{2-j1}\right) = -5\angle 0$$

$$\hat{V}_1 = 3.57\angle -177.95^\circ \text{ V}$$

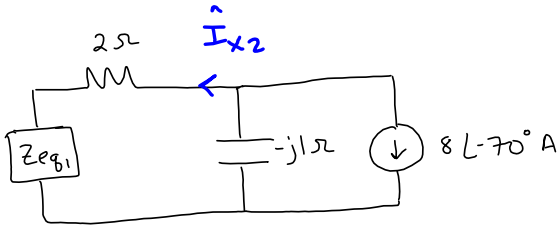
$$\hat{I}_{x_1} = 1.60\angle 28.61^\circ \text{ A}$$

8∠-70 A ON



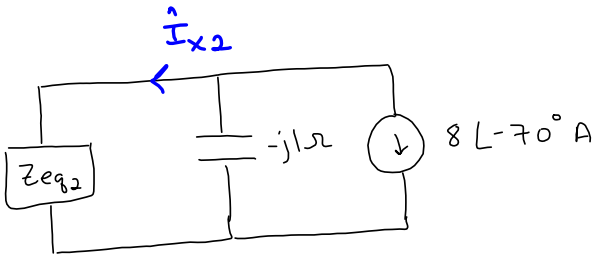
$Zeq_1 = 1 \,||\, j4$

$= 0.94 + j0.235\,\Omega$



$Zeq_2 = Zeq_1 + 2$

$= 2.94 + j.235\,\Omega$



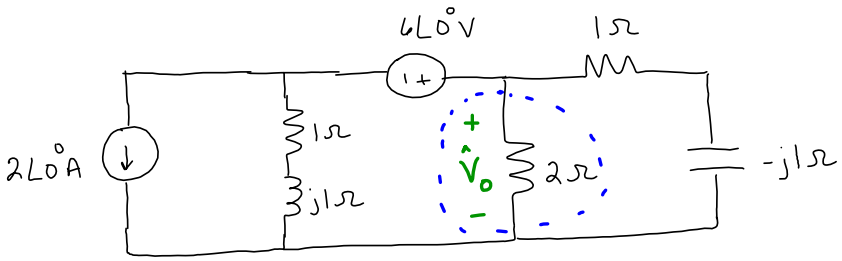
$$\hat{I}_{x2} = -\left[8\angle -70^\circ \cdot \frac{(-j1 \,||\, Zeq_2)}{Zeq_2}\right]$$

$$\hat{I}_{x2} = 2.63\angle 34.57^\circ \text{ A}$$

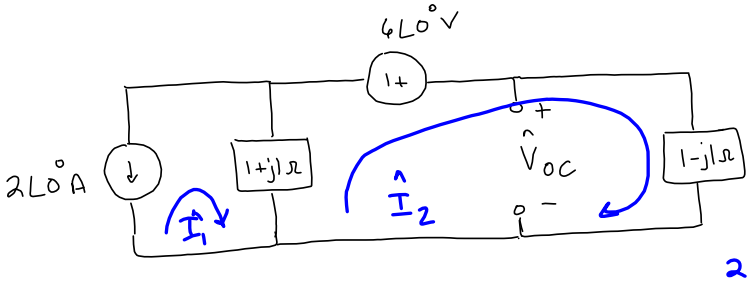
$$\hat{I}_x = \hat{I}_{x1} + \hat{I}_{x2} = 1.60\angle 28.61^\circ + 2.63\angle 34.57^\circ$$

$$= 4.22\angle 32.32^\circ \text{ A}$$

$$i_x(t) = 4.22\cos(t + 32.32^\circ) \text{ A}$$



Use Thev Eq. ckt to find $\hat{V}_o$.



Know

$\hat{I}_1 = -2\angle 0^\circ \text{ A}$

$= 2\angle 180^\circ \text{ A}$

$\hat{V}_{oc} = \hat{I}_2(1-j1)$

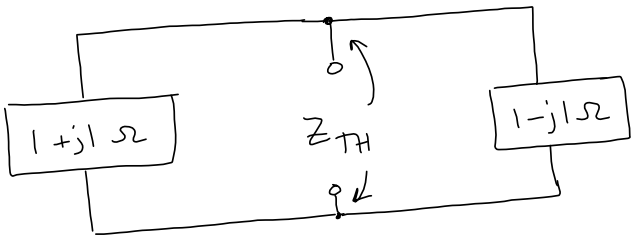
$2\angle 180^\circ$

m2: $6\angle 0^\circ - (1-j1)\hat{I}_2 - (1+j1)(\hat{I}_2 - \hat{I}_1) = 0$

$\hat{I}_2 = 2.24\angle -26.54^\circ \text{ A}$

$\hat{V}_{oc} = 3.16\angle -71.57^\circ \text{ V}$

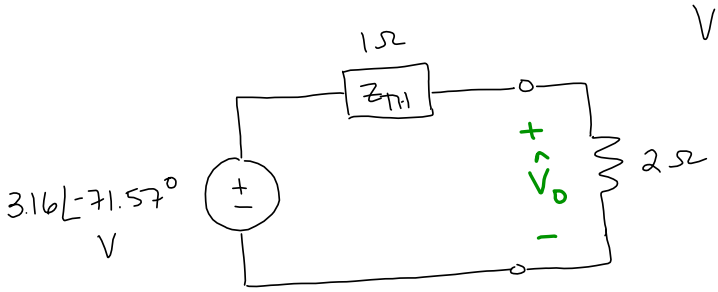
Find Z_{TH}



$Z_{TH} = (1+j1)\,||\,(1-j1)$

$= 1\Omega$

$\hat{V}_o = 3.16\angle -71.57 \left(\frac{2}{2+Z_{TH}}\right)$



$\hat{V}_o = 2.11\angle -71.57^\circ \text{ V}$

$v_o(t) = 2.11\cos(\omega t - 71.57^\circ)\text{ V}$

Average value of a function, $f(t) \Rightarrow F$, $g(t) \Rightarrow G$

$$F = \frac{1}{T}\int_0^T f(t)\,dt$$

$v(t) = V_m \cos(\omega t + \theta)$ $\quad \omega = 2\pi f$, $f = \frac{1}{T}$

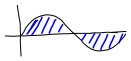
$$V = \frac{1}{T}\int_0^T V_m \cos(\omega t + \theta)\,dt$$

$$V = \frac{1}{T}\left[\frac{V_m}{\omega}\sin(\omega t + \theta)\Big|_0^T\right]$$

$$V = \frac{1}{T}\left[\frac{V_m}{\omega}\left(\sin(\omega T + \theta) - \sin(\theta)\right)\right]$$

$\sin(\omega T + \theta) - \sin(\theta) = 0$

$V = 0$



ROOT MEAN SQUARE value of voltage (or current) $v(t)$ (or $i(t)$)

$v(t) = V_m \cos(\omega t + \theta)$

$$V_{rms} = \sqrt{\frac{1}{T}\int_0^T v^2(t)\,dt}$$

$$V_{rms} = \sqrt{\frac{1}{T}\int_0^T (V_m \cos(\omega t + \theta))^2\,dt}$$

$$= \sqrt{\frac{1}{T}\int_0^T V_m^2 \cos^2(\omega t + \theta)\,dt}$$

$$= \sqrt{\frac{V_m^2}{T}\int_0^T \cos^2(\omega t + \theta)\,dt} \qquad \cos^2(x) = \frac{1 + \cos(2x)}{2}$$

$$= \sqrt{\frac{V_m^2}{T}\int_0^T \frac{1 + \cos(2\omega t + 2\theta)}{2}\,dt}$$

$$= \sqrt{\frac{V_m^2}{T}\int_0^T \left(\frac{1}{2}\,dt + \frac{\cos(2\omega t + 2\theta)}{2}\,dt\right)}$$

$\int_0^T \frac{\cos(2\omega t + 2\theta)}{2}\,dt = 0$ ← sinusoid

$$V_{rms} = \sqrt{\frac{V_m^2}{T}\int_0^T \frac{1}{2}\,dt}$$

$$= \sqrt{\frac{V_m^2}{T}\left(\frac{1}{2}t\Big|_0^T\right)}$$

$$V_{rms} = \sqrt{\frac{V_m^2}{T}\left(\frac{1}{2}T\right)}$$

$$V_{rms} = \sqrt{\frac{V_m^2}{2}}$$

$$\boxed{V_{rms} = \frac{V_m}{\sqrt{2}}}$$

$i(t) = I_m \cos(\omega t + \Phi)$ $\qquad \boxed{I_{rms} = \frac{I_m}{\sqrt{2}}}$

$v(t) = 10\cos(2t + 30^\circ) \Rightarrow 10\angle 30^\circ$ V

$\frac{10}{\sqrt{2}}\angle 30^\circ$ V_{rms}

$i(t) = 6\sin(8t - 70^\circ)$

$= 6\cos(8t - 160^\circ)$ A $\Rightarrow 6\angle -160^\circ$ A

$\frac{6}{\sqrt{2}}\angle -160^\circ$ A_{rms}