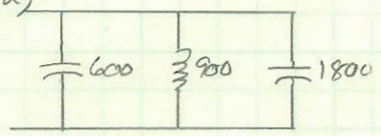
Chap 18 (32, 33a, 36, 41)

18-32

READ: CALCULATE Z_T

SOLN:

a)



$Z_{C_1} = -600j$

$Z_L = 900j$

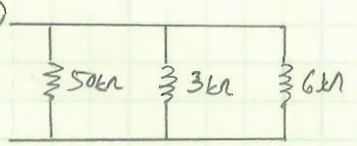
$Z_{C_2} = -1800j$

$Z_T = (-600j)//(900j)//(-1800j)$

$= \left[\frac{1}{-600j} + \frac{1}{900j} + \frac{1}{-1800j}\right]^{-1}$

$= \boxed{900\angle -90 = Z_T}$

b)



$Z_R = 50\angle 0$ kΩ

$Z_{L_1} = 3\angle 90$ kΩ

$Z_{L_2} = 6\angle 90$ kΩ

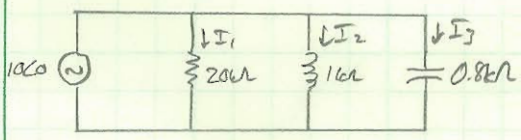
$Z_T = (50\angle 0)//(3\angle 90)//(6\angle 90)$ kΩ

$= \left[\frac{1}{50\angle 0} + \frac{1}{3\angle 90} + \frac{1}{6\angle 90}\right]^{-1}$ kΩ

$= \boxed{2\angle 87.7° \text{ kΩ} = Z_T}$

18-33a

GIVEN



READ: Z_T I_T I_1 I_2 I_3

SOLN

$Z_T = (20\text{kΩ}\angle 0)//(1\text{kΩ}\angle 90)//(0.8\text{kΩ}\angle -90) = \left[\frac{1}{20\angle 0} + \frac{1}{1\angle 90} + \frac{1}{0.8\angle -90}\right]^{-1}$ kΩ $= \boxed{3.92\angle -78.7° \text{ kΩ} = Z_T}$

$\vec{I}_T = \frac{\vec{E}}{Z_T} = \frac{10\angle 0 \text{ V}}{3.92\angle -78.7 \text{ kΩ}} = \boxed{2.55\angle 78.7° \text{ mA} = \vec{I}_T}$

$\vec{I}_1 = \frac{\vec{E}}{Z_R} = \frac{10\angle 0 \text{ V}}{20\angle 0 \text{ kΩ}} = 0.5\angle 0 \text{ mA} = \boxed{500\angle 0 \text{ μA} = \vec{I}_1}$

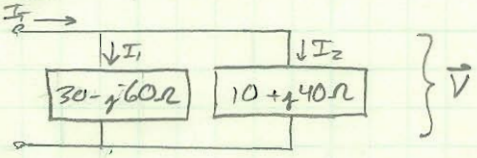
$\vec{I}_2 = \frac{\vec{E}}{Z_L} = \frac{10\angle 0 \text{ V}}{1\angle 90 \text{ kΩ}} = \boxed{10\angle -90 \text{ mA} = \vec{I}_2}$

$\vec{I}_3 = \frac{\vec{E}}{Z_C} = \frac{10\angle 0}{0.8\angle -90 \text{ kΩ}} = \boxed{12.5\angle 90 \text{ mA} = \vec{I}_3}$

✓ KCL → $\vec{I}_T = \vec{I}_1 + \vec{I}_2 + \vec{I}_3 = 0.5\angle 0 + 10\angle -90 + 12.5\angle 90 = 2.55\angle 78.7$ ✓

18-36

GIVEN $I_1 = 100\angle 30^\circ$ mA



READ: Z_T, $\vec{V}$, $\vec{I}_2$ $\vec{I}_T$

SOLN

$\vec{V} = \vec{I}_1 \vec{Z}_1 = (100\angle 30\,mA)(30 - j60) = \boxed{6.7\angle -33\,V = \vec{V}}$

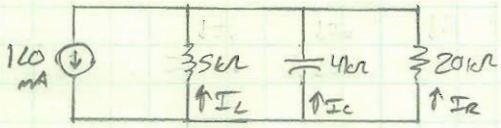
$\vec{Z}_T = \vec{Z}_1 // \vec{Z}_2 = (30 - j60) // (10 + j40) = \left[\frac{1}{(30-j60)} + \frac{1}{(10+j40)}\right]^{-1} = \boxed{61.7\angle 39^\circ\,\Omega = \vec{Z}_T}$

$\vec{I}_2 = \frac{\vec{V}}{\vec{Z}_2} = \frac{6.7\angle -33\,V}{(10+j40)} = \boxed{163\angle -109\,mA = \vec{I}_2}$

$\vec{I}_T = \vec{I}_1 + \vec{I}_2 = 100\angle 30 + 163\angle -109\,mA = \boxed{109\angle -72.5^\circ\,mA = \vec{I}_T}$

18-41

GIVEN



READ: USE CDR TO FIND $\vec{I}_L$ $\vec{I}_C$ $\vec{I}_R$. VERIFY KCL.

SOLN

$\vec{Z}_T = (5000\angle 90) // (4000\angle -90) // (20000\angle 0) = \left[\frac{1}{5\angle 90} + \frac{1}{4\angle -90} + \frac{1}{20\angle 0}\right]^{-1} k\Omega = \boxed{14.1\angle -45\,k\Omega = \vec{Z}_T}$

$\vec{I}_L = \vec{I}_T\left(\frac{\vec{Z}_T}{\vec{Z}_L}\right) = (100\,mA)\left(\frac{14.1\angle -45\,k\Omega}{5\angle 90\,k\Omega}\right) = \boxed{2.82\angle -135\,mA = \vec{I}_L}$

$\vec{I}_C = \vec{I}_T\left(\frac{\vec{Z}_T}{\vec{Z}_C}\right) = (100\,mA)\left(\frac{14.1\angle -45\,k\Omega}{4\angle -90\,k\Omega}\right) = \boxed{3.53\angle 45\,mA = \vec{I}_C}$

$I_R = \vec{I}_T\left(\frac{\vec{Z}_T}{\vec{Z}_R}\right) = (100\,mA)\left(\frac{14.1\angle -45\,k\Omega}{20\angle 0\,k\Omega}\right) = \boxed{0.705\angle -45\,mA = \vec{I}_R}$

KCL → $I_T = \vec{I}_L + \vec{I}_C + \vec{I}_R = 2.82\angle -135 + 3.53\angle 45 + 0.705\angle -45\,mA = 1.0\angle 0\,mA$ ✓