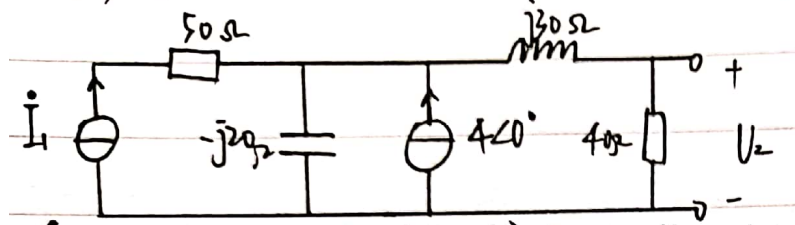
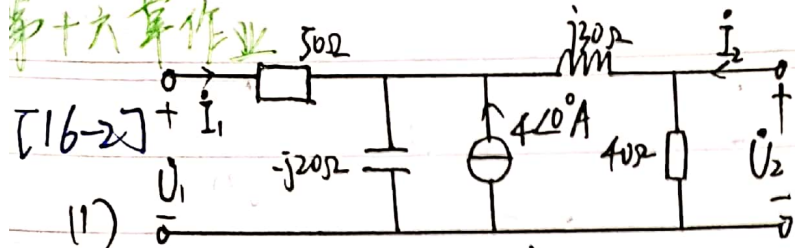


第十六章作业



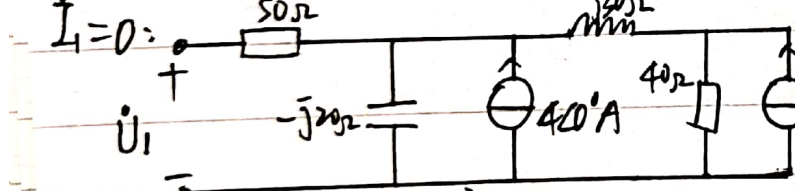
$$I_2 = 0: U_1 = (50 - \frac{j20(j30+40)}{j10+40}) I_1 - \frac{j20(j30+40)}{j10+40} \times 4\angle 0^\circ$$

$$= (\frac{1010}{17} - j\frac{380}{17}) I_1 - 4(-\frac{160}{17} + j\frac{380}{17})$$

$$= (\frac{1010}{17} - j\frac{380}{17}) I_1 + (\frac{640}{17} - j\frac{1520}{17})$$

$$U_2 = 40 \times (\frac{-j20}{j10+40} I_1 - \frac{j20}{j10+40} \times 4\angle 0^\circ)$$

$$= (-\frac{80}{17} - j\frac{320}{17}) I_1 + (\frac{-320-j1280}{17})$$



$$U_1 = -j20 \times (\frac{40}{j10+40} I_2 + \frac{j30 \times 40}{j10+40} \times 4\angle 0^\circ)$$

$$= (-\frac{80}{17} - j\frac{320}{17}) I_2 + (\frac{640}{17} - j\frac{1520}{17})$$

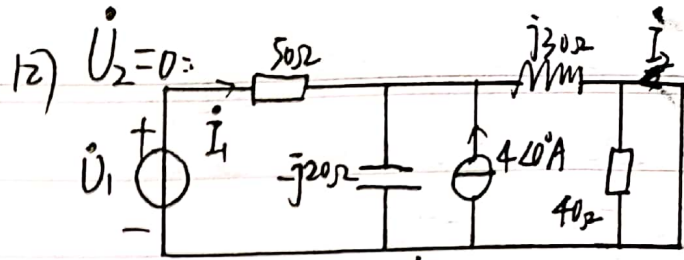
$$U_2 = \frac{40 \times j10}{40+j10} I_2 + \frac{-j20}{j10+40} \times 4\angle 0^\circ \times 40$$

$$= (\frac{40}{17} + j\frac{160}{17}) I_2 + (\frac{-320-j1280}{17})$$

$$\begin{cases} U_1 = Z_{11} I_1 + Z_{12} I_2 + (\frac{640}{17} - j\frac{1520}{17}) \\ U_2 = Z_{21} I_1 + Z_{22} I_2 + (\frac{-320-j1280}{17}) \end{cases}$$

$$Z_{11} = \frac{1010}{17} - j\frac{380}{17} \quad Z_{12} = -\frac{80}{17} - j\frac{320}{17}$$

$$Z_{21} = -\frac{80}{17} - j\frac{320}{17} \quad Z_{22} = \frac{40}{17} + j\frac{160}{17}$$

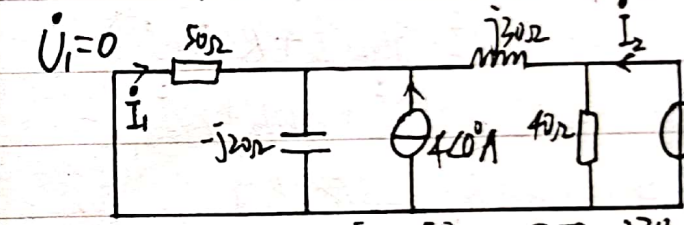


$$I_1 = \frac{U_1}{50 - \frac{j20 \times j30}{j10}} - \frac{\frac{1}{50}}{\frac{1}{50} + \frac{1}{j20} + \frac{1}{j30}} \times 4\angle 0^\circ$$

$$= \frac{U_1}{50 - j60} + (-\frac{144}{61} + j\frac{120}{61})$$

$$I_2 = \frac{j30}{j10} \times \frac{U_1}{50 - \frac{j20 \times j30}{j10}} + \frac{\frac{1}{j30}}{\frac{1}{50} + \frac{1}{j20} + \frac{1}{j30}} \times 4\angle 0^\circ$$

$$= \frac{-3U_1}{50 - j60} + \frac{200 + j240}{61}$$



$$Z_{eq1} = j30 + \frac{-j20 \times 50}{j20 + 50} = -\frac{200}{29} + j\frac{370}{29}$$

$$Z_{eq2} = \frac{(-\frac{200}{29} + j\frac{370}{29}) \times 40}{-\frac{200}{29} + j\frac{370}{29} + 40} = -\frac{152}{73} + j\frac{1184}{73}$$

$$I_2 = \frac{U_2}{-\frac{152}{73} + j\frac{1184}{73}} - \frac{\frac{1}{j30}}{\frac{1}{50} + \frac{1}{j30} + \frac{1}{j20}} \times 4\angle 0^\circ$$

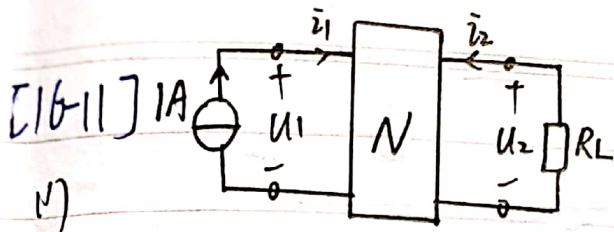
$$= \frac{U_2}{-\frac{152}{73} + j\frac{1184}{73}} + \frac{200 + j240}{61}$$

$$I_1 = \frac{j20}{50 - j20} \times \frac{40}{40 + Z_{eq1}} I_2 - \frac{\frac{1}{50}}{\frac{1}{50} - \frac{1}{j20} + \frac{1}{j30}} \times 4\angle 0^\circ$$

$$= \frac{j20 \times 40}{50 - j20} \times \frac{U_2}{-\frac{152}{73} + j\frac{1184}{73}} + \frac{-144 + j120}{61}$$

$$\begin{cases} I_1 = Y_{11} U_1 + Y_{12} U_2 + (\frac{-144}{61} + j\frac{120}{61}) \\ I_2 = Y_{21} U_1 + Y_{22} U_2 + (\frac{200}{61} + j\frac{240}{61}) \end{cases}$$





1)

$\therefore N$ 为对称二端口网络

$$\therefore Z_{12} = Z_{21}, Z_{11} = Z_{22}$$

$$\begin{cases} U_1 = Z_{11}i_1 + Z_{12}i_2 \\ U_2 = Z_{21}i_1 + Z_{22}i_2 \end{cases}$$

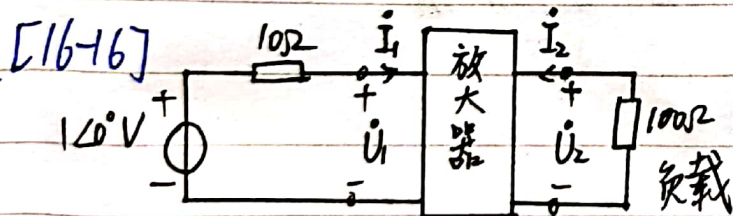
$$R_L = \infty \text{ 时, } i_2 = 0 \therefore \begin{cases} 16 = Z_{11}i_1 \\ 6 = Z_{21}i_1 \end{cases} \text{ 又 } i_1 = 1A$$

$$\therefore Z_{11} = 16\Omega, Z_{21} = 6\Omega, Z_{12} = 6\Omega, Z_{22} = 16\Omega$$

$$\therefore Z = \begin{bmatrix} 16\Omega & 6\Omega \\ 6\Omega & 16\Omega \end{bmatrix}$$

2) $R_L = 0$ 时, $U_2 = 0$

$$\therefore \begin{cases} U_1 = 16 + 6i_2 \\ 0 = 6 + 16i_2 \end{cases} \therefore \begin{cases} U_1 = \frac{55}{4}V \\ U_2 = -\frac{3}{8}A \end{cases}$$



$$\begin{cases} \dot{I}_1 = Y_{11}\dot{U}_1 + Y_{12}\dot{U}_2 \\ \dot{I}_2 = Y_{21}\dot{U}_1 + Y_{22}\dot{U}_2 \end{cases} \Rightarrow \begin{cases} \dot{I}_1 = 25 \times 10^{-3} \dot{U}_1 - 1 \times 10^{-3} \dot{U}_2 \\ \dot{I}_2 = -250 \times 10^{-3} \dot{U}_1 - 40 \times 10^{-3} \dot{U}_2 \end{cases}$$

$$\text{又 } \begin{cases} 1\angle 0^\circ = 10\dot{I}_1 + \dot{U}_1 \\ \dot{U}_2 = -100\dot{I}_2 \end{cases}$$

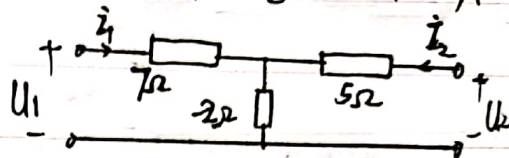
$$\therefore \begin{cases} \dot{I}_1 = 25 \times 10^{-3} (1\angle 0^\circ - 10\dot{I}_1) + 0.1\dot{I}_2 \\ \dot{I}_2 = -0.25(1\angle 0^\circ - 10\dot{I}_1) + 4\dot{I}_2 \end{cases}$$

$$\Rightarrow \begin{cases} \dot{I}_1 = 0.025A \\ \dot{I}_2 = 0.0625A \end{cases} \Rightarrow \begin{cases} = 25mA \\ = 62.5mA \end{cases}$$

$$[16-26] 1) \therefore Z_{12} = Z_{21} = -2$$

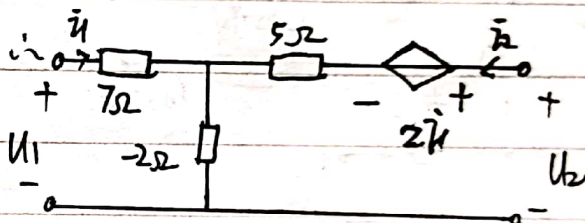
\therefore 为互易二端口网络

$$\begin{cases} U_1 = 5I_1 - 2I_2 = 7I_1 - 2(I_1 + I_2) \\ U_2 = -2I_1 + 3I_2 = -2(I_1 + I_2) + 5I_2 \end{cases}$$

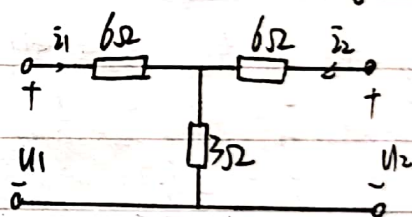


2) $\therefore Z_{12} \neq Z_{21} \therefore$ 含有受控源

$$\begin{cases} U_1 = 5i_1 - 2i_2 \\ U_2 = 3i_2 \end{cases}$$



$$[16-30] 1)$$



$$\begin{cases} U_1 = 6i_1 + 3(i_1 + i_2) = 9i_1 + 3i_2 \\ U_2 = 6i_2 + 3(i_1 + i_2) = 3i_1 + 9i_2 \end{cases} \Rightarrow \begin{cases} U_1 = 3(U_2 - 9i_2) + 3i_2 = 3U_2 + 24(-i_2) \\ i_1 = \frac{1}{3}U_2 + 3(-i_2) \end{cases}$$

$$\therefore T = \begin{bmatrix} 3 & 24\Omega \\ \frac{1}{3}S & 3 \end{bmatrix}$$

2) 两个二端口网络级联:

$$\therefore T = T_1 \times T_2 = \begin{bmatrix} 2 & 30\Omega \\ 0.1S & 2 \end{bmatrix} \times \begin{bmatrix} 3 & 24\Omega \\ \frac{1}{3}S & 3 \end{bmatrix} = \begin{bmatrix} 16 & 138S \\ \frac{29}{30}S & 84 \end{bmatrix}$$

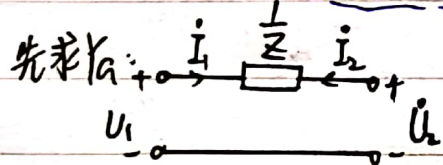
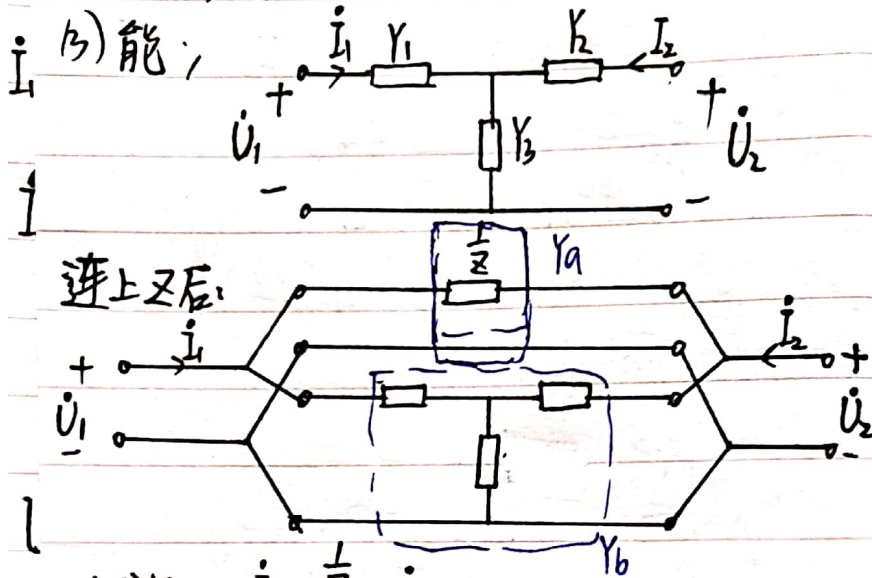
$$\text{即 } \begin{cases} U_1 = 16U_2 + 138I_2 \\ I_1 = \frac{29}{30}U_2 + 84I_2 \end{cases}$$

$$I_2 = 0 \text{ 时, } \frac{U_2}{U_1} = \frac{1}{16}$$



[16-36] (1) 原端口条件不变时, 连上阻抗 Z 后
还是二端口网络, 否则不是

(2) 是



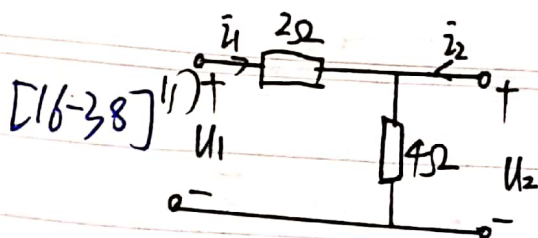
知 $U_2=0$ 时, $I_1 = \frac{1}{2}U_1$, $I_2 = -\frac{1}{2}U_1$

$U_1=0$ 时, $I_1 = -\frac{1}{2}U_2$, $I_2 = \frac{1}{2}U_2$

$$Y_a = \begin{bmatrix} \frac{1}{2} & -\frac{1}{2} \\ -\frac{1}{2} & \frac{1}{2} \end{bmatrix}$$

设 $Y_b = \begin{bmatrix} Y_{11} & Y_{12} \\ Y_{21} & Y_{22} \end{bmatrix}$

并联, $Y = Y_a + Y_b = \begin{bmatrix} Y_{11} + \frac{1}{2} & Y_{12} - \frac{1}{2} \\ Y_{21} - \frac{1}{2} & Y_{22} + \frac{1}{2} \end{bmatrix}$



由 KCL, KVL: $\begin{cases} U_1 = 2\bar{i}_1 + 4(\bar{i}_1 + \bar{i}_2) = 6\bar{i}_1 + 4\bar{i}_2 \\ U_2 = 4(\bar{i}_1 + \bar{i}_2) \end{cases}$

$$\therefore U_1 = 6 \cdot \left(\frac{U_2}{4} - \bar{i}_2 \right) + 4\bar{i}_2 = \frac{3}{2}U_2 + 2(-\bar{i}_2)$$

$$\bar{i}_1 = \frac{1}{4}U_2 + 1(-\bar{i}_2)$$

$$\therefore T_a = \begin{bmatrix} \frac{3}{2} & 2\Omega \\ \frac{1}{4}S & 1 \end{bmatrix}$$

(2) 两个二端口网络级联

$$T = T_a \times T_b = \begin{bmatrix} \frac{3}{2} & 2\Omega \\ \frac{1}{4}S & 1 \end{bmatrix} \times \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} \frac{3}{2} & 2\Omega \\ \frac{1}{4}S & 1 \end{bmatrix}$$

(3) 知: $\begin{cases} U_1 = \frac{3}{2}U_2 + 2(-\bar{i}_2) \\ \bar{i}_1 = \frac{1}{4}U_2 + 1(-\bar{i}_2) \end{cases}$

$U_1 = 10V$, $U_2 = 0$ 时,

$\bar{i}_2 = -5A$, $\bar{i}_1 = 5A$

