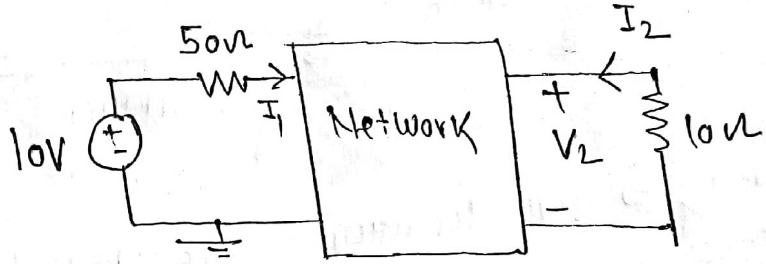
Soln: 01

Given y matrix → $\begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} 0.2 & 0.4 \\ 0.3 & 0.6 \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \end{bmatrix}$

Find $\frac{V_2}{V_1}$?

Given network –



Voltage (V_2) from network –

$$V_2 = -I_2 \times 10 \quad \text{— (i)}$$

From the y-matrix –

$$I_1 = 0.2V_1 + 0.4V_2 \quad \text{— (ii)}$$

$$I_2 = 0.3V_1 + 0.6V_2 \quad \text{— (iii)}$$

Substitute the value I_2 from (i) into (iii)

$$-\frac{V_2}{10} = 0.3V_1 + 0.6V_2$$

$$-V_2 = 3V_1 + 6V_2$$

$$-7V_2 = 3V_1$$

$$\boxed{\frac{V_2}{V_1} = -\frac{3}{7} \text{ volt}}$$

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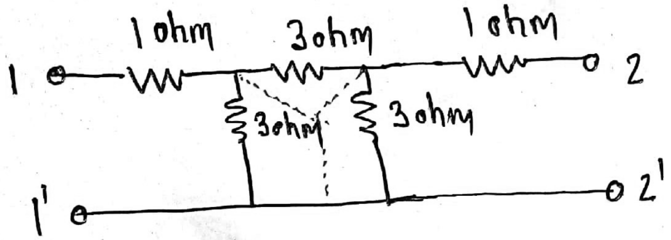
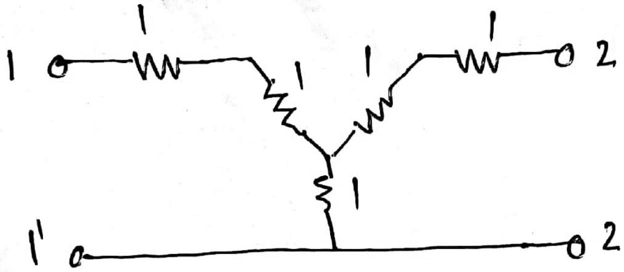
Solⁿ: 02



Note:

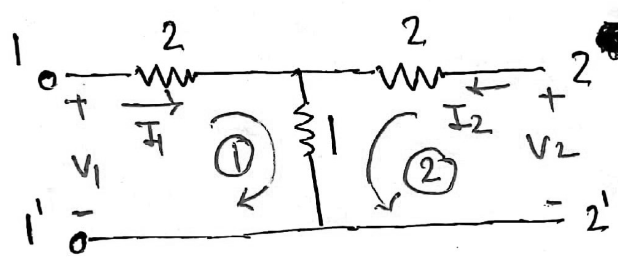
$\Delta \to Y$



$$R_A = \frac{R_1 \times R_2}{R_1 + R_2 + R_3}$$

$$R_B = \frac{R_2 \times R_3}{R_1 + R_2 + R_3}$$

$$R_C = \frac{R_1 \times R_3}{R_1 + R_2 + R_3}$$



[redacted]

Note:

$$\begin{bmatrix} V_1 \\ V_2 \end{bmatrix} = \begin{bmatrix} Z_{11} & Z_{12} \\ Z_{21} & Z_{22} \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix}$$

Apply KVL in mesh ①

$V_1 = 2I_1 + 1(I_1 + I_2)$

$V_1 = 3I_1 + I_2$ — (i)

Apply KVL in mesh ②

$V_2 = 2I_2 + 1(I_2 + I_1)$

$V_2 = I_1 + 3I_2$ — (ii)

$Z_{11} = \left.\frac{V_1}{I_1}\right|_{I_2=0}$ $Z_{12} = \left.\frac{V_1}{I_2}\right|_{I_1=0}$

$Z_{21} = \left.\frac{V_2}{I_1}\right|_{I_2=0}$ $Z_{22} = \left.\frac{V_2}{I_2}\right|_{I_1=0}$

$$\begin{bmatrix} V_1 \\ V_2 \end{bmatrix} = \begin{bmatrix} 3 & 1 \\ 1 & 3 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix}$$

compare from standard z-matrix

$Z_{11} = 3$ ohm, $Z_{12} = 1$ ohm

$Z_{21} = 1$ ohm, $Z_{22} = 3$ ohm

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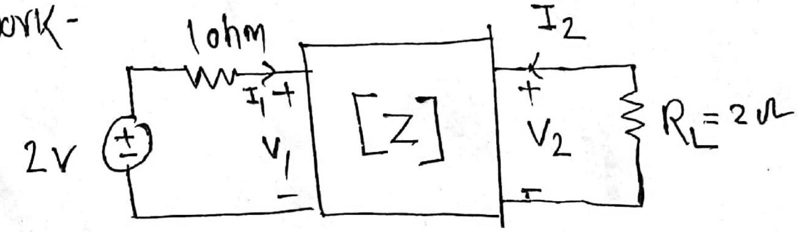
Solⁿ:03

Given parameters Values → $Z_{11} = 4$ ohm, $Z_{12} = 6$ ohm, $Z_{21} = 8$ ohm, $Z_{22} = 10$ ohm

Given Network -



for Z parameters -

$$V_1 = I_1 Z_{11} + I_2 Z_{12} \quad \text{— (i)}$$

$$V_2 = I_1 Z_{21} + I_2 Z_{22} \quad \text{— (ii)}$$

From Network -

$$V_2 = -I_2 R_L \quad \text{— (iii)}$$

$$V_1 = 2 - I_1 \quad \text{— (iv)}$$

Average Power deliver to R_L →

$$P = I_2^2 R_L = \frac{V_2^2}{R_L} \quad \text{— (v)}$$

Substitute V_1 from (iv) into (i)

$$2 - I_1 = I_1 Z_{11} + I_2 Z_{12}$$

$$2 - I_1 = 4I_1 + 6I_2$$

$$2 = 5I_1 + 6I_2 \quad \text{— (v)}$$

Substitute V_2 from (iii) into (ii)

$$-I_2 R_L = I_1 Z_{21} + I_2 Z_{22}$$

$$-2I_2 = 8I_1 + 10I_2$$

$$0 = 8I_1 + 12I_2 \quad \text{— (vi)}$$

By solving (v) and (vi) equation - we get, $I_1 = 2$ Amp, $I_2 = -\frac{4}{3}$ Amp

Therefore Power deliver to R_2

$$P = I_2^2 \times R_L = \frac{32}{9} \text{ watts}$$

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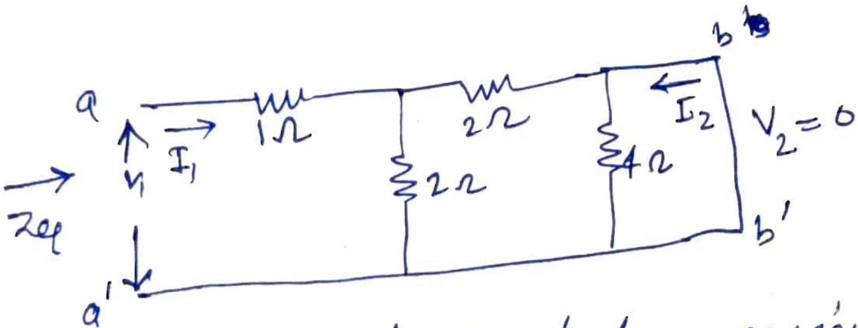
dv

$h_{11} = \frac{V_1}{I_1}\Big|_{V_2=0}$; $h_{21} = \frac{I_2}{I_1}\Big|_{V_2=0}$; $h_{12} = \frac{V_1}{V_2}\Big|_{I_1=0}$; $h_{22} = \frac{I_2}{V_2}\Big|_{I_1=0}$

If port b-b' is short circuited, $V_2 = 0$.

$h_{11} = \frac{V_1}{I_1}\Big|_{V_2=0}$; $V_1 = I_1 Z_{eq}$



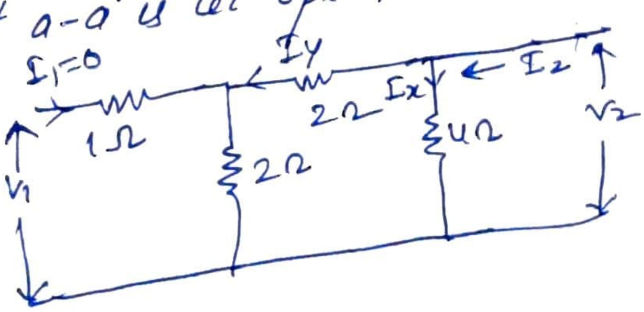
Zeq the equivalent impedance as viewed from the port a-a' is 2Ω

$V_1 = I_1 2V$

$h_{11} = \frac{V_1}{I_1} = 2\Omega$ $\quad h_{21} = \frac{I_2}{I_1}\Big|_{V_2=0}$ when $V_2 = 0$; $-I_2 = \frac{I_1}{2}$

$h_{21} = \frac{-1}{2}$

If port a-a' is let open, $I_1 = 0$. ~~the circuit is~~



$h_{12} = \frac{V_1}{V_2}\Big|_{I_1=0}$

$V_1 = I_y 2$; $I_y = \frac{I_2}{2}$

$V_2 = I_x 4$; $I_x = \frac{I_2}{2}$

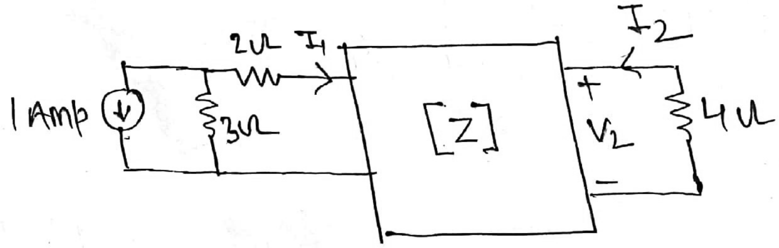
$h_{12} = \frac{V_1}{V_2}\Big|_{I_1=0} = \frac{1}{2}$

$h_{22} = \frac{I_2}{V_2}\Big|_{I_1=0} = \frac{1}{2}\mho$

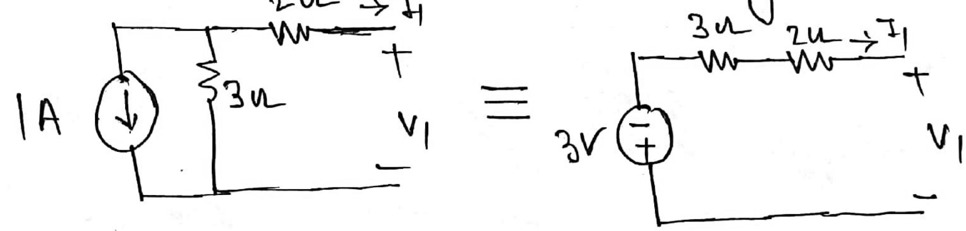
Soln: 05

Given parameters- $Z_{11} = 1\Omega$, $Z_{12} = 2\Omega$, $Z_{21} = 3\Omega$, $Z_{22} = 4\Omega$

Given Network-



The current source of 1 Amp with 3Ω can be converted into equivalent Voltage source as shown in the following figure



Apply KVL, we get, $V_1 = -3 - 5I_1 \rightarrow$ (i)

From the given value of z parameters-

$V_1 = 1I_1 + 2I_2 \longrightarrow$ —(ii)

$V_2 = 3I_1 + 4I_2 \longrightarrow$ —(iii)

From the Network— $V_2 = -4I_2 \rightarrow$ —(iv)

Substitute the V_1 from (i) into (ii)

$-3 - 5I_1 = I_1 + 2I_2$

$-3 = 6I_1 + 2I_2$ —(v)

Substitute the V_2 from (iv) into (iii)

$-4I_2 = 3I_1 + 4I_2$

$I_2 = -\frac{3}{8} I_1$ —(vi)

Solving the eqution (v) and (vi) we get -

$I_1 = -\frac{4}{7}$ Amp

$I_2 = \frac{3}{14}$ Amp

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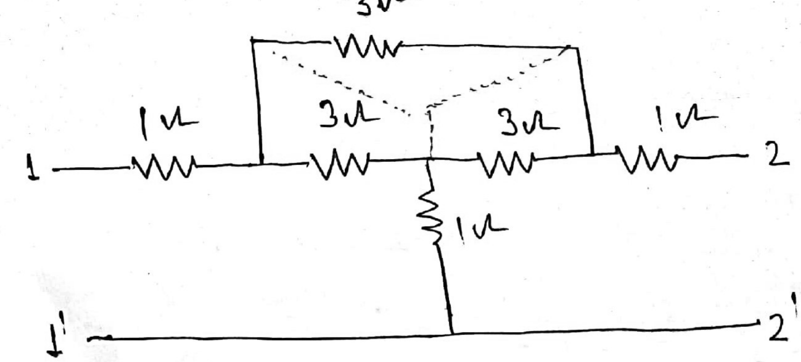
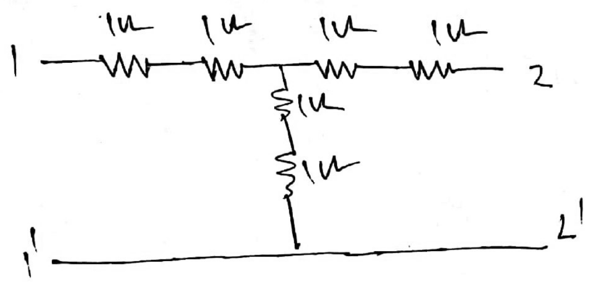
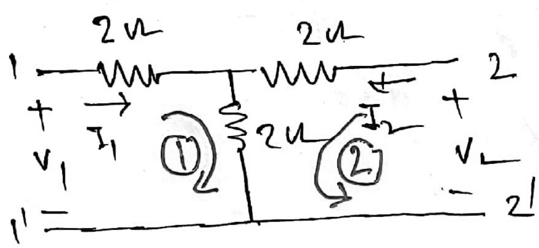
Soln.: 06

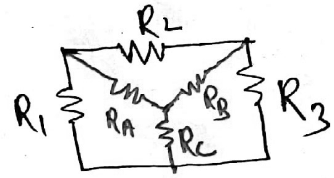






Note:

Δ-Y



$$R_A = \frac{R_1 \times R_2}{R_1 + R_2 + R_3}$$

$$R_B = \frac{R_2 \times R_3}{R_1 + R_2 + R_3}$$

$$R_C = \frac{R_3 \times R_1}{R_1 + R_2 + R_3}$$

Apply KVL in mesh 1

$$V_1 = 2I_1 + 2(I_1 + I_2)$$

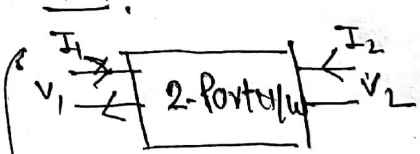
$$V_1 = 4I_1 + 2I_2 \quad \text{—— (i)}$$

Apply KVL in mesh 2

$$V_2 = 2I_2 + 2(I_1 + I_2)$$

$$V_2 = 2I_1 + 4I_2 \quad \text{—— (ii)}$$

Note:



$$\begin{bmatrix} V_1 \\ V_2 \end{bmatrix} = \begin{bmatrix} Z_{11} & Z_{12} \\ Z_{21} & Z_{22} \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix}$$

In matrix form -

$$\begin{bmatrix} V_1 \\ V_2 \end{bmatrix} = \begin{bmatrix} 4 & 2 \\ 2 & 4 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix}$$

Compare from standard z-matrix

$Z_{11} = 4$ ohm, $Z_{12} = 2$ ohm

$Z_{21} = 2$ ohm, $Z_{22} = 4$ ohm

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