6

$2||6 = \frac{2\times6}{2+6} = \frac{12}{8} = 1.5\Omega$

find the Current through 3Ω resistor

Using KCL at node 1

$i_1 + i_2 + i_3 + i_4 = 0$

$\frac{V_1 - 24}{4} + \frac{V_1}{3} + \frac{V_1}{6} + \frac{V_1}{2} = 0$

$\Rightarrow \frac{3(V_1 - 24) + 6V_1 + 2V_1 + 6V_1}{12} = 0$

$\Rightarrow 3V_1 - 72 + 6V_1 + 2V_1 + 6V_1 = 0$

$\Rightarrow 17V_1 - 72 = 0$

$17V_1 = 72 \quad \cdots (1)$

Using KCL at node 2

$\Rightarrow -V - 9 + V_1 = 0$

$-V + V_1 = 9 \quad \cdots (2)$

$17V + 6V_1 = 72$

$-V + V_1 = 9$

Using my calculator to solve simultaneously

$V = -0.96V$; $V_1 = 8.04V$

- The current through 3Ω resistor,

Using node analysis

$I_{3\Omega} = \frac{V_1 - 0}{3}$

$$= \frac{-0.6-0}{3} = \frac{-0.6}{3}$$

$$\therefore I_{3\Omega} = -0.2\,A$$

And the Current through the 2Ω resistor

$$I_{2\Omega} = \frac{V_1 - 0}{2}$$

$$= \frac{9.4-0}{2} = \frac{9.4}{2}$$

$$I_{2\Omega} = 4.2\,A$$

(4)

Find the voltages and Currents through 6Ω &

8

$\rightarrow V_1 - V_2 = 6V$

Assume $V_1 - V_2 = i_2$

Using KCL at node 1

$6mA = i_1 + i_2$

$6mA = \frac{V_1}{6} + \frac{(V_1 - V_2)}{6}$

$6mA = \frac{V_1 + 6(V_1 - V_2)}{6}$

$6mA = \frac{V_1 + 6V_1 - 6V_2}{6}$

$36mA = 7V_1 - 6V_2$

At node 2; $i_2 = i_4 + i_3$ $\quad i_3 = 4mA$

$\rightarrow i_2 = i_4 + 4mA$ $\quad \therefore 4mA = i_2 - i_4$

$4mA = (V_1 - V_2) - \frac{V_2}{12}$

$4mA = \frac{12(V_1 - V_2) - V_2}{12}$

$48mA = 12V_1 - 12V_2 - V_2$

$48 = 12V_1 - 13V_2$ $\quad (2)$

Solving

$V_1 =$ V

Current through resistor

$R = \frac{1}{} = 1.5\Omega$

$$10 = \tfrac{5}{6}V_1 - \tfrac{1}{3}V_2 - \tfrac{1}{2}V_3$$
$$64 = \tfrac{1}{3}V_1 - \tfrac{3}{10}V_2 + 0V_3$$
$$64 = -\tfrac{1}{2}V_1 - 0 + \tfrac{1}{3}V_3$$

Using matrix method

$$\begin{bmatrix} 10 \\ 64 \\ 64 \end{bmatrix} = \begin{bmatrix} 5/6 & -1/3 & -1/2 \\ 1/3 & -3/10 & 0 \\ -1/2 & 0 & 1/3 \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix}$$

A B C

$C = B^{-1}A$

$$B^{-1}A = \begin{bmatrix} 1.73 & -2.13 & 2.8 \\ 2.13 & -2.93 & 1.6 \\ 2.8 & -1.6 & 3.6 \end{bmatrix} \begin{bmatrix} 10 \\ 64 \\ 64 \end{bmatrix}$$

$$C = \begin{bmatrix} 80 \\ -64 \\ 156 \end{bmatrix}$$

$\therefore V_1 = 80V, \quad V_2 = -64V \quad V_3 = 156V$

(3)

$$\Rightarrow \frac{V_1 - V_2}{2} - \frac{V_2}{4} = -18$$

$$\frac{2(V_1 - V_2)}{4} - \frac{V_2}{4} = -18$$

$$\frac{2V_1 - 2V_2 - V_2}{4} = -18$$

$$\frac{2V_1 - 3V_2}{4} = -18$$

$$2V_1 - 3V_2 = -72 \quad ---- (ii)$$

$$8V_1 - 5V_2 = -120$$

$$2V_1 - 3V_2 = -72$$

Using Calculator to solve simultaneously

$V_1 = 0V$ & $V_2 = 24V$

$$i_1 = \frac{V_1}{10} = \frac{0}{10} = 0A$$

$$i_2 = \frac{V_2}{5} = \frac{0}{5} = 0A$$

$$i_3 = \frac{V_2}{4} = \frac{24}{4} = 6A$$

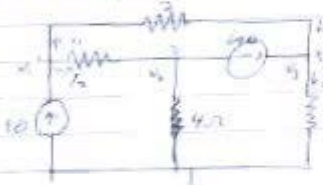
$$i_4 = \frac{V_1 - V_2}{2} = \frac{0 - 24}{2} = \frac{-24}{2} = -12A$$

4

2

Find the voltages at node 1, 2 & 3

Soln



At node 1, using KCL $10 = i_1 + i_2$

$$10 = \frac{V_1 - V_2}{2} + \frac{V_1 - V_3}{3}$$

At node 2, using KCL $i_1 = 6v_x + i_3$

$$\frac{V_1 - V_2}{2} = 6v_x + \frac{V_2}{4}$$

At node 3 using KCL $i_4 = 6v_x + i_2$

$$\frac{V_3}{6} = 6v_x + \frac{V_2 - V_3}{3}$$

$10 = 5/6$

$6v_x = 4/3$

$6v_x = 1/2$

Using

$$\begin{bmatrix} 10 \\ 6v_x \\ 6v_x \end{bmatrix} =$$

21V

2

From node 1; using KCL

$$i_1 + i_2 + i_4 = -12A$$

$$i_1 = \frac{V_1 - 0}{10} = \frac{V_1}{10}$$

$$i_2 = \frac{V_1 - 0}{5} = \frac{V_1}{5}$$

$$i_4 = \frac{V_1 - V_2}{2}$$

$$\frac{V_1}{10} + \frac{V_1}{5} + \frac{V_1 - V_2}{2} = -12$$

$$\equiv \frac{V_1}{10} + \frac{2V_1}{10} + \frac{5(V_1 - V_2)}{10} = -12$$

$$= \frac{V_1 + 2V_1 + 5V_1 - 5V_2}{10} = -12$$

$$\frac{8V_1 - 5V_2}{10} = -12$$

$$\Rightarrow 8V_1 - 5V_2 = -120$$

Applying KCL at node 2

$$i_3 + i_5 + i_6 = 0$$

$$12 - i_3 + i_6 = 0$$

$$i_3 = \frac{V_2 - 0}{15}$$

$$i_5 = \frac{V_2 - 0}{5} = \frac{V_2}{5}$$