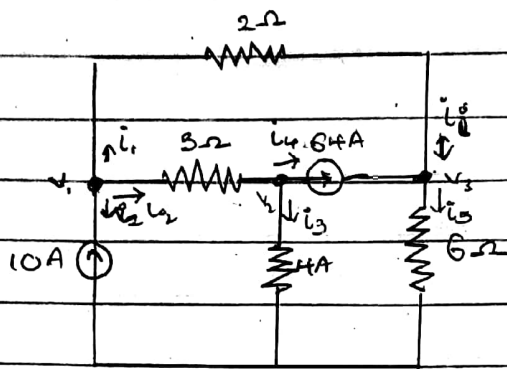


Elektronika I

EEF 322 Assign

17/ANON/019

ELECT/ELECT ENGR



At node 1, KCL:

$$10 = i_1 + i_2 = \frac{V_1 - V_2}{2} + \frac{V_1 - V_2}{3}$$

$$60 = 2(V_1 - V_2) + 3(V_1 - V_2)$$

$$60 = 2V_1 - 2V_2 + 3V_1 - 3V_2$$

$$60 = 5V_1 - 2V_2 - 3V_3 \quad \text{--- (1)}$$

At node 2, KCL

$$i_2 = i_3 + 6$$

$$6 = i_2 - i_3$$

$$6 = \frac{V_1 - V_2}{3} - \frac{V_2 - 0}{4}$$

$$768 = 4(V_1 - V_2) - 3V_2$$

$$768 = 4V_1 - 7V_2 \quad \text{--- (2)}$$

At Node 3, KCL

$$6 + i_1 = i_5$$

$$6 = i_5 - i_1$$

$$6 = \frac{V_3 - 0}{6} - \frac{V_1 - V_2}{2}$$

$$384 = V_3 - 3(V_1 - V_2)$$

$$384 = -3V_1 + 4V_2 + V_3 \quad \text{--- (3)}$$

Using Cramer's Rule

$$5V_1 - 2V_2 - 3V_3 = 60$$

$$4V_1 - 7V_2 = 768$$

$$-3V_1 + 0 + 4V_3 = 384$$

$$\therefore \begin{bmatrix} 5 & -2 & -3 \\ 4 & -7 & 0 \\ -3 & 0 & 4 \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix} = \begin{bmatrix} 60 \\ 768 \\ 384 \end{bmatrix}$$

$$V_1 = \frac{\Delta_1}{\Delta}, \quad V_2 = \frac{\Delta_2}{\Delta}, \quad V_3 = \frac{\Delta_3}{\Delta}$$

$$\Delta = \begin{vmatrix} 5 & -2 & -3 \\ 4 & -7 & 0 \\ -3 & 0 & 4 \end{vmatrix} = \underline{\underline{-45}}$$

$$\Delta_1 = \begin{vmatrix} 60 & -2 & -3 \\ 768 & -7 & 0 \\ 384 & 0 & 4 \end{vmatrix} = -3600$$

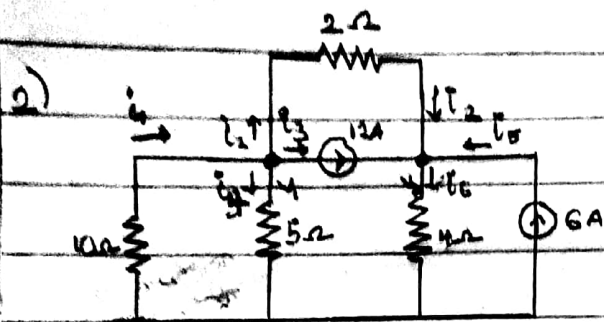
$$\Delta_2 = \begin{vmatrix} 5 & 60 & -3 \\ 4 & 768 & 0 \\ -3 & 384 & 4 \end{vmatrix} = 2800$$

$$\Delta_3 = \begin{vmatrix} 5 & -2 & 60 \\ 4 & -7 & 768 \\ -3 & 0 & 384 \end{vmatrix} = -7020$$

$$V_1 = \frac{\Delta_1}{\Delta} = \frac{-3600}{-45} = \underline{\underline{80V}}$$

$$V_2 = \frac{\Delta_2}{\Delta} = \frac{2800}{-45} = \underline{\underline{-64V}}$$

$$V_3 = \frac{\Delta_3}{\Delta} = \frac{-7020}{-45} = \underline{\underline{156V}}$$



At node 1 KCL

$$i_1 = i_2 + i_3 + i_4$$

$$\frac{0 - V_1}{10} = \frac{V_1 - V_2}{2} + 12 + \frac{V_1 - 0}{5}$$

$$-V_1 = 5(V_1 - V_2) + 120 + 2V_1$$

$$120 = -8V_1 + 5V_2 \quad \text{--- (1)}$$

At node 2

$$i_3 + i_2 + i_5 = i_6$$

$$12 + \frac{V_1 - V_2}{2} + 6 = \frac{V_2 - 0}{4}$$

$$96 + 4(V_1 - V_2) + 48 = 2V_2$$

$$144 = -4V_1 + 6V_2 \quad \text{--- (2)}$$

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

$$144 = -4V_1 + 6V_2$$

Solving simultaneously

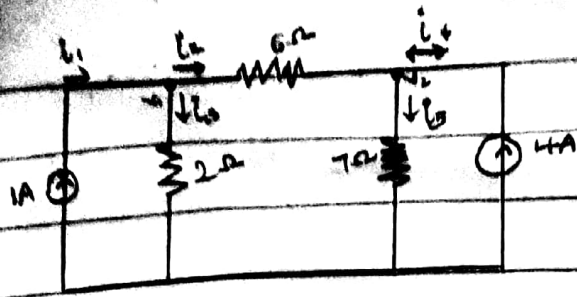
$$\Rightarrow V_1 = 0, \quad V_2 = \underline{\underline{24V}}$$

$$i_2 = \frac{V_1 - V_2}{2} = \frac{24 - 0}{2} = \underline{\underline{12A}}$$

$$i_6 = \frac{V_2 - 0}{4} = \frac{24}{4} = \underline{\underline{6A}}$$

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

$$i_4 = \frac{V_1 - 0}{5} = \frac{0}{5} = 0A$$



At node 1

$$i_1 = i_2 + i_3$$

$$1 = \frac{V_1 - V_2}{6} + \frac{V_1 - 0}{2}$$

$$6 = 4(V_1 - V_2) + 3V_1$$

$$6 = 4V_1 - V_2 \quad \text{--- (i)}$$

At node 2

$$i_2 = i_4 + i_5$$

$$\frac{V_1 - V_2}{6} = 4 + \frac{V_2 - 0}{7}$$

$$7(V_1 - V_2) = 168 + 6V_2$$

$$168 = 7V_1 - 13V_2 \quad \text{--- (ii)}$$

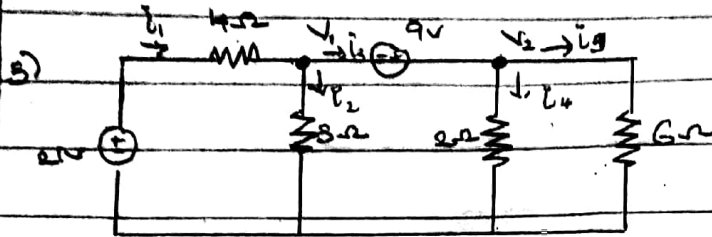
Solving (i) & (ii) simultaneously.

$$V_1 = -2V$$

$$V_2 = -14V$$

$$i_2 = \frac{V_1 - V_2}{6} = \frac{-2 + 14}{6} = 2A \quad \quad i_3 = \frac{V_1}{2} = \frac{-2}{2} = -1A$$

$$i_5 = \frac{V_2}{5} = \frac{-14}{5} = -2.8A$$



At Node 1

$$i_1 + i_2 + i_3 + i_4 = 0$$

$$\frac{V_1 - 21}{4} + \frac{V_1}{8} + \frac{V_2}{6} + \frac{V_2}{2} = 0$$

$$7V_1 + 8V_2 - 63 = 0 \quad \text{--- (1)}$$

At loop-1, KVL:

$$V_1 - V_2 = 9 \quad \text{--- (2)}$$

solving (1) & (2) simultaneously

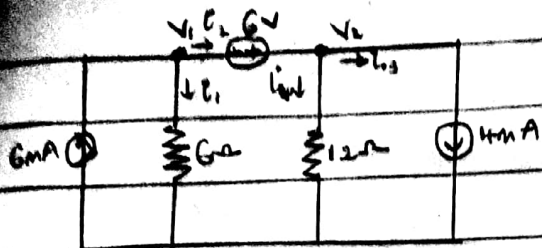
$$V_1 = \underline{\underline{-0.6\text{V}}} \quad V_2 = \underline{\underline{8.04\text{V}}}$$

$$i_1 = \frac{V_1 - 21}{4} = \frac{-0.6 - 21}{4} = -5.04\text{A}$$

$$i_2 = \frac{V_1}{8} = \frac{-0.6}{8} = -0.075\text{A} //$$

$$i_3 = \frac{V_2}{6} = \frac{8.04}{6} = 1.34\text{A} //$$

$$i_4 = \frac{V_2}{2} = \frac{8.04}{2} = 4.02\text{A} //$$



$$V_1 - V_2 = 6V \quad \text{--- (1)}$$

At node 1

$$6mA = i_1 + i_2$$

$$6 \times 10^{-3} = \frac{V_1}{6} + \frac{V_1 - V_2}{6}$$

$$36 \times 10^{-3} = V_1 + 6(V_1 - V_2)$$

$$36 \times 10^{-3} = 7V_1 - 6V_2 \quad \text{--- (2)}$$

At node 2

$$i_2 = i_3 + i_4$$

$$\frac{V_1 - V_2}{6} = \frac{V_2}{12} + 4 \times 10^{-3}$$

$$12(V_1 - V_2) = V_2 + 48 \times 10^{-3}$$

$$12 \frac{(V_1 - V_2)}{6} = \frac{V_2}{12} + 48 \times 10^{-3}$$

$$48 \times 10^{-3} = 12V_1 + 13V_2 \quad \text{--- (3)}$$

Solving V_1 & V_2 simultaneously,

$$V_1 = 0.0095V$$

$$V_2 = 0.0051$$

$$= 9.5mV$$

$$= 5.1mV$$

$$i_1 = \frac{V_1}{6} = \frac{9.5 \times 10^{-3}}{6} = 1.583mA$$

$$i_4 = \frac{V_2}{12} = \frac{5.1 \times 10^{-3}}{12} = 0.425mA$$