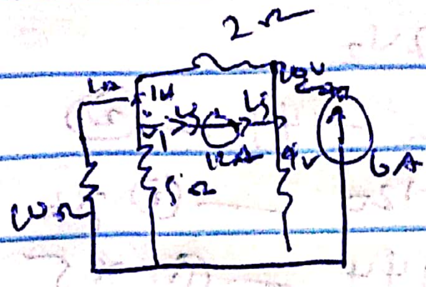
Emmanuel Orbolmwa 17/MHS01/113



Node 1

$i_1 + i_2 + i_3 + i_4 = 0$

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

$$\frac{V_1 + 2V_1 + 120 + 5V_1 - 5V_2}{10} = 0$$

$$\frac{8V_1 - 5V_2 + 120}{10} = 0$$

$$8V_1 - 5V_2 + 120 = 0$$

$$8V_1 - 5V_2 + 120 = 0$$

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

Node 2

$i_3 + i_5 + i_6 = i_7$

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

$$\frac{V_1 - V_2 + 24 + 12}{2} = \frac{V_2}{4}$$

$$\frac{V_1 - V_2 + 36}{2} = \frac{V_2}{4}$$

$4v_1 - 4V_2 + 144 = 2V_2$

$4v_1 - 6V_2 = -144$ — ②

$8v_1 - 5V_2 = -120$ — ① $\times 6$

$4V_1 - 6V_2 = -144$ — ② $\times 5$

$48v_1 - 30V_2 = -720$

$20v_1 - 30V_2 = -720$

$48v_1 - 20v_1$

$28v_1 = 0$

$v_1 = 0$

Lt eqn

$8V_1 - 5V_2 = -120$

Sub $v_1 = 0$ into eqn ①

$8(0) - 5(V_2) = -120$

$\cancel{-5V_2 + 120}$ $\quad \frac{-5V_2}{-5} = \frac{-120}{-5}$

$V_2 = 24$

$V_1 = 0$, $V_2 = 24V$

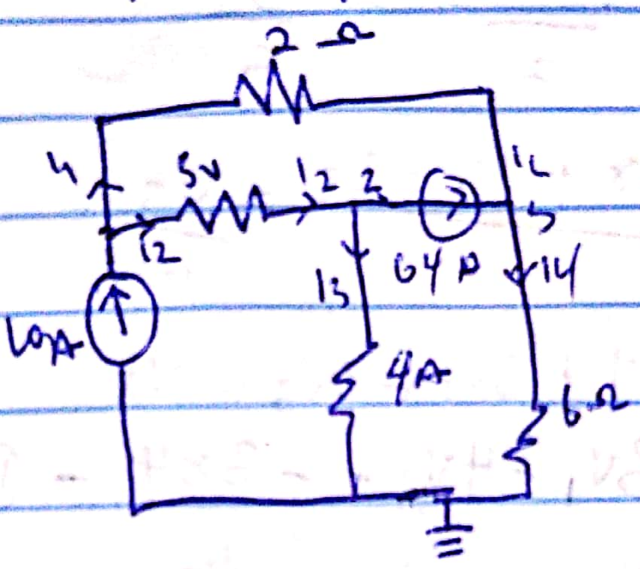
current flowing through resistor.

10Ω: $\frac{V_1}{10} = \frac{0}{10} = 0A$

5Ω: $\frac{V_1}{5} = 0/5 = 0A$

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

$4\Omega : \frac{V_2}{4} = \frac{24}{4} = 6A$



Node 1

$= 10 = I_1 + I_2$

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

$10 = \frac{3V_1 - 3V_3 + 2V_1 - 2V_2}{6}$

$60 = 5V_1 - 2V_2 - 3V_3$ —— (i)

Node 2

$64 + I_3 = I_2$

$\frac{64}{1} + \frac{V_2}{4} = \frac{V_1 - V_2}{3}$

$\frac{256 + V_2}{4} = \frac{V_1 - V_2}{3}$

$768 + 3V_2 = 4V_1 - 4V_2$

$768 = 4V_1 - 7V_2$ —— (ii)

Scanned with CamScanner

Node 3

$$64 + I_1 = I_4$$

$$64 + \frac{V_1 - V_3}{2} = \frac{V_3}{6}$$

$$2 \times \frac{128 + V_1 - V_3}{2} = \frac{V_3}{6_3}$$

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

$$3V_1 - 4V_3 = -384 \quad \text{— (iii)}$$

Using cramer's rules

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

$$4V_1 - 7V_2 + 0 = 768$$

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

$$\begin{bmatrix} 3 & -2 & -3 \\ 4 & 7 & 6 \\ 3 & 0 & 4 \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix} = \begin{bmatrix} 60 \\ 768 \\ -384 \end{bmatrix}$$

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

$$\Delta = \begin{vmatrix} 5 & -2 & -3 \\ 4 & -7 & 6 \\ 3 & 0 & 4 \end{vmatrix} \begin{matrix} 5 & -2 \\ 4 & 7 \\ 3 & 0 \end{matrix}$$

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

$$\Delta_2 \begin{vmatrix} 5 & -2 & -3 \\ 4 & -7 & 0 \\ 3 & 0 & 4 \end{vmatrix} \begin{matrix} 5 & -2 \\ 4 & -7 \\ 3 & 0 \end{matrix}$$

$(+140 + 0 + 0) - (32 + 0 + 63)$

$+140 - (+95)$

$+140 - 95$

$\Delta = 45$

$$\Delta_1 = \begin{pmatrix} 60 & -2 & -2 \\ 768 & -7 & 0 \\ -384 & 0 & -4 \end{pmatrix} \begin{matrix} 60 & -2 \\ 768 & -7 \\ -384 & 0 \end{matrix}$$

$(1680 + 0 + 0) - (6144 + 0 - 8064)$

$1680 - (-1920)$

$\Delta_1 = 3600$

$D_2 = (-15360 + 0 + 4608) - (-9600 + 0)$
(-6912)

$-10752 - (-7872)$

$-10752 + 7872$

$\Delta = -2880$

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

$(13440 - 4668 + 0) - (3072 + 0 - 1260)$

$8832 - (1812)$

$\Delta_3 = 7020$

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

$V_2 = \frac{\Delta_2}{\Delta} = \frac{-2880}{45} = -64V$

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