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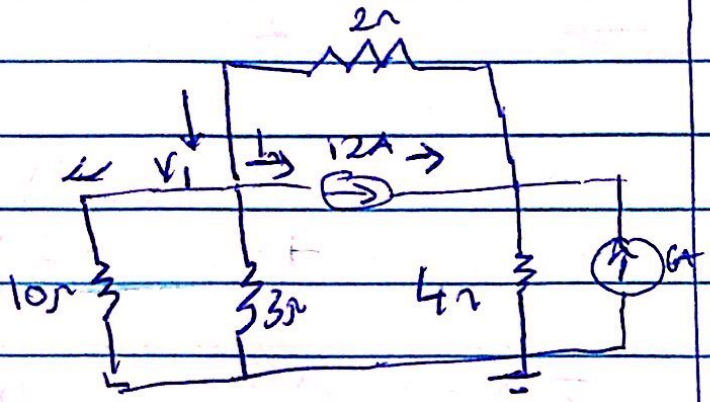
17/ENG02/070

Computer Engineering

EEE 322



at node V_1

$I_3 = i_1 + I_5 + I_6 = I_2 + I_5 + I_6$ $\therefore I_2 = I_3 - I_5 - I_6$

~~$I_2 = \frac{V_1 + V_2}{2}$~~

$I_2 = \frac{V_2 - V_1}{2} - \left[\frac{V_1 - 0}{5}\right] - \left[\frac{V_1 - 0}{10}\right]$

$I_2 = \frac{V_2 - V_1}{2} - \frac{V_1}{5} - \frac{V_1}{10}$

$I_2 = 5(V_2 - V_1) - 2(V_1) - V/10$

$120 = 5V_2 - 5V_1 - 2V_1 - V_1$

$120 = 5V_2 - 8V_1$ — (1)

from node V_2

$i_1 + i_2 = I_3 + I_4$

$I_2 + 0 = \frac{V_2 - V_1}{2} + \left[\frac{V_2}{4}\right]$

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

$18 = 2(V_2 - V_1 + V_2/4)$

$72 = 3V_2 - 2V_1$ — (2)

Using Simultaneous Eqn

$120 = 5V_2 - 8V_1$ — $\times 2$

$72 = 3V_2 - 2V_1$ — $\times 8$

$240 = 10V_2 - 16V_1$

$576 = 24V_2 - 16V_1$

$-336 = -14V_2$

$V_2 = 24V$

from Eqn (1)

$120 = 5(24) - 8V_1$

$120 = 120 - 8V_1$

$8V = 120 - 120$

$V_1 = 0V$

Current flowing through the 2Ω resistor

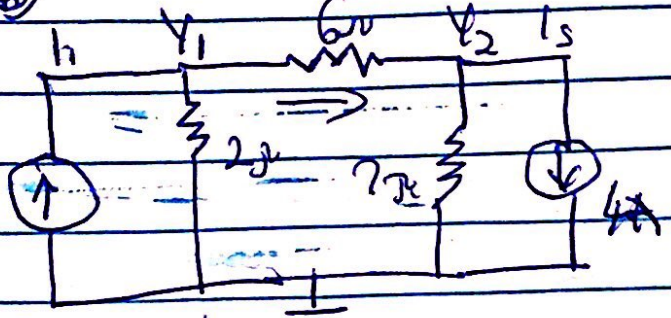
$= \frac{V_2 - V_1}{2} = \frac{24 - 0}{2} = 12A$

while Current flowing through the 4Ω resistor

$= 4/4 = 24/4 = 3A$

Due to the long or the current moving through the 10Ω & 3Ω resistor both equal zero (0).

b)



at node 2

$i_1 = i_2 + i_3$

$1 = \left[\frac{v_1 - v_2}{6}\right] + \left[\frac{v_1 - v_2}{2}\right]$

$1 = \frac{v_1 - v_2}{6} + v_1/2$

$1 = v_1 - v_2 + 3v_1/6$

$6 = 4v_1 - v_2$ (1) $4v_1 - v_2 = 6$

$i = i_4 + i_5$

$\left[\frac{v_1 - v_2}{6}\right] = \left[\frac{v_2}{7}\right] + 4$

$v_1 - v_2/6 - v_2/7 = 4$

$7(v_1 - v_2) - 6v_2/42 = 4$

$168 = 7v_1 - 13v_2 - 2$

Solving simultaneously

$v_1 = -2V$ and $v_2 = -14V$

from the cct moving through the 6Ω

$= \frac{-2 - 14}{6} = -16/6$

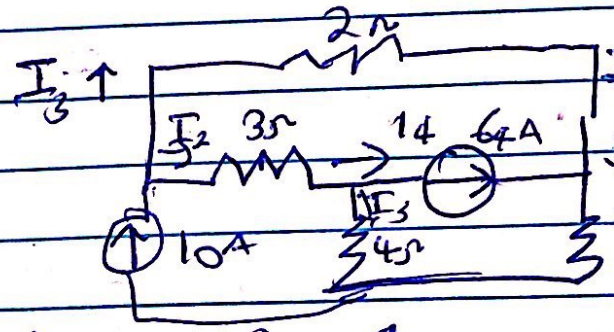
$= -2.67A$

from the cct moving through the 2Ω resistor

$= v_1/2 = -2/2 = 1A$

cct moving through 7Ω

$= v_2/7 = -14/7 = -2A$



from node 1

$I_1 = I_2 + I_3$

$\Rightarrow 10 = v_1 - v_2/3 + v_1 - v_3/3$

$10 = (v_1 - v_2)2 + (v_1 - v_3)3$

$60 = 2v_1 - 2v_2 + 3v_1 - 3v_3$ 6

$6v_0 = 5v_1 - 2v_2 - 3v_3$ (1)

from node 2

$I_2 = I_3 + I_4$

$v_1 - v_2/3 = v_2/4 + 6$

$4v_1 - 4v_2 - 3v_2/12 = 6$

$4v_1 - 7v_2/12 = 6$

$4v_1 - 7v_2 = 72$ (2)

from node 3

$I_4 + I_6 = I_5$

$64 + V_1 - V_3/2 = V_3/6$

$64 = V_3/6 - (V_1 - V_3)/2$

$64 = 2V_3 - 3V_1 + 3V_3/6$

$384 = 4V_3 - 3V_1$ —(3)

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

$768 = 4V_1 - 7V_2 + 0V_3$

$384 = -3V_1 + 0V_2 + 4V_3$

Using Cramers rule

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

$V_1 = \Delta_1/\Delta$; $V_2 = \Delta_2/\Delta$; $V_3 = \Delta_3/\Delta$

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

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

$= 5(-28 - 0) + 2(16 - 0) - 3(0 - 21)$

$= -140 + 32 + 63 = -45$

$$\Delta_1 = \begin{vmatrix} 60 & -2 & -1 \\ 668 & -7 & 0 \\ 384 & 0 & 4 \end{vmatrix}$$

$= 60(-28) + 2(3072 - 0) - 3(0 + 2688)$

$= 1680 + 6144 - 8064$

$= 6144 - 9744$

$= -3600$

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

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

$= 5(3072 - 0) - 60(16 - 0) - 3(1536 + 2304)$

$= 15360 - 960 - 11520$

$= 15360 - 12480$

$= 2880$

$V_2 = 2880/-45 = -64V$

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

$= 5(-2688 - 0) + 2(1536 + 2304) + 60(0 - 21)$

$= -13440 + 7080 - 1260 = -7020$

$\therefore V_3 = \frac{-7020}{45}$

$= 156V$