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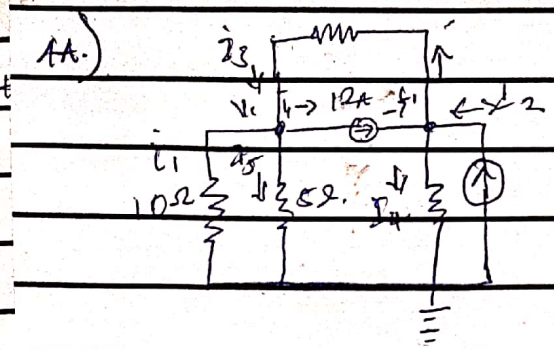
17/ENG05/[illegible]

Mechatronics Engineering

44.)



$i_1 = 12$ Amps

$i_2 = 6$ Amps

at node V_1

$$i_3 = i_1 + i_5 + i_6 = 12 + i_5 + i_6.$$

$$12 = i_3 - (i_5 + i_6).$$

$$12 = \frac{V_3 - V_1}{2} - \left[\frac{V_1 - 0}{5}\right] - \left[\frac{V_1 - 0}{10}\right]$$

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

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

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

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

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

at node V_2

$$i_1 + i_2 = i_3 + i_4$$

$$12 + 6 = \frac{V_2 - V_1}{2} + \left[\frac{V_2 - 0}{4}\right]$$

$$18 = V_2 - V_1 + V_2$$

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

$$18 = 3V_2 - 2V_1 / 4$$

$72 = 3V_2 - 2V_1$.

$3V_2 - 2V_1 = 72$.

Solving simultaneously

$5V_2 - 8V_1 = 120$

$5V_2 - 2V_1 = 72$

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

current is flowing through the 8Ω resistor

$I_3 = \frac{V_2 - V_1}{2} = \frac{24 - 0}{2}$.

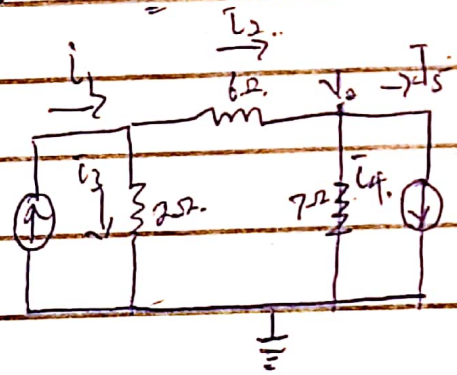
$I_3 = 12A$.

Current flowing through the 4Ω resistor

$I_4 = \frac{V_2 - 0}{4} = \frac{24 - 0}{4} = 6A$.

Since voltage at node $V_1 = 0$. Hence current flowing through 5Ω and 10Ω resistor $= 0$ (I_5 & $I_6 = 0$)

4b)



$I_1 = 1$ Amps

$I_5 = 4$ Amp.

at node V_1:

$I_1 = I_2 + I_3$

$1 = \left[\frac{V_1 - V_2}{6}\right] + \left[\frac{V_1 - 0}{2}\right]$

$1 = V_1 - V_2/6 + V_1/2$.

$1 = \frac{V_1 - V_2 + 3V_1}{6}$

$4V_1 - V_2 = 6$ --- ①

at node V_2:

$i_2 = i_4 + i_5$.

$$\left[\frac{V_1 - V_2}{6}\right] = \left[\frac{V_2 - 0}{7}\right] + 4.$$

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

$$\frac{7(V_1 - V_2) - 6V_2}{42} = 4$$

$7V_1 - 7V_2 - 6V_2 = 168$

solving simultaneously

$4V_1 - V_2 = 6.$

$7V_1 - 13V_2 = 168$

$V_1 = -2V$

$V_2 = -14V$

Current flowing through the 6Ω resistor

$$i_2 = \frac{V_1 - V_2}{6} = \frac{-2 - (-4)}{6.}$$

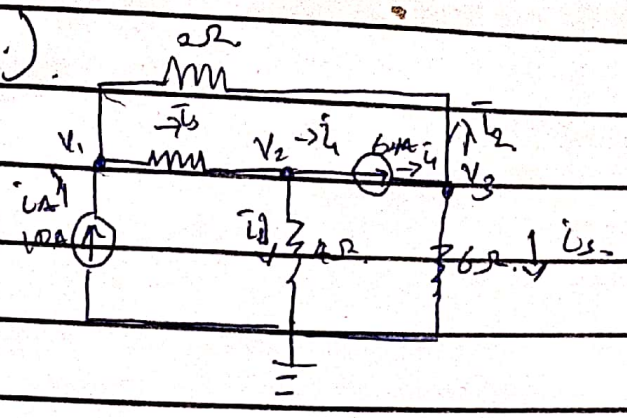
$$i_2 = \frac{12}{6} = 2A//.$$

Current flowing through the 2Ω resistor

$$i_3 = \frac{V_1 - 0}{2} = \frac{-2}{2} = -1A//$$

Current flowing through the 7Ω resistor $i_4 = \frac{V_2 - 0}{} = -14$, $i_4 = -2A//$

6.)



$i_1 = 64$ Amps.

$i_4 = 10$ Amps.

at node V_1

$$i_2 + i_4 = i_5$$

$$\therefore \frac{V_3 - V_1}{2} + 10 = \left[\frac{V_1 - V_2}{3}\right]$$

$$10 = \left[\frac{V_1 - V_2}{3} - \frac{V_3 - V_1}{3}\right]$$

$$10 = \frac{2(V_1 - V_2) - 3(V_3 - V_1)}{6}.$$

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

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

$$5V_1 - 2V_2 - 3V_3 = 60 \quad \cdots\cdots (1)$$

at node V_2

$$i_5 = i_1 + i_6$$

$$\frac{V_1 - V_2}{3} = 64 + \left[\frac{V_2 - 10}{4}\right]$$

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

$$64 = \frac{4(V_1 - V_2) - 3V_2}{12}.$$

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

at node V_3

$i_1 = i_2 + i_3$

$64 = \left[\frac{V_3 - V_1}{2}\right] + \left[\frac{V_3 - 0}{6}\right]$

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

$64 = \frac{3(V_3 - V_1) + V_3}{6}$

$64 = \frac{3V_3 - 3V_1 + V_3}{6} = \frac{4V_3 - 3V_1}{6}$

$384 = -3V_1 + 4V_3$

$= -3V_1 + 4V_3 = 384$

Solving Simultaneously

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

$4V_1 - 7V_2 + 0 = 768$

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

$V_1 = 80V$, $V_2 = -64V$, $V_3 = 186V$.