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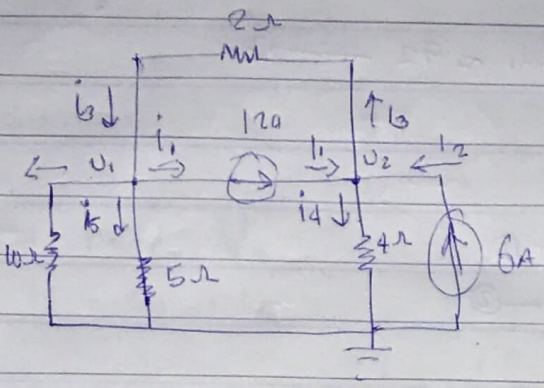
17/eng04/075
ELEC/ELECT

Circuit theory

40)



where $I_1 = 12A$

$I_2 = 6A$

at node V_1

$I_3 = I_1 + I_5 + I_6 = I_2 + I_5 + I_6$

$I_2 = I_3 - (I_5 + I_6)$

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

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

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

$$I_2 = \frac{5V_2 - 8V_1}{10}$$

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

at node 2

$I_1 + I_2 = I_5 + I_4$

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

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

$$I_6 = \frac{3V_2 - 2V_1}{4}$$

$$12 = 3V_2 - 2V_1 \quad \therefore 3V_2 - 2V_1 = 72 \text{ ——— (2)}$$

Solving Simultaneously

$$5V_2 - 8V_1 = 120 \text{ ——— (1)}$$

$$5V_2 - 2V_1 = 72 \text{ ——— (2)}$$

$V_1 = 0_v$, $V_2 = 24_v$

Current is flowing throug the 2Ω resistor

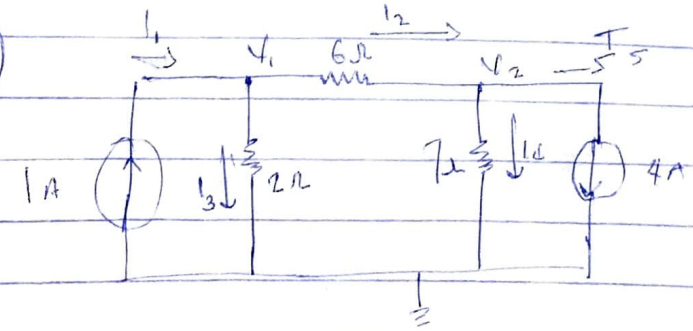
$$I_3 = \frac{V_2 - V_1}{2} = \frac{24}{2} = 12A$$

Current flowing through the 4Ω resistor

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

I_5 and $I_6 = 0$ because the total Voltage at a node = 0

4b)



$I_1 = 1$

$I_5 = 4$

At node V_1

$$I_1 = I_2 + I_3$$

$$1 = \left(\frac{V_1 - V_2}{6}\right) + \left(\frac{V_1}{2}\right)$$

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

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

$$4V_1 - V_2 = 6 \quad \text{---} \quad (1)$$

At node V_2

$$I_2 = I_4 + I_5$$

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

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

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

$$7V_1 - 13V_2 = 168 \quad \text{---} \quad (2)$$

Solving simultaneously

$$7V_1 - 13V_2 = 168 \quad \text{---} \quad (2)$$

$$4V_1 - V_2 = 6 \quad \text{---} \quad (1)$$

$$V_1 = -2V$$

$$V_2 = -14V$$

Current flowing through the 6Ω resistor

$$I_2 = \frac{V_1 - V_2}{6} = \frac{-2 - (-14)}{6}$$

$$I_2 = \frac{12}{6} = 2A$$

Current flowin through the 2Ω resistor

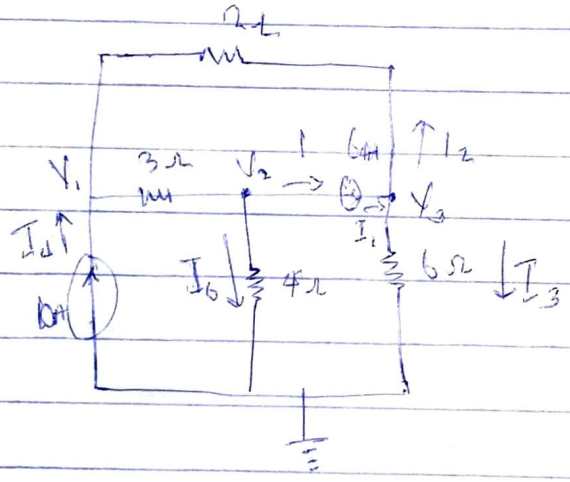
$$I_3 = \frac{V_1 - 0}{2} = \frac{-2}{2} = -1A$$

Current flowing through the 7Ω resistor

$$I_4 = \frac{V_2 - 0}{7} = \frac{-14}{7}$$

$$I_4 = -2A$$

6)



$I_1 = 64A$

$I_4 = 10A$

At node V_1

$$I_2 + I_d = I_5$$

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

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

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

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

At node V_2:

$$I_3 = I_1 + I_0$$

$$\frac{V_1 - V_2}{3} = 64 + \left(\frac{V_2 - 0}{4}\right)$$

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

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

at node V_3:

$$\frac{I_1}{2} = I_2 + I_3$$

$$64 = \frac{V_3 - V_1}{2} + \left(\frac{V_3}{6}\right)$$

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

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

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

Solving simultaneously

$$5V_1 - 2V_2 - 3V_3 = 60 \quad \text{—— (1)}$$
$$4V_1 - 7V_2 + 0 = 768 \quad \text{—— (2)}$$
$$-3V_1 + 0 + 4V_3 = 384 \quad \text{—— (3)}$$

$V_1 = 80V$, $V_2 = -64V$, $V_3 = 156V$