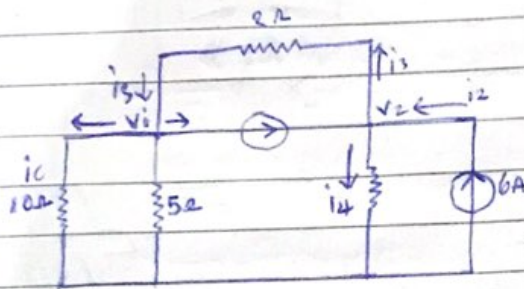
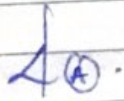


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4 MATRIC NO: 171EN004 1001

EEE 32Q



at node v_1

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

$$\therefore 12 = i_3 - (i_5 + i_6)$$

$$12 = \frac{v_2 - v_1}{2} - \left[\frac{v_1 - 0}{5} \right] - \left[\frac{v_1 - 0}{10} \right]$$

$$12 = \frac{v_2 - v_1}{2} - \frac{v_1}{5} - \frac{v_1}{10}$$

$$12 = \frac{v_2 - v_1}{2} - \frac{v_1}{5} - \frac{v_1}{10}$$

$$12 = \frac{5(v_2 - v_1) - 2(v_1) - v_1}{10}$$

$$12 = \frac{5v_2 - 5v_1 - 2v_1 - v_1}{10}$$

$$12 = \frac{5v_2 - 8v_1}{10}$$

$$5v_2 - 8v_1 = 10 \times 12 \quad \text{--- (1)}$$

(2) node v_2 ;

$$i_1 + i_2 = i_3 + i_4$$

$$12 + i_6 = \frac{v_2 - v_1}{2} + \left[\frac{v_2 - 0}{4} \right]$$

$$18 = \frac{v_2 - v_1}{2} + \frac{v_2}{4}$$

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

$$18 = \frac{3V_2 - 2V_1}{4}$$

$$72 = 3V_2 - 2V_1$$

$$\angle 3V_2 - 2V_1 = 72 \quad \text{--- (2)}$$

Solving Simultaneously

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

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

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

Current flowing through the 2Ω resistor:

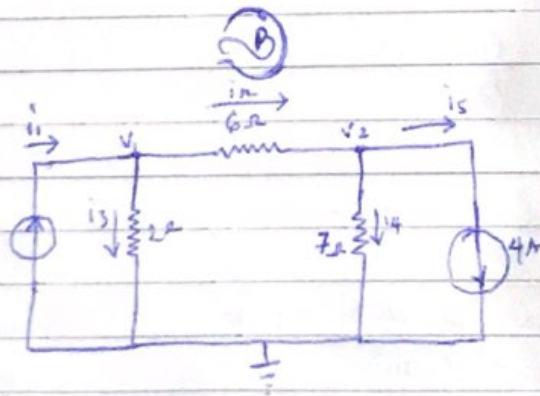
$$i_3 = \frac{V_2 - V_1}{2} = \frac{24 - 0}{2}$$

$$i_3 = 12A$$

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 resistors = 0 (i_5 & $i_6 = 0$)



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at node V_1 ;

$$i_1 = i_2 + i_3$$

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

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

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

$$V_1 - V_2 + 3V_1 = 6$$

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

at node V_2 ;

$$i_2 = i_4 + i_5$$

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

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

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

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

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

Solving Simultaneously;

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

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

$$V_1 = -2V$$

$$V_2 = -14V$$

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 flowing through the 2Ω resistor

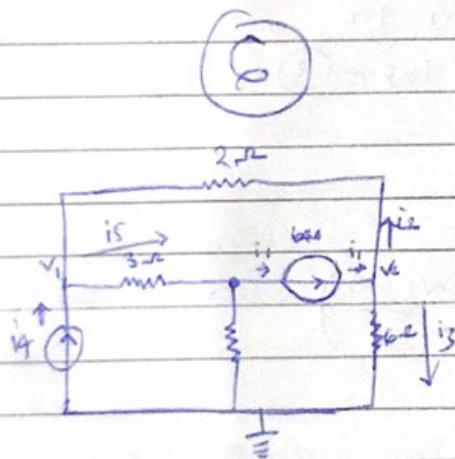
$$i_3 = \frac{v_1 - 0}{2} = \frac{-2}{2}$$

$$i_3 = -1A$$

Current flowing through the 1Ω resistor,

$$i_4 = \frac{v_2 - 0}{1} = \frac{-14}{1}$$

$$i_4 = -2A$$



at node v_1 :

$$i_2 + i_4 = 15$$

$$\therefore \left[\frac{v_3 - v_1}{2} \right] + 10 = \left[\frac{v_1 - v_2}{3} \right]$$

$$\therefore 10 = \left[\frac{v_1 - v_2}{3} \right] - \left[\frac{v_3 - v_1}{2} \right]$$

$$= \frac{v_1 - v_2}{3} - \frac{v_3 - v_1}{2}$$

$$10 = \frac{2(v_1 - v_2) - 3(v_3 - v_1)}{6}$$

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

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

at node V_2 .

$$i_5 = i_1 + i_6$$

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

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

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

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

$$768 = 4V_1 - 7V_2$$

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

at node V_3 :

$$i_1 = i_2 + i_5$$

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

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

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

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

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

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

Solving Simultaneously

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

$$4V_1 - 7V_2 + 0 = 768 \quad \text{--- (2)}$$

$$-3V_1 + 0 + 4V_3 = 384 \quad \text{--- (3)}$$

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