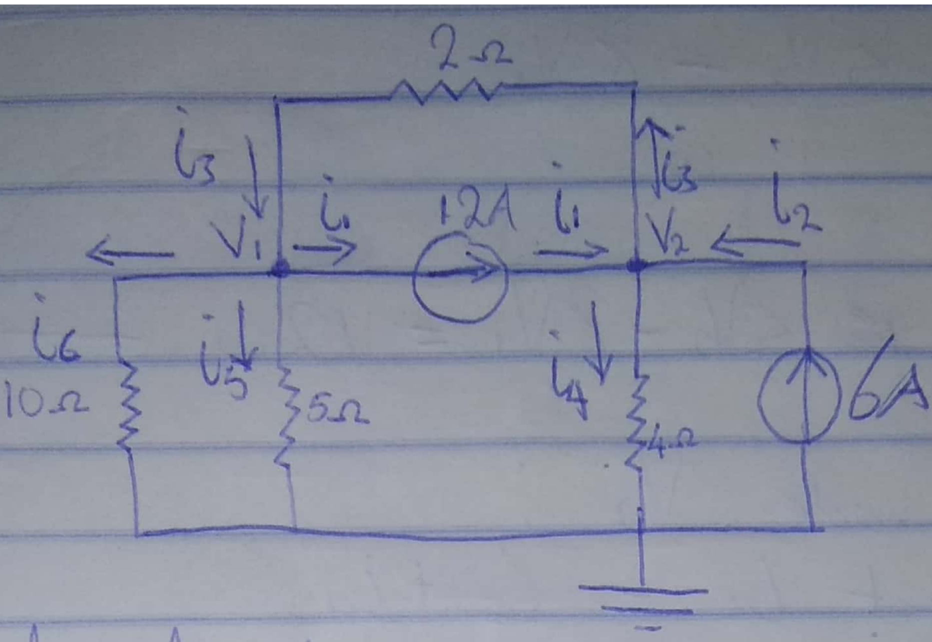
4a



$i_1 = 12A$

$i_2 = 6A$

at node V_1 ;

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

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

$$12 = \frac{V_2 - V_1}{2} - \left[\frac{V_1 - 0}{5}\right] - \left[\frac{V_1 - 0}{10}\right]$$

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

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

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

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

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

at node V_2;

$$i_1 + i_2 = i_3 + i_4$$

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

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

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

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

$$72 = 3V_2 - 2V_1$$

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

Solving Simultaneously

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

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

$V_1 = 0v$, $V_2 = 24v$ //

Current i_3 flowing through the 2Ω resistor;

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

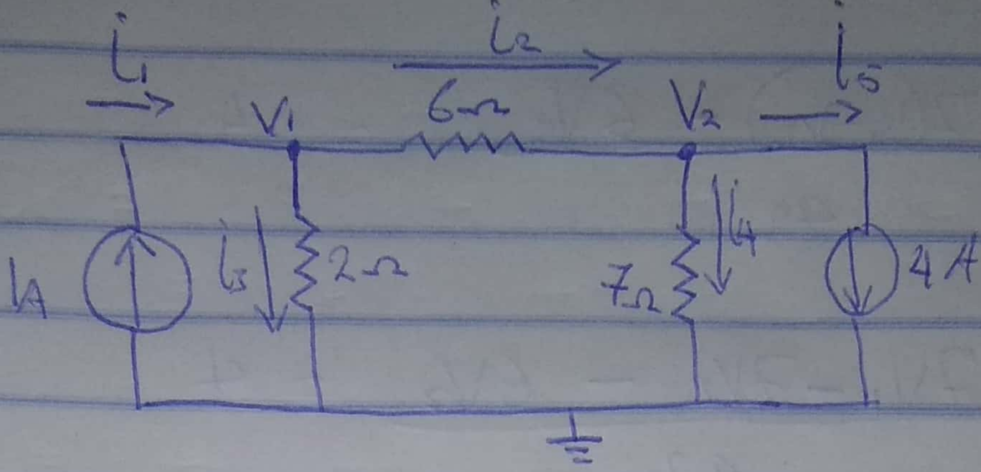
$$i_3 = 12A_{//}$$

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 ~~resistor~~ 5Ω and 10Ω resistors $= 0_{//}$ (i_5 & $i_6 = 0$)

4b



$i_1 = 1$

$i_5 = 4$

at node V_1;

$i_1 = i_2 + i_3$

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

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

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

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

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;

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

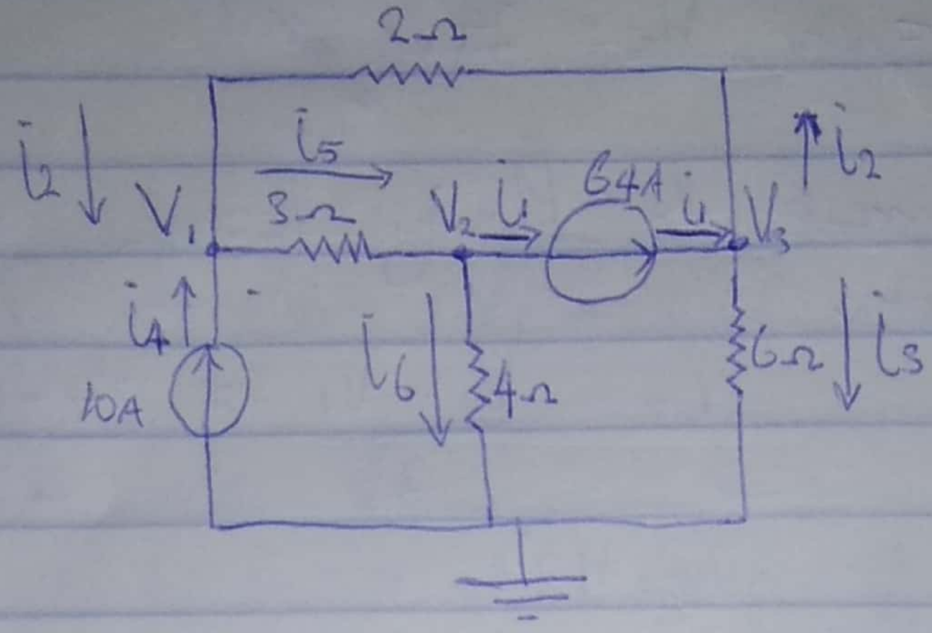
$$i_3 = -1A$$

Current flowing through the 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;

$$i_2 + i_4 = i_5$$

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

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

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

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

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

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

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

at node V_2 :

$i_5 = i_1 + i_6$

$\therefore \quad \dfrac{V_1 - V_2}{3} = 64 + \left[\dfrac{V_2 - 0}{4}\right]$

$\therefore \quad 64 = \dfrac{V_1 - V_2}{3} - \dfrac{V_2}{4}$

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

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

$768 = 4V_1 - 7V_2$

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

at node V_3 :

$i_1 = i_2 + i_5$

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

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

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

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

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

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

Solving Simultaneously

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

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

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

$\therefore V_1 = 80v, \; V_2 = -64V, \; V_3 = 156v.$