At node 3,

$$\frac{V_3 - V_2}{2} + \frac{V_3}{2} + \frac{V_3 - 20}{4} = 0$$

or, $\frac{V_3}{2} - \frac{V_2}{2} + \frac{V_3}{2} + \frac{V_3}{4} - \frac{20}{4} = 0$

or, $-\frac{V_2}{2} + \frac{5V_3}{4} = 5$ —— (iii)

or, $-2V_2 + 5V_3 = 20$ —— (iii)

Solving (i), (ii), (iii), we get.

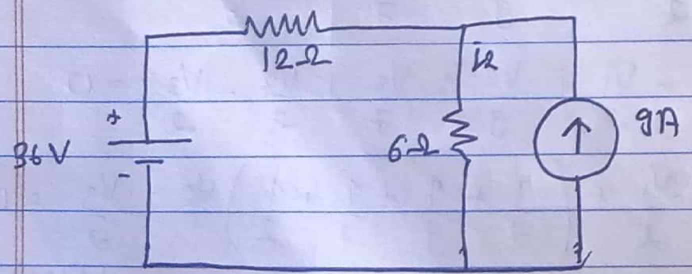
$V_1 = -6.41$ V

$V_2 = -2.825$ V

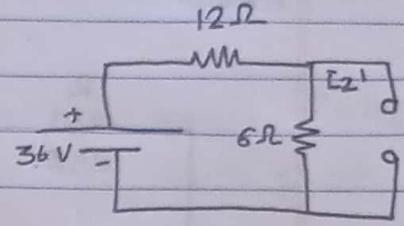
$V_3 = 2.87$ V

~~<Num. No. 48/49/50 & 12 numericals solving>~~

<Num. No. 48>: Find the current I_2 using superposition theorem.



Step: 1: Consider the source voltage $E = 36V$ and replace current source with open circuit,

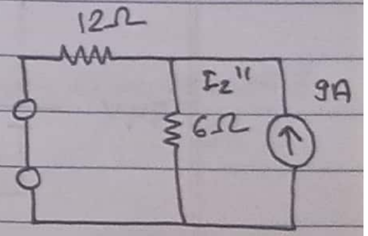


Now,

$$I_2' = \frac{E}{R_1 + R_2} = \frac{36}{18}$$

$\therefore I_2' = 2A\ (\downarrow)$

Step 2: Consider the current source $I = 9A$, replacing voltage source with short circuit,



Here,

$R_{eq} = 12 \parallel 6$

$= \frac{\cancel{12}\,4 \times \cancel{6}\,1}{\cancel{18}\,\cancel{3}\,1} = 4\Omega.$

$\therefore I_2'' = \frac{\cancel{9}\,3 \times \cancel{4}\,2}{\cancel{6}\,\cancel{3}} = 6A\ (\downarrow)$

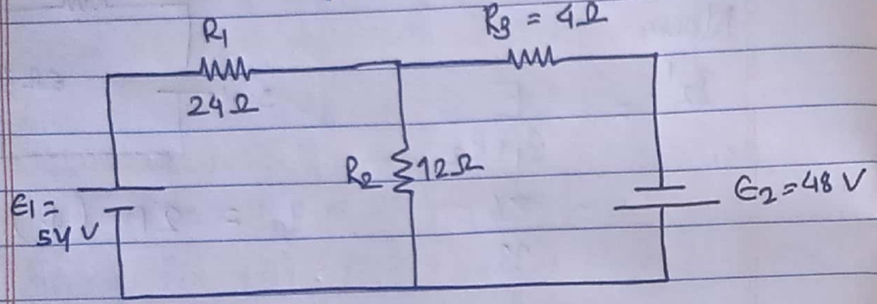
Now,

$I_2 = I_2' + I_2''$

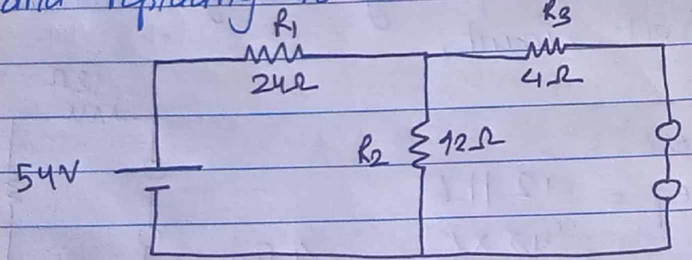
$= 2 + 6 = 8A.$

⟨Num.No.49⟩: Using superposition theorem, determine the current through 12Ω resistor.

Sol^n:



Step 1: Consider the voltage source $E = 54V$ and replacing another with short circuit,



Here,

$$R_{eq} = 24 + (12 \| 4)$$

$$= 24 + \frac{\cancel{12}^{3} \times \cancel{4}}{\cancel{16}_{4}} = 27\,\Omega$$

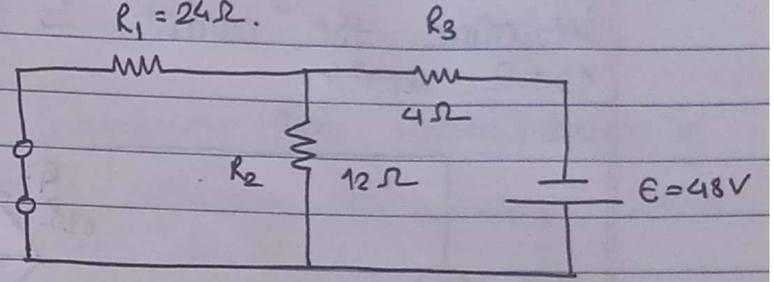
Then,

$$I = \frac{E_1}{R_{eq}} = \frac{54}{27} = 2\,A$$

Now

$$\therefore I_{12\Omega}' = \frac{I \times R_3}{R_2 + R_3} = \frac{2\times 4}{16} = 0.5\ (\downarrow)$$

Step 2: Consider the voltage source $E = 48$ and replacing ~~with~~ another with short circuit,



Here,

$$R_{eq} = 4 + (12 \| 24) = 4 + \frac{\cancel{12} \times \cancel{24}^{8}}{\cancel{36}_{3}}$$

$$\therefore R_{eq} = 12\,\Omega$$

$$I = \frac{V}{R_{eq}} = \frac{48}{12} = 4A.$$

Now,

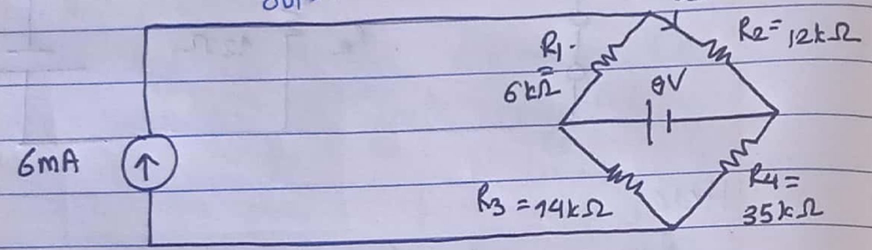
$$I_{12\Omega}'' = \frac{I \times R_1}{R_2 + R_1} = \frac{4 \times 24}{36} = 2.67A\ (\uparrow)$$

Then,

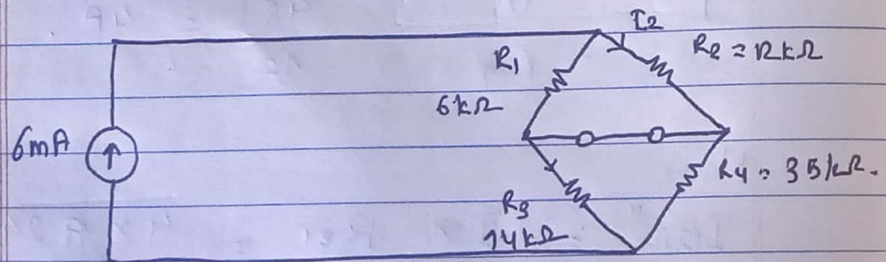
$$I_{12\Omega} = I_{12}'' - I_{12}'$$
$$= 2.67 - 0.5$$
$$\therefore I_{12\Omega} = 2.17 \text{ (A)} \ (\uparrow)$$

<Num.No- 50>:- Using superposition theorem, determine the current I_2 through $12\,k\Omega$ resistor.

Soln.



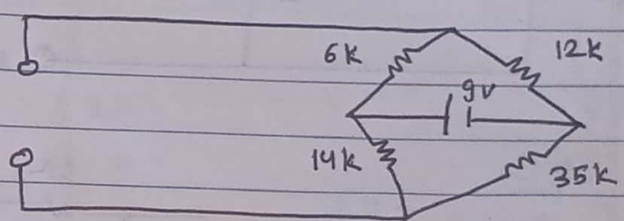
Step 1: Replacing the 9V voltage source by a short circuit considering 6mA current source.



Using current divider rule,

$$I_2' = \frac{I \times R_1}{R_1 + R_2}$$
$$= \frac{6 \times 6}{12 + 6} = \frac{\cancel{6} \times \cancel{6}}{\cancel{18}}$$
$$\therefore I_2' = 2\,mA. \ (\downarrow)$$

Step 2: Considering the voltage source of 9V and replacing the current source with open circuit.



Here,

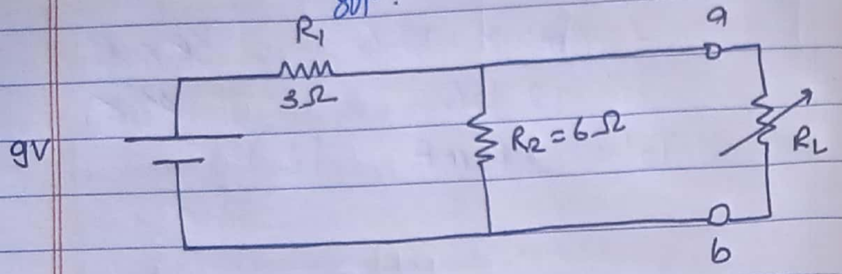
$$R_{eq} = (6+12) \,||\, (14+35)$$
$$= \frac{18 \times 49}{18 + 49} = 13.16\,k\Omega.$$

Now, $I_2'' = \frac{V}{R_{eq}} = \frac{9}{\cancel{13.16}\ 18} = 0.5\,mA \ (\downarrow)$

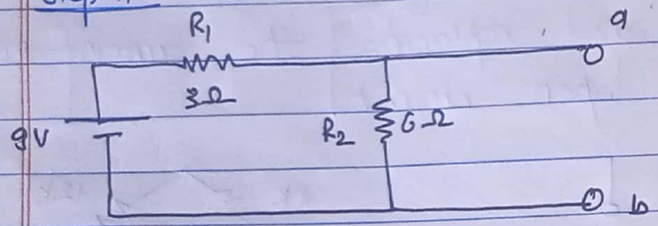
Then, $I_2 = I_2' + I_2'' = 2 + 0.5 = 2.5\,mA.$

<Num. No. 51>: Find the Thevenin's equivalent circuit for the network in figure marked by a and b point.

Sol^n:



Step 1/2:

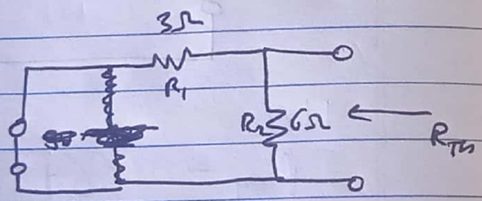


Step 3:

$R_{TH} = 3 \parallel 6$

$= \dfrac{3 \times 6}{9}$

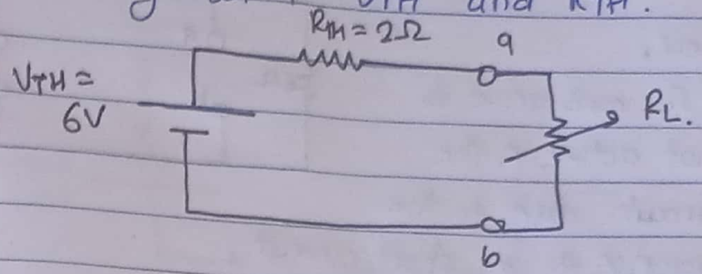
$= 2\Omega$



Step 4:

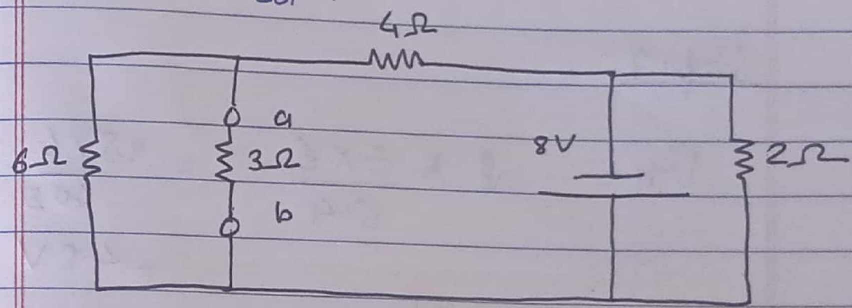
$V_{TH} = V_{6\Omega} = \dfrac{9 \times 6}{6+3} = 6\,V.$

Step: 5 The Thevenin equivalent circuit redrawing with V_{TH} and R_{TH}.

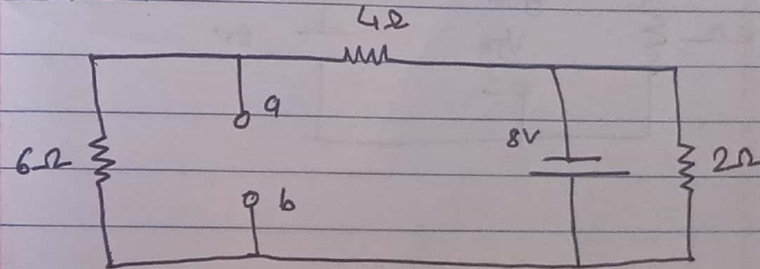


<Num. No. 52>: Find the Thevenin's equivalent circuit for the network between point a & b.

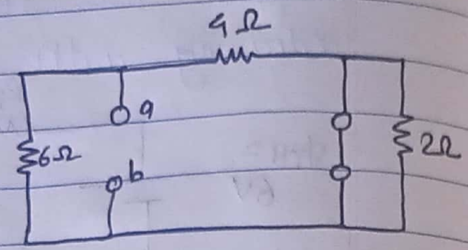
Sol^n:



Step 1/2:



Step: 3:

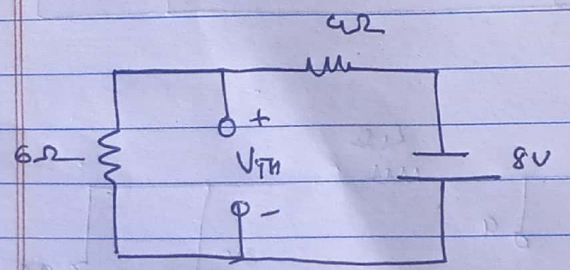


Here,
2Ω resistance is not active in the circuit due to the presence of a short circuit,

$$R_{TH} = 6 \| 4$$
$$= \frac{6\times 4}{10} = 2.4\,\Omega.$$

Step: 4

$$V_{TH} = \frac{E\times 6}{6+4} = \frac{48\times 6}{105}$$
$$= 4.8\,V$$



Step: 5: Using V_{TH} and R_{TH}, drawing the equivalent Thevenin's circuit,