(x) Note: (Note copy content)

When to use mesh analysis or node analysis

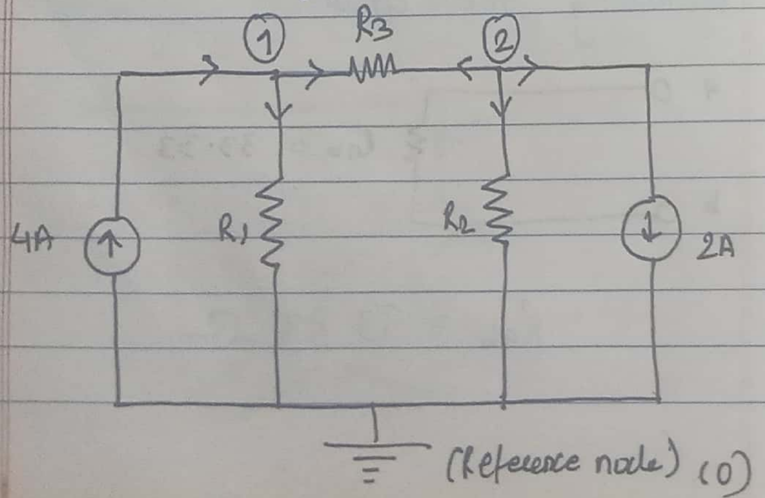
(i): If numbers of nodes = numbers of mesh, we can use any method

(ii) If numbers of nodes less than numbers of mesh, we use nodal analysis.

(iii) If numbers of ~~nodes~~ mesh less than number of nodes, we use mesh analysis.

<Num.No.43>: Determine the nodal voltage for the network.

Soln.



Given,

$R_1 = 2\Omega$ $R_2 = 6\Omega$

$R_3 = 12\Omega$

Now, at node 1, applying KCL,

$$4 = \frac{V_1}{R_1} + \frac{V_1 - V_2}{R_3}$$

or, $$4 = \frac{V_1}{2} + \frac{V_1 - V_2}{12}$$

or, $$4 = \frac{V_1}{2} + \frac{V_1}{12} - \frac{V_2}{12}$$

or, $$4 = \left(\frac{1}{2} + \frac{1}{12}\right) V_1 - \frac{1}{12} V_2$$

or, $$4 = \frac{7 V_1}{12} - \frac{V_2}{12}$$

or, $$48 = 7V_1 - V_2 \quad \text{——(i)}$$

At node 2,

$$2 + \frac{V_2}{R_2} + \frac{V_2 - V_3}{R_3} = 0$$

or, $$2 + \frac{V_2}{6} + \frac{V_2}{12} - \frac{V_{31}}{12} = 0$$

or, $$2 + \left(\frac{1}{6} + \frac{1}{12}\right) V_2 - \frac{1}{12} V_{31} = 0$$

or, $2 + \frac{1}{4}V_2 - \frac{1}{12}V_1 = 0$

or, $-2 = \frac{3V_2 - V_1}{12}$

or, $3V_2 - V_1 = -24$ —— (ii)

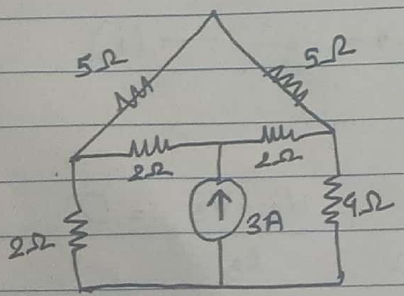
Solving (i) & (ii), we get.

$V_1 = 6\ V$

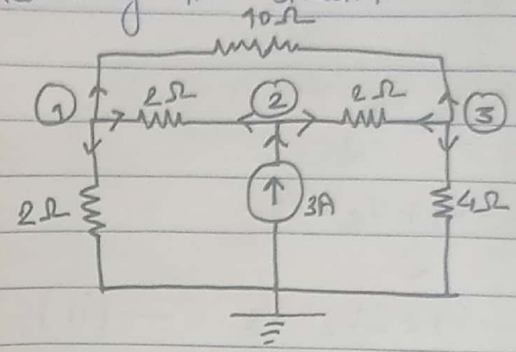
$V_2 = -6\ V$

<Num.No.44>: Using the nodal analysis, find the potential across 4Ω resistor.

Soln:



Redrawing the circuit,



At node 1,

$$\frac{V_1}{2} + \frac{V_1 - V_2}{2} + \frac{V_1 - V_3}{10} = 0$$

or, $\frac{V_1}{2} + \frac{V_1}{2} - \frac{V_2}{2} + \frac{V_1}{10} - \frac{V_3}{10} = 0$

or, $\frac{V_1}{2} + \frac{V_1}{2} + \frac{V_1}{10} - \frac{V_2}{2} - \frac{V_3}{10} = 0$

or, $\left(\frac{1}{2} + \frac{1}{2} + \frac{1}{10}\right)V_1 - \frac{1}{2}V_2 - \frac{V_3}{10} = 0$

or, $\frac{11V_1}{10} - \frac{V_2}{2} - \frac{V_3}{10} = 0$

or, $\frac{11V_1 - 5V_2 - V_3}{10} = 0$

or, $11V_1 - 5V_2 - V_3 = 0$ —— (i).

At node 2,

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

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

or $$6 = -V_1 + 2V_2 - V_3 \quad \text{— (ii)}$$

At node 3,

$$\frac{V_3}{4} + \frac{V_3 - V_2}{2} + \frac{V_3 - V_1}{10} = 0$$

or $$\frac{V_3}{4} + \frac{V_3}{2} - \frac{V_2}{2} + \frac{V_3}{10} - \frac{V_1}{10} = 0$$

or $$-\frac{V_1}{10} - \frac{V_2}{2} + \left(\frac{1}{4} + \frac{1}{2} + \frac{1}{10}\right) V_3 = 0$$

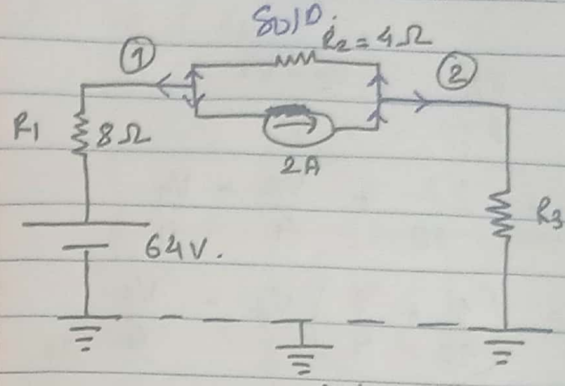
or $$-\frac{V_1}{10} - \frac{V_2}{2} + \frac{17V_3}{20} = 0$$

or $$-2V_1 - 10V_2 + 17V_3 = 0 \quad \text{— (iii)}$$

Solving (i), (ii), (iii), we get,
$V_3 = V_{4\Omega} = 4.65\ V.$

⟨Num. No- 45⟩: Find voltage across the nodes.

Soln:



(reference node: 0)

At node 1,

$$\frac{V_1 - 64}{8} + 2 + \frac{V_1 - V_2}{4} = 0$$

or, $$\frac{V_1}{8} - \frac{64}{8} + 2 + \frac{V_1}{4} - \frac{V_2}{4} = 0$$

or $$\frac{V_1}{8} - 8 + 2 + \frac{V_1}{4} - \frac{V_2}{4} = 0$$

or $$\left(\frac{1}{8} + \frac{1}{4}\right) V_1 - \frac{V_2}{4} - 6 = 0$$

or, $$\frac{3}{8} V_1 - \frac{V_2}{4} = 6$$

or, $$\frac{3V_1 - 2V_2}{8} = 6$$ or, $$3V_1 - 2V_2 = 48 \quad \text{— (i)}$$

At node 2,

$$2 = \frac{V_2}{10} + \frac{V_2 - V_1}{4}$$

or, $$2 = \frac{V_2}{10} + \frac{V_2}{4} - \frac{V_1}{4}$$

or $$2 = \left(\frac{1}{10} + \frac{1}{4}\right) V_2 - \frac{V_1}{4}$$

or, $$2 = \frac{7}{20} V_2 - \frac{V_1}{4}$$

or $$2 = \frac{7V_2 - 5V_1}{20}$$

or $$-5V_1 + 7V_2 = 40 \quad \text{—— (ii)}$$

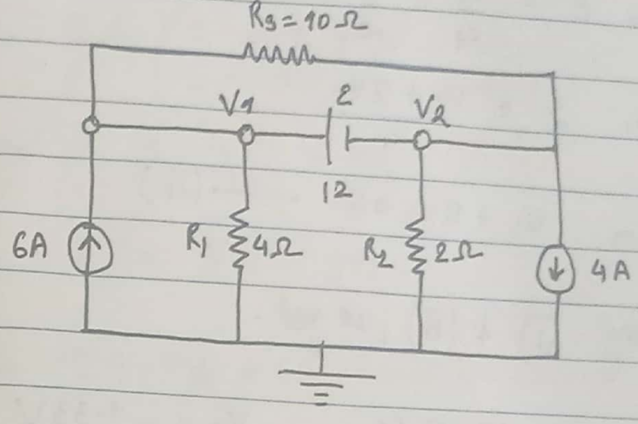
Solving (i) and (ii), we get.

$\therefore V_1 = 37.81\ V$

$\therefore V_2 = 32.72\ V.$

<Num. No. 46>: Determine the nodal voltage at V_1 & V_2.

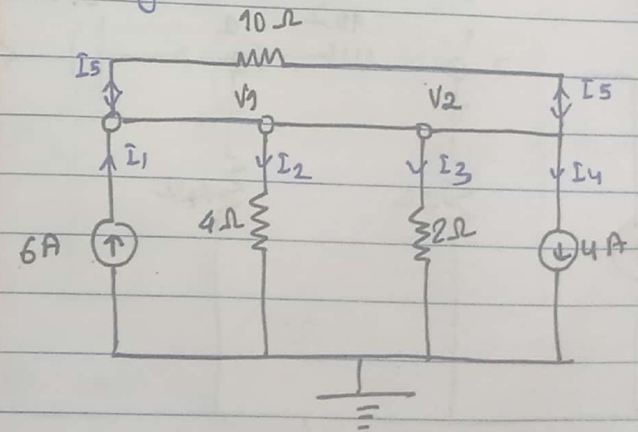
Soln:



Here,

$$V_1 - V_2 = 12 \quad - (i)$$

Redrawing the circuit,



Now,

Now,

$$I_1 = I_2 + I_3 + I_4$$

or $6 = \frac{V_1}{4} + \frac{V_2}{2} + 4$

or $2 = \frac{V_1 + 2V_2}{4}$

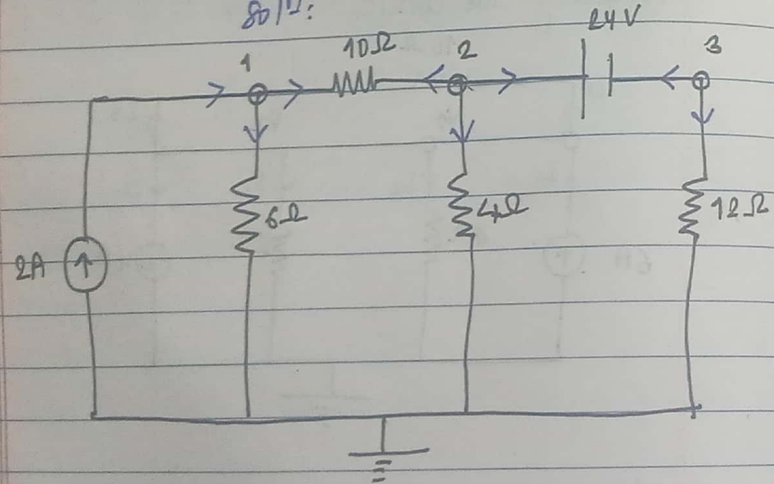
or $V_1 + 2V_2 = 8$ —— (ii)

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

$\therefore V_1 = 10.67\ V$ $\quad V_2 = -1.33\ V$

<Num. No. 47>: Find the nodal voltage.

Soln:



At node 1,

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

or, $\cancel{2 = \left(\frac{1}{6} + \frac{1}{10}\right)V_1 - \frac{V_2}{10}}$

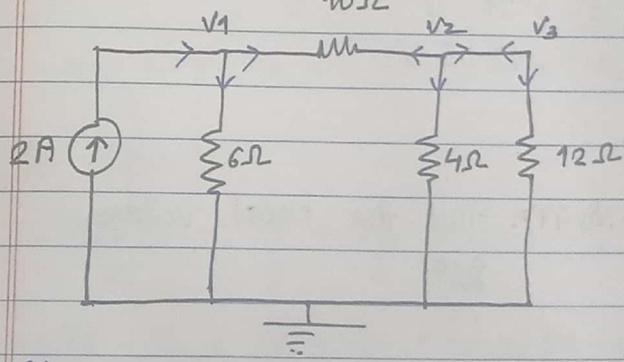
or $\cancel{2 = \frac{4V_1}{15} - \frac{V_2}{10}}$

or $\cancel{2 = \frac{8V_1 - 3V_2}{30}}$

or $\cancel{8V_1 - 3V_2 = 60}$ — (i)

$V_2 - V_3 = 24$ — (i).

Redrawing the circuit,



At node 1;

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

or, $8V_1 - 3V_2 = 60$ —— (ii)

At node 2,

$$\frac{V_2-V_1}{10}+\frac{V_2}{4}+\frac{V_3}{12}=0$$

or, $$\frac{V_2}{10}-\frac{V_1}{10}+\frac{V_2}{4}+\frac{V_3}{12}=0$$

or, $$-\frac{V_1}{10}+\left(\frac{1}{10}+\frac{1}{4}\right)V_2+\frac{V_3}{12}=0$$

or, $$\frac{-V_1}{10}+\frac{7V_2}{20}+\frac{V_3}{12}=0$$

or, $$-6V_1+21V_2+5V_3=0 \quad \text{——(iii)}$$

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

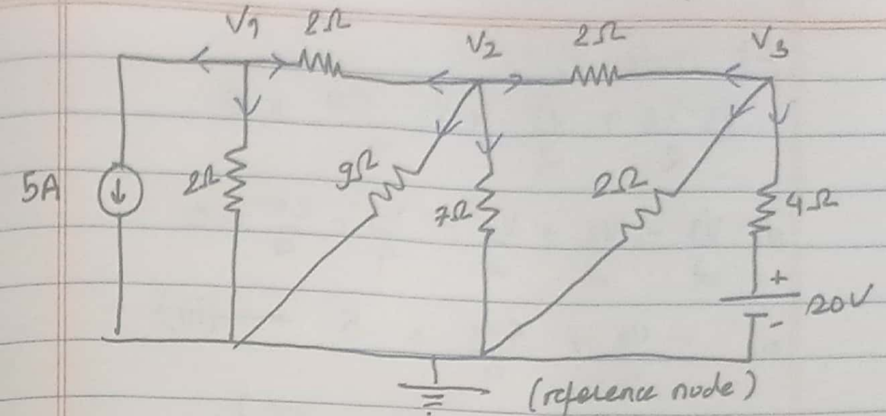
$V_1 = 10.10$ V

$V_2 = 6.94$ V

$V_3 = -17.05$ V.

<Num. No. 47>: Find the nodal voltage.

Soln:



At node 1,

$$5+\frac{V_1}{2}+\frac{V_1-V_2}{2}=0$$

or, $$5+\frac{V_1}{2}+\frac{V_1}{2}-\frac{V_2}{2}=0$$

or, $$V_1-\frac{V_2}{2}=-5$$

or, $$2V_1-V_2=-10 \quad \text{——(i)}$$

At node 2,

$$\frac{V_2-V_1}{2}+\frac{V_2}{9}+\frac{V_2}{7}+\frac{V_2-V_3}{2}=0$$

or, $$\frac{V_2}{2}-\frac{V_1}{2}+\frac{V_2}{9}+\frac{V_2}{7}+\frac{V_2}{2}-\frac{V_3}{2}=0$$

or, $$-\frac{V_1}{2}+\left(\frac{1}{2}+\frac{1}{9}+\frac{1}{7}+\frac{1}{2}\right)V_2-\frac{V_3}{2}=0$$

or, $$-\frac{V_1}{2}+\frac{79V_2}{63}-\frac{V_3}{2}=0$$ or, $$-63V_1+79V_2-63V_3=0 \quad \text{——(ii)}$$

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.