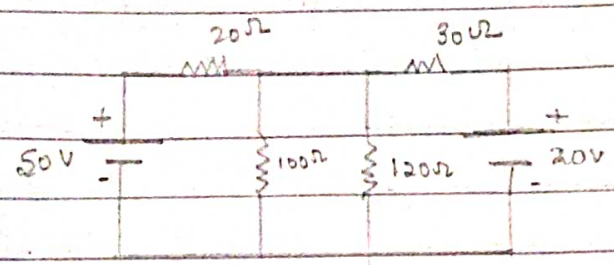
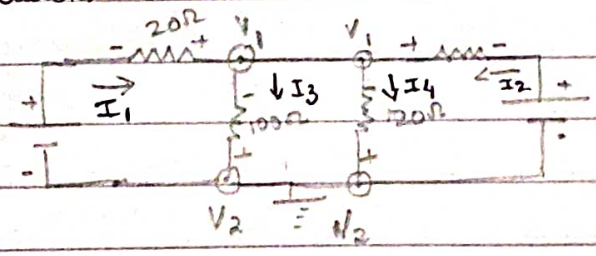
24/08/23 IEEE S. Praveen Kumar

Assignment-1 ch.en.u4aie22048 AIE

(1)



⇒ Solution:-



here, V_2 is reference node

Apply KCL at node ① → V_1

$$I_1 + I_2 = I_3 + I_4$$

$$\frac{50 - V_1}{20} + \frac{20 - V_1}{30} = \frac{V_1}{120} + \frac{V_1}{100}$$

$$\frac{50 - V_1}{2} + \frac{20 - V_1}{3} = \frac{V_1}{12} + \frac{V_1}{10}$$

$$\frac{150 - 3V_1 + 40 - 2V_1}{6} = \frac{10V_1 + 12V_1}{120}$$

$$20(190 - 5V_1) = 22V_1$$

$$3800 - 100V_1 = 22V_1$$

$$122V_1 = 3800$$

$$\boxed{V_1 = 31.147\,V}$$

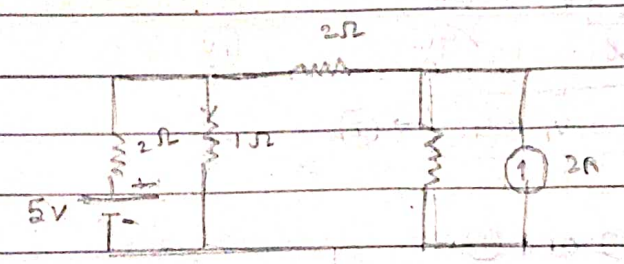
the voltage through 120Ω

$$I_4 = \frac{V_1}{120}$$

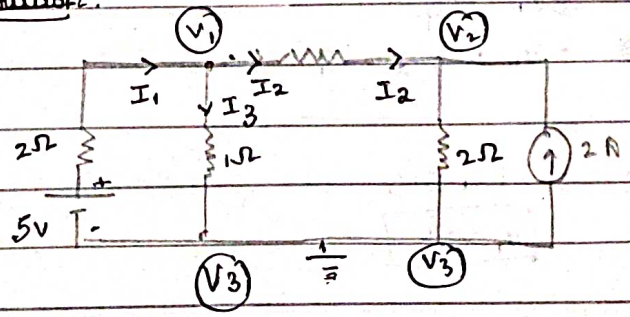
$$= \frac{31.147}{120}$$

$$\boxed{I_4 = 0.25A}$$

(2)



⇒ Solution:-



here, V_3 is reference node

$$\boxed{V_3 = 0}$$

Apply KCL at V_1:-

$$I_1 = I_2 + I_3$$

$$\frac{5 - V_1}{2} = \frac{V_1 - V_2}{2} + \frac{V_1 - 0}{1}$$

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

$$\boxed{4V_1 - V_2 = 5} \rightarrow (1)$$

Apply KCL at V_2

$$I_2 + I_4 = I_5$$

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

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

$$\boxed{2V_2 - V_1 = 4} \rightarrow (2)$$

from eq (1) and (2)

$$(1) \times 2 \Rightarrow 8V_1 - 2V_2 = 10$$
$$(2) \Rightarrow -V_1 + 2V_2 = 4$$

$$7V_1 = 14$$

$$\boxed{V_1 = 2V}$$

$$\boxed{V_2 = 3V}$$

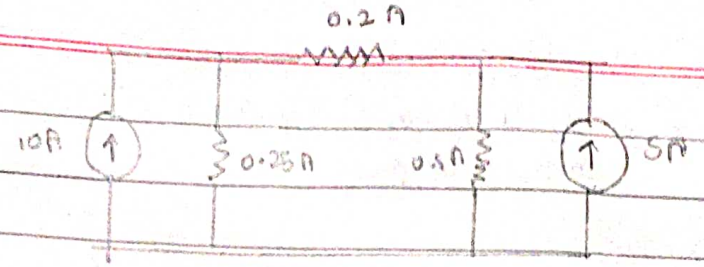
I_3 is the current through 1Ω resistor

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

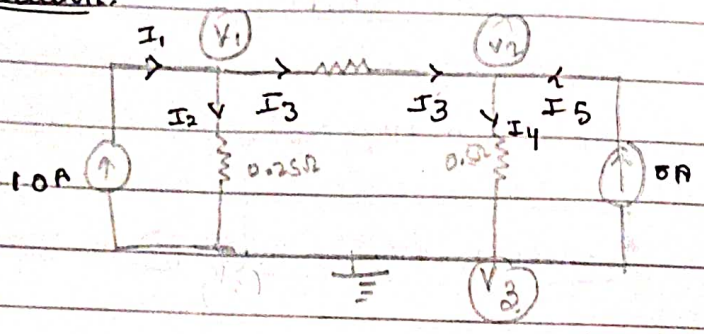
$$\boxed{I_3 = 2A}$$

∴ Value of current through 1Ω resistor is '2A'

③



Solution:-



Here, taking V_3 as reference node

$$\boxed{V_3 = 0V}$$

Apply Kcl at node V_1

$$I_1 = I_2 + I_3$$

$$I_1 = 10A, \quad I_2 = \frac{V_1}{0.25}, \quad I_2 = \frac{V_1 - V_2}{0.2}$$

$$10 = \frac{V_1 - 0}{0.25} + \frac{V_1 - V_2}{0.2}$$

$$10 = \frac{(0.2)(V_1) + (0.25)V_1 - (0.25)V_2}{0.05}$$

$$\boxed{0.5 = (0.45)V_1 - (0.25)V_2} \rightarrow (1)$$

Apply Kcl at node V_2

$$\boxed{I_5 = 5A}$$

$$I_3 + I_5 = I_4$$

$$\frac{V_1 - V_3}{0.2} + 5 = \frac{V_2 - 0}{0.5}$$

$$5 = \frac{V_2}{0.5} + \frac{V_2 - V_1}{0.2}$$

$$5 = \frac{(0.2)V_2 + (0.5)V_2 - (0.5)V_1}{0.1}$$

$$0.5 = 0.7V_2 - 0.5V_1$$

$$\boxed{-0.5V_1 + 0.7V_2 = 0.5} \rightarrow (2)$$

from eqn (1) and (2)

$$V_1 = \frac{0.7V_2 - 0.5}{0.5}$$

$$\boxed{V_1 = 2.5V}$$

$$\boxed{V_2 = 2.5V}$$

Current through:

$0.2\Omega \Rightarrow I_3 = \frac{V_1 - V_2}{0.2}$

$= 0A$

$0.25\Omega \Rightarrow I_2 = \frac{V_1}{0.25}$

$= \frac{2.5}{0.25}$

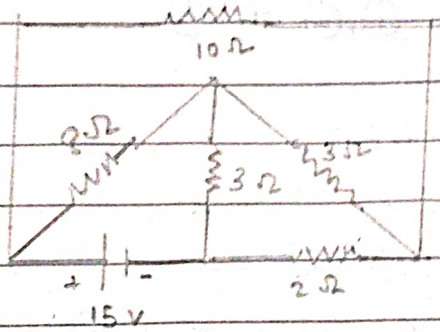
$\Rightarrow 10A$

$0.5\Omega \Rightarrow I_4 = \frac{V_1}{0.5}$

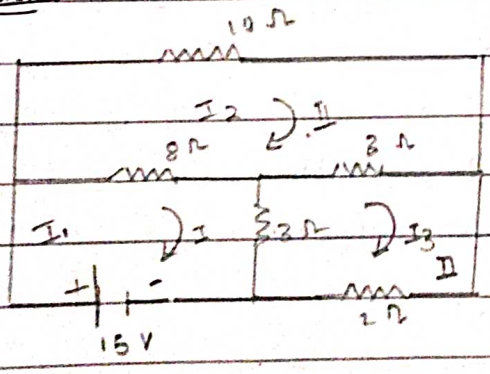
$= \frac{2.5}{0.5}$

$= 5A$

4)



Solution:-



Apply KVL at mesh ①

$-15 + (I_1 - I_2)\,8 + (I_1 - I_3)\,3 = 0$

$$\boxed{11I_1 - 8I_2 - 3I_3 = 15} \rightarrow ①$$

Apply KVL at mesh ②

$10I_2 + (I_2 - I_3)\,3 + (I_2 - I_1)\,8 = 0$

$21I_2 - 3I_3 - 8I_1 = 0$

$$\boxed{-8I_1 + 21I_2 - 3I_3 = 0} \rightarrow ②$$

Apply KVL at mesh (3)

$$(I_3)2 + (I_3 - I_1)3 + (I_3 - I_2)3 = 0$$

$$I_3 - 3I_1 - 3I_2 = 0$$

$$\boxed{3I_1 + 8I_2 - 8I_3 = 0} \rightarrow (3)$$

from eqn (1), (2) and (3)

$I_1 = 2.63A$

$I_2 = 1.21A$

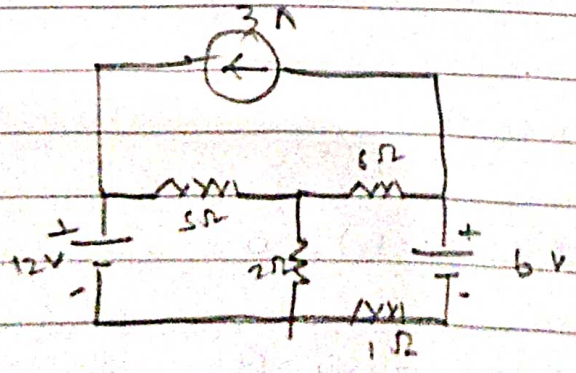
$I_3 = 1.44A$

Current through

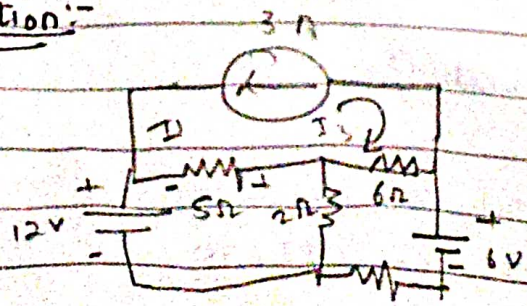
10Ω is 1.21A.

2Ω is 1.44A.

(5/2)



Solution:-



mesh (1)

$$-12 + 5(I_1 - I_2) + 2(I_1 - I_3) = 0$$

$$-12 + 5I_1 - 5I_2 + 2I_1 - 2I_3 = 0$$

$$-12 + 7I_1 - 5I_2 - 2I_3 = 0$$

$$7I_1 - 5I_2 - 2I_3 = 12 \rightarrow (1)$$

mesh (2) :-

$$I_2 = -3\ A$$

$$7I_1 - 5I_2 - 2I_3 = 12$$

$$7I_1 - 2I_3 = 12 - 15$$

$$\boxed{7I_1 - 2I_3 = -3} \rightarrow (2)$$

mesh (3)

$$6(I_3 - I_2) + 6 + I_3 + 2(I_3 - I_1) = 0$$

$$-2I_1 - 6I_2 + 9I_3 = -6$$

$$\boxed{2I_1 - 6I_2 - 9I_3 = -6} \rightarrow (3)$$

equation (3)

$$2I_1 - 6I_1 - 6I_2 - 9I_3 = -6$$

$$2I_1 - 9I_3 = -6 - 18$$

$$2I_1 - 9I_3 = -6 - 18$$

$$\boxed{2I_1 - 9I_3 = -24} \rightarrow (4)$$

Showing (2) and (4)

$I_1 = 0.355\ A$

$I_2 = -3\ A$

$I_3 = 2.745\ A$

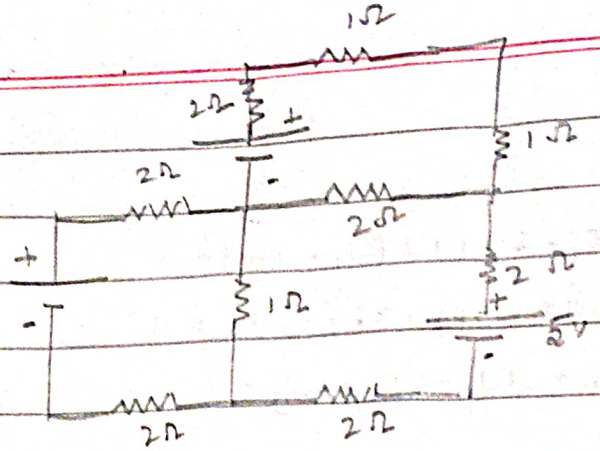
Current through

$I\ 5\Omega = 3.3\ A$

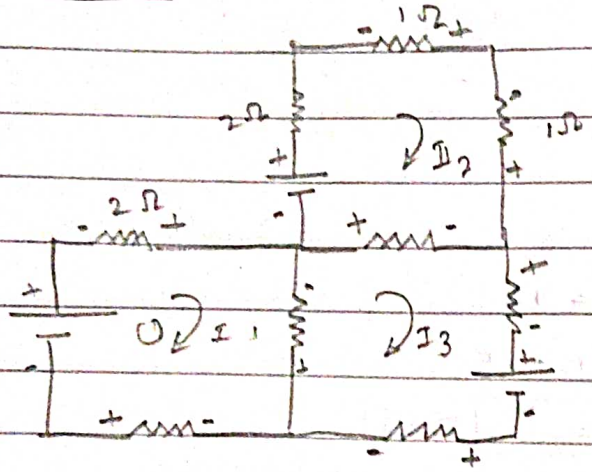
$I\ 6\Omega = 5.44\ A$

$I_{2\Omega} = 2.745\Omega$

(6)



Solution :-



Apply at KVL at mesh (1) :-

$$2(I_1) + 2(I_1) + (I_1 - I_3) = 5$$

$$\boxed{5I_1 - I_3 = 5} \rightarrow (1)$$

Apply KVL at mesh (2) :-

$$2I_3 + I_2 + I_2 + (I_2 - I_3)2 = 5$$

$$\boxed{6I_2 - 2I_3 = 5} \rightarrow (2)$$

Apply KVL at mesh (3) :-

$$2(I_3 - I_2) + 2I_3 + 5 + 2I_3 + (I_3 - I_1) = 0$$

$$\boxed{-I_3 - 2I_2 - I_1 = -5} \rightarrow (3)$$

from the eqn (1) and (2), (3)

$$\boxed{I_1 = 0.913\,A}$$

$$\boxed{I_2 = 0.706\,A}$$

$$\boxed{I_3 = -0.380\,A}$$

Current through

mesh (1) →

$I_{2\Omega} = 0.913\,A$

$I_{1\Omega} = 1.29\,A$

$I_{2\Omega} = 0.913\,A$

mesh (2)

$I_{2\Omega} = 0.706\,A$

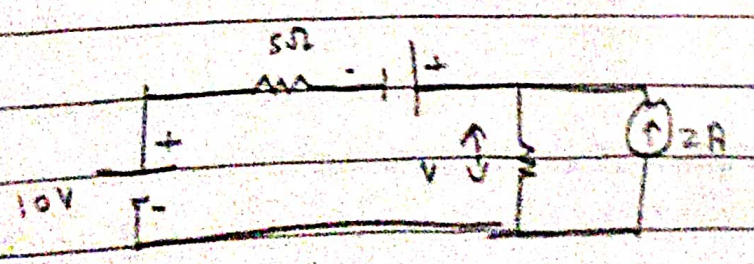
$I_{1\Omega} = 0.706\,A$

mesh (3)

$I_{2\Omega} = 0.38\,A$

$I_{2\Omega} = 0.38\,A$

(5)



Solution:-

Using Superposition theorem,

Case 1:-

$V_1 = I_1 R_1$

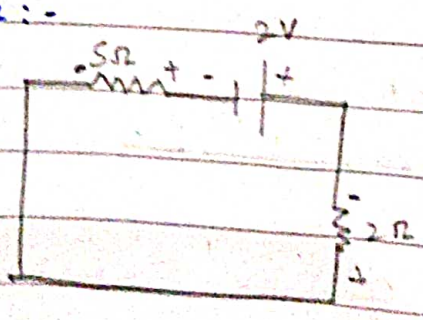
$R_1 = 2 + 5$

$= 7\ \Omega$

$I_1 = \frac{10}{7} = 1.42A$

$\boxed{I_1 = 1.42\ A}$

Case 2:-



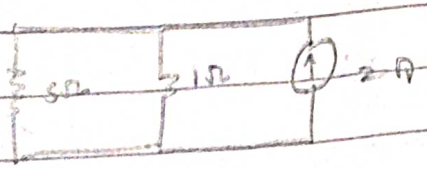
$V_2 = I_2 R_2$

$R_2 = 2 + 5 = 7\Omega$

$I_2 = \frac{2}{7}$

$\boxed{I_2 = 0.28\ A}$

Case 3:



$$\frac{1}{R} = \frac{1}{5} + \frac{1}{2}$$

$$\Rightarrow \quad R_{eq} = \frac{10}{7}$$

$$\boxed{R_{eq} = 1.42\ \Omega}$$

$$V = IR$$

$$\boxed{V = 2.84\ V}$$

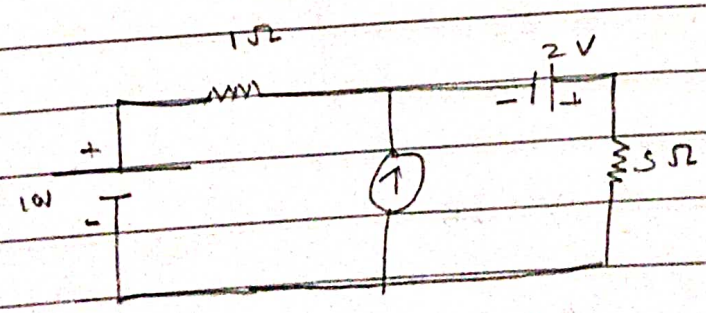
Superposition theorm:-

$$V = V_{10V} + V_{2V} - V_{2\,A}$$

$$= 0.285 + 0.56 - 2.85$$

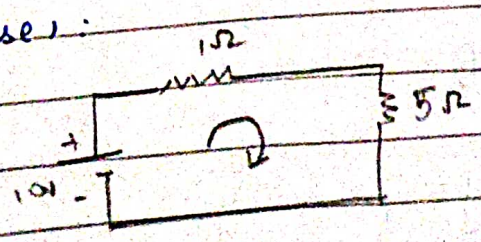
$$\boxed{V = 2.01\ V}$$

8)



Solution:-

Case 1:



$V = IR$

$R = 1 + 5 = 6\Omega$

$$\boxed{I = \frac{10}{6} = \frac{5}{3}\ A}$$

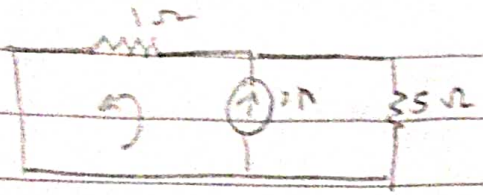
at 1Ω

$I = \frac{5}{3}$ A

V at 1Ω is

$\left[\frac{5}{3}\ V\right]$ ↓

Case 2:



$$\frac{1}{R} = \frac{1}{1} + \frac{1}{5}$$

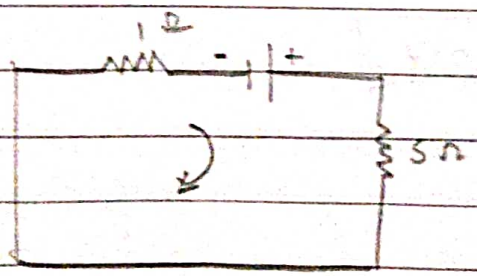
$$R_{eq} = \frac{5}{6}\,\Omega$$

$$V = IR$$
$$= (2)\left(\frac{5}{6}\right)$$

$$\boxed{V = \frac{5}{3}\,V}$$

∴ voltage 1Ω is $\left[\frac{5}{3}\,V\right]\uparrow$

Case 3:



$$V = IR$$

$$3 = I(6)$$

$$\boxed{I = \frac{1}{3}\,A}$$

at 1Ω

$$\frac{1}{3} = V(1)$$

$$\boxed{V = \frac{1}{3}\,V}$$

Voltage at 1Ω is $\left[\frac{1}{3}\,V\right]\downarrow$

the total voltage at 1Ω resistor is $\Rightarrow \left[\frac{1}{3} + \frac{5}{3} - \frac{5}{3}\right] V$

$\Rightarrow \frac{1}{3} V$

$$V_{1\Omega} \Rightarrow 0.33V$$