CSE250

MID ASSIGNMENT

SUMMER 22

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Sec : 19

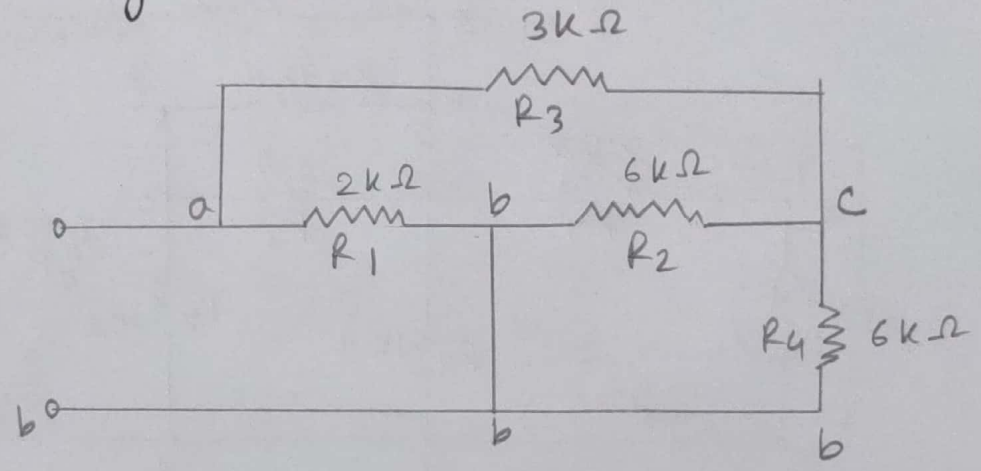
course : CSE250

Date : 18/07/2022

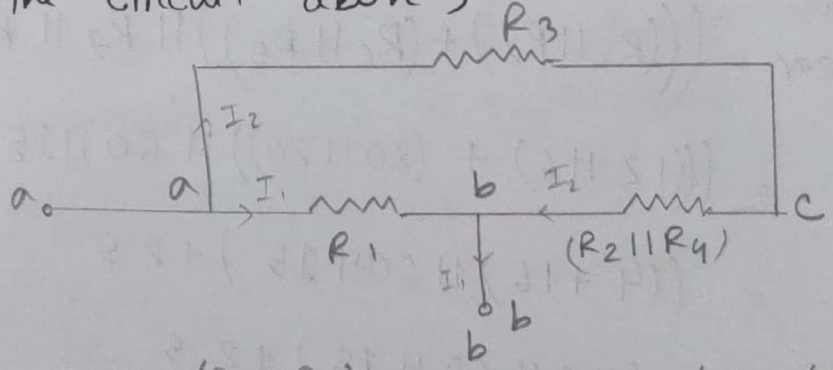
Series-Parallel Configuration

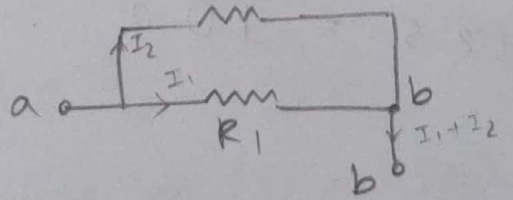
Ans to the qr no 1

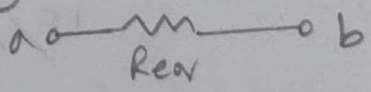
Redrawing the given circuit and labeling it we get,



From the circuit above,

① 

② 

③ 

$$\therefore Req = R1 \,||\, (R_3 + (R_2 \,||\, R_4))$$

$$= 2 \,||\, (3 + (6 \,||\, 6))$$

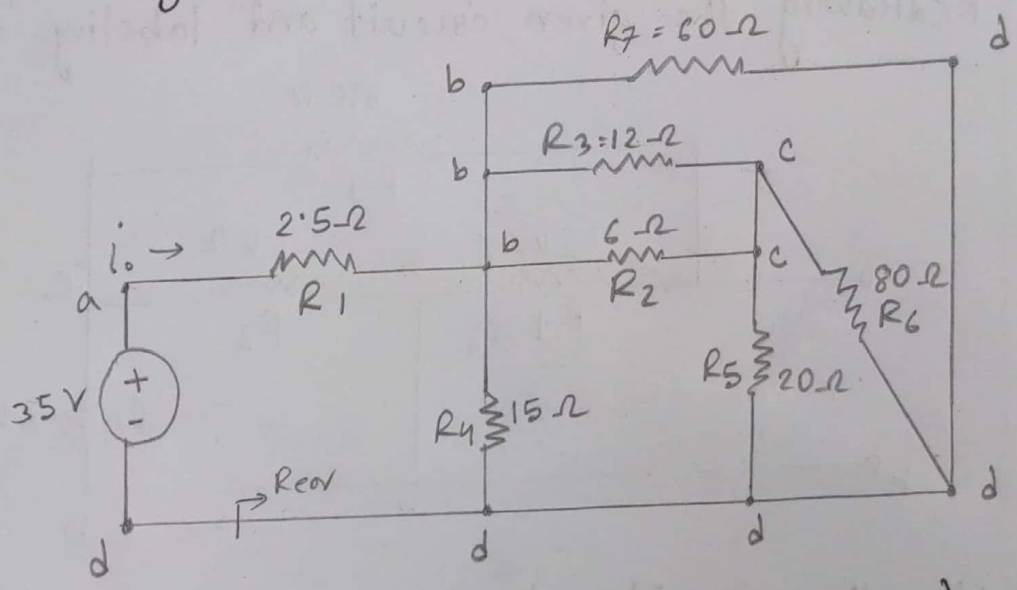
$$= 2 \,||\, (3 + 3)$$

$$= 2 \,||\, 6$$

$$= \frac{3}{2} \ k\Omega$$

Ans to the qr no 2

Redrawing and labeling the given circuit,



Here $R_{eq} = \left(\left((R_3 \| R_2) + (R_6 \| R_5)\right) \| R_7 \| R_4\right) + R_1$

$= \left(\left((12 \| 6) + (80 \| 20)\right) \| 60 \| 15\right) + 2{\cdot}5$

$= \left((4 + 16) \| 60 \| 15\right) + 2{\cdot}5$

$= (20 \| 60 \| 15) + 2{\cdot}5$

$= 15/2 + 2{\cdot}5 = 10\ \Omega$

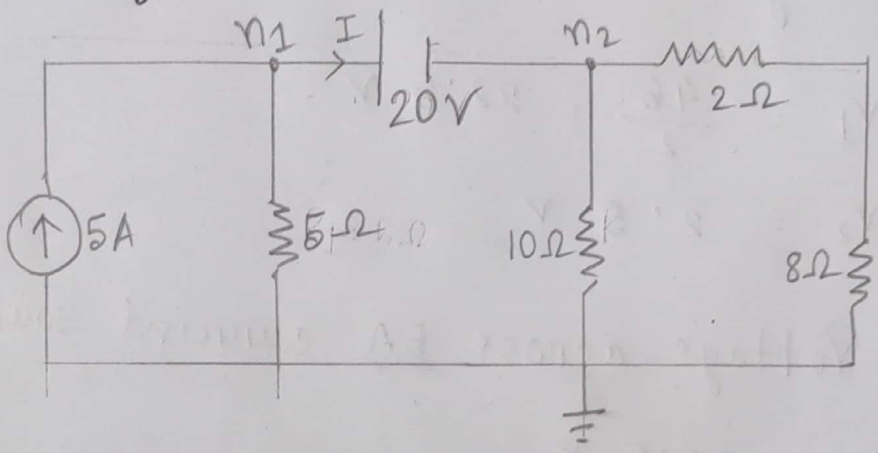
$\therefore R_{eq} = 10\ \Omega$

Now, $i_0 = \frac{V}{R_{eq}} = \frac{35}{10} = 3{\cdot}5\ A$

Nodal Analysis

Ans to the qr no 3

Redrawing the given circuit,



Let, current flow is I between node n_1 and n_2 because it is a supernode.

Now, KCL at node n_1,

$$5 = \frac{v_1}{5} + I \quad \ldots (1)$$

KCL at node n_2,

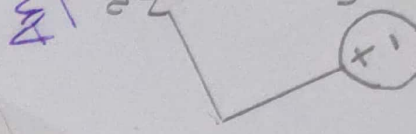
$$I = \frac{v_2}{10} + \frac{v_2}{8+2} = \frac{2v_2}{10} = \frac{v_2}{5} \quad \ldots (2)$$

Adding eqn (1) and (2),

$$5 + I = \frac{v_1}{5} + \frac{v_2}{5} + I$$

$$\Rightarrow 5 = \frac{v_1 + v_2}{5}$$

$$\Rightarrow 25 = v_1 + v_2 \quad \ldots (3)$$



KVL at supernode,

$$-V_1 + 20v + V_2 = 0$$

$$\Rightarrow V_1 - V_2 = 20 \quad \ldots (4)$$

Solving eqn (3) and (4),

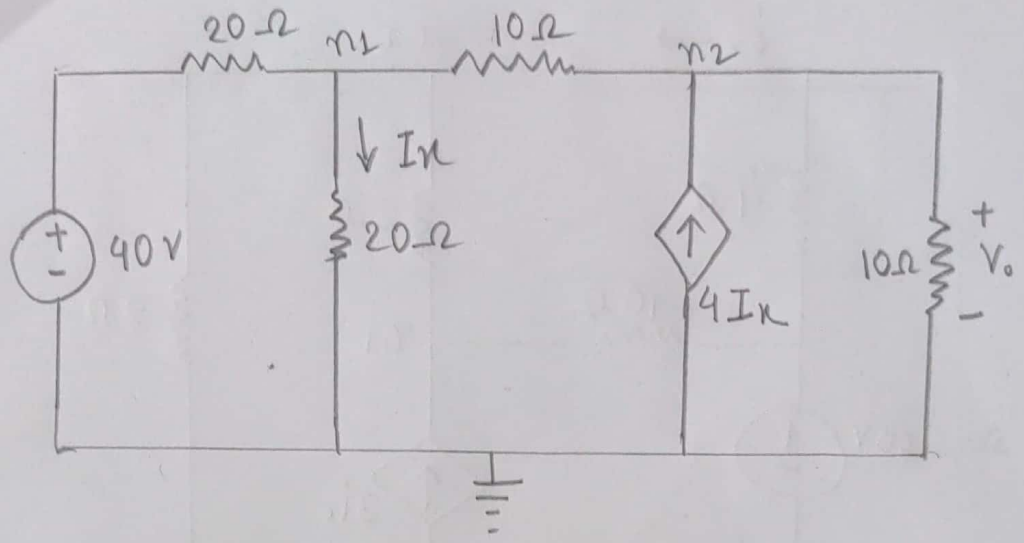
$$V_1 = \frac{45}{2} = 22.5\ V$$

$$V_2 = 2.5\ V$$

∴ Voltage across 5A current source is

$$V_1 = 22.5\ V.$$

Ans to the qr no 4



KCL at n1,

$$\frac{V_1 - 40}{20} + \frac{V_1}{20} = \frac{V_2 - V_1}{10}$$

$$\Rightarrow 2V_1 - 40 = 2V_2 - 2V_1$$

$$\Rightarrow 4V_1 - 2V_2 = 40 \quad \text{---(1)}$$

KCL at node n_2,

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

$$\Rightarrow \frac{2V_2 - V_1}{10} = 4 \times \frac{V_1}{20} \qquad \left[\because I_x = \frac{V_1}{20}\right]$$

$$\Rightarrow 2V_2 - V_1 = 2V_1$$

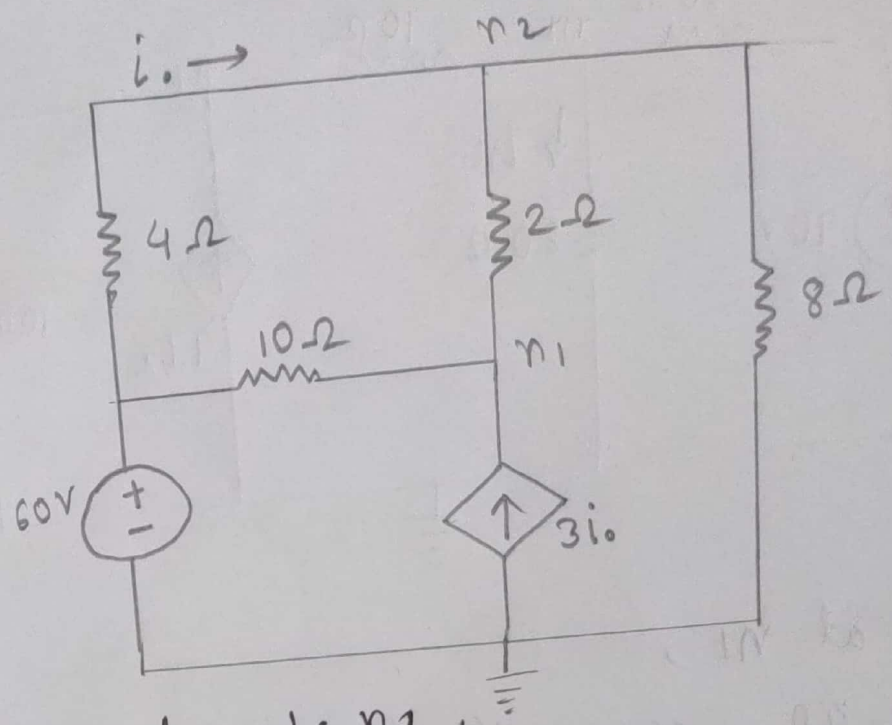
$$\Rightarrow 2V_2 - 3V_1 = 0 \quad \text{---(2)}$$

Solving eqr (1) and (2),

$V_2 = 60\,V$

$\therefore$ V_o in the circuit is $V_2 = V_o = 60\,V$

Ans to the qr no 5



KCL at node n1,

$$3i_0 = \frac{v_1 - 60}{10} + \frac{v_1 - v_2}{2}$$

$$\Rightarrow 3\left(\frac{60 - v_2}{4}\right) = \frac{v_1 - 60 + 5v_1 - 5v_2}{10} \quad \left[\because i_0 = \frac{60 - v_2}{4}\right]$$

$$\Rightarrow \frac{180 - 3v_2}{4} = \frac{6v_1 - 5v_2 - 60}{10}$$

$$\Rightarrow 24v_1 + 10v_2 = 2040 \quad \text{——— (1)}$$

KCL at node n2,

$$\frac{60 - v_2}{4} + \frac{v_1 - v_2}{2} - \frac{v_2}{8} = 0$$

$$\Rightarrow \frac{120 - 2v_2 + 4v_1 - 4v_2 - v_2}{8} = 0$$

$$\Rightarrow 4v_1 - 7v_2 = -120 = 0 \quad \text{——— (2)}$$

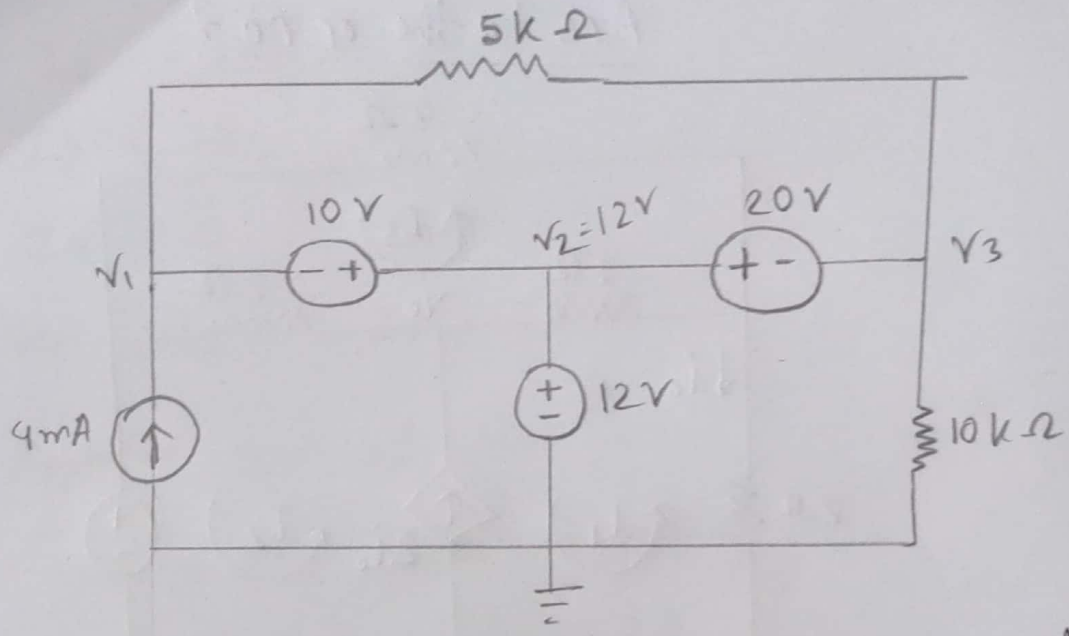
Solving eqn (1) and (2),

$$v_2 = \frac{690}{13} V = 53.07\ V$$

Current i_0 in the circuit, $i_0 = \frac{60 - v_2}{4} = \frac{60 - 53.07}{4}$

$$i_0 = 1.73\ A$$

Ans to the qr no 6



Since node V_2 is shorted with 12V voltage,

$$V_2 = 12\,V$$

Again,

$$V_1 - V_2 = -10$$

$$\Rightarrow V_1 = V_2 - 10$$

$$\Rightarrow V_1 = 12 - 10 = 2$$

$$\therefore V_1 = 2\,V$$

Now,

$$V_2 - V_3 = 20$$

$$\Rightarrow V_3 = -20 + V_2$$

$$\Rightarrow V_3 = 12 - 20$$

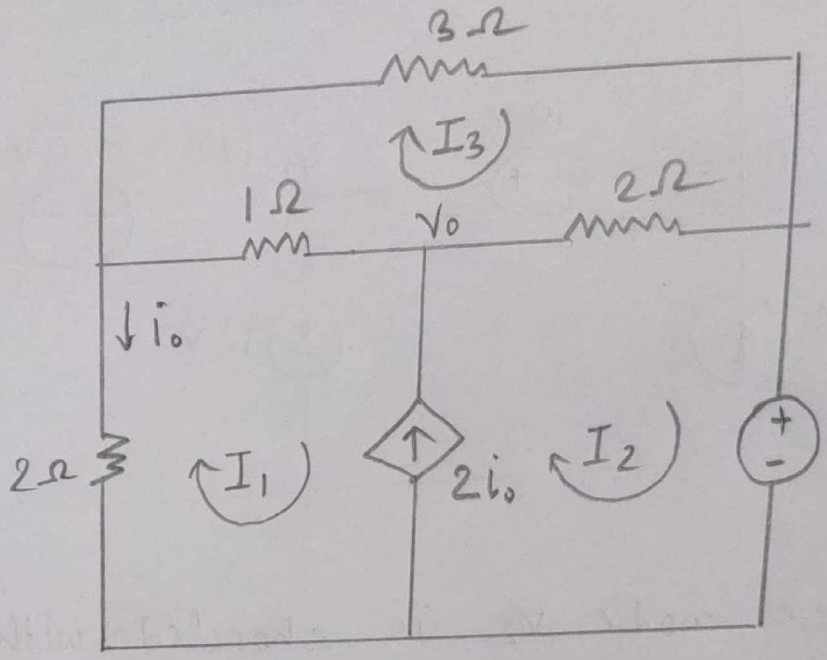
$$\Rightarrow V_3 = -8\,V$$

The node voltages of the circuit,

$$V_1 = 2V,\ V_2 = 12V,\ V_3 = -8\,V$$

Mesh Analysis

Ans to the or no 7



KVL at loop (1+2) due to supermesh,

$$2I_1 + I_1 - I_3 + 2I_2 - 2I_3 + 27 = 0$$

$$\Rightarrow 3I_1 + 2I_2 - 3I_3 = -27 \quad \text{—— (1)}$$

At the dependent source,

$$I_2 - I_1 = 2i_o$$

$$\Rightarrow I_2 - I_1 + 2I_1 = 0 \quad [\because i_o = -I_1]$$

$$\Rightarrow I_1 + I_2 = 0 \quad \text{—— (2)}$$

KVL at loop 3,

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

$$\Rightarrow -I_1 - 2I_2 + 6I_3 = 0 \quad \text{—— (3)}$$

Solving eqn 1, 2, 3 we get,

$I_1 = -18$,

$I_2 = 18$,

$I_3 = 3$.

Now, $i_o = -I_1 = 18\ A$

Applying KVL at loop 2,

$$-V_o + 2I_2 - 2I_3 + 27 = 0$$

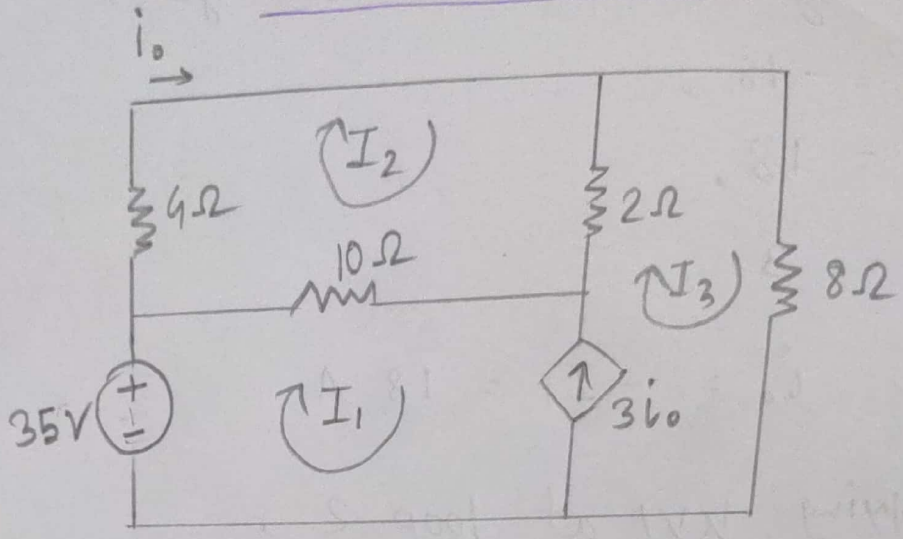
$$\Rightarrow V_o = 2(18) - 2(3) + 27$$

$$\Rightarrow V_o = 57\ V$$

$\therefore V_o = 57\ V$

$i_o = 18\ A$

Ans to the qr no 8



KVL at loop (1+3) due to supermesh,

$-35 + 10I_1 - 10I_2 + 2I_3 - 2I_2 + 8I_3 = 0$

$\Rightarrow 10I_1 - 12I_2 + 10I_3 = 35$ ——— (1)

Again, at the dependent source,

$I_3 - I_1 = 3i_o$

$\Rightarrow -I_1 - 3I_2 + I_3 = 0$ ——— (2) $[\because i_o = I_2]$

Now, KVL at loop 2,

$10I_2 - 10I_1 + 4I_2 + 2I_2 - 2I_3 = 0$

$\Rightarrow -10I_1 + 16I_2 - 2I_3 = 0$ ——— (3)

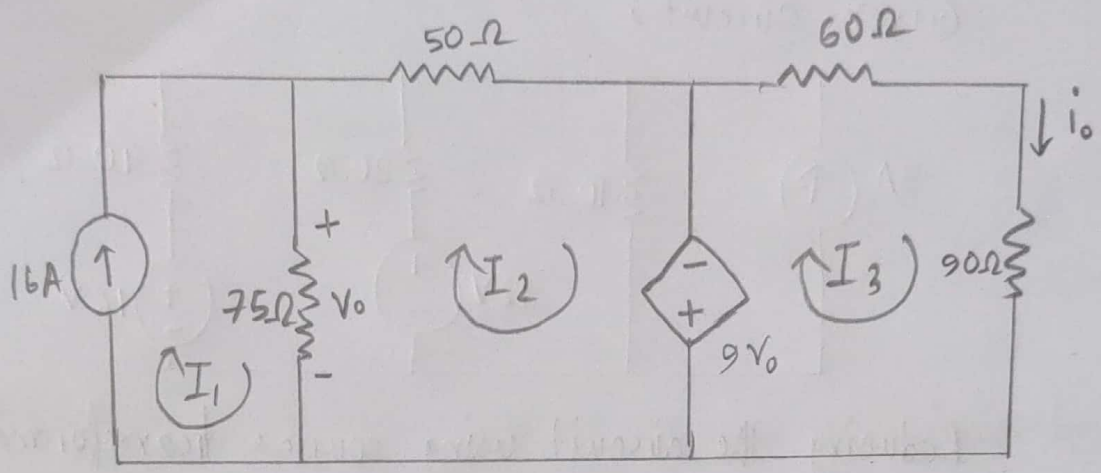
Solving eqr 1, 2, 3 we get,

$I_1 = 0.841\ A$, $I_2 = 1.009\ A$, $I_3 = 3.8701\ A$

$\therefore i_o = I_2 = 1.009\ A$

∴ Current i_o is 1.009 A.

Ans to the qr no 9



From loop 1,

$I_1 = 16\ A$

KVL at loop 2,

$75I_2 - 75I_1 + 50I_2 - 9V_o = 0$

$\Rightarrow 125I_2 - 75I_1 = 9V_o$

$\Rightarrow 125I_2 - 75I_1 = 9 \times \{75(I_1 - I_2)\}$

$\Rightarrow -750I_1 + 800I_2 = 0$

$\Rightarrow I_2 = \frac{750 \times 16}{800}$

$\Rightarrow I_2 = 15\ A$

$75 = \frac{V_o}{I_1 - I_2}$

$\Rightarrow V_o = 75(I_1 - I_2)$

Now, $V_o = 75(I_1 - I_2)$

$\Rightarrow V_o = 75(16 - 15)$

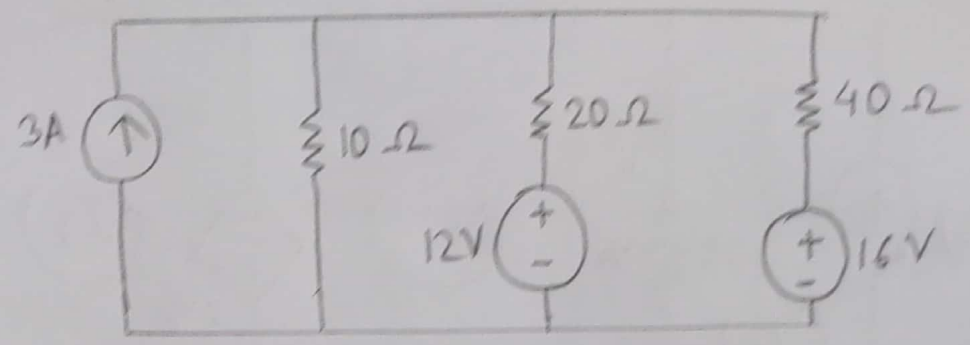
$\Rightarrow V_o = 75\ V$

$\therefore$ V_o in this circuit is $75\ V$.

Source Transformation

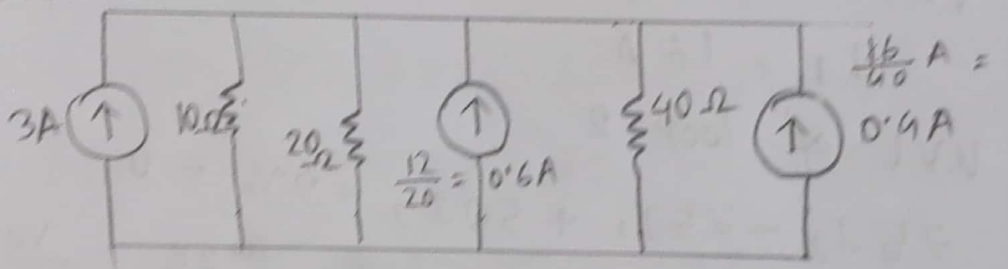
Ans to the or no 10

Given circuit,

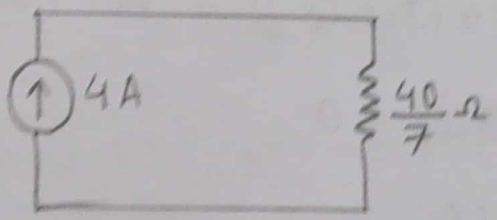


Reducing the circuit using source transformation,

step 1 :



step 2 :

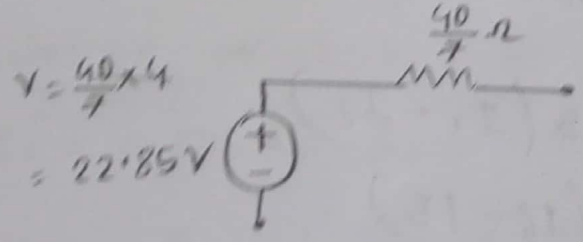


Here,

① 4A = (3 + 0.6 + 0.4) A

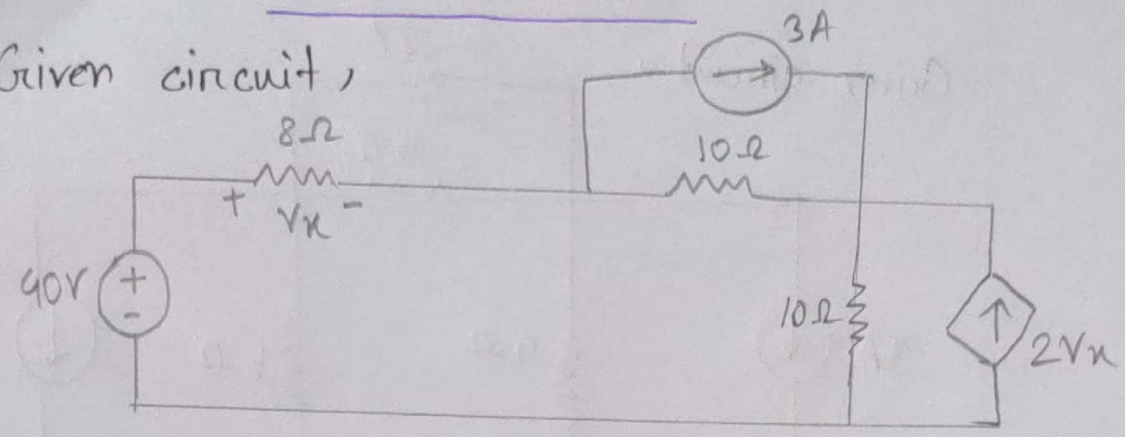
② 40/7 Ω = (10 || 20 || 40) Ω

step 3 :



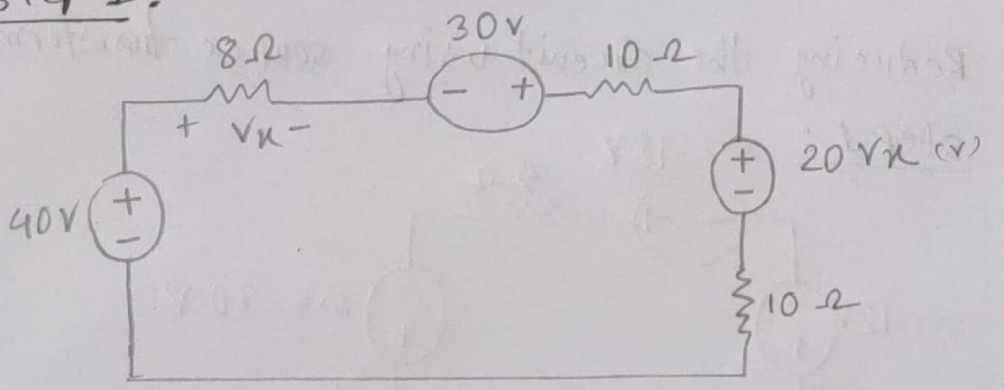
Ans to the qr no 11

Given circuit,

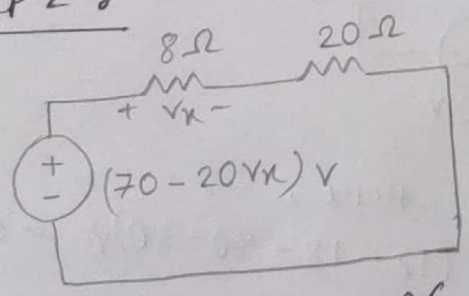


Reducing the circuit using source transformation,

step 1:



step 2:



Here,

$(40 + 30 - 20V_x)V = (70 - 20V_x)V$

Now, current, $I = \frac{V}{R_{eq}} = \frac{70 - 20V_x}{28}$

Again, $V_x = IR_8$

$\Rightarrow V_x = \frac{70 - 20V_x}{28} \times 8$

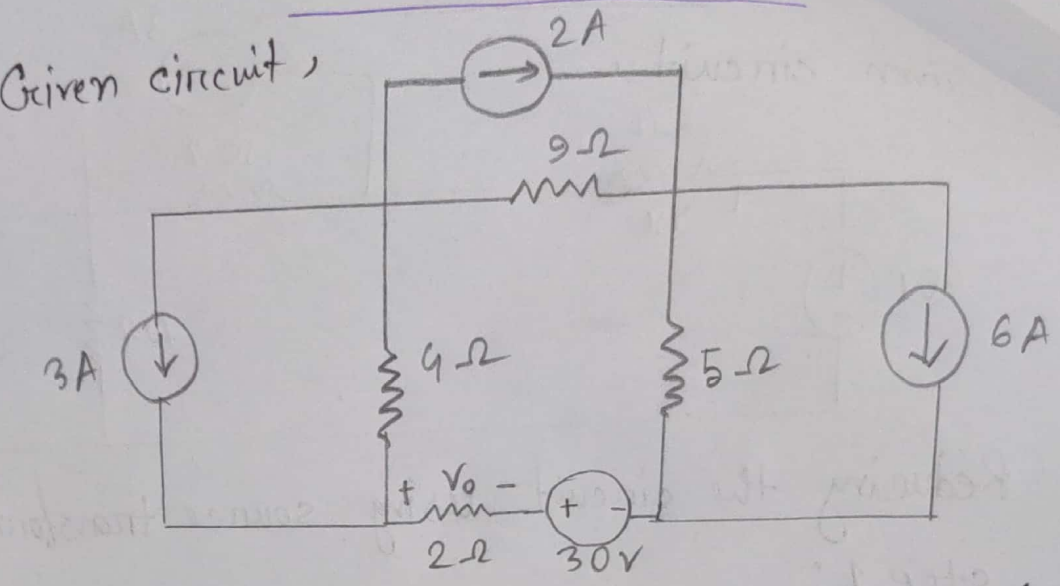
$\Rightarrow 23.5V_x = 70$

$\Rightarrow V_x = 2.98\ V$

$\therefore$ Voltage V_x in the circuit is $2.98\ V$

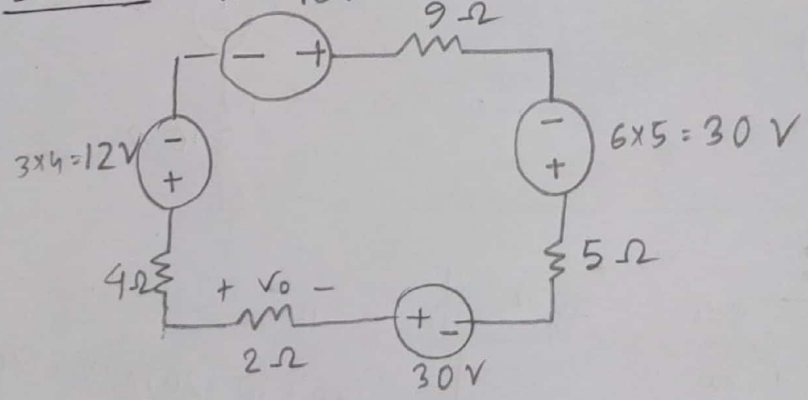
Ans to the qr no 12

Given circuit,

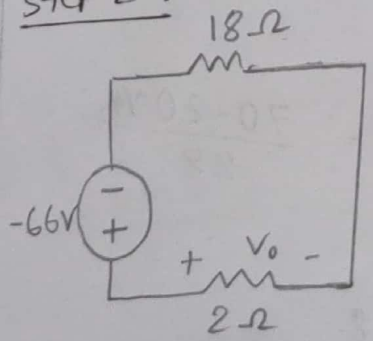


Reducing the circuit using source transformation,

step 1: $9 \times 2 = 18\,V$



step 2:



Here,

$(12 - 18 - 30 - 30)V = -66\,V$

Now,

Current, $I = \frac{V}{R_{eqv}} = \frac{-66}{20}$.

$$v_o = IR_2 = \frac{-66}{20} \times 2$$

$$= -6.6\,V$$

$\therefore v_o$ in the circuit is $-6.6\,V$