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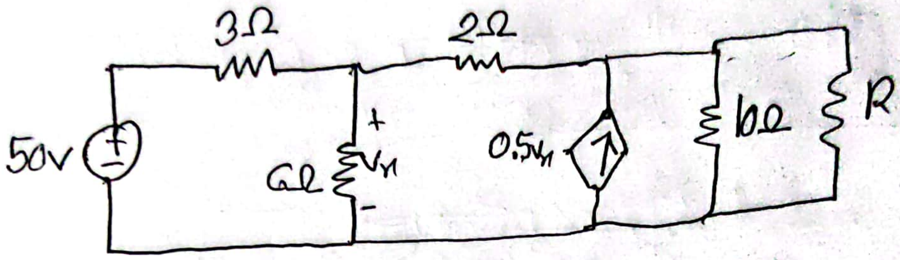
ID: 2020-2-60-037

Answer to the question no: 4



Apply Nodal analysis at the node A.

$$i + 0.5V_x = \left(\frac{1}{10}\right) + \left(\frac{1 - V_x}{2}\right)$$

$$i + 0.5x = 0.1 + 0.5 - 0.5V_x$$

$$i + 0.5V_x + 0.5V_x = 0.6$$

$$i + V_x = 0.6 \quad \cdots (1)$$

Apply Nodal analysis at the node B.

$$\frac{V_x - V_A}{2} + \frac{V_x}{6} + \frac{V_x}{3} = 0$$

(1)

$$\frac{V_x - 1}{2} + \frac{V_x}{6} + \frac{V_x}{3} = 0$$

$$\frac{3(V_x - 1) + V_x + 2V_x}{6} = 0$$

$$\frac{6V_x - 3}{6} = 0$$

$$V_x = \frac{1}{2} V$$

$$V_x = 0.5V$$

Substitute 0.5v for V_x in eq (1)

$$i + 0.5 = 0.6$$

$$i = 0.1A$$

Thevenin's resistance is the ratio of the test ~~sou~~ source voltage and the current it is generating. The expression for the Thevenin's resistance is,

$$R_{th} = \frac{V_A}{i} = \frac{1}{0.1} = 10\Omega$$

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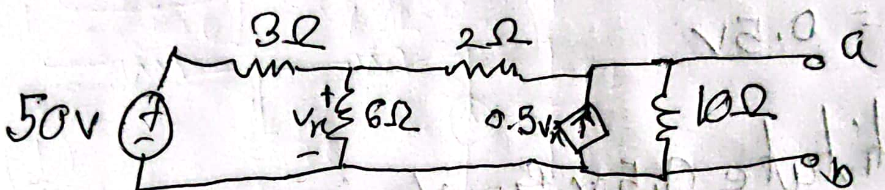
Thus, the Thevenin's resistance is ~~10~~ 10Ω

The Thevenin's voltage across the a-b terminal due to the 50V voltage source. Label the nodes and redraw the circuit diagram.



Apply nodal analysis at the node with node voltage V_x.

$$\frac{V_x - 50}{3} + \frac{V_x}{6} + \frac{V_x - V_a}{2} = 0$$

$$\frac{2(V_x - 50) + V_x + 3(V_x - V_a)}{6} = 0$$

$$2V_x - 100 + V_x + 3V_x - 3V_a = 0$$

$$6V_x - 3V_a = 100 \quad \text{--- (2)}$$

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Apply nodal analysis at the node a.

$$\frac{V_a - V_x}{2} + \frac{V_a}{10} = 0.5V_x$$

$$\frac{6V_a}{10} = V_x$$

$$\frac{3}{5}V_a = V_x \quad \text{---} \ (3)$$

Substitute equation (3) in eq (2)

$$6\left(\frac{3V_1}{5}\right) - 3V_1 = 100$$

$$\left(\frac{18V_1 - (5(3V_1))}{5}\right) = 100$$

$$\frac{18V_0 - 15V_1}{5} = 100$$

$3V_1 = 500$

$V_a = 166.67\,V$

But the node voltage V_a is the voltage across the terminals a-b it is the thevenin's voltage

$V_a = V_{ab} = V_{th}$

Thus the thevenin's voltage is 166.67V

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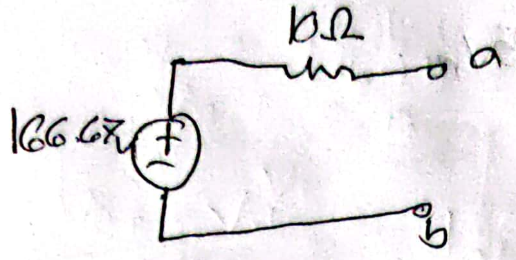
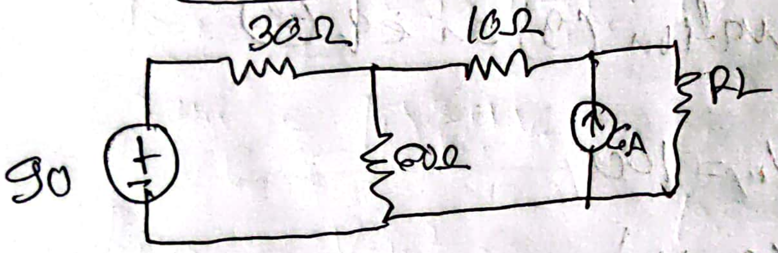
Draw The resultant Thevenin circuit



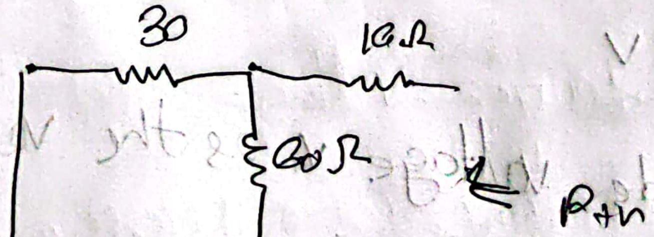
Answer to the question 05



First find the Rth - Thevenin Resistn

c.s - open circuit

Voltage source - Short circet



$$R_{th} = 10 + \frac{30 \times 60}{3 + 60}$$

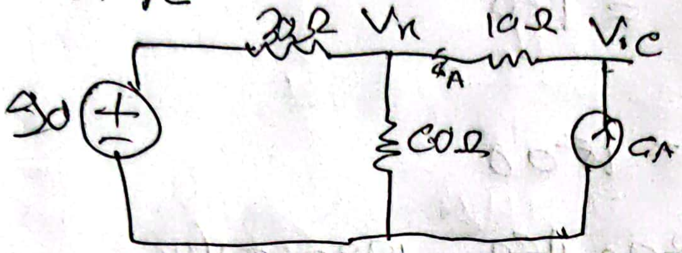
$$R_{th} = 10 + 20$$

$$R_{th} = R_L - 30\ \Omega$$

$R_L = 30\,\Omega$

Now find the V_{th} Thevenin voltage → open circuit

Voltage



Apply nodal at point A we get to

$$\frac{V_x - 90}{30} + \frac{V_x - 0}{60} - 6 = 0$$

$$2V_x - 180 + V_x = 6 \times 60$$

$$3V_x = 360 + 180 = 540$$

$$\frac{V_{oc} - V_x}{10} \quad 6$$

$$V_{oc} - 60 = 60$$

$$V_{oc} = 120V$$

(6)

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$3V_n = 590$

$V_n = \frac{590}{3} = 180\ V$

$\frac{V_{oc} - V_n}{10} = 180$

$V_{oc} - 180 = 1800$

$V_{oc} = 1800 + 180 = 1980 = V_{th}$

$V_{th} = 1980\ V$

$P_{max} = \frac{V_{th}^2}{4 R_{th}} = \frac{(1980)^2}{4 \times 30} = 32670$

$P_{max} = 32.67\ kW$

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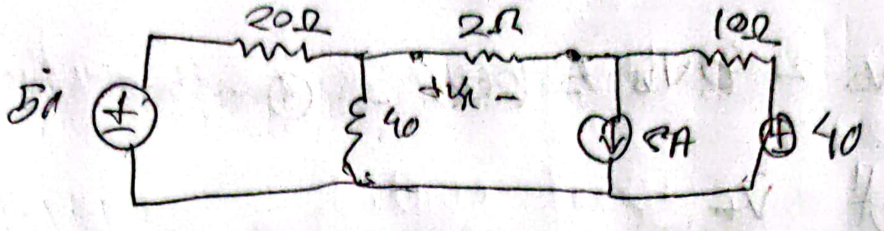
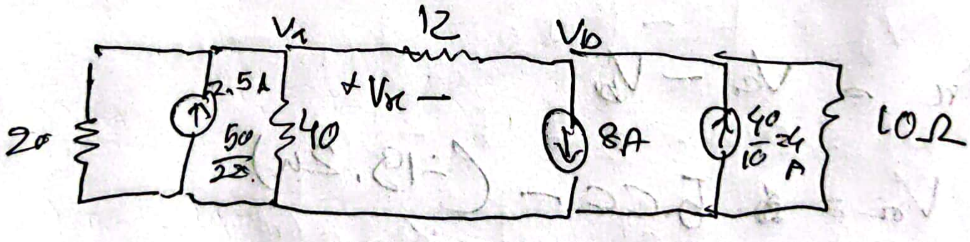
Ans to the question no: 3



$V_x = V_a - V_b$

40V Voltage source ~ 10Ω resistor is in series we can transform to current source

40V voltage source ~ 10Ω. can be transformed



KCL At Va

$$\frac{V_a}{20} + \frac{V_a}{40} + \frac{V_a - V_b}{12} = 2.5$$

$$V_a\left(\frac{1}{20} + \frac{1}{40} + \frac{1}{12}\right) - \frac{V_b}{12} = 2.5$$

$$V_a\left(\frac{36 + 40}{40 \times 12}\right) - \frac{V_b}{12} = 2.5$$

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$$V_a\left(\frac{70}{40\times12}\right)-\frac{40V_b}{40\times12}=2.5$$

$$76V_a-40V_b=1200 \quad \text{--- (1)}$$

KCL at V_b

$$\frac{V_b-V_a}{12}\cancel{+8}+\frac{V_b}{10}\cancel{+}=-4$$

$$V_b\left(\frac{10+12}{120}\right)-\frac{V_a}{12}=-4$$

$$22V_b-10V_a=-\cancel{10}\ 480 \quad \text{--- (2)}$$

Solve (1) & (2)

$V_a = 5.66\,V$, $V_b = -19.24V$

$V_x = V_a - V_b$

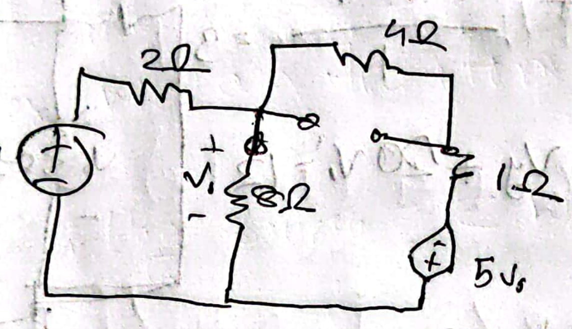
$V_x = 5.66-(-19.24)$

$V_x = 24.9V$

Answer to question no: 2

Case-1: When only 12v source is active and 3A current source is deactivated and replaced by internal impedance

3A → open circuited



Apply KCL at node (1)

$$\frac{V_o'-12}{2} + \frac{V_o'+5V_o'}{4+1} + \frac{V_o'-0}{8} = 0$$

$$V_o'\left(\frac{1}{2}+\frac{6}{5}+\frac{1}{8}\right) = \frac{12}{2}$$

$$V_o'\left(\frac{73}{40}\right) = \frac{12}{2}$$

$$V_o' = \frac{12}{2} \times \frac{40}{73}$$

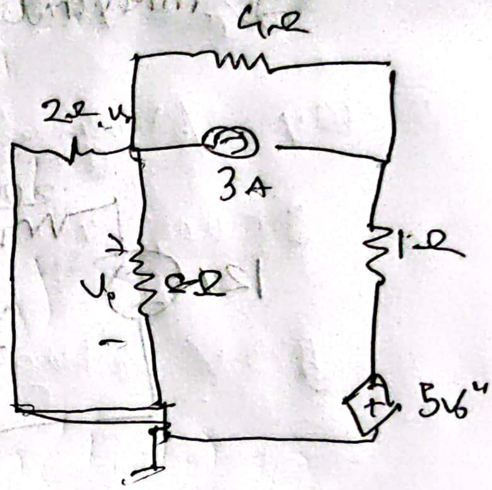
$$V_o' = 3.28767V \text{ --- (A)}$$

(a)

Case 2: when only 3A current source is active and 12V source is deactivated.

i.e 12V → short circuited

Apply KCL node ⓐ



$$\frac{V_y - V_1''}{4} + \frac{V_y + 5V_1''}{1} = 3$$

$$V_y - V_1'' + 4V_y + 20V_1' = 12$$

$$5V_y + 19V_o'' = 12$$

$$5V_y = 12 - 19V_o''$$

$$V_y = 2.4 - 3.8V_o'' \quad (10)$$

Apply KCL at node ⓑ

$$\frac{V_o'' - V_y}{4} + \frac{V_o'' - 0}{2} + \frac{V_o'' - 0}{8} = -3$$

$$V_o''\left(\frac{1}{4} + \frac{1}{2} + \frac{1}{8}\right) - \frac{V_y}{4} = -3$$

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put equation ① in above equation

$$V_a''\left(\frac{7}{8}\right) - \frac{1}{4}\left(2.4 - 3.8V_a''\right) = -3$$

$$V_a'\left(\frac{7}{8} + \frac{3.8}{4}\right) = -3 + \frac{2.4}{4}$$

$$1.825\ V_a'' = -2.4$$

$$V_a'' = \frac{-2.4}{1.825} = -1.28$$

$$V_a'' = -1.28V$$

By superposition theorem

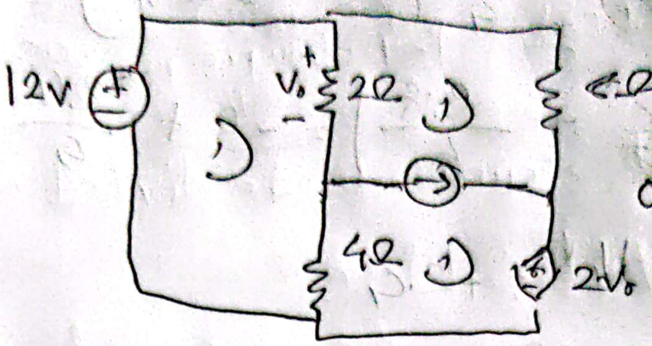
$$V_a = V_a' + V_a''$$

$$V_a = 3.2876 - 1.28$$

$$\Rightarrow V_a = 2.0076V \quad \text{or} \quad V_a = 2V$$

12

Ans to the question no: 01



$0.i_1 - i_2 + i_3 = 3$ — (i)

Applying KVL at mesh 1,

$-12 + V_0 + 4(i_1 - i_3) = 0$

$\Rightarrow -12 + 2(i_1 - i_2) + 4(i_1 - i_3) = 0$

$\Rightarrow -12 + 2i_1 - 2i_2 + 4i_1 - 4i_3 = 0$

$\Rightarrow 6i_1 - 2i_2 - 4i_3 = 12$ — (ii)

KVL at Supermesh

$2(i_2 - i_1) + 8i_2 + 2V_0 + 4(i_3 - i_1) = 0$

$\Rightarrow 2(i_2 - i_1) + 2.2(i_1 - i_2) + 8i_2 +$

$4(i_3 - i_1) = 0$

$$\Rightarrow -2i_1 + 6i_2 + 4i_3 = 0 \quad \text{--- (4)}$$

Applying Cramers rule,

$$i_1 = \frac{\begin{vmatrix} 3 & -1 & 1 \\ 12 & -2 & -4 \\ 0 & 6 & 4 \end{vmatrix}}{\begin{vmatrix} 0 & -1 & 1 \\ 6 & -2 & -4 \\ -2 & 6 & 4 \end{vmatrix}} = \frac{168}{48} = 3.5A$$

$$i_2 = \frac{\begin{vmatrix} 0 & 3 & 1 \\ 6 & 12 & -4 \\ -2 & 0 & 4 \end{vmatrix}}{\begin{vmatrix} 0 & -1 & 1 \\ 6 & -2 & -4 \\ -2 & 6 & 4 \end{vmatrix}} = \frac{-24}{48} = -0.5A$$

$$i_3 = \frac{\begin{vmatrix} 0 & -1 & 3 \\ 6 & -2 & 12 \\ -2 & 6 & 0 \end{vmatrix}}{\begin{vmatrix} 0 & -1 & 1 \\ 6 & -2 & -4 \\ -2 & 6 & 4 \end{vmatrix}} = \frac{120}{48} = 2.5A$$