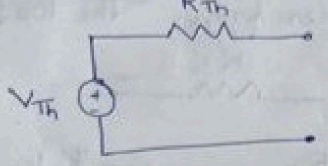
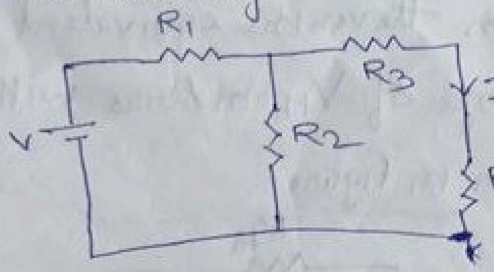
Lec 08 · 22/2/20..

Thevenin's Theorem. In any linear ~~bitte~~ bilateral n/w. consisting of any number of independent sources or dependent source can be replaced by simple equivalent network of Voltage source in series with an internal resistance

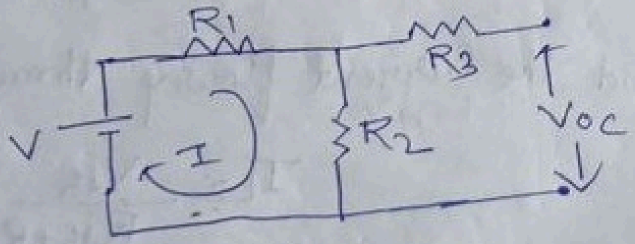


~~Step 1. To find V_{th} or V_{oc}~~

Steps to solve the n/w using Thevenin's theorem



Step 1. To Find V_{th} or V_{oc} :→ Remove R_L (Load resistor) and find open circuit voltage (V_{oc} or V_{th}) by using mesh or nodal or KCL or KVL analyses

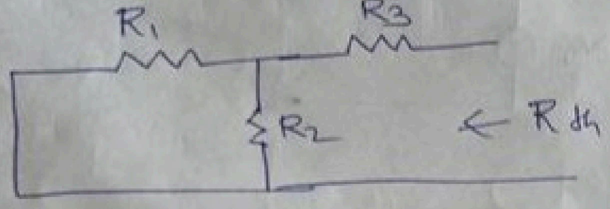


$$I = \frac{V}{R_1 + R_2}$$

$$V_{oc} = V_{Th} = I R_2$$

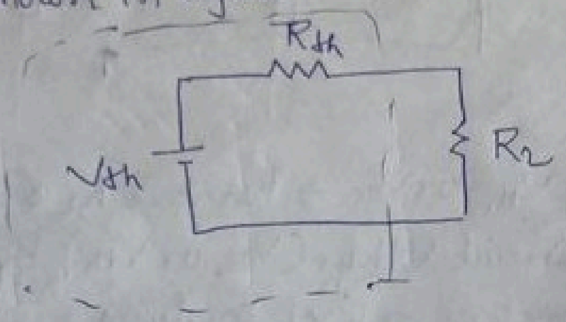
Step 2. To find R_{th}:

Remove load resistor R_L and deactivate all indep. source (Voltage source is removed by short circuiting. Current source removed by open ckt) and thevenin's equivalent resistance seen from the load terminal



$R_{th} \rightarrow \underline{R_1 \| R_2} + R_3$

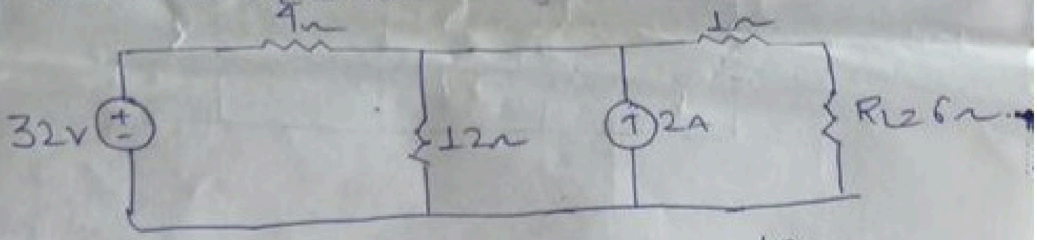
Step 3. Obtain thevenin's equivalent ckt by connecting Voltage source of V_{th} in series with internal resistance of R_{th} shown in figure



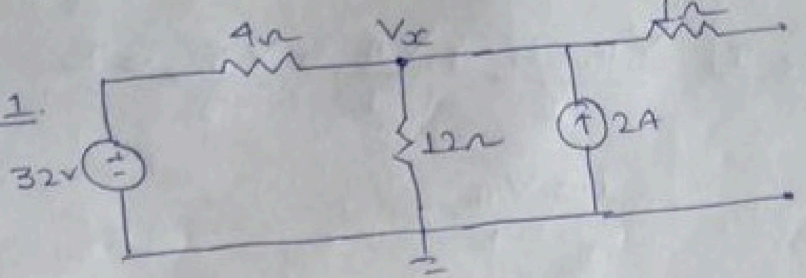
Step 4. Find the current flowing through load resistor

$$I_L = \frac{V_{th}}{R_{th} + R_L}$$

Q) In the below given n/w find current flowing through the load resistance R_L is 6Ω.



Sol. Step 1.



$$\frac{V_x - 32}{4} + \frac{V_x}{12} = 2$$

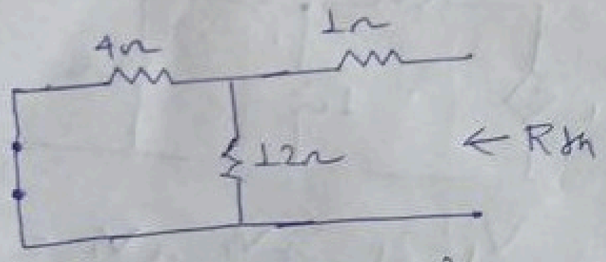
$$3V_x - 96 + V_x = 24$$

$$4V_x = 120$$

$$V_x = 30$$

$$V_{Th} = V_x = 30V$$

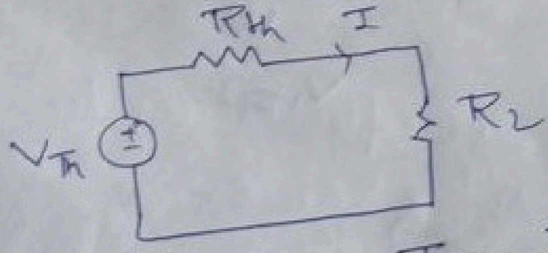
Step.2



$$R_{th} = 1 + (12 \| 4)$$

$$\Rightarrow 4Ω$$

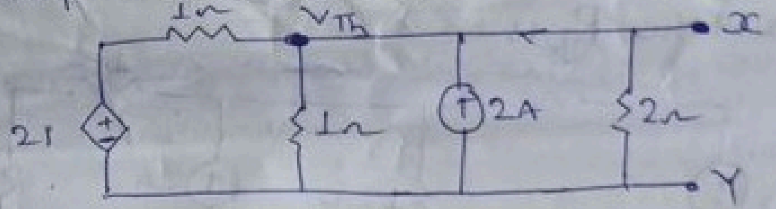
Step3.



$$I = \frac{V_{Th}}{R_{th} + R_L}$$

$$\therefore I = \frac{30}{4+6} \Rightarrow 10A$$

(Q) Develop Thevnin ckt b/w terminal x and Y



Case I. $\frac{V_{Th}-2i}{1} + \frac{V_{Th}}{1} + \frac{V_{Th}}{2} = 2$

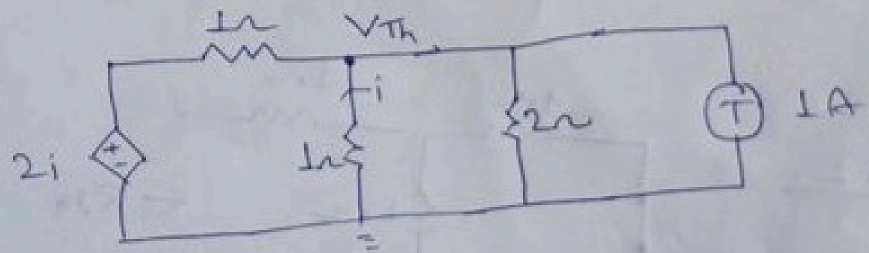
$i = \frac{V_{Th}}{1}$

$2V_{Th} - 2i + \frac{V_{Th}}{2} = 2$

$2V_{Th} - 2V_{Th} + \frac{V_{Th}}{2} = 2$

$\boxed{V_{Th} = 4V}$

Case 2

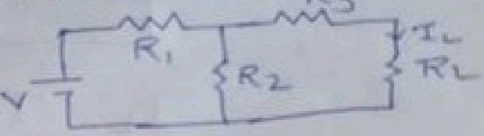


$\frac{V_1-2i}{1} + \frac{V_1}{1} + \frac{V_1}{2} = 1$

$i = \frac{V_1}{1}$

$V_1 = 2$

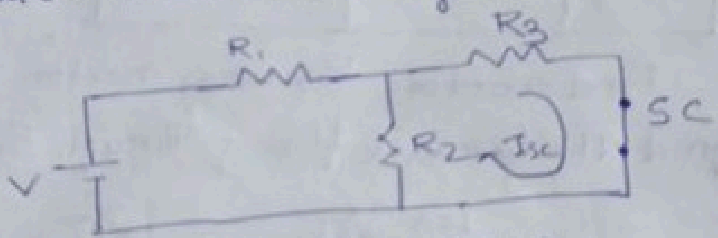
Norton's theorem → In any linear bilateral network consisting of any number of independent or dependent sour[ces] can be replaced by an equivalent network of current so[urce] (I_N or I_{SC}) and parallel internal resistance R_{th}



Step.

Step 1 To find I_N or I_{SC}

Remove R_L and short circuit the terminal further, find out short circuit current i.e $I_N = I_{SC}$ using mesh or nodal or KCL or KVL analysis

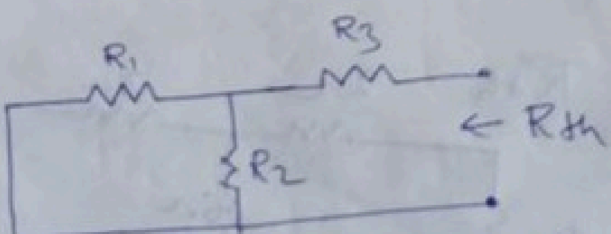


$$R_T = R_1 + R_2 \| R_3$$

$$I_T = \frac{V}{R_T}$$

$$I_N = I_{SC} = I_T \left(\frac{R_2}{R_2 + R_3} \right)$$

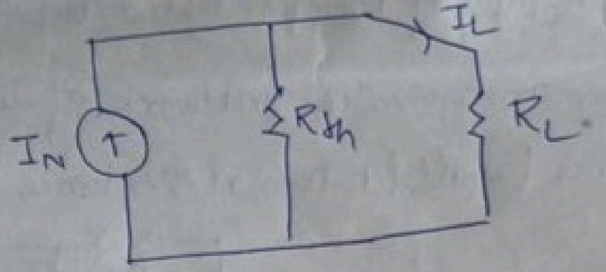
Step 2. To find R_{th}



Remove load resistor R_L and deactivate all independent source, find internal resistance seen from load terminal

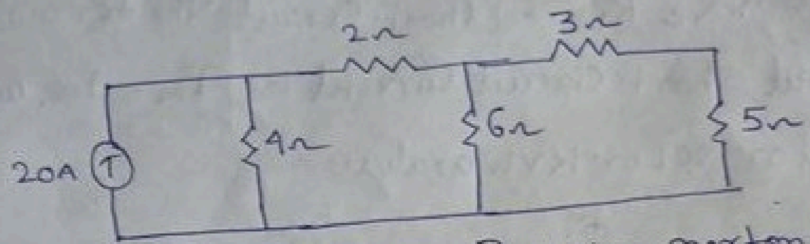
$$R_{th} = R_3 + \frac{R_1 R_2}{R_1 + R_2}$$

Step 3. Draw norton's equivalent ckt



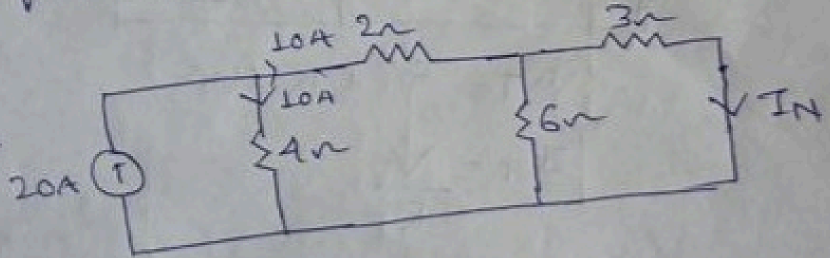
$$I_L = I_N\left(\frac{R_{th}}{R_{th}+R_L}\right)$$

Q)



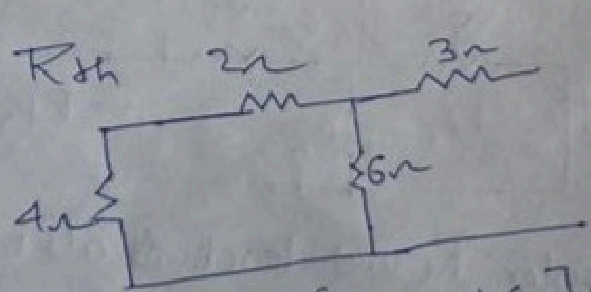
~~Find norton~~ By using norton theorem find the current flowing through 5Ω resistor

Sol



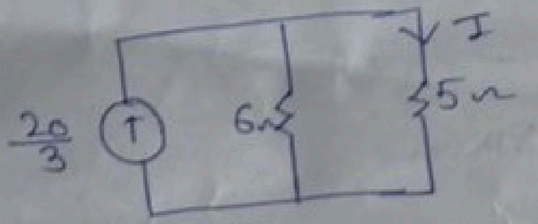
Case I. $I_N = \frac{10}{3+6} \times 6 = \frac{60}{9} = \frac{20}{3}A$

Case 2. R_{th}



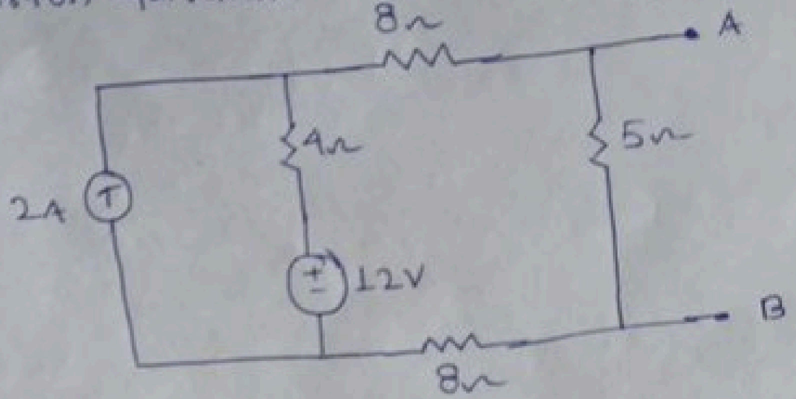
$R_{th} = [4+2 \| 6]+3$

$R_{th} = 6Ω$

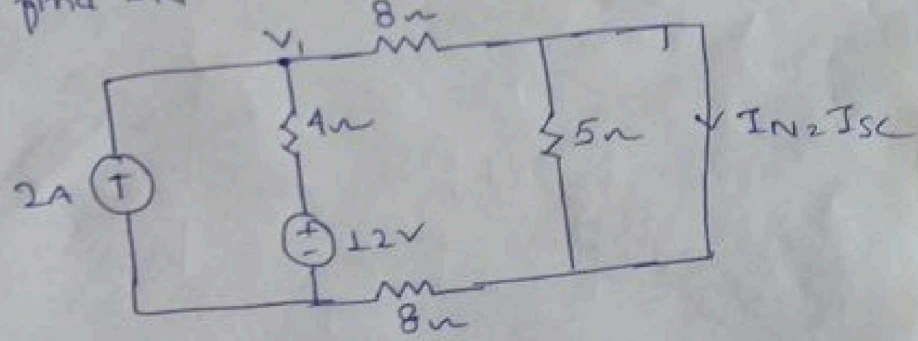


$I = \frac{40}{11} A$

(Q) Find norton equivalent circuit through ~~RL = 5Ω~~ RL = 6Ω



Step 1. To find I_N



$$\frac{V_1 - 12}{4} + \frac{V_1}{16} = 2$$

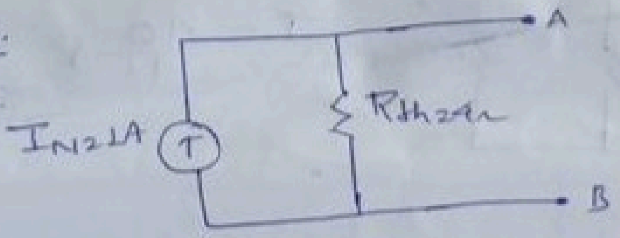
$$V_1 = 16V$$

$$I_N = \frac{V_1}{16} = 1A$$

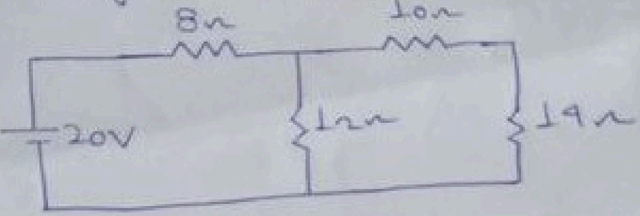
Step 2

$R_{th} = 5 \| 20 = 4\Omega$ ~~16Ω~~ 20Ω

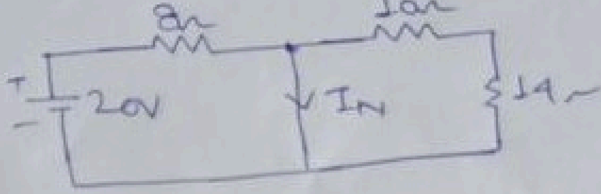
Step3.



(Q) Find 'I' through 12 Ω resistor

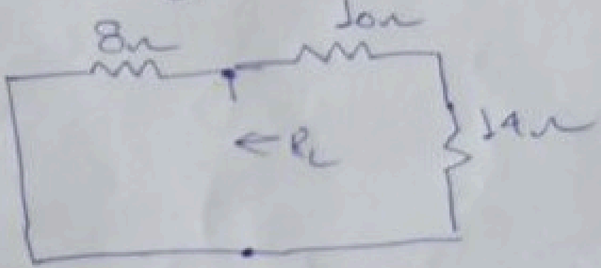


Step 1.



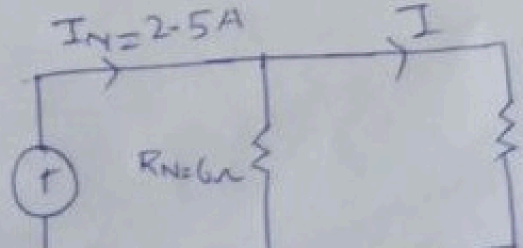
$$I_N = \frac{20}{8} \Rightarrow 2.5\,A$$

Step 2



$$R_L = \frac{8 \times (10+14)}{8+(10+14)} = 6\Omega$$

Step 3.



$$I = I_N \times \frac{R_N}{R_N + R_L}$$

$$\Rightarrow 2.5 \times \frac{6}{6+12}$$

$$= 0.833A.$$