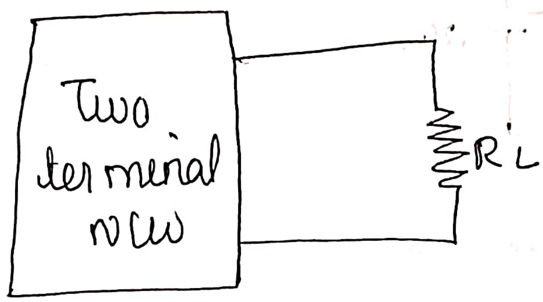
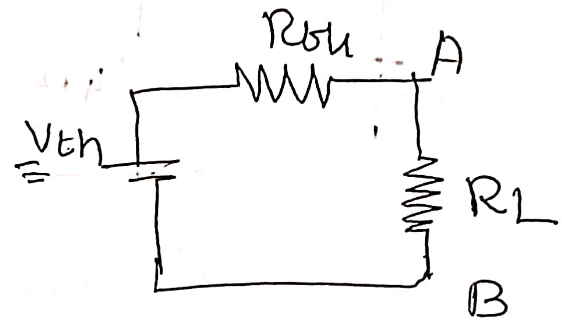
Thevenines Theorem.

Any two terminal, bi-lateral linear network can be replaced by an equivalent circuit that consist of a single voltage source (V_{th}) connected in series with resistance R_{th}.





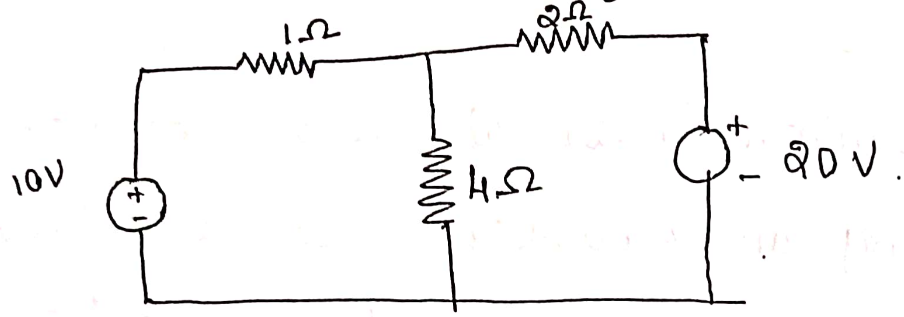
Procedure

step 1 :- Remove the load resistor R_L and find the opencircuit voltage V_{th} across the load terminal.

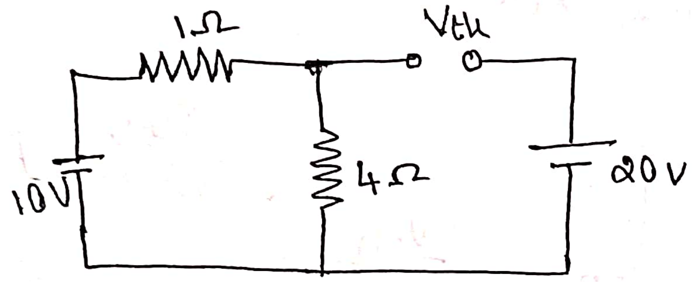
step 2 :- short circuit all voltage sources and open circuit all current sources. find R_{th} looking through load terminal.

step 3 :- Obtain thevenine equivalent circuit by replacing V_{TH} in series with R_{TH} and adding the load resistance.

(19) 1) Find the current flowing through the 2Ω resistor.



1) Remove the load to find Vth.



Apply KVL to loop 1

$$10V - (1+4)i = 0$$

$$5i = 10$$

$$i = \frac{10}{5} = 2A.$$

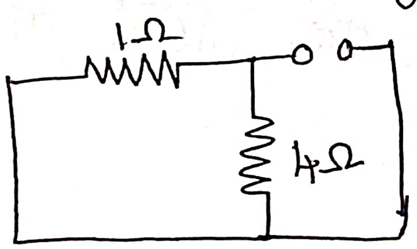
∴ voltage across 4Ω is $4 \times 2 = 8V$

∴ Vth is difference b/w 8 and 20.

$$\therefore V_{th} = 20 - 8$$

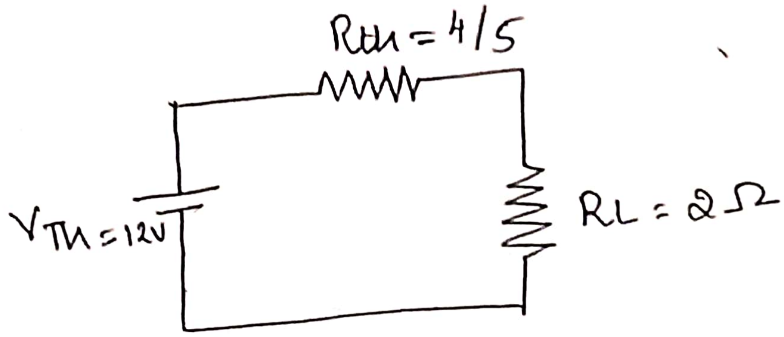
$$\boxed{V_{th} = 12V}$$

<u>To find Rth.</u> S.C vlg source, OC ct source



$R_{eq} = 1\Omega \parallel 4\Omega$

$$R_{th} = \frac{1 \times 4}{4+1} = \frac{4}{5}$$

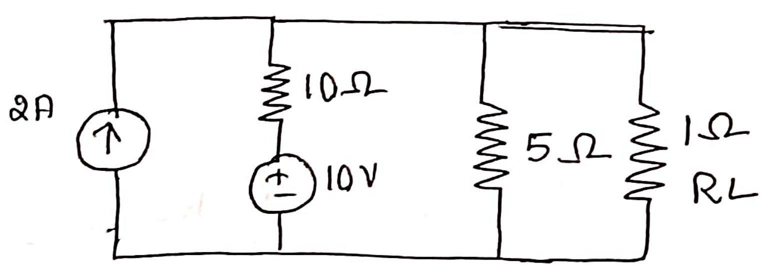


$$I = \frac{V}{R} = \frac{12}{\frac{4}{5}+2}$$

$$= \frac{12 \times 5}{4+10} = \frac{5 \times \cancel{12}^{6}}{\cancel{14}\ 7} = \frac{30}{7}$$

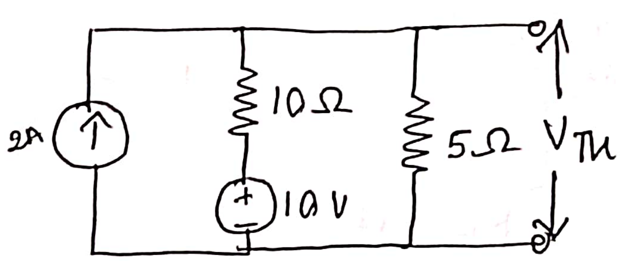
$\boxed{I_L = 4.28\text{ A}}$ ∵ it is series ckt.

2. Find the power loss in 1Ω resistor in given ckt using Thevenines theorem.



Soln

1) To Find V_{Th} remove RL



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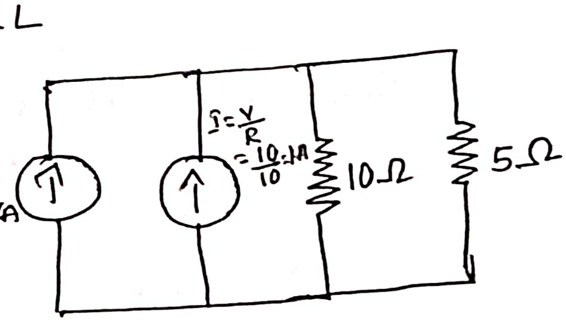

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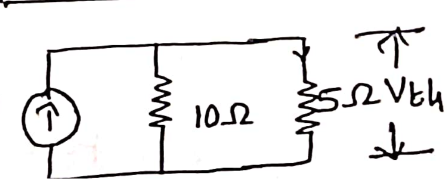


ct through 5Ω $= 3 \times \frac{10}{10+5}$ [ct. divider Rule]

$= \cancel{3} \times \frac{\cancel{10}\,2}{\cancel{15}\,\cancel{5}}$

$\boxed{I_{5\Omega} = 2A}$

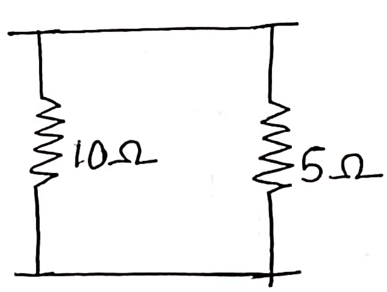
$\therefore V_{th} = I_{5\Omega} \times 5$

$= 2 \times 5$

$\boxed{V_{Th} = 10V}$

<u>To find R_{Th}</u>

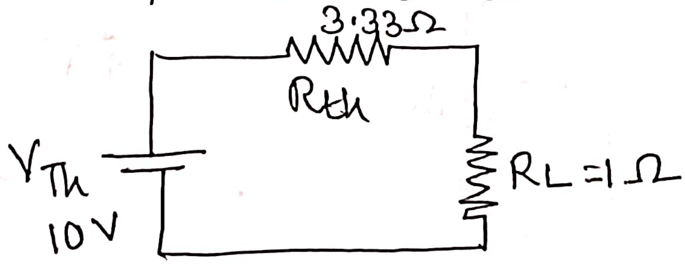
Remove R_L, S.C vlg source, O.C ct source



$R_{Th} = \frac{R_1 R_2}{R_1+R_2} = \frac{10 \times 5}{10+5} = \frac{10 \times \cancel{5}}{\cancel{15}\,3}$

$\boxed{R_{Th} = 3.33\Omega}$

Thevenine equivalent ct is



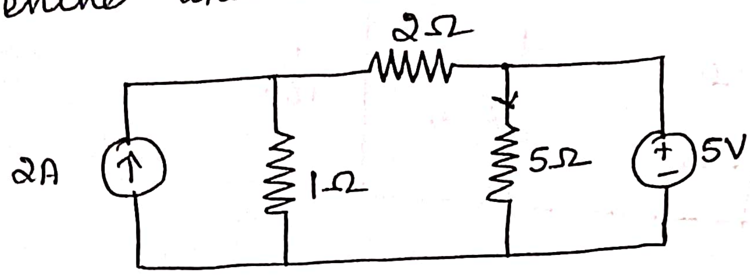
$I_L = \frac{V_{Th}}{R_{th}+R_L}$

$= \frac{10}{3.33+1} = \frac{10}{4.33}$

$I_L = 2.309$

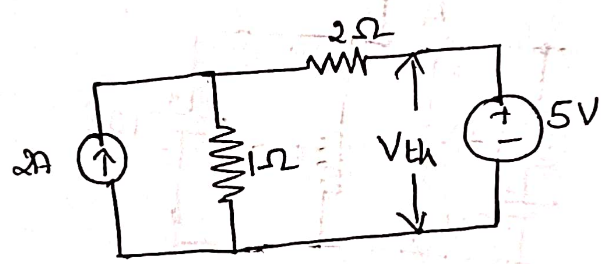
$\therefore$ Power loss across $R_L = \frac{I_L^2}{R_L} = \frac{(2.309)^2}{1} = 5.33W$

3 (4) Find the current through 5Ω resistor using Thevenine theorem.



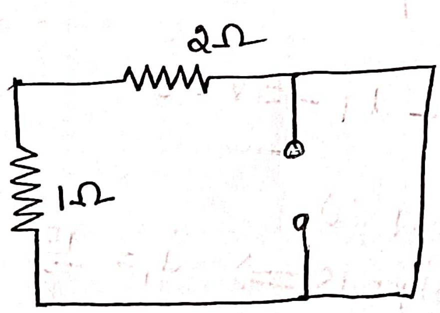
Soln

Remove 5Ω and find V_{TH}.



$\boxed{V_{th} = 5V}$

To find R_{th} S.C Vtg source & O.C ct source. Remove R_L.

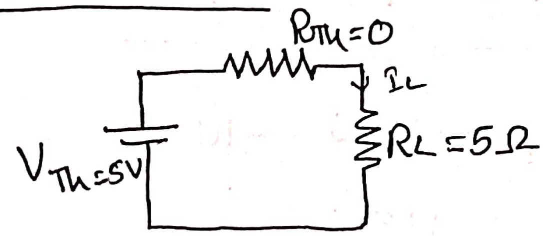


$R_{th} = \cancel{2 \| 1} = \frac{\cancel{2 \times 1}}{\cancel{2+1}} = \frac{\cancel{2}}{\cancel{3}}$

$R_{th} = 3Ω \| 0Ω$

$\boxed{R_{th} = 0}$

Thevenine ckt

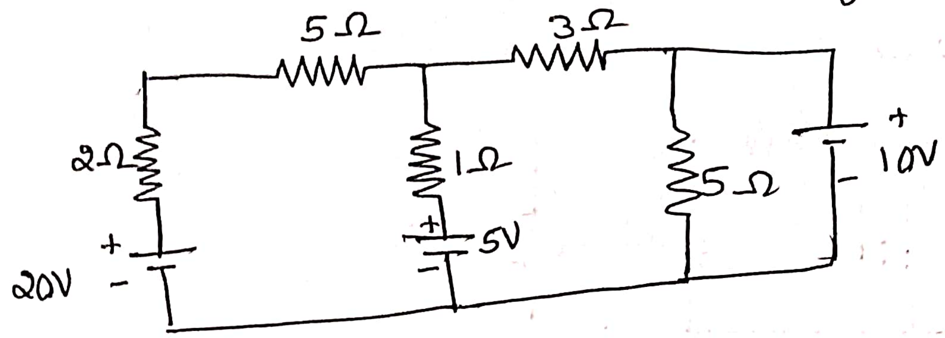


$I_L = \frac{V_{TH}}{R_L} = \frac{5}{5}$

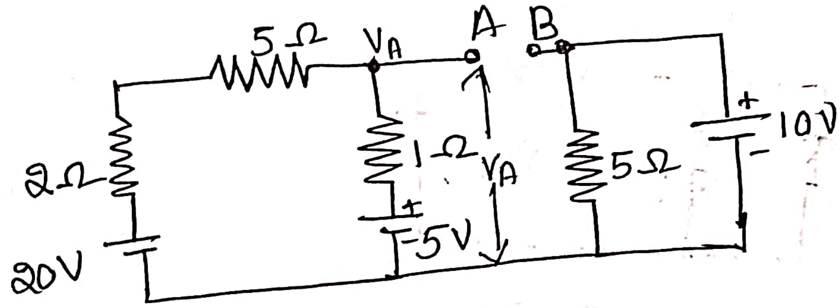
$\boxed{I_L = 1A}$

(23)

4(b) Find the power across 3Ω using Thevenin's Theorem



To find V_{th}:- Remove 3Ω.



$$V_{Th} = V_A - V_B.$$

Apply KVL to loop I

~~By node vtg,~~

$\cancel{\frac{V_A - 20}{7} = \frac{V_A - 5}{1}}$

$\cancel{V_A - 20 = 7V_A - 35}$

$\cancel{6V_A = 15}$

$\cancel{V_A = \frac{15}{6}}$

$=$

$$20V - 7i_1 - i_1 - 5V = 0$$

$$15 - 8i_1 = 0$$

$$8i_1 = 15 \Rightarrow i_1 = \frac{15}{8} \Rightarrow \boxed{i_1 = 1.875A}$$

$$V_A = +i_1 \times 1 + 5$$

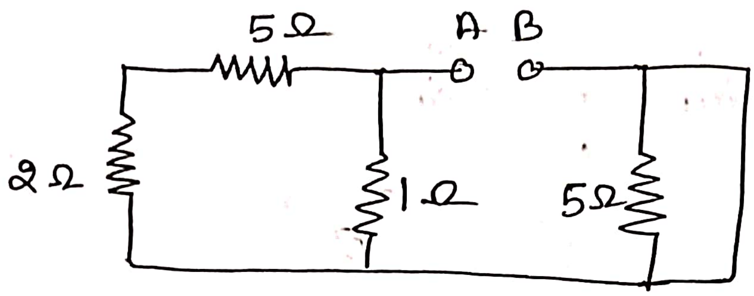
$$= +1.875 + 5 = +6.875V$$

$$\therefore V_{Th} = +6.875 - 10$$

$$= -3.125V$$

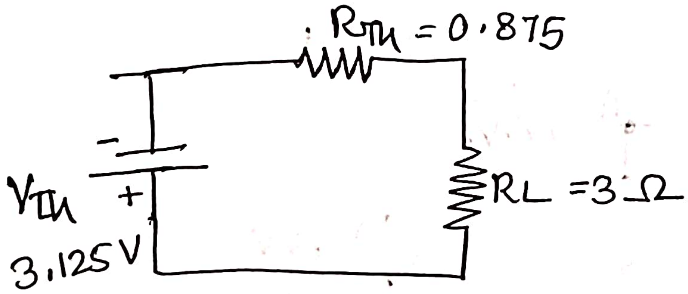
To find R_{Th}

Remove R_L, S.C vtg source, O.C ct source



$$R_{th} = (2+5) \parallel 1 = \frac{7\times 1}{7+1} = \frac{7}{8}$$

$$\boxed{R_{th} = 0.875\Omega}$$



$$I_L = \frac{-3.125}{3.875}$$

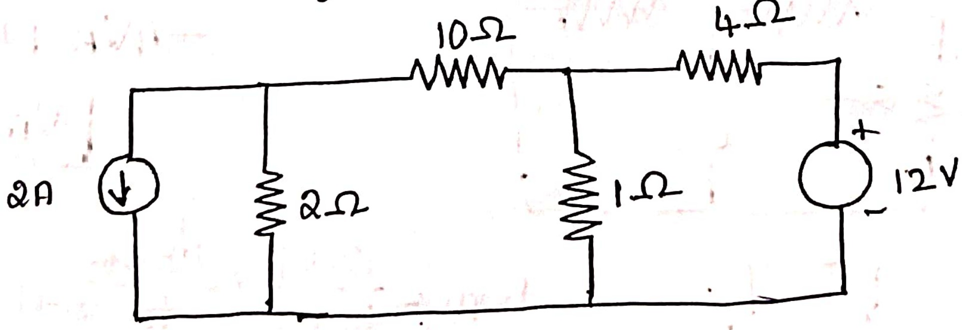
$$= -0.8065\ A$$

$$\text{Power square} = I^2 R_L$$

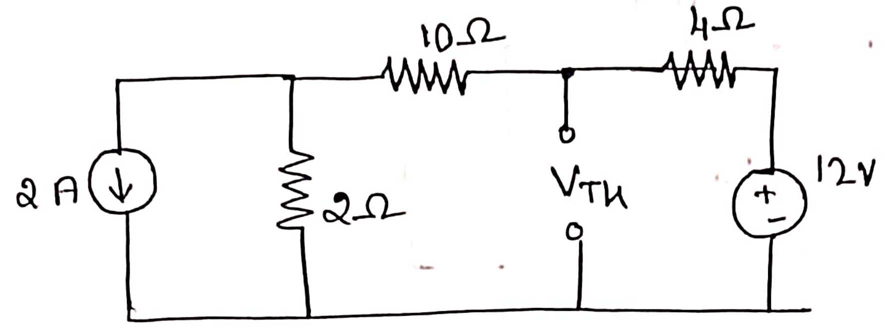
$$= (-0.806)^2 3$$

$$\boxed{P_l = 1.94W}$$

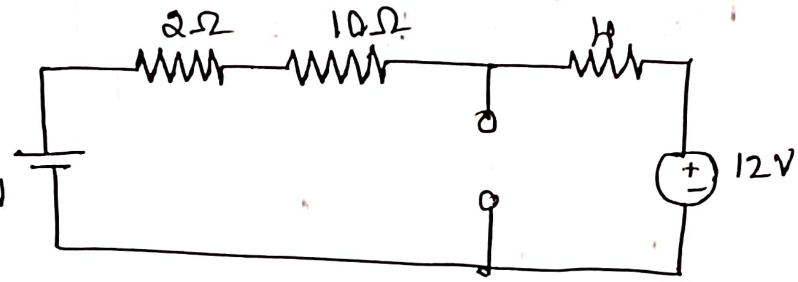
5) Find current through 1Ω.

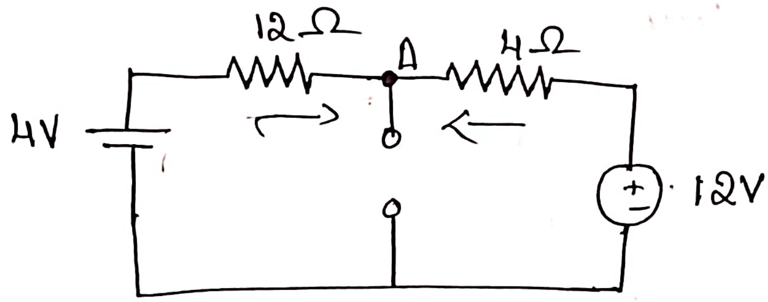


25 To find V_{TH} remove 1Ω



$V = IR$
$= 2 \times 2 = 4V$





$$\frac{V_A - 4}{3\,\cancel{12}} = \frac{V_A - 12}{\cancel{4}}$$

$$V_A - 4 = 3V_A - 36$$

$$32 = 2V_A$$

$$V_A = 16.$$

$$\frac{4 - V_A}{12} + \frac{12 - V_A}{4} = 0$$

$$\frac{4 - V_A}{3} + \frac{12 - V_A}{1} = 0$$

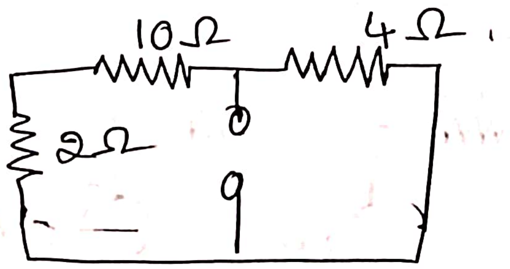
$$4 - V_A + 36 - 3V_A = 0$$

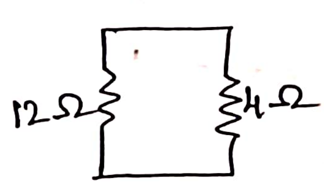
$$\cancel{2V_A \ldots + 40 = 0}$$

$$-4V_A + 40 = 0$$

$$\boxed{V_A = 10}$$

<u>To find R_{th}.</u>





$$R_{TH} = \frac{12 \times 4}{12 + 4} = \frac{\cancel{12}^{3} \times \cancel{4}}{\cancel{16}\ \cancel{8}\ \cancel{4}} = 3\Omega.$$