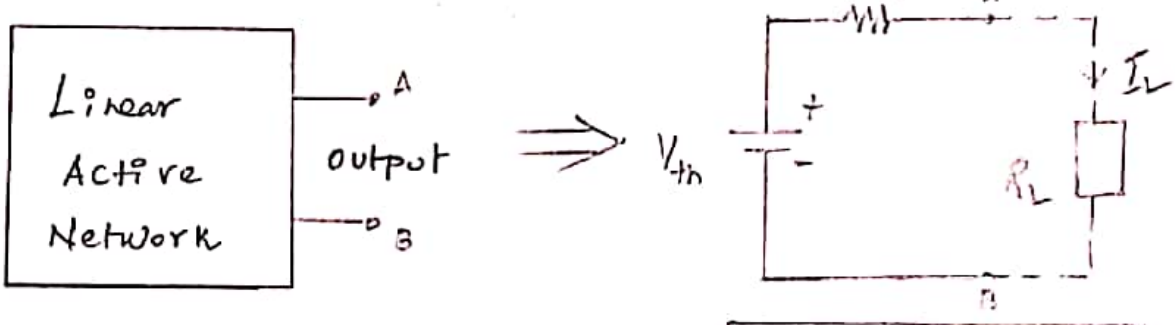
Thevenin's theorem

Statement: Any linear active network can be replaced by a single voltage source (V_{th}) in series with a single resistance (R_{th}).



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

Where,

V_{th} - thevenin's voltage

R_{th} - thevenin's resistance

R_L - load resistance

I_L - load current

V_{oc} - open circuit voltage.

$V_{th} = V_{oc}$

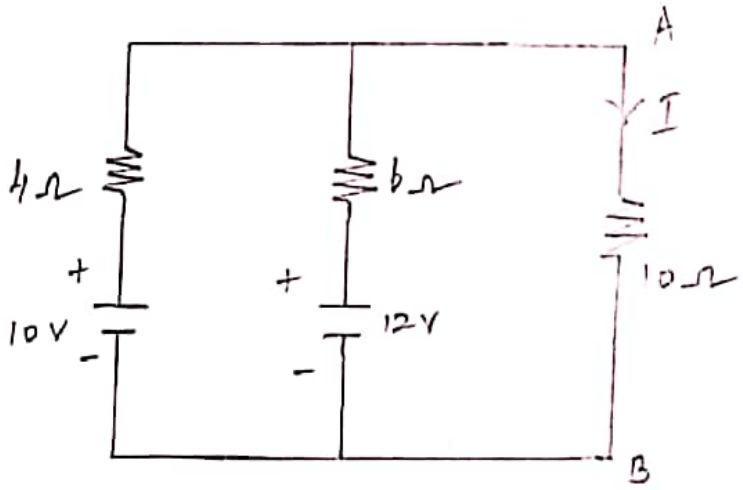
Steps to find V_{th} & R_{th}

1. Remove R_L, mark the terminals A & B
2. Find V_{th}
3. Remove R_L, mark the terminal A & B

4. Kill the Sources (oc ← open circuit the current source, short circuit the Voltage Source.)

5. Find R_{th}.

1. Determine the current I in the network by using thevenin's theorem.

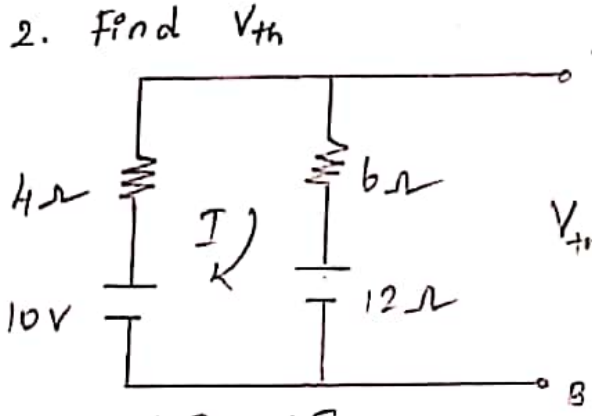


$I = I_L$

V_{th} :

1. Remove R_L, mark the terminals A B

2. Find V_{th}

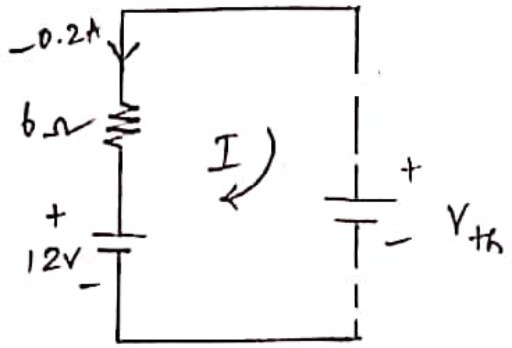


$V_{th} = V_{oc}$

$10 - 12 = 4I + 6I$

$-2 = 10I$

$$\boxed{I = -0.2\ A}$$



$$12 - V_{th} = 6I$$

$$12 - V_{th} = 6(-(-0.2))$$

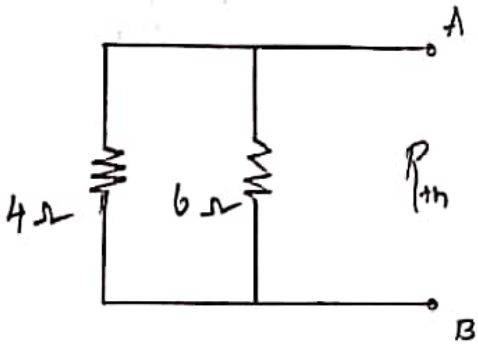
$$-V_{th} = 1.2 - 12$$

$$-V_{th} = -10.8$$

$$\boxed{V_{th} = 10.8\ V}$$

R_{th}:

1. Remove R_L mark terminals A B
2. Kill the Sources (Sc Voltage Source, Oc current Source)
3. Find R_{th}



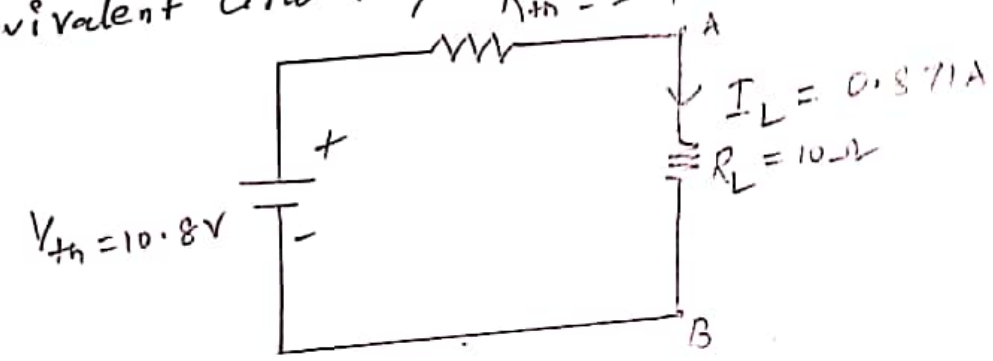
$$R_{th} = \frac{4 \times 6}{4+6} = 2.4\ \Omega$$

$$\boxed{R_{th} = 2.4\ \Omega}$$

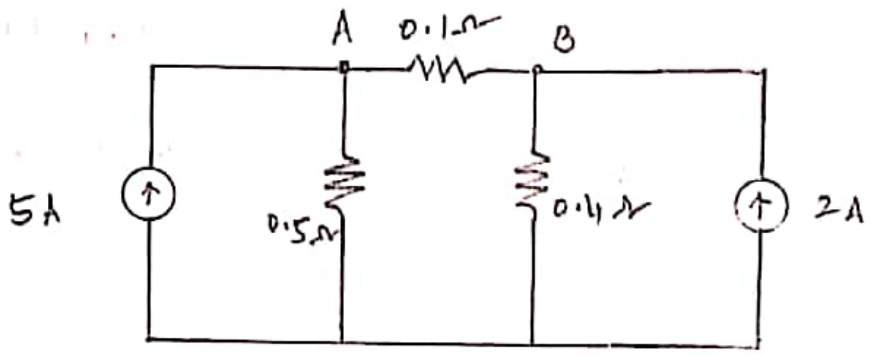
$$I_L = \frac{V_{th}}{R_{th} + R_L} = \frac{10.8}{2.4 + 10} = 0.871\ A$$

$$\boxed{I_L = 0.871\ A}$$

Thevenin's equivalent circuit $\Rightarrow$ $R_{th} = 2.4\Omega$

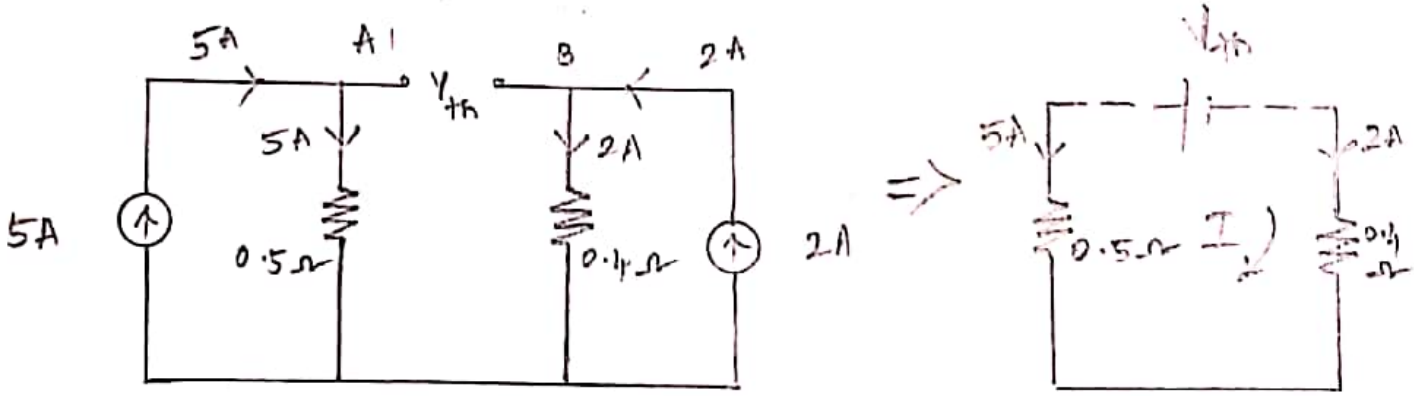


2. It's required to find current through the 0.1Ω resistor in the figure. Using thevenin's theorem.



V_{th} :

1. Remove R_L mark terminals A & B
2. Find V_{th}



$-V_{th} = -0.5(-5) + 0.4(2) = -2.5 + 0.8 = -1.7$

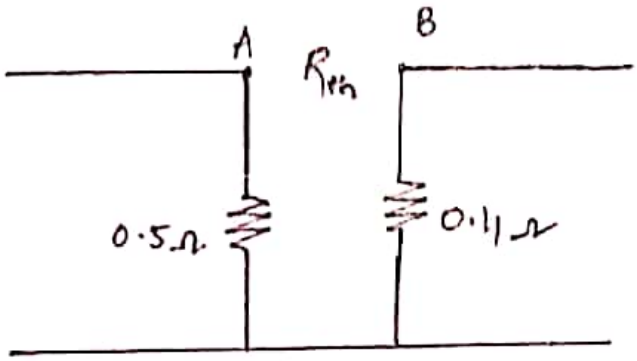
$$V_{th} = 1.7\ V$$

R_{th} :

Remove R_L, Mark terminals A & B

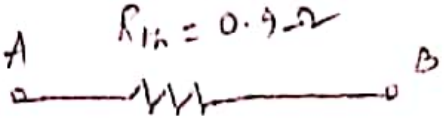
Kill Sources (OC current source,
SC voltage source)

Find R_{th}



$R_{th} = 0.5 + 0.4$

$$\boxed{R_{th} = 0.9\,\Omega}$$



$$I_L = \frac{V_{th}}{R_L + R_{th}} = \frac{1.7}{0.1+0.9} = 1.7\,A$$

$$\boxed{I_L = 1.7\ A}$$

Thevenin's equivalent circuit