Electric Circuits and Networks **11-09-2018**

Lecture 17: Thevenin/Nortan Equivalent Circuit

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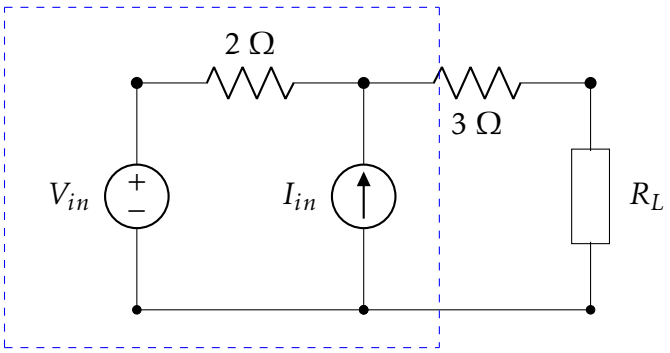
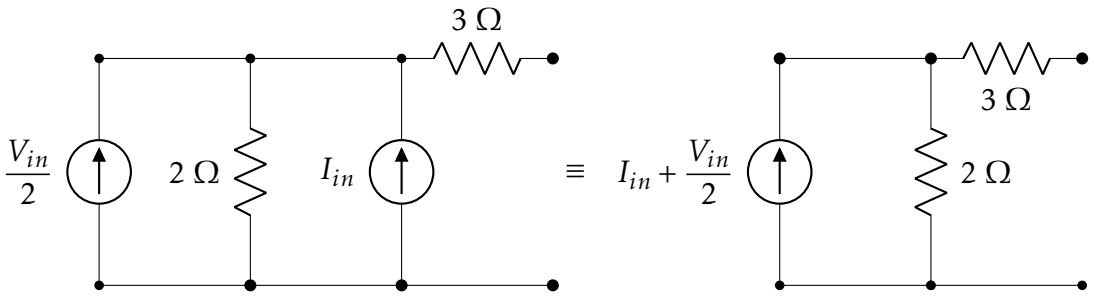
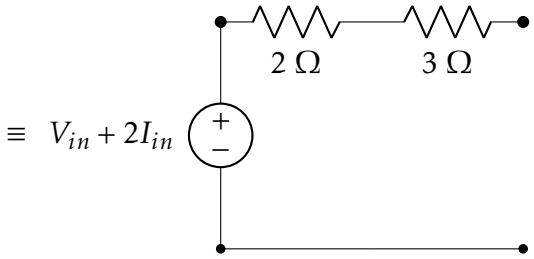
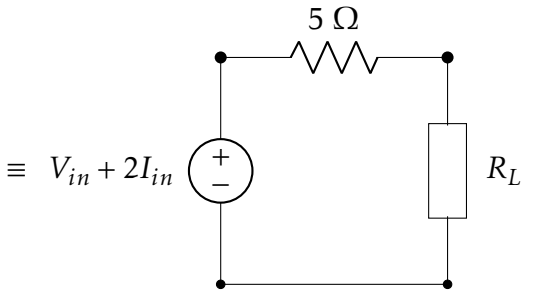
Example 1 : Replace the dashed part of given circuit by single voltage source in series with a resistance

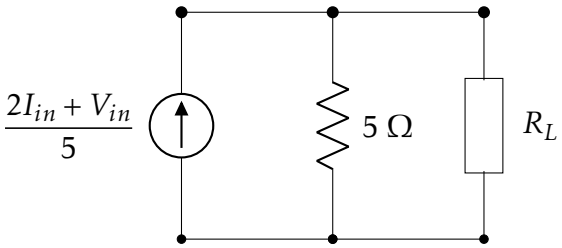






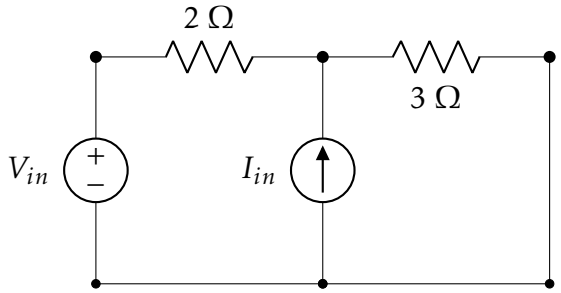


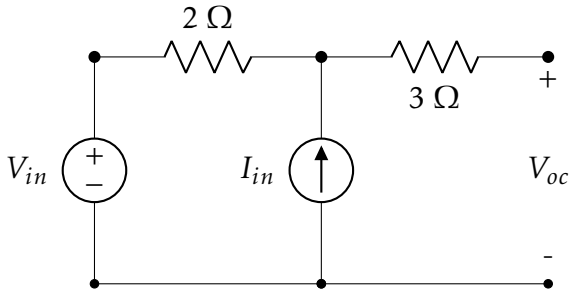
As far as R_L is concerned there is no difference between this network and the original network. This is true for any value of R_L, V_{in}, I_{in}.
This resultant circuit is known as "Thevenin equivalent"
Similarly



"Nortan equivalent circuit"

Now the question arises that "What if we can not do source transformation ?" Since the network will be equivalent for any value of R_L; in particular for $R_L = 0, R_L = \infty$

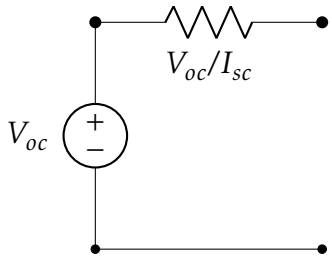




$$I_{sc} = \frac{2I_{in} + V_{in}}{5}$$

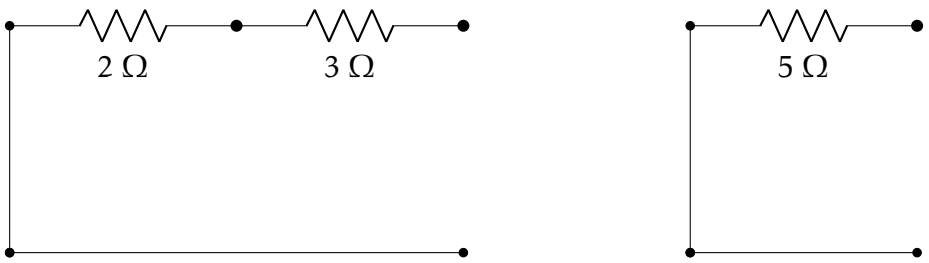
$$V_{oc} = 2I_{in} + V_{in}$$

Now R_{th} can be calculated as $\Rightarrow R_{th} = \frac{V_{oc}}{I_{sc}}$



So instead of doing source transformation, we can find open circuit voltage and short circuit current

Another way to find the Thevenin equivalent is , first find V_{oc} and then use the fact that circuits are equivalent for any V_{in} and I_{in}; in particular for $V_{in} = 0, I_{in} = 0$



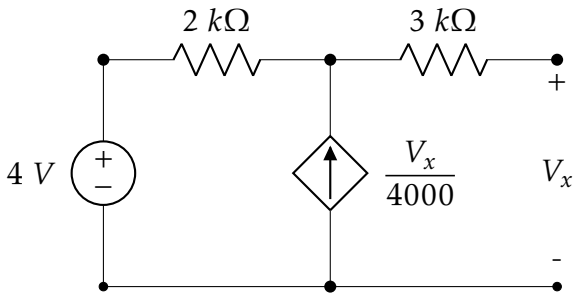
We can find R_{th} by setting all independent sources and initial conditions to zero and finding equivalent resistance (impedence)

Three methods to find Thevenin's Equivalent

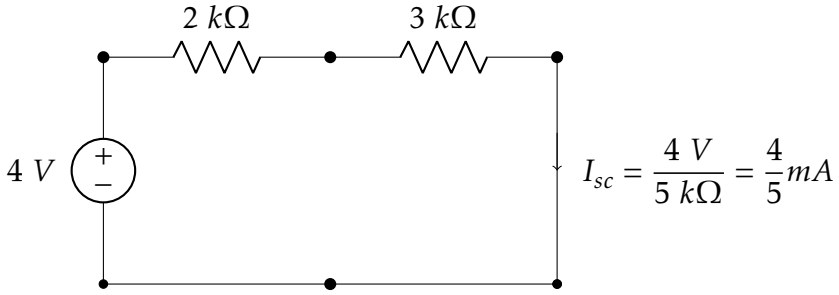
1. Source transformations
2. Find $V_{oc}, I_{sc}; V_{th} = V_{oc}, Z_{th} = V_{oc}/I_{sc}$

3. Find V_{oc}; set all independent, initial conditions to zero and find Z_{th}

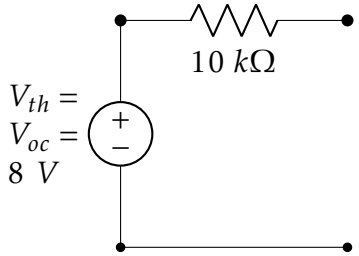
Example 2 : Find thevenin equivalent



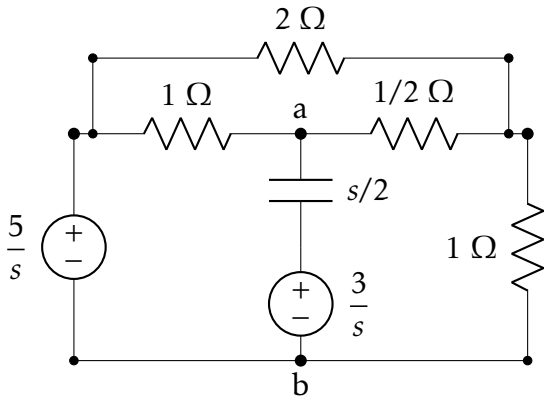
Clearly $V_{oc} = V_x = 8V$. For calculating R_{th} we will first calculate the I_{sc}. as we short the terminal i.e. $V_x = 0 \Rightarrow$ dependent current source = 0

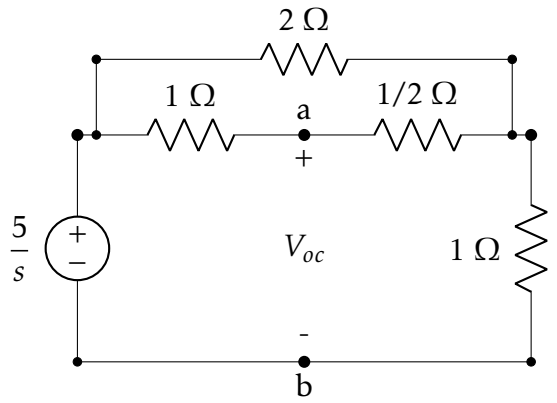


hence the thevenin equivalent will be as follows:

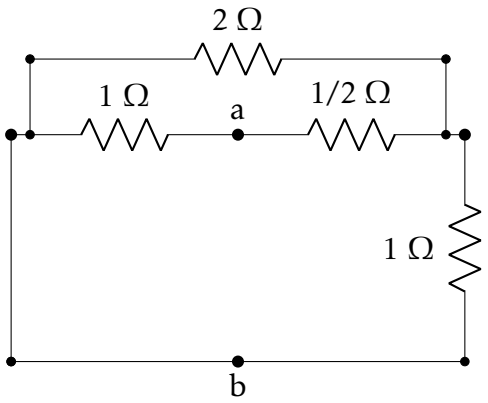


Example 3 : Find thevenin equivalent between terminal a-b



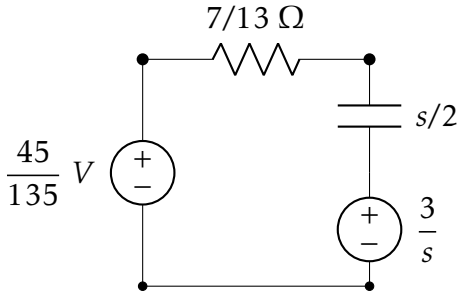


$$V_{oc} = \frac{45}{135}$$

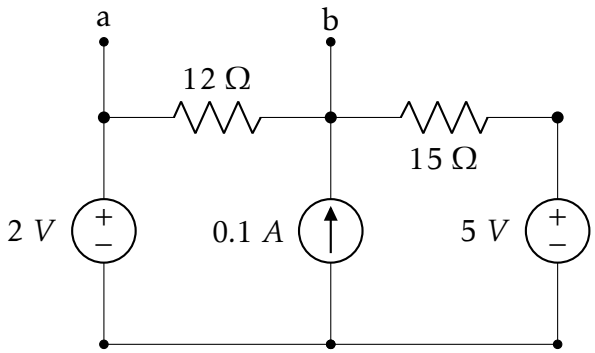


$$R_{eq} = \frac{7}{13}\Omega$$

hence the thevenin equivalent between terminal a-b will be as follows:



Exercise : Find thevenin equivalent between terminal a-b



Hint: Do repeated source transformation and make it one mesh.