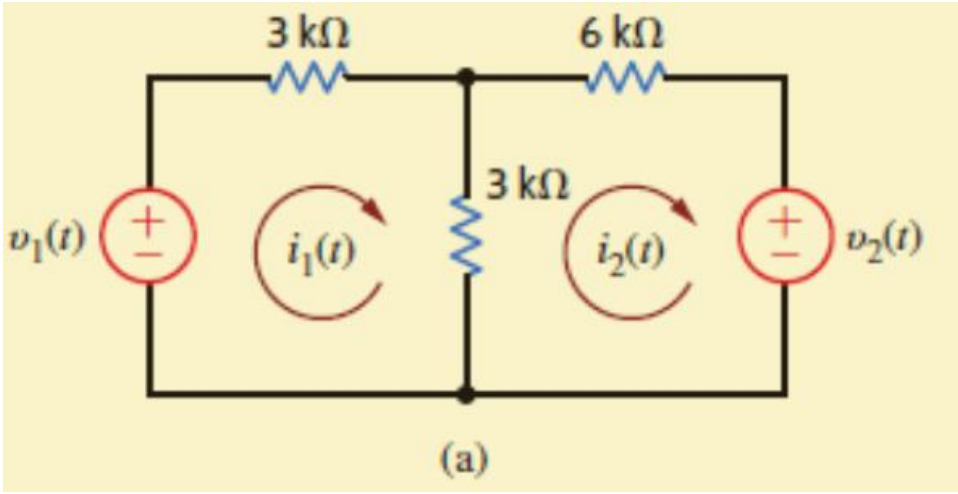
Last Lecture → Superposition

10/2/2019

In any linear circuit containing multiple independent sources, the current or voltage at any point in the network may be calculated as the algebraic sum of the individual contributions of each source acting alone.



Analysis:

$$i_1(t) = i_1'(t) + i_1''(t)$$

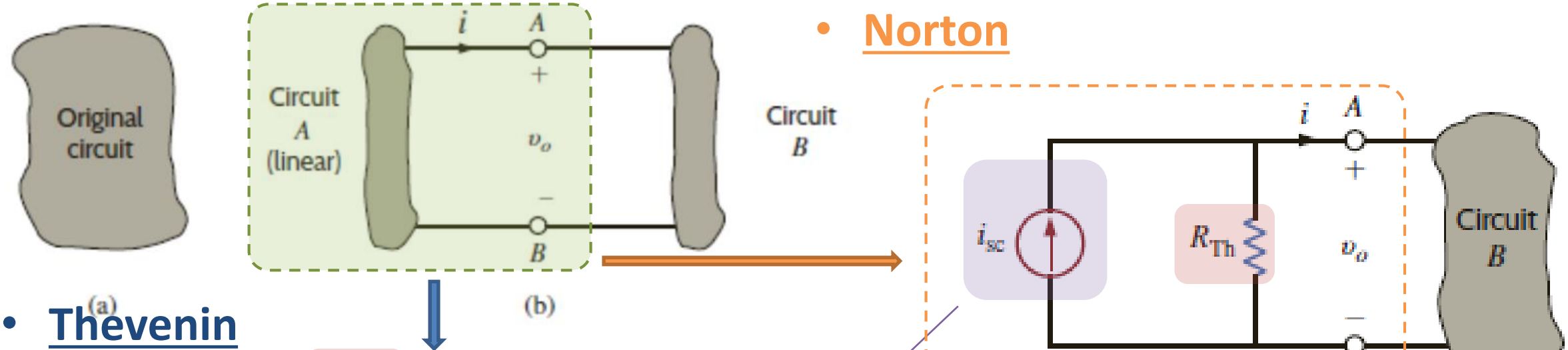
Each independent source can be applied independently with the remaining source turned off:

- ***Turn off a voltage source*** → *short circuit*
- ***Turn off a current source*** → *open circuit*

The final solution is the algebraic sum of the independent results!.

Last Lecture → Thevenin & Norton

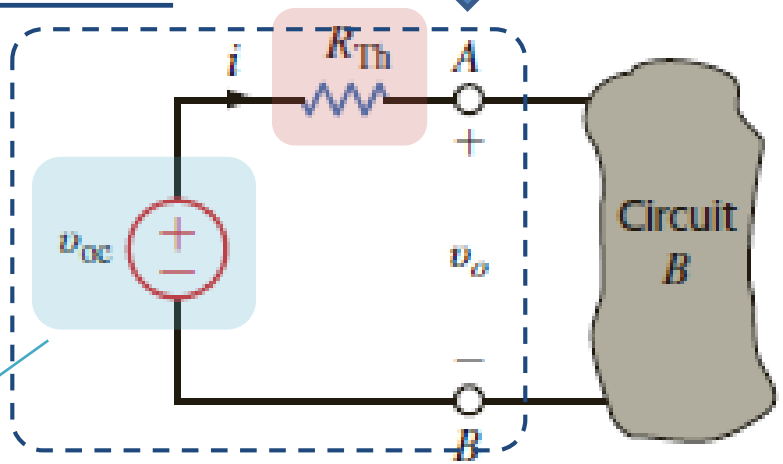
10/2/2019



- **Norton**

i_{sc}: short circuit current from circuit A measured at A-B

- **Thevenin**



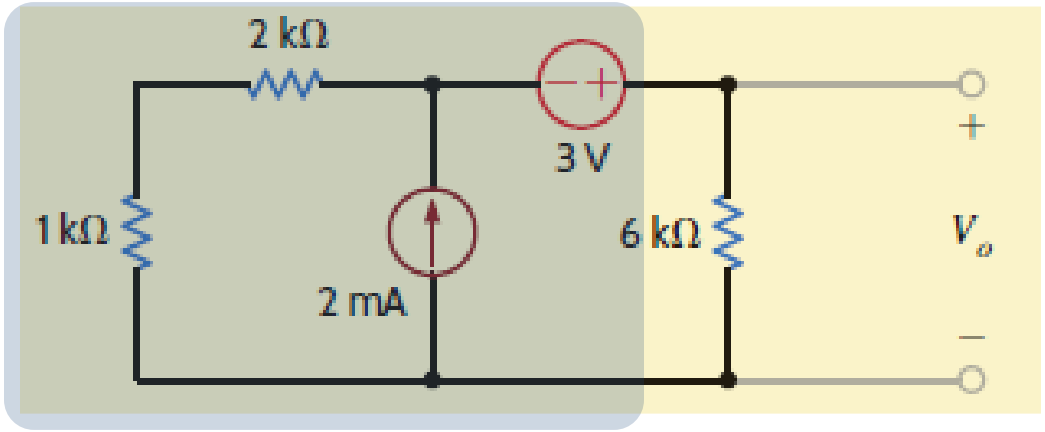
v_{oc}: open circuit voltage from circuit A measured at A-B

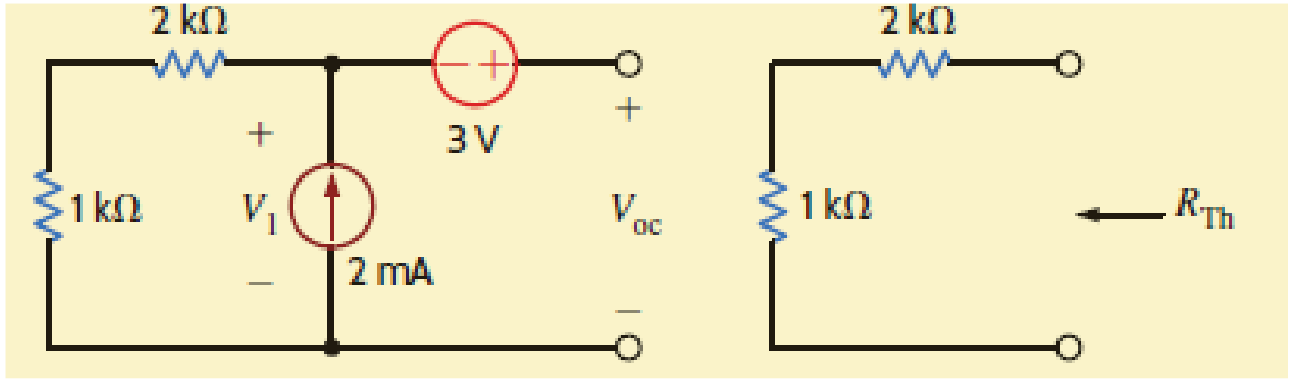
R_{Th}: equivalent resistance looking back into circuit A from A-B with all independent sources in circuit A made zero

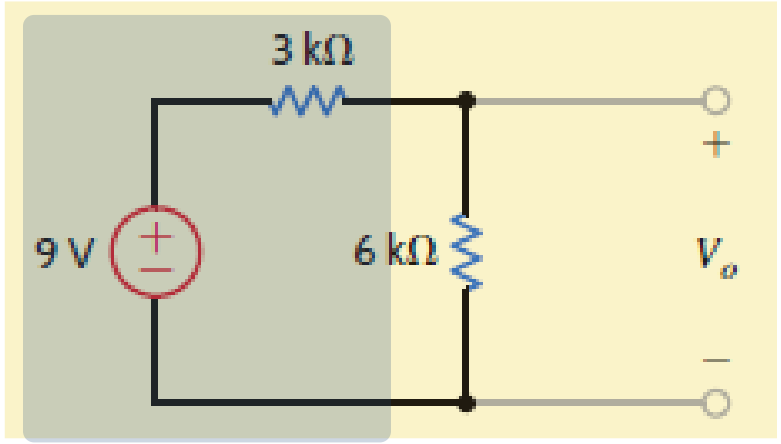
$$v_{oc} = R_{Th} \cdot i_{sc}$$

Last Lecture → Thevenin's Equivalent

Example 5.5: Use Thevenin's and Norton's theorems to find V_0 in the network provided.







$$V_{OC} = 2m(1k + 2k) + 3 = 9V$$

$$R_{th} = 1k + 2k = 3k\Omega$$

$$V_O = 9\frac{6k}{3k + 6k} = 6V$$

Thevenin and Norton Equivalent Circuits

10/2/2019

1) **Independent Sources Only**
   - **Find either V_{oc} or I_{sc}**
   - **R_{Th} can be extrapolated directedly from the network**
2) **Dependent Sources Only**
   - **The equivalent circuit is R_{Th} only**
   - **Find R_{th} through ohms law by placing an voltage/current source and measuring the current/voltage**
3) **Independent and Dependent Sources**
   - **Must calculate both the V_{OC} and I_{SC} to calculate R_{TH}.**
   - **Must not split the dependent source an its controlling variable**

Thevenin's Theorem → Dependent Sources Only

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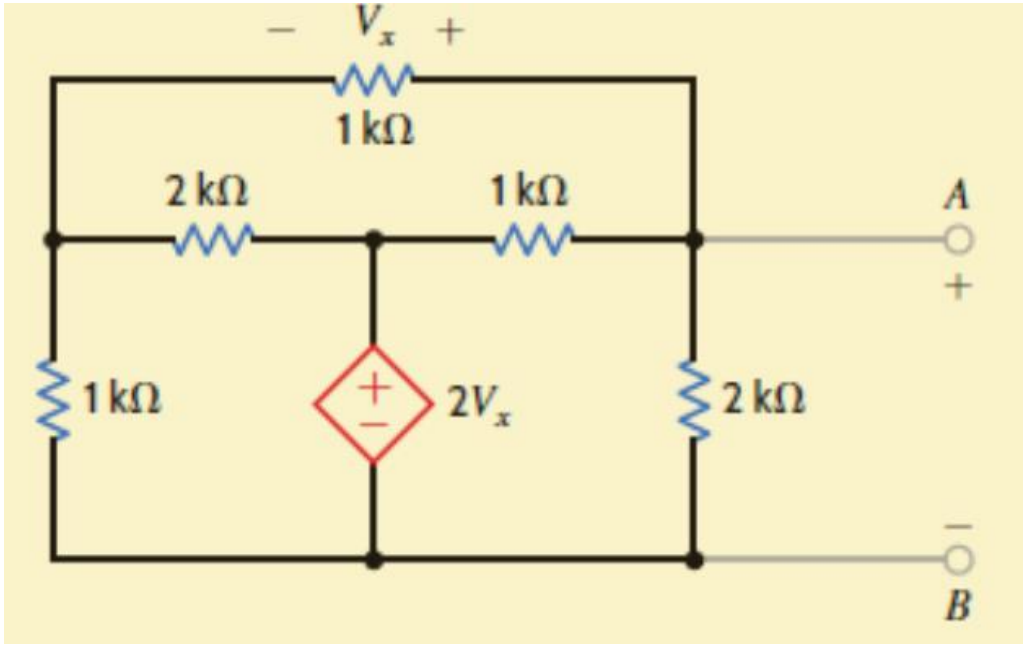
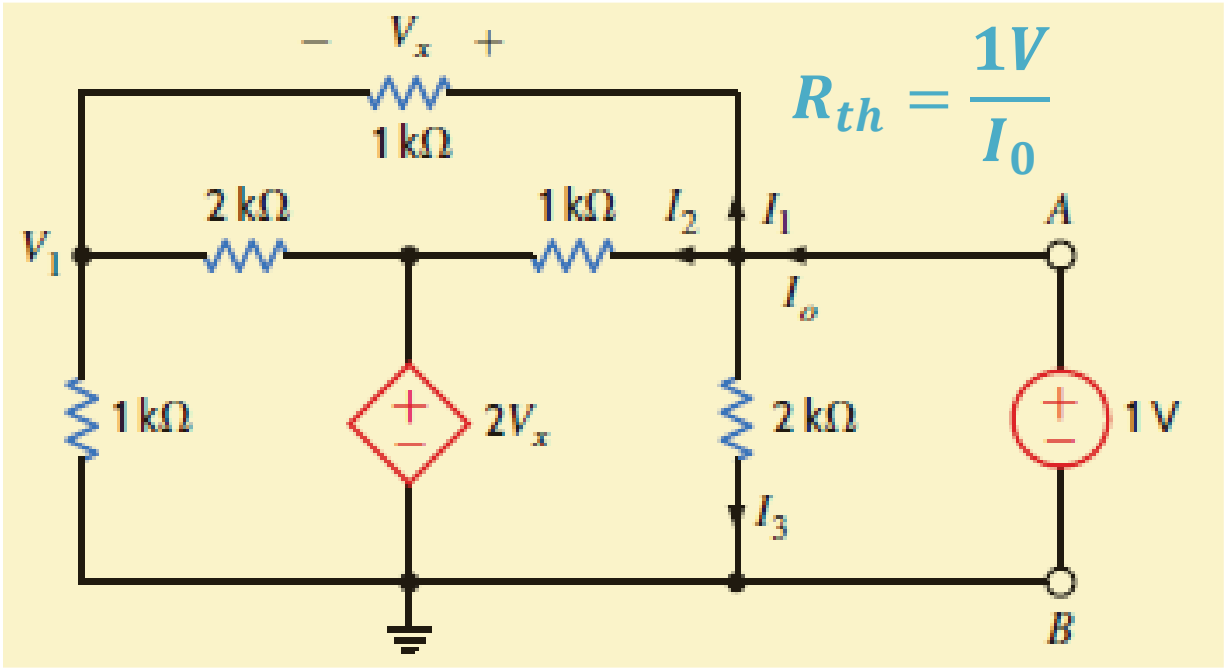
The Thevenin /Norton equivalent of a network containing only dependent sources is R_{th}!

Example 5.8:

Determine the Thevenin equivalent of the network provided at terminals A-B.

Measure R_{th} via a current or voltage source





Thevenin's Theorem → Independent & Dep. Sources

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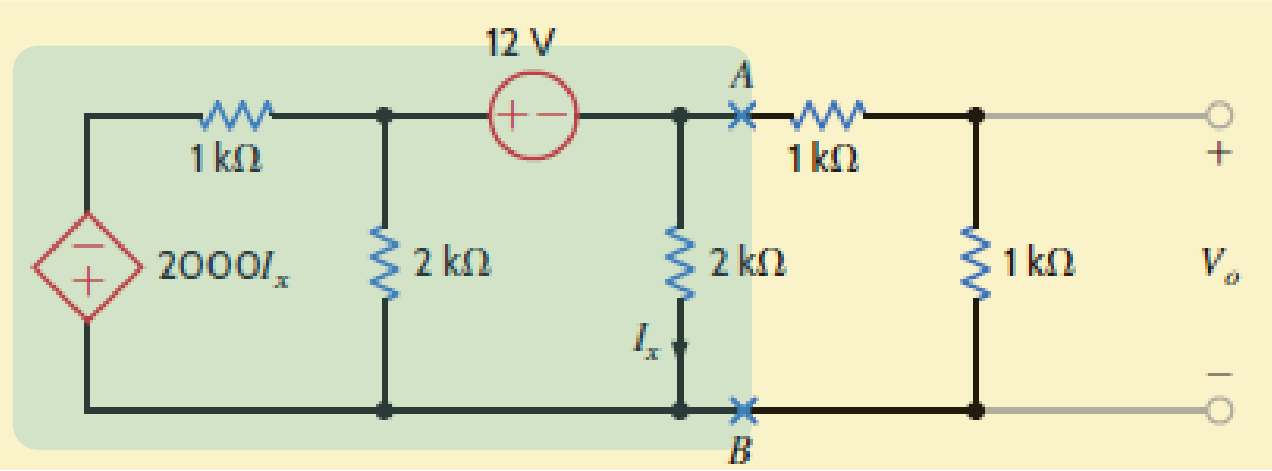
- ***Must calculate both the V_{OC} and I_{SC} to calculate R_{TH}.***
- ***Must not split the dependent source an its controlling variable***

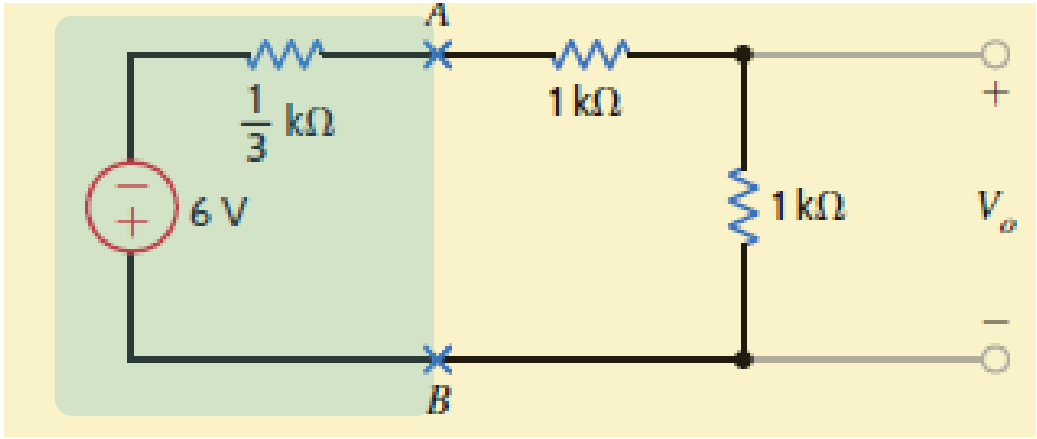
Example 5.10:

Use Thevenin's theorem to find V_0 in the network provided..



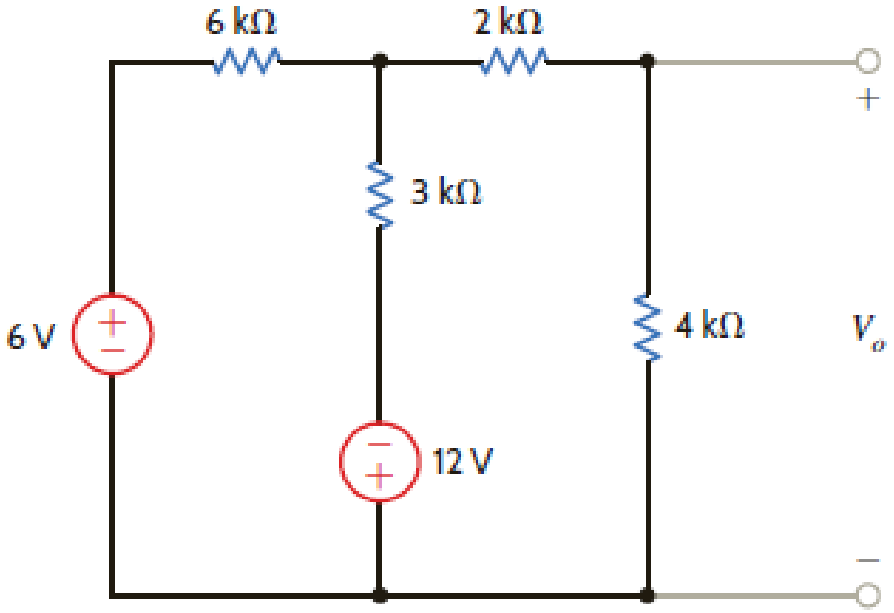
$$I_{SC} = -18mA$$
$$V_{OC} = -6V$$
$$\therefore R_{th} = \frac{1}{3}k\Omega$$

$$V_O = -\frac{18}{7}V$$



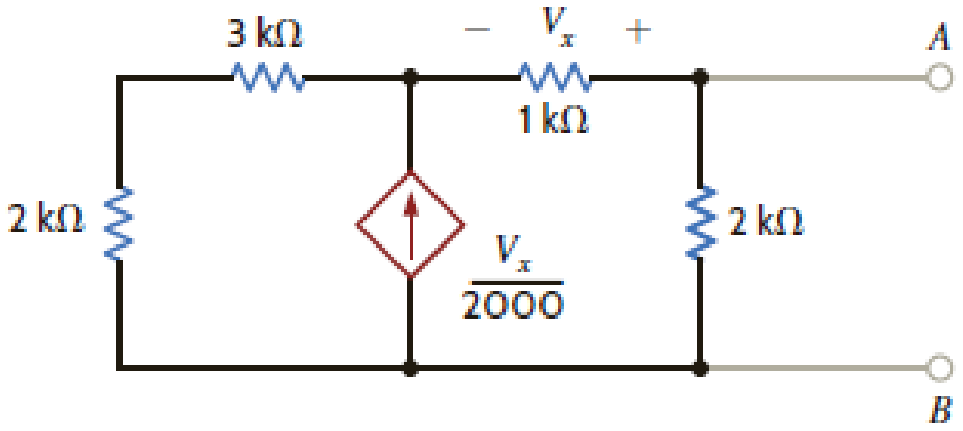
Learning Assessment → E5.6

Use Thevenin's Theorem to find V_0 in the network provided.



Learning Assessment → E5.13

Find the Thevenin equivalent of the network at terminals A-B.



Source Transformation

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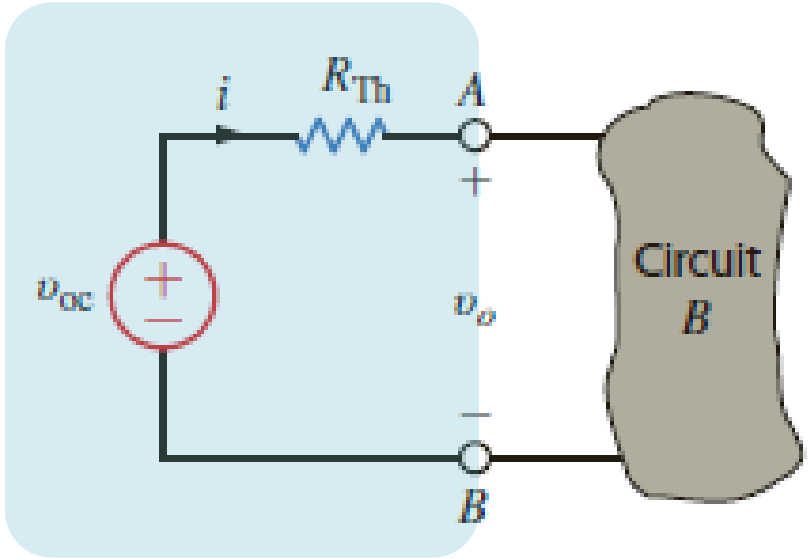
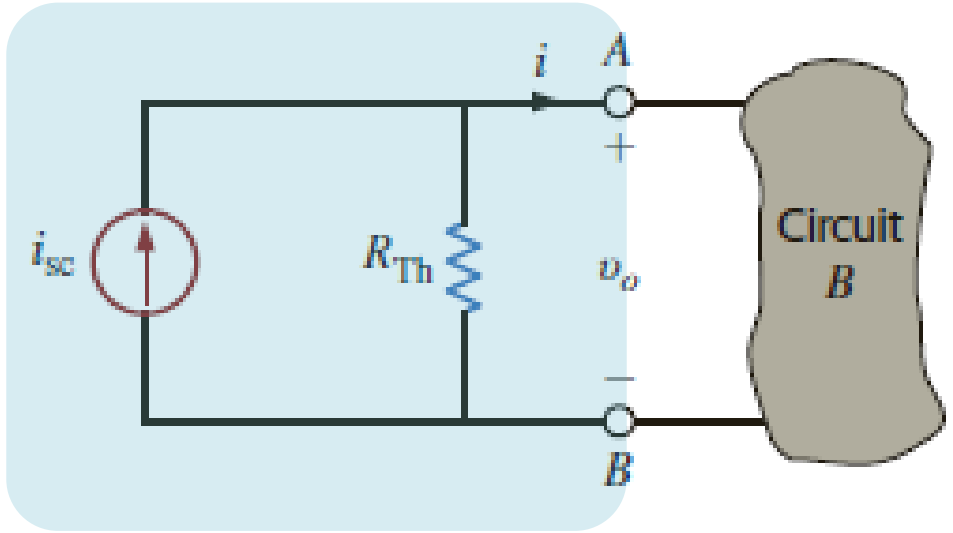
- **Thevenin**



- **Norton**



Thevenin and Norton Equivalent circuits are equivalent…

… hence source transformation is possible remembering

$$v_{oc} = R_{Th} \cdot i_{sc}$$

Learning Assessment → E5.13

Use source transformation to find V_0 in the network provided.