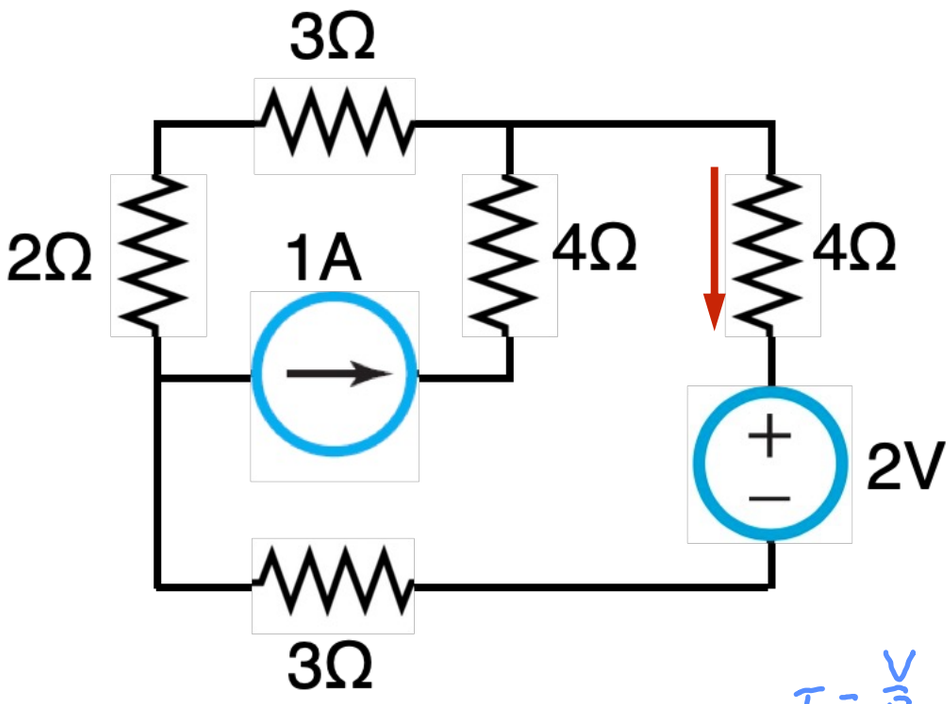
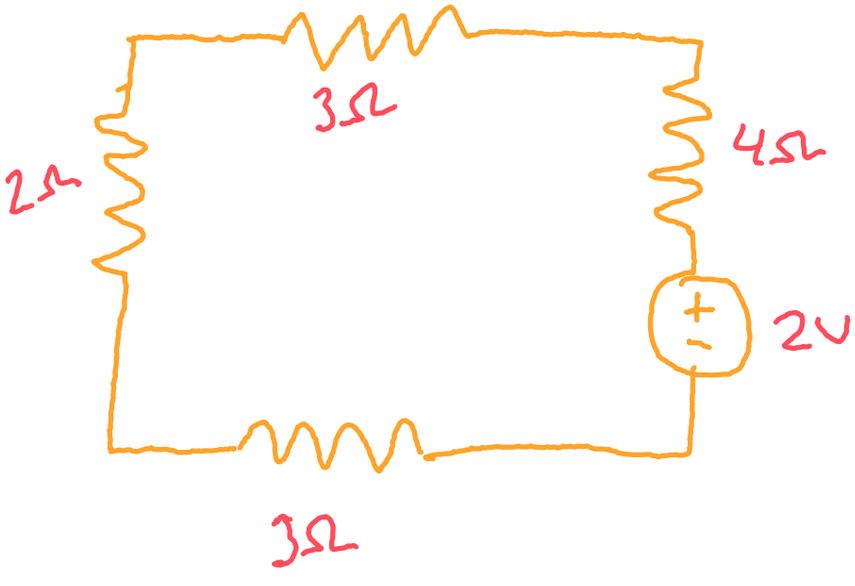
Last Class…

Use the principle of superposition to find the current i.





$I = \frac{V}{R}$

$I = \frac{2}{12}$

$I = \frac{1}{6}\,A$

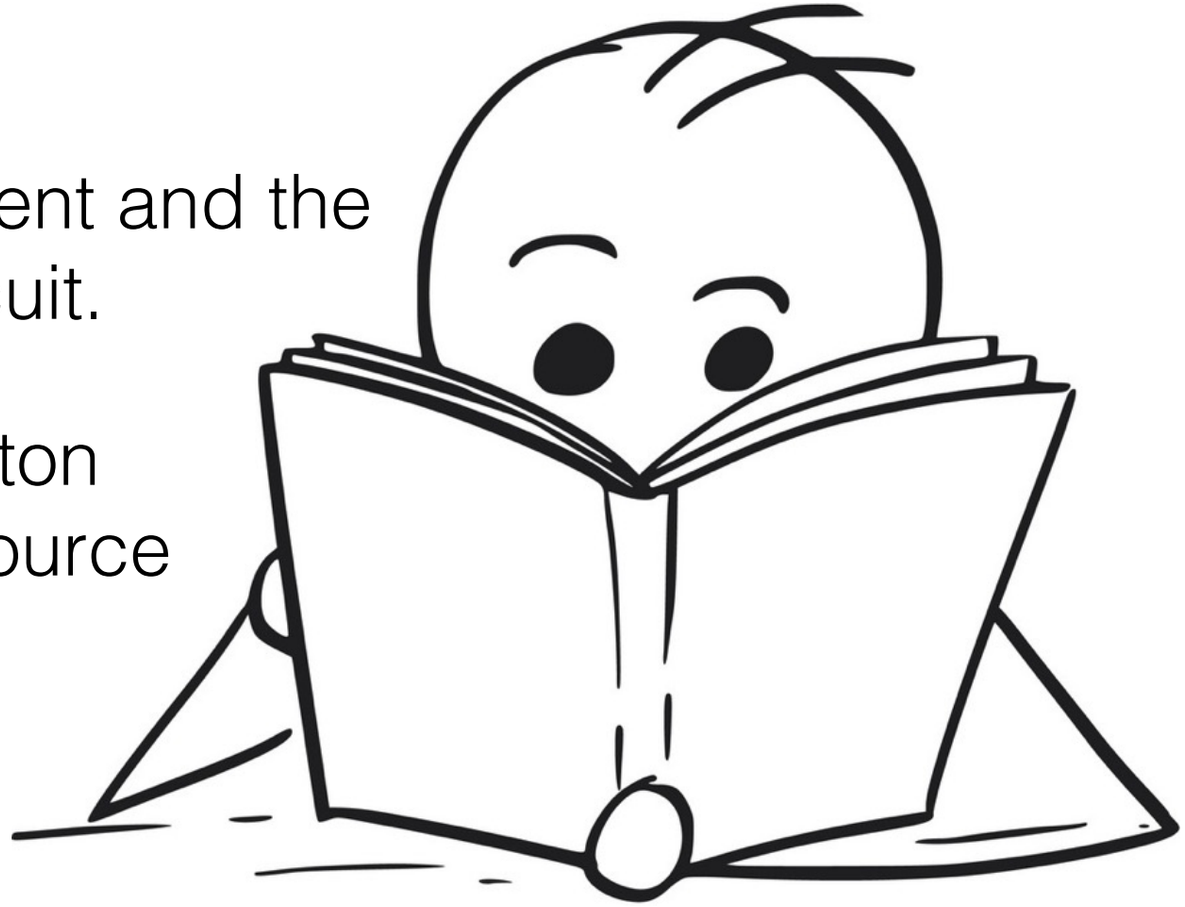
THE OHIO STATE UNIVERSITY

COLLEGE OF ENGINEERING

Equivalent Circuits

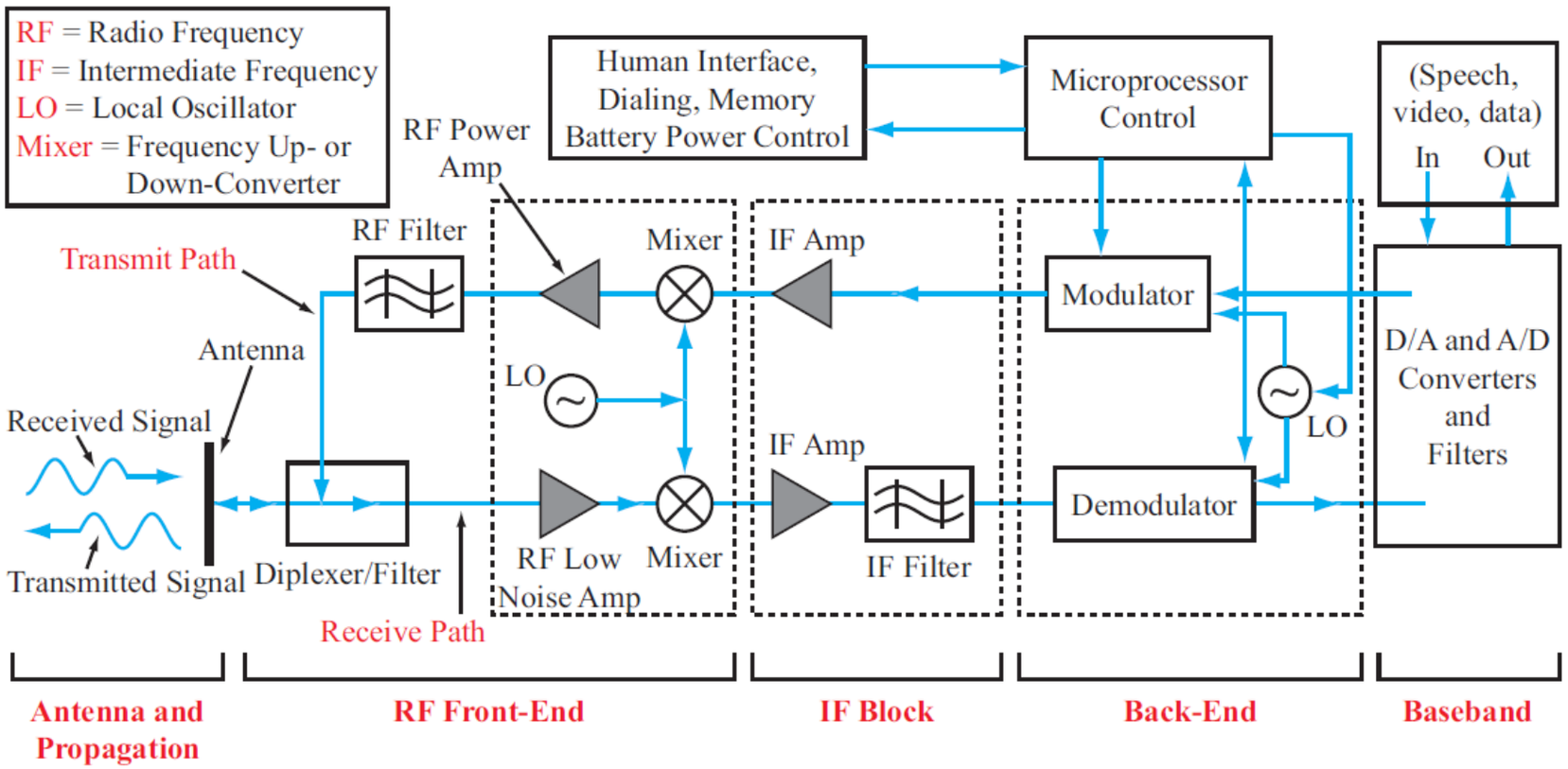
This Lecture…

- Learning Objectives:
  - Understand the importance and application of equivalent circuits.
  - Determine the Thévenin voltage and the Thevenin resistance of a circuit.
  - Determine the Norton current and the Norton resistance of a circuit.
  - Given the Thévenin or Norton equivalent circuit, apply source transformation.



Cell Phone

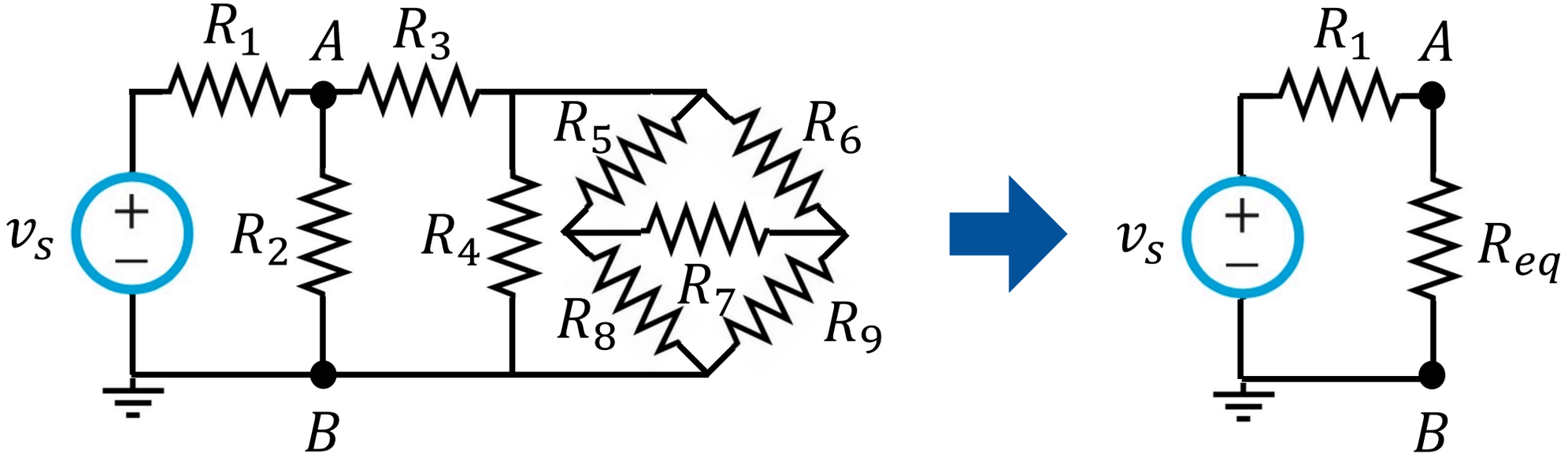
- Today's systems are complex. We use a block diagram approach to represent circuit sections.



Equivalent Circuit

Recall that:

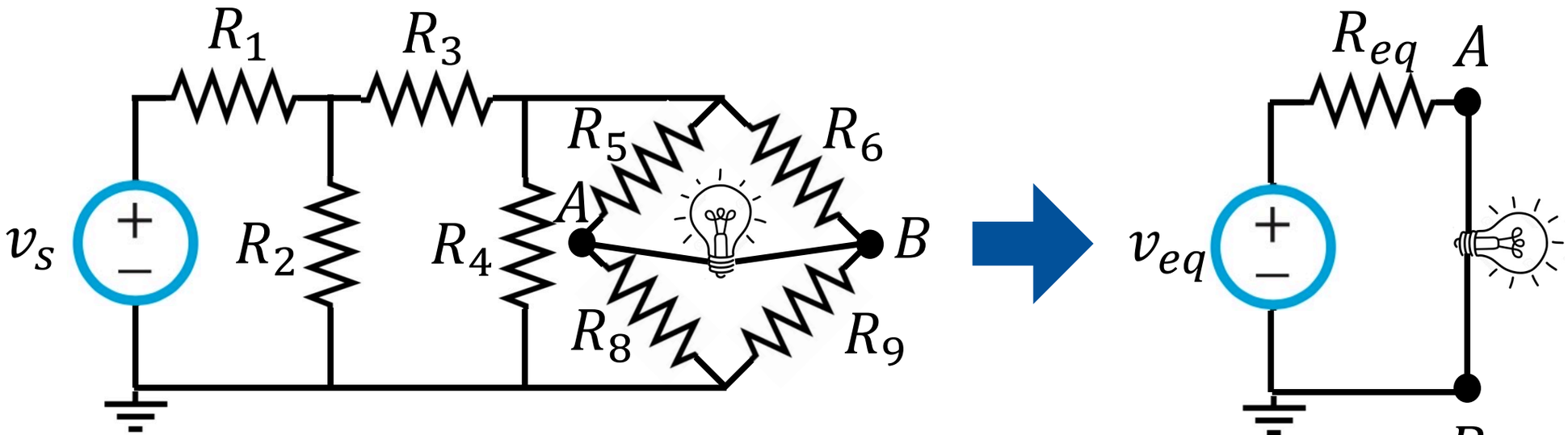
- Simplify analysis.
- Voltage and Current between A and B do not change.



Equivalent Circuit

Recall that:

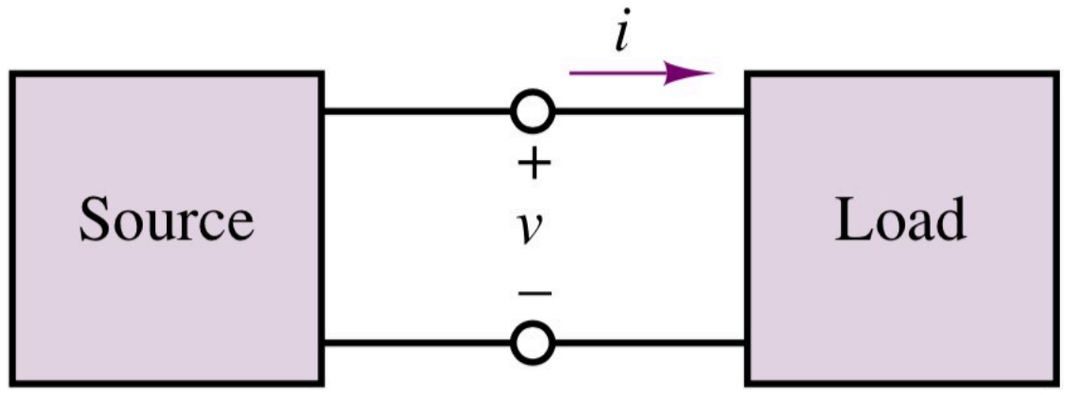
- Simplify analysis.
- Voltage and Current between A and B do not change.



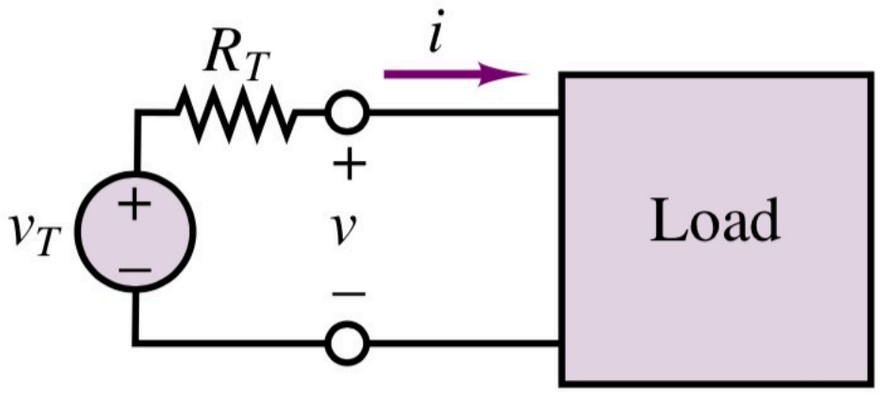
Our ability to develop equivalent-circuit representations is made possible (in part) by a pair of theorems of fundamental significance known as Thévenin's and Norton's theorems.

Thevenin and Norton Equivalent

- Linear two-terminal circuit can be replaced by an equivalent circuit:

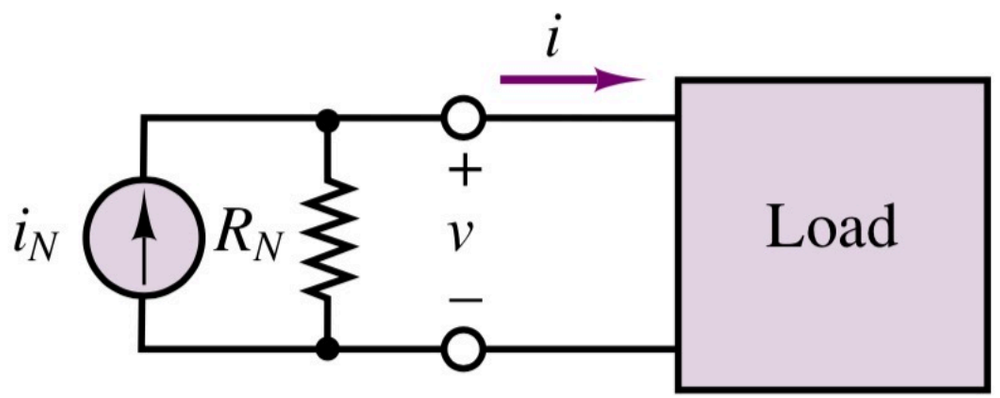


Thévenin equivalent



Composed of a voltage source and a series resistor.

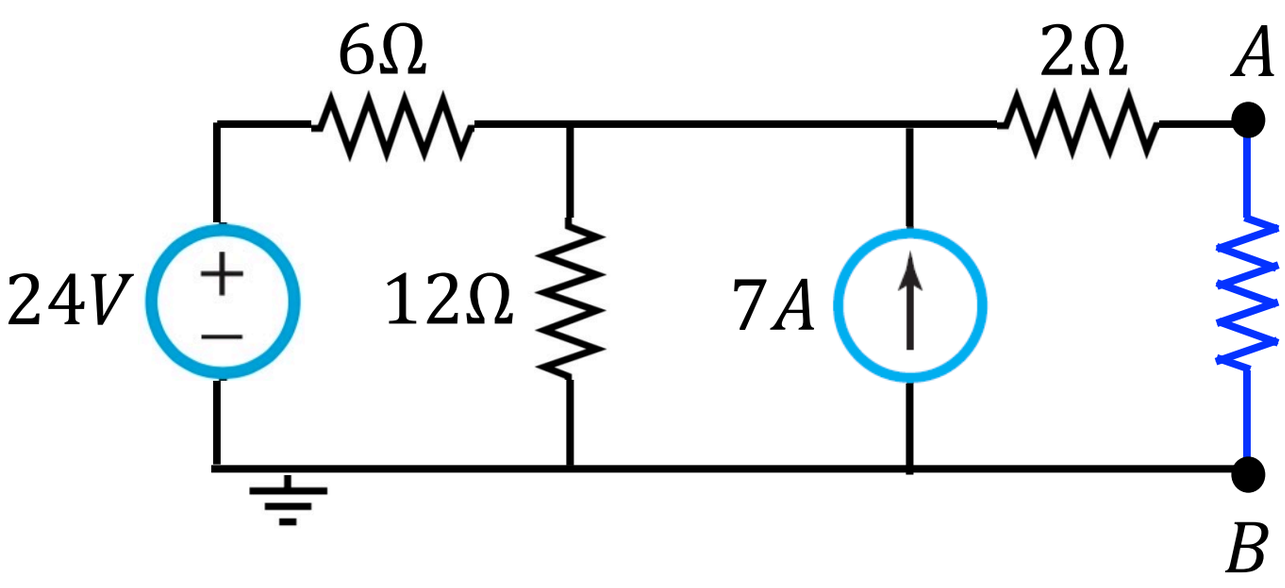
Norton equivalent



Composed of a current source and parallel resistor.

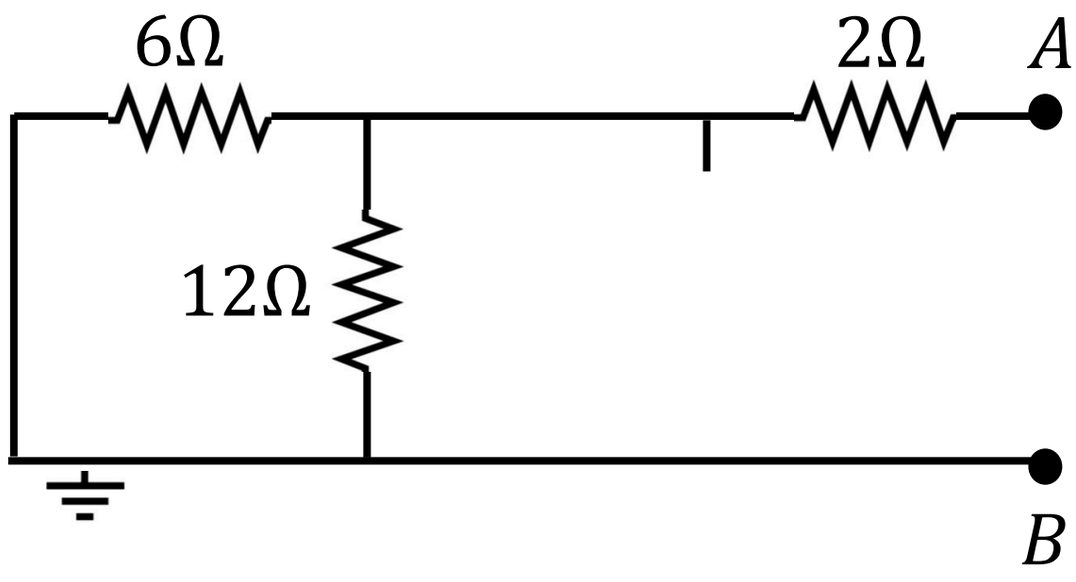
Computation of R_{TH}

1. Remove the load and set all independent sources to zero.



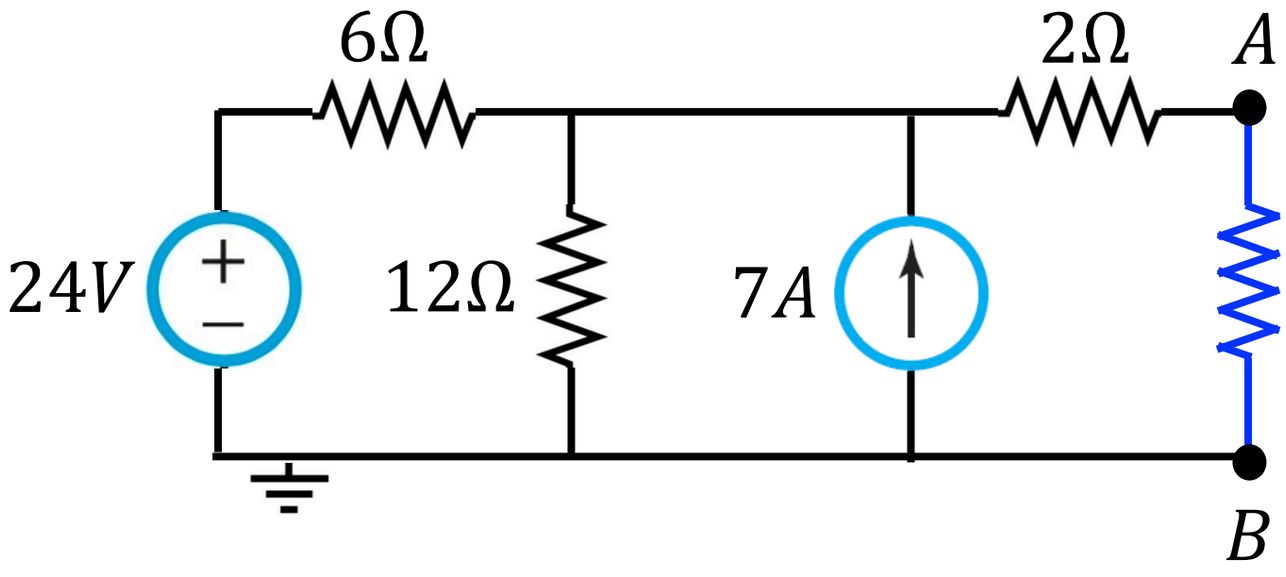
Computation of R_{TH}

1. Remove the load and set all independent sources to zero.
2. Apply series and parallel equivalent resistance substitutions to find effective equivalent resistance.
   - Sometimes may need to attach independent voltage source to the terminals (e.g., when there is a dependent source).



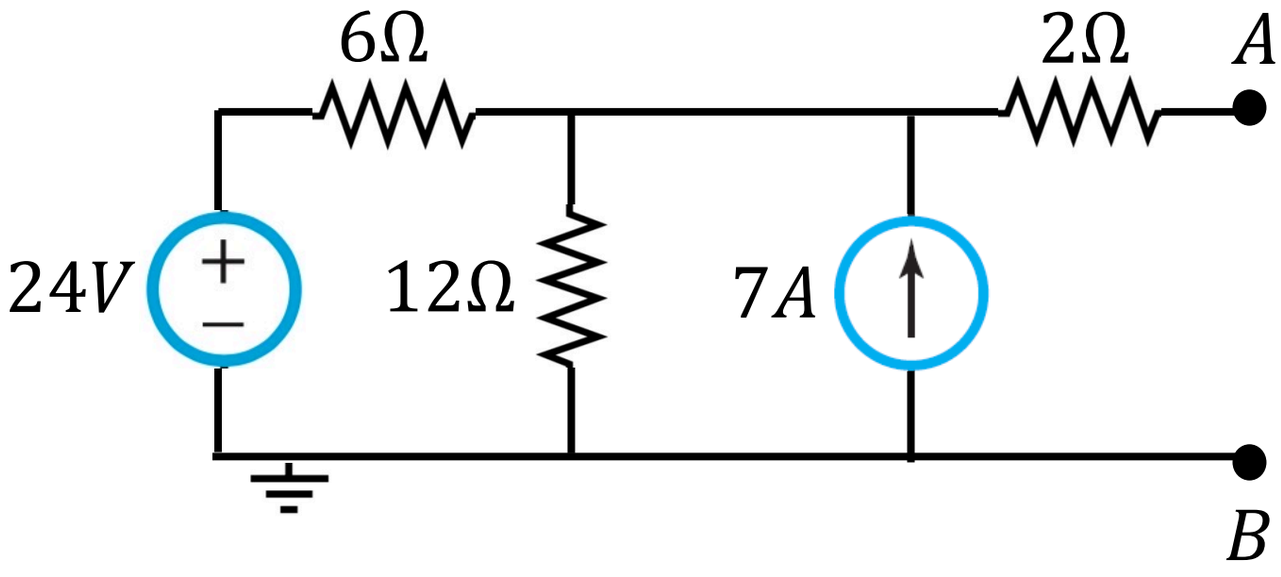
Thévenin Voltage

1. Remove the load, leaving the load terminals open-circuited.



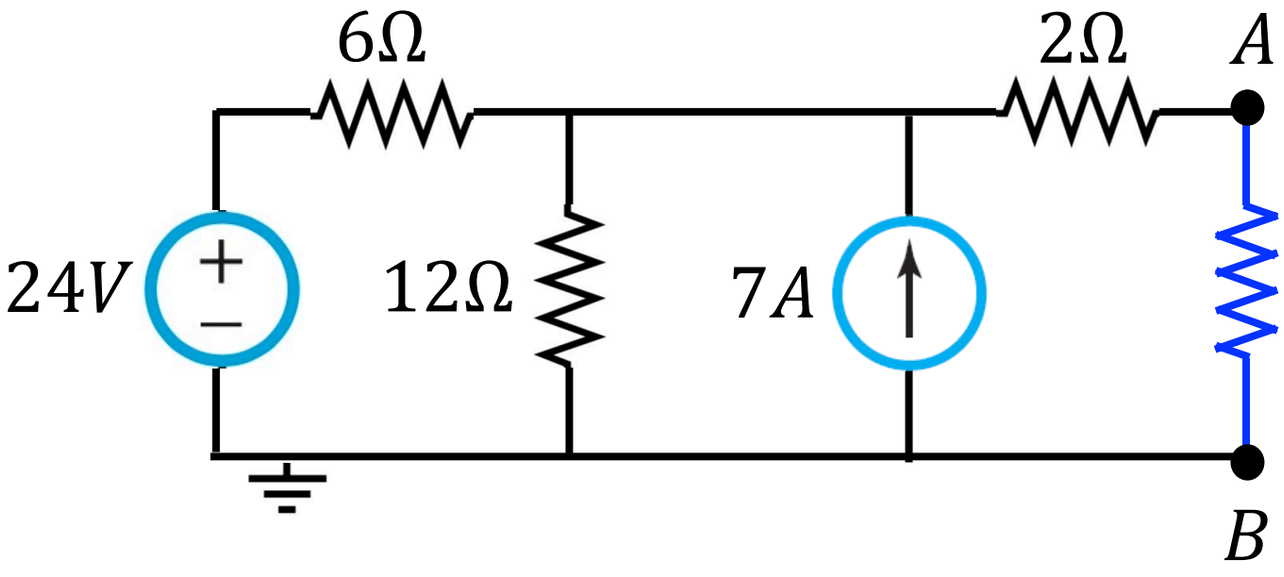
Thévenin Voltage

1. Remove the load, leaving the load terminals open-circuited.
2. Define the open-circuit voltage v_{TH} across the open load terminals.
3. Apply any preferred method (e.g., nodal analysis, mesh analysis) to solve for v_{TH}.



Norton Current

1. Replace the load with a short circuit.

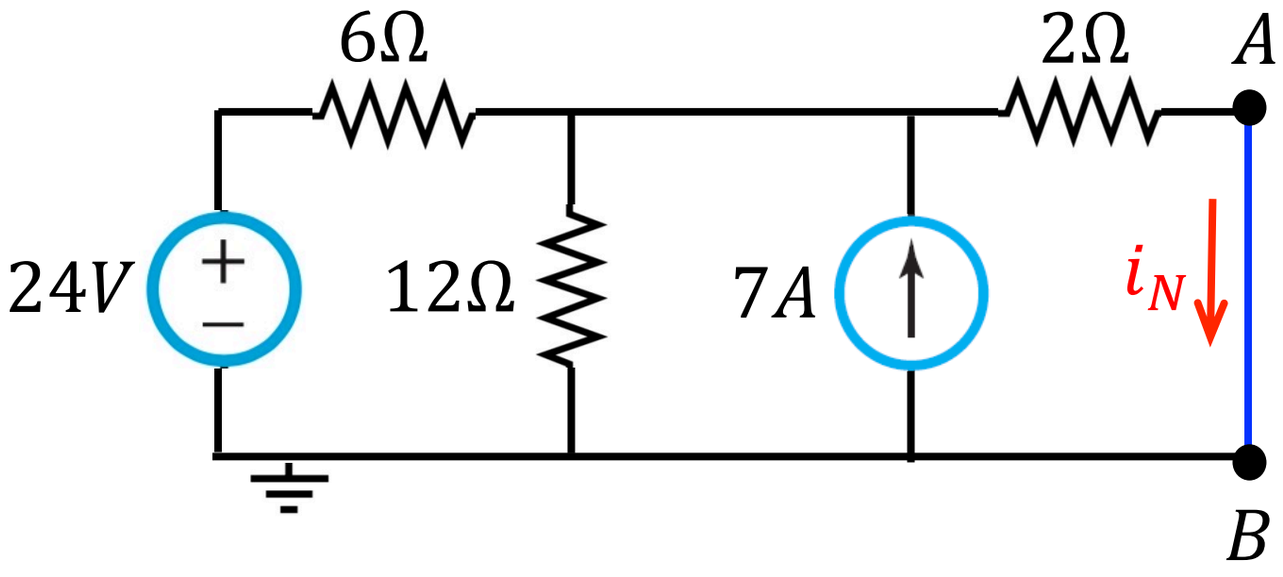


Norton Current

1. Replace the load with a short circuit.

2. Define the short circuit current, i_N, to be the Norton equivalent current.

3. Apply any preferred method (e.g., nodal analysis) to solve for i_N.



Equivalent Circuits