Chapter 3 - Resistive Circuits

Lecture 5
Section 3.2

MEMS 0031 Electrical Circuits

Mechanical Engineering and Materials Science Department
University of Pittsburgh

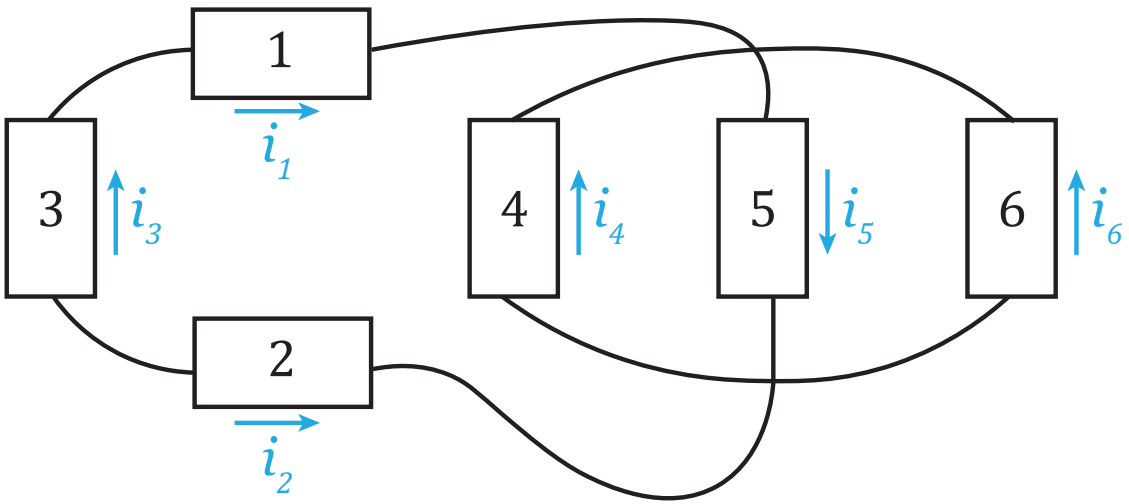
Student Learning Objectives

At the end of the lecture, students should be able to:

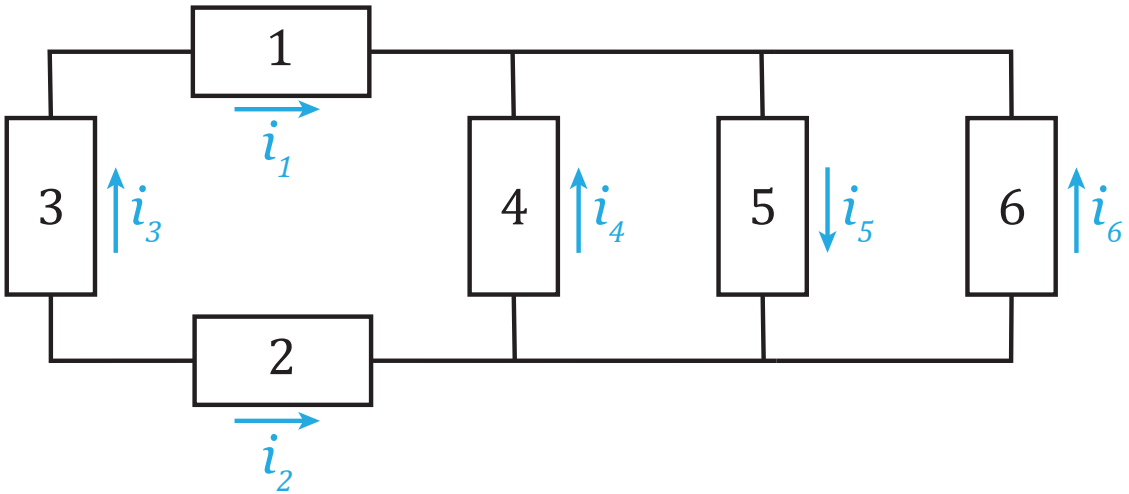
- Draw a circuit network and understand the principle of equivalent
- Understand and apply Kirchoff's Current Law (KCL)
- Understand and apply Kirchoff's Voltage Law (KVL)

Circuits

- There are a variety of ways to draw circuits:



- Then there is the correct way:

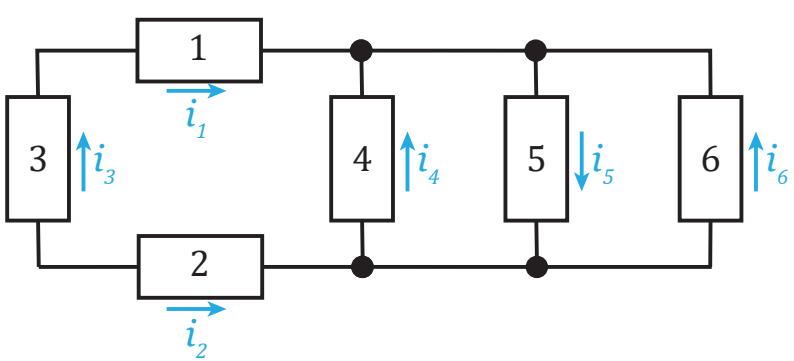


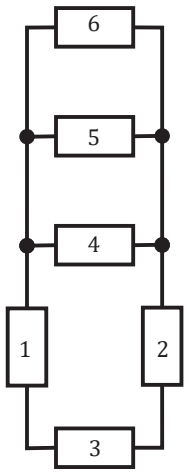
Equivalence

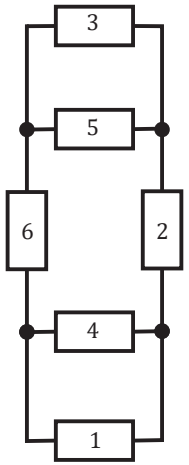
- For two electrical circuits to be equivalent, the following have to be satisfied:
  1. Same number of nodes
  2. Same number of elements
  3. Same nodes connect same elements

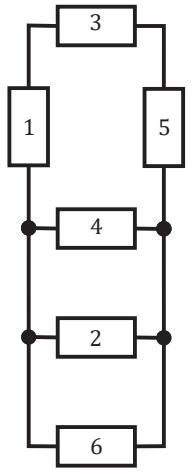
Equivalence

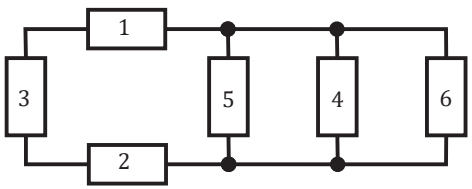
- Which of the following circuits are equivalent?

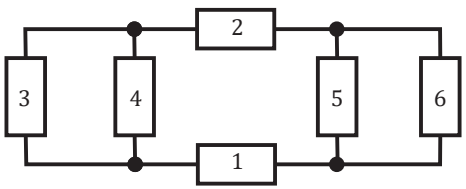


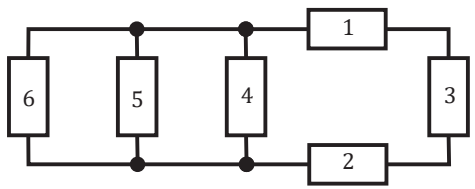












Kirchoff's Laws

- **Kirchoff's Current Law** (KCL) states the sum of all currents flowing into or out of a node must equal zero:

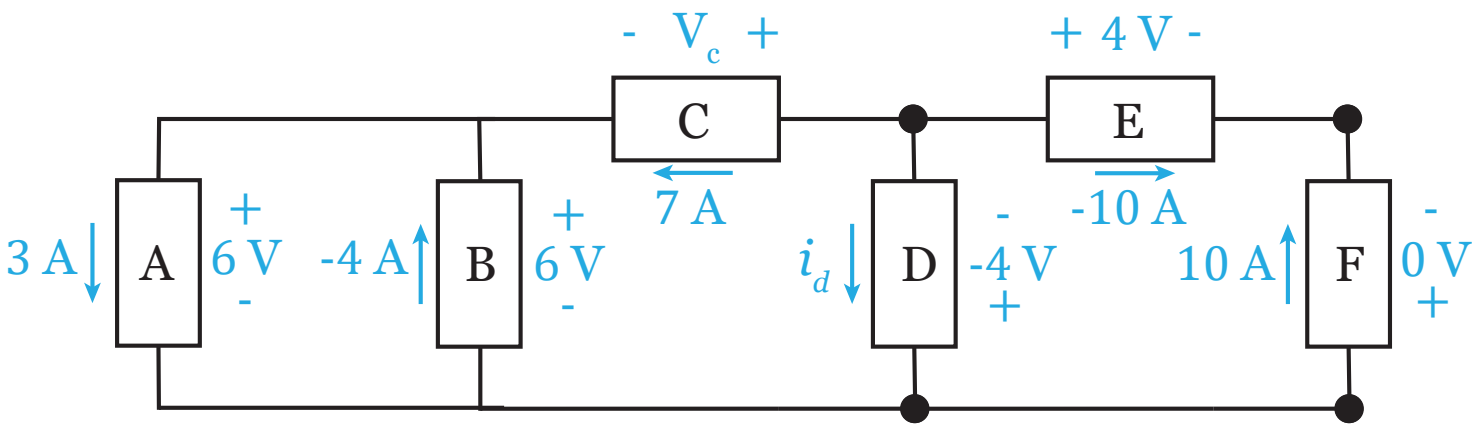
$$\boxed{\sum i_{\text{in}} = \sum i_{\text{out}}}$$

- **Kirchoff's Voltage Law** (KVL) states the sum of all voltages around a loop equals zero:

$$\boxed{\sum V_{\text{drop}} = \sum V_{\text{rise}}}$$

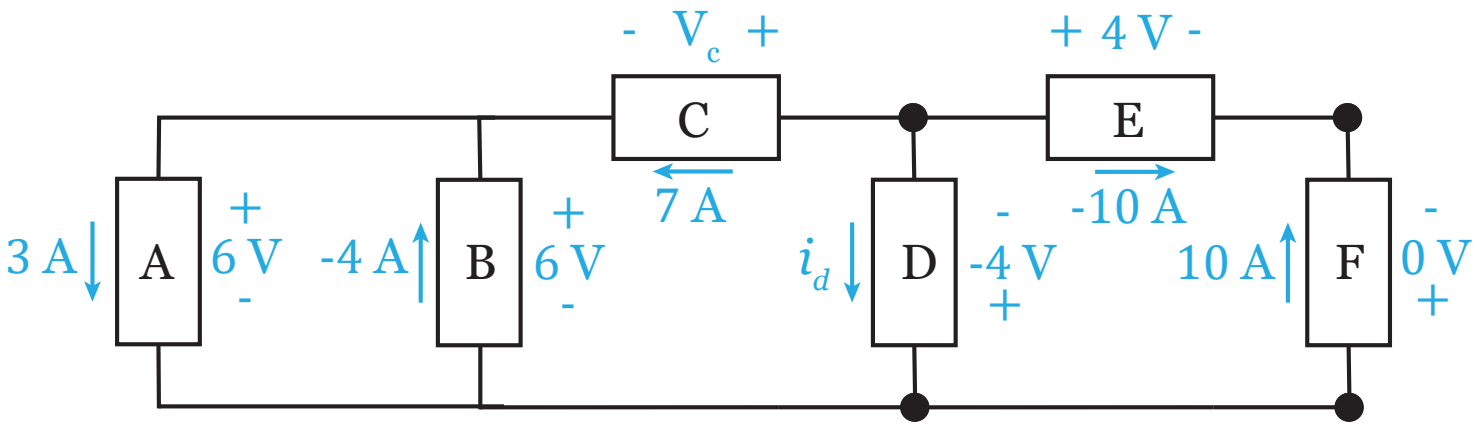
Example #1

- Find the power supplied by element C and the power received by element D



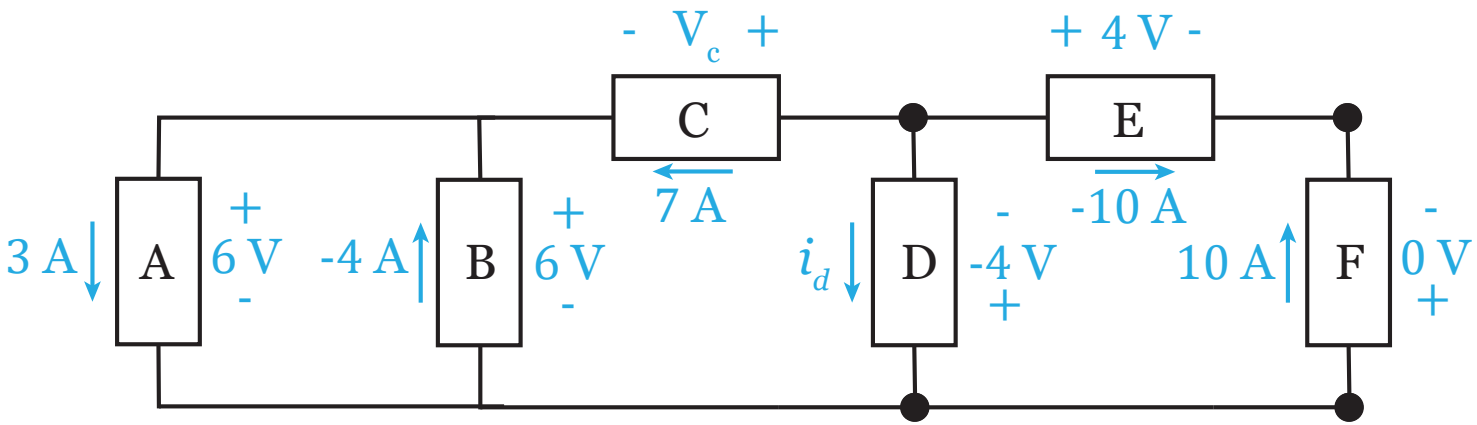
Example #1

- Solution:



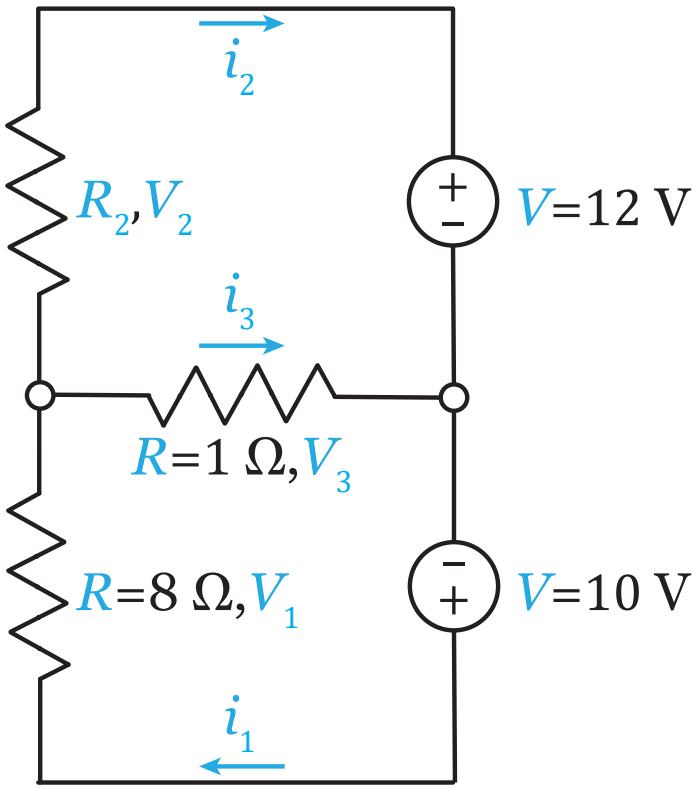
Example #1

- Solution:



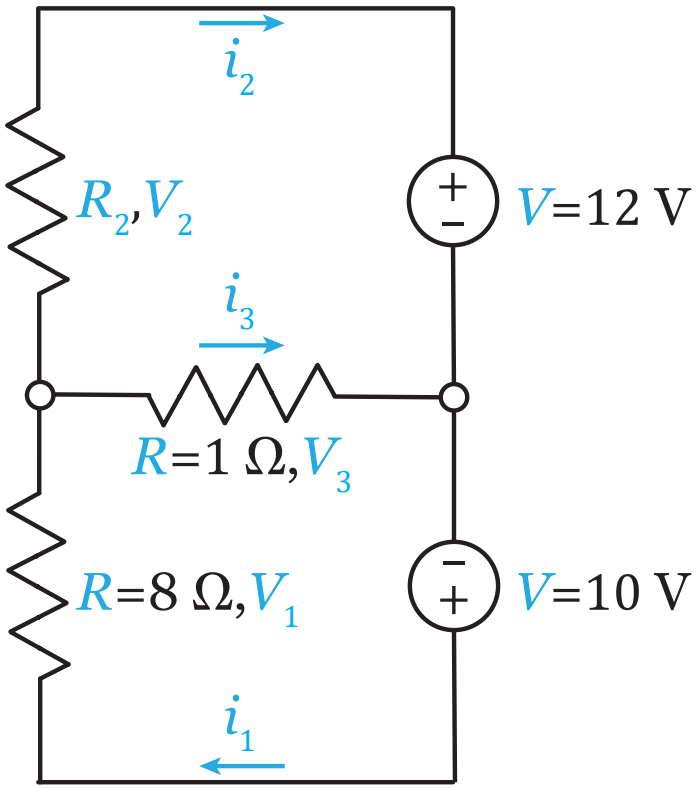
Example #2

- Find the currents through each resistor as well as the value of R_2 given i_3=2 [A]



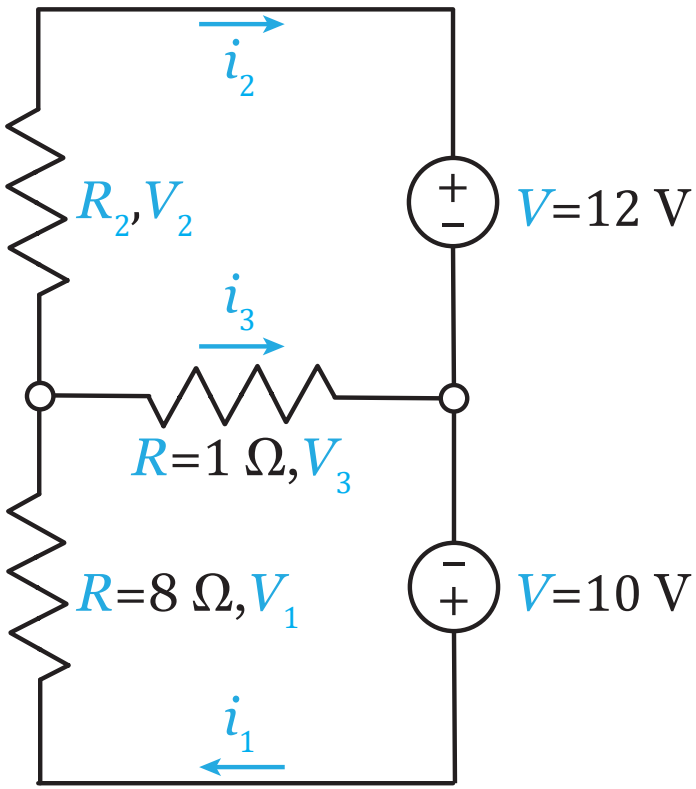
Example #2

- Solution:



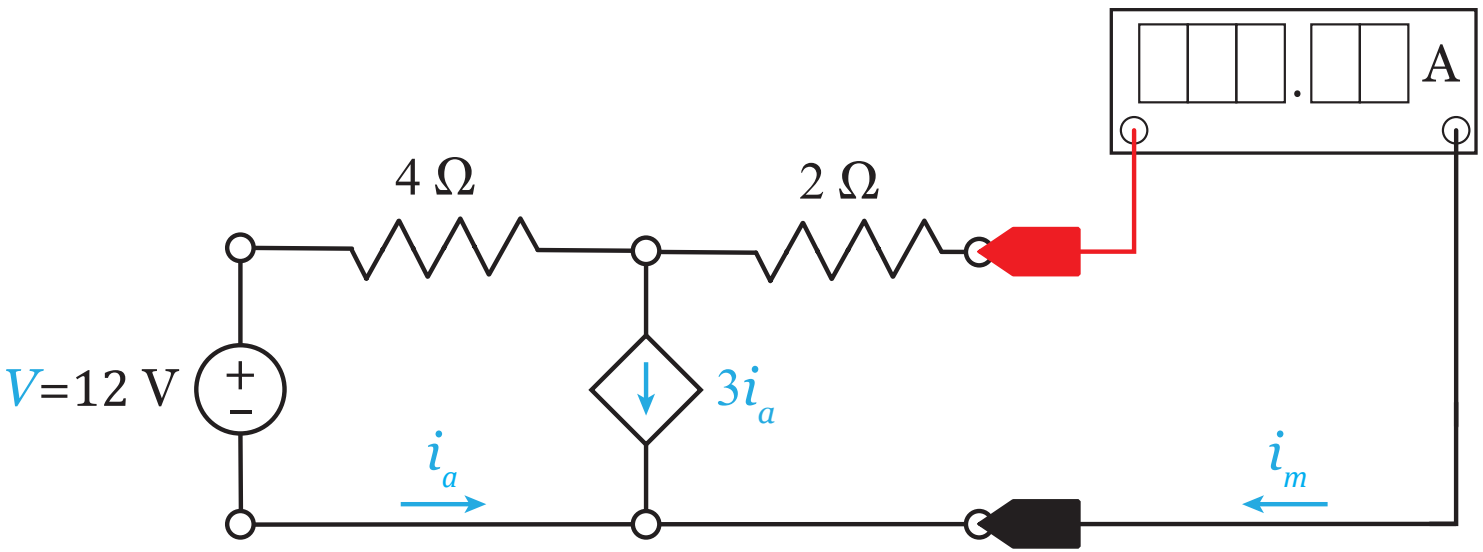
Example #2

- Solution:



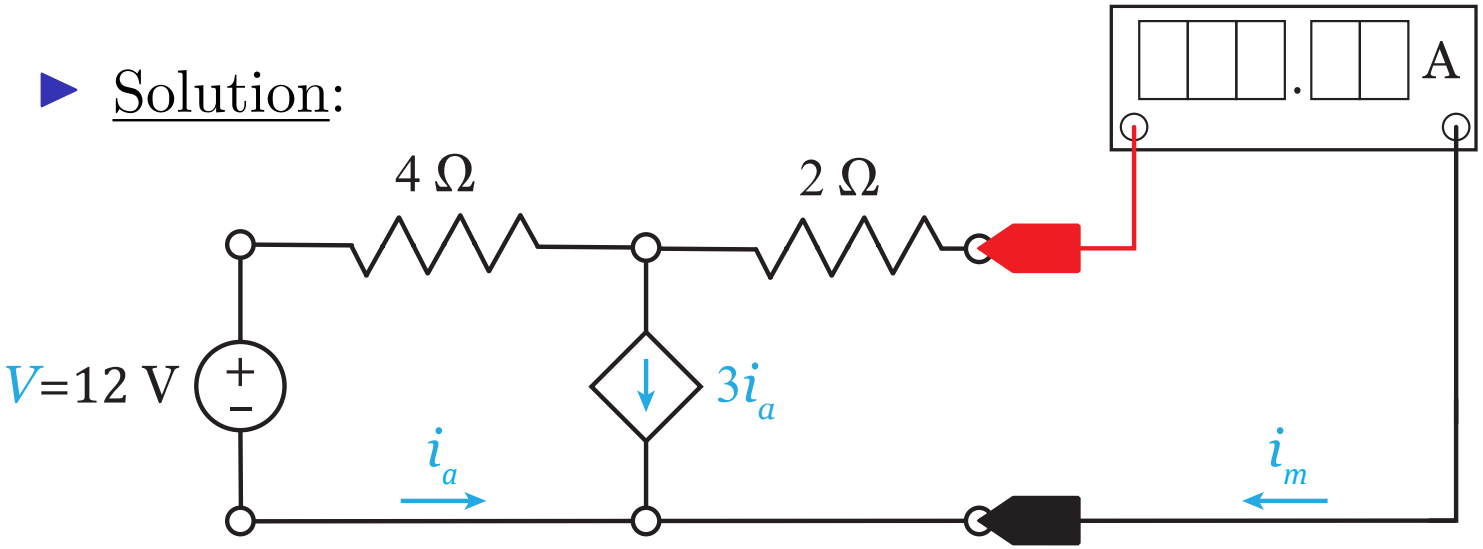
Example #3

- What is the current measured by the ammeter?



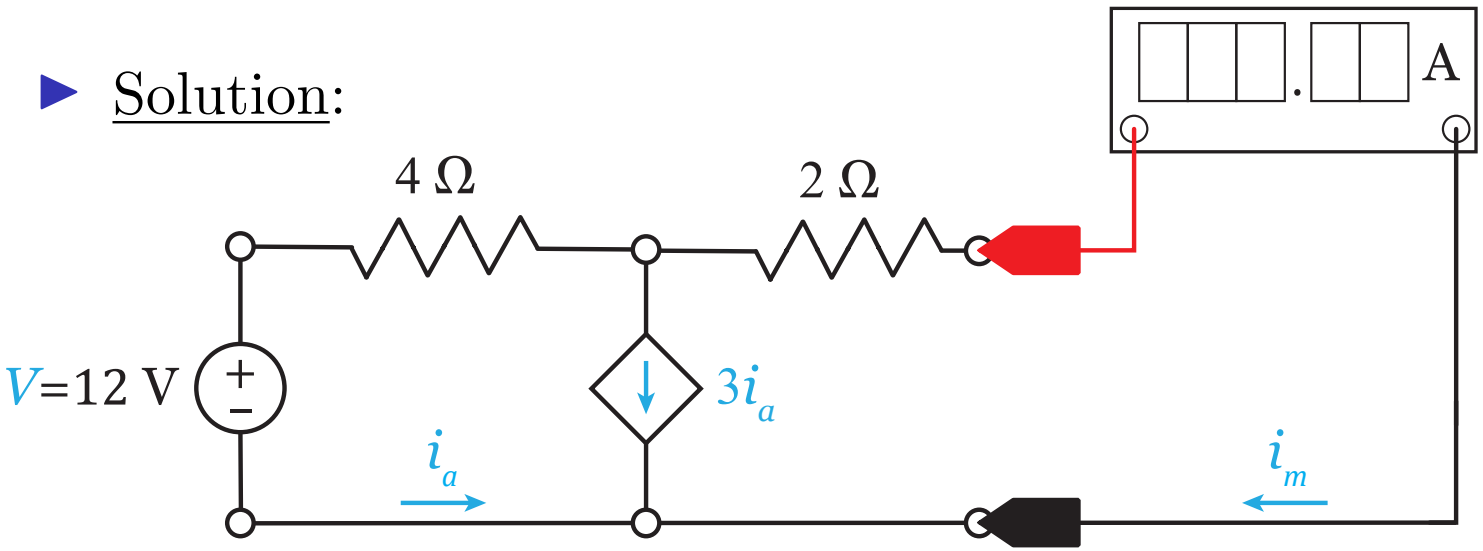
Example #3

- Solution:



Example #3

- Solution:



Student Learning Objectives

At the end of the lecture, students should be able to:

- Draw a circuit network and understand the principle of equivalent
  - The principle of equivalence states that two circuits are equivalent if they have the same number of nodes and elements, and the same nodes connect the same elements.
- Understand and apply Kirchoff's Current Law (KCL)
  - KCL states the sum of currents entering a node must be the sum of currents exiting a node. This is equivalent to the continuity equation in Fluid Mechanics.

Student Learning Objectives

- Understand and apply Kirchoff's Voltage Law (KVL)
  - KVL states the sum of voltage potentials around a loop must equal zero. That is, the potential provided by a source must be dissipated by a sink - there can be not net potential.

Suggested Problems

- 3.2-1, 3.2-2, 3.2-3, 3.2-5, 3.2-6, 3.2-7, 3.2-12, 3.2-21