

Chapter 3 - Resistive Circuits

Lecture 5

Section 3.2

Learning Objectives

3.2 Kirchoff's Laws

Summary

MEMS 0031 Electrical Circuits

Mechanical Engineering and Materials Science Department
University of Pittsburgh



Student Learning Objectives

Chapter 3 -
Resistive Circuits

MEMS 0031

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)

[Learning Objectives](#)

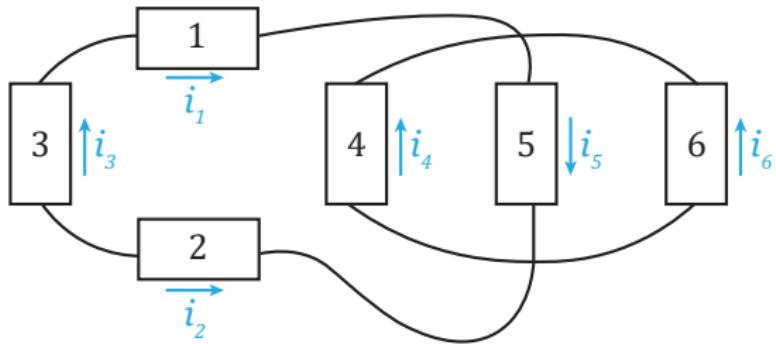
[3.2 Kirchoff's Laws](#)

[Summary](#)



Circuits

- There are a variety of ways to draw circuits:



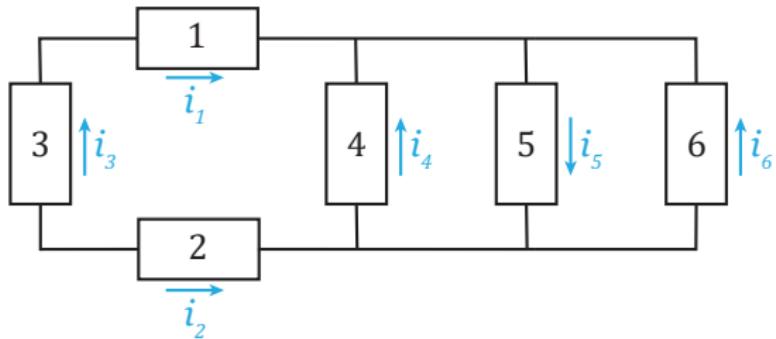
Learning Objectives

3.2 Kirchoff's Laws

Summary



- ▶ Then there is the correct way:



Learning Objectives

3.2 Kirchoff's Laws

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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

Learning Objectives

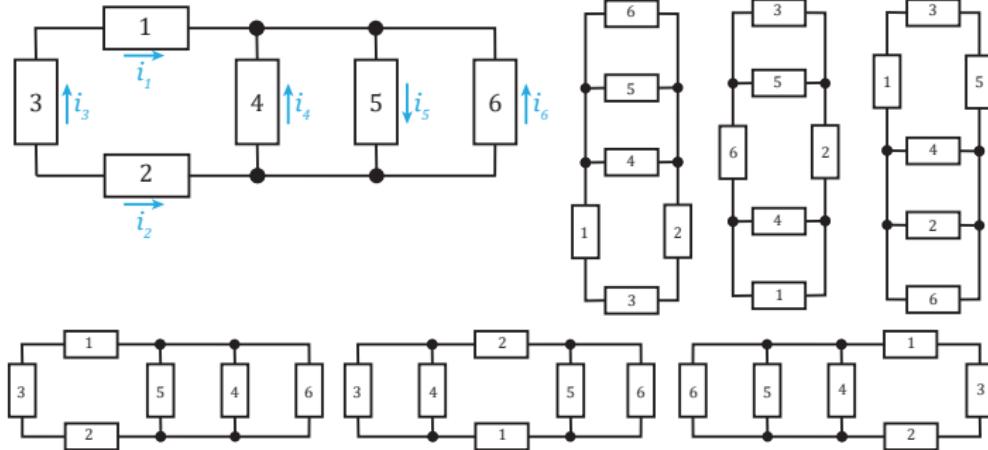
3.2 Kirchoff's Laws

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Equivalence

- Which of the following circuits are equivalent?



Learning Objectives

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

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

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

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

Learning Objectives

3.2 Kirchoff's Laws

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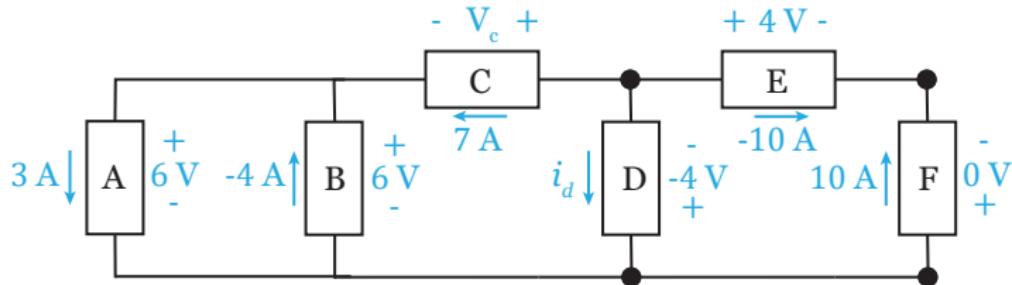
Example #1

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

Learning Objectives

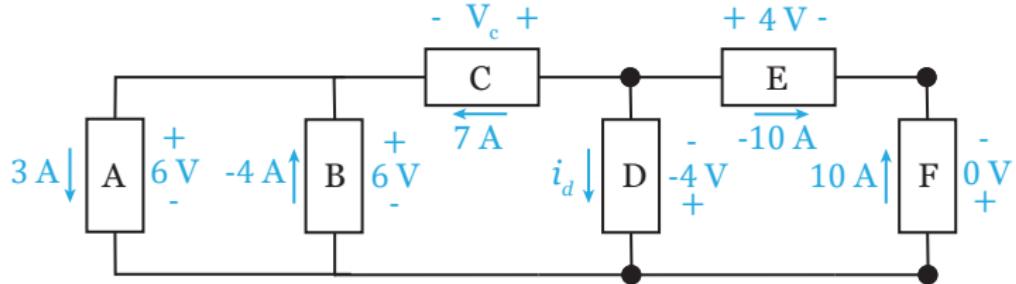
3.2 Kirchoff's Laws

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Example #1

► Solution:



Learning Objectives

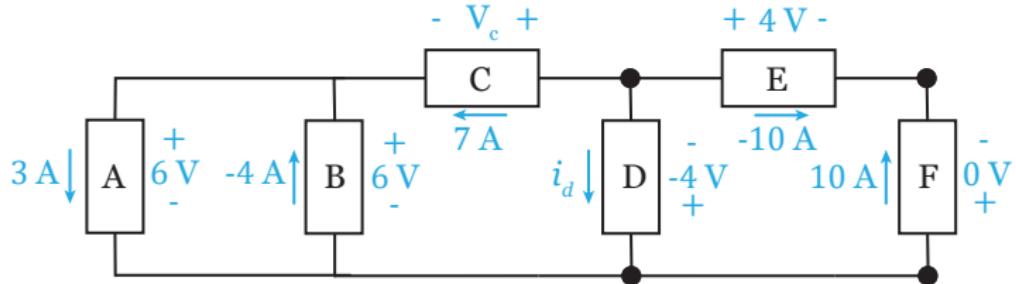
3.2 Kirchoff's Laws

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Example #1

► Solution:



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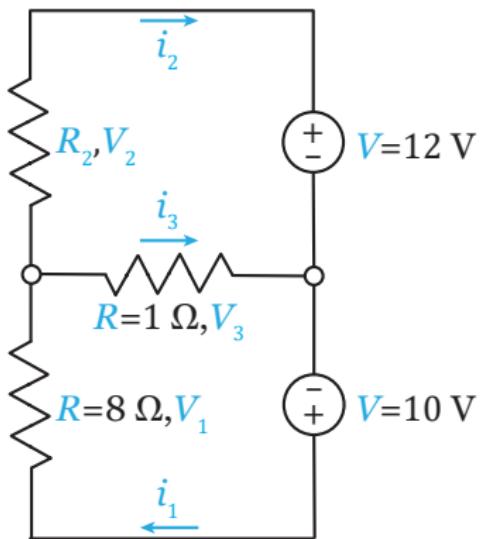


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3.2 Kirchoff's Laws

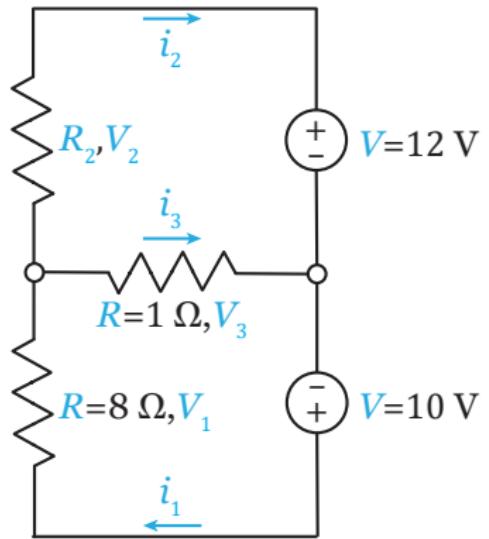
Summary

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



Example #2

► Solution:



Learning Objectives

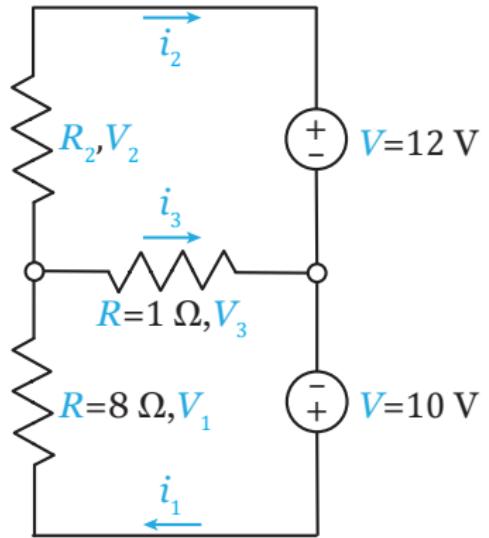
3.2 Kirchoff's Laws

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Example #2

► Solution:



Learning Objectives

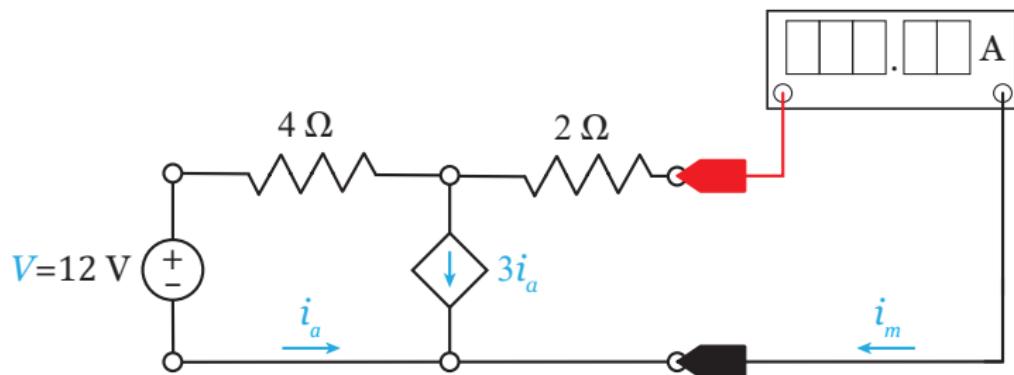
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Example #3

- ▶ What is the current measured by the ammeter?



Learning Objectives

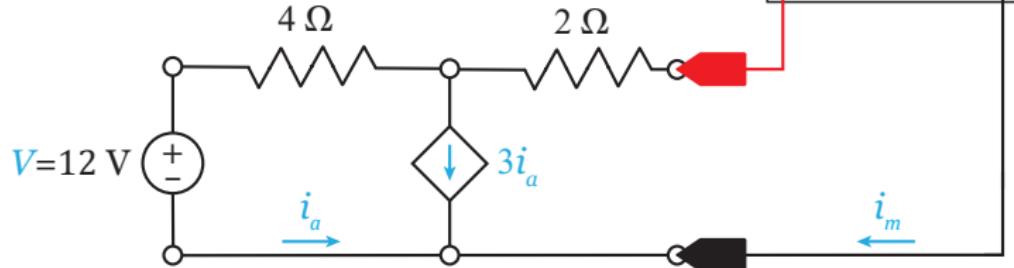
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Example #3

► Solution:



Learning Objectives

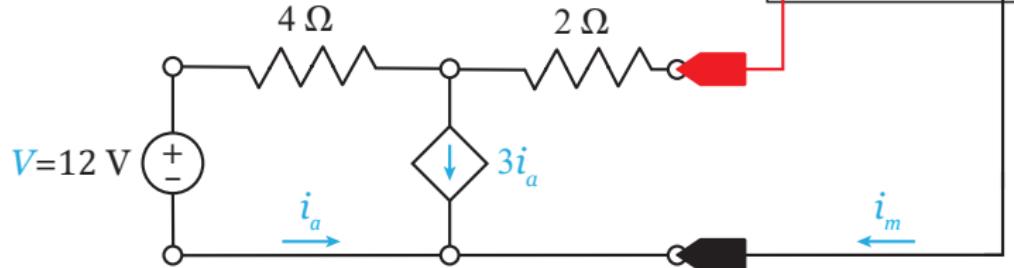
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Example #3

► Solution:



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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.

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- ▶ 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 no net potential.

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Suggested Problems

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

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