Chapter 4 - Methods of Analysis of Resistive Circuits

Lecture 9
Section 4.2

MEMS 0031 Electrical Circuits

Mechanical Engineering and Materials Science Department
University of Pittsburgh

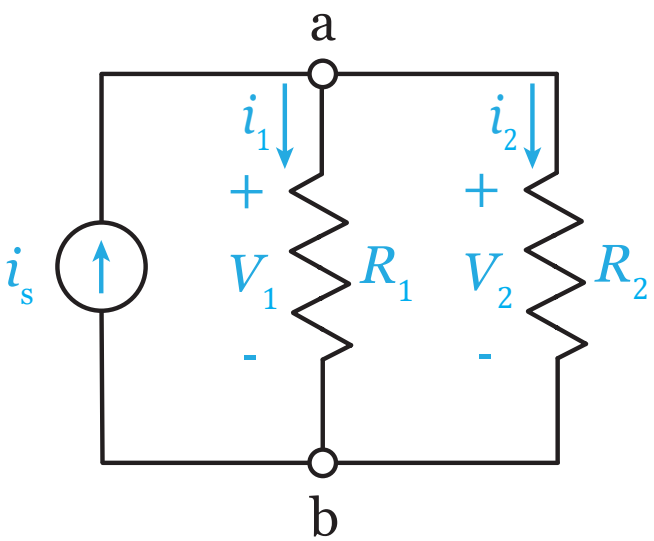
Student Learning Objectives

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

- Apply Node Voltage Analysis (NVA) to circuits with independent current sources

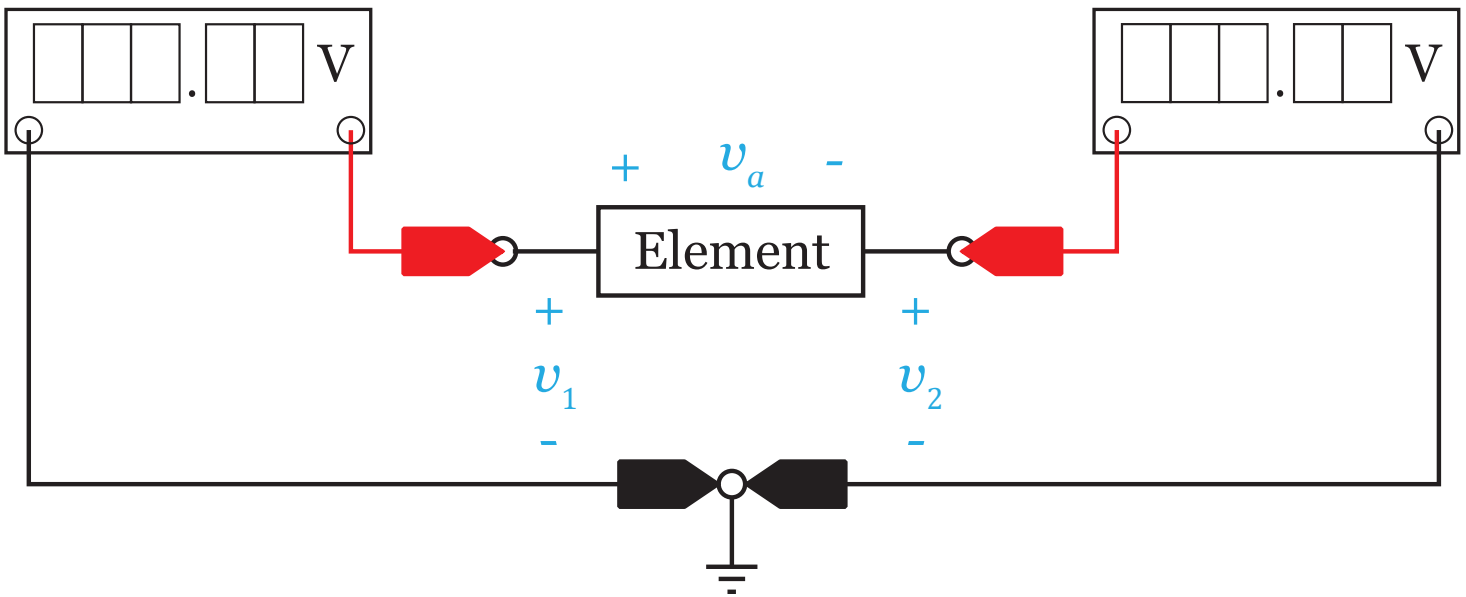
NVA

- So far, we've used KCL, KVL and Ohm's law to solve for the behavior of a circuit
- We want a formal, automated way to analyze circuits
- NVA uses strictly KCL and Ohm's law
- We will construct "node voltages" - based upon N nodes we will have N-1 KCL equations

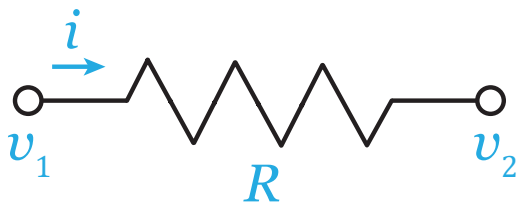


- Consider the following circuit: How many nodes do we have?

- Finding the voltage across an element:

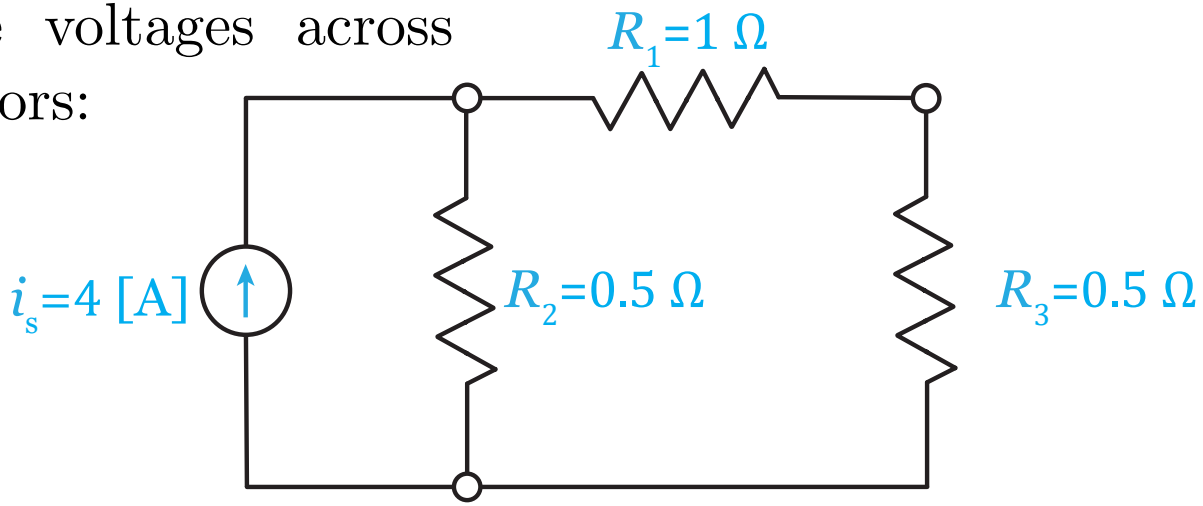


- Finding the current through a resistive element:



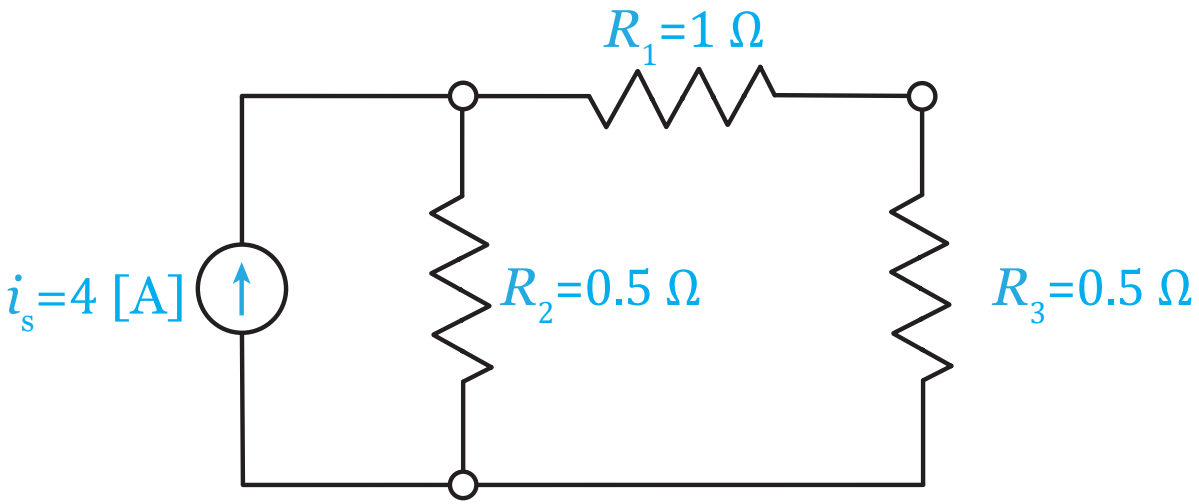
Example #1

Find the voltages across the resistors:



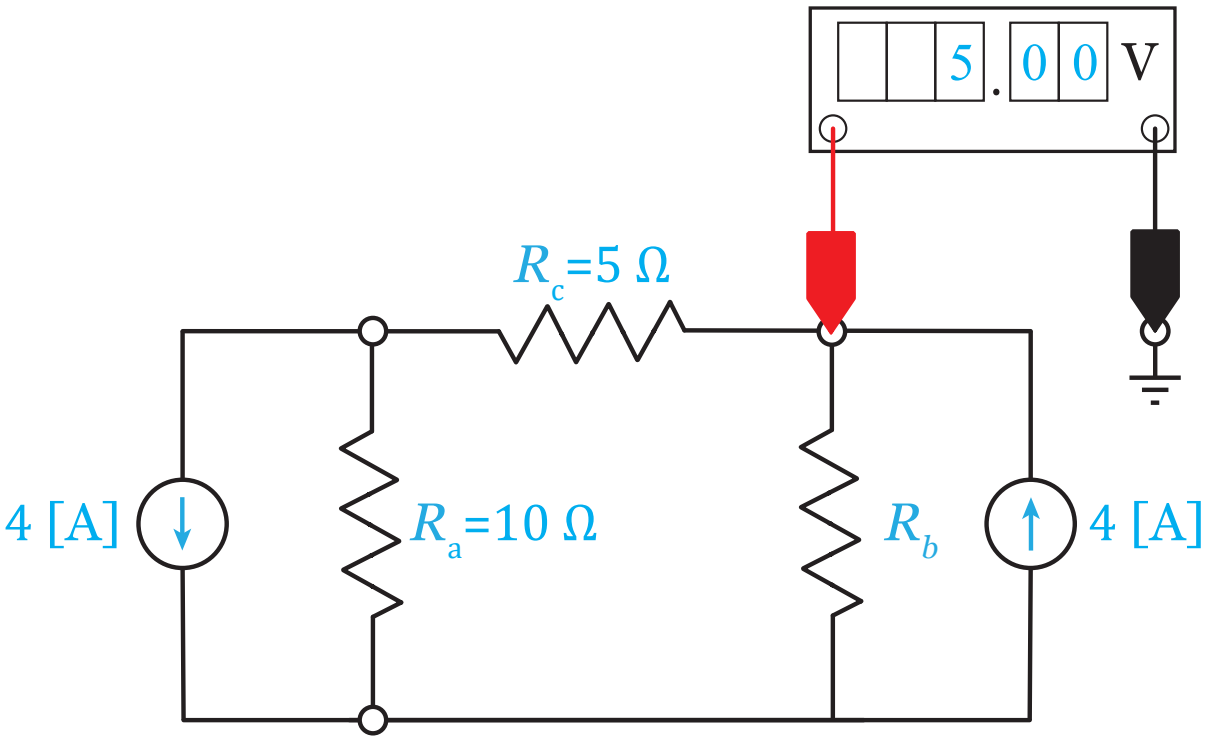
Example #1

Solution:



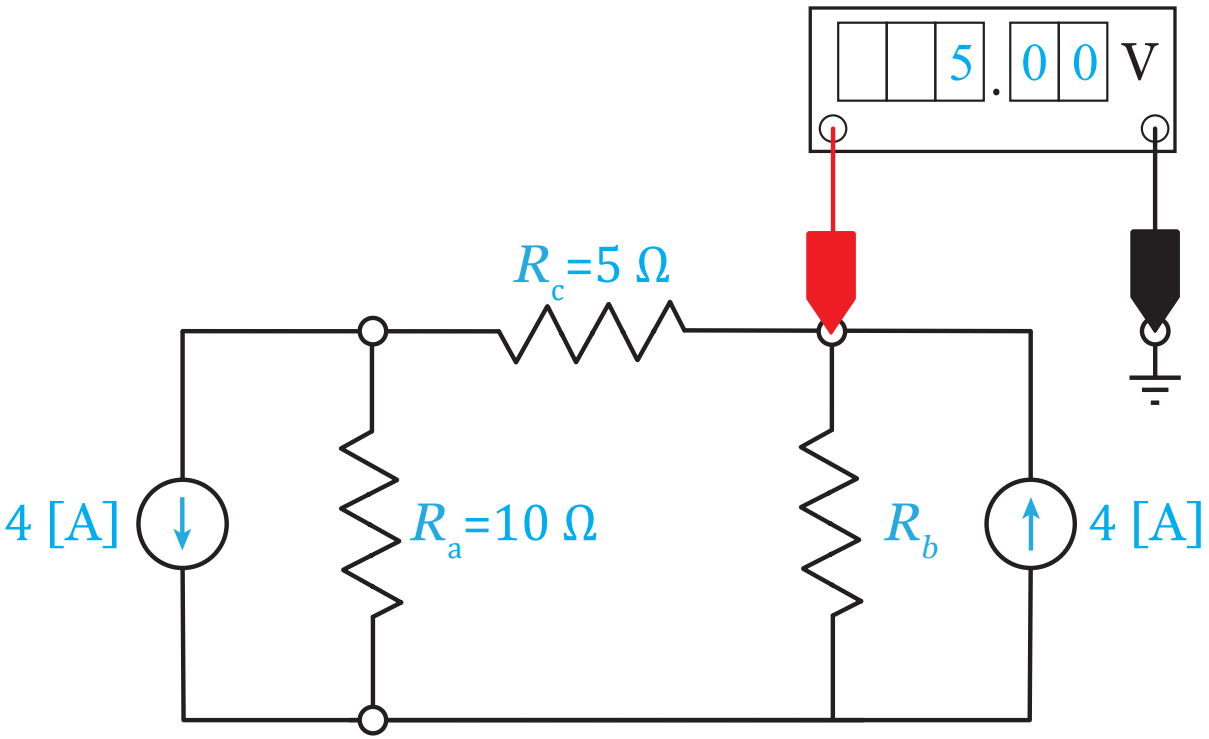
Example #2

Find R_b:



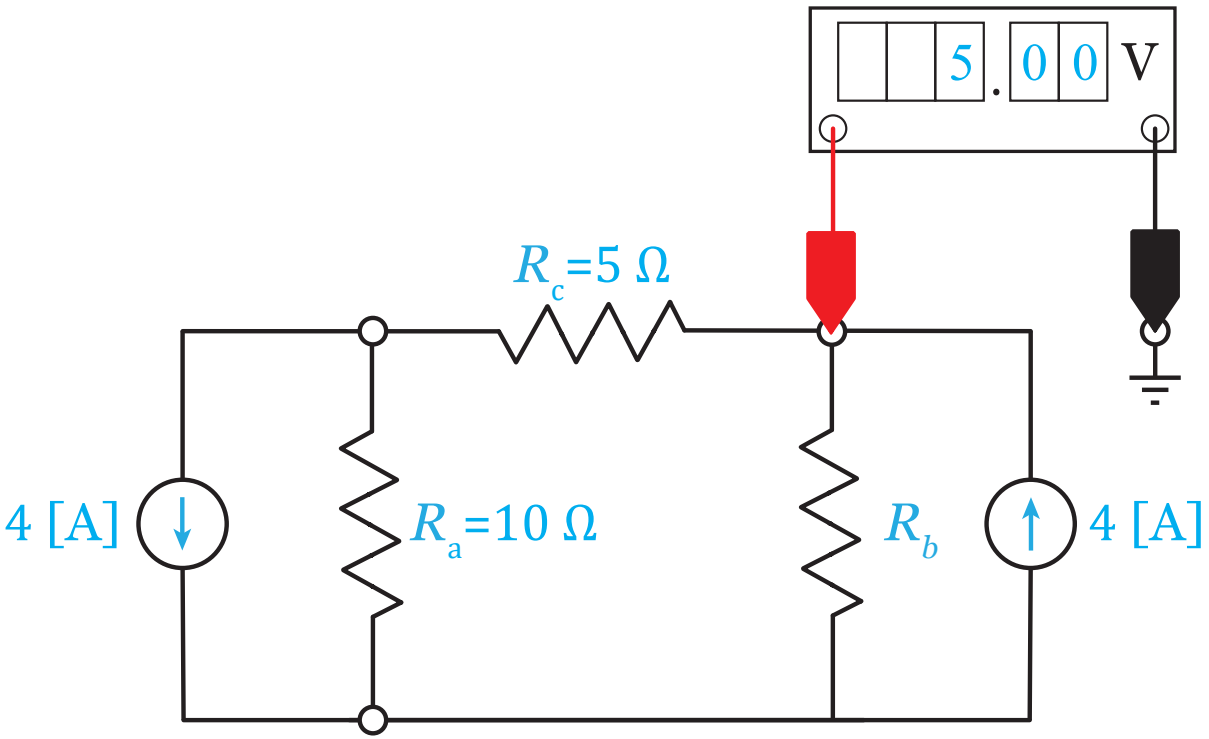
Example #2

Solution:



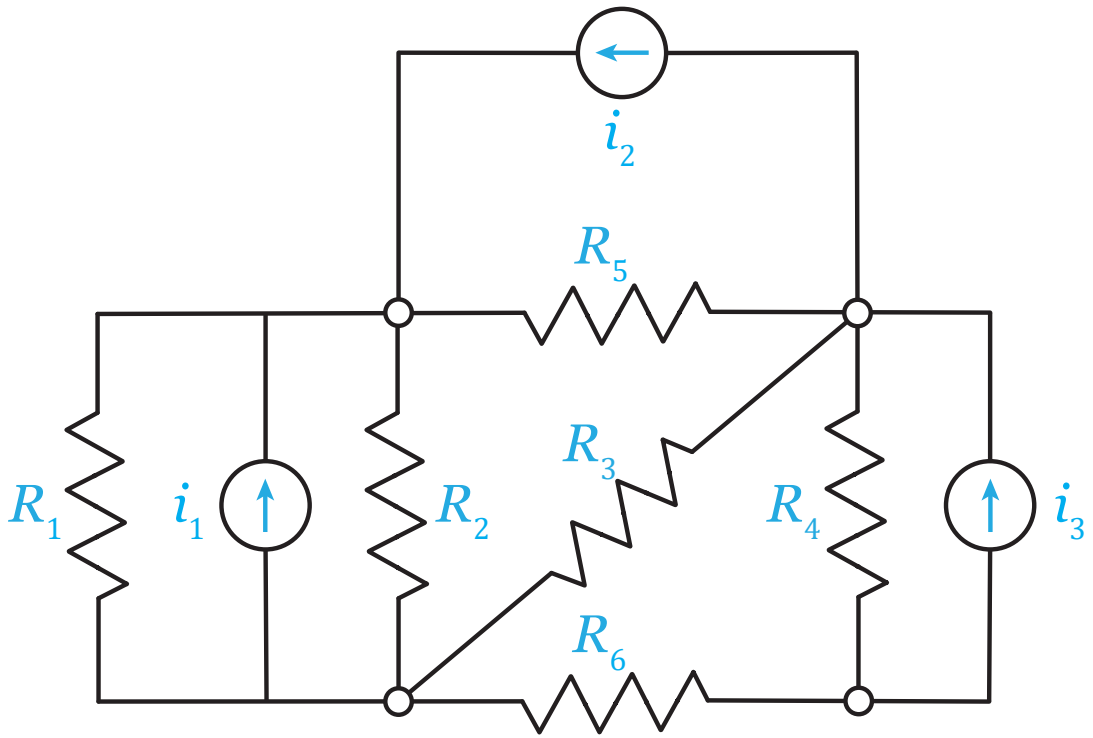
Example #2

Solution:



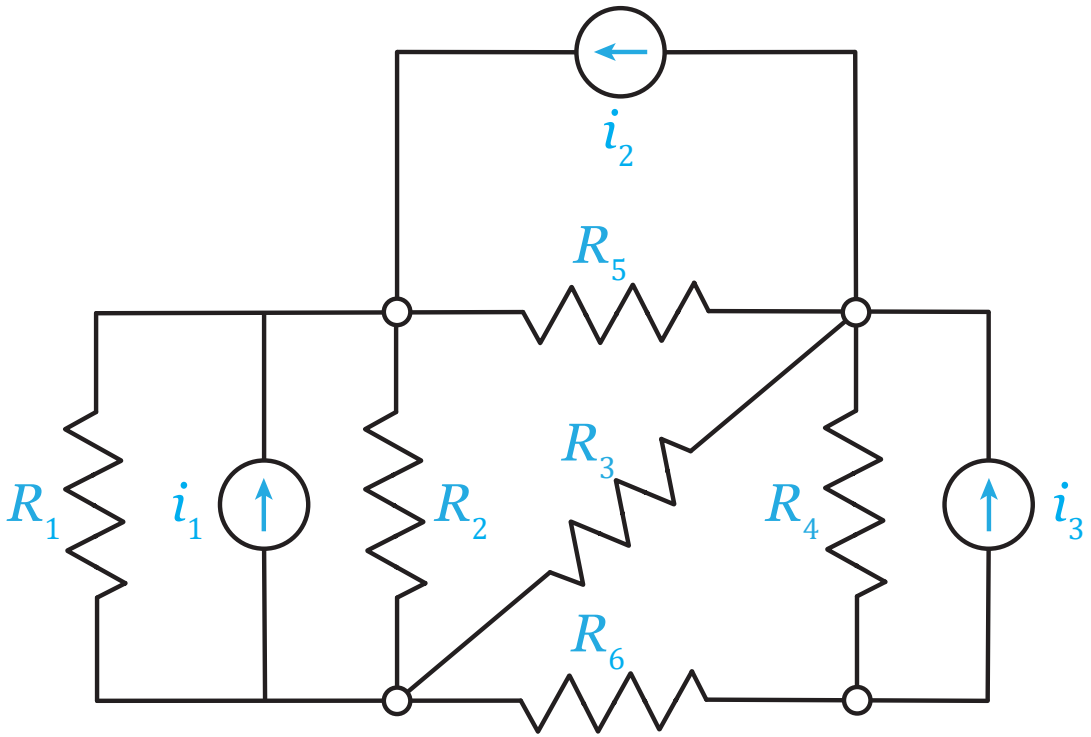
Example #3

- Solve for the node voltages of the given circuit given i_1=1 [A], i_2=2 [A], i_3=3 [A], R_1=5 [Ω], R_2=2 [Ω], R_3=10 [Ω], R_4=4 [Ω], R_5=5 [Ω] and R_6=2 [Ω]



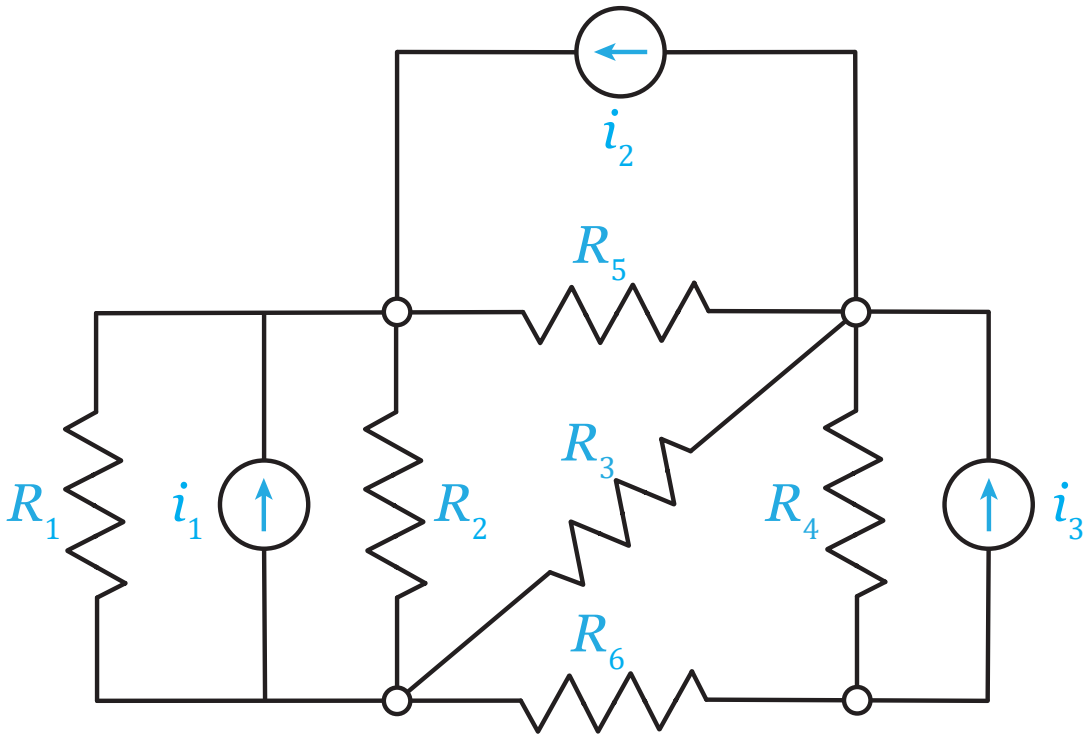
Example #3

Solution:



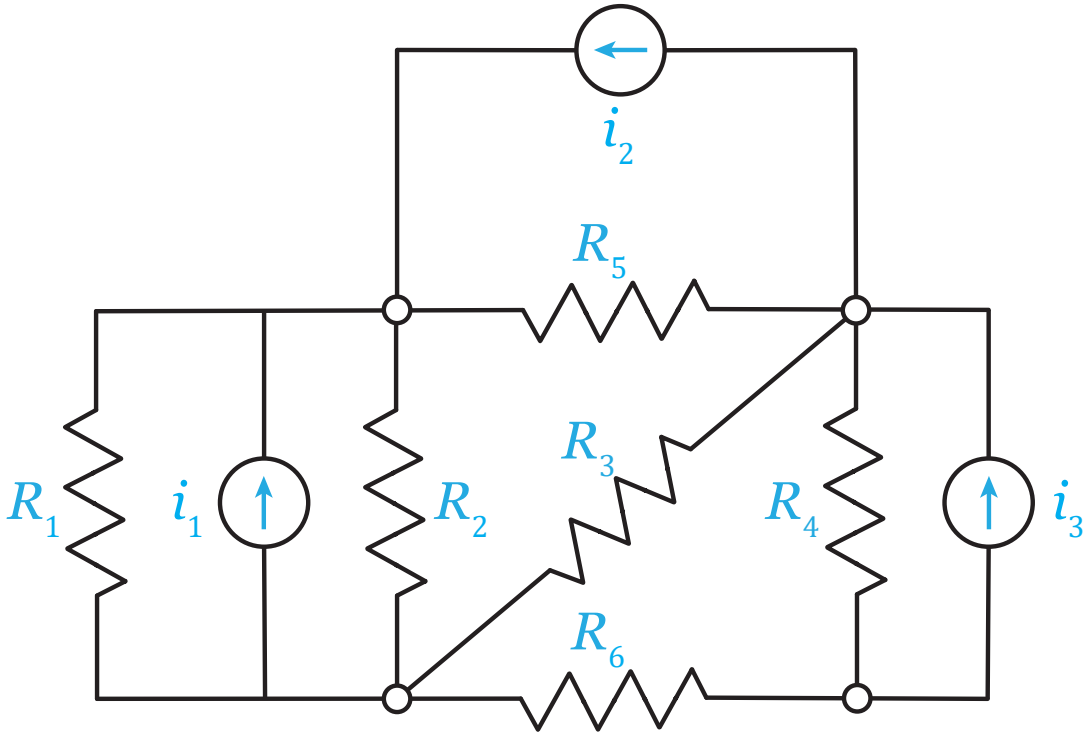
Example #3

Solution:



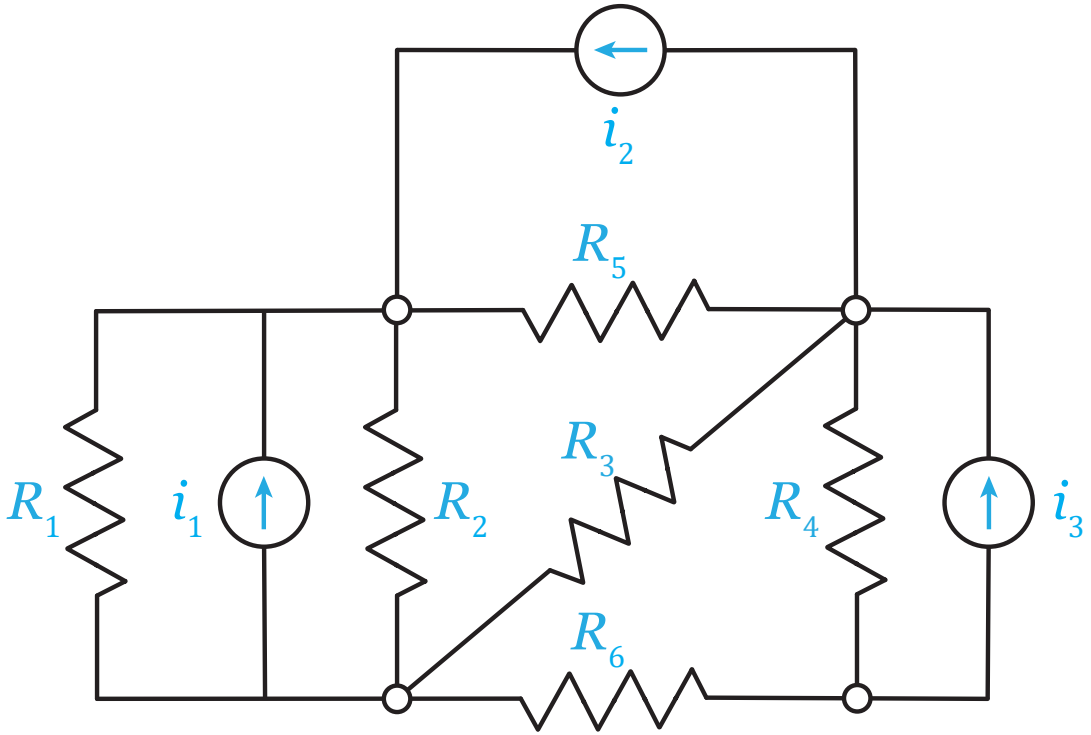
Example #3

Solution:



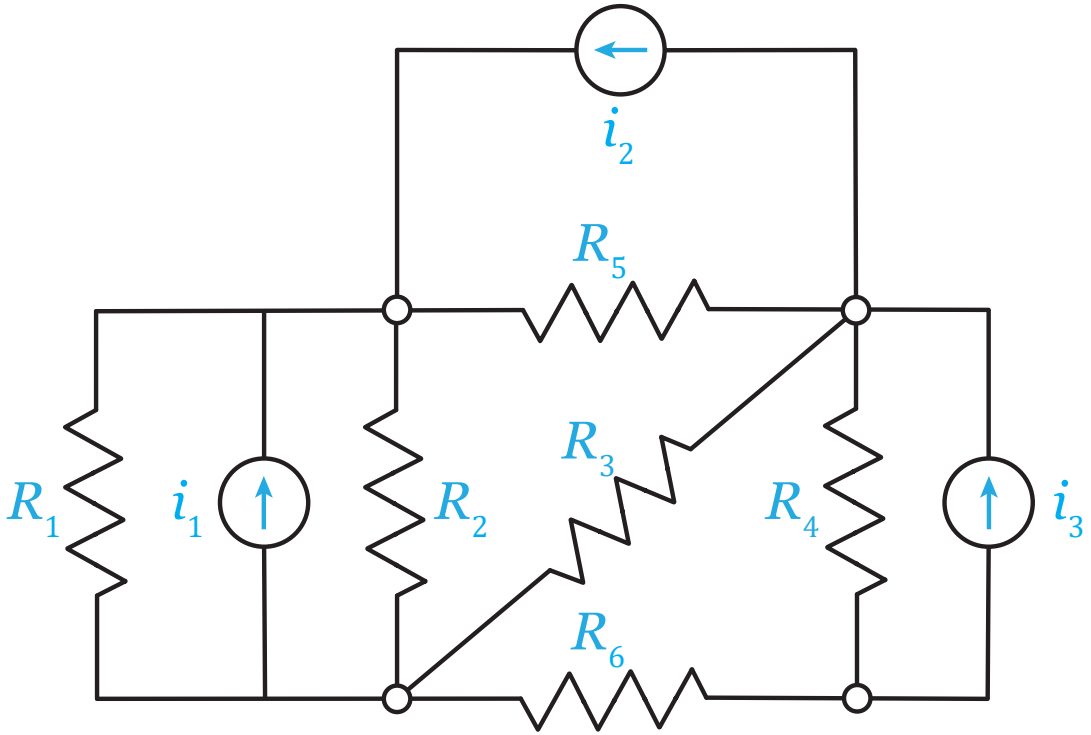
Example #3

Solution:



Example #3

Solution:



Student Learning Objectives

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

- Apply Node Voltage Analysis (NVA) to circuits with independent current sources
  - NVA requires the sole use of KCL. We construct $N-1$ KCL equations, applied at non-zero, and relate the currents to voltages using Ohm's law.

Suggested Problems

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

- 4.2-1, 4.2-2, 4.2-3, 4.2-4, 4.2-5, 4.2-6, 4.2-7