Chapter 4 - Methods of Analysis of Resistive Circuits

Lecture 11
Section 4.4

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 dependent sources

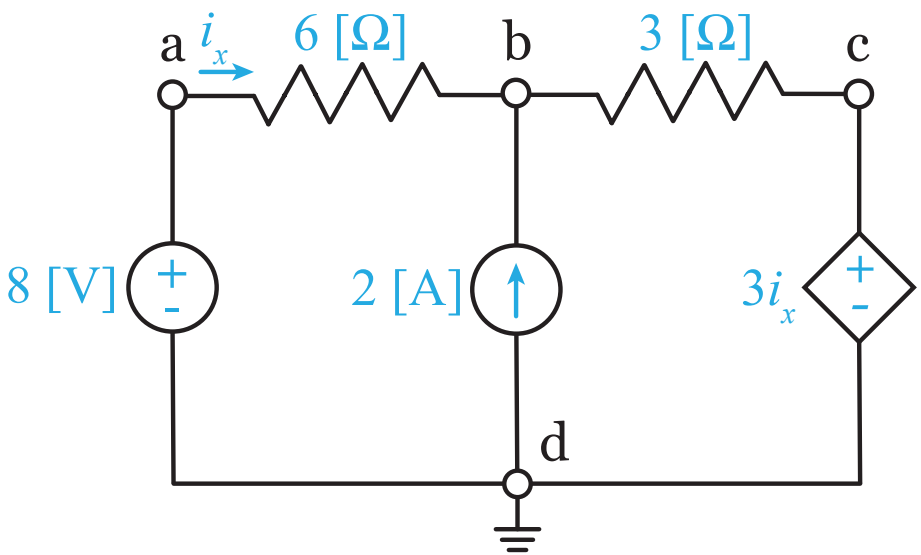
NVA with Independent VS

- By adding an dependent source, we must express behavior (voltage) in terms of node voltages.
- The number of KCL equations still holds as:

$$\#\,\text{KCL Eqns.} = N - \#\,\text{VS} - 1$$

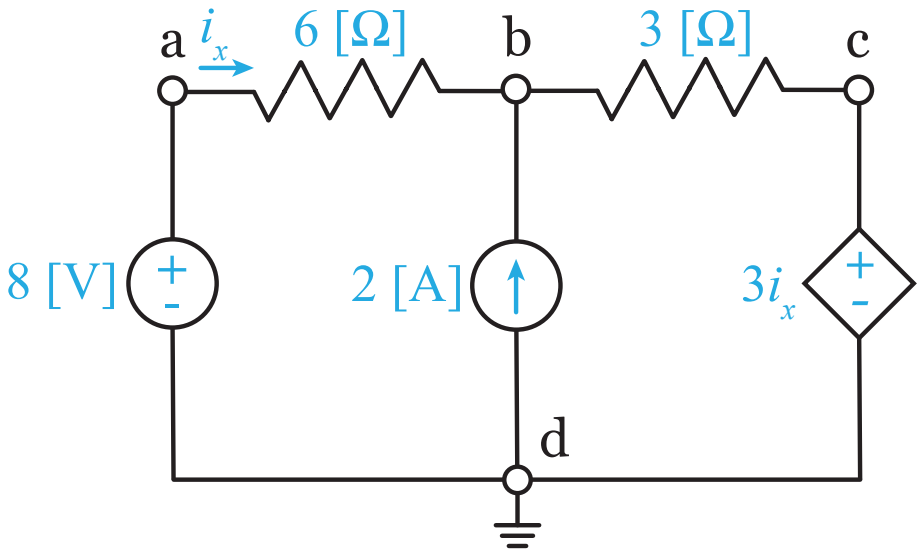
- "Supernode" formulation is still valid

Example #1



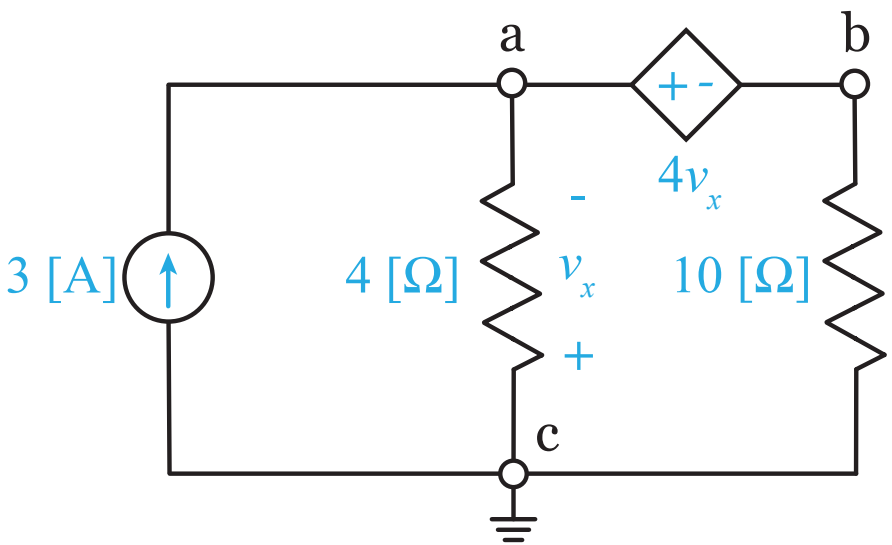
- Use NVA to determine the node voltages:

Example #1



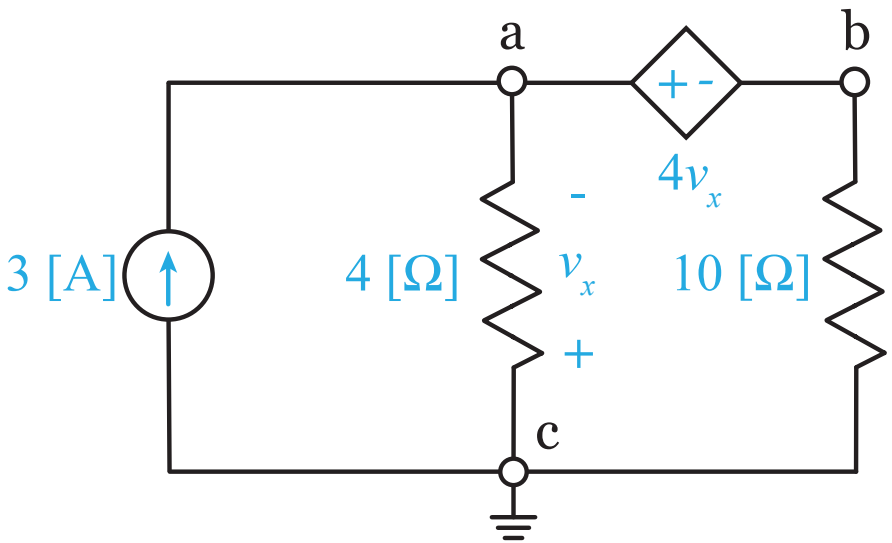
▶ Solution:

Example #2



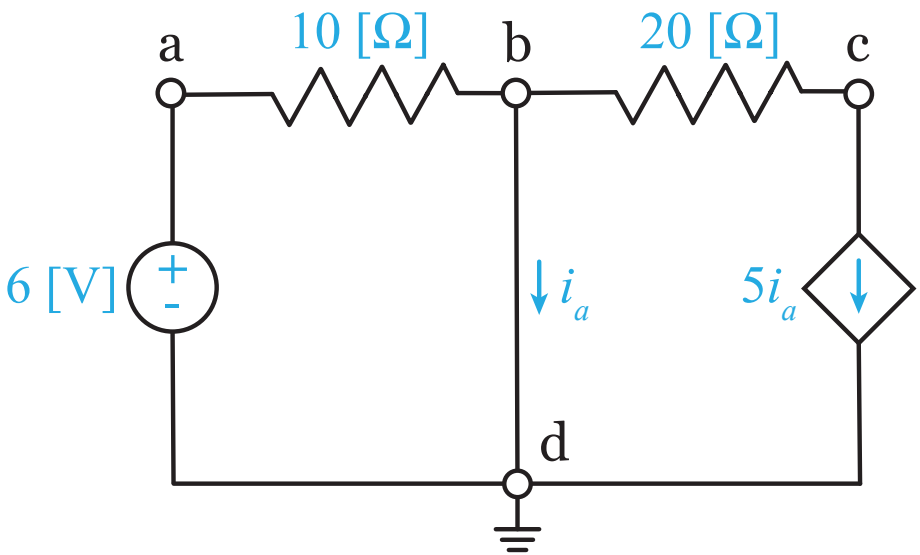
- Determine the voltage at a and b:

Example #2



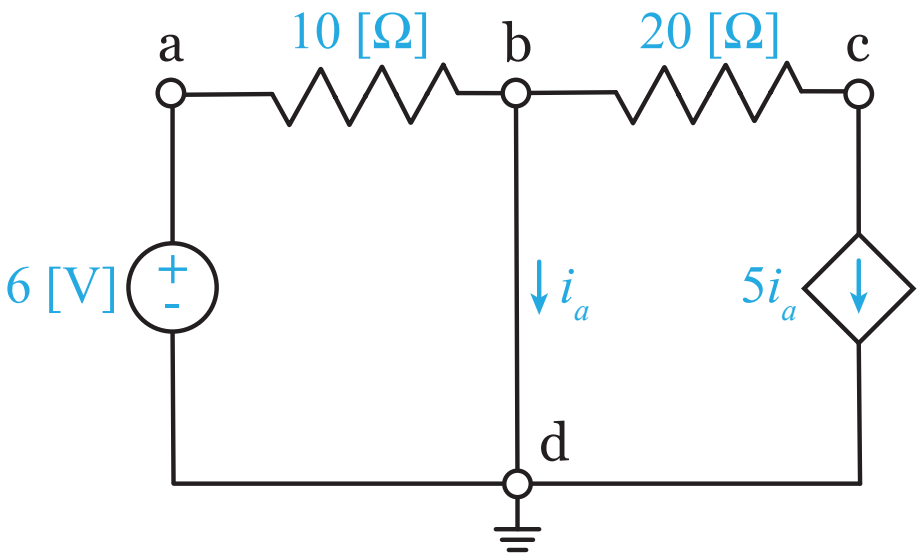
▶ Solution:

Example #3



- Determine all unknowns:

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 $N - 1 - \#\text{VS}$ KCL equations, applied at non-zero and non-specified, and relate the currents to voltages using Ohm's law.
  - A voltage source (independent and dependent) between two non-zero nodes creates a supernode, i.e. an equation that relates two node voltages - apply KCL here!
  - A voltage source between a non-zero and zero-voltage nodes specifies the non-zero node voltage.

Suggested Problems

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

- 4.4-1, 4.4-2, 4.4-3, 4.4-4, 4.4-5, 4.4-6, 4.4-7, 4.4-13, 4.4-14