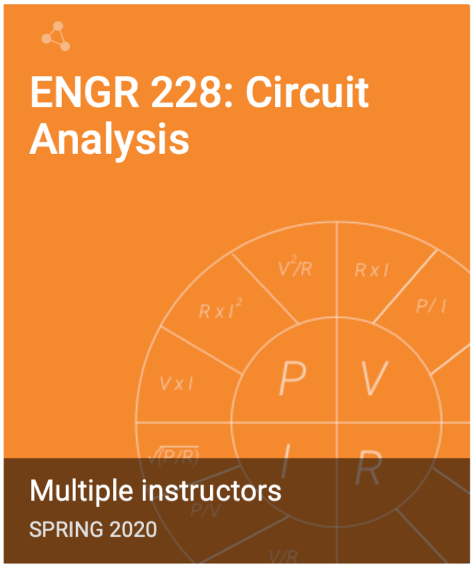


Chapter 3.2,3

Analysis Techniques

Super-Node and Super-Mesh Methods

Engr228 - Circuit Analysis

Spring 2020

Dr Curtis Nelson

Section 3.2a and 3.3a Objective

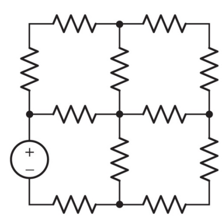
- Learn to identify and apply the super-node and super-mesh analysis methods to analyze an electric circuit.

Circuit Analysis

- We need an organized method of applying KVL, KCL, and Ohm's law;
- *Nodal* analysis assigns *voltages* to each node, and then we apply *Kirchhoff's Current Law* to solve for the *node voltages;*
- *Mesh* analysis assigns *currents* to each mesh, and then we apply *Kirchhoff's Voltage Law* to solve for the *mesh currents.*

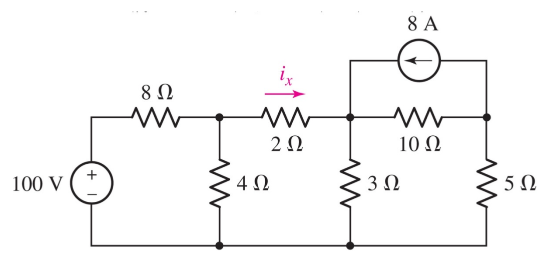
Mesh Analysis: Nodal Alternative

- A mesh is a loop that does not contain any other loops within it;
- In mesh analysis, we assign mesh currents and solve using KVL;
- All terms in the equations are in units of ***voltage;***
- Remember – voltage drops in the direction of current flow except for sources that are generating power;
- The circuit below has four meshes:



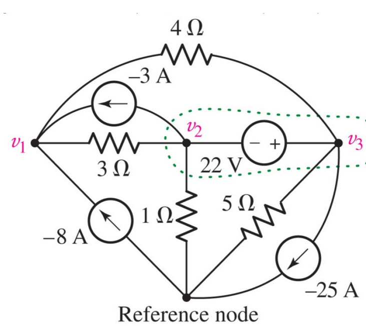
Node or Mesh: How to Choose?

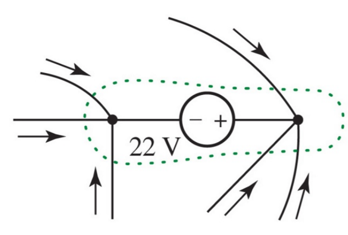
- Use the one with fewer equations, or
- Use the method you like best, or
- Use both, and check your answers.



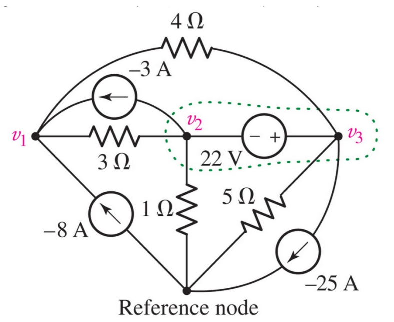
Voltage Sources and the Supernode

If there is a DC voltage source between two non-reference nodes the current through the voltage source may not be known and an equation cannot be written for it. Therefore, we create a ***supernode***.





The Supernode Analysis Technique



- Apply KCL at Node v_1;
- Apply KCL at the supernode;
- Add the equation for the voltage source inside the supernode.

$$\frac{v_1 - v_3}{4} + \frac{v_1 - v_2}{3} = -3 - 8$$

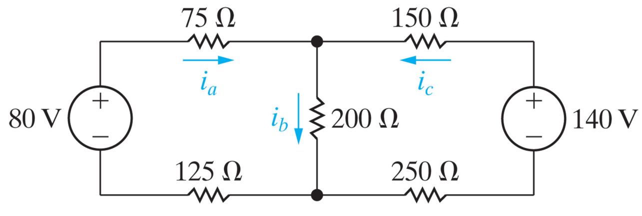
$$\frac{v_1 - v_2}{3} + \frac{v_1 - v_3}{4} = -3 + \frac{v_2}{1} + \frac{v_3}{5} - 25$$

$$v_3 - v_2 = 22$$

$v_1 = 1.0714V$
$v_2 = 10.5V$
$v_3 = 32.5V$

Textbook Problem 4.36 (Nilsson 11th)

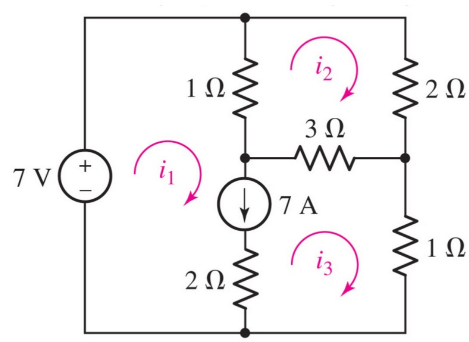
Choose the reference point wisely and solve for the currents in the circuit below.



Answer: $i_a = 0.1A$
$i_b = 0.3A$
$i_c = 0.2A$

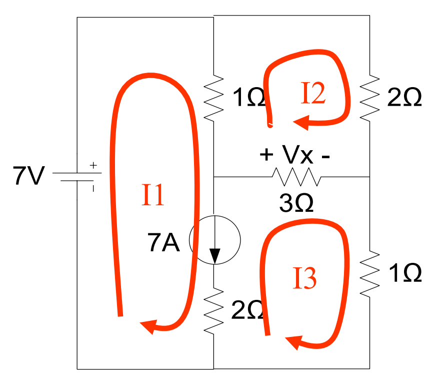
Current Sources and the Supermesh

If a current source is present in the network and shared between two meshes you must use a ***supermesh*** formed from the two meshes that have the shared current source.

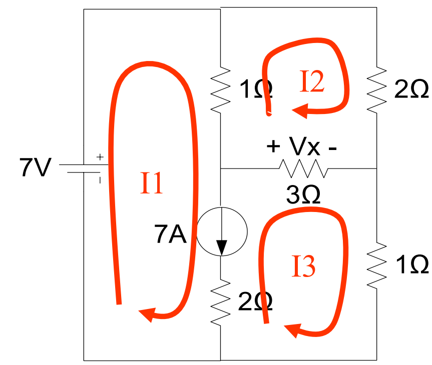


Supermesh Example

Use mesh analysis to find Vx



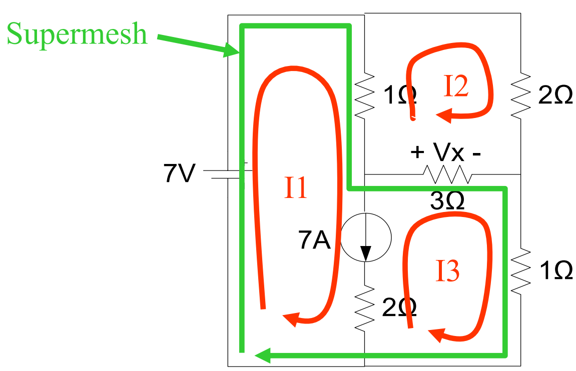
Supermesh Example - continued



Loop 2: $1(I2 - I1) + 2I2 + 3(I2 - I3) = 0$

$-I1 + 6I2 - 3I3 = 0$ *Equation I*

Supermesh Example - continued



$I_1 = 9A$
$I_2 = 2.5A$
$I_3 = 2A$
$Vx = 3(I3\text{-}I2) = -1.5V$

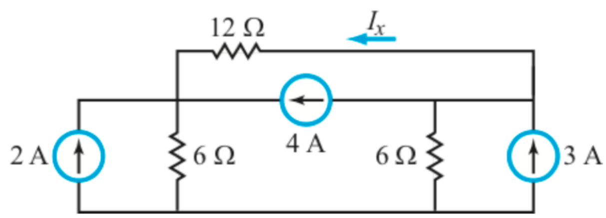
$-7 + 1(I1 - I2) + 3(I3 - I2) + I3 = 0$

$I1 - 4I2 + 4I3 = 7$ *Equation II*

$I1 - I3 = 7$ *Equation III*

Supermesh Example – Zybooks Exercise 3.3.8

(a) Use the supermesh concept to solve for I_x in the circuit below.



$I_X = -1.75A$

Section 3.2a and 3.3a Summary

- Learned to identify and apply the super-node and super-mesh analysis methods to analyze an electric circuit.