Administrivia

- Computer accounts and newsgroup stuff: Check the EECS 40 homepage!
- HW will cover concepts from Friday, Monday and Wednesday lecture.
- HW 1 corrections:
  - In problem 1 (a), the phrase should read “calculate the power in the devices” instead of “calculate the power in the interconnection”
  - In problem 8, the phrase should read “In figure 8(a) below, the device” instead of “In figure 8(a) below, the box”
  - In problem 6, it should be “the arm, leg and trunk to rise BY 5 degrees Celsius” instead of “the arm, leg and trunk to rise to 5 degrees Celsius”
  - Problems 2, 3, 6 and 7 - add an extra *

Administrivia (contd).

- TA office hours. (location: 140 Cory)
  - Nir: Tu 12 - 2 and Th 2 - 3
  - Jesse: M 2 - 5
  - Jonathan: Tu 10 - 12 and Th 10 - 11
- Changes to lecture schedule
  - Midterms 1 and 2 moved to Wednesday of the week instead of Monday
  - Lecture on Thevenin/Norton swapped with op-amps
- **WTh 5 - 8 lab cancelled!**
- Guest lecture on 07/11!

Last Time...

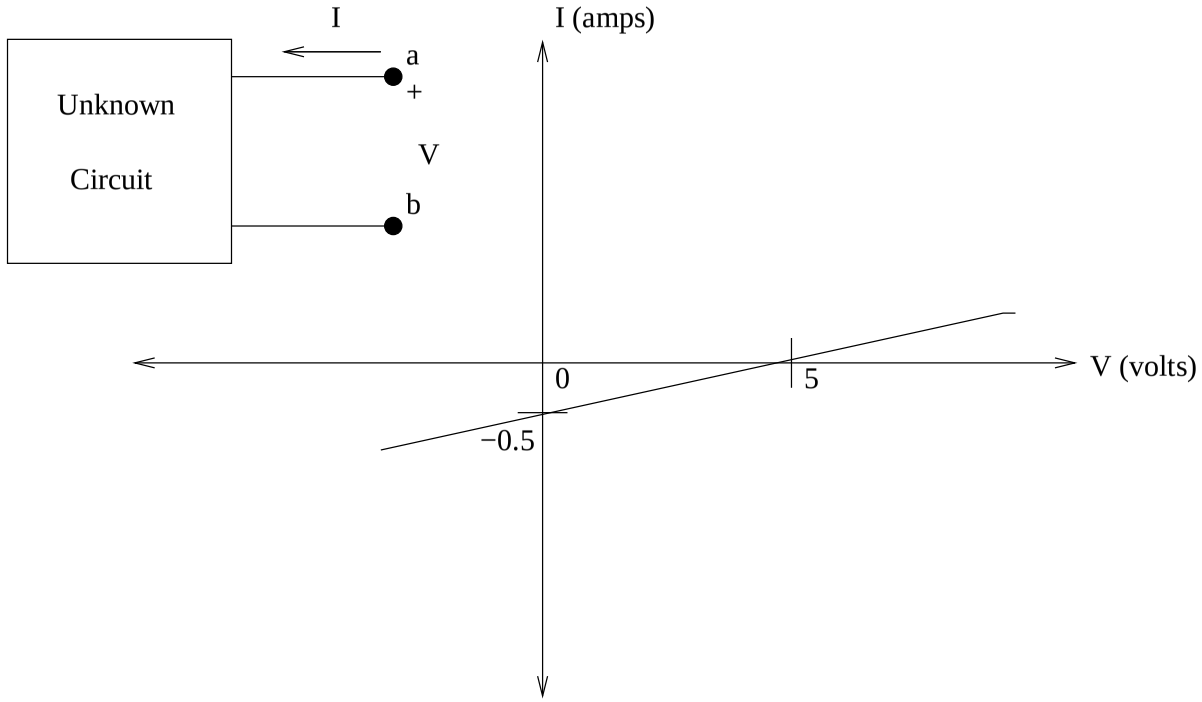
- Circuit analysis tools: KCL, KVL, IV, Series and parallel circuits
- Devices: Dependent sources and resistors
- **Do you have questions on any of these concepts?**

This Time...

- IV example
- Voltage Divider and Current Divider
- Voltmeters and Ammeters
- Nodal analysis: Steps
- Nodal analysis: Illustrate with examples
  - Only independent sources
  - Dependent and independent sources
  - Floating voltage source
- Overview of mesh analysis

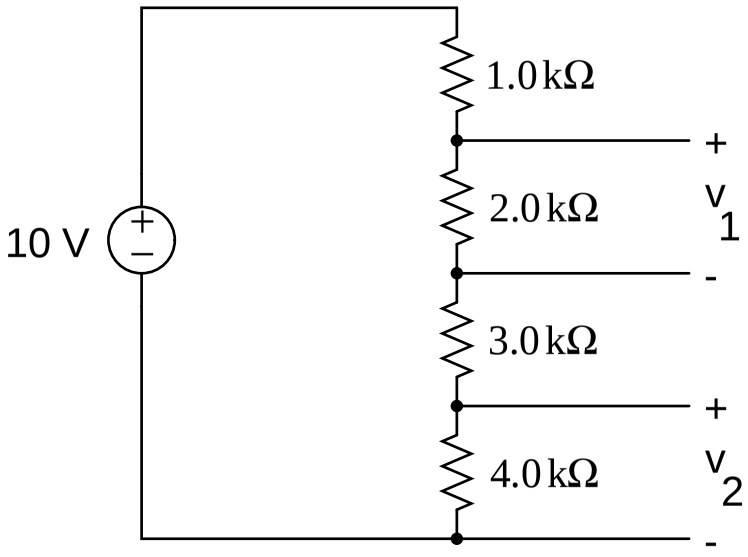
IV example

- Give a circuit model for the I-V graph below:



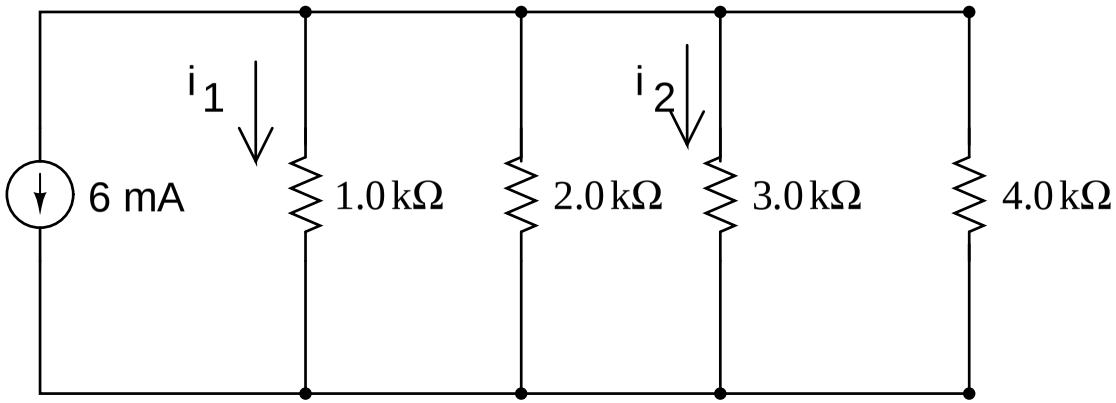
Voltage and Current Divider

- Voltage Divider: Find v_1 and v_2 in the circuit below.



Voltage and Current Divider

- Current Divider. Find i_1 and i_2 in the circuit below.

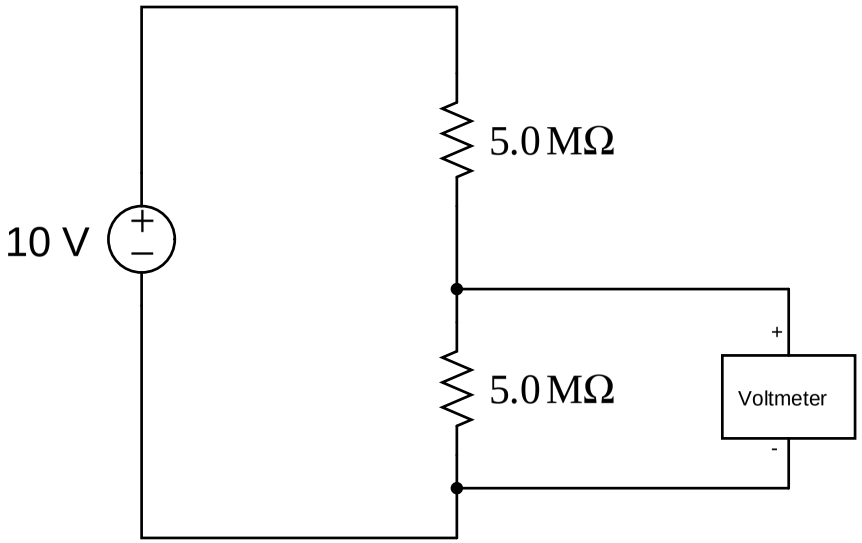


Voltmeters and Ammeters

- Voltmeter: measures voltage across a device.
  - Should connect in parallel with the device of interest
  - Works on the principle of Ohm's law.
  - Therefore, internal resistance of a voltmeter should be _____ compared to the resistance of the device across which the voltage is to be measured.

Voltmeters and Ammeters

- Example: What voltage does the voltmeter measure? Assume internal resistance is 1 MΩ



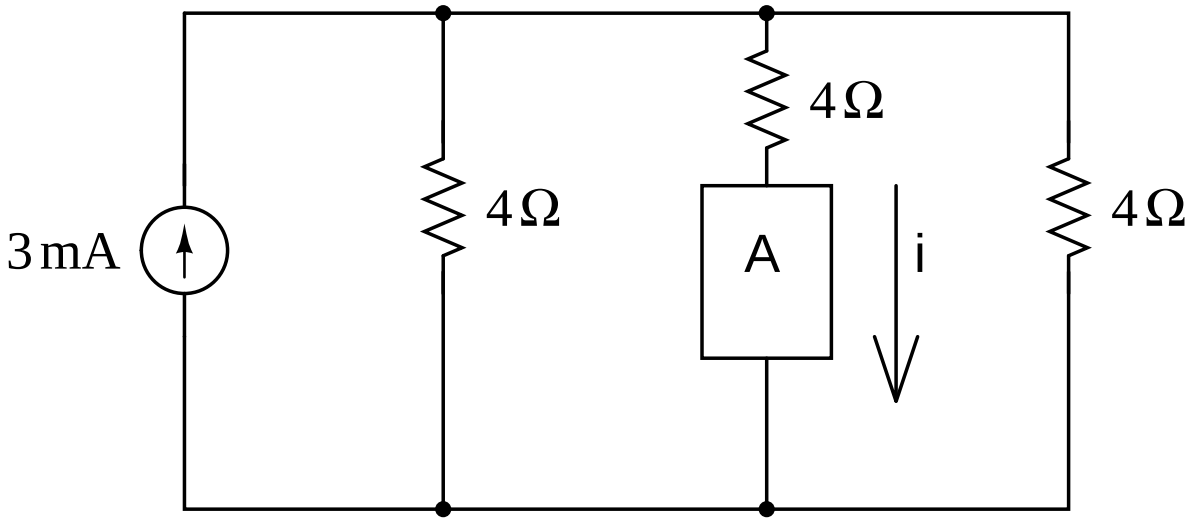
Voltmeters and Ammeters

- Ammeters: measures current through a device.
  - Should connect in series with the device through which the current of interest is flowing.
  - Also works on the principle of Ohm's law.
  - Internal resistance of ammeter is very small? Why: _____?

Voltmeters and Ammeters

- Example: What is the current measured by the ammeter?

  Assume internal resistance of the meter is 2 Ωs

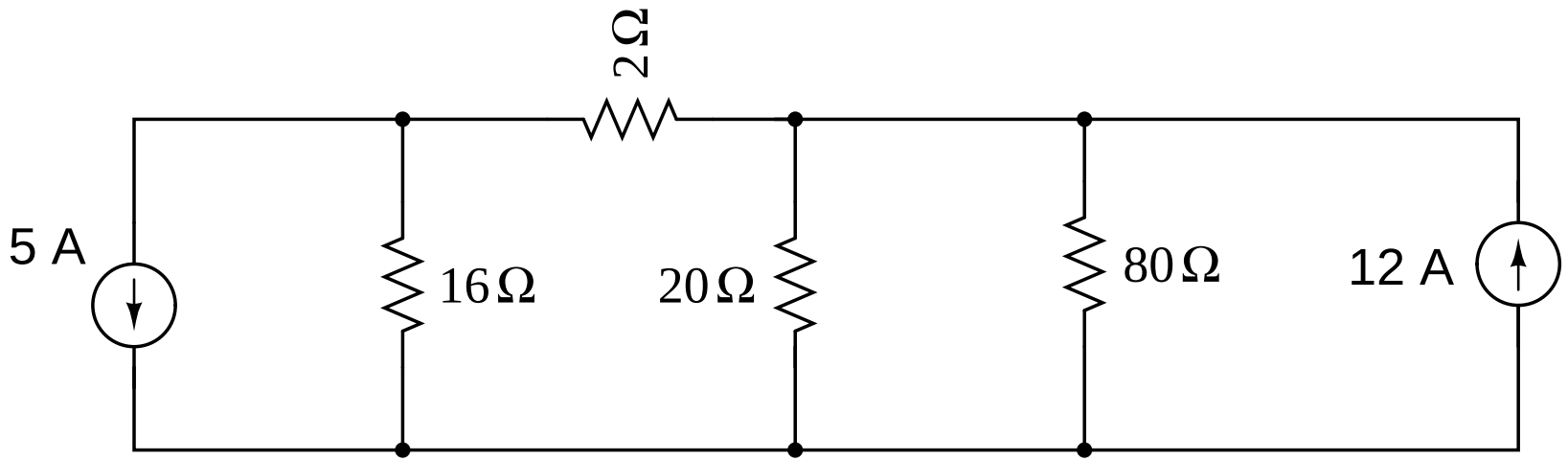


Nodal Analysis: Steps

- An **algorithm** to find **unknown node voltages** in any electric circuit (assumption: circuit has an unique solution).
- The algorithm (a little different from the reader):
  1. Select a reference node.
  2. Label the unknown node voltages.
  3. Apply KCL at each unknown node voltages.
  4. Substitute voltages for currents using device IV relationships (example, use Ohm's law for resistors)
- With circuits that have more than 3 unknown node voltages, we will ask you to set up equations only.

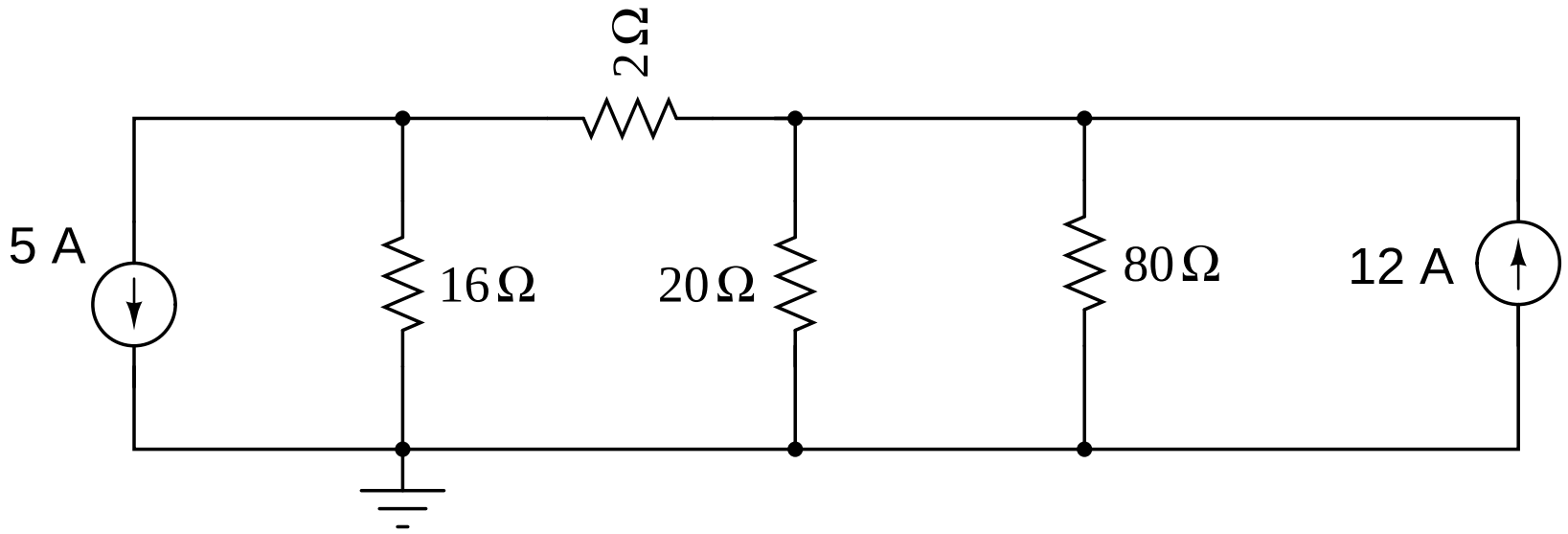
Nodal Analysis: Example 1

- Let us walk through the algorithm for the following circuit (only independent sources, drill exercise 4.5 (a)):



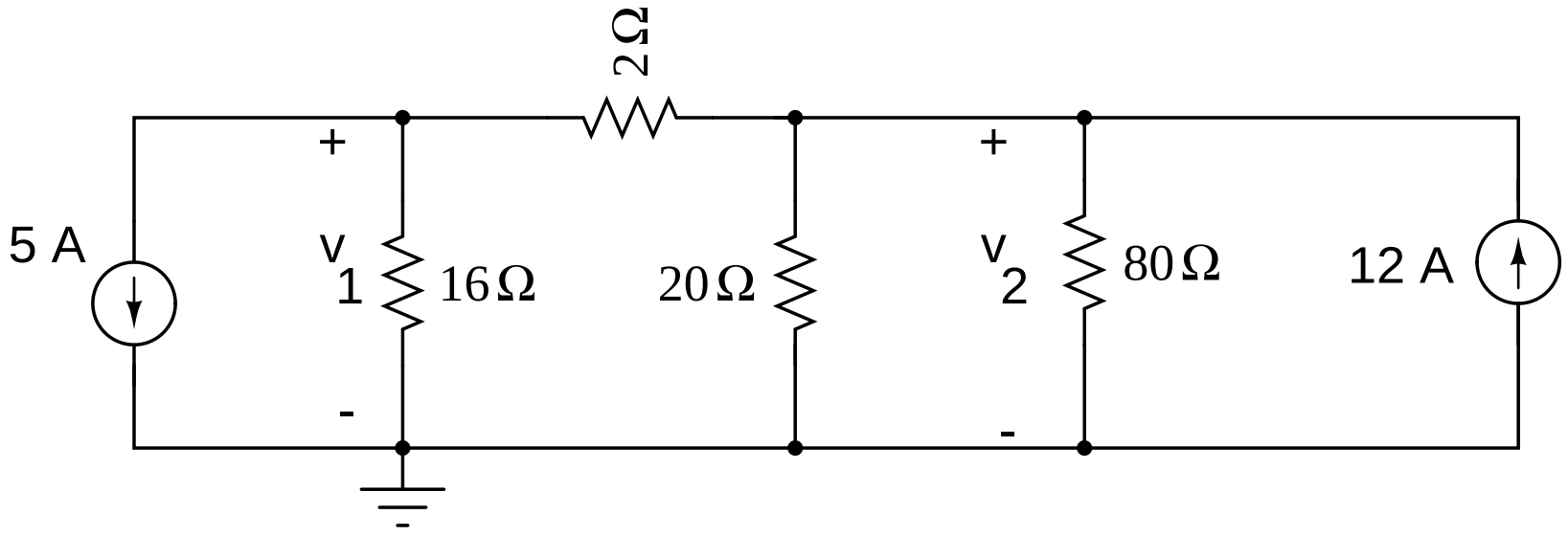
Nodal Analysis: Example 1, Step 1

- Select a reference node



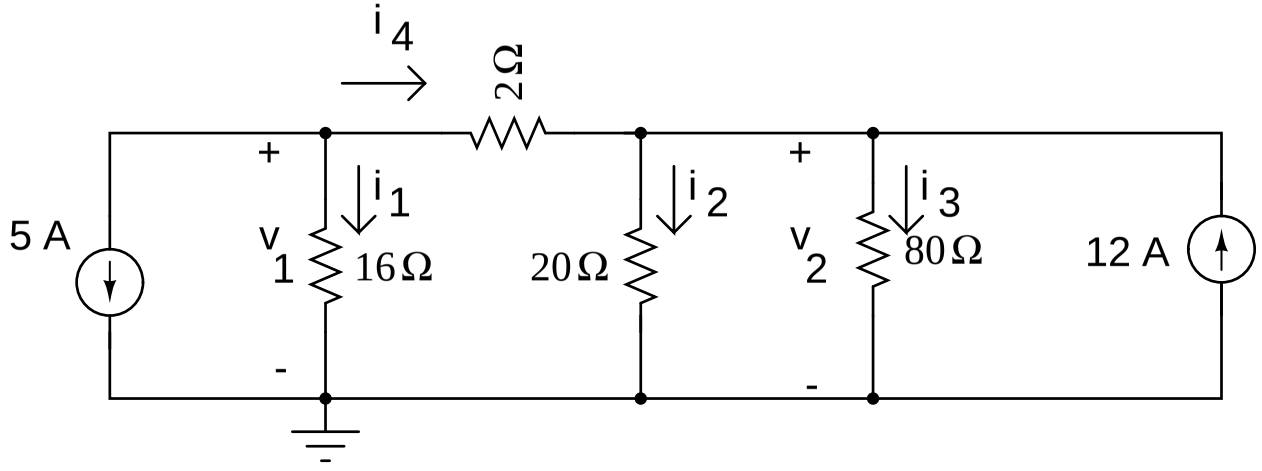
Nodal Analysis: Example 1, Step 2

- Label the unknown node voltages



Nodal Analysis: Example 1, Step 3

- Write KCL at each unknown node



- The KCL equations are (assume current leaving a node is negative):

  At v_1: -5 - i_1 - i_4 = 0

  At v_2: i_4 + 12 -i_2 - i_3 = 0

Nodal Analysis: Example 1, Step 4

- Substitute voltages for currents using device IV relationships

  (example, use Ohm's law for resistors)

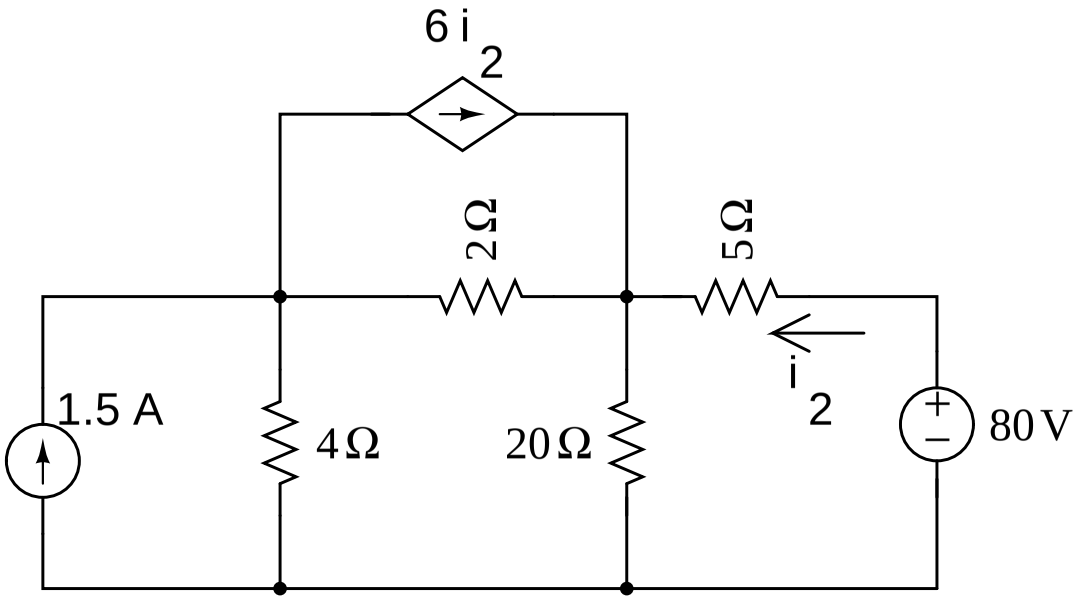
  At v_1: -5 - $\frac{v_1}{16}$ - $\frac{v_1 - v_2}{2}$ = 0

  At v_2: $\frac{v_1 - v_2}{2}$ + 12 - $\frac{v_2}{20}$ - $\frac{v_2}{80}$ = 0

- Solving, we get:

Example 2 - Dependent Sources

- Consider the following example (Drill 4.7):



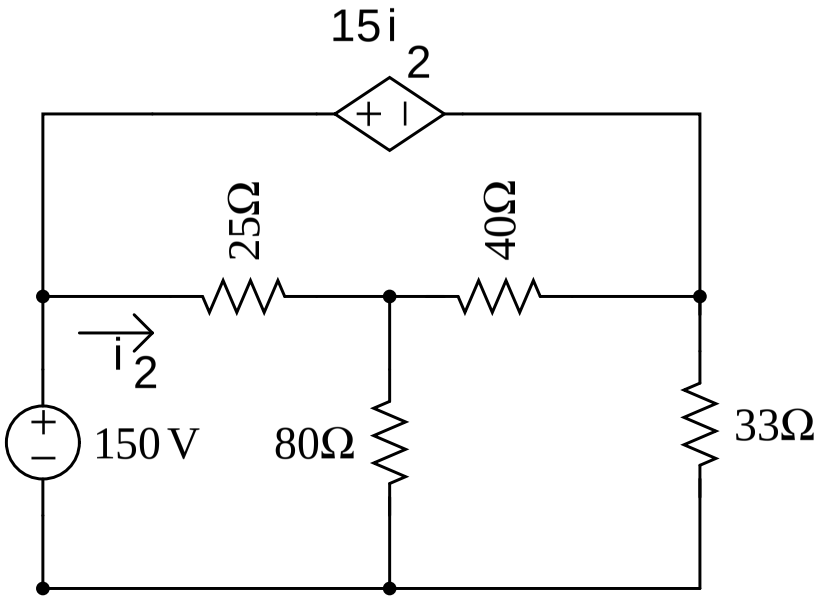
- Now, you can use constraint equations. You can write the solutions on the next page.

Example 2 - Dependent Sources

- Solution:

Example 3 - Floating voltage sources

- Floating voltage source: A voltage source (dependent or independent) whose terminals are not connected to ground. For example, consider (Drill 4.9) :



- To solve such circuits, you can use either constraint equations or the supernode concept. Since we already did constraint equations, we will use a supernode.

Example 3 - Floating voltage sources

- Solution:

An overview of mesh analysis

- "The KVL analog" of nodal analysis
- The algorithm (refer to reader):
  - Identify unknown loop currents
  - Apply KVL to each mesh (or loop).
  - Substitute currents for voltages using device IV relationships (example, use Ohm's law for resistors)

Nodal versus mesh analysis

- Which is better? Nodal is preferred over mesh, although that does not imply nodal is better!
- Nodal is used more often because:
  - Handles supernodes more conveniently
  - Mesh analysis only works for planar circuits (circuits which can be drawn on a plane with no crossing branches), it does not work for non planar circuits.
    - Proof: Requires mathematical topology. Beyond the scope of this class. If interested, please refer to appendix C in Nilsson and Riedel.
- Look over mesh analysis in the reader.
- Good news: I won't quiz you on mesh analysis. No homework problems as well!

Summary

- We added more tools to our circuit analysis toolbox:
  - Voltage and Current divider techniques
  - Nodal analysis
- We also looked at two instruments: voltmeters and ammeters

In Conclusion...

- Next time: Capacitors, RC circuits, propogation delay, look at inductors
- Reading: will be online at the EECS 40 webpage under “Additional Reader Notes” by Sunday.
- Lab 3 next week should help you understand RC circuits
- Questions?

Have a great weekend!