EELE 250: Circuits, Devices, and Motors

Lecture 6

Assignment Reminder

- Read 3.1 - 3.3
- Practice problems:
  - P2.69, P2.72, 2.77, 2.80, 2.81, 2.83
  - P2.94, 2.97
- D2L Quiz #3 *by 11AM on Monday* 19 Sept.

Exam Reminder

- **Exam #1 in class on Monday 19 September.**
- **Covers material from chapters 1 and 2.**
- **Closed book. One 8.5”x11” sheet of handwritten notes. Pencil. Calculator.**
- **Format: Mix of multiple choice and short answer questions.**

Circuit Analysis: review

- General techniques to find currents and voltages in electrical networks
- Use KVL, KCL, and Ohm's Law
- Remember: voltages and currents can be positive or negative, so be meticulous with the math!

A question…

- What is your instructor's name?

A. Prof. Mayer
B. Prof. Mahar
C. Prof. Meagher
D. Prof. Mahr
E. Prof. Maher

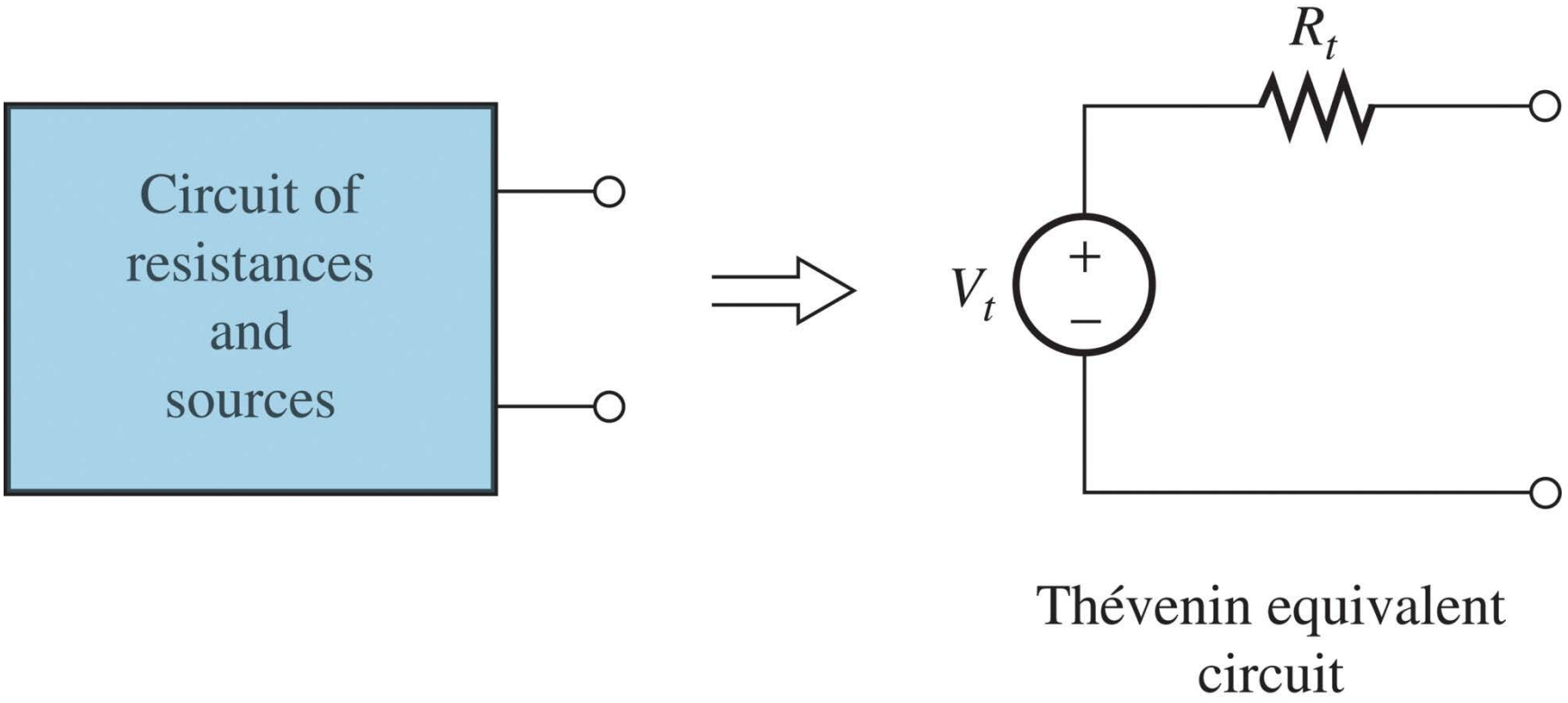
Equivalent Circuits

- We often want to connect one circuit to another. The *output* of one circuit connects to the *input* of another circuit.
- We can characterize a complicated linear circuit by determining a simpler circuit that behaves the same way (as was done for parallel and series resistor circuits).

Equivalent Circuits (cont.)

- A “two-terminal circuit” means a circuit with two nodes available externally.
- Sometimes this is an electrical *input* or an *output*: one node is ground and the other node is a signal voltage with respect to ground.
- If the circuit attached to the two terminals contains only linear elements, there exists an equivalent circuit containing just a single voltage source and a single series resistance.

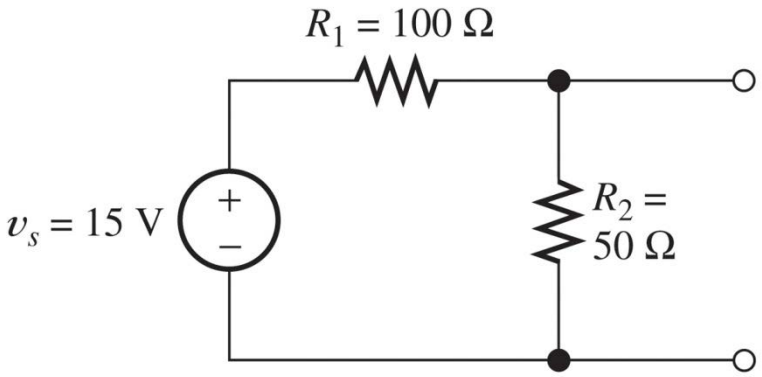
Thévenin Equivalent



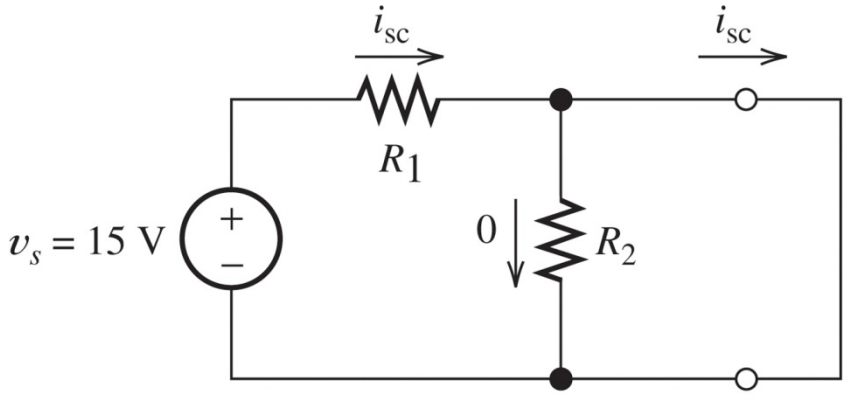
Thévenin equivalent circuit

Thévenin Equivalent (cont.)

- V_t is the *open circuit voltage* between the two terminals
- R_t is the ratio of V_t divided by the *short circuit current* (I_{SC}) between the two terminals

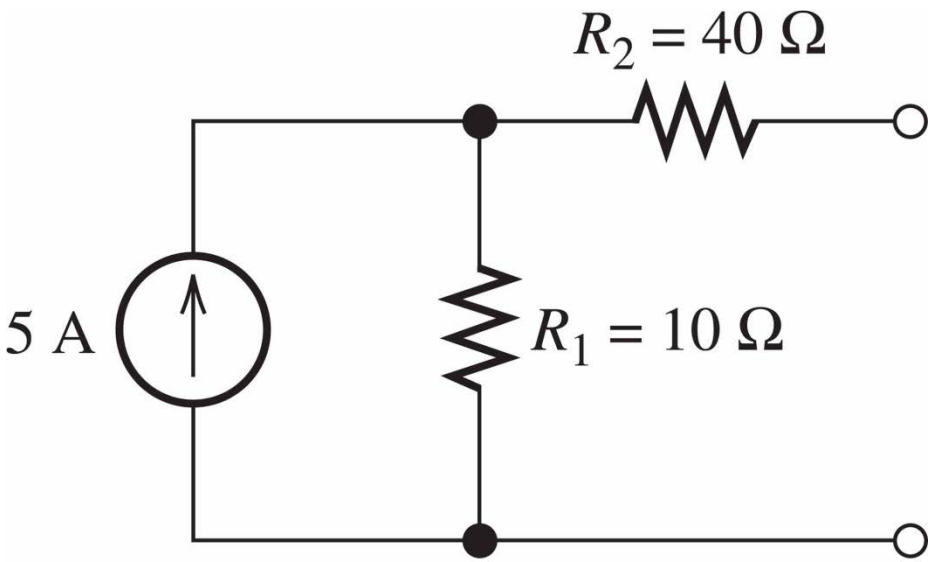


(a) Original circuit



(c) Analysis with a short circuit

Thévenin Equivalent (cont.)



What is V_{OC}?

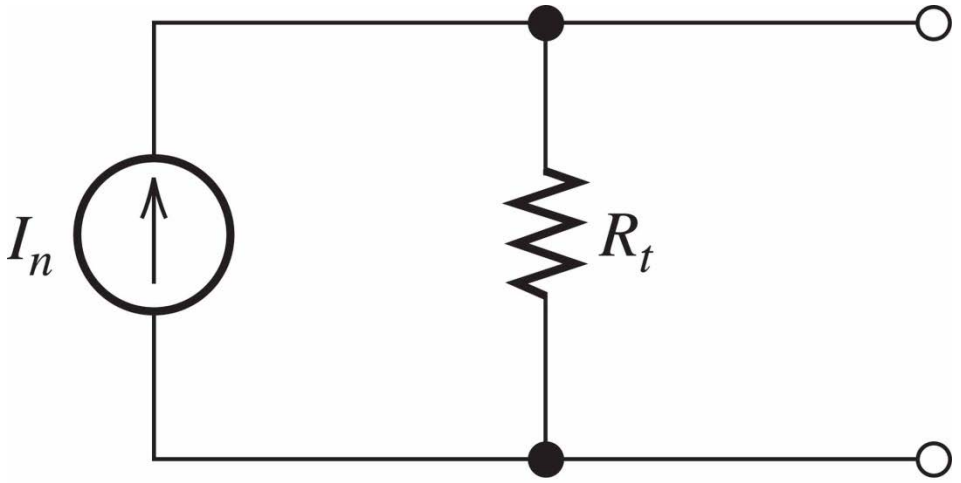
(a) 5 volts (b) 50 volts (c) 100 volts (d) 150 volts (e) 200 volts

What is I_{SC}?

(a) 1 amp (b) 2 amps (c) 3 amps (d) 4 amps (e) 5 amps

Norton Equivalent

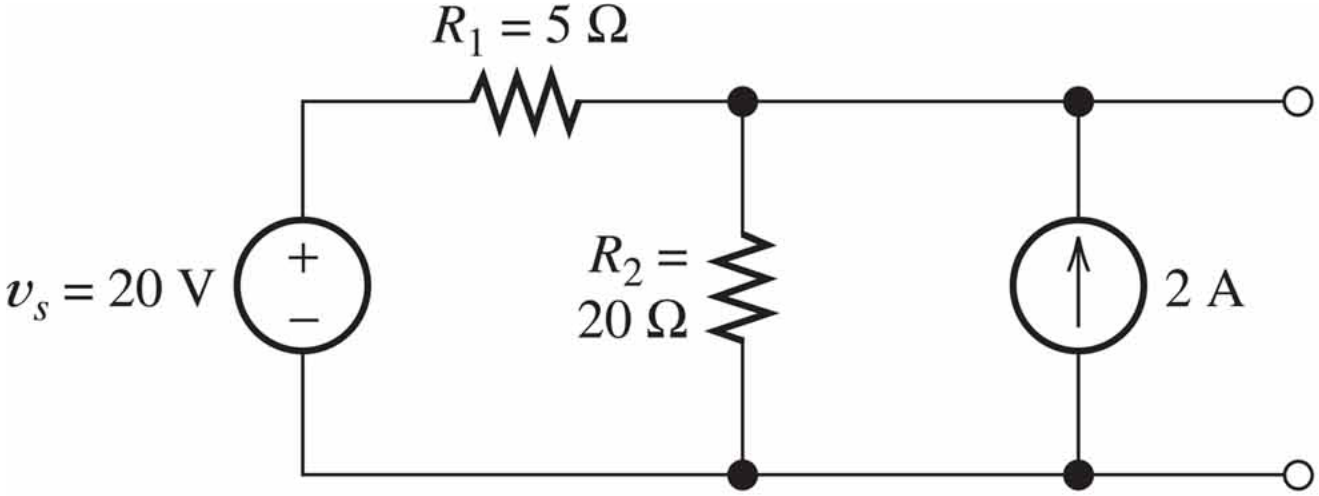
- Another formulation that is equivalent to the Thévenin representation includes a current source and a parallel resistance.
- $I_{norton} = I_{SC}$
- $R_t = R_{norton} = V_{OC}/I_{SC}$
- $V_{OC} = I_{norton} * R_t$



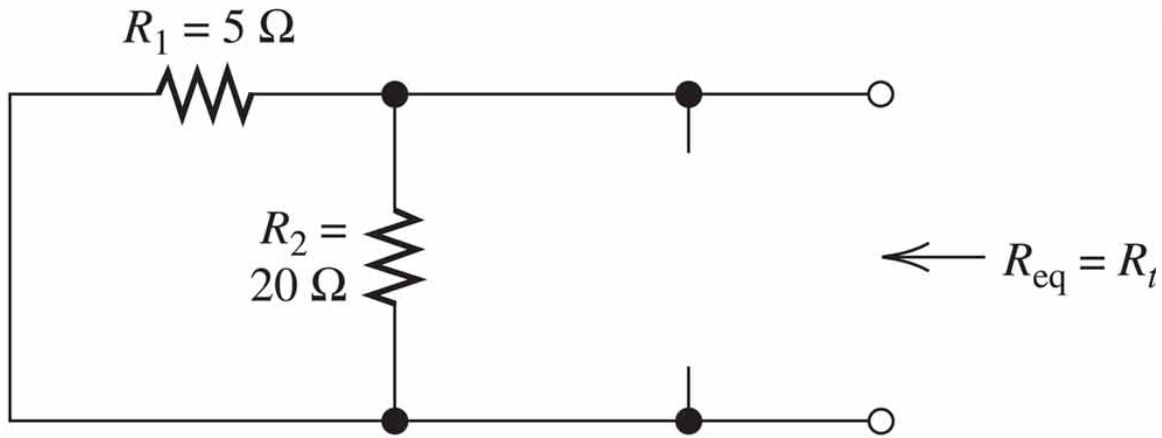
Finding R_t

- It is possible to find R_t by *turning off* the independent voltage and current sources in the circuit and simplifying the resistive network
  - Turn off voltage source: set voltage to zero, which is a short circuit
  - Turn off current source: set current to zero, which is an open circuit

Finding R_t (cont.)



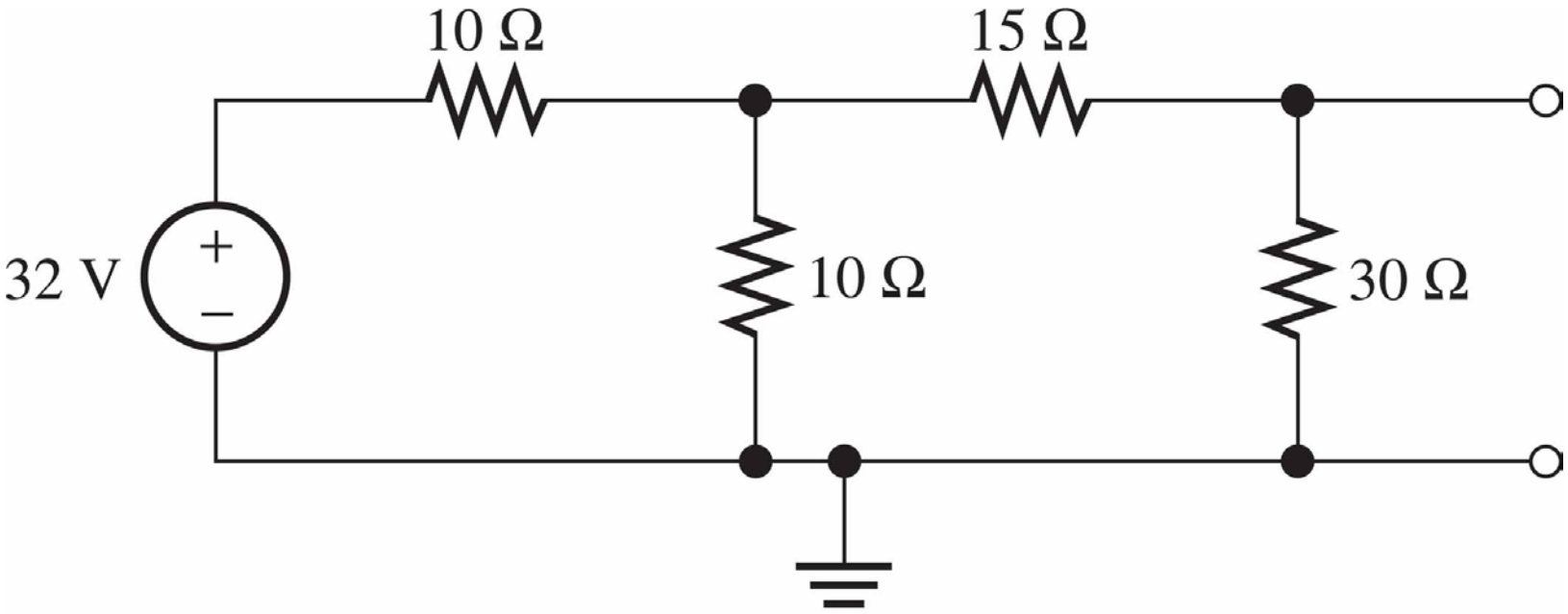
(a) Original circuit



(b) Circuit with sources zeroed

Simplifying via Source Transformation

- Thévenin and Norton transformation



Summary and Review

- Source transformation by equivalent Thévenin and Norton circuits
- Use open circuit voltage and short-circuit current at the terminals
- $V_{thevenin} = V_{oc}$
- $I_{norton} = I_{sc}$
- $R_t = V_{oc}/I_{sc}$