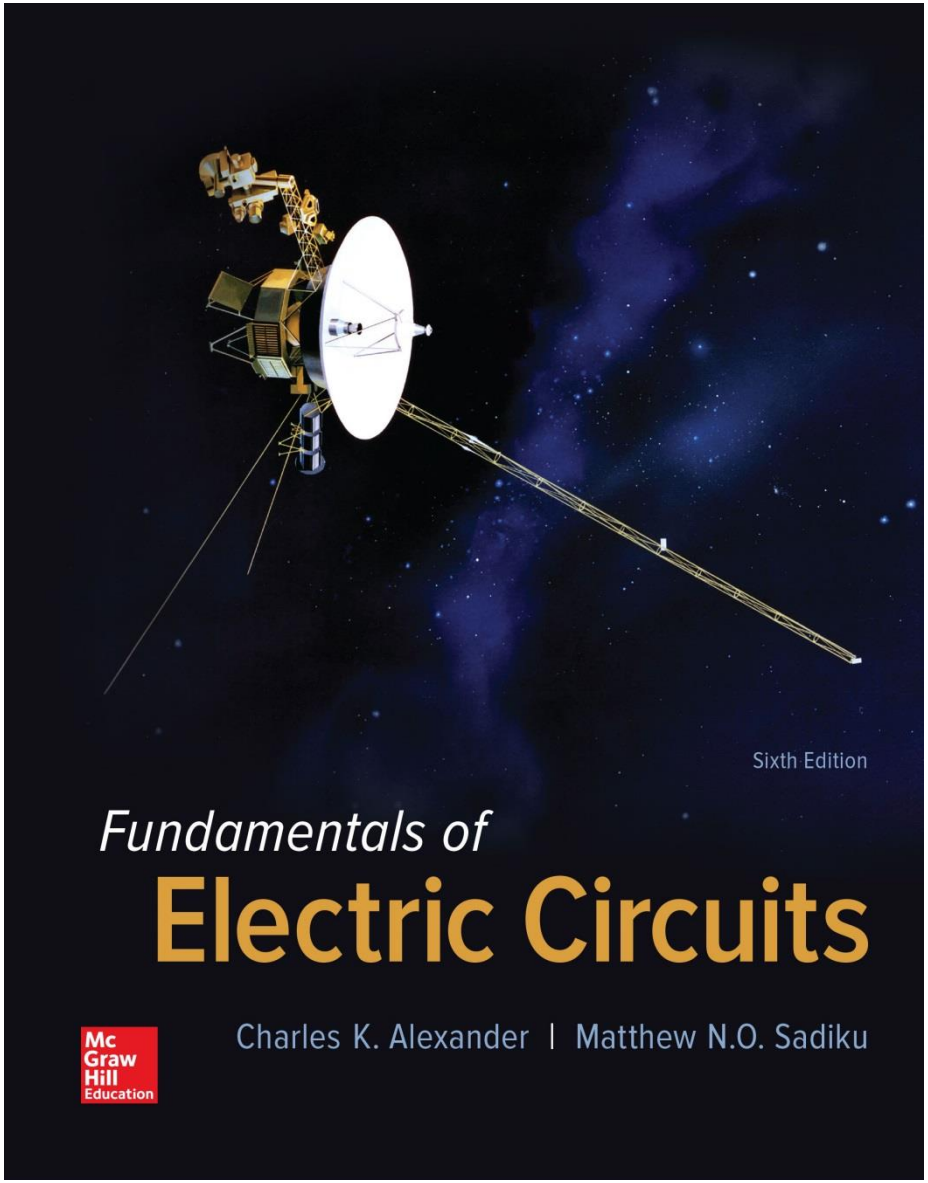
Fundamentals of Electric Circuits
Chapter 4

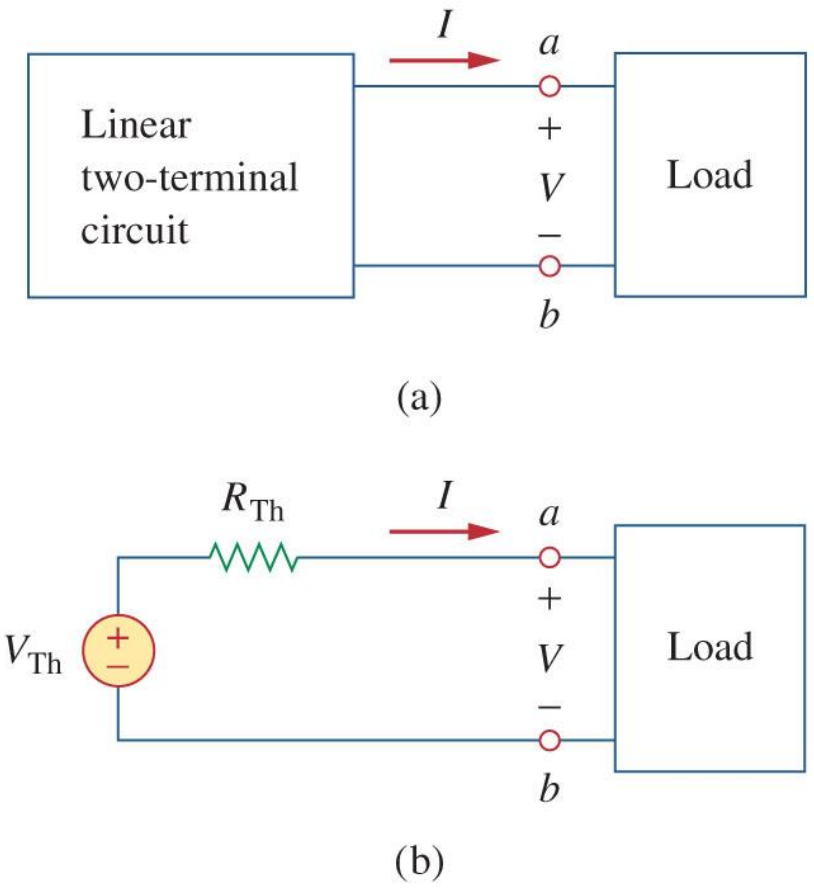


Thevenin's theorem

- **In many circuits, one element will be variable.**
- **An example of this is mains power; many different appliances may be plugged into the outlet, each presenting a different resistance.**
- **This variable element is called the load.**
- **Ordinarily one would have to reanalyze the circuit for each change in the load.**

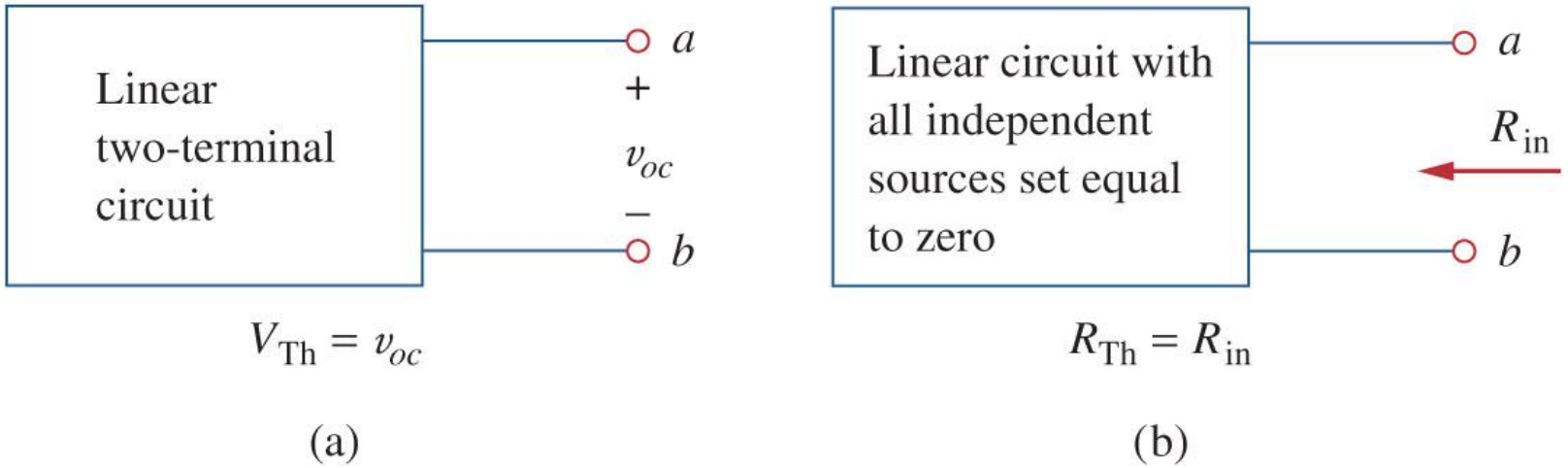
Thevenin's theorem II

- Thevenin's theorem states that a linear two terminal circuit may be replaced with a voltage source and resistor.
- The voltage source's value is equal to the open circuit voltage at the terminals.
- The resistance is equal to the resistance measured at the terminals when the independent sources are turned off.



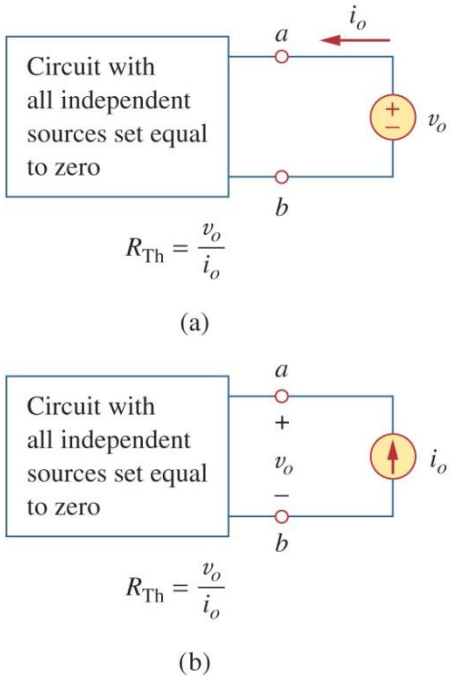
Thevenin's theorem III

- **There are two cases to consider when finding the equivalent resistance.**
- **Case 1: If there are no dependent sources, then the resistance may be found by simply turning off all the sources.**



Thevenin's theorem IV

- **Case 2: If there are dependent sources, we still turn off all the independent sources.**
- **Now apply a voltage v_0 (or current i_0)to the terminals and determine the current i_0 (voltage v_0).**

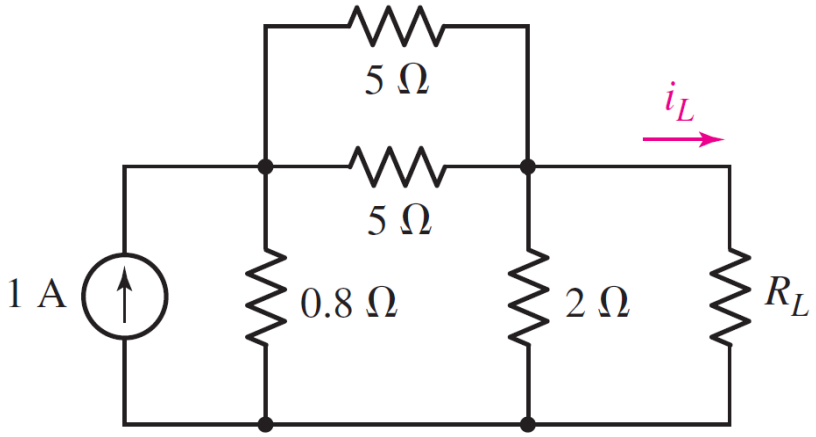


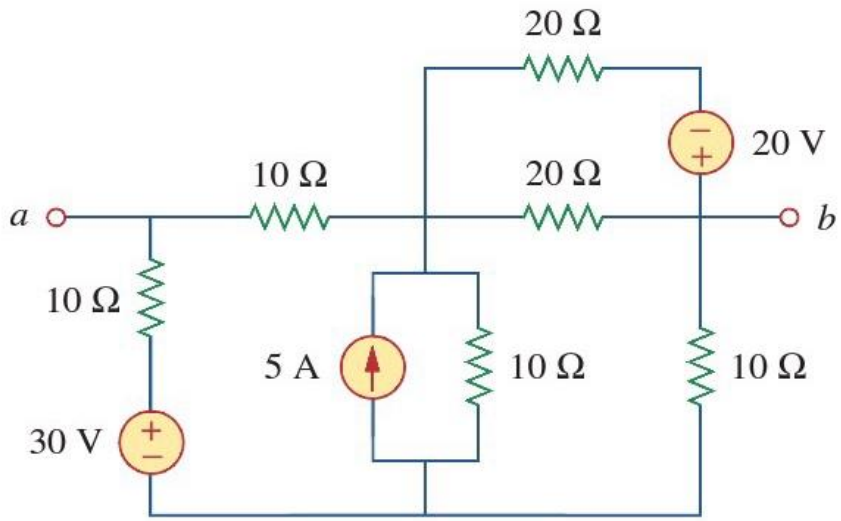
Thevenin's theorem V

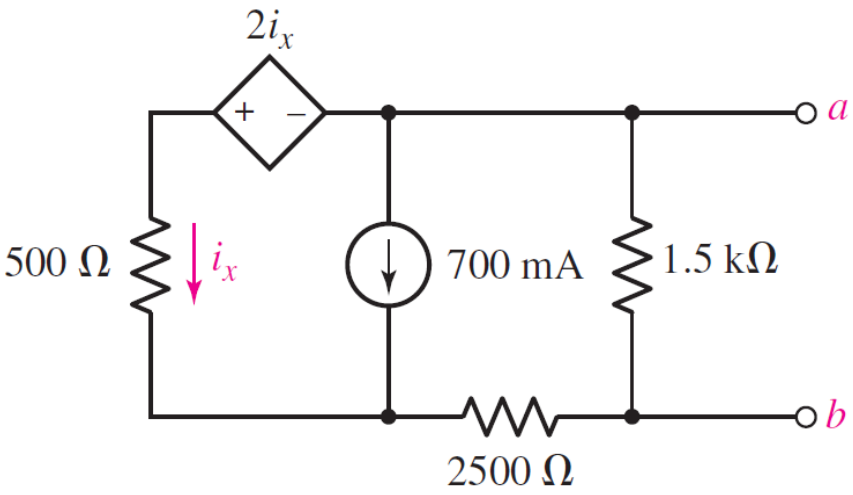
- Thevenin's theorem is very powerful in circuit analysis.
- It allows one to simplify a circuit
- A large circuit may be replaced by a single independent voltage source and a single resistor.
- The equivalent circuit behaves externally exactly the same as the original circuit.

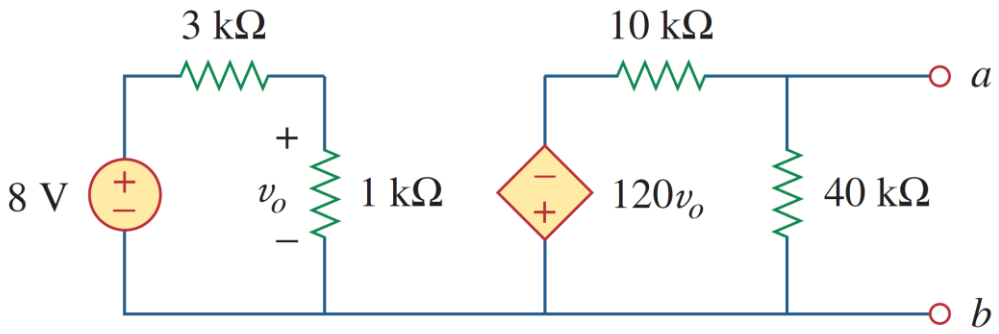
Negative resistance?

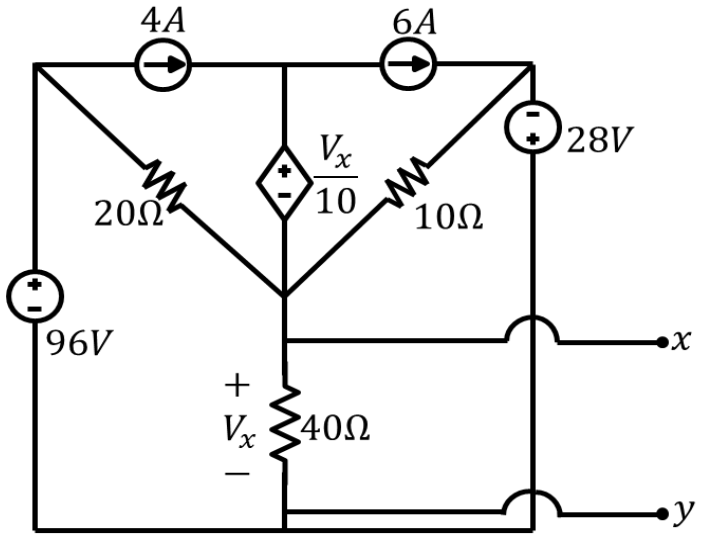
- It is possible for the result of this analysis to end up with a negative resistance.
- This implies the circuit is supplying power.
- This is reasonable with dependent sources
- Note that in the end, the Thevenin equivalent makes working with variable loads much easier.
- Load current can be calculated with a voltage source and two series resistors.
- Load voltages use the voltage divider rule.


5 Ω
i_L
5 Ω
1 A
0.8 Ω
2 Ω
R_L


20 Ω
20 V
10 Ω
20 Ω
a
b
10 Ω
5 A
10 Ω
10 Ω
30 V


$2i_x$
+
−
a
500 Ω
i_x
700 mA
1.5 kΩ
b
2500 Ω


3 kΩ
10 kΩ
a
8 V
+
v_o
−
1 kΩ
120v_o
40 kΩ
b


4A
6A
28V
$\frac{V_x}{10}$
20Ω
10Ω
96V
x
+
V_x
−
40Ω
y