

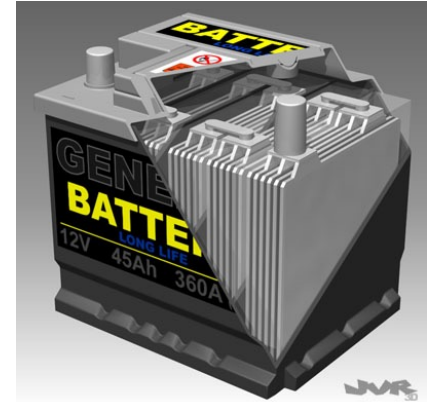
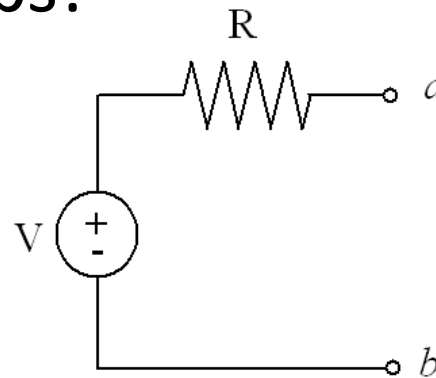
Lecture 26

Theorems – 3 of 6

more Thevenin; Norton

Everyday Example

- Car battery – 12.6 volts
- Can provide 100-200 amps!
- Thévenin model:
 - 12.6 volt source
 - 0.05-0.2 Ω resistance



- “Dead” when resistance increases (age/cold)
- Short circuit measurement ? (!)
 - How to test?

Alternative Method – Known Load

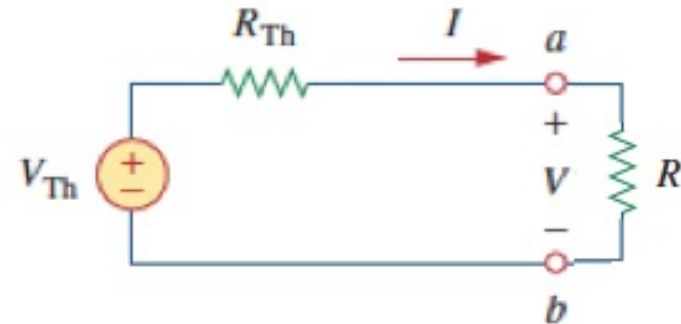
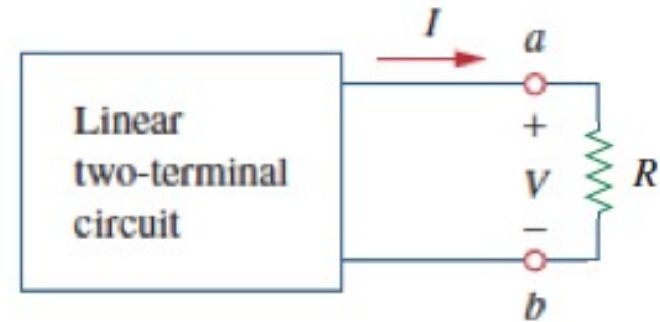
- Connect a known resistance across the terminals

$$V = \frac{R}{R_{TH} + R} V_{TH}$$

- Original relationships

$$V_{OC} = V_{TH}$$

$$V_{TH} = I_{SC} R_{TH}$$



Car battery problem – version 1:

- Open circuit test: 12.6 volts across the terminals
- 10 Ω precision resistor load: 12.46 volts

Solution 1:

- Open circuit test: 12.6 volts across the terminals

$$V_{Th} = V_{oc} = 12.8 \text{ volts}$$

- 10 Ω precision resistor load: 12.46 volts

$$V = \frac{R}{R_{TH} + R} V_{TH}$$

$$12.46 = \frac{10}{R_{TH} + 10} 12.6$$

$$R_{TH} = 0.112 \Omega$$

Car battery problem – version 2:

- 100 Ω precision resistor load: 12.45 volts
- 10 Ω precision resistor load: 12.2 volts

Solution 2:

- 100 Ω precision resistor load: 12.45 volts
- 10 Ω precision resistor load: 12.2 volts

$$12.45 = \frac{100}{R_{TH} + 100} V_{TH} \Rightarrow 100 V_{TH} - 12.45 R_{TH} = 1245$$

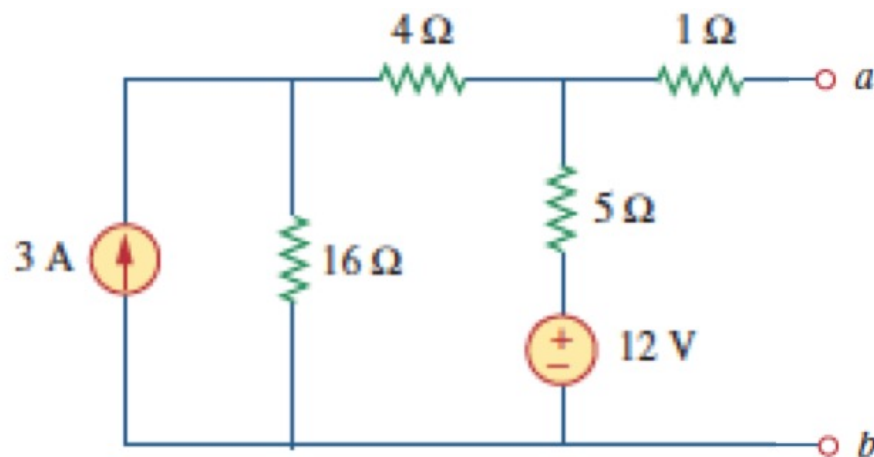
$$12.2 = \frac{10}{R_{TH} + 10} V_{TH} \Rightarrow 10 V_{TH} - 12.2 R_{TH} = 122$$

Solving

$$V_{TH} = 12.48 \text{ volts} \qquad R_{TH} = 0.228 \text{ } \Omega$$

“Ohmmeter” Test for R_{Th}

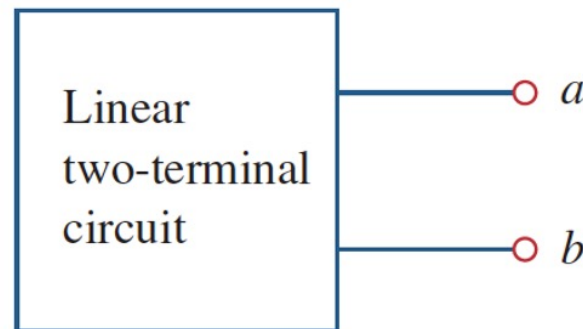
- If no dependent sources, then
 - Turn off independent sources
 - Compute equivalent resistance looking into terminals a - b



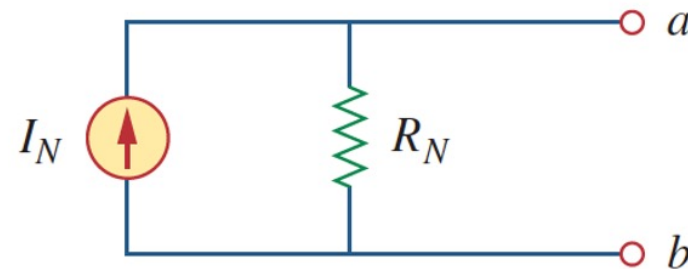
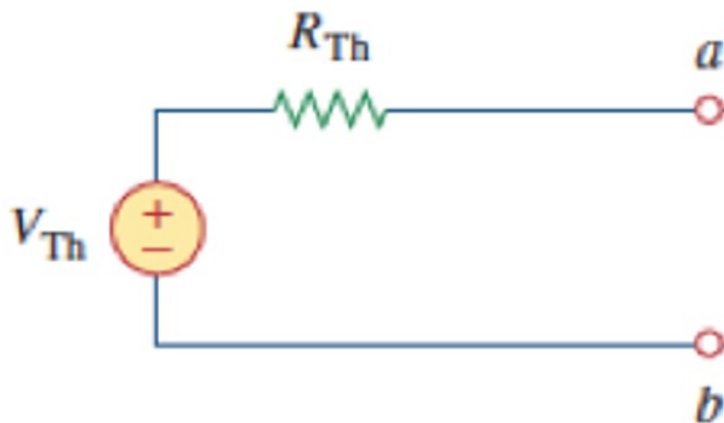
19.2 V, 5 Ω

Norton Equivalent

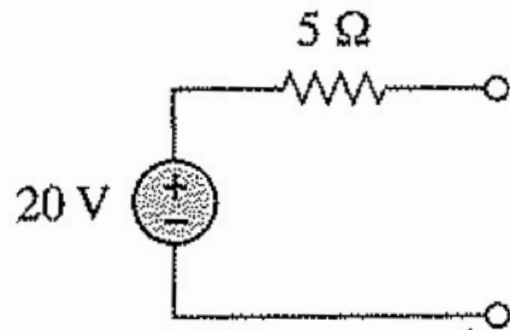
- Recall source transformations, then



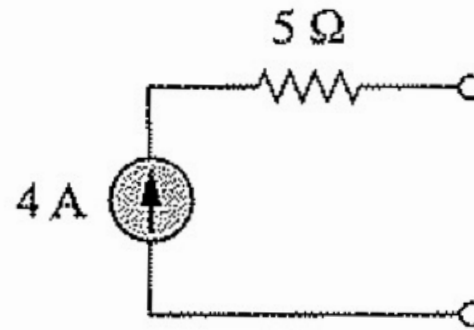
$$R_N = R_{TH}$$
$$I_n = I_{SC}$$



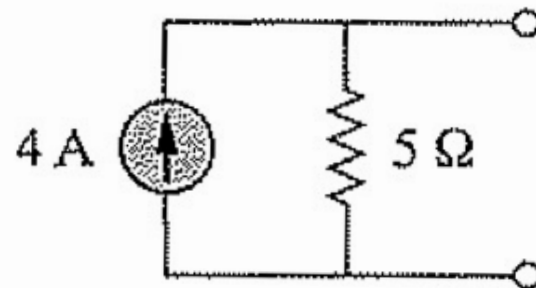
Example: which 2 are equivalent



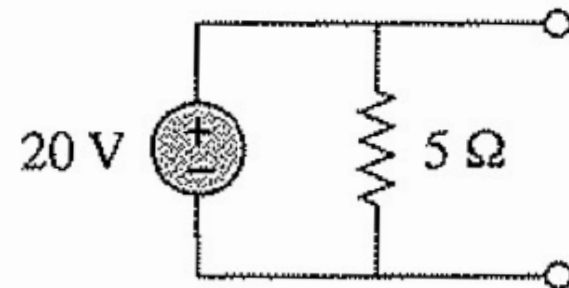
(a)



(b)

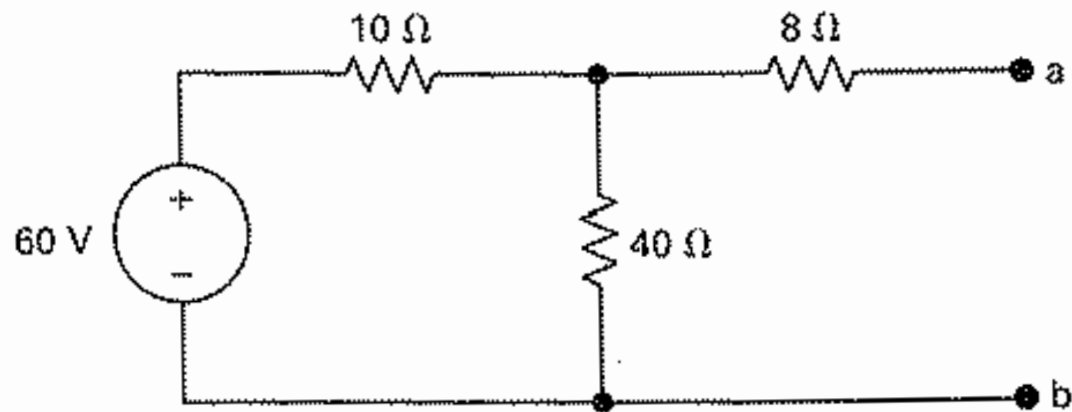


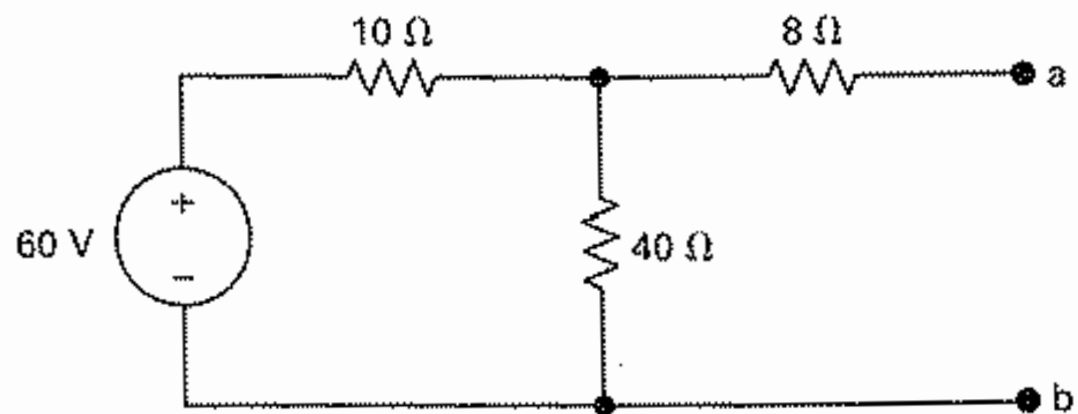
(c)



(d)

Example: Find I_N and R_N

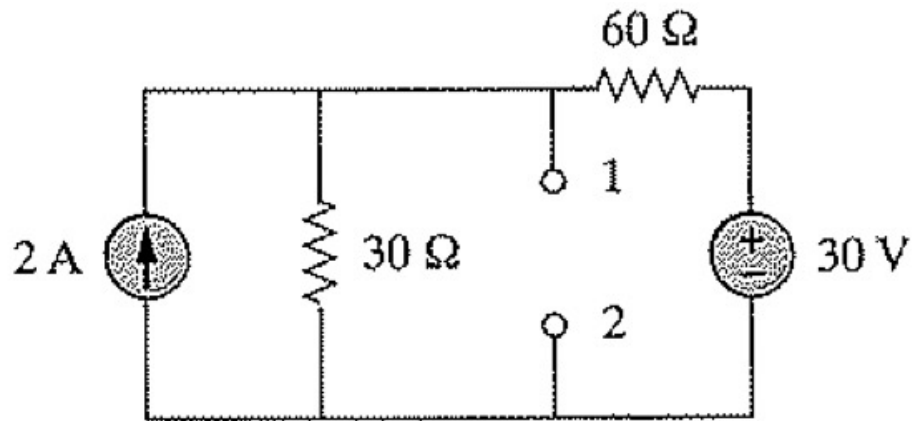




$$I_N = 3 \text{ A}, R_N = 16 \text{ } \Omega$$

50 V, 20 Ω , 2.5 A

Practice problem: find Thevenin and Norton



Practice problem: find Thevenin and Norton 92 V, 28 Ω , 3.29 A

