Conditions for the Thevenin Equivalent

- The Thevenin circuit must be "equivalent" from the terminal point of view, that is, it must provide the same voltage and current to the "load" as the original circuit.

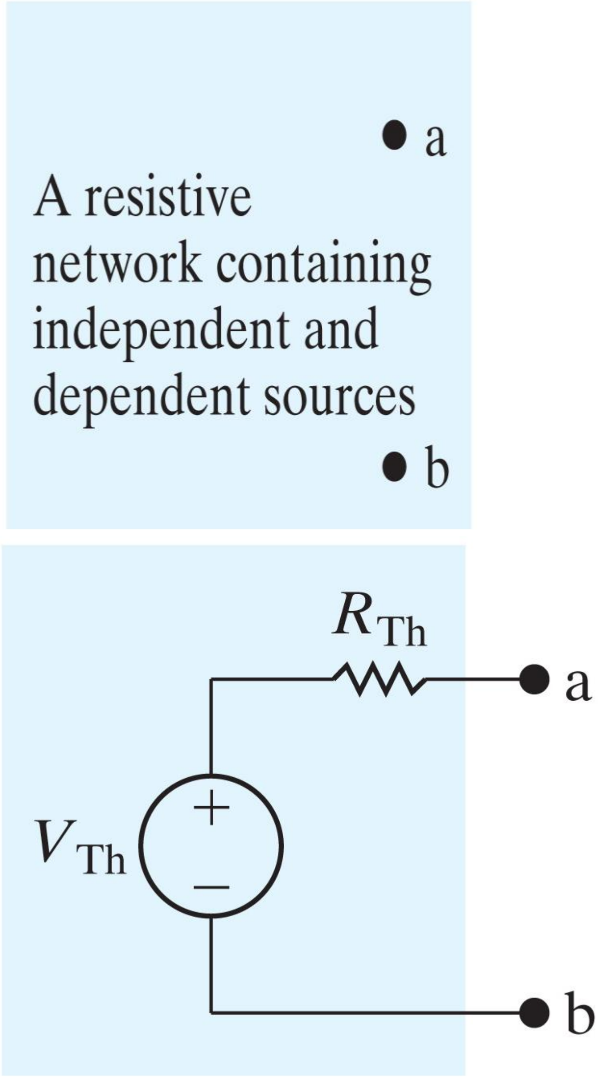
- This "equivalence" must hold for all values of load resistance.

Open-Circuit Consideration

- When the load resistance on the original circuit tends towards infinity, the current goes to zero, but there is still an "open-circuit" voltage at the load terminals.
- This "open-circuit" voltage must be provided by the Thevenin equivalent circuit.

Open-Circuit Conditions

- There is an open-circuit voltage at the a-b terminals in the original circuit.
- The open-circuit voltage is provided by the voltage source in the Thevenin equivalent circuit.



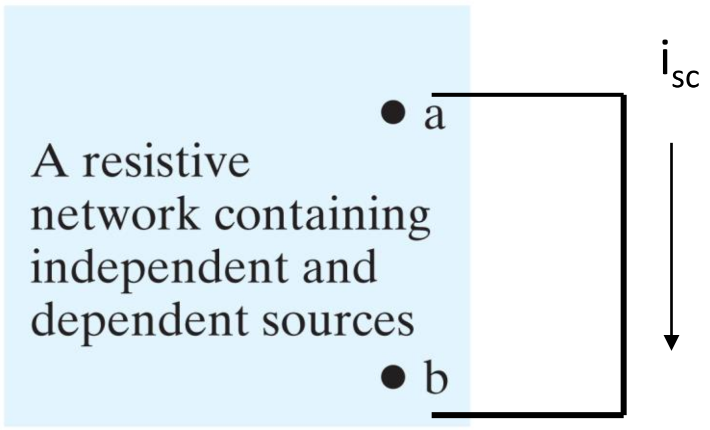
Short-Circuit Considerations

- When the load resistance on the original circuit tends towards a short circuit, the circuit provides a “short-circuit” current to the load.

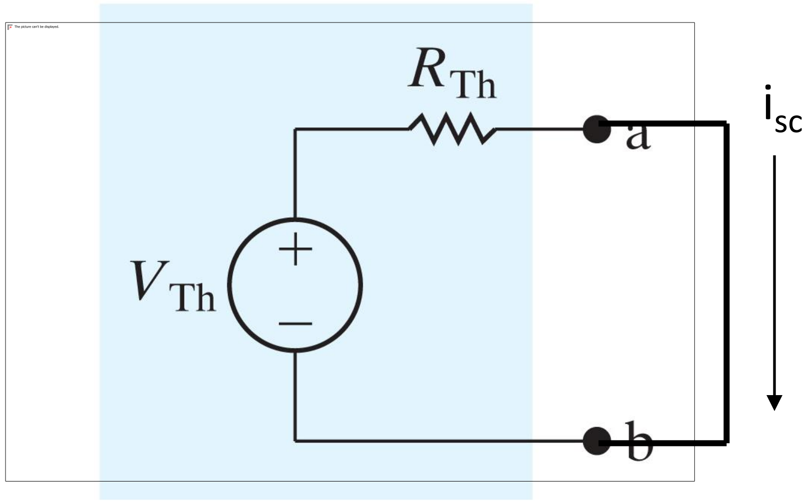
- This “short-circuit” current must also be provided by the Thevenin equivalent circuit.

Short-Circuit Conditions

- The short-circuit current that flows in the Thevenin equivalent must be identical to the current that flows in the original circuit.

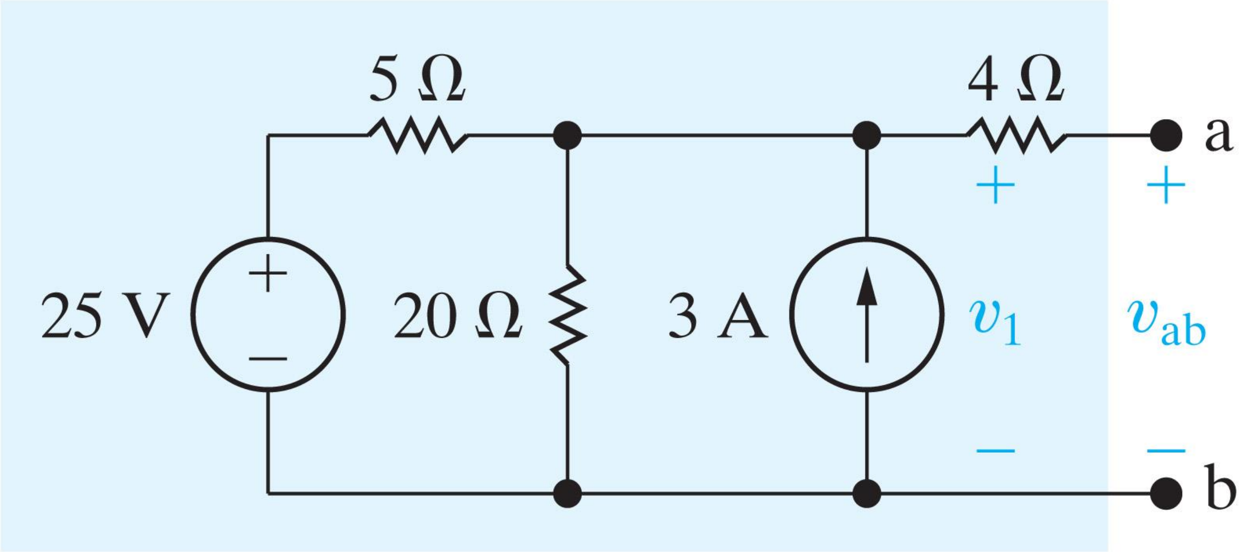


$$i_{sc} = \frac{V_{Th}}{R_{Th}}$$

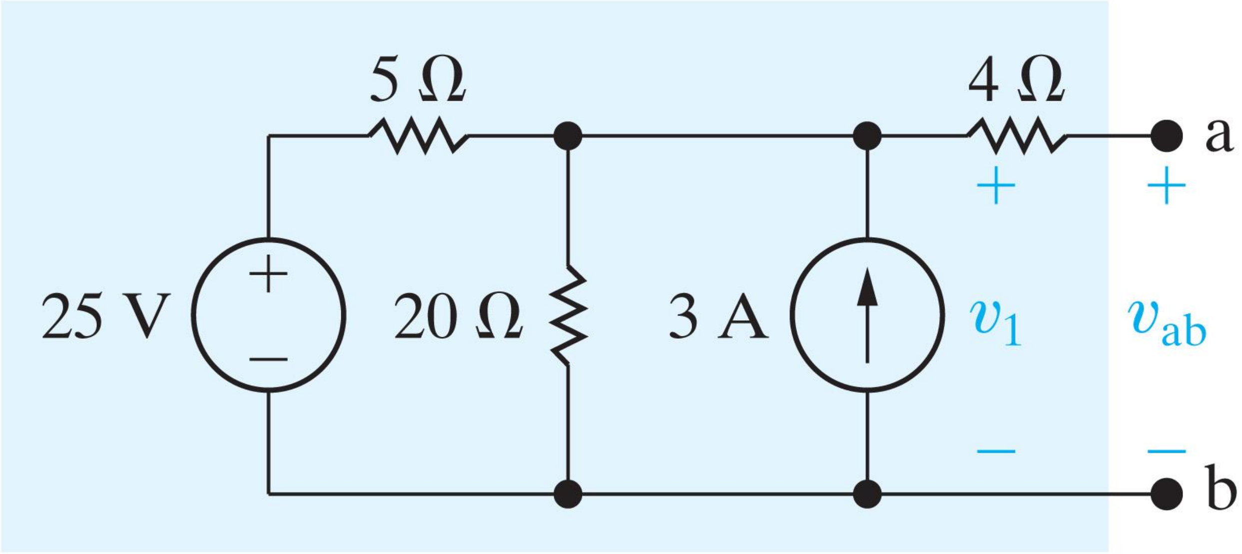


Finding an Equivalent Circuit

- Find the Thevenin equivalent circuit for



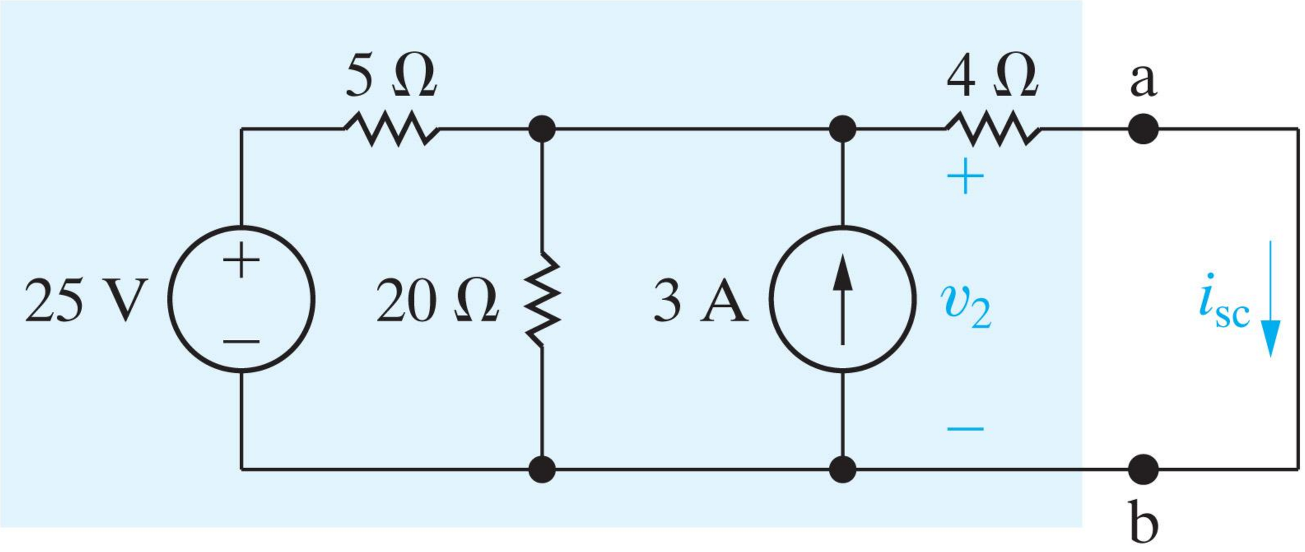
Determine the voltage at a-b



$$\frac{v_1 - 25}{5} + \frac{v_1}{20} - 3 = 0$$

$$v_1 = 32\text{Volts}$$

Determine the short-circuit current



$$\frac{v_2 - 25}{5} + \frac{v_2}{20} - 3 + \frac{v_2}{4} = 0$$

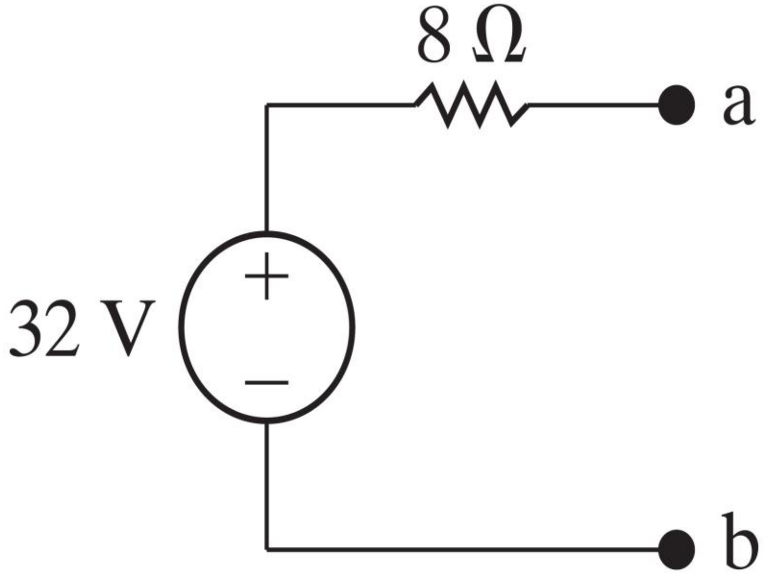
$$v_2 = 16V$$

$$i_{sc} = \frac{16V}{4\Omega} = 4A$$

The Thevenin Equivalent Circuit

- By Ohm's Law,

$$R_{Th} = \frac{V_{Th}}{i_{sc}} = \frac{32V}{4A} = 8\Omega$$



Summary