How Do We Find Thévenin/Norton Equivalent Circuits?

Method 2: Equivalent Resistance

1. Analyze circuit to find either $v_{oc}$ or $i_{sc}$.

2. Deactivate all independent sources by replacing voltage sources with short circuits and current sources with open circuits.

3. Simplify circuit to find equivalent resistance $R_{th}$.

Note: This method does not apply to circuits that contain dependent sources.
Example 3-12: $R_{Th}$

Replace with SC

Replace with OC

(Circuit has no dependent sources)

Example 3-11: $R_{Th}$

Replace with SC

(Circuit has no dependent sources)
Replace with OC

\[
\left( \frac{50\Omega}{50} + 35 \right) \parallel 30 = \frac{60}{130} = 2\Omega
\]
Problem 3-65

Find the Thévenin equivalent circuit at terminals (a, b) for the circuit.

\[
-4V + \frac{V}{4} + \frac{V}{6} + \frac{V}{3} = 0 \Rightarrow -48 + 3V + 24V + 6V - 8 = 0
\]

\[
\Rightarrow 4V = 56 \quad \Rightarrow V = \frac{56}{4} = 14V
\]

\[
V_{oc} = V - 2 = \frac{56}{7} - 2 = \frac{36}{7}V
\]

**Solution:**

\[
\frac{V}{4} + \frac{V}{6} + \frac{V - 2}{3} = 4
\]

Hence, \( V = \frac{56}{7} \) V.

\[V_{Th} = V_{oc} = V - 2 = \frac{56}{9} - 2 = 4.22 \text{ V.}\]

Suppressing the sources:

\[
R_{Th} = \frac{4}{3} + 2.5 = 3.83 \Omega
\]

Thévenin equivalent circuit:

\[
V_{oc} = 4.22 \text{ V}
\]
Nodal Analysis:

\[-4 + \frac{V'}{4} + \frac{V'}{6} + \frac{V'-2}{3/12.5} = 0\]

\[-4 + \frac{V'}{4} + \frac{V'}{6} + \frac{11}{15}(V'-2) = 0\]

\[(\times 60) \quad -240 + 15V' + 10V' + 44(V'-2) = 0\]

\[69V' = 328\]

\[V' = \frac{328}{69}\]

\[i_{sc} = \frac{V' - 2}{3/12.5} \times \frac{3}{3 + 2.5} = \frac{328 - 2}{69} \times \frac{3}{3 + 2.5} = \frac{190}{69} \times \frac{3}{2.5} = \frac{76}{69} \text{ A}\]

\[R_{th} = \frac{V_{oc}}{i_{sc}} = \frac{38}{76} \times \frac{76}{69} = \frac{69}{9 	imes 2} = \frac{23}{6} \text{ \Omega}\]