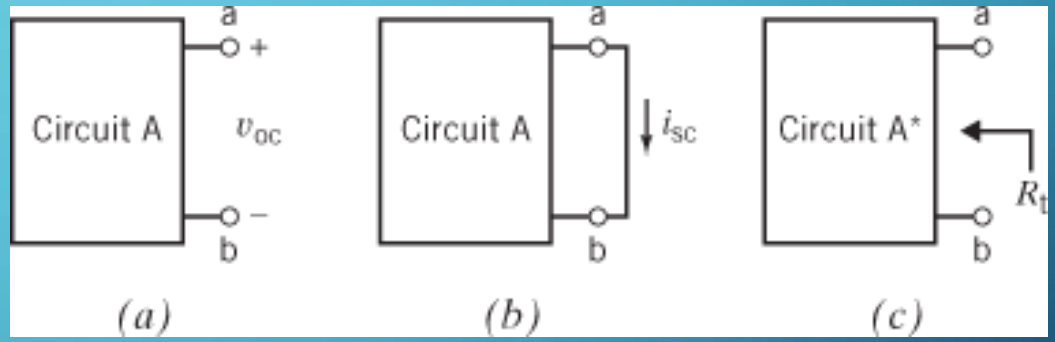
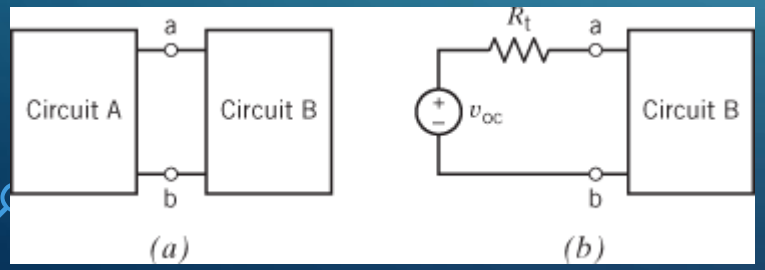
How to find Thevenin/Norton with DS ?

1. Compute Voc
2. Compute Isc

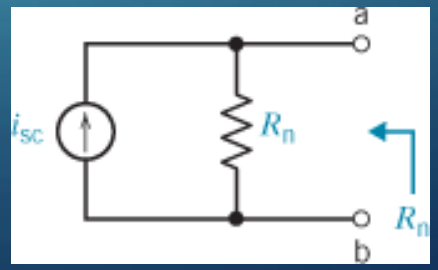
→ R_t = Voc/Isc



Thevenin

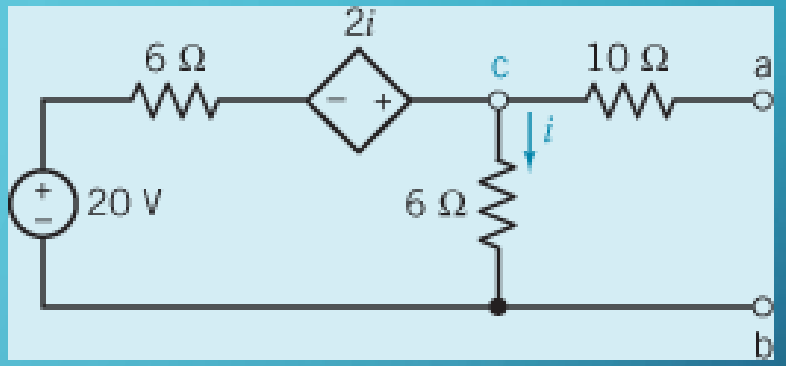


Norton



EXAMPLE 5.4-3

Find the Thévenin equivalent circuit for the circuit shown which includes a dependent source.



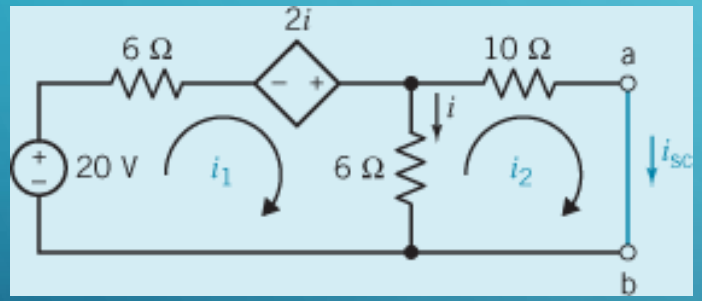
$v_{oc} = v_{ab}$. Writing KVL

$$\rightarrow -20 + 6i - 2i + 6i = 0$$

$$i = 2\,\text{A}$$

Hence, $v_{oc} = 6i = 12\,\text{V}$

Next Find Isc



and

$$-20 + 6i_1 - 2i + 6(i_1 - i_2) = 0$$

$$6(i_2 - i_1) + 10i_2 = 0$$

Substitute $i = i_1 - i_2$ and rearrange the two equations to obtain

$$10i_1 - 4i_2 = 20$$

$$i_2 = i_{sc} = 120/136\,\text{A}$$

$$\rightarrow R_t = \frac{v_{oc}}{i_{sc}} = \frac{12}{120/136} = 13.6\,\Omega$$

** See Ex 5.5-3

Super Position With DS…

$$Vo = \sum ai\, Vi$$

- Acceptable inputs are Independent sources only.
- You solve regularly while never changing the DS (like a Resistor).

EX 5.3-2) FIND THE CURRENT I FOR THE FOLLOWING CIRCUIT

- Step 1: Apply Kirchhoff's voltage law to the loop in Figure-b to get

$$-24 + (3+2)i_1 + 3i_1 + 0 \quad \Rightarrow \quad i_1 = 3\,\text{A}$$

- Step 2: First, express the controlling current of the dependent source in terms of the node voltage, va, using Ohm's law:

$$i_2 = -\frac{v_a}{3} \quad \Rightarrow \quad v_a = -3i_2$$

Next, apply Kirchhoff's current law at node a to get

$$i_2 + 7 = \frac{v_a - 3i_2}{2} \quad \Rightarrow \quad i_2 + 7 = \frac{-3i_2 - 3i_2}{2} \quad \Rightarrow \quad i_2 = -\frac{7}{4}\,\text{A}$$

- Step 3: The current, i, caused by the two independent sources acting together is equal to the sum of the currents, i1 and i2 , caused by each source acting separately:

$$i = i_1 + i_2 = 3 - \frac{7}{4} = \frac{5}{4}\,\text{A}$$