Example 1. Given that $0 \leq R \leq \infty$ in this circuit, consider these two observations:

When $R = 2 \, \Omega$ then $v_R = 4 \, V$ and $i_R = 2 \, A$.
When $R = 6 \, \Omega$ then $v_R = 6 \, V$ and $i_R = 1 \, A$.

Determine $v_{oc}$, $i_{sc}$ and $R_1$.

Solution: We can replace the part of the circuit to the left of the terminals by its Thevenin equivalent circuit:

Using voltage division $v_R = \frac{R}{R + R_1} v_{oc}$ and using Ohm’s law $i_R = \frac{v_{oc}}{R + R_1}$.

Let’s substitute the given data into the equation $i_R = \frac{v_{oc}}{R + R_1}$.

When $R = 2 \, \Omega$ we get $2 = \frac{v_{oc}}{2 + R_1} \Rightarrow 4 + 2 R_1 = v_{oc}$.
When $R = 6 \, \Omega$ we get $1 = \frac{v_{oc}}{6 + R_1} \Rightarrow 6 + R_1 = v_{oc}$.

So $6 + R_1 = 4 + 2 R_1 \Rightarrow R_1 = 2 \, \Omega$ and $v_{oc} = 4 + 2 R_1 = 8 \, V$. Also $i_{sc} = \frac{v_{oc}}{R_1} = \frac{8}{2} = 4 \, A$.

Example 2. This circuit has two inputs, $v_s$ and $i_s$, and one output $i_o$. The output is related to the inputs by the equation

$$i_o = a i_s + b v_s$$

Given the following two facts:

The output is $i_o = 0.45 \, A$ when the inputs are $i_s = 0.25 \, A$ and $v_s = 15 \, V$.
and

The output is $i_o = 0.30 \, A$ when the inputs are $i_s = 0.50 \, A$ and $v_s = 0 \, V$.

Determine the following the values of the constants $a$ and $b$.

Solution:

From the 1st fact: $0.45 = a (0.25) + b (15)$

From the 2nd fact: $0.30 = a (0.50) + b (0) \Rightarrow a = \frac{0.30}{0.50} = 0.60$

Substituting gives $0.45 = (0.60) (0.25) + b (15) \Rightarrow b = \frac{0.45 - (0.60)(0.25)}{15} = 0.02$