Examples

1. This circuit has three inputs: $v_1$, $v_2$ and $v_3$. The output of the circuit is $v_o$. The output is related to the inputs by

$$v_o = a \cdot v_1 + b \cdot v_2 + c \cdot v_3$$

where $a$, $b$ and $c$ are constants.

Determine the values of $a$, $b$ and $c$.

2. This circuit has two inputs: $v_1$ and $v_2$. The output of the circuit is $v_o$. The output is related to the inputs by

$$v_o = a \cdot v_1 + b \cdot v_2$$

where $a$ and $b$ are constants.

Determine the values of $a$ and $b$. 
### Solutions

1. Use units of V, mA and kΩ.

\[
v_o = - \left[ \left( \frac{120}{40} \right) - \frac{20}{20} \right] v_1 + \left( \frac{120}{120} \right) \frac{20}{20+20} v_2 + \left( \frac{120}{30} \right) \left[ 1 + \frac{20}{20} \right] v_3 = 3 v_1 - 0.5 v_2 - 8 v_3
\]

so

\[a = 3, \ b = -0.5 \text{ and } c = -8\]

2. Label the node voltages as shown.

Use units of V, mA and kΩ.

\[v_3 = v_1 \text{ and } v_4 = -v_2\]

Write a node equation

\[
\frac{v_5 - v_3}{40} + \frac{v_5 - v_4}{20} = 0
\]

Solving for \(v_5\)

\[
v_5 = \frac{1}{3} (v_3 + 2v_2) = \frac{1}{3} v_1 - \frac{2}{3} v_2
\]

so

\[a = -\frac{1}{3} \text{ and } b = -\frac{2}{3}\]