Example 12: Non-Inverting Amplifier

Consider the circuit in Figure 21. Because no current flows into either input of the op amp (characteristic 1), \( i_1 = i_2 \).

Writing the currents in terms of voltages, we get:

\[
0 - v^- = \frac{v^- - v_{out}}{R_1} = \frac{v^- - v_{out}}{R_2}
\]

Since the voltages at \( v^+ \) and \( v^- \) are the same (characteristic 2) and \( v^+ = v_{in}, \ v^- = v_{in} \).

Substituting into the previous equation, we get:

\[
\frac{v_{in}}{R_1} = \frac{v_{in} - v_{out}}{R_2}
\]

\[
\frac{v_{out}}{v_{in}} = \frac{R_1 + R_2}{R_1} = 1 + \frac{R_2}{R_1}
\]

So, for example, if \( \frac{R_2}{R_1} \gg 1 \), \( v_{out} = \frac{R_2}{R_1} v_{in} \) (the output is amplified by a factor of \( \frac{R_2}{R_1} \)).

Note that the voltage of the amplified output cannot exceed the voltage of the external supplies.