Example 4.1: Non-inverting Voltage Amplifier

Consider the op-amp circuit shown in Figure 3.3. By obtain the corresponding equation show that it represents a non-inverting voltage amplifier. What is the amplifier gain?

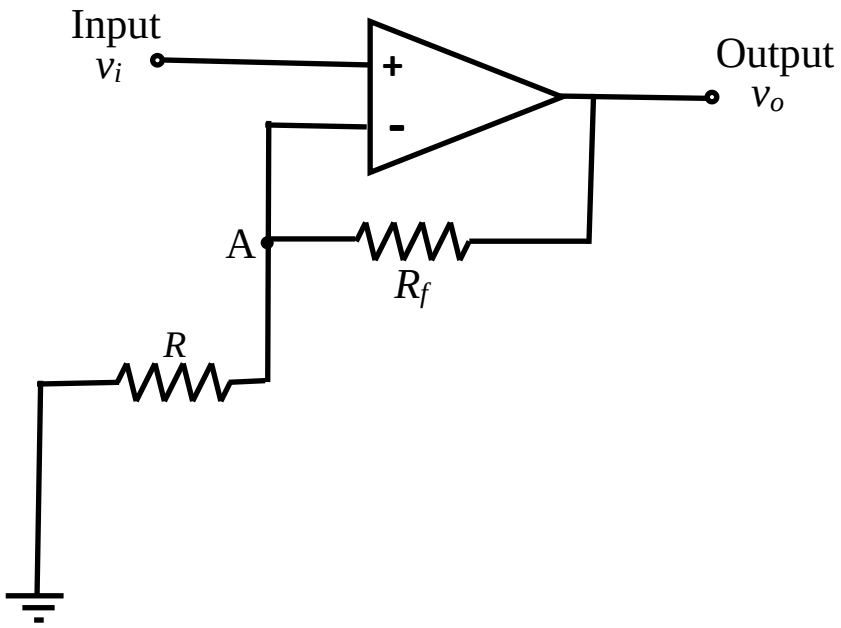

Figure 3.3: An op-amp circuit.

Solution

In writing the equations for the op-amp circuit, we use the following two main properties of an op-amp:

1. Voltages at the two input leads (inverting and non-inverting) are equal (due to high differential gain)
2. Currents at each input lead is zero (due to high input impedance)

We will use these conditions repeatedly in the following derivations of the equations for practical amplifiers.

From the first property it is seen that the voltage at node A is v_i. Next we write the current balance at node A while using the second property indicated above. We have

$$\frac{v_o - v_i}{R_f} = \frac{v_i}{R}.$$

This gives the circuit equation:

$$v_o = \left(1 + \frac{R_f}{R}\right) v_i$$

This corresponds to a non-inverting voltage amplifier (i.e., with a positive gain). The amplifier gain is $K_v = 1 + \frac{R_f}{R}$