Example  Two-stage amplifier consisting of two inverting amplifiers.

- Using equation (5.9) \( v_o = \frac{-R_f}{R_i} v_i \) for an inverting amplifier, the closed-loop voltage gain of a single inverting amplifier is given by \( A_v = \frac{v_o}{v_i} = \frac{-R_f}{R_i} \).

- If \( R_{i,A1} = 3 \, \text{kΩ} \) and \( R_{f1} = 33 \, \text{kΩ} \) for op-amp \( A_1 \), the gain for stage 1 is
  \[
  A_{v1} = \frac{v_{o,A1}}{v_i} = \frac{-R_{f1}}{R_{i,A1}} = \frac{-33}{3} \quad \Rightarrow \quad A_{v1} = -11, \\
  \text{or} \quad A_{v1}(\text{dB}) = 20\log_{10} |A_{v1}| = 20\log_{10}(11) \quad \Rightarrow \quad A_{v1}(\text{dB}) = 20.828 \, \text{(dB)}.
  \]

- If \( R_{i,A2} = 10 \, \text{kΩ} \) and \( R_{f2} = 50 \, \text{kΩ} \) for op-amp \( A_2 \), the gain for stage 2 is
  \[
  A_{v2} = \frac{v_o}{v_{o,A1}} = \frac{-R_{f2}}{R_{i,A2}} = \frac{-50}{10} \quad \Rightarrow \quad A_{v2} = -5, \\
  \text{or} \quad A_{v2}(\text{dB}) = 20\log_{10} |A_{v2}| = 20\log_{10}(5) \quad \Rightarrow \quad A_{v2}(\text{dB}) = 13.979 \, \text{(dB)}.
  \]

- The output voltage \( (v_{o,A1}) \) of the stage 1 inverting amplifier is the input voltage for the stage 2 inverting amplifier. Therefore, the overall voltage gain is given by
  \[
  A_v = \frac{v_o}{v_i} = \left( \frac{v_{o,A1}}{v_i} \right) \left( \frac{v_o}{v_{o,A1}} \right) = A_{v1} A_{v2} = (-11)(-5) \quad \Rightarrow \quad A_v = 55.
  \]

- In decibels (dB), the overall voltage gain is
  \[
  A_v(\text{dB}) = 20\log_{10} |A_v| = 20\log_{10}(55) \quad \Rightarrow \quad A_v(\text{dB}) = 34.807 \, \text{dB}, \\
  \text{or} \quad A_v(\text{dB}) = A_{v1}(\text{dB}) + A_{v2}(\text{dB}) = 20.828 + 13.979 \quad \Rightarrow \quad A_v(\text{dB}) = 34.807 \, \text{(dB)}.
  \]