

Chapter 5, Solution 62.

Let v_1 = output of the first op amp

v_2 = output of the second op amp

The first stage is a summer

$$v_1 = -\frac{R_2}{R_1} v_i - \frac{R_2}{R_f} v_o \quad (1)$$

The second stage is a follower. By voltage division

$$v_o = v_2 = \frac{R_4}{R_3 + R_4} v_1 \quad v_1 \Rightarrow \frac{R_3 + R_4}{R_4} v_o \quad (2)$$

From (1) and (2),

$$\begin{aligned} \left(1 + \frac{R_3}{R_4}\right) v_o &= -\frac{R_2}{R_1} v_i - \frac{R_2}{R_f} v_o \\ \left(1 + \frac{R_3}{R_4} + \frac{R_2}{R_f}\right) v_o &= -\frac{R_2}{R_1} v_i \\ \frac{v_o}{v_i} &= -\frac{R_2}{R_1} \cdot \frac{1}{1 + \frac{R_3}{R_4} + \frac{R_2}{R_f}} = \frac{-R_2 R_4 R_f}{R_1 (R_2 R_4 + R_3 R_f + R_4 R_f)} \end{aligned}$$