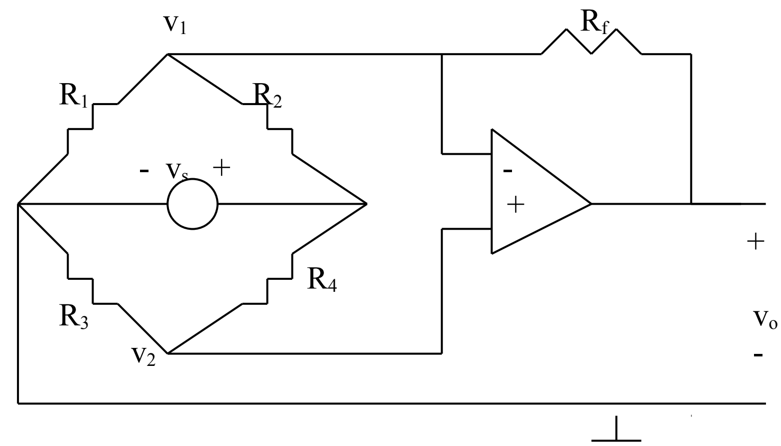
Chapter 5, Solution 24



We notice that $v_1 = v_2$. Applying KCL at node 1 gives

$$\frac{v_1}{R_1} + \frac{(v_1 - v_s)}{R_2} + \frac{v_1 - v_o}{R_f} = 0 \longrightarrow \left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_f}\right)v_1 - \frac{v_s}{R_2} = \frac{v_o}{R_f} \qquad (1)$$

Applying KCL at node 2 gives

$$\frac{v_1}{R_3} + \frac{v_1 - v_s}{R_4} = 0 \longrightarrow v_1 = \frac{R_3}{R_3 + R_4} v_s \qquad (2)$$

Substituting (2) into (1) yields

$$v_o = R_f\left[\left(\frac{R_3}{R_1} + \frac{R_3}{R_f} - \frac{R_4}{R_2}\right)\left(\frac{R_3}{R_3 + R_4}\right) - \frac{1}{R_2}\right]v_s$$

i.e.

$$\underline{\boldsymbol{k = R_f\left[\left(\frac{R_3}{R_1} + \frac{R_3}{R_f} - \frac{R_4}{R_2}\right)\left(\frac{R_3}{R_3 + R_4}\right) - \frac{1}{R_2}\right]}}$$