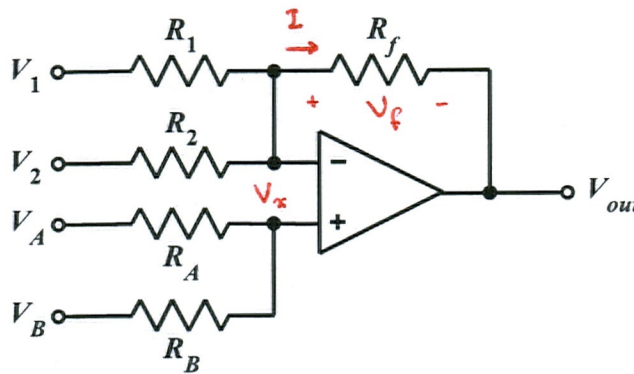


Homework Problem #01

For the circuit shown below, determine a relationship of the form

$$V_{out} = K_1 V_1 + K_2 V_2 + K_A V_A + K_B V_B$$

i.e., find K_1 , K_2 , K_A , and K_B in terms of the resistor values in the circuit. Assume the op amp is ideal.



$$V_x = \frac{R_B}{R_A + R_B} (V_A - V_B)$$

$$I = \frac{V_1 - V_x}{R_1} + \frac{V_2 - V_x}{R_2} = \frac{V_1}{R_1} + \frac{V_2}{R_2} - \left(\frac{1}{R_1} + \frac{1}{R_2} \right) V_x$$

$$V_p = R_f I = \frac{R_f}{R_1} V_1 + \frac{R_f}{R_2} V_2 - R_f \left(\frac{1}{R_1} + \frac{1}{R_2} \right) V_x$$

$$\begin{aligned} V_{out} &= V_x - V_p = V_x - \frac{R_f}{R_1} V_1 - \frac{R_f}{R_2} V_2 + R_f \left(\frac{1}{R_1} + \frac{1}{R_2} \right) V_x \\ &= -\frac{R_f}{R_1} V_1 - \frac{R_f}{R_2} V_2 + \left[1 + R_f \left(\frac{1}{R_1} + \frac{1}{R_2} \right) \right] \frac{R_B}{R_A + R_B} (V_A - V_B) \end{aligned}$$

$$K_1 = -\frac{R_f}{R_1}$$

$$K_2 = -\frac{R_f}{R_2}$$

$$K_A = \frac{1 + R_f \left(\frac{1}{R_1} + \frac{1}{R_2} \right)}{1 + \frac{R_A}{R_B}}$$

$$K_B = -\frac{1 + R_f \left(\frac{1}{R_1} + \frac{1}{R_2} \right)}{1 + \frac{R_A}{R_B}}$$