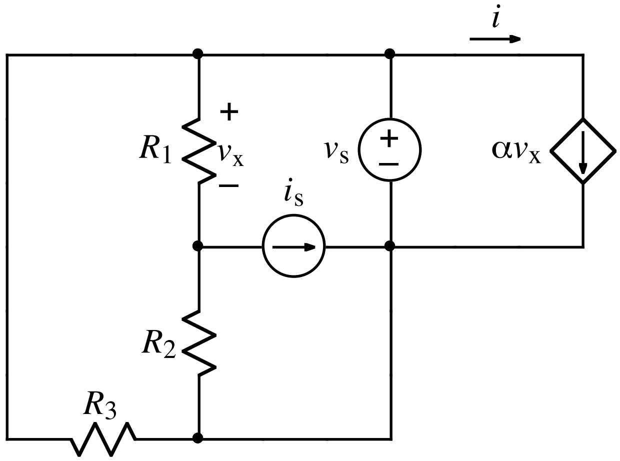
HOMEWORK 12 Solution Prob 5

Ex:



Using superposition, derive an expression for i that contains no circuit quantities other than i_s, v_s, R_1, R_2, R_3, and α.

SOL'N: We turn on the independent sources one at a time. First, we turn on v_s and turn off i_s, which then acts like an open circuit. That leaves R_1 and R_2 across v_s, forming a voltage divider.

$$v_{x1} = v_s \frac{R_1}{R_1 + R_2}$$

The current we seek is the same as the current in the dependent source, which will be

$$i_1 = \alpha v_{x1} = v_s \frac{\alpha R_1}{R_1 + R_2}.$$

Second, we turn on i_s and turn off v_s, which then acts like a wire. Careful examination of the circuit reveals that R_1 and R_2 are now in parallel, and the voltage across them is given by Ohm's law:

$$v_{x2} = i_s \cdot R_1 \| R_2$$

The current in the dependent source will be

$$i_2 = \alpha v_{x2} = i_s \alpha \cdot R_1 \| R_2$$

Summing the currents yields our final answer:

$$i = i_1 + i_2 = v_s \frac{\alpha R_1}{R_1 + R_2} + i_s \alpha \cdot R_1 \| R_2$$