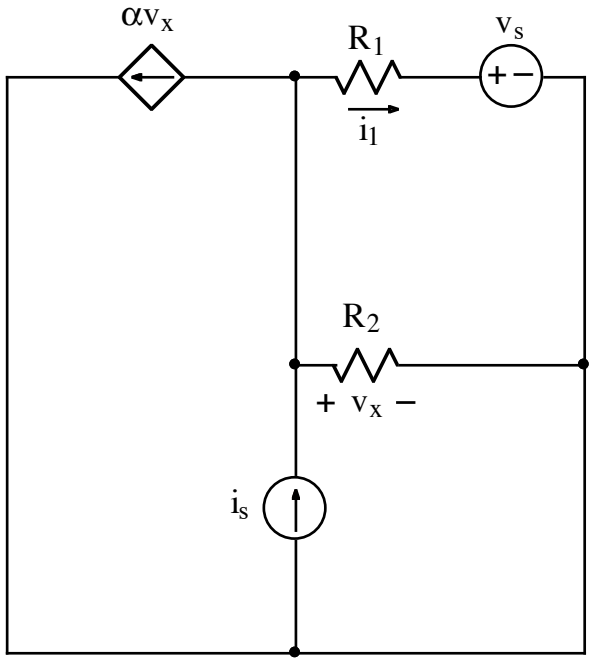
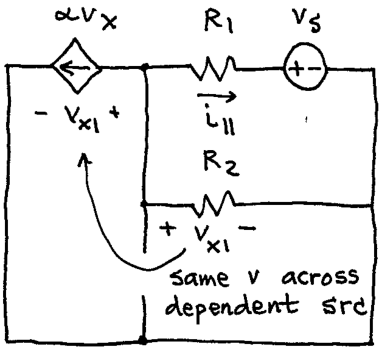
EX:



Using superposition, derive an expression for i_1 that contains no circuit quantities other than i_s, v_S, R_1, R_2, and α, where $\alpha>0$.

Sol'n: We turn on one source at a time.
(Never turn off dependent source.)
case I: v_s on, i_s off



The dependent source is equivalent to $R_{eq} = \frac{v}{i} = \frac{v_{x1}}{\alpha v_{x1}} = \frac{1}{\alpha}$.

$$\text{or } i_{12} = i_S \frac{\frac{R_2/\alpha}{R_2 + 1/\alpha}}{\frac{R_2/\alpha}{R_2+1/\alpha} + R_1}$$

$$\text{or } i_{12} = i_S \frac{R_2/\alpha}{R_2/\alpha + R_1(R_2 + 1/\alpha)}$$

$$\text{or } i_{12} = i_S \frac{R_2}{R_2 + R_1(\alpha R_2 + 1)}$$

We sum i_{11} and i_{12} to get i_1:

$$i_1 = i_{11} + i_{12}$$

$$\text{or } i_1 = -\frac{V_S}{R_1 + R_2 \| \frac{1}{\alpha}} + i_S \frac{R_2}{R_2 + R_1(\alpha R_2 + 1)}$$

Note: When a current source is off it becomes an open circuit.
When a voltage source is off it becomes a wire.