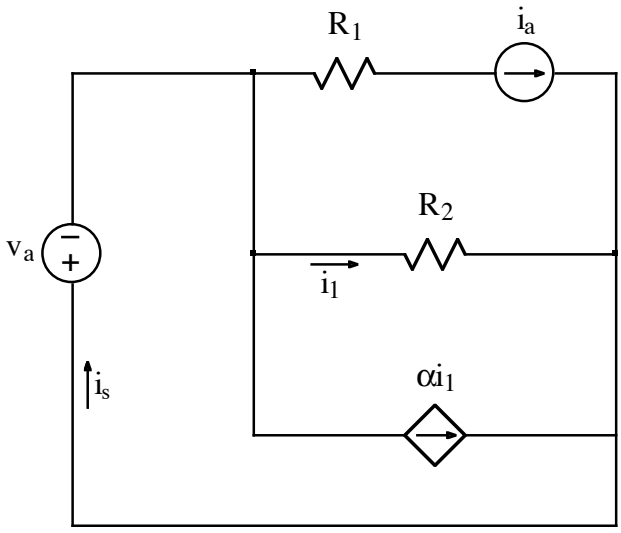
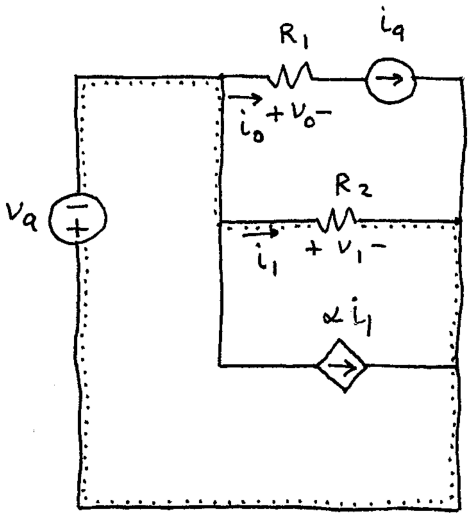
EX:



Derive an expression for i_s. The expression must not contain more than the circuit parameters α, i_a, v_a, R_1, and R_2. **(Make sure to eliminate i_1 from the answer.)**

SOL'N:

Label R's



Only v-loop without current source is thru v_a and R_2, (dotted line).

$$-v_a - v_1 = 0V$$

We look for nodes where we can write i-sum eq'ns. Here, however, we really only have two nodes, and they are connected by only v-src V_a.

Thus, we have no i-sum eq'ns.

We look for components in series carrying the same current.

$$i_o = i_a$$

From Ohm's law:

$$v_o = i_o R_1 = i_a R_1$$

$$v_1 = i_1 R_2$$

Substituting for v_1 in our v-loop eq'n:

$$-v_a - i_1 R_2 = 0V$$

or $$i_1 = -\frac{v_a}{R_2}$$

It follows that $$\alpha i_1 = -\alpha \frac{v_a}{R_2}.$$

Now we write i-sum eq'n (for node consisting of wire on right side) to find i_s.

$$i_s - \alpha i_1 - i_1 - i_a = 0A$$

$$\text{or} \quad i_s = \alpha i_1 + i_1 + i_a$$

$$\text{or} \quad i_s = (\alpha + 1)\left(\frac{-v_a}{R_2}\right) + i_a$$

$$\text{or} \quad i_s = i_a - (\alpha + 1)\frac{v_a}{R_2}$$