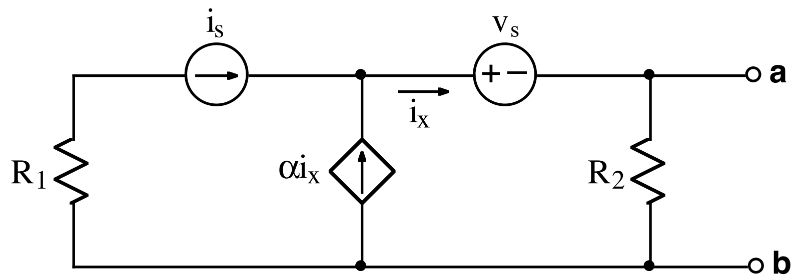
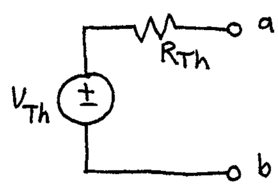
Ex:



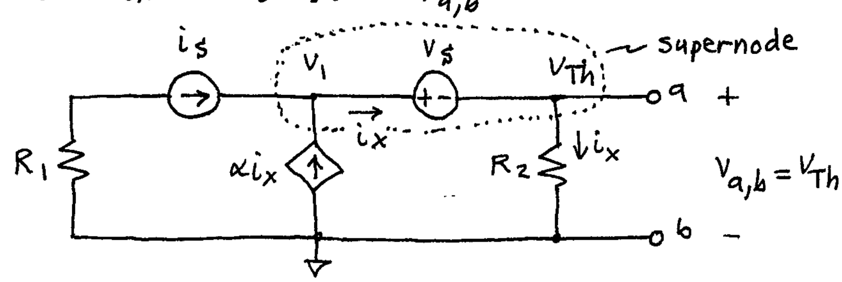
Find the Thevenin's equivalent circuit at terminals a-b. i_X must not appear in your solution. **Note:** $\alpha \neq 1$.

sol'n: We must find V_{Th} and R_{Th} for the Thevenin equivalent circuit that has the same behavior as the above circuit when viewed from a, b terminals.



$V_{Th} = V_{a,b}$ for circuit with nothing connected across a, b.

We can use node-v method or another method of our choice to find $V_{a,b}$



We first define i_x in terms of node voltages. Here, i_x flows thru R_2. Thus $i_x = \dfrac{V_{Th}}{R_2}$.

We have a supernode for v_1 and v_{Th}.

So we sum currents out of a bubble around v_1, v_{Th}, and v_s.

$$v_1, v_{Th} \text{ node: } -i_s - \alpha \frac{v_{Th}}{R_2} + \frac{v_{Th}}{R_2} = 0\text{A}$$

We could continue on to write a voltage eq'n for v_1 and v_{Th}: $v_1 = v_{Th} + v_s$

But our first eq'n has only v_{Th} in it; we can solve the first eq'n for v_{Th} and stop there.

Rearranging gives $v_{Th}\left(\frac{1}{R_2} - \frac{\alpha}{R_2}\right) = i_s$

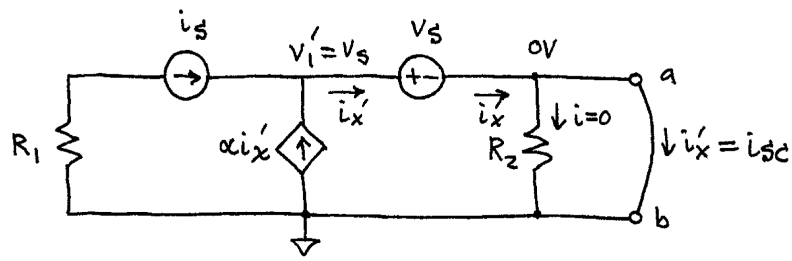
$$\text{or } v_{Th} = \frac{i_s R_2}{1-\alpha}$$

To find R_{Th}, we can use the method of shorting out a and b and measuring the current in the wire. This is i_{sc} for $i_{\underline{s}hort\ \underline{c}ircuit}$. If we look at a Thevenin

equivalent circuit with a wire from a to b, we have current $i_{sc} = \frac{v_{Th}}{R_{Th}}$.

Thus, $R_{Th} = \frac{v_{Th}}{i_{sc}}$.

We redraw our circuit with a wire from a to b.



This is a different circuit than before. We have 0V at a, (instead of v_{Th}), and no current flows in R_2 since it is bypassed by a wire. Also, $i_{sc} = i_x'$.

We also have $v_1 = 0V + v_s = v_s$. Circuit is solved. Or is it? We still need to find $i_{sc} = i_x'$

Using a current summation at v_1, we have

$$-i_s - \alpha i_x' + i_x' = 0A$$

or $$i_x'(1-\alpha) = i_s$$

or $$i_x' = \frac{i_s}{1-\alpha} = i_{sc}$$

Using $R_{Th} = \frac{v_{Th}}{i_{sc}}$ gives $R_{Th} = \dfrac{\frac{i_s R_2}{1-\alpha}}{\frac{i_s}{1-\alpha}}$

or $R_{Th} = R_2$ (Nothing else plays a role in R_{Th}.)

Consistency check: Set $\alpha = 0 \Rightarrow$ dependent src = open. Then R_1, v_s in series with current src i_s irrelevant. We have Norton equiv, i_s and R_2: $v_{Th} = i_s R_2$, $R_{Th} = R_2$ ✓