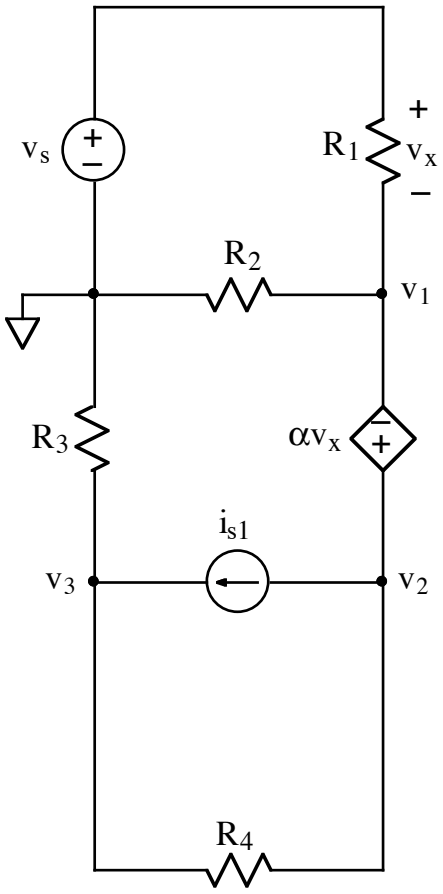
EX:

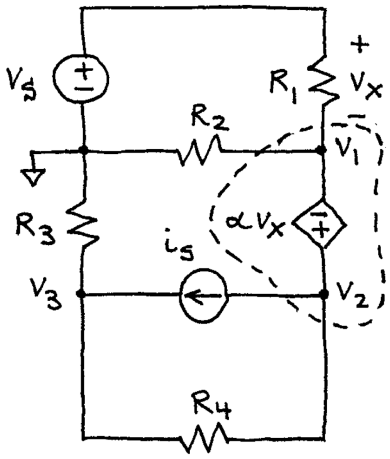


For the circuit shown, write three independent equations for the node voltages v_1, v_2, and v_3. The quantity v_x must not appear in the equations.

soln: First, we define v_x in terms of node-v's:

$$v_x = v_s - v_1$$

Second, we see that v_1 and v_2 are connected by a v-src. Thus, we have a supernode for v_1 and v_2. We draw a bubble enclosing v_1 and v_2 along with the αv_x source.



We sum the currents flowing out of the bubble:

$$(1)\quad \frac{v_1 - v_s}{R_1} + \frac{v_1}{R_2} + i_s + \frac{v_2 - v_3}{R_4} = 0A$$

Third, we write a voltage eq'n for v_1 and v_2:

$$(2)\quad v_1 + \alpha \underbrace{(v_s - v_1)}_{v_x} = v_2$$

Fourth, we write a current-sum eq'n for node v_3:

$$(3)\quad \frac{v_3}{R_3} - i_s + \frac{v_3 - v_2}{R_4} = 0A$$

We now have three independent eq'ns, (1), (2), and (3) that we could solve to find v_1, v_2, and v_3.