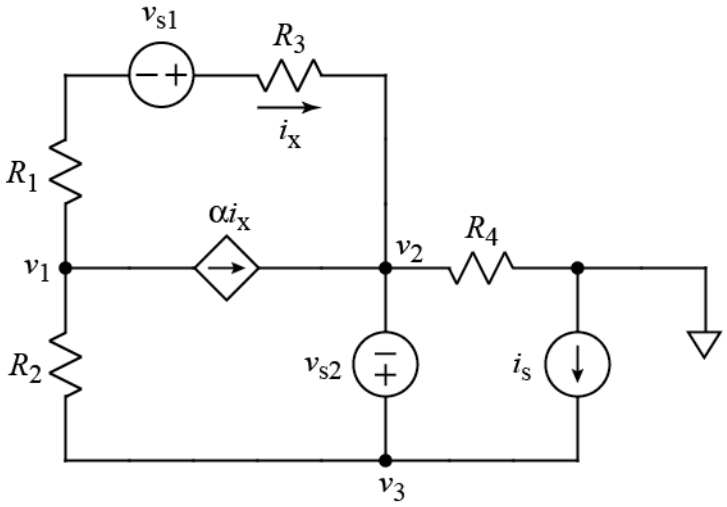
# EXAM #2 prob 1 solution

Ex:




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

**Sol'n:** For the $v_1$ node on the left:

$$\frac{v_1 + v_{s1} - v_2}{R_1 + R_3} + \alpha \frac{v_1 + v_{s1} - v_2}{R_1 + R_3} + \frac{v_1 - v_3}{R_2} = 0\,\text{A}$$

Note that $i_x$ is the same as the current in the top branch from $v_1$ to $v_2$. We substitute this current for $i_x$ in the middle term.

Nodes $v_2$ and $v_3$ form a super-node. The voltage equation for the nodes is

$$v_2 + v_{s2} = v_3\,.$$

The current summation for the super-node is formed by all currents flowing out of the $v_2$ and $v_3$ nodes except those flowing in $v_{s2}$:

$$\frac{v_2 - v_{s1} - v_1}{R_1 + R_3} + \alpha \frac{v_2 - v_{s1} - v_1}{R_1 + R_3} + \frac{v_2}{R_4} + \frac{v_3 - v_1}{R_2} - i_s = 0\,\text{A}\,.$$

This complete the set of three equations.