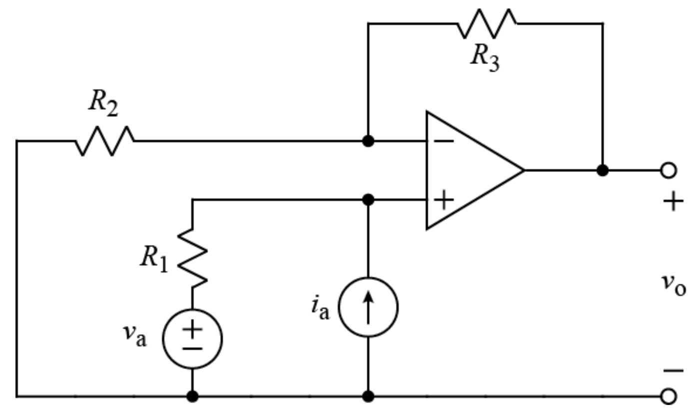
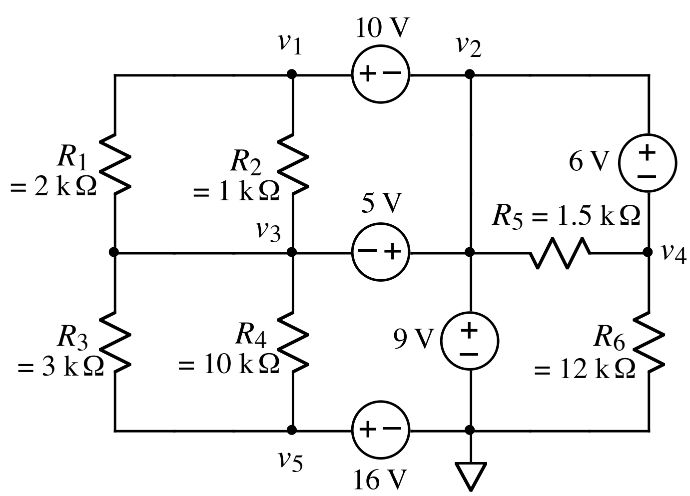
Homework 5

1.



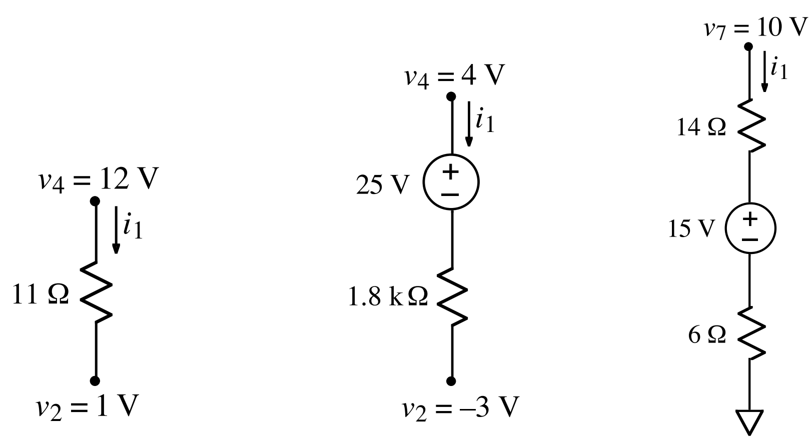
The op-amp operates in the linear mode. Using an appropriate model of the op-amp, derive an expression for v_o in terms of not more than v_a, i_a, R_1, R_2, and R_3.

2.

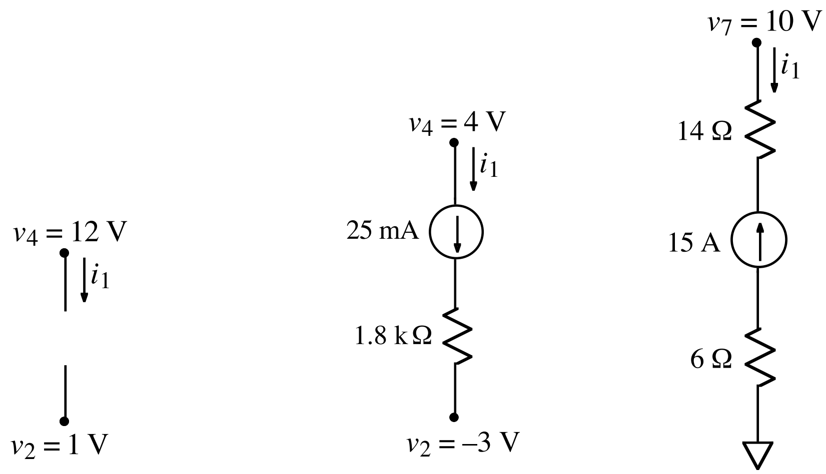


Find the absolute voltages at all the labeled nodes in the above circuit.

3.

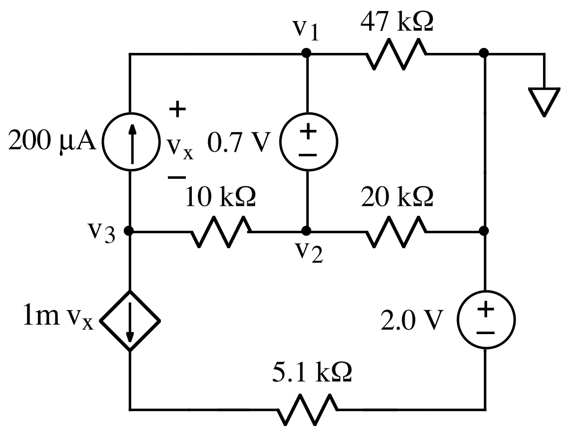


a) Find the value of current, i_1, for each of the above circuits.



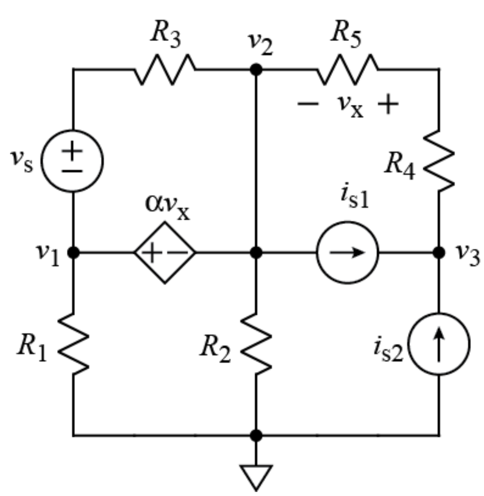
b) Find the value of current, i_1, for each of the above circuits.

4.



Use the node-voltage method to find v_1, v_2, and v_3.

5.



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. Only component and source names may appear in answer.

Answers:

1. $v_o = (1 + \frac{R_3}{R_2}) \cdot$ (V across i_a [+ on top])

2. $v_2 = 14$ V

3.a) $i_1 = -10$ mA for middle circuit , put R's together in 3rd circuit

3.b) How much current flows in an open? What do we do with things in series with current source?

4. Equation for supernode v2 and v1 is: $-200\ \mu\text{A} + \frac{v_1}{47\ \text{k}\Omega} + \frac{v_2 - v_3}{10\ \text{k}\Omega} + \frac{v_2}{20\ \text{k}\Omega} = 0\ \text{A}$

   Also need voltage equation for supernode and current sum for v3 node. vx in erms of node V's is just v1 - v3.

5. First write equation for v_x in terms of node V's: $v_x = (v_3 - v_2)\frac{R_5}{R_4 + R_5}$

   Supernode equation for v1 and v2: $\frac{v_1}{R_1} + \frac{v_1 + v_s - v_2}{R_3} + \frac{v_2 - v_3}{R_4 + R_5} + \text{two more terms} = 0\ \text{A}$

   Also need to write voltage equation for v1 and v2 (they differ by vx, but use the node voltage version of vx) and current sum for v3 node.