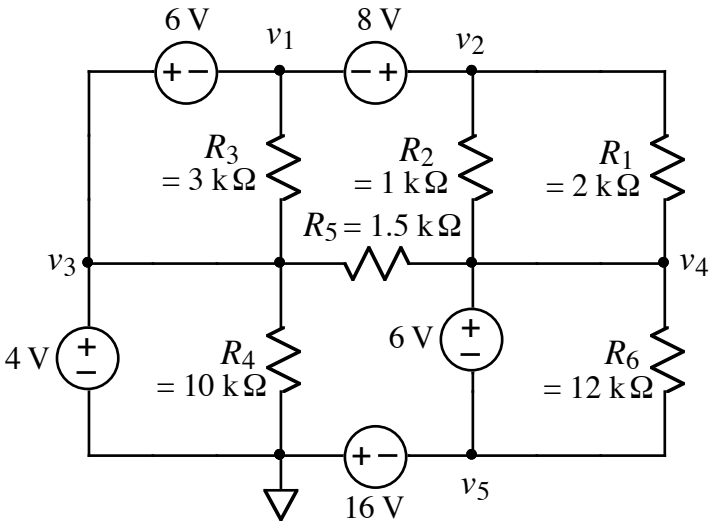
# HOMEWORK #5 solution



**Ex:**




Using Ohm's law and the node voltages, find the currents for all the resistors in the above circuit.

**SOL'N:** The node voltages are found by starting at the reference and stepping from node to node via voltage sources:

$$v_1 = -2 \text{ V}$$

$$v_2 = 6 \text{ V}$$

$$v_3 = 4 \text{ V}$$

$$v_4 = -10 \text{ V}$$

$$v_5 = -16 \text{ V}$$

Currents may be measured in one of two directions for each resistor. Here, they will all be measured with the arrow pointing down or to the right.

The resistor currents are found by taking the difference of the node voltage on each end of the resistor and dividing by the resistance. Note that nodes connected by wires are really the same node and have the same voltage.

$R_1$ is between nodes $v_2$ and $v_4$:

$$i_1 = \frac{v_2 - v_4}{R_1} = \frac{6 \text{ V} - -10 \text{ V}}{2 \text{ k}\Omega} = 8 \text{ mA}$$

$R_2$ is also between nodes $v_2$ and $v_4$:

$$i_2 = \frac{v_2 - v_4}{R_2} = \frac{6\text{ V} - -10\text{ V}}{1\text{ k}\Omega} = 16\text{ mA}$$

$R_3$ is between nodes $v_1$ and $v_3$:

$$i_1 = \frac{v_1 - v_3}{R_3} = \frac{-2\text{ V} - 4\text{ V}}{3\text{ k}\Omega} = -2\text{ mA}$$

$R_4$ is between nodes $v_3$ and reference (i.e., 0 V):

$$i_4 = \frac{v_3 - 0\text{ V}}{R_4} = \frac{4\text{ V} - 0\text{ V}}{10\text{ k}\Omega} = 0.4\text{ mA}$$

$R_5$ is between nodes $v_3$ and $v_4$:

$$i_5 = \frac{v_3 - v_4}{R_5} = \frac{4\text{ V} - -10\text{ V}}{1.5\text{ k}\Omega} = \frac{28}{3}\text{ mA} \approx -9.33\text{ mA}$$

$R_6$ is between nodes $v_4$ and $v_5$:

$$i_6 = \frac{v_4 - v_5}{R_6} = \frac{- -10\text{ V} - 16\text{ V}}{12\text{ k}\Omega} \approx -0.5\text{ mA}$$