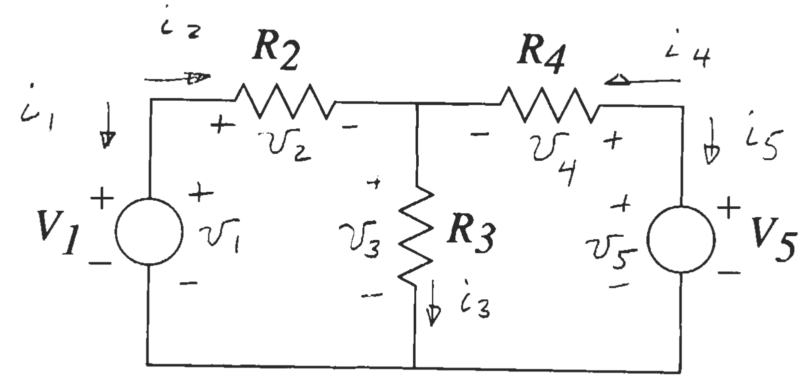
1. The labeling is arbitrary, except for the voltage sources. Also, each current arrow must be drawn into the "+" terminal, or out of the "−" terminal.



2. There are two loops, one on the left, one on the right. KVL gives

$$-v_1 + v_2 + v_3 = 0 \quad (1)$$

$$-v_3 - v_4 + v_5 = 0 \quad (2)$$

3. Write KCL for upper left, upper middle, and upper right nodes:

$$i_1 + i_2 = 0 \quad (3)$$

$$-i_2 + i_3 - i_4 = 0 \quad (4)$$

$$i_4 + i_5 = 0 \quad (5)$$

4. For the voltages sources,

$$v_1 = V_1 = 4\text{ V} \quad (6)$$

$$v_5 = V_5 = 6\text{ V} \quad (7)$$

For the resistors,

$$v_2 = i_2 R_2 = 4 i_2 \quad (8)$$

$$v_3 = i_3 R_3 = 6 i_3 \quad (9)$$

$$v_4 = i_4 R_5 = 12 i_4 \quad (10)$$

5. There are 10 unknowns (5 i's, 5 v's), and 10 equations, so we should be able to solve.

To solve, substitute (6)–(10) into (1) and (2):

$$4 i_2 + 6 i_3 = 4 \quad (11)$$

$$-6 i_3 - 12 i_4 = -6 \quad (12)$$

(Note that I've dropped the units for now.)

Now, begin reducing equations:

$$(3) \Rightarrow i_1 = -i_2 \quad (13)$$

$$(4) \Rightarrow i_3 = i_2 + i_4 \quad (14)$$

$$(5) \Rightarrow i_5 = -i_4 \quad (15)$$

Plug these into (11), (12) to obtain

$$4 i_2 + 6 (i_2 + i_4) = 4 \quad (16)$$

$$-6 (i_2 + i_4) - 12 i_4 = -6 \quad (17)$$

Simplifying,

$$10\, i_2 + 6\, i_4 = 4 \qquad (18)$$

$$6\, i_2 + 18\, i_4 = 6 \qquad (19)$$

Solve for i_2, i_4 using Cramer's rule or Gaussian elimination. The result is

$$i_2 = 0.25 \text{ A} \qquad (20)$$

$$i_4 = 0.25 \text{ A} \qquad (21)$$

Plug these back into (13)–(15):

$$i_1 = -0.25 \text{ A} \qquad (22)$$

$$i_3 = 0.5 \text{ A} \qquad (23)$$

$$i_5 = -0.25 \text{ A} \qquad (24)$$

Use constitutive laws [(6)–(10)] to find voltages:

$$v_1 = 4 \text{ V}$$
$$v_2 = 1 \text{ V}$$
$$v_3 = 3 \text{ V}$$
$$v_4 = 3 \text{ V}$$
$$v_5 = 6 \text{ V}$$

To check our answer, it is easily verified that these values satisfy KVL, KCL, and the constitutive laws.