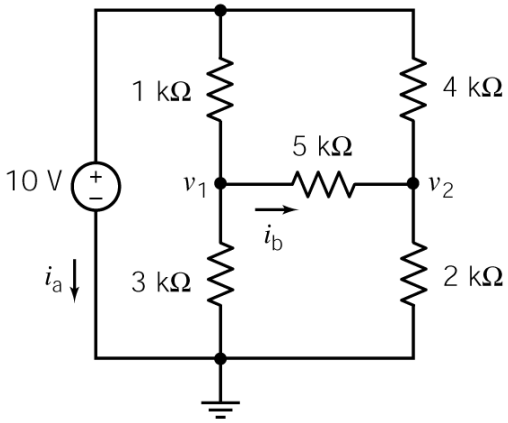
Problem 4.3-7 Determine the values of the node voltages, v_1 and v_2. Determine the values of the currents i_a and i_b.



Solution Apply KCL at nodes 1 and 2 to get

$$\frac{10-v_1}{1000}=\frac{v_1}{3000}+\frac{v_1-v_2}{5000} \quad \Rightarrow \quad 23v_1-3v_2=150$$

$$\frac{10-v_2}{4000}+\frac{v_1-v_3}{5000}=\frac{v_3}{2000} \quad \Rightarrow \quad -4v_1+19v_3=50$$

Solving, e.g. using MATLAB, gives

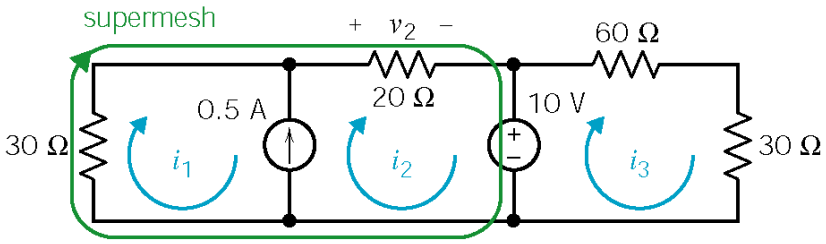
$$\begin{bmatrix}23 & -3\\ -4 & 19\end{bmatrix}\begin{bmatrix}v_1\\ v_2\end{bmatrix}=\begin{bmatrix}150\\ 50\end{bmatrix} \quad \Rightarrow \quad v_1=7.06 \text{ V and } v_1=4.12 \text{ V}$$

Then $$i_b=\frac{v_1-v_2}{5000}=\frac{7.06-4.12}{5000}=0.588 \text{ mA}$$

Apply KCL at the top node to get

$$i_a=\frac{v_1-10}{1000}+\frac{v_2-10}{4000}=\frac{7.06-10}{1000}+\frac{4.12-10}{4000}=-4.41 \text{ mA}$$

Problem 4.6-3 Write and solve mesh equations in order to find v_2 for this circuit



Solution to Problem 4.6-3

Express the current source current as a function of the mesh currents:

$$i_1-i_2 = -0.5 \Rightarrow i_1 = i_2-0.5$$

Apply KVL to the supermesh:

$$30\,i_1+20\,i_2+10=0 \quad \Rightarrow \quad 30\,(i_2-0.5)+20i_2 = -10$$

$$50\,i_2-15 = -10 \quad \Rightarrow \quad i_2 = \frac{5}{50} = 0.1 \text{ A}$$

$$i_1 = -0.4 \text{ A} \quad \text{and} \quad v_2 = 20\,i_2 = \underline{2 \text{ V}}$$