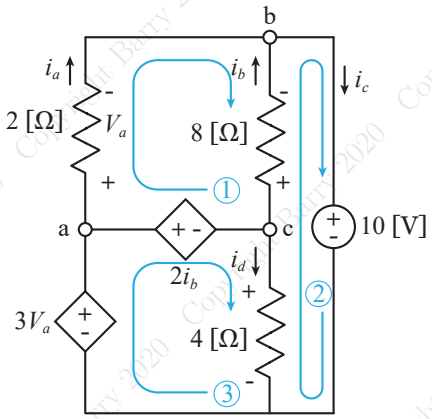
MEMS 0031 - Electrical Circuits
Quiz #1
Assigned: May 21st, 2020
Due: May 22nd, 2020, 9:00 pm

Name: _____

Problem #1

Using a combination of KCL and KVL, determine the currents i_b and i_c and the voltage V_a:



Applying KVL around loop 1:

$$-2i_b + (2\,[\Omega])i_a - (8\,[\Omega])i_b = 0$$

Applying KVL around loop 2:

$$-(4\,[\Omega])i_d + (8\,[\Omega])i_b + 10\,[\mathrm{V}] = 0$$

Applying KVL around loop 3:

$$-3V_a + 2i_b + (4\,[\Omega])i_d = 0 \implies -3((2\,[\Omega])i_a) + 2i_b + (4\,[\Omega])i_d = 0$$

In matrix form:

$$\begin{bmatrix} 2 & -10 & 0 \\ 0 & 8 & -4 \\ -6 & 2 & 4 \end{bmatrix} \begin{bmatrix} i_a \\ i_b \\ i_d \end{bmatrix} = \begin{bmatrix} 0 \\ -10 \\ 0 \end{bmatrix} \implies \begin{bmatrix} i_a \\ i_b \\ i_d \end{bmatrix} = \begin{bmatrix} 2.5 \\ 0.5 \\ 3.5 \end{bmatrix}$$

Applying KCL at node be:

$$i_a + i_b = i_c \implies i_c = 3\,[\mathrm{A}]$$

The voltage V_a is found via Ohm's law:

$$V_a = i_a R = (2.5\,[\mathrm{A}])(2\,[\Omega]) = 5\,[\mathrm{V}]$$