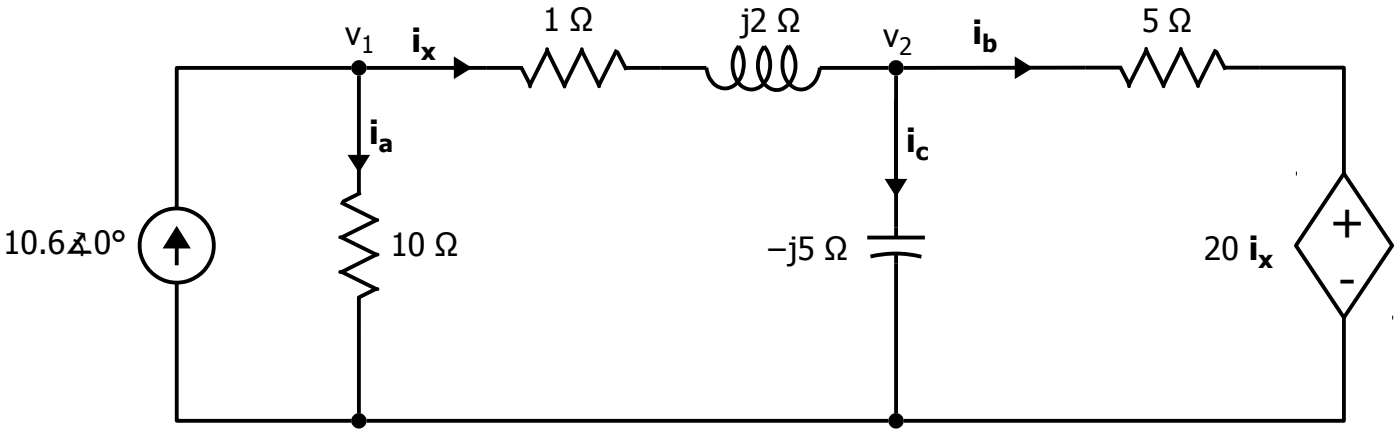
EE3 Fall 2020
Homework Problem 6



Find the currents $\mathbf{i_a}$, $\mathbf{i_b}$, and $\mathbf{i_c}$ in this sinusoidal steady-state circuit.

Node v_1: $-10.6+\frac{v_1}{10}+\frac{v_1-v_2}{1+j2}=0$

Node v_2: $\frac{v_2-v_1}{1+j2}+\frac{v_2}{-j5}+\frac{v_2-20i_x}{5}=0$

$i_x=\frac{v_1-v_2}{1+j2}$

$i_a=\frac{v_1}{10}$

$i_b=\frac{v_2-20i_x}{5}$

$i_c=i_x-i_b$

$$\begin{bmatrix} \frac{1}{10}+\frac{1}{1+j2} & \frac{-1}{1+j2} & 0 & 0 & 0 & 0 \\ \frac{-1}{1+j2} & \frac{1}{1+j2}-\frac{1}{j5}+\frac{1}{5} & -4 & 0 & 0 & 0 \\ \frac{1}{1+j2} & \frac{-1}{1+j2} & -1 & 0 & 0 & 0 \\ \frac{1}{10} & 0 & 0 & -1 & 0 & 0 \\ 0 & \frac{1}{5} & -4 & 0 & -1 & 0 \\ 0 & 0 & 1 & 0 & -1 & -1 \end{bmatrix} \begin{bmatrix} v_1 \\ v_2 \\ i_x \\ i_a \\ i_b \\ i_c \end{bmatrix} = \begin{bmatrix} 10.6 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}$$

$v_1=68.4-j16.8$ V

$v_2=68-j26$ V

$i_x=3.76-j1.68$ A

$i_a=6.84-j1.68$ A

$i_b=-1.44-j11.92$ A

$i_c=5.2+j13.6$ A