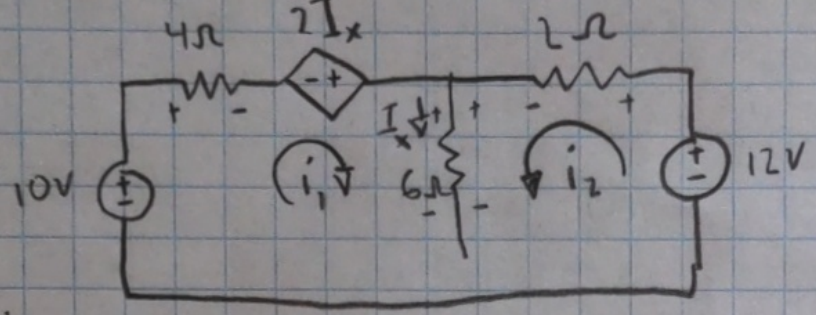
Chris Hunt Homework 6 ENGR 201

6.1) Find i_1 and i_2



$I_x = 6\Omega i_1 + 6\Omega i_2$

Mesh i_1:

$(-10V + 4\Omega i_1 - 2(6(i_1+i_2)) + 6(i_1+i_2) = 0)\ \frac{1}{1\Omega}$

$4i_1 - 12i_1 - 12i_2 + 6i_1 + 6i_2 = 10A$

$-2i_1 - 6i_2 = 10A$

Mesh i_2:

$(-12V + 2\Omega i_2 + 6(i_1+i_2) = 0)\ \frac{1}{1\Omega}$

$2i_2 + 6i_1 + 6i_2 = 12A$

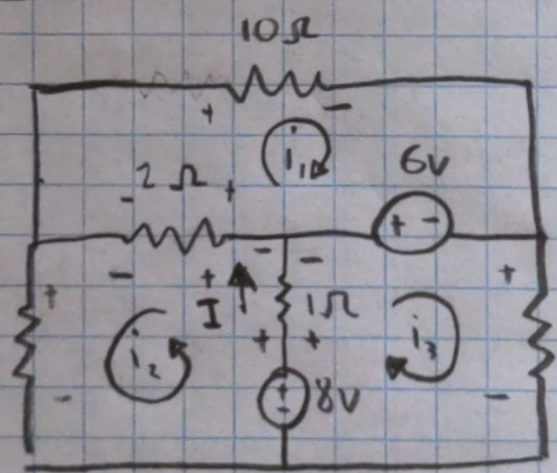
$6i_1 + 8i_2 = 12A$

$$\underset{A}{\begin{bmatrix} -2 & -6 \\ 6 & 8 \end{bmatrix}} \underset{x}{\begin{bmatrix} i_1 \\ i_2 \end{bmatrix}} = \underset{b}{\begin{bmatrix} 10 \\ 12 \end{bmatrix}}$$

$A^{-1}b = x$

$$x = \begin{bmatrix} 7.6 \\ -4.2 \end{bmatrix}$$

6.2) Find I



Mesh i_1:

$(-6V + 2\Omega(i_1+i_2) + 10\Omega i_1 = 0)$

$2i_1 + 2i_2 + 10i_1 = 6A$

$12i_1 + 2i_2 = 6A$

Mesh i_2:

$(2\Omega(i_1+i_2) + 4\Omega i_2 - 8V + i_2 + i_3 = 0)\ \frac{1}{1\Omega}$

$2i_1 + 2i_2 + 4i_2 + i_2 + i_3 = 8A$

$2i_1 + 7i_2 + i_3 = 8A$

Mesh i_3:

$(6V + 5\Omega i_3 - 8V + i_2 + i_3 = 0V)\ \frac{1}{1\Omega}$

$i_2 + 6i_3 = 2A$

$$\underset{A}{\begin{bmatrix} 12 & 2 & 0 \\ 2 & 7 & 1 \\ 0 & 1 & 6 \end{bmatrix}} \underset{x}{\begin{bmatrix} i_1 \\ i_2 \\ i_3 \end{bmatrix}} = \underset{b}{\begin{bmatrix} 6 \\ 8 \\ 2 \end{bmatrix}}$$

$$x = \begin{bmatrix} 0.329 \\ 1.026 \\ 0.162 \end{bmatrix}$$

$I = i_1 + i_2$

$I = 1.188\ A$

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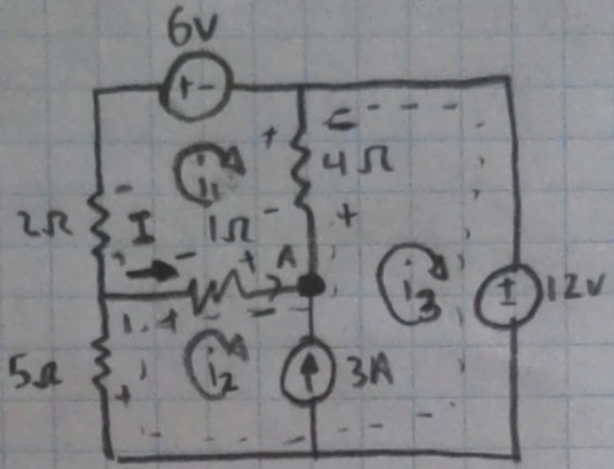
6.3) Find I



KCL:

@A) $i_2 + 3 = i_3$

$-i_2 + i_3 = 3A$

$$\begin{bmatrix} 0 & -1 & 1 \\ -5 & 6 & 4 \\ 7 & -1 & -4 \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \\ i_3 \end{bmatrix} = \begin{bmatrix} 3 \\ -17 \\ -6 \end{bmatrix}$$

A x b

$\frac{1}{V} A^{-1} b = X$

$$\begin{bmatrix} i_1 \\ i_2 \\ i_3 \end{bmatrix} = \begin{bmatrix} -1.333 \\ -3.067 \\ -0.067 \end{bmatrix} A$$

$I = i_2 - i_1$

$\boxed{I = -1.734\ A}$

Supermesh:

$(12V + 5\Omega\, i_2 + i_2 - i_1 + 4(i_3 - i_1) = 0)\ \frac{1}{1\Omega}$

$-5i_1 + 6i_2 + 4i_3 = -12A$

Mesh i_1:

$(6V + 4(i_1 - i_3) + i_1 - i_2 + 2\Omega\, i_1 = 0)\ \frac{1}{1\Omega}$

$4i_1 - 4i_3 + i_1 - i_2 + 2i_1 = -6A$

$7i_1 - i_2 - 4i_3 = -6A$

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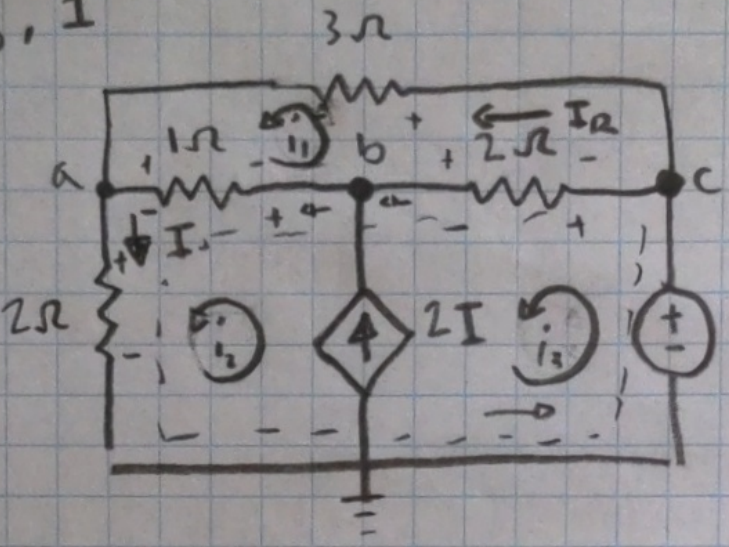
6.41 Find V_b, I



$I = i_2$

KCL:

@ b) $2I + i_3 = i_2$

$2(i_2) + i_3 = i_2$

$i_2 + i_3 = 0$

Mesh i_1)

$(3\Omega i_1 + i_1 - i_2 + 2\Omega(i_1 - i_3) = 0)\ \frac{1}{1\Omega}$

$6i_1 - i_2 - 2i_3 = 0A$

Supermesh)

$(-16v + 2\Omega(i_3 - i_1) + i_2 - i_1 + 2i_2 = 0)\ \frac{1}{1\Omega}$

$-3i_1 + 3i_2 + 2i_3 = 16A$

$$A \quad x \quad b$$

$$\begin{bmatrix} 0 & 1 & 1 \\ 6 & -1 & -2 \\ -3 & 3 & 2 \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \\ i_3 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 16 \end{bmatrix}$$

$$A^{-}b = X$$

$$\begin{bmatrix} i_1 \\ i_2 \\ i_3 \end{bmatrix} = \begin{bmatrix} -1.778 \\ 10.667 \\ -10.667 \end{bmatrix}$$

$V_c = 16v$ $\quad V_b = V_c - 2\Omega \cdot I_R$ $\quad I_R = i_1 + i_3$

$V_b = 16v - 2\Omega(-12.445A)$

$V_b = 40.89v \quad I = 10.667A$

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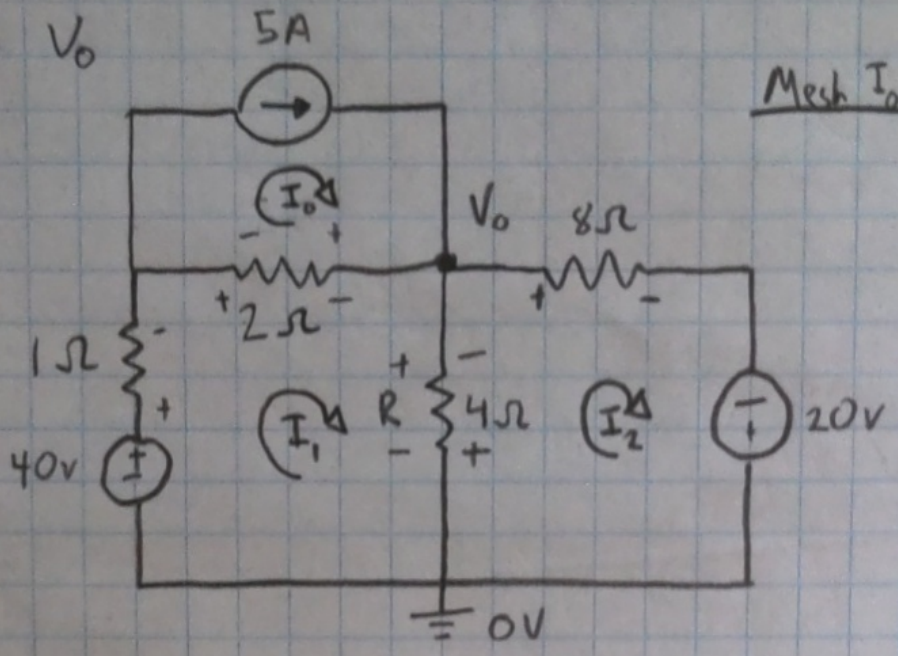
6.5) Find V_o



Mesh I_o:

$I_o = 5A$

Mesh I_1:

$(-40V + 1\Omega I_1 + 2\Omega(I_1 - I_o) + 4\Omega(I_1 - I_2) = 0)\ \frac{1}{1\Omega}$

$I_1 + 2I_1 - 2I_o + 4I_1 - 4I_2 = 40A$

$7I_1 - 10A - 4I_2 = 40A \rightarrow 7I_1 - 4I_2 = 50A$

$+10A$

Mesh I_2:

$(4\Omega(I_2 - I_1) + 8\Omega I_2 - 20V = 0)\ \frac{1}{1\Omega}$

$4I_2 - 4I_1 + 8I_2 = 20A \rightarrow +4I_1 + 12I_2 = 20A$

$$\underset{A}{\begin{bmatrix} 7 & -4 \\ -4 & 12 \end{bmatrix}} \underset{x}{\begin{bmatrix} I_1 \\ I_2 \end{bmatrix}} = \underset{b}{\begin{bmatrix} 50 \\ 20 \end{bmatrix}} A \qquad A^{-1}b = x \rightarrow \begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} 10 \\ 5 \end{bmatrix} A$$

$V_o = 0 + R \cdot (I_1 - I_2)$

$V_o = 4\Omega \cdot 5A$

$V_o = 20V$