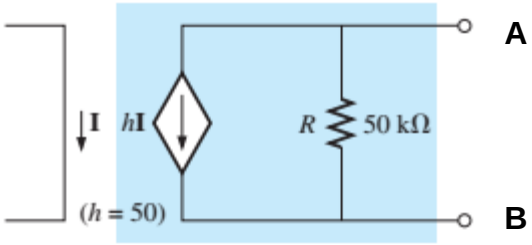
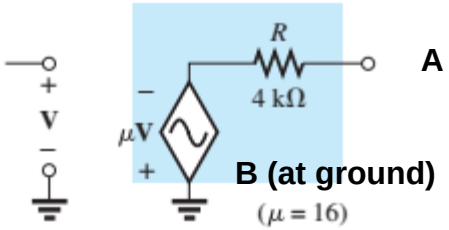
In Class Problem Set – Source Conversions

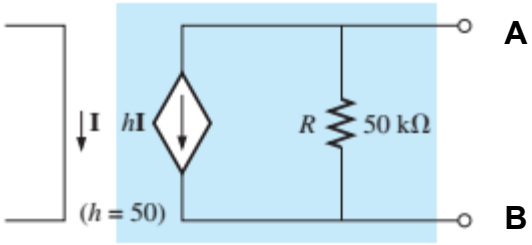


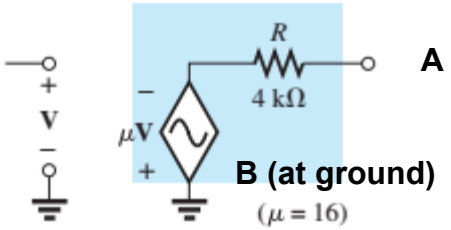
Convert to a voltage source



Convert to a current source

In Class Problem Set – Source Conversions



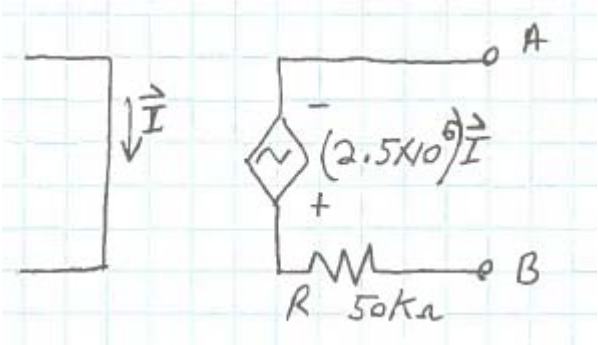


Convert to a voltage source

$$\vec{V} = \vec{I} \cdot \vec{Z}$$

$$= (50)\vec{I} \cdot 50{,}000\,\Omega$$

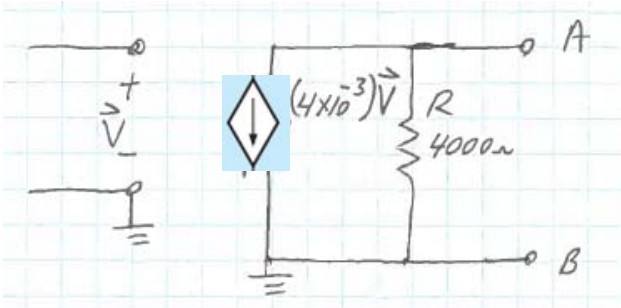
$$\vec{V} = (2.5\times10^{6})\vec{I}$$



Convert to a current source

$$\vec{I} = \frac{\vec{E}}{\vec{Z}} = \frac{(16)\vec{V}}{4000\,\Omega}$$

$$\vec{I} = (4\times10^{-3})\vec{V}$$



NP

In Class Problem Set – Simultaneous Equations

Solve the following 3x3 system of equations (from last semester's mesh/nodal lab) using the inverse matrix method :

$7300\ I_1 - 2200\ I_2 - 3300\ I_3 = 15$ (E1)
$-2200\ I_1 + 3960\ I_2 - 560\ I_3 = 0$ (E2)
$-3300\ I_1 - 560\ I_2 + 4680\ I_3 = -5$ (E3)

Solve the following 2x2 system of **complex equations** (note I_1 and I_2 represent phasors and hence have magnitude and angle components) using the inverse matrix method:

$-1000\ \mathbf{I_1} + 12{,}000\ \mathbf{I_2} = 10$ (E1)

$0\ \mathbf{I_1} - (2000 - j4000)\ \mathbf{I_2} = -10$ (E2)

In Class Problem Set – Simultaneous Equations

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$7300\ I_1 - 2200\ I_2 - 3300\ I_3 = 15$ (E1)
$-2200\ I_1 + 3960\ I_2 - 560\ I_3 = 0$ (E2)
$-3300\ I_1 - 560\ I_2 + 4680\ I_3 = -5$ (E3)

Describe the system using matrices:

$$\begin{bmatrix} 7300 & -2200 & -3300 \\ -2200 & 3960 & -560 \\ -3300 & -560 & 4680 \end{bmatrix} \cdot \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 15 \\ 0 \\ -5 \end{bmatrix}$$

A (3x3) X (3x1) B (3x1)

Write the solution equation (note the number of rows and columns)

$$X = A^{-1} \cdot B \quad (3\times3)\ (3\times1) \rightarrow (3\times1)$$

Perform the calculations (calculator or Excel)

$$X = \begin{bmatrix} 308.3\times10^{-6} & 205.5\times10^{-6} & 242.0\times10^{-6} \\ 205.5\times10^{-6} & 393.8\times10^{-6} & 192.0\times10^{-6} \\ 242.0\times10^{-6} & 192.0\times10^{-6} & 407.3\times10^{-6} \end{bmatrix} \cdot \begin{bmatrix} 15 \\ 0 \\ -5 \end{bmatrix}$$

$$X = \begin{bmatrix} 3.41\times10^{-3} \\ 2.12\times10^{-3} \\ 1.59\times10^{-3} \end{bmatrix}$$

Interpret the results:

OR $I_1 = 3.41\ mA$
$I_2 = 2.12\ mA$
$I_3 = 1.59\ mA$

NP

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$-1000\ \mathbf{I_1} + 12{,}000\ \mathbf{I_2} = 10$ (E1)

$0\ \mathbf{I_1} - (2000 - j4000)\ \mathbf{I_2} = -10$ (E2)

Describe the system using matrices:

$$\underbrace{\begin{bmatrix} -1000 & 12{,}000 \\ 0 & -(2000-j4000) \end{bmatrix}}_{A\ (2\times2)} \cdot \underbrace{\begin{bmatrix} \vec{I}_1 \\ \vec{I}_2 \end{bmatrix}}_{X\ (2\times1)} = \underbrace{\begin{bmatrix} 10 \\ -10 \end{bmatrix}}_{B\ (2\times1)}$$

Write the solution equation

$$X = A^{-1} \cdot B$$
$$(2\times2)\ (2\times1) \rightarrow 2\times1$$

Perform the calculations (calculator or Excel)

$$X = \begin{bmatrix} -1.00\times10^{-3} & (-1.20\times10^{-3} - j\,2.4\times10^{-3}) \\ 0 & (-100\times10^{-6} - j\,200\times10^{-6}) \end{bmatrix} \begin{bmatrix} 10 \\ -10 \end{bmatrix}$$

$$X = \begin{bmatrix} 2.00\times10^{-3} + j\,24.0\times10^{-3} \\ 1.00\times10^{-3} + j\,2.00\times10^{-3} \end{bmatrix}$$

Interpret the results:

OR

$$\begin{bmatrix} 24.1\times10^{-3} \angle 85.2^\circ \\ 2.24\times10^{-3} \angle 63.4^\circ \end{bmatrix} \begin{matrix} \leftarrow \vec{I}_1 \\ \leftarrow \vec{I}_2 \end{matrix}$$

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