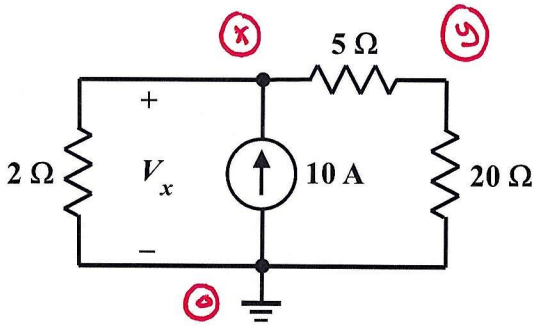
EE 2240

Homework Problem #021

Use the nodal analysis method to determine V_x.



$\frac{V_x}{2\Omega} - 10A + \frac{V_x - V_y}{5\Omega} = 0$ (KCL for node x)

$\frac{V_y - V_x}{5\Omega} + \frac{V_y}{20\Omega} = 0$ (KCL for node y)

In matrix form:

$$\begin{bmatrix} \frac{1}{2}+\frac{1}{5} & -\frac{1}{5} \\ -\frac{1}{5} & \frac{1}{5}+\frac{1}{20} \end{bmatrix} \begin{bmatrix} V_x \\ V_y \end{bmatrix} = \begin{bmatrix} 10 \\ 0 \end{bmatrix}$$

or

$$\begin{bmatrix} 7 & -2 \\ -4 & 5 \end{bmatrix} \begin{bmatrix} V_x \\ V_y \end{bmatrix} = \begin{bmatrix} 100 \\ 0 \end{bmatrix}$$

Solving yields:

$$V_x = \frac{\begin{vmatrix} 100 & -2 \\ 0 & 5 \end{vmatrix}}{\begin{vmatrix} 7 & -2 \\ -4 & 5 \end{vmatrix}} = \frac{500}{35-8}\,V = \frac{500}{27}\,V$$

$$V_y = \frac{\begin{vmatrix} 7 & 100 \\ -4 & 0 \end{vmatrix}}{27} = \frac{400}{27}\,V$$