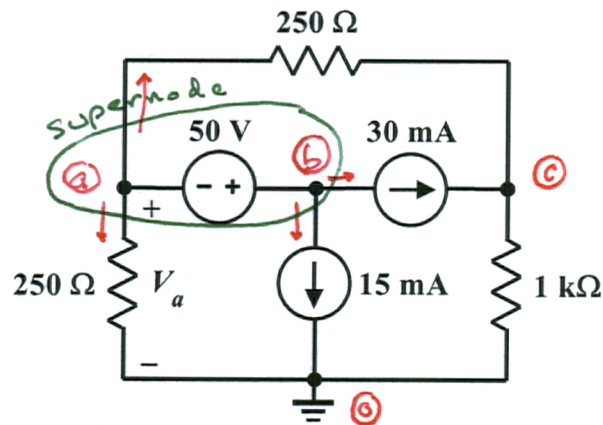


Homework Problem #15

Use the nodal analysis method to write nodal equations and express them in the matrix form discussed in class. Then solve the equations to determine V_a .



$$V_b - V_e = 50V \quad (\text{supernode constraint equation})$$

$$\frac{V_a - V_e}{250\Omega} + 30\text{mA} + 15\text{mA} + \frac{V_a}{250\Omega} = 0 \quad (\text{KCL for the supernode})$$

$$\frac{V_c - V_a}{250\Omega} - 30\text{mA} + \frac{V_c}{1\text{k}\Omega} = 0 \quad (\text{KCL for node c})$$

↓

$$\begin{bmatrix} -1 & 1 & 0 \\ 1/250 & 0 & -1/250 \\ -1/250 & 0 & 1/200 \end{bmatrix} \begin{bmatrix} V_a \\ V_b \\ V_c \end{bmatrix} = \begin{bmatrix} 50 \\ -45 \times 10^{-3} \\ 30 \times 10^{-3} \end{bmatrix}$$

or

$$\begin{bmatrix} 1 & 1 & 0 \\ 0.008 & 0 & -0.004 \\ -0.004 & 0 & 0.005 \end{bmatrix} \begin{bmatrix} V_a \\ V_b \\ V_c \end{bmatrix} = \begin{bmatrix} 50 \\ -0.045 \\ 0.03 \end{bmatrix}$$

↓

$$\boxed{V_a = -4.375\text{V}}, \quad V_b = 54.375\text{V}, \quad V_c = 2.5\text{V}$$