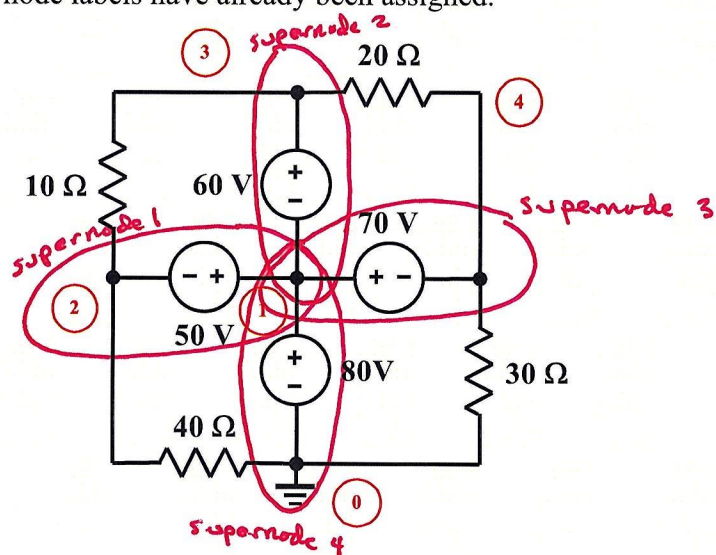


Homework Problem #020

Express the node equations in the matrix form discussed in class, then determine the value of each node voltage. Note that node labels have already been assigned.



$$\begin{aligned}
 V_1 - V_2 &= 50V && \text{(constraint equation for supernode 1)} \\
 V_3 - V_1 &= 60V && \text{(constraint equation for supernode 2)} \\
 V_1 - V_4 &= 70V && \text{(constraint equation for supernode 3)} \\
 V_1 &= 80V && \text{(constraint equation for supernode 4)}
 \end{aligned}$$

In matrix form:

$$\begin{bmatrix} 1 & -1 & 0 & 0 \\ -1 & 0 & 1 & 0 \\ 1 & 0 & 0 & -1 \\ 1 & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \\ V_3 \\ V_4 \end{bmatrix} = \begin{bmatrix} 50 \\ 60 \\ 70 \\ 80 \end{bmatrix}$$

Solving yields:

$$V_1 = 80V, \quad V_2 = V_1 - 50V = 30V$$

$$V_3 = 60V + V_1 = 140V, \quad V_4 = V_1 - 70V = 10V$$