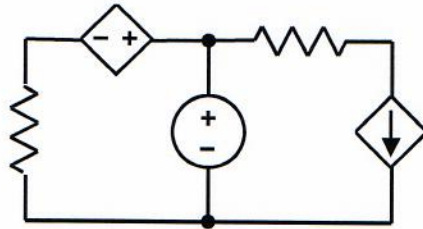


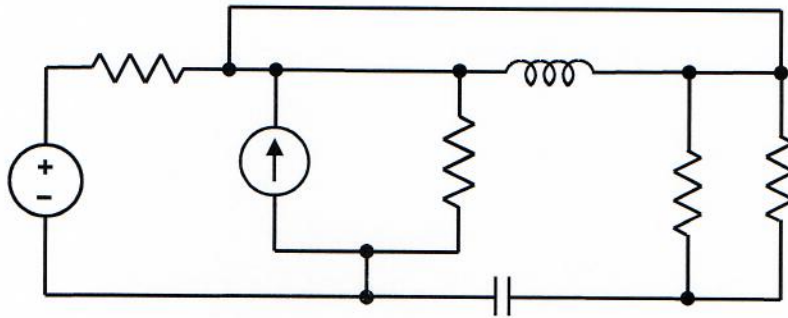
EE/EET 2240
Homework Problem #001

For each of the following circuits, determine the number of components and the number of nodes.

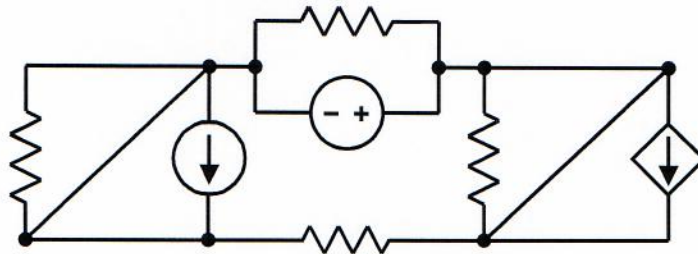
a.



b.

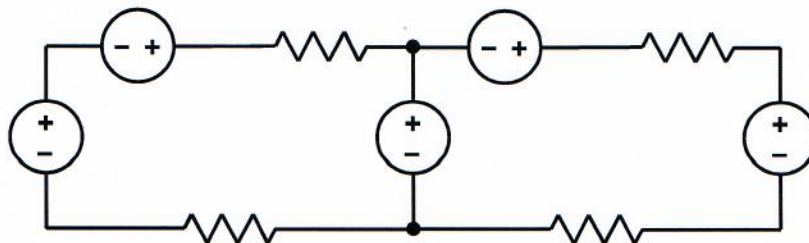


c.



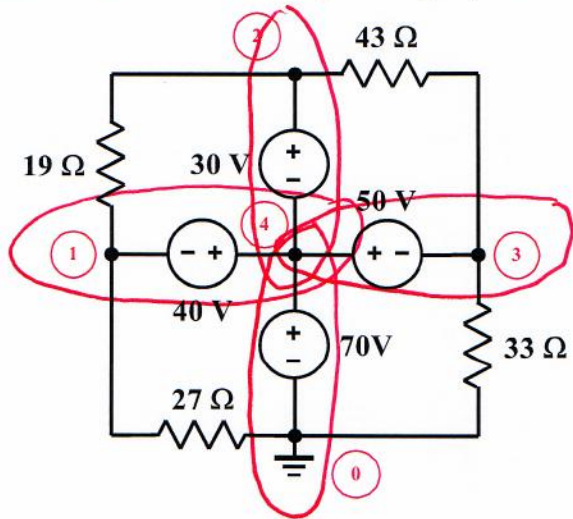
*2 nodes
not 4*

d.



EE/EET 2240
Homework Problem #014

Determine the value of each of the four node voltages using any method of your choosing.



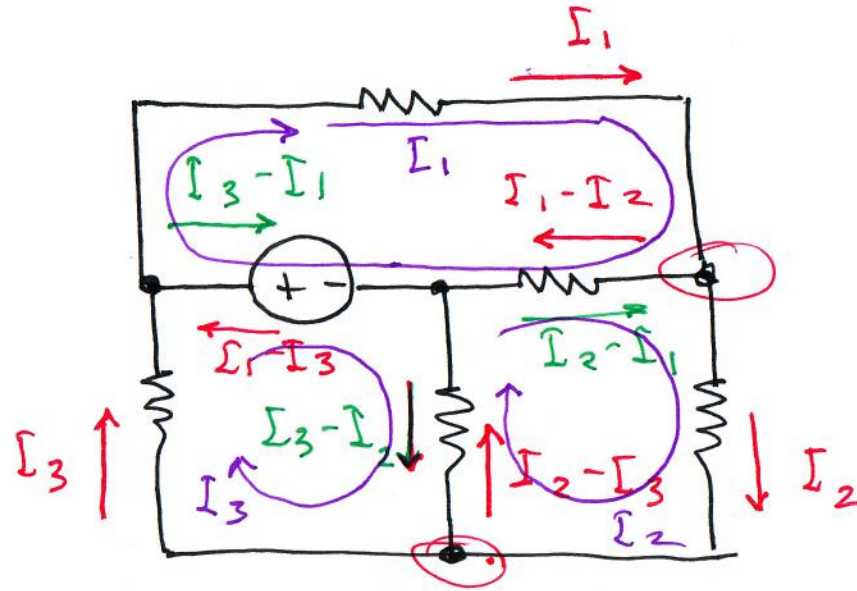
$$V_4 = 70$$

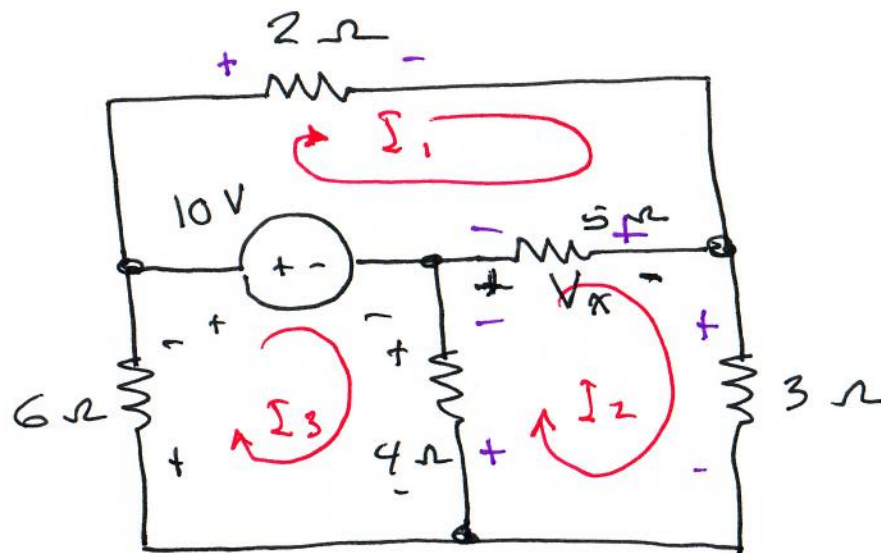
$$V_4 - V_3 = 50$$

$$V_2 - V_4 = 30$$

$$V_4 - V_1 = 40$$

Mesh Analysis





$$\text{KVL for mesh \#1: } +2I_1 + 5(I_1 - I_2) - 10 = 0$$

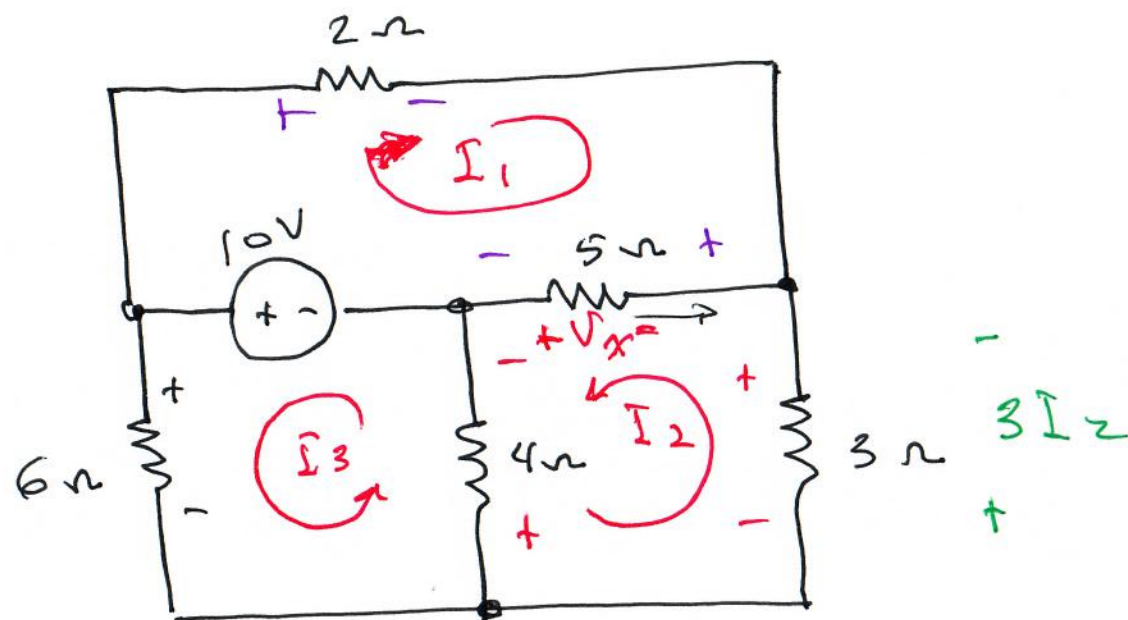
$$\text{KVL for mesh \#2: } +4(I_2 - I_3) + 5(I_2 - I_1) + 3I_2 = 0$$

$$\text{KVL for mesh \#3: } +6I_3 + 10 + 4(I_3 - I_2) = 0$$

$$\begin{bmatrix} 7 & -5 & 0 \\ -5 & 12 & -4 \\ 0 & -4 & 10 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 10 \\ 0 \\ -10 \end{bmatrix}$$

$$I_1 = 1.75 \text{ A} \quad I_2 = .46 \text{ A} \quad I_3 = -.815 \text{ A}$$

$$V_x = 5(.46 - 1.75) = 5(-1.29) = -6.45 \text{ V}$$



$$\text{KVL for mesh \#1: } +2I_1 + 5(I_1 + I_2) - 10 = 0$$

$$\text{KVL for mesh \#2: } +4(I_3 - I_2) + 5(-I_1 - I_2) - 3I_2 = 0$$

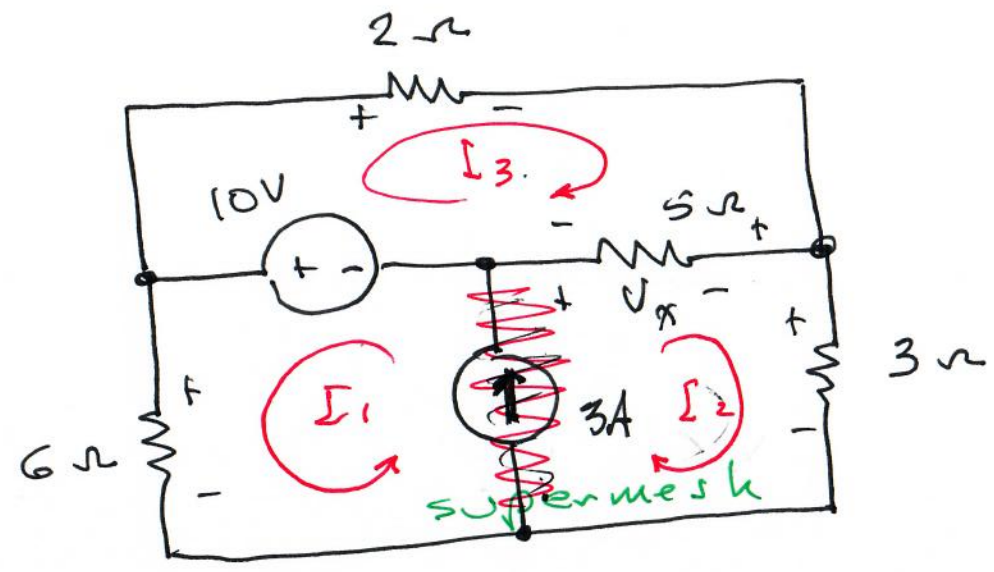
$$\text{KVL for mesh \#3: } -10 + 6I_3 + 4(I_3 - I_2) = 0$$

~~$-5(I_1 + I_2)$~~

$$\begin{bmatrix} 7 & 5 & 0 \\ -5 & -12 & 4 \\ 0 & -4 & 10 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 10 \\ 0 \\ 10 \end{bmatrix}$$

$$I_1 = 1.76 \text{ A} \quad I_2 = -.46 \text{ A} \quad I_3 = .82 \text{ A}$$

$$\begin{aligned} V_x &= -5 (I_1 + I_2) = -5 (1.76 - .46) \\ &= -5 (1.3) = -6.5 \end{aligned}$$



$$I_1 + I_2 = 3 \quad (\text{constraint})$$

$$2I_3 + 5(I_3 - I_2) - 10 = 0 \quad (\text{KVL for mesh 3})$$

clockwise

$$-6I_1 + 10 + 5(I_2 - I_3) + 3I_2 = 0$$

Same equation

$$6I_1 - 3I_2 - 5(I_2 - I_3) - 10 = 0 \quad (\text{KVL for the supermesh})$$

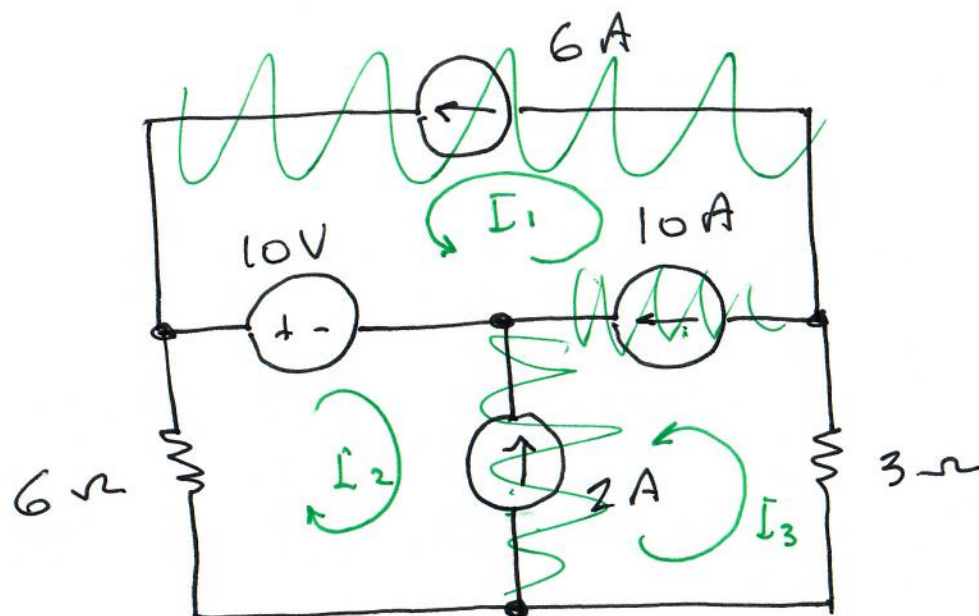
counterclockwise

$$\begin{bmatrix} 1 & 1 & 0 \\ 0 & -5 & 7 \\ -6 & 0 & -5 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 3 \\ 10 \\ -10 \end{bmatrix}$$

$$V_x = 5(\underline{I_2 - I_3})$$

$$I_1 = 1.55 \text{ A} \quad I_2 = 1.45 \text{ A} \quad I_3 = 2.47 \text{ A}$$

$$\begin{aligned} V_x &= 5(1.45 - 2.47) \\ &= 5(-1.02) \\ &= -5.1 \text{ V} \end{aligned}$$



$$I_1 = 6A$$

$$I_3 - I_1 = 10A$$

$$-I_2 - I_3 = 2A$$

In matrix form:

10

$$\begin{bmatrix} 1 & 0 & 0 \\ -1 & 0 & 1 \\ 0 & -1 & -1 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 6 \\ 10 \\ 2 \end{bmatrix}$$