HW4 for Quiz 4 (on Oct 24)

1) Prob. 3.32
2) Prob 3.34
3) Prob 3.45
4) Prob 3.48
5) Prob 3.58
6) Prob 3.59
7) Prob 3.64
8) Prob 3.65
9) Prob 3.72
10) Prob 3.74
11) Prob 3.77
12) Prob 3.80
13) Prob 4.1
14) Prob 4.3
15) Prob 4.6

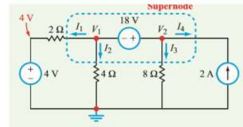


Figure 3-6: Circuit for Example 3-3.

which is a much simpler equation than the typical node-voltage equation.

Supernode Attributes

(1) At a supernode, Kirchhoff's current law (KCL) can be applied to the combination of the two nodes as if they are a single node, but the two nodes retain their own identities.

(2) Kirchhoff's voltage law (KVL) is used to express the voltage difference between the two nodes in terms of the voltage of the source between them. This provides the ***supernode auxiliary equation***.

(3) If a supernode contains a resistor in parallel with the voltage source, the resistor exercises no influence on the currents and voltages in the other parts of the circuit, and therefore, it may be ignored altogether.

(4) For a quasi-supernode, the node-voltage of the non-reference node is equal to the voltage magnitude of the source.

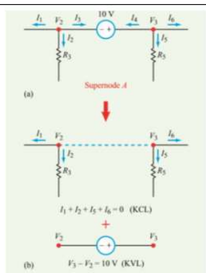


Figure 3-5: A supernode composed of nodes V_2 and V_3 can be represented as a single node, in terms of summing currents flowing out of them, plus an auxiliary equation that defines the voltage difference between V_3 and V_2.

we show currents I_1 to I_3 leaving node 2 and currents I_4 to I_6 leaving node 3. KCL requires that

$$I_1 + I_2 + I_3 = 0 \quad \text{(node } V_2\text{)}, \tag{3.10a}$$

and

$$I_4 + I_5 + I_6 = 0 \quad \text{(node } V_3\text{)}. \tag{3.10b}$$

Adding the two equations together and recognizing that $I_3 = -I_4$ leads to

$$I_1 + I_2 + I_5 + I_6 = 0 \quad \text{(supernode A)}, \tag{3.11}$$

Exercise 3-3: Apply the supernode concept to determine I in the circuit of **Fig. E3.3**.

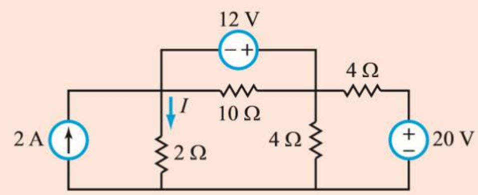


Figure E3.3

Exercise 3-3: Apply the supernode concept to determine I in the circuit of **Fig. E3.3**.

KCL $2 + \frac{20 - V_2}{4} = \frac{V_1}{2} + \frac{V_2}{4}$

$V_2 = V_1 + 12$

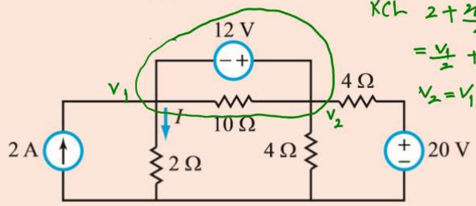
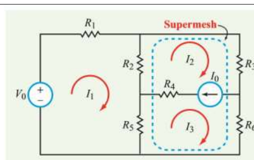
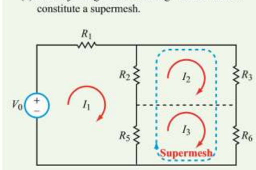


Figure E3.3



(a) Two adjoining meshes sharing a current source constitute a supermesh.



(b) Meshes 2 and 3 can be combined into a single supermesh equation, plus an auxiliary equation $I_0 = I_2 - I_3$.

Figure 3-10: Concept of a supermesh.

$$I_0 = I_2 - I_3 \quad \textbf{(auxiliary eq.)}. \qquad (3.18)$$

The mesh-current equations for mesh 1 and the joint combination of meshes 2 and 3 are

$$(R_1 + R_2 + R_5)I_1 - R_2 I_2 - R_5 I_3 = V_0 \quad \textbf{(mesh 1)}, \qquad (3.19)$$

and

$$-(R_2 + R_5)I_1 + (R_2 + R_3)I_2 + (R_5 + R_6)I_3 = 0 \quad \textbf{(supermesh)}. \qquad (3.20)$$

Exercise 3-5: Determine the current I in the circuit of **Fig. E3.5**.

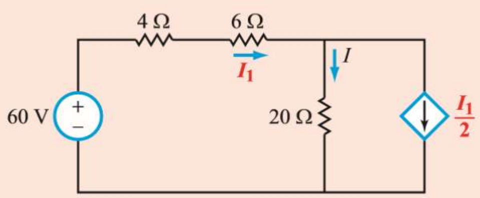
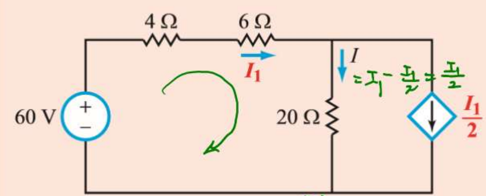


Figure E3.5

Exercise 3-5: Determine the current I in the circuit of **Fig. E3.5**.



KVL $-60 + 4I_1 + 6I_1 + 20\left(\frac{I_1}{2}\right) = 0$

Figure E3.5

Exercise 3-6: Apply mesh analysis to determine I in the circuit of **Fig. E3.6**.

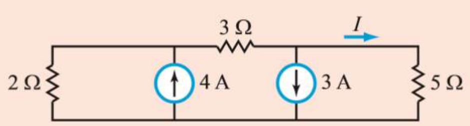


Figure E3.6

Exercise 3-6: Apply mesh analysis to determine I in the circuit of **Fig. E3.6**.

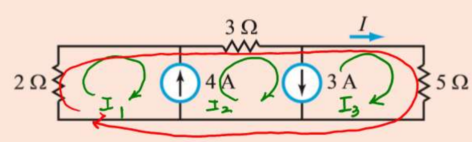


Figure E3.6

$-2I_1 + 3I_2 + 5I_3 = 0$

$I_2 - I_1 = 4$

$I_2 - I_3 = 3$

$I = I_3$