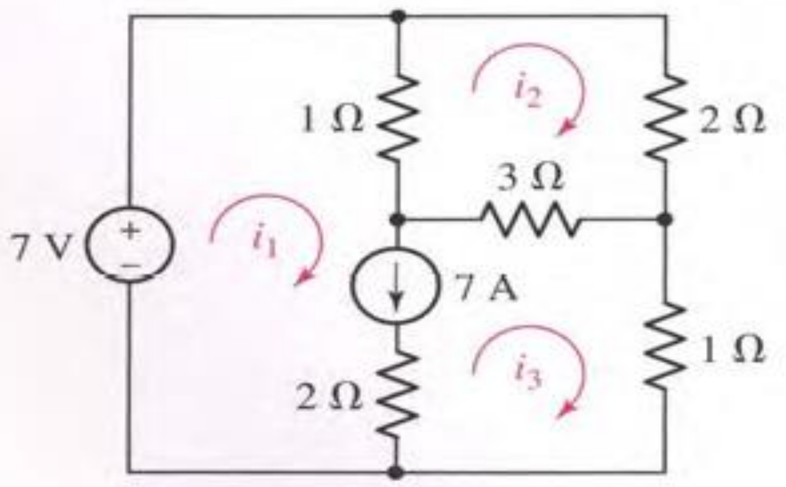
Chapter 4

Basic Nodal and Mesh Analysis

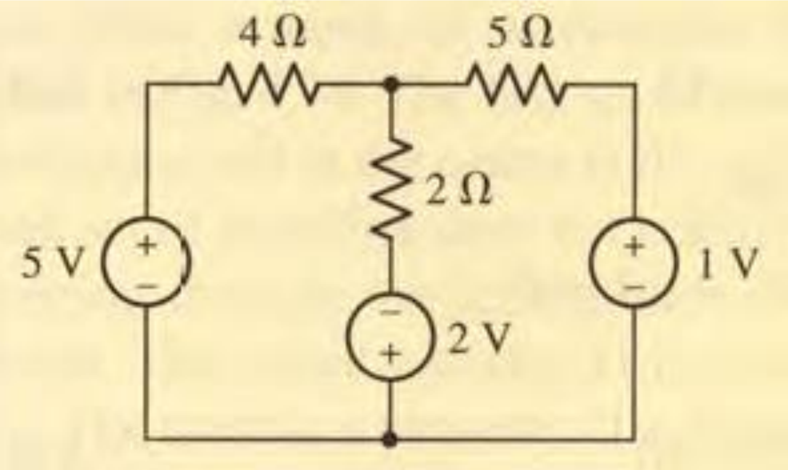
THE SUPERMESH

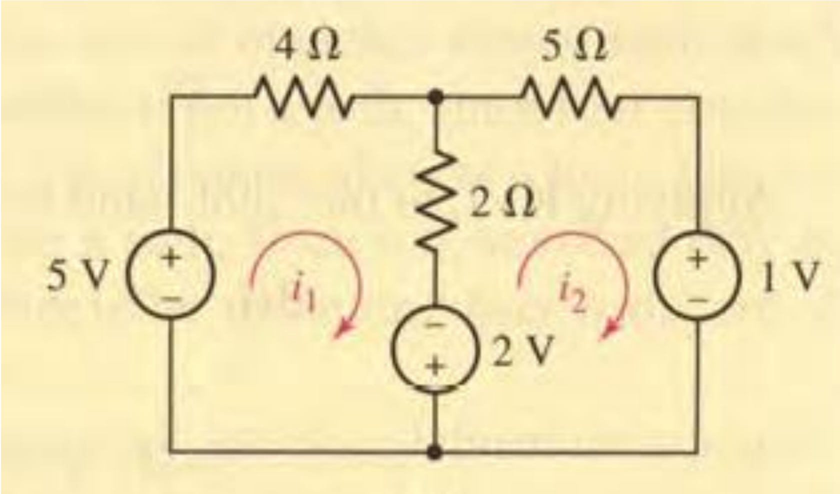
A super mesh is the case in which a current source belongs to two meshes
Each super mesh gives two equations
One equation from the relation of current source and mesh currents
The other equation from applying KVL at the two meshes together
and in the same equation

Use the technique of mesh analysis to evaluate the three mesh currents in Fig. 4.24*a*.



Determine the power supplied by the 2 V source of Fig. 4.17*a*.





KVL at mesh 1

$$-5 + 4i_1 + 2(i_1 - i_2) - 2 = 0$$

KVL at mesh 2

$$+2 + 2(i_2 - i_1) + 5i_2 + 1 = 0$$

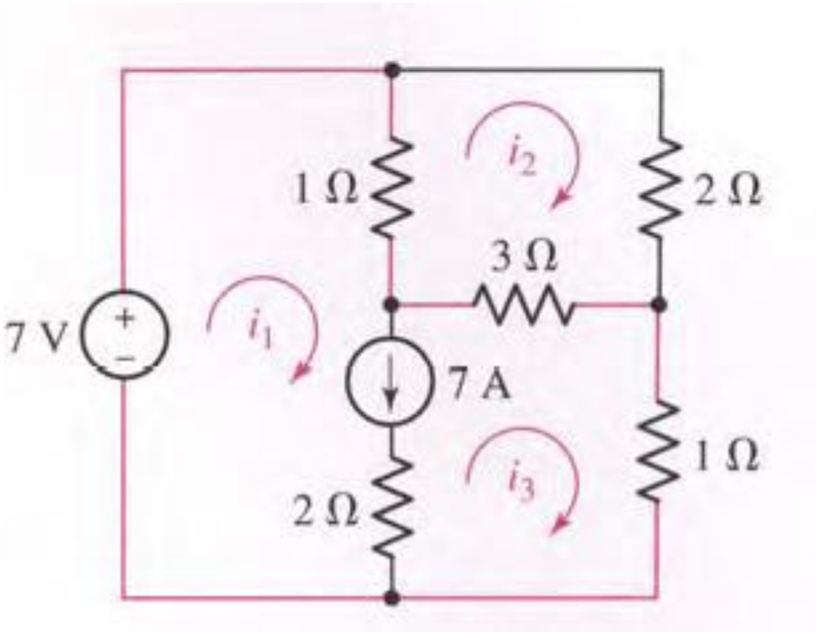
Mesh 1 and 3 are super mesh

The super mesh gives two equations

$$i_1 - i_3 = 7$$

$$-7 + 1(i_1 - i_2) + 3(i_3 - i_2) + 1i_3 = 0$$

$$i_1 - 4i_2 + 4i_3 = 7$$



KVL at mesh 2

$$1(i_2 - i_1) + 2i_2 + 3(i_2 - i_3) = 0$$

$$-i_1 + 6i_2 - 3i_3 = 0$$

Solving above equations we get $i_1 = 9$ A, $i_2 = 2.5$ A, and $i_3 = 2$ A.

Use mesh analysis to evaluate the three unknown currents in the circuit of Fig. 4.26.

$i_1 = 15$ A.

$$\frac{v_x}{9} = i_3 - i_1 = \frac{3(i_3 - i_2)}{9}$$

which can be written more compactly as

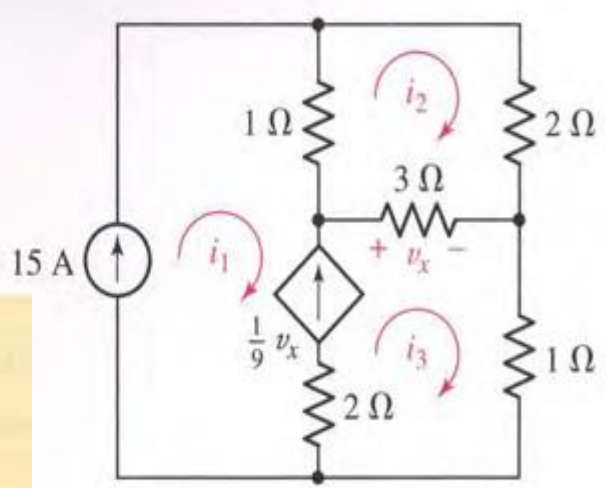
$$-i_1 + \frac{1}{3}i_2 + \frac{2}{3}i_3 = 0 \quad \text{or} \quad \frac{1}{3}i_2 + \frac{2}{3}i_3 = 15$$

KVL equation about mesh 2

$$1(i_2 - i_1) + 2i_2 + 3(i_2 - i_3) = 0$$

or

$$6i_2 - 3i_3 = 15$$



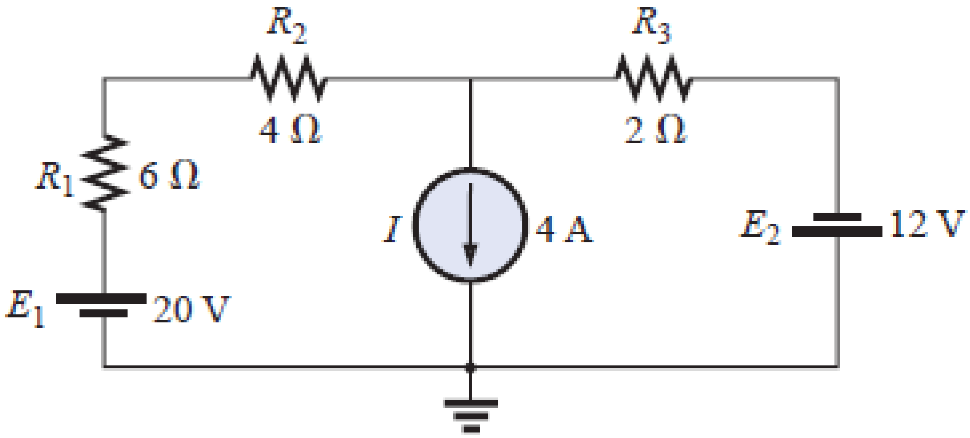
Solving equations
We get

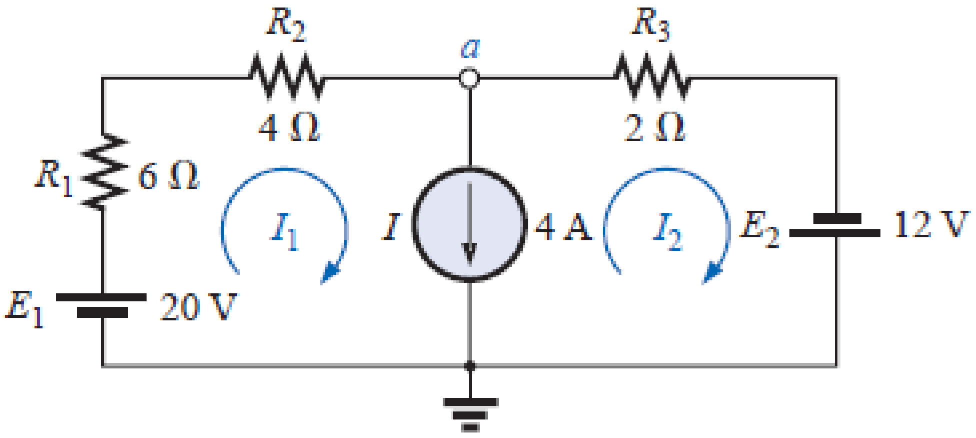
$i_3 = 17$ A

$i_2 = 11$ A

$i_1 = 15$ A

Find mesh currents





From super mesh

KVL at super mesh

$$20\text{ V} - I_1(6\ \Omega) - I_1(4\ \Omega) - I_2(2\ \Omega) + 12\text{ V} = 0$$

or

$$10I_1 + 2I_2 = 32$$

From relationships

$$I_1 - I_2 = 4$$

Solving we get

$$I_1 = \frac{\begin{vmatrix} 32 & 2 \\ 4 & -1 \end{vmatrix}}{\begin{vmatrix} 10 & 2 \\ 1 & -1 \end{vmatrix}} = \frac{(32)(-1) - (2)(4)}{(10)(-1) - (2)(1)} = \frac{40}{12} = \mathbf{3.33\ A}$$

$$I_2 = I_1 - I = 3.33\ \text{A} - 4\ \text{A} = \mathbf{-0.67\ A}$$