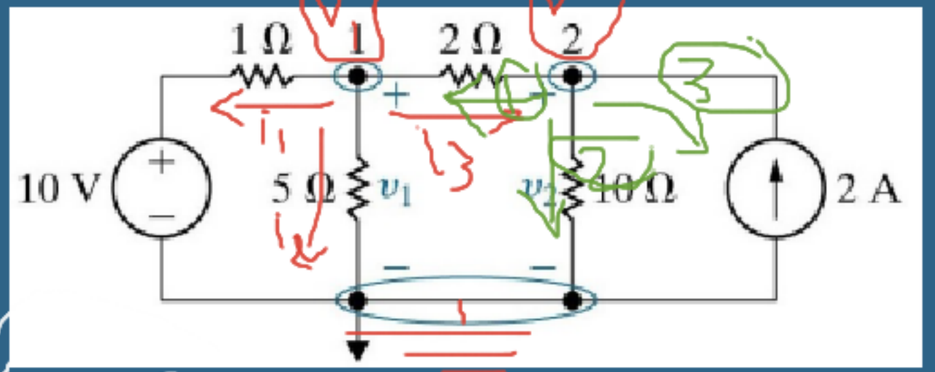
# The Node-Voltage Method

1- a node as a reference node

2- We apply KCL at the nodes that results in simultaneous equations to solve for the voltages.

==> The sum of the three currents leaving node 1 must equal zero.




$$\frac{V_1 - 10}{1} + \frac{V_1 - 0}{5} + \frac{V_1 - V_2}{2} = 0$$

$$10V_1 - 100 + 2V_1 + 5V_1 - 5V_2 = 0 \quad (1)$$

$$\frac{V_2 - V_1}{2} + \frac{V_2 - 0}{10} + (-2) = 0 \quad (2)$$

$V_1 = 9.11V$

$V_2 = 10.92V$

# The Mesh-Current Method

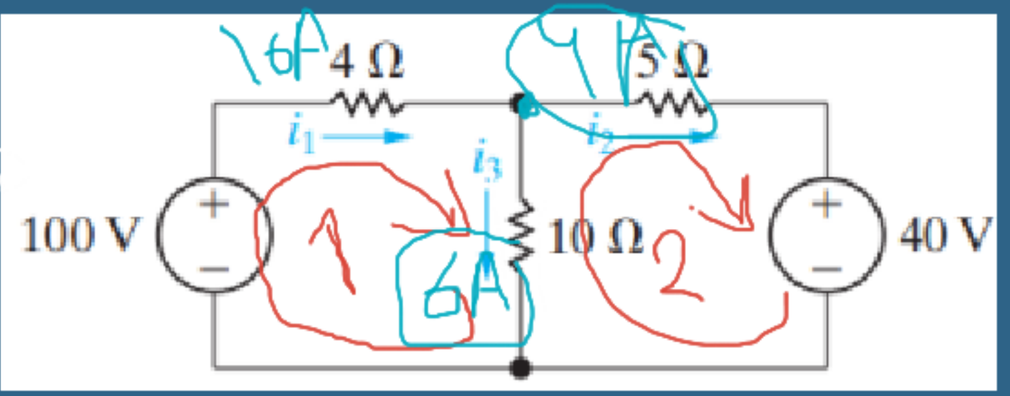
KVL

$$-100 + 4I_1 + 10(I_1 - I_2) =$$

$$+40 + 5I_2 + 10(I_2 - I_1) =$$

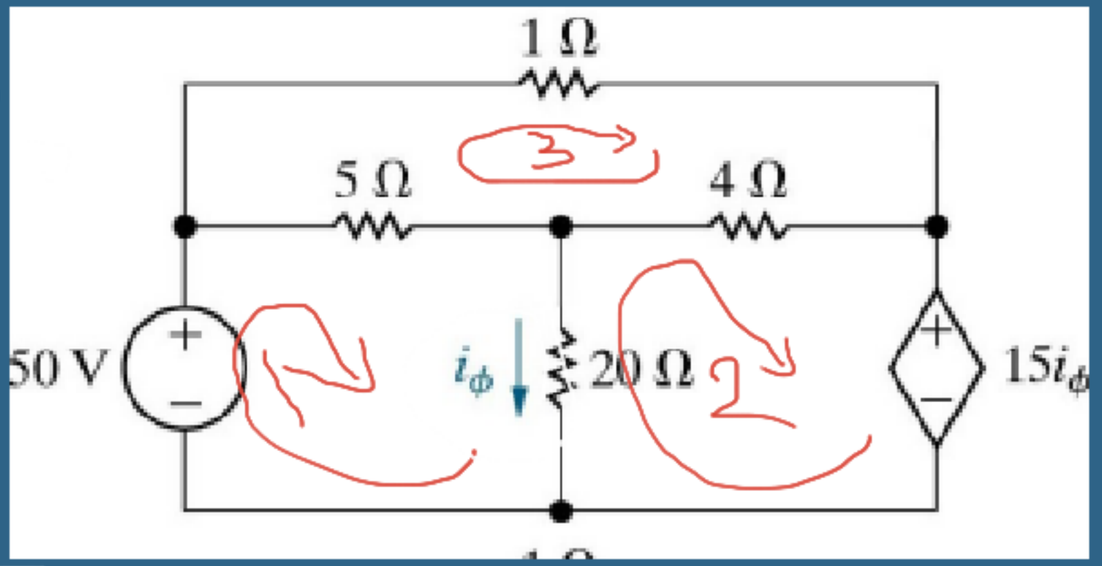
$$I_1 = 12A$$

$$I_2 = 4A$$




1. **Identify the meshes** with curved directed arrows that follow the perimeter of each mesh.
2. **Label the mesh currents** for each mesh.
3. **Write the KVL equations** for each mesh.
4. **Solve the KVL equations** to find the mesh current values.
5. **Solve the circuit** using mesh currents from Step 4 to find component currents, voltages, and power values.

# The Mesh-Current Method




(1) $-50 + 5(I_1 - I_3) + 20(I_1 - I_2) = 0$

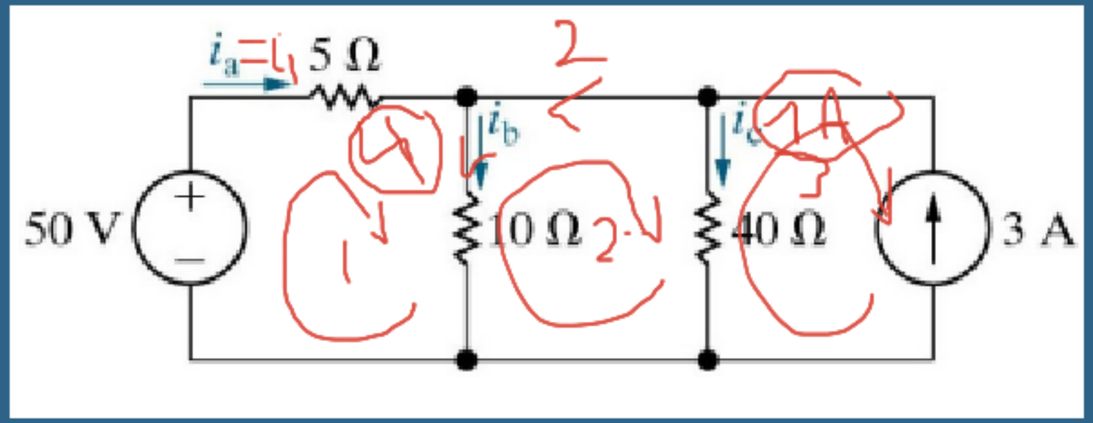
(2) $(I_1 - I_2)$

$+15I_\phi + 20(I_2 - I_1) + 4(I_2 - I_3) = 0$

(3) $10I_3 + 4(I_3 - I_2) + 5(I_3 - I_1) = 0$

$I_\phi = I_1 - I_2$

# The Mesh-Current Method




① $-50 + 5i_1 + 10(i_1 - i_2) = 0$

② $10(i_2 - i_1) + 40(i_2 - (-3)) = 0$

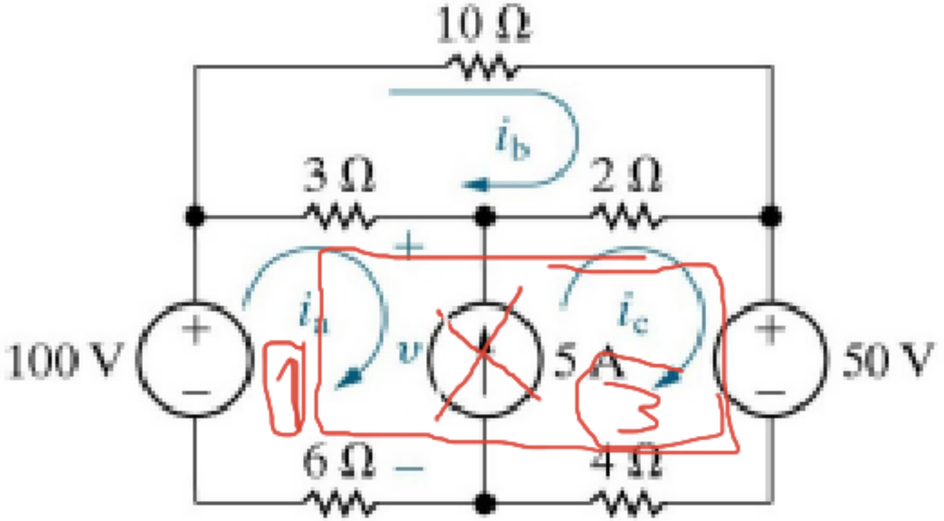
$i_3 = -3\,A$

$i_1 = 2A$

$i_2 = -2A$

# supermesh

When a current source is shared between two meshes, we can combine these meshes to form a supermesh, which traverses the perimeters of the two meshes and avoids the branch containing the shared current source.



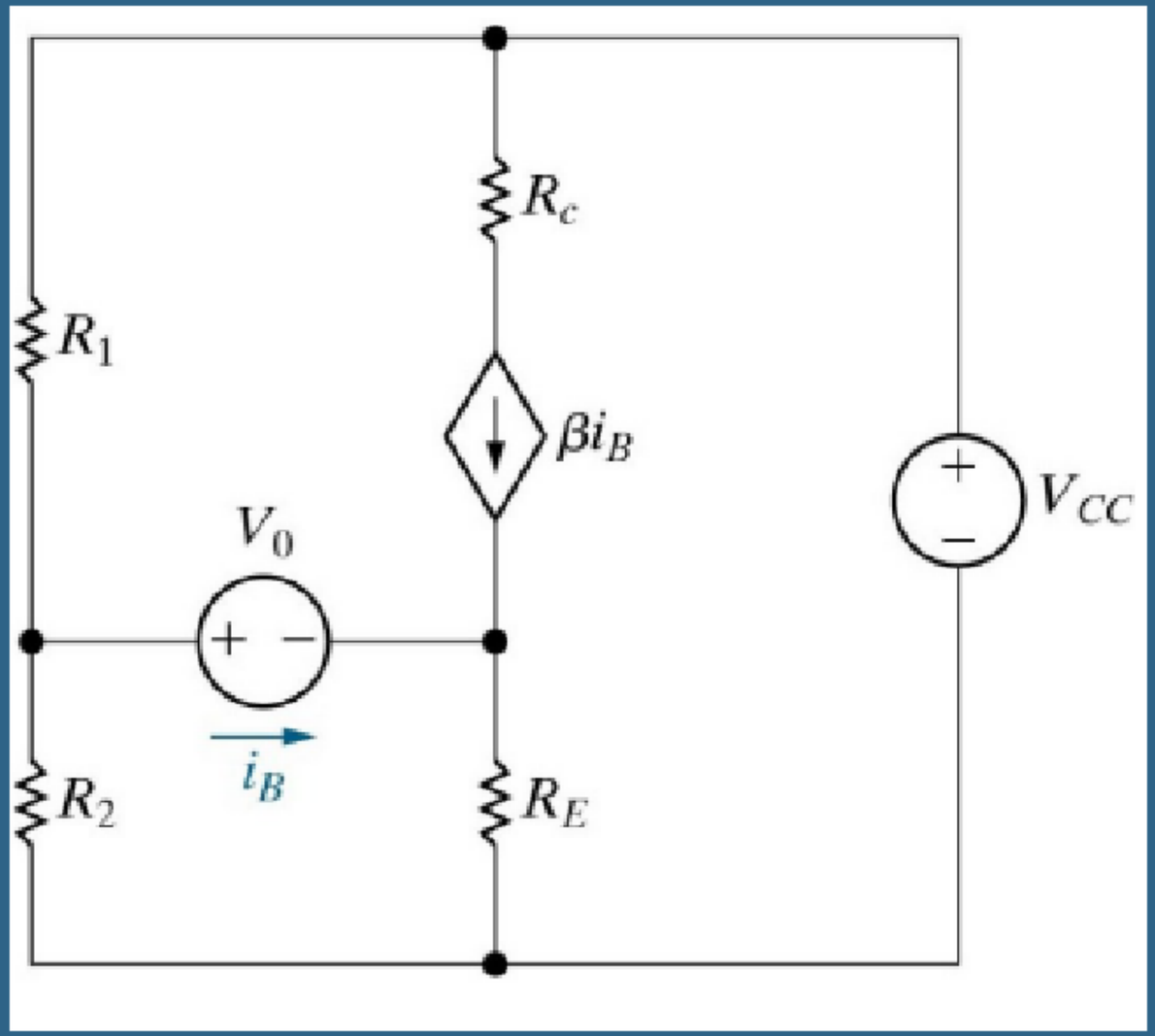

$$-100 + 3(i_a - i_b) + 6(i_a) + V = 0$$

$$10 i_b + 3(i_b - i_a) + 2(i_b - i_c) = 0$$

$$+50 + 4 i_c + 2(i_c - i_b) - V = 0$$

$$5 = i_c - i_a$$

$$-100 + 3(i_a - i_b) + 2(i_c - i_b) + 50 + 4 i_c + 6 i_a = 0$$




$\beta i_B = i_a - i_c$