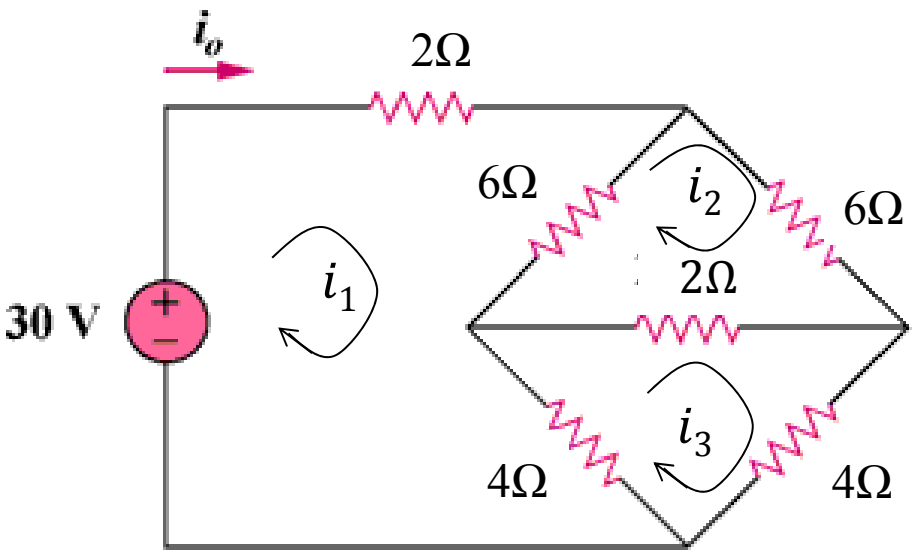
Practice 1: Form 3 mesh equations for i_1, i_2, i_3



Use the short cut without assigning resistor voltages:

KVL along mesh 1:

$2i_1 + 6(i_1 - i_2) + 4(i_1 - i_3) - 30 = 0$ (note: i_1 terms with "+")

Simplify to get

➔ $12i_1 - 6i_2 - 4i_3 = 30$ (1)

KVL along mesh 2:

$6i_2 + 2(i_2 - i_3) + 6(i_2 - i_1) = 0$ (note: i_2 terms with "+")

➔ $-6i_1 + 14i_2 - 2i_3 = 0$ (2)

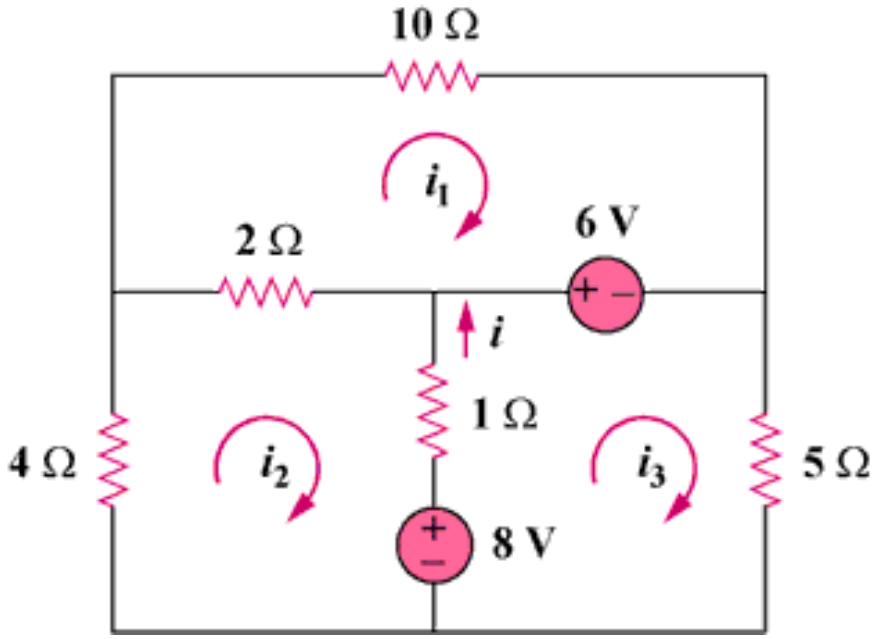
KVL along mesh 3:

$2(i_3 - i_2) + 4i_3 + 4(i_3 - i_1) = 0$ (note: i_3 terms with "+")

➔ $-4i_1 - 2i_2 + 10i_3 = 0$ (3)

$$\begin{aligned} 12i_1 - 6i_2 - 4i_3 &= 30 \\ -6i_1 + 14i_2 - 2i_3 &= 0 \\ -4i_1 - 2i_2 + 10i_3 &= 0 \end{aligned}$$

Practice 2: Form 3 mesh equations for i_1, i_2, i_3



KVL along mesh 1:

$10i_1 - 6 + 2(i_1 - i_2) = 0$ (note: i_1 terms with "+")

➔ $12i_1 - 2i_2 = 6$ (1)

Mesh 2:

$2(i_2 - i_1) + 1(i_2 - i_3) + 8 + 4i_2 = 0$ (i_2 terms with "+")

➔ $-2i_1 + 7i_2 - i_3 = -8$ (2)

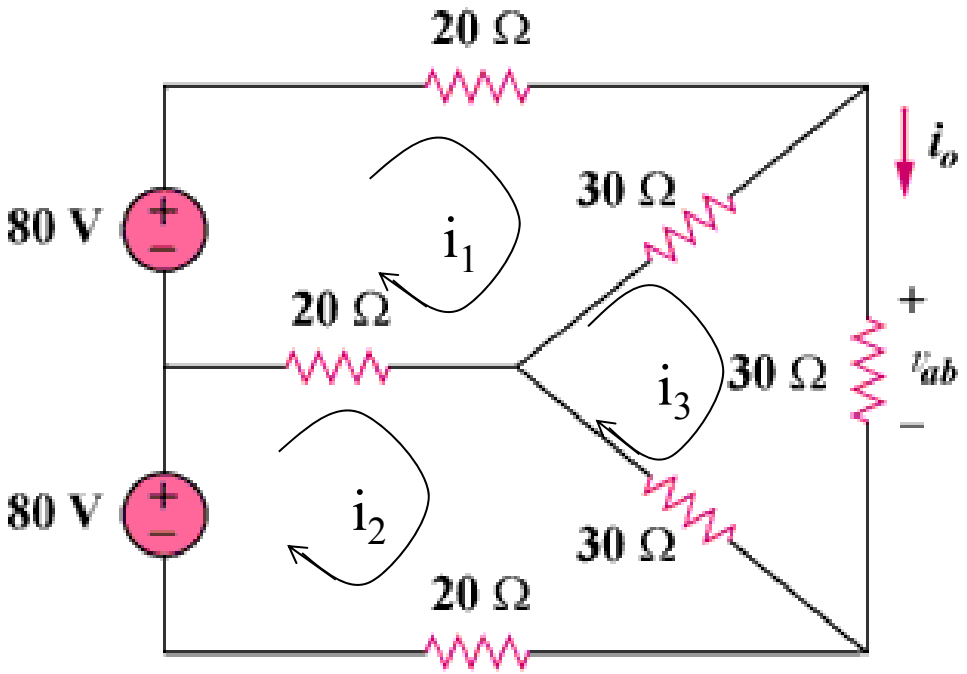
Mesh 3:

$6 + 5i_3 - 8 + 1(i_3 - i_2) = 0$ (i_3 terms with "+")

➔ $-i_2 + 6i_3 = 2$ (3)

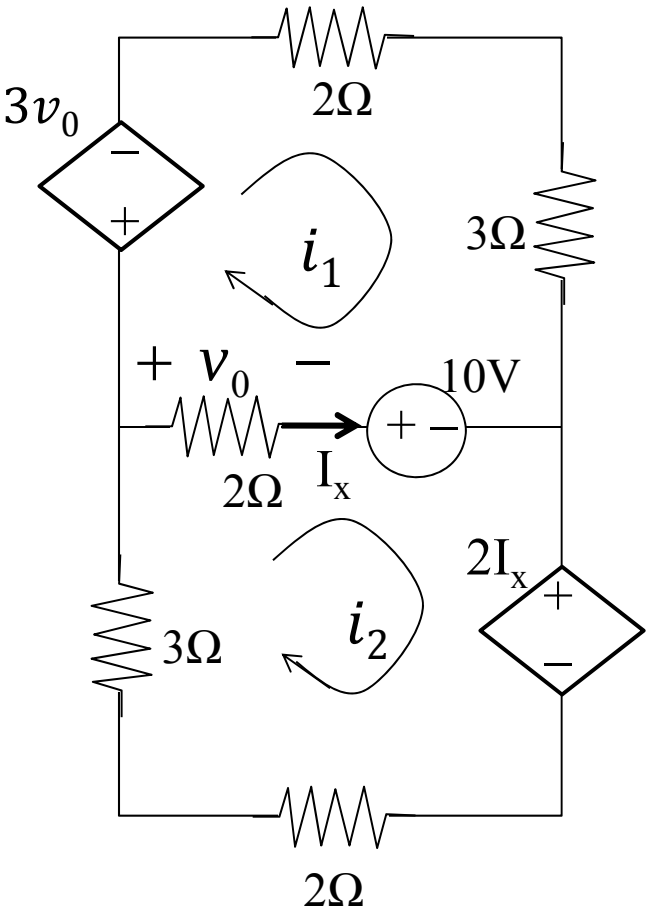
$$12i_1 - 2i_2 = 6$$
$$-2i_1 + 7i_2 - i_3 = -8$$
$$-i_2 + 6i_3 = 2$$

Practice 3: Form 3 mesh equations for i_1, i_2, i_3



$70i_1-20i_2-30i_3=80$
$-20i_1+70i_2-30i_3=80$
$-30i_1-30i_2+90i_3=0$

Practice 4: Find i_1, i_2 and v_0



Express controlling variables:

$v_0 = 2(i_2 - i_1), I_x = i_2 - i_1$

KVL along mesh 1:

$5i_1 - 10 + 2(i_1 - i_2) + 3v_0 = 0$

$5i_1 - 10 + 2i_1 - 2i_2 + 3\times2(i_2 - i_1) = 0$

$i_1 + 4i_2 = 10 \qquad (1)$

Along mesh 2:

$2(i_2 - i_1) + 10 + 2I_x + 5i_2 = 0$

$2i_2 - 2i_1 + 10 + 2(i_2 - i_1) + 5i_2 = 0$

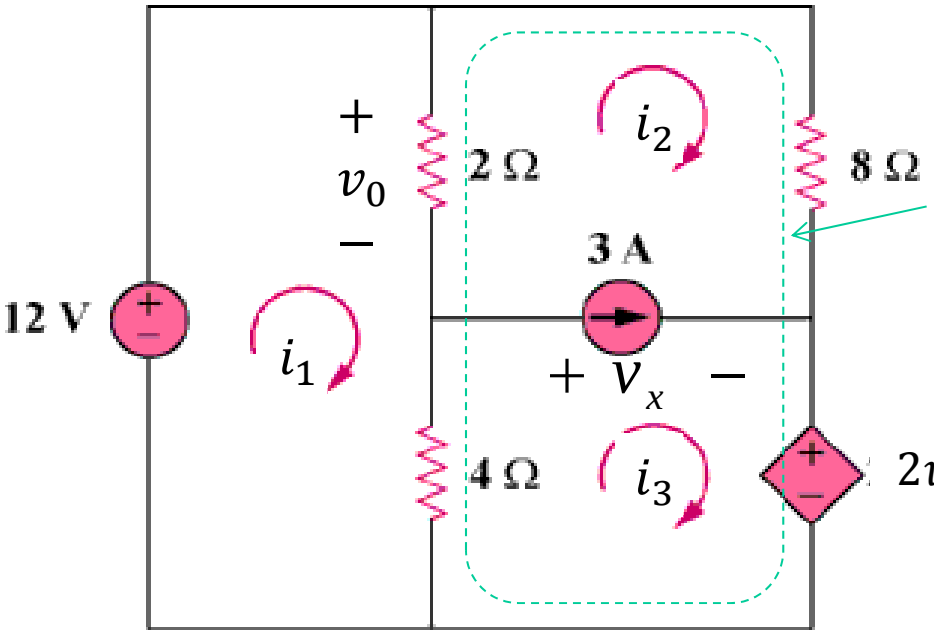
$-4i_1 + 9i_2 = -10 \qquad (2)$

Solving (1) and (2) to get

$i_1 = 5.2A;\ \ i_2 = 1.2A$

$v_0 = 2(i_2 - i_1) = -8V$

Practice 5: Find the mesh currents and v_x



Overview:
Due to 3A current source, a super mesh needs to be formed by combining mesh 2 and mesh 3
One equation from mesh 1
One from super mesh
One from 3A source

First, express controlling voltage v_0: $v_0 = 2(i_1 - i_2)$

KVL along mesh 1: $2(i_1 - i_2) + 4(i_1 - i_3) = 12$

$$\Rightarrow \quad 6i_1 - 2i_2 - 4i_3 = 12 \qquad (1)$$

Along super mesh: $2(i_2 - i_1) + 8i_2 + 2v_0 + 4(i_3 - i_1) = 0$

$$\Rightarrow \; 2(i_2 - i_1) + 8i_2 + 2 * 2(i_1 - i_2) + 4(i_3 - i_1) = 0$$

$$\Rightarrow \quad -2i_1 + 6i_2 + 4i_3 = 0 \qquad (2)$$

By the 3A current source: $i_3 - i_2 = 3 \qquad (3)$

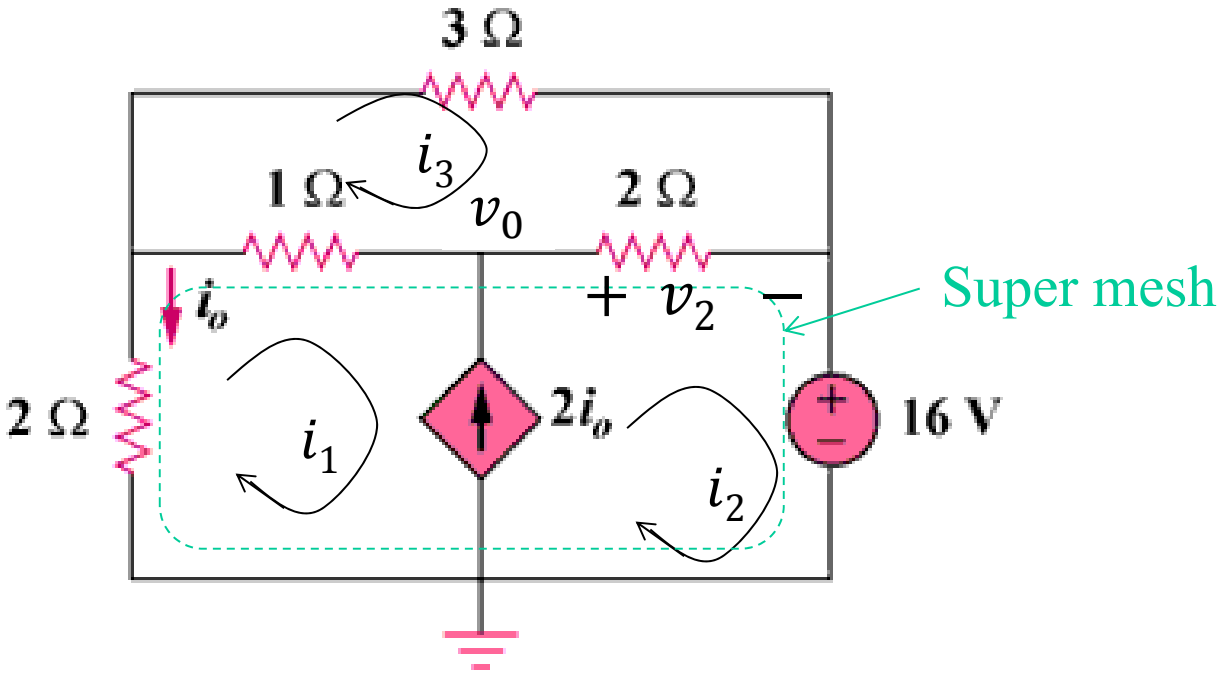
Solving (1)-(3): $i_1 = 3.5A;\ i_2 = -0.5A;\ i_3 = 2.5A$

To find v_x, apply KVL along mesh 2:

$$v_x = -v_0 + 8i_2 = -2(3.5 + 0.5) + 8(-0.5) = -12V$$

$$v_x = -12V$$

Practice 6: Find i_0 and v_0:



First, express controlling current i_0: $i_0 = -i_1$ (0)

KVL along mesh 3: $3i_3 + 2(i_3 - i_2) + (i_3 - i_1) = 0$

$\Rightarrow \quad -i_1 - 2i_2 + 6i_3 = 0$ (1)

KVL along super mesh: $2i_1 + (i_1 - i_3) + 2(i_2 - i_3) + 16 = 0$

$3i_1 + 2i_2 - 3i_3 = -16$ (2)

By dependent current source: $2i_0 = i_2 - i_1$, plug in (0)

$-2i_1 = i_2 - i_1, \quad \rightarrow \quad i_1 + i_2 = 0$ (3)

Solving (1)-(3), $i_1 = -10.667A, i_2 = 10.667A, \ i_3 = 1.778A$

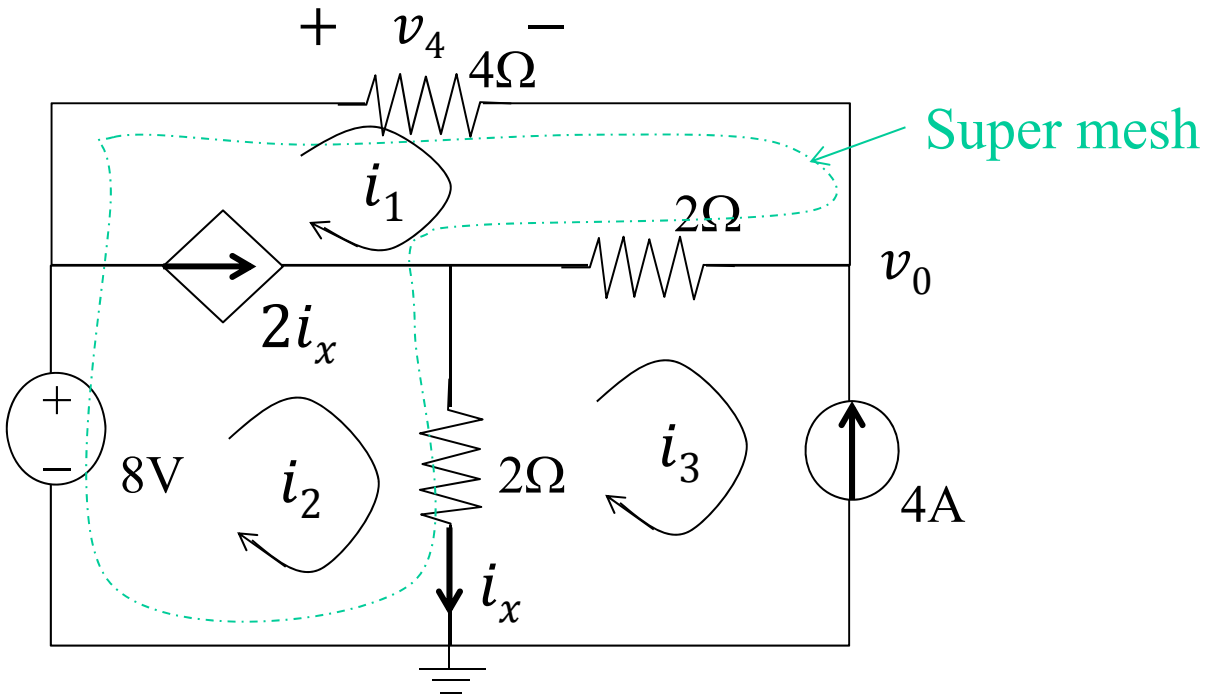
To find v_0, assign v_2, then

$v_0 = v_2 + 16 = 2(i_2 - i_3) + 16 = 33.778V$

$i_0 = -i_1 = 10.667A$

$v_0 = 33.778V$

Practice 7: Use mesh analysis method to find i_x and v_0:



First, notice, $i_3 = -4A$ (a)

Express controlling current i_x:

$i_x = i_2 - i_3 \rightarrow \quad i_x = i_2 + 4$ (b)

KVL along super mesh: $4i_1 + 2(i_1 + 4) + 2(i_2 + 4) = 8$

$\Rightarrow \quad 6i_1 + 2i_2 = -8$ (1)

By dependent current source: $i_2 - i_1 = 2i_x = 2(i_2 + 4)$

$\rightarrow \quad -i_1 - i_2 = 8$ (2)

Solving (1) and (2): $i_1 = 2A;\ i_2 = -10A$

$$i_x = i_2 + 4 = -10 + 4 = 6A$$

To find v_0, assign v_4: $v_0 = 8 - v_4 = 8 - 4i_1 = 0V$

$$v_0 = 0V$$