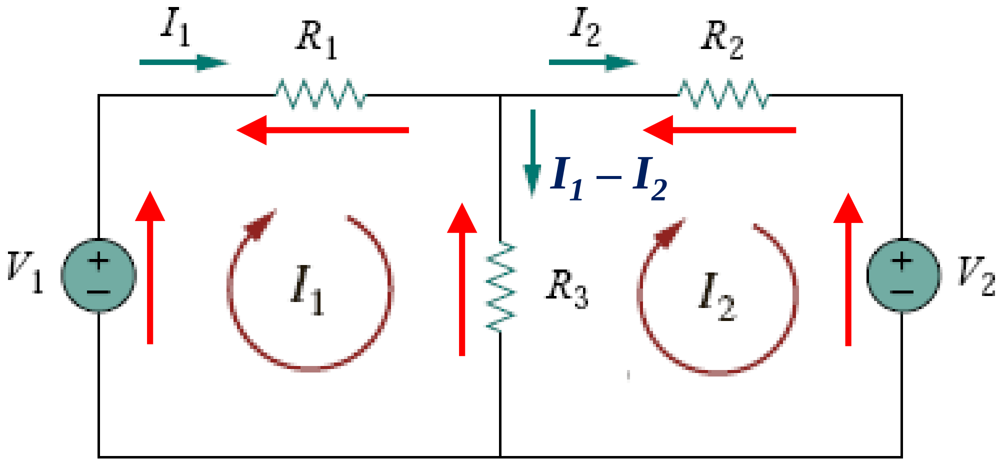
# 2- Mesh Analysis
# Strategy of Mesh Analysis

$$I_1R_1 + R_3(I_1 - I_2) = V_1$$

$$(R_1 + R_3)I_1 - R_3I_2 = V_1 \quad (1)$$




$$I_2R_2 - R_3(I_1 - I_2) + V_2 = 0$$

$$-R_3I_1 + (R_2 + R_3)I_2 = -V_2 \quad (2)$$

## In Matrix form

$$\begin{bmatrix} R_1 + R_3 & -R_3 \\ -R_3 & R_2 + R_3 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} V_1 \\ -V_2 \end{bmatrix}$$

# Circuits Containing Only Independent Voltage Sources

# Problem (3.68)

3.68 Find $I_o$ in the circuit in Fig. P3.68 using mesh analysis.

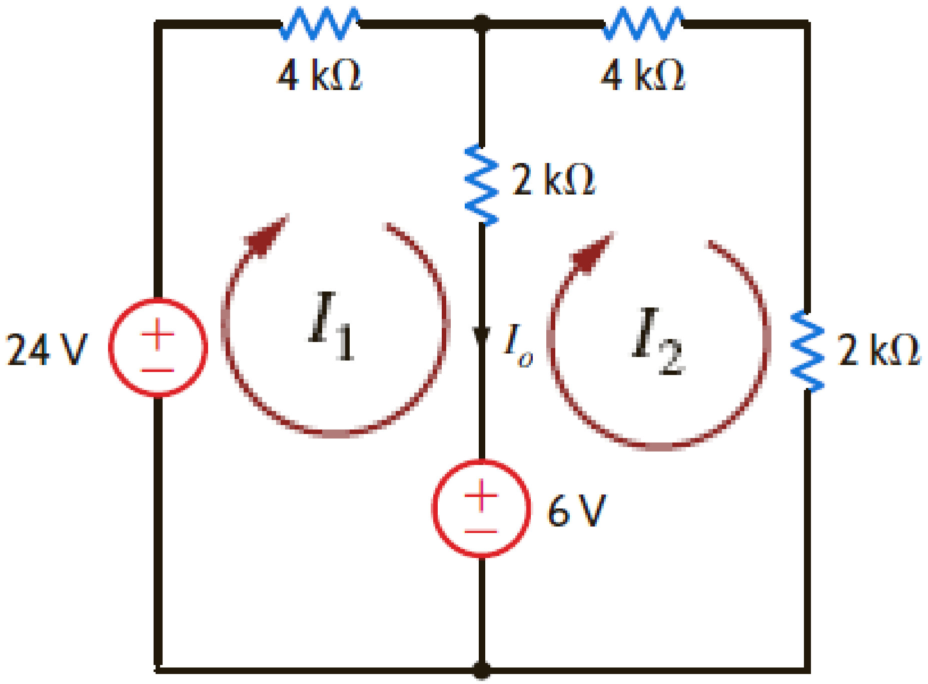
$$6I_1 - 2I_2 = 18 \quad (1)$$

$$-2I_1 + 8I_2 = 6 \quad (2)$$

$$\therefore \quad I_1 = \frac{39}{11} mA,$$

$$I_2 = \frac{18}{11} mA,$$

$$I_o = I_1 - I_2 = \frac{21}{11} mA$$

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# Circuits Containing Only Independent Voltage Sources

## Problem (3.74)

$$2I_1 - I_2 - I_3 = 12 \quad (1)$$
$$-I_1 + 3I_2 \qquad = 6 \quad (2)$$
$$-I_1 \qquad + 2I_3 = -6 \quad (3)$$

$$\therefore \quad I_1 = \frac{66}{7} mA, \quad I_2 = \frac{36}{7} mA,$$

$$I_3 = \frac{12}{7} mA$$

$$V_o = 1k(I_2 - I_1) = -\frac{30}{7} V$$

3.74 Find $V_o$ in Fig. P3.74 using mesh analysis.

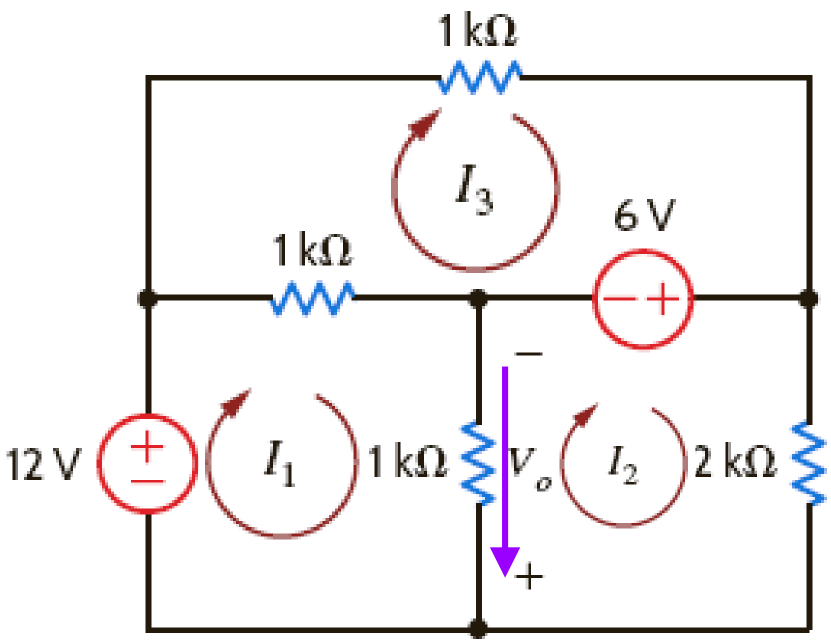


Figure P3.74

# Circuits Containing Independent Current Sources

# Problem (3.71)

3.71 Use mesh analysis to find $V_o$ in the network in Fig. P3.71.

$$9I_1 - 6I_2 = 12 \quad (1)$$

$$I_2 = 2mA \quad (2)$$

$$\therefore \quad I_1 = \frac{8}{3} mA$$

$$V_o + 2I_2 = 6(I_1 - I_2)$$

$$V_o + 2(2) = 6(\frac{8}{3} - 2)$$

$$V_o = 0V$$

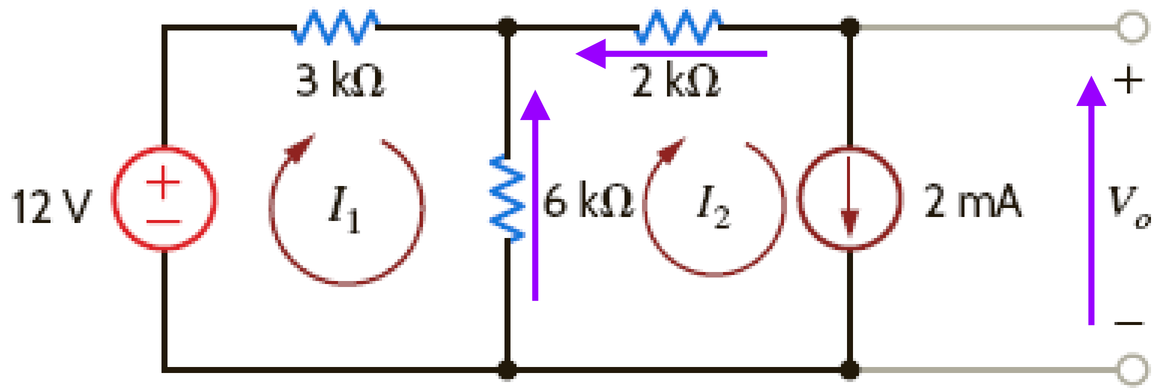


Figure P3.71

# Circuits Containing Independent Current Sources

## Problem (3.78)

3.78 Find $I_o$ in the circuit in Fig. P3.78 using mesh analysis.

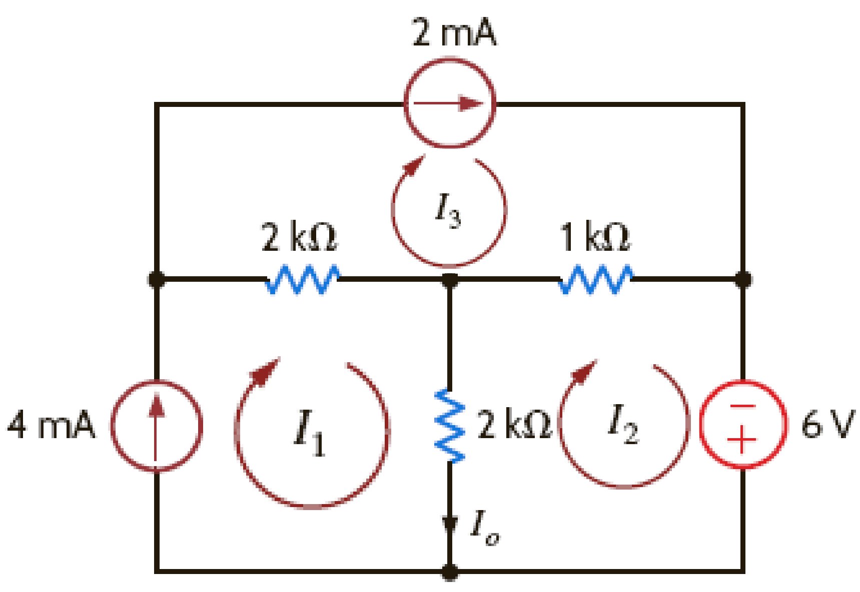


Figure P3.78

$$I_1 = 4mA \quad (1)$$

$$I_3 = 2mA \quad (2)$$

$$-2I_1 + 3I_2 - I_3 = 6 \quad (3)$$

$$-2(4) + 3I_2 - (2) = 6$$

$$\therefore \quad I_2 = \frac{16}{3} mA$$

$$I_o = I_1 - I_2 = 4 - \frac{16}{3} = -\frac{4}{3} mA$$

# Circuits Containing Dependent Sources

# Problem (3.114)

3.114 Find $I_x$ in the circuit in Fig. P3.114 using mesh analysis.

$$I_3 = 2mA \quad (1)$$

$$I_1 = I_x = I_2 - I_3 = I_2 - 2 \quad (2)$$

$$-I_x + 2I_2 - 2 = -V_x \quad (3)$$

$$V_x = 2(I_x - 2) \quad (4)$$

*from (3), (4)*

$$I_x + 2I_2 = 6 \quad (5)$$

*from (2), (5)*

$$I_x = \frac{2}{3} mA$$

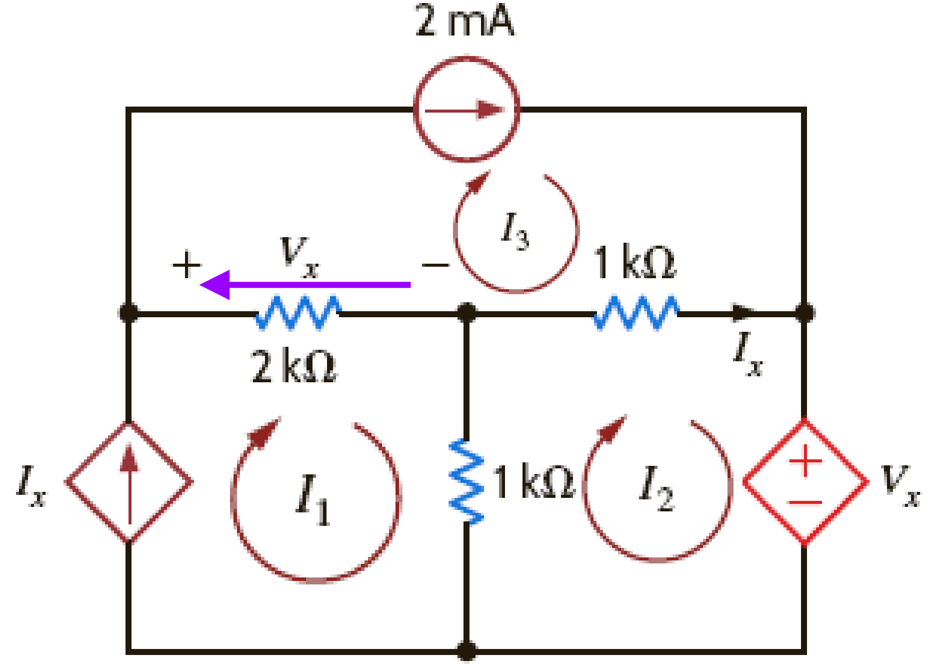


Figure P3.114

# The Concept of Supermesh

## Problem (3.83)

**3.83** Use mesh analysis to calculate the power supplied by the 20-V voltage source in the circuit in Fig. P3.83.

$$-5I_1 - 10I_2 + 20I_3 = 0 \quad (1)$$

*Supermesh*

$$I_2 - I_1 = 2 \quad (2)$$

$$20I_1 + 5(I_1 - I_3) + 10(I_2 - I_3) = -20$$

$$25I_1 + 10I_2 - 15I_3 = -20 \quad (3)$$

$$I_1 = -\frac{20}{19}A, \quad I_2 = \frac{18}{19}A, \quad I_3 = \frac{4}{19}A$$

$$\therefore \quad P_{20\Omega} = (20)\left(\frac{18}{19}\right) = \frac{360}{19}W(Abs)$$

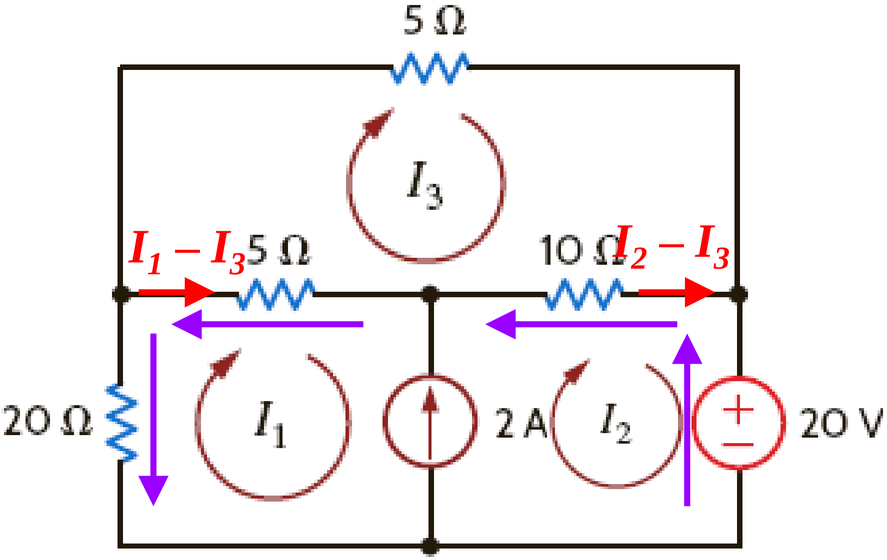


Figure P3.83

# The Concept of *Supermesh*

## Problem (3.102)

3.102 Use loop analysis to find $V_o$ in the network in Fig. P3.102.

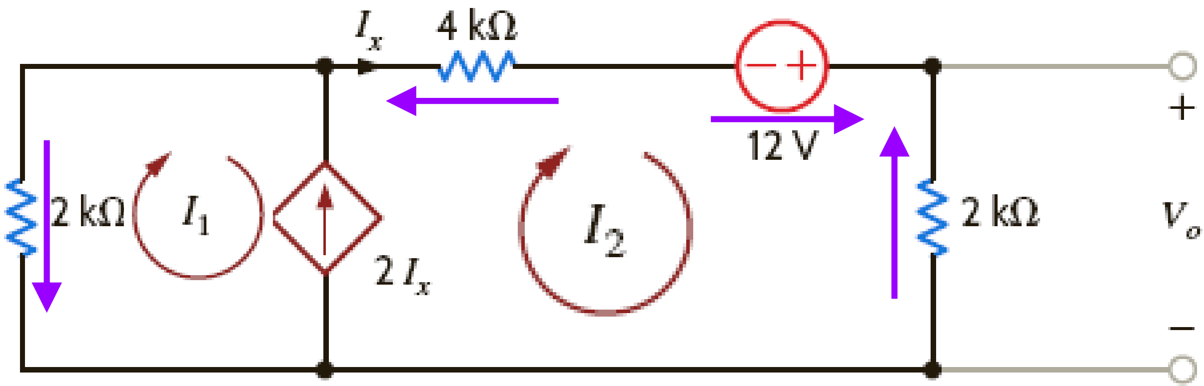


Figure P3.102

$$I_2 = I_x$$

$$I_2 - I_1 = 2I_x = 2I_2, \quad I_1 + I_2 = 0 \quad (1)$$

$$2I_1 + 2I_x + 4I_x = 12, \quad I_1 + 3I_2 = 6 \quad (2)$$

$$I_2 = 3mA, \quad V_o = (3mA)(2k\Omega) = 6V$$