1. Brute force
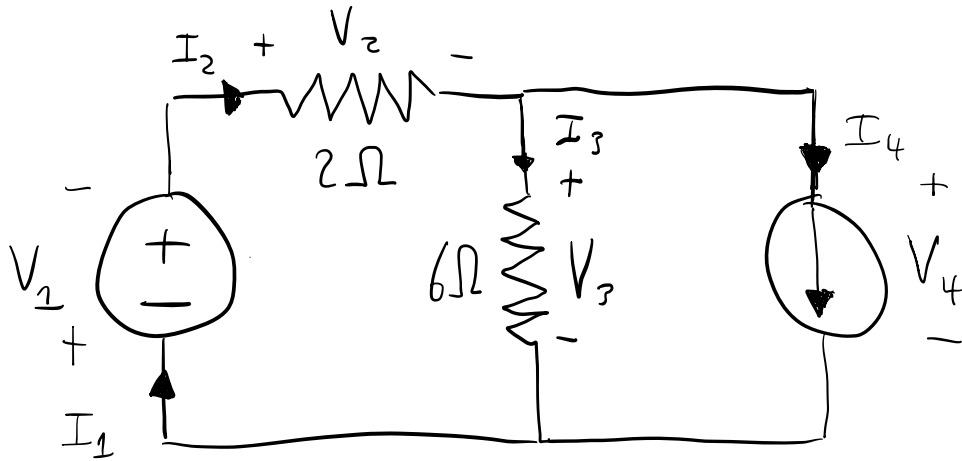

3 Nodes , 4 Branches , 8 equations

Constitutive relations

$V_1 = -12V$

$V_2 = I_2 \cdot 2\Omega$

$V_3 = I_3 \cdot 6\Omega$

$I_4 = 2A$

KCL

$I_2 = I_3 + I_4$

$I_1 = I_3 + I_4$

$\cancel{I_1 = I_2}$ repetative

KVL

$V_3 - V_4 = 0$

$V_3 + V_2 + V_1 = 0$

Solve

$\dfrac{V_2}{2\Omega} = \dfrac{V_3}{6\Omega} + 2A$

$V_3 = 12V - V_2$

$$\frac{V_2}{2\Omega} = \frac{12V}{6\Omega} - \frac{V_2}{6\Omega} + 2A \qquad V_2\left(\frac{1}{2\Omega} + \frac{1}{6\Omega}\right) = 2A + 2A$$
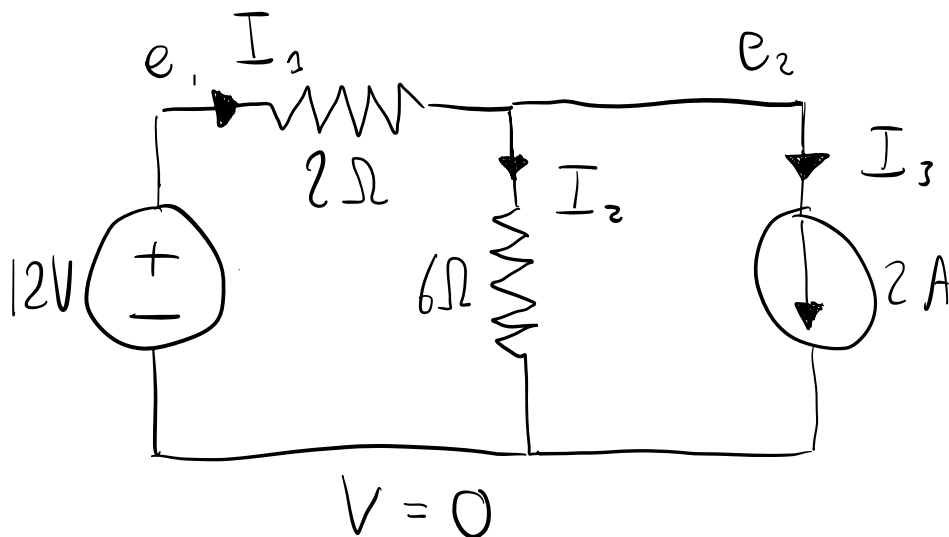
$$V_2 = 4A \cdot \left(\frac{3\Omega}{2}\right)$$

Voltages

$$V_4 = 6V, \quad V_3 = 6V \quad, \quad V_2 = 6V \quad, \quad V_1 = -12V$$

Currents

$$I_2 = 3A \qquad I_1 = 3A \qquad I_4 = 2A \quad, \quad I_3 = 1A$$

2. Node Method

$$V = 0$$

$$e_1 = 12V$$

$$\frac{e_1 - e_2}{2\Omega} = \frac{e_2}{6\Omega} + 2A$$

$$\frac{e_1}{2\Omega} - \frac{e_2}{2\Omega} = \frac{e_2}{6\Omega} + 2A$$

$$\downarrow$$

$$6A - 2A = e_2 \left(\frac{1}{2\Omega} + \frac{1}{6\Omega} \right)$$

$$e_2 = 6V$$

$$\left(\frac{3\Omega}{2} \right) 4A = e_2$$

Voltages

$$e_1 = 12V \, , \, e_2 = 6V$$

Currents

$$I_3 = 2A, \quad I_2 = \frac{6V}{6\Omega} = 1A \quad I_1 = 3A$$