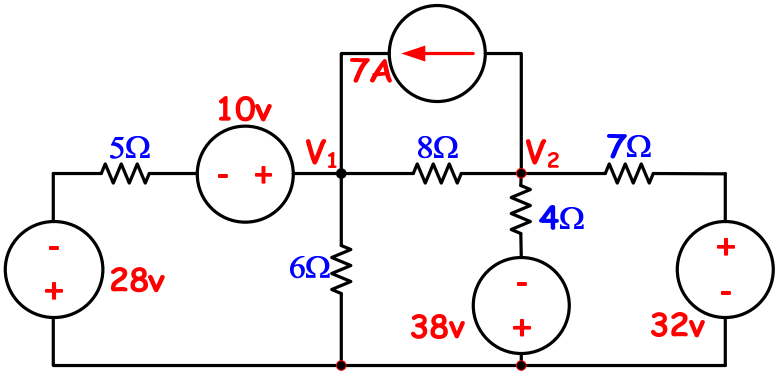
For the circuit shown,

(a) Write the **node voltage equations**,

(b) Arrange the results of (a) in a mathematical standard form and **solve for the node voltages**, and

(c) **Determine the voltage across the 5 ohm resistor.**



Solution:

Node V_1

$$0 = \frac{V_1 - (-18v)}{5\Omega} - 7A + \frac{V_1 - V_2}{8\Omega} + \frac{V_1}{6\Omega}$$

$$\left[7A = \frac{V_1 + 18v}{5\Omega} + \frac{V_1 - V_2}{8\Omega} + \frac{V_1}{6\Omega}\right] \bullet 120\Omega$$

$$840 = 24\left[V_1 + 18v\right] + 15\left[V_1 - V_2\right] + 20V_1$$

$$840 = 24V_1 + 432 + 15V_1 - 15V_2 + 20V_1$$

$$408 = 59V_1 - 15V_2$$

Node V_2

$$0 = \frac{V_2 - (32v)}{7\Omega} + 7A + \frac{V_2 - (-38v)}{4\Omega} + \frac{V_2 - V_1}{8\Omega}$$

$$\left[-7A = \frac{V_2 - 32v}{7\Omega} + \frac{V_2 + 38v}{4\Omega} + \frac{V_2 - V_1}{8\Omega}\right] \bullet 56\Omega$$

$$-392 = 8\left[V_2 - 32v\right] + 14\left[V_2 + 38v\right] + 7\left[V_2 - V_1\right]$$

$$-392 = 8V_2 - 256 + 14V_2 + 532 + 7V_2 - 7V_1$$

$$-392 + 256 - 532 = -7V_1 + (8 + 14 + 7)V_2$$

$$-668 = -7V_1 + 29V_2$$

$$\begin{bmatrix} 408 \\ -668 \end{bmatrix} = \begin{bmatrix} 59 & -15 \\ -7 & 29 \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \end{bmatrix} = \begin{bmatrix} 1.128v \\ -22.762v \end{bmatrix}$$

$$V_{5\Omega} = V_1 - (-18v) = -1.128v - 18v = \boxed{-19.128v}$$