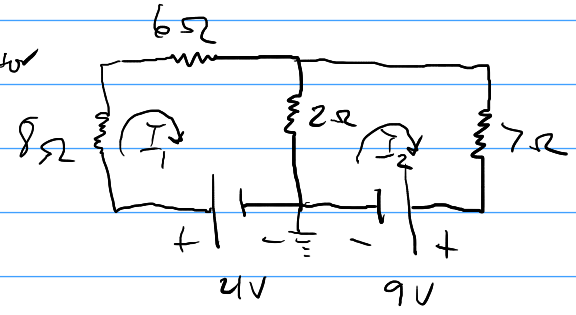
Chapter 9

Example

Find current through the 7Ω resistor



$8I_1 + 6I_1 + 2(I_1 - I_2) - 4 = 0$

$7I_2 + 9 + 2(I_2 - I_1) = 0$

$16I_1 - 2I_2 = 4$

$-2I_1 + 9I_2 = -9$

$8(-2I_1 + 9I_2 = -9)$

$16I_1 - 2I_2 = 4$

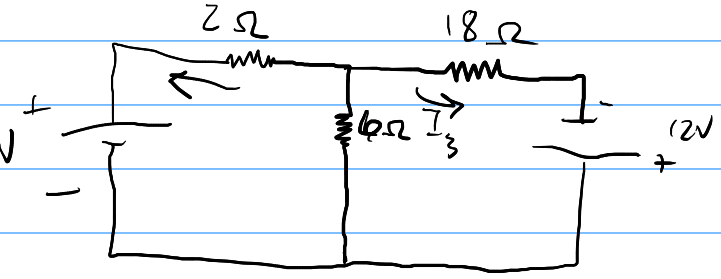
$-16I_1 + 72I_2 = -72$

$70I_2 = -68$

$I_2 = \frac{-68}{70} = -0.971A$

Example:

Write a nodal equation to find the current through 18Ω



$\frac{V_x - (+8)}{2} + \frac{V_x - 0}{6} + \frac{V_x - (-12)}{18}$

$\frac{V_x - 8}{2} + \frac{V_x}{6} + \frac{V_x + 12}{18} = 0$

$$9(V_x - 8) + 3V_x + V_x + 12 = 0$$

$$9V_x - 72 + 3V_x + V_x + 12 = 0$$

$$13V_x = 60 \qquad V_x = \frac{60}{13} = 4.6\,V$$

$$I_3 = \frac{4.6 - (-12)}{18} = \frac{16.6}{18}$$

$$I_3 = 922\,mA$$

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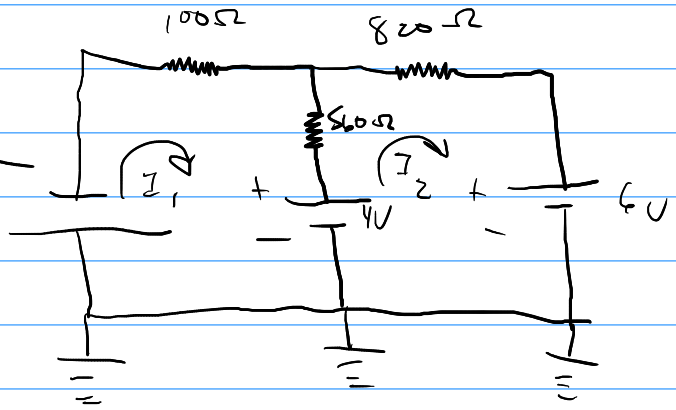


$$+2 + 1060 I_1 + 560(I_1 - I_2) + 4 = 0$$

$$820 I_2 + 6 - 4 + 560(I_2 - I_1) = 0$$

Nodal

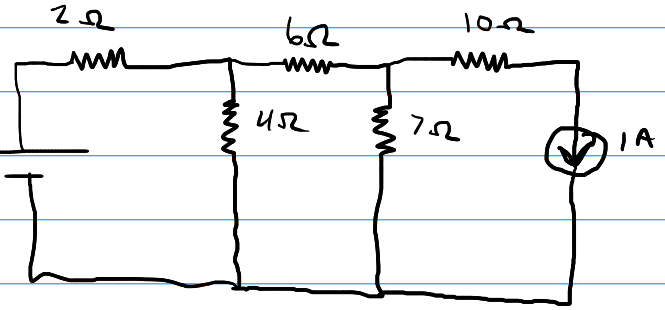
$$\frac{V_x - (-2)}{1000} + \frac{V_x - (+4)}{560} + \frac{V_x - (+6)}{820} = 0$$

$$\frac{V_x + 2}{1000} + \frac{V_x - 4}{560} + \frac{V_x - 6}{820}$$

$$\frac{V_X}{1000} + \frac{2}{1000} + \frac{V_X}{560} + \frac{4}{560} + \frac{V_X}{820} + \frac{6}{820} = 0$$

$$V_X\left(\frac{1}{1000} + \frac{1}{560} + \frac{1}{820}\right) = \frac{2}{1000} + \frac{4}{560} + \frac{6}{820}$$

Example



$$12\left(\frac{V_A - (+8)}{2} + \frac{V_A - 0}{4} + \frac{V_A - V_B}{6}\right) = 0$$

$$\frac{V_B - V_A}{6} + \frac{V_B - 0}{3} + 1 = 0$$

$$6(V_A - 8) + 3V_A + 2(V_A - V_B) = 0$$

$$V_B - V_A + 2V_B + 6 = 0$$

$$11V_A - 2V_B = 48$$
$$-V_A + 3V_B = -6$$

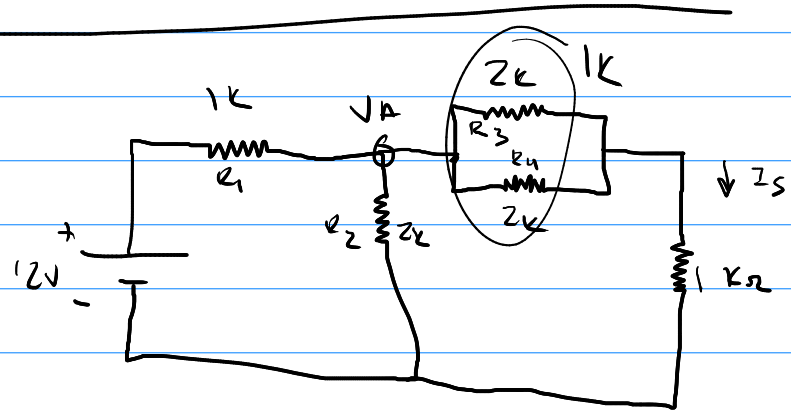
$$\begin{bmatrix} 11 & -2 \\ -1 & 3 \end{bmatrix} \begin{bmatrix} V_A \\ V_B \end{bmatrix} = \begin{bmatrix} 48 \\ -6 \end{bmatrix}$$

(V_A column: 11, −1; V_B column: −2, 3)

$$V_B = \frac{\begin{vmatrix} 11 & 48 \\ -1 & -6 \end{vmatrix}}{\begin{vmatrix} 11 & -2 \\ -1 & 3 \end{vmatrix}} = \frac{(11)(-6) - (-1)(48}{(11)(3) - (-2)(-1)}$$

$$V_A = \frac{\begin{vmatrix} 48 & -2 \\ -6 & -3 \end{vmatrix}}{\begin{vmatrix} 11 & -2 \\ -1 & 3 \end{vmatrix}}$$

Example:



$$2K\left(\frac{V_A - 12}{1K} + \frac{V_A}{2K} + \frac{V_A}{2K}\right) = 0$$

$$2(V_A - 12) + V_A + V_A = 0$$

$$4V_A = 24 \qquad V_A = 6V$$

$$I_S = \frac{6V}{2K} = 3mA$$