Resistive Network. Solutions to Problem 6.

Resistive Network with 2 Loops and DC Sources

(a) The system in augmented matrix form is

$$\left(\begin{array}{ccc|c} 1 & -1 & -1 & 0 \\ 4 & 2 & 0 & 28 \\ 0 & 2 & -1 & 7 \end{array}\right)$$

$$\left(\begin{array}{ccc|c} 1 & -1 & -1 & 0 \\ 0 & 6 & 4 & 28 \\ 0 & 2 & -1 & 7 \end{array}\right) \quad \text{combo}(1,2,-4)$$

$$\left(\begin{array}{ccc|c} 1 & -1 & -1 & 0 \\ 0 & 0 & 7 & 7 \\ 0 & 2 & -1 & 7 \end{array}\right) \quad \text{combo}(3,2,-3)$$

$$\left(\begin{array}{ccc|c} 1 & -1 & -1 & 0 \\ 0 & 2 & -1 & 7 \\ 0 & 0 & 7 & 7 \end{array}\right) \quad \text{swap}(2,3)$$

$$\left(\begin{array}{ccc|c} 1 & -1 & -1 & 0 \\ 0 & 2 & -1 & 7 \\ 0 & 0 & 1 & 1 \end{array}\right) \quad \text{mult}(3, 1/7)$$

$$\left(\begin{array}{ccc|c} 1 & -1 & -1 & 0 \\ 0 & 2 & 0 & 8 \\ 0 & 0 & 1 & 1 \end{array}\right) \quad \text{combo}(3,2,1)$$

$$\left(\begin{array}{ccc|c} 1 & -1 & 0 & 1 \\ 0 & 2 & 0 & 8 \\ 0 & 0 & 1 & 1 \end{array}\right) \quad \text{combo}(3,1,1)$$

$$\left(\begin{array}{ccc|c} 1 & -1 & 0 & 1 \\ 0 & 1 & 0 & 4 \\ 0 & 0 & 1 & 1 \end{array}\right) \quad \text{mult}(2, 1/2)$$

$$\left(\begin{array}{ccc|c} 1 & 0 & 0 & 5 \\ 0 & 1 & 0 & 4 \\ 0 & 0 & 1 & 1 \end{array}\right) \quad \text{combo}(2,1,1)$$

Last frame test passed ✓

Solution: $\begin{cases} I_1 = 5 \\ I_2 = 4 \\ I_3 = 1 \end{cases}$ Unique solution case

(b) The voltage drop across a resistor is given by Ohm's Law: $V_R = RI$

Drop across $R_1 = 4\ \Omega$: $V_{R_1} = R_1 I_1 = 20$

Drop across $R_2 = 2\ \Omega$: $V_{R_2} = R_2 I_2 = 8$

Drop across $R_3 = 1\ \Omega$: $V_{R_3} = R_3 I_3 = 1$