

Sample Quiz 6

Solutions

Problem 1. Resistive Network with 2 Loops and DC Sources

(a) The system in augmented matrix form is

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

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

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

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

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

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

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

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

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

Last frame test passed ✓

Sample Quiz 6, Solutions

2

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

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

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

Sample Quiz 6, Solutions

Problem 2. Separation Train

- (a) Technology will be used, to speed the solution. If computers are not your thing, then you will fatter, A lot.

Illustration for MATLAB, part (a)

$$A = \begin{bmatrix} 7 & 18 & 15 & 24 \\ 4 & 24 & 10 & 65 \\ 54 & 42 & 54 & 10 \\ 35 & 16 & 21 & 1 \end{bmatrix};$$

$$f = [15*70 \quad 25*70 \quad 40*70 \quad 2*70];$$

$$X = A \setminus f';$$

Solution: 26.25 17.5 8.75 17.5
 Variables: D₁ B₁ D₂ B₂

$$\begin{aligned} \text{(b) Molar flow rates} &= \frac{D_1}{100} \begin{pmatrix} 7 \\ 4 \\ 54 \\ 35 \end{pmatrix} + \frac{B_1}{100} \begin{pmatrix} 18 \\ 24 \\ 42 \\ 16 \end{pmatrix} \\ &= \begin{pmatrix} 4.9875 \\ 5.25 \\ 21.525 \\ 11.9875 \end{pmatrix} \end{aligned}$$

Illustration for MAPLE, part (b)

$$\begin{aligned} \text{Flow Rate} &:= (26.25/100) * \langle 7, 4, 54, 35 \rangle \\ &+ (17.5/100) * \langle 18, 24, 42, 16 \rangle; \end{aligned}$$