

# 1

## Linear Equations in Linear Algebra

### 1.1 SOLUTIONS

**Notes:** The key exercises are 7 (or 11 or 12), 19–22, and 25. For brevity, the symbols  $R_1, R_2, \dots$ , stand for row 1 (or equation 1), row 2 (or equation 2), and so on. Additional notes are at the end of the section.

$$1. \quad \begin{aligned} x_1 + 5x_2 &= 7 \\ -2x_1 - 7x_2 &= -5 \end{aligned} \quad \begin{bmatrix} 1 & 5 & 7 \\ -2 & -7 & -5 \end{bmatrix}$$

Replace  $R_2$  by  $R_2 + (2)R_1$  and obtain:

$$\begin{aligned} x_1 + 5x_2 &= 7 \\ 3x_2 &= 9 \end{aligned} \quad \begin{bmatrix} 1 & 5 & 7 \\ 0 & 3 & 9 \end{bmatrix}$$

Scale  $R_2$  by  $1/3$ :

$$\begin{aligned} x_1 + 5x_2 &= 7 \\ x_2 &= 3 \end{aligned} \quad \begin{bmatrix} 1 & 5 & 7 \\ 0 & 1 & 3 \end{bmatrix}$$

Replace  $R_1$  by  $R_1 + (-5)R_2$ :

$$\begin{aligned} x_1 &= -8 \\ x_2 &= 3 \end{aligned} \quad \begin{bmatrix} 1 & 0 & -8 \\ 0 & 1 & 3 \end{bmatrix}$$

The solution is  $(x_1, x_2) = (-8, 3)$ , or simply  $(-8, 3)$ .

$$2. \quad \begin{aligned} 2x_1 + 4x_2 &= -4 \\ 5x_1 + 7x_2 &= 11 \end{aligned} \quad \begin{bmatrix} 2 & 4 & -4 \\ 5 & 7 & 11 \end{bmatrix}$$

Scale  $R_1$  by  $1/2$  and obtain:

$$\begin{aligned} x_1 + 2x_2 &= -2 \\ 5x_1 + 7x_2 &= 11 \end{aligned} \quad \begin{bmatrix} 1 & 2 & -2 \\ 5 & 7 & 11 \end{bmatrix}$$

Replace  $R_2$  by  $R_2 + (-5)R_1$ :

$$\begin{aligned} x_1 + 2x_2 &= -2 \\ -3x_2 &= 21 \end{aligned} \quad \begin{bmatrix} 1 & 2 & -2 \\ 0 & -3 & 21 \end{bmatrix}$$

Scale  $R_2$  by  $-1/3$ :

$$\begin{aligned} x_1 + 2x_2 &= -2 \\ x_2 &= -7 \end{aligned} \quad \begin{bmatrix} 1 & 2 & -2 \\ 0 & 1 & -7 \end{bmatrix}$$

Replace  $R_1$  by  $R_1 + (-2)R_2$ :

$$\begin{aligned} x_1 &= 12 \\ x_2 &= -7 \end{aligned} \quad \begin{bmatrix} 1 & 0 & 12 \\ 0 & 1 & -7 \end{bmatrix}$$

The solution is  $(x_1, x_2) = (12, -7)$ , or simply  $(12, -7)$ .

# Lay Linear Algebra Solutions Manual

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## **Table of Contents Lay Linear Algebra Solutions Manual**

1. Understanding the eBook Lay Linear Algebra Solutions Manual
  - The Rise of Digital Reading Lay Linear Algebra Solutions Manual
  - Advantages of eBooks Over Traditional Books
2. Identifying Lay Linear Algebra Solutions Manual
  - Exploring Different Genres
  - Considering Fiction vs. Non-Fiction
  - Determining Your Reading Goals
3. Choosing the Right eBook Platform
  - Popular eBook Platforms
  - Features to Look for in an Lay Linear Algebra Solutions Manual
  - User-Friendly Interface
4. Exploring eBook Recommendations from Lay Linear Algebra Solutions Manual
  - Personalized Recommendations
  - Lay Linear Algebra Solutions Manual User Reviews and Ratings
  - Lay Linear Algebra Solutions Manual and Bestseller Lists

5. Accessing Lay Linear Algebra Solutions Manual Free and Paid eBooks
  - Lay Linear Algebra Solutions Manual Public Domain eBooks
  - Lay Linear Algebra Solutions Manual eBook Subscription Services
  - Lay Linear Algebra Solutions Manual Budget-Friendly Options
6. Navigating Lay Linear Algebra Solutions Manual eBook Formats
  - ePub, PDF, MOBI, and More
  - Lay Linear Algebra Solutions Manual Compatibility with Devices
  - Lay Linear Algebra Solutions Manual Enhanced eBook Features
7. Enhancing Your Reading Experience
  - Adjustable Fonts and Text Sizes of Lay Linear Algebra Solutions Manual
  - Highlighting and Note-Taking Lay Linear Algebra Solutions Manual
  - Interactive Elements Lay Linear Algebra Solutions Manual
8. Staying Engaged with Lay Linear Algebra Solutions Manual
  - Joining Online Reading Communities
  - Participating in Virtual Book Clubs
  - Following Authors and Publishers Lay Linear Algebra Solutions Manual
9. Balancing eBooks and Physical Books Lay Linear Algebra Solutions Manual
  - Benefits of a Digital Library
  - Creating a Diverse Reading Collection Lay Linear Algebra Solutions Manual
10. Overcoming Reading Challenges
  - Dealing with Digital Eye Strain
  - Minimizing Distractions
  - Managing Screen Time
11. Cultivating a Reading Routine Lay Linear Algebra Solutions Manual
  - Setting Reading Goals Lay Linear Algebra Solutions Manual
  - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Lay Linear Algebra Solutions Manual
  - Fact-Checking eBook Content of Lay Linear Algebra Solutions Manual
  - Distinguishing Credible Sources
13. Promoting Lifelong Learning

- Utilizing eBooks for Skill Development
- Exploring Educational eBooks

#### 14. Embracing eBook Trends

- Integration of Multimedia Elements
- Interactive and Gamified eBooks

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