Finite Mathematics and Its Applications 12th Edition

Solution Manual for Finite Mathematics and Its Applications 12th by Goldstein Schneider Siegel and Hair ISBN 0134437764 9780134437767

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CHAPTER 2

Exercises 2.1, page 47

1. $\xrightarrow{2R_1}$ $\begin{cases} x - 6y = 4 \\ 5x + 4y = 1 \end{cases}$ **2.** $\xrightarrow{(-1)R_2}$ $\begin{cases} x + 4y = 6 \\ y = -2 \end{cases}$ **3.** $\xrightarrow{R_2 + 5R_1}$ $\begin{cases} x + 2y = 3 \\ 14y = 16 \end{cases}$ **4.** $\xrightarrow{R_2 + (-\frac{1}{2})R_1}$ $\begin{cases} x - 6y = 4 \\ 5y = -1 \end{cases}$

5. $\xrightarrow{R_3 + (-4)R_1}$ $\begin{cases} x - 2y + z = 0 \\ y - 2z = 4 \\ 9y - z = 5 \end{cases}$ **6.** $\xrightarrow{R_3 + 3R_2}$ $\begin{cases} x + 6y - 4z = 1 \\ y + 3z = 1 \\ 16z = 5 \end{cases}$ **7.** $\xrightarrow{R_1 + \frac{1}{2}R_2}$ $\begin{bmatrix} 1 & 0 & 5 \\ 0 & 1 & 4 \end{bmatrix}$

8. $\xrightarrow{R_3 + (-4)R_2}$ $\left[\begin{array}{cccc} 1 & 0 & 7 & 9 \\ 0 & 1 & -2 & 3 \\ 0 & 0 & 16 & -7 \end{array}\right]$ **9.** $\begin{bmatrix} -3 & 4 & -2 \\ 1 & -7 & 8 \end{bmatrix}$ **10.** $\xrightarrow{\frac{2}{3}}$ $\begin{bmatrix} -3 & 4 \\ 0 & -5 \end{bmatrix}$ **11.** $\left[\begin{array}{cccc} 1 & 13 & -2 & 0 \\ 2 & 0 & -1 & 3 \\ 0 & 1 & 0 & 5 \end{array}\right]$

12. $\left[\begin{array}{ccc} 0 & 1 & -1 \\ 2 & 0 & 0 \\ 1 & -3 & 0 \end{array}\right]$ $\left[\begin{array}{c} 22 \\ -2y = 3 \\ \end{array}\right]$ $\xrightarrow{\frac{1}{3}}$ $\left[\begin{array}{c} \\ -5x + \frac{2}{3}y = 3 \\ \end{array}\right]$ $\left[\begin{array}{c} \\ 3x + 2y = -3 \\ \end{array}\right]$ $\left[\begin{array}{c} \\ \frac{6}{5}x - y + 12z = -\frac{2}{3} \\ \end{array}\right]$

17§ **13.** e $x + 7y = -5$ **14.** e $x + 7y = -4$ **15.** • $\frac{}{12}$ **16.** • $-x = 6$ $2y - z = 4$ $-5x - y + 7z = 0$

17. Multiply the second row of the matrix by $\frac{1}{3}$. **18.** Change the second row of the matrix by adding to it -4 times the first row. **19.** Change the first row of the matrix by adding to it 3 times the second row. **20.** Multiply the first row of the matrix by -1. **21.** Interchange rows 2 and 3. **22.** Interchange rows 1 and 2.

23. $\begin{bmatrix} 1 & 2 & 0 \\ 0 & 10 & 5 \end{bmatrix}$ **24.** $\begin{bmatrix} 1 & -4 & -\frac{3}{2} \\ -3 & 4 & 9 \end{bmatrix}$ **25.** $\begin{bmatrix} 1 & 2 & 3 \\ 3 & -2 & 0 \end{bmatrix}$ **26.** $\begin{bmatrix} 1 & 3 & -2 \\ 0 & -8 & 13 \end{bmatrix}$ **27.** $\begin{bmatrix} 1 & 3 & -5 \\ 0 & 1 & 7 \end{bmatrix}$ **28.** $\begin{bmatrix} 1 & 7 & 6 \\ -3 & 2 & 0 \end{bmatrix}$

29. $R_2 + 2R_1$ **30.** $\frac{1}{2}R_2$ **31.** $R_1 + (-2)R_2$ **32.** $R_3 + (-4)R_1$ **33.** $R_1 \leftrightarrow R_2$ or $R_1 \leftrightarrow R_3$ **34.** $\frac{1}{3}(-1)R_2$

35. $R_1 + (-3)R_3$ or $R_2 + (-2)R_3$ **36.** $R_2 \leftrightarrow R_3$ **37.** £0 10 2 18§ **38.** £0 −7 −11 5§

0 −6 5 −13 0 14 37 −9

39. e $x + y = 7$, $x - y = 1$; $x = 4, y = 3$ **40.** e $2x + 3y = 23$, $6x - 4y = 4$; $x = 4, y = 5$ **41.** e $3x - 4y = -27$, $x + 2y = 11$; $x = -1, y = 6$

$4x - 3y = 18$ $2x + y + 3z = 31$ $2x + 7y + 4z = 1$

42. e $2x - y = 8$; $x = 3, y = -2$ **43.** $x + y - 2z = 3$; $x = 3, y = 10, z = 5$ **44.** • $3x - 8y + 9z = 20$; $x = 4, y = -1, z = 0$ •

$4x - 2y + 5z = 17$ $4x + 5z = 16$

$3x + 7y + 2z = 5$ $3x + 2y + z = 10$

45. • $7x - 6y - 3z = 4$; $x = 1, y = 0, z = 1$ **46.** • $8x - y + 6z = 16$; $x = .5, y = 3, z = 2.5$ **47.** $x = -1, y = 1$

$10x + 9y - 7z = 3$ $5x + 3y - z = 9$

48. $x = -6, y = -3$ **49.** $x = -8, y = -9, z = -$ **50.** $x = 6, y = 1, z = 0$ **51.** $x = -1, y = 1$ **52.** $x = 2, y = 0$

53. $x = 1, y = 2, z = -1$ **54.** $x = 1, y = 2, z = 3$ **55.** $x = -2.5, y = 15$ **56.** $x = 18, y = -3$ **57.** $x = 1, y = -6, z = 2$

58. $x = 1, y = 2, z = 3$ **59.** $x = -1, y = -2, z = 5$ **60.** $x = 1, y = -3, z = 4$ **61.** 30 **62.** 8 **63.** d **64.** c

65. 150 short sleeve, 200 long sleeve **66.** 47 bottles of national brand, 35 bottles of store brand **67.** 190 adults, 85 children

68. 15 at-bats, 3 hits, 200 batting average **69.** $x = 3.7, y = 3.9, z = 1.9$ **70.** $x = 13, y = 19, z = 68$ **71.** 3 ounces of Brazilian, 6 ounces of Columbian, 7 ounces of Peruvian **72.** 5 ounces of cashews, 6 ounces of almonds, 5 ounces of walnuts

73. \$25,000 in the bond fund, \$50,000 in the health sciences fund, \$25,000 in the real estate fund **74.** 6 ounces of food I, 3 ounces of food II, 1 ounce of food III **75.** $23\frac{1}{3}$ pounds of first type, 85 pounds of second type, $201\frac{2}{3}$ pounds of third type **76.** \$1250 in the savings account, \$1250 in the certificate of deposit, and \$2500 in the prepaid college fund

77. $\begin{bmatrix} 1 & 0 & -5 \\ 0 & 1 & 4 \end{bmatrix}$ **78.** £0 1 0 −3§ **79.** ≥0 1 0 ¥ **80.** ≥0 1 0 ¥ **81.** $x = -2.5, y = 15$

0 0 1 $-\frac{9}{13}$ 0 0 1 $\frac{9}{26}$ 0 0 1 $-\frac{11}{13}$

$\begin{bmatrix} 1 & 0 & 0 & \frac{58}{13} \\ 0 & 1 & 0 & \frac{175}{54} \\ 0 & 0 & 1 & \frac{109}{11} \end{bmatrix}$ $\begin{bmatrix} 1 & 0 & 0 & \frac{175}{16} \\ 0 & 1 & 0 & \frac{7}{27} \\ 0 & 0 & 1 & \frac{11}{27} \end{bmatrix}$ $\begin{bmatrix} 1 & 0 & 0 & \frac{109}{7} \\ 0 & 1 & 0 & \frac{11}{27} \\ 0 & 0 & 1 & \frac{11}{27} \end{bmatrix}$

82. $x = 18, y = -3$ **83.** $x = 1, y = -6, z = 2$ **84.** $x = 1, y = 2, z = 3$

Exercises 2.2, page 56

1. $\begin{bmatrix} 1 & -2 & 3 \\ 0 & 13 & -8 \\ 4 & 3 & 0 \end{bmatrix}$ **2.** $\begin{bmatrix} -\frac{1}{2} & 0 & 0 & 6 \\ & 1 & 0 & 3 \\ & & 1 & -\frac{3}{2} \end{bmatrix}$ **3.** $\begin{bmatrix} 9 & -1 & 0 & -7 \\ -\frac{1}{2} & \frac{1}{2} & 1 & 3 \\ 5 & -1 & 0 & -3 \end{bmatrix}$ **4.** $\begin{bmatrix} 15 & 0 & 0 & -28 \\ 7 & 0 & 9 & 0 \\ -1 & 1 & -1 & 4 \end{bmatrix}$ **5.** $\begin{bmatrix} 1 & -\frac{3}{2} & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & 0 & 0 \end{bmatrix}$ **6.** $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & 0 & 0 \end{bmatrix}$

7. $\begin{bmatrix} 1 & 1 & 0 \\ \frac{1}{6} & \frac{1}{2} & 1 \end{bmatrix}$ **8.** $\begin{bmatrix} \frac{1}{2} & -\frac{1}{2} & 1 \\ -2 & 5 & 0 \end{bmatrix}$ **9.** $\begin{cases} x + y + 4z = 6 \\ 2x + y + z = 10 \end{cases}$; z = any value, $y = 2 - 7z$, $x = 4 + 3z$

10. $\begin{cases} 2x - 2y + z = 2 \\ -6x + 6y - 3z = 5 \end{cases}$; no solution **11.** $\begin{cases} -5x + 15y - 10z = 5 \\ x - 3y + 2z = 0 \end{cases}$; no solution

12. $\begin{cases} 2x - 6y - 4z = 0 \\ -3x + 9y + 6z = 0 \end{cases}$; y = any value, z = any value, $x = 3y + 2z$

13. $\begin{cases} -x - 4y + 2z = 3 \\ 8x + 5y + 11z = 30 \\ x + 2y + 3z - w = 4 \end{cases}$; z = any value, $y = z - 2$, $x = 5 - 2z$ **14.** $\begin{cases} 3x + y + z = -2 \\ x + 2y - z = 5 \\ 2x - y + 2z = 4 \end{cases}$; no solution

15. $\begin{cases} 2x + 3y + w = -3 \\ 4x + 7y + 6z - w = 5 \\ x + y + z = -1 \end{cases}$; z = any value, w = any value, $y = 11 - 6z + 3w$, $x = 9z - 5w - 18$

16. $\begin{cases} x + 2y - z = -6 \\ 2x + y + 4z = 3 \end{cases}$; z = any value, $y = 2z - 5$, $x = 4 - 3z$ **17.** y = any value, $x = 3 + 2y$ **18.** No solution

19. No solution **20.** y = any value, $x = 4 + 3y$ **21.** $x = 1$, $y = 2$ **22.** y = any value, $x = 6y + 12$ **23.** No solution

24. $x = 3$, $y = 2$ **25.** No solution **26.** z = any value, $x = 11z + 8$, $y = 4z + 1$ **27.** z = any value, $x = -6 - z$, $y = 5$

28. y = any value, $x = 3y + 2$, $z = 4$ **29.** No solution **30.** No solution **31.** No solution **32.** $x = 3$, $y = -1$, $z = 0$

33. z = any value, w = any value, $x = 2z + w$, $y = 5 - 3w$ **34.** w = any value, $x = -\frac{1}{2}w + \frac{11}{2}$, $y = \frac{1}{2}w - \frac{5}{2}$, $z = 6$

35. No solution **36.** w = any value, $x = 1 - 4w$, $y = 2w + 3$, $z = 0$

37. Possible answers: $z = 0$, $x = -13$, $y = 9$; $z = 1$, $x = -8$, $y = 6$; $z = 2$, $x = -3$, $y = 3$

38. Possible answers: $z = 0$, $x = -56$, $y = 13$; $z = 1$, $x = -64$, $y = 14$; $z = 2$, $x = -72$, $y = 15$

39. Possible answers: $y = 0$, $x = 23$, $z = 5$; $y = 1$, $x = 16$, $z = 5$; $y = 2$, $x = 9$, $z = 5$

40. Possible answers: $z = 0$, $x = 4$, $y = 7$; $z = 1$, $x = 4$, $y = 10$; $z = 2$, $x = 4$, $y = 13$

41. Food 3: z = any value between 0 and 100, food 2: $y = 100 - z$, food 1: $x = 300 - z$ **42.** No solution

44. 4 grams of food A, 3 grams of food B, 2 grams of food C; 1.5 grams of food A, 3.9 grams of food B, 1.9 grams of food C

45. 50 ottomans, 30 sofas, 40 chairs; 5 ottomans, 55 sofas, 35 chairs; 95 ottomans, 5 sofas, 45 chairs

46. 9 computers, 4 printers, 2 scanners; 8 computers, 2 printers, 5 scanners

47. 6 floral squares, the other 90 any mix of solid green and solid blue

48. The same number of \$7 and \$13 plants, up to 7 of each type, the rest \$10 plants

49. No solution if $k \neq -12$; infinitely many if $k = -12$ **50.** 3 **51.** None

52. No, there still could be a unique solution or infinitely many solutions depending on the other rows of the matrix.

53. One; $x = 7$, $y = 3$ **54.** None **55.** None **56.** One; $x = 5$, $y = 6$

57. There has been a pivot about the bottom right element. **58.** Does not differ

Exercises 2.3, page 68

1. 2 * 3 **2.** 2 * 1, column matrix **3.** 1 * 3, row matrix **4.** 2 * 2 square, identity matrix **5.** 2 * 2, square matrix

6. 1 * 1, square, column, and row matrix **7.** -4; 0 **8.** -1; 2 **9.** $i = 1$, $j = 3$ **10.** $i = 2$, $j = 2$

11. $\begin{bmatrix} 9 & 3 \\ 7 & -1 \end{bmatrix}$ **12.** $\begin{bmatrix} 13 \\ 3 \end{bmatrix}$ **13.** $\begin{bmatrix} 2 & 4 & 2.5 \\ -5.5 & 1 & 1.2 \end{bmatrix}$ **14.** $\begin{bmatrix} 3 \\ \frac{3}{2} \\ 3 \\ 24 \end{bmatrix}$ **15.** $\begin{bmatrix} 1 & 3 \\ 1 & 2 \\ 4 & -2 \end{bmatrix}$ **16.** $\begin{bmatrix} .2 & -.5 \\ -.2 & .5 \end{bmatrix}$ **17.** $\begin{bmatrix} -7 \\ -\frac{1}{6} \end{bmatrix}$

18. $\begin{bmatrix} .8 & 1 & 0 \\ .4 & -1.6 & 1.5 \end{bmatrix}$ **19.** [11] **20.** $\begin{bmatrix} 1 \\ \frac{1}{2} \end{bmatrix}$ **21.** [10] **22.** [0] **23.** $\begin{bmatrix} 4 & 0 & -\frac{2}{3} \\ -6 & \frac{1}{2} & \frac{1}{3} \end{bmatrix}$ **24.** $\begin{bmatrix} 6 & .75 \\ 0 & 1.8 \end{bmatrix}$ **25.** $\begin{bmatrix} 3 & 19 \\ 23 & 3 \end{bmatrix}$

26. [0 18] **27.** Yes; 3 * 5 **28.** Yes; 3 * 4 **29.** No **30.** Yes; 1 * 1 **31.** Yes; 3 * 1 **32.** No **33.** $\begin{bmatrix} 6 \\ 17 \\ 6 \\ 10 \end{bmatrix}$ **34.** $\begin{bmatrix} 10 \\ 7 \end{bmatrix}$

$\begin{bmatrix} 21 & 0 & 0 \\ 8 & -10 & 2 \\ 25 & 17 & 2 \end{bmatrix}$

35. $\begin{bmatrix} -4 \\ 8 \end{bmatrix}$ **36.** $\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$ **37.** $\begin{pmatrix} 7 & 8 \end{pmatrix}$ **38.** $\begin{pmatrix} 0 & 1 \end{pmatrix}$ **39.** $\begin{pmatrix} .52 & .61 \end{pmatrix}$ **40.** $\begin{bmatrix} -1 & 6 & 3 \\ 3 & 5 & 11 \end{bmatrix}$ **41.** $\begin{bmatrix} 3 & -1 & 2 \\ 1 & 1 & 4 \end{bmatrix}$

42. $\begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}$ **43.** $\begin{bmatrix} \frac{1}{3} & \frac{2}{3} \\ \frac{1}{3} & \frac{2}{3} \end{bmatrix}$ **44.** $\begin{bmatrix} .4 & .4 & .4 \\ .4 & .4 & .4 \\ .2 & .2 & .2 \end{bmatrix}$ **45.** $\begin{bmatrix} 30 & 41 \\ 23 & 24 \end{bmatrix}$ **46.** $\begin{bmatrix} 8 & 18 \\ 2.4 & 5.6 \end{bmatrix}$ **47.** $\begin{bmatrix} 10 & 0 \\ 0 & 15 \end{bmatrix}$ **48.** $\begin{bmatrix} 2 & 0 \\ 0 & 2 \end{bmatrix}$ **49.** $\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$ **50.** $\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$

$2x + 3y = 6$

$-3x + 4y = 1$

51. $\begin{bmatrix} 25 & 26 \end{bmatrix}$ **52.** $\begin{bmatrix} 7.8 & 9.9 \end{bmatrix}$ **53.** $\begin{cases} 4x + 5y = 7 \\ y = 1 \end{cases}$

54. $\begin{cases} x + 2y + 3z = 10 \\ 4x + 5y + 6z = 11 \\ 7x + 8y + 9z = 12 \end{cases}$

55. $\begin{cases} x = 1 \\ y = 2 \\ z = 3 \end{cases}$

56.

57. $\begin{bmatrix} 7 & -1 \end{bmatrix}\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 2 \end{bmatrix}$ **58.** $\begin{bmatrix} -2 & 4 \end{bmatrix}\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 0 \end{bmatrix}$ **59.** $\begin{bmatrix} 0 & 1 & 1 \\ 1 & -2 & 3 \\ 0 & 0 & 1 \end{bmatrix}\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 5 \\ 6 \\ 2 \end{bmatrix}$ **60.** $\begin{bmatrix} 1 & 6 & 3 \\ -2 & 4 & -1 \\ 7 & 0 & 4 \end{bmatrix}\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} -1 \\ 5 \\ 8 \end{bmatrix}$

65. (a) $\begin{bmatrix} 340 \\ 265 \end{bmatrix}$ **(b)** Mike's clothes cost $340; Don's clothes cost $265. **(c)** $\begin{bmatrix} 18.75 \\ 62.50 \end{bmatrix}$ **(d)** The costs of the three items of clothing after a 25% increase **66. (a)** [15,400 16,050] **(b)** The monthly sales for Store 1 were $15,400 and for Store 2 were $16,050. **(c)** [275 88 66] **(d)** The retail prices after a 10% increase **67. (a)** [2282.50 2322.50 3550.50], total retail value for the white chocolate-covered, milk chocolate-covered, and dark chocolate-covered items **(b)** $\begin{bmatrix} 3337.50 \\ 3138.00 \end{bmatrix}$, total revenue from peanuts, raisins, and espresso beans **(c)** $\begin{bmatrix} 351.50 \\ 94.50 \end{bmatrix}$, 10% reduction in the number of pounds sold **68. (a)** [18,500 21,750 24,250], November wholesale costs for each of the three stores **(b)** [18,000 26,500 27,500], December wholesale costs for each of the three stores **(c)** [31,500 37,250 40,750]. November revenue for each of the three stores **(d)** [31,000 44,500 46,500]. December revenue for each of the three stores **(e)** [200 200 300], profits for each of the three appliances **(f)** [13,000 15,500 16,500], November profits for each of the three stores **(g)** [13,000 18,000 19,000], December profits for each of the three stores **(h)** $\begin{bmatrix} 256.50 \\ 40 \\ 20 \end{bmatrix}\begin{bmatrix} 50 & 90 & 50 \\ 30 & 25 & 65 \end{bmatrix}$, quantities of each of appliances sold during November and December **(i)** [26,000 33,500 35,500], combined November and December profits for each of the three stores **(j)** [475 427.50 712.50], 5% discount off retail prices **69. (a)** I: 2.75, II: 2, III: 1.3 **(b)** A: 74, B: 112, C: 128, D: 64, F: 22 **70.** Scheme III **71.** 10,100 voting Democratic, 7900 voting Republican **72. (a)** Democrats; 56.1% **(b)** Republicans; 50.6% **73.** Carpenters: $2000, bricklayers: $2100, plumbers: $1200 **74.** $\begin{bmatrix} 232{,}000 & 260{,}500 \\ 86{,}000 & 97{,}500 \\ 42{,}000 & 47{,}000 \end{bmatrix}$ **(a)** **(b)** 86,000 **(c)** 47,000

75. (a) [162 150 143], number of units of each nutrient consumed at breakfast **(b)** [186 200 239], number of units of each nutrient consumed at lunch **(c)** [288 300 344], number of units of each nutrient consumed at dinner **(d)** [5 8], total number of ounces of each food that Mikey eats during a day **(e)** [636 650 726], number of units of each nutrient consumed per day

76. (a) [100 115 85 75], units of each ingredient needed to fill to order **(b)** $\begin{bmatrix} 108 \\ 67 \\ 182 \\ 43 \end{bmatrix}$, cost to make each type of cookie **(c)** [5850], total cost to fill order **(d)** $\begin{bmatrix} 48 \\ 43 \end{bmatrix}$, profit for each type of cookie **(e)** [2275], total profit for the order **(f)** [8125], total price of the order **77. (a)** $\begin{bmatrix} 720 \\ 646 \end{bmatrix}$ **(b)** $720

78. (a) $T = \begin{bmatrix} \text{DVD} & \text{TV} \\ 3 & 5 \\ \frac{1}{2} & 1 \end{bmatrix}$ Assembly / Packaging **(b)** $S = \begin{bmatrix} 30 \\ 20 \end{bmatrix}$ DVDs / TVs; 190 hours of assembly, 35 hours of packaging

79. (a) $T = \begin{bmatrix} \text{Boston cream pie} & \text{Carrot cake} & \\ 30 & 45 & \text{Preparation} \\ 30 & 50 & \text{Baking} \\ 15 & 10 & \text{Finishing} \end{bmatrix}$ **(b)** $S = \begin{bmatrix} 20 \\ 8 \end{bmatrix}$ Boston cream pie / Carrot cake; $TS = \begin{bmatrix} 960 \\ 1000 \\ 380 \end{bmatrix}$ Preparation / Baking / Finishing

(c) Total baking time: 1000 minutes, or $16\frac{2}{3}$ hours; total finishing time: 380 minutes, or $6\frac{1}{3}$ hours

80. **(a)** $T = \begin{bmatrix} & \text{Preparation} & \text{Lacquering} & \text{Drying} & \\ & 20 & 5 & 15 & \text{Manicure} \\ & 30 & 5 & 20 & \text{Pedicure} \end{bmatrix}$ **(b)** $S = \begin{bmatrix} & \text{Manicure} & \text{Pedicure} \\ & 15 & 9 & 4; \end{bmatrix}$

$ST = \begin{bmatrix} & \text{Preparation} & \text{Lacquering} & \text{Drying} \\ & 570 & 120 & 405 & 4 \end{bmatrix}$ **(c)** Total drying time is 405 minutes, or $6\frac{3}{4}$ hours.

81. **(a)** $T = \begin{bmatrix} & \text{Cutting} & \text{Sewing} & \text{Finishing} & \\ & 2 & 3 & 2 & \text{Huge One} \\ & 1.5 & 2 & 1 & \text{Regular Joe} \end{bmatrix}$ **(b)** $S = \begin{bmatrix} & \text{Huge One} & \text{Regular Joe} \\ & 24 & 32 & \end{bmatrix}$

(c) $A = \begin{bmatrix} & \text{Huge One} & \text{Regular Joe} \\ & 27 & 56 & 4; \end{bmatrix}$ $AT = \begin{bmatrix} & \text{Cutting} & \text{Sewing} & \text{Finishing} \\ & 138 & 193 & 110 & 4; \end{bmatrix}$ $AS = \begin{bmatrix} & 2208 & 4 \end{bmatrix}$ **(d)** 193 hours **(e)** \$2208

82. **(a)** $BC = \begin{bmatrix} 740 \\ 90.6 \end{bmatrix}$; The total revenue is \$7000. **(b)** $AC = \begin{bmatrix} 2065 \end{bmatrix}$; The total size is 740 GB, the total battery life is 2065 hours, and the total weight is 90.6 ounces. **(c)** The total battery life for all MP3 players sold is 2065 hours. **84.** $a = 1, b = -2$

85. $\begin{bmatrix} 3 & -2 & 1 \\ -5 & 6 & 7 \end{bmatrix}$ **86.** $\begin{bmatrix} 5 & 4 & -3 \\ 0 & -1 & 2 \end{bmatrix}$ **87.** $4 * 4$ **88.** $3 * 3$ **89.** $\begin{bmatrix} 39257 & 57,718 & 89,389 \end{bmatrix}$

90. $\begin{bmatrix} 3155,959 & 95,997 & 66,554 \end{bmatrix}$

91. $\begin{bmatrix} 250.0 & 6.4 & -2 & -2.7 \\ 20.5 & 22.5 & -2.4 \\ 107.8 & -14 & 17.6 & 16 \end{bmatrix}$ **92.** $\begin{bmatrix} 5.6 & -16 & 3.3 \\ -17.5 & 21.5 & -5.6 \\ 4 & -4.4 & 12 \end{bmatrix}$

93. $\begin{bmatrix} -171.3 & 40.8 & -31.8 \\ 454.6 & -22.5 & 22.7 \\ -2.6 & 122.3 & 53.56 \end{bmatrix}$ **94.** $\begin{bmatrix} 27.9 & 130.6 & -69.88 \\ 106.75 & -149.44 & 26.1 \\ -47.5 & 336.2 & -18.7 \end{bmatrix}$ **95.** $\begin{bmatrix} 1.2 & 21 & -9 \\ 57 & 1.5 & 4.8 \\ -27 & 33 & 6 \end{bmatrix}$ **96.** $\begin{bmatrix} 1.8 & 14 & -6 \\ 38 & 2 & 3.2 \\ -18 & 22 & 5 \end{bmatrix}$

Exercises 2.4, page 78

1. $x = 2, y = 0$ **2.** $x = 6, y = 1$ **3.** $\begin{bmatrix} 1 & -2 \\ -3 & 7 \end{bmatrix}$ **4.** $\begin{bmatrix} -7 & 3 \\ 5 & -2 \end{bmatrix}$ **5.** $\begin{bmatrix} 1 & -1 \\ -\frac{2}{5} & 3 \end{bmatrix}$ **6.** $\begin{bmatrix} 1 & -1 \\ 0 & 2 \end{bmatrix}$ **7.** $\begin{bmatrix} 1.6 & -.4 \\ -.6 & 1.4 \end{bmatrix}$ **8.** $\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$

9. $3\frac{1}{4}$ **10.** [5] **11.** $x = 4, y = -\frac{1}{3}$ **12.** $x = 2, y = -3$ **13.** $x = 32, y = -6$ **14.** $x = 1, y = 2$ **15.** **(a)** $\begin{bmatrix} .8 & .3 \\ .2 & .7 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} m \\ s \end{bmatrix}$

(b) $\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 1.4 & -.6 \\ -.4 & 1.6 \end{bmatrix} \begin{bmatrix} m \\ s \end{bmatrix}$ **(c)** 110,000 married; 40,000 single **(d)** 130,000 married; 20,000 single **16.** $\begin{bmatrix} \frac{1}{3} & \frac{1}{4} \\ -\frac{1}{3} & \frac{3}{4} \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} s \\ w \end{bmatrix}$

(a) $\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 9 & -3 \\ -8 & 4 \end{bmatrix} \begin{bmatrix} s \\ w \end{bmatrix}$ **(b)** $\begin{bmatrix} .7 & .1 \\ .3 & .9 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} u \\ y \end{bmatrix}$ **(c)** 12,000 **(d)** 24,000 **17.** **(a)** $\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 3 & 1 \\ -\frac{1}{2} & \frac{2}{3} \end{bmatrix} \begin{bmatrix} u \\ y \end{bmatrix}$ **(b)** $\begin{bmatrix} s \\ y \end{bmatrix} = \begin{bmatrix} \frac{2}{3} & -\frac{6}{7} \\ \frac{1}{2} & \frac{6}{7} \end{bmatrix} \begin{bmatrix} t \\ y \end{bmatrix}$ **(c)** 8500; 4500

18. **(a)** $\begin{bmatrix} .8 & .5 \\ .2 & .5 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} u \\ y \end{bmatrix}$ **(b)** 24; 28 **19.** $x = 9, y = -2, z = -2$ **20.** $x = 5, y = -1, z = -1$ **21.** $x = 21, y = 25, z = 26$

22. $x = 6, y = 7, z = 8$ **23.** $x = 1, y = 5, z = -4, w = 9$ **24.** $x = -4, y = 1, z = 19, w = 5$ **25.** $x = 4, y = -19, z = 2, w = -4$

26. $x = -9, y = 25, z = -4, w = 5$ **28.** True

29. **(a)** $\begin{bmatrix} 1 & 2 \\ .9 & 0 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} a \\ b \end{bmatrix}$ **(b)** After 1 year: 1,170,000 in group I and 405,000 in group II. After 2 years: 1,980,000 in group I and 1,053,000 in group II. **(c)** 700,000 in group I and 55,000 in group II. **30.** $\begin{bmatrix} 0 & -1 \\ 2 & 1 \end{bmatrix}$

33. One possible answer is $\begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 2 \\ 3 \end{bmatrix}$. **34.** One possible answer is $A = \begin{bmatrix} 4 & 6 \\ 6 & 9 \end{bmatrix}$ and $B = \begin{bmatrix} 12 \\ 18 \end{bmatrix}$. **35.** $\begin{bmatrix} s \\ t \end{bmatrix} = \begin{bmatrix} \frac{5}{73} & -\frac{10}{73} \\ -\frac{2}{25} & \frac{11}{292} \end{bmatrix} \begin{bmatrix} 6 \\ 2 \end{bmatrix} = \begin{bmatrix} \frac{75}{292} \\ -\frac{2110}{5703} \end{bmatrix} \approx \begin{bmatrix} .3414 \\ -.3701 \end{bmatrix}$

36. $\begin{bmatrix} s \\ t \end{bmatrix} = \begin{bmatrix} \frac{123}{410} & \frac{82}{205} \\ \frac{41}{41} & \frac{20}{41} \end{bmatrix} \begin{bmatrix} 2 \\ 3 \end{bmatrix} = \begin{bmatrix} \frac{1020}{8887} & \frac{2910}{8887} & \frac{500}{8887} \\ \frac{125}{8887} & \frac{618}{8887} & \frac{810}{8887} \end{bmatrix} \begin{bmatrix} 2 \\ 3 \\ 5 \end{bmatrix} = \begin{bmatrix} \frac{4}{1901} \\ \frac{655}{5703} \end{bmatrix} \approx \begin{bmatrix} .2105 \\ .1148 \end{bmatrix}$

37. $\begin{bmatrix} \frac{3050}{8887} & \frac{860}{8887} & \frac{1990}{8887} \\ \frac{220}{1901} & \frac{2525}{5703} & \frac{2305}{5703} \\ \frac{170}{1901} & \frac{1112}{5703} \end{bmatrix}$ **38.** $\begin{bmatrix} \frac{3050}{8887} & \frac{860}{8887} & \frac{1990}{8887} \\ \frac{220}{1901} & \frac{2525}{5703} & \frac{2305}{5703} \\ \frac{170}{1901} & \frac{1112}{5703} \end{bmatrix}$ **39.** $x = -\frac{28}{5}, y = \frac{28}{5}, z = 5$

40. $x = \frac{23}{4}, y = \frac{257}{4}, z = \frac{209}{4}$

41. $x = 0, y = 2, z = 0, w = 2$ **42.** $x = \frac{8}{181}, y = \frac{413}{181}, z = \frac{749}{181}, w = \frac{367}{181}$

Exercises 2.5, page 82

1. $\begin{bmatrix} -2 & 3 \\ 5 & -7 \end{bmatrix}$ **2.** $\begin{bmatrix} \frac{1}{11} & \frac{1}{11} \\ -\frac{3}{11} & \frac{2}{11} \end{bmatrix}$ **3.** $\begin{bmatrix} \frac{7}{2} & \frac{3}{2} \\ -2 & -1 \end{bmatrix}$ **4.** $\begin{bmatrix} 1 & 3 \\ 0 & 1 \end{bmatrix}$ **5.** No inverse **6.** No inverse **7.** $\begin{bmatrix} 1 & -1 & 3 \\ 0 & 0 & 1 \\ -1 & 2 & -4 \end{bmatrix}$

8. $\begin{bmatrix} \frac{1}{2} & \frac{1}{2} & 0 \\ 0 & -\frac{1}{2} & 0 \\ -\frac{3}{2} & \frac{3}{2} & 1 \end{bmatrix}$ **9.** No inverse **10.** $\begin{bmatrix} 1 & 0 & 0 \\ -\frac{5}{2} & \frac{5}{2} & 0 \\ 1 & -\frac{5}{5} & \frac{1}{5} \end{bmatrix}$ **11.** $\begin{bmatrix} -5 & 6 & 0 & 0 \\ 1 & -1 & 0 & 0 \\ 0 & 0 & -\frac{1}{46} & \frac{1}{46} \\ 0 & 0 & \frac{25}{46} & -\frac{23}{46} \end{bmatrix}$ **12.** $\begin{bmatrix} \frac{1}{4} & 0 & -2 & 0 \\ -\frac{1}{2} & 1 & 0 & -1 \\ -\frac{1}{4} & 0 & \frac{3}{2} & 0 \\ 2 & 0 & -3 & 1 \end{bmatrix}$

13. $x = 2, y = -3, z = 2$ **14.** $x = -9, y = 5, z = 1$ **15.** $x = 2, y = 1, z = 3$ **16.** $x = 2, y = 7, z = -3$

17. $x = 4, y = -4, z = 3, w = -1$ **18.** $x = 6, y = 3, z = 0, w = 3$ **19.** $\begin{bmatrix} -3 & 5 \\ 10 & -16 \end{bmatrix}$ **20.** $\begin{bmatrix} -23 & -10 \\ 9 & 4 \end{bmatrix}$ **21.** $x = 42, y = 21, z = 37$

22. $x = 58, y = 27, z = 15$ **23.** $x = 82, y = 17, z = 1$ **24.** $x = 14, y = 46, z = 22$

Exercises 2.6, page 88

1. 20 cents **2.** 15 cents **3.** Energy sector **4.** Energy sector **5.** $6 million **6.** $4.5 million **7.** Manufacturing **8.** Services

9. $AX = \begin{bmatrix} 11.50 \\ 9.50 \end{bmatrix}$ **11.** $X = \begin{bmatrix} 14.06 \\ 13.08 \end{bmatrix}$ **12.** $X = \begin{bmatrix} 19.90 \\ 31.35 \end{bmatrix}$ **13.** Coal: $8.84 billion; steel: $3.725 billion; electricity: $9.895 billion

14. Computers: $482 million; semiconductors: $298.5 million; business forms: $155.5 million **15.** Computers: $354 million; semiconductors: $172 million **16.** Coal: $4.124 billion; steel: $1.788 billion; electricity: $3.354 billion **17.** $1.55 billion worth of coal, $0.86 billion worth of steel, and $4.55 billion worth of electricity **18.** $358,000,000 worth of computers, $118,000,000 worth of semiconductors, and $253,000,000 worth of business forms

19. **(a)** $\begin{matrix} \\ T \\ E \end{matrix}\begin{matrix} \begin{matrix} T & E \end{matrix} \\ \begin{bmatrix} .25 & .30 \\ .20 & .15 \end{bmatrix} \end{matrix}$ **(b)** $\begin{bmatrix} 1.47 & .52 \\ .35 & 1.30 \end{bmatrix}$ **(c)** Transportation: $8.91 billion; energy: $5.65 billion **(d)** Transportation: $3.92 billion; energy: $2.63 billion

20. **(a)** $\begin{matrix} \\ T \\ E \end{matrix}\begin{matrix} \begin{matrix} T & E \end{matrix} \\ \begin{bmatrix} .25 & .30 \\ .20 & .15 \end{bmatrix} \end{matrix}$ **(b)** $\begin{bmatrix} 1.47 & .52 \\ .35 & 1.30 \end{bmatrix}$ **(c)** Transportation: $9.52 billion; energy: $10.50 billion **(d)** Transportation: $5.53 billion, energy: $3.48 billion **21.** Plastics: $955,000; industrial equipment: $590,000 **22.** Plastics: $1.93 million; industrial equipment: $3.14 million

$$\begin{matrix} \\ W \end{matrix}\begin{matrix} \begin{matrix} W & S & C \end{matrix} \\ \begin{bmatrix} .30 & 0 & .10 \end{bmatrix} \end{matrix} \qquad \begin{bmatrix} 1.47 & .05 & .16 \end{bmatrix}$$

23. **(a)** $\begin{matrix} \\ S \\ C \end{matrix}\begin{matrix} \begin{matrix} S & C \end{matrix} \\ \begin{bmatrix} .20 & .30 & .20 \\ .10 & .20 & .05 \end{bmatrix} \end{matrix}$ **(b)** $\begin{bmatrix} .49 & 1.54 & .38 \\ .26 & .33 & 1.15 \end{bmatrix}$ **(c)** Wood: $1.99; steel: $7.41; coal: $3.88 **(d)** Wood: $0.98; steel: $3.39; coal: $1.87

$$\begin{matrix} \\ W \end{matrix}\begin{matrix} \begin{matrix} W & S & C \end{matrix} \\ \begin{bmatrix} .30 & 0 & .10 \end{bmatrix} \end{matrix} \qquad \begin{bmatrix} 1.47 & .05 & .16 \end{bmatrix}$$

24. **(a)** $\begin{matrix} \\ S \\ C \end{matrix}\begin{matrix} \begin{matrix} S & C \end{matrix} \\ \begin{bmatrix} .20 & .30 & .20 \\ .10 & .20 & .05 \end{bmatrix} \end{matrix}$ **(b)** $\begin{bmatrix} .49 & 1.54 & .38 \\ .26 & .33 & 1.15 \end{bmatrix}$ **(c)** Wood: $437; steel: $864; coal: $1071 **(d)** Wood: $237; steel: $564; coal: $271 **25.** Manufacturing: $398 million; transportation: $313 million; agriculture: $452 million

$$\begin{matrix} \\ A \end{matrix}\begin{matrix} \begin{matrix} A & E & M \end{matrix} \\ \begin{bmatrix} .08 & .15 & .25 \end{bmatrix} \end{matrix} \qquad \begin{bmatrix} 1.19 & .25 & .34 \end{bmatrix}$$

26. **(a)** $\begin{matrix} \\ E \\ M \end{matrix}\begin{matrix} \begin{matrix} E & M \end{matrix} \\ \begin{bmatrix} .10 & .14 & .12 \\ .20 & .10 & .05 \end{bmatrix} \end{matrix}$ **(b)** $\begin{bmatrix} .18 & 1.22 & .20 \\ .27 & .18 & 1.15 \end{bmatrix}$ **(c)** Agriculture: $6.18 billion; energy: $4.75 billion; manufacturing: $3.91 billion **(d)** Agriculture: $2.18 billion; energy: $1.75 billion; manufacturing: $1.91 billion **27.** Merchant: $85,000; baker: $68,000; farmer: $103,000 **28.** U.S.: $846 million; Canada: $333 million; England: $1440 million **30.** The second and third columns of $(I - A)^{-1}$ represent the increased production levels required by $1 billion increases in the final demand for steel and electricity, respectively.

31. $\begin{bmatrix} 11.91 \\ 15.83 \\ 9.57 \\ 7.26 \end{bmatrix}$ **32.** $\begin{bmatrix} 11.61 \\ 8.17 \\ 5.09 \\ 13.32 \end{bmatrix}$

Chapter 2: Answers to Fundamental Concept Check Exercises, page 93

1. Values of $x, y, z, \ldots$ that satisfy each equation in the system **2.** Rectangular array of numbers **3. (a)** Interchange any two equations (or rows). **(b)** Multiply an equation (or row) by a nonzero number. **(c)** Change an equation (or row) by adding to it a multiple of another equation (or row). **4.** System of equations: $x = c_1$; $y = c_2$; ⋱; Matrix: all entries on the main diagonal are 1; all entries off the main diagonal are zero **5.** Use elementary row operations to make the entry have value 1, and make the other entries in its column have value 0. **6. (a)** Create a matrix corresponding to the system of linear equations. **(b)** Attempt to put the matrix into diagonal form as described in the box following Example 1 of Section 2.2. **(c)** If the matrix cannot be put into diagonal form, follow the first step in the box following Example 3 of Section 2.2. **(d)** Write the system of linear equations corresponding to the matrix, and read off the solution(s). **7.** Row matrix: a matrix consisting of a single row (that is, a $1 * n$ matrix); Column matrix: a matrix consisting of a single column (that is, an $m * 1$ matrix); Square matrix: a matrix having the same number of columns as rows (that is,
an $n * n$ matrix); Identity matrix: a square matrix having 1s on the main diagonal and 0s elsewhere **8.** The entry in the i^{th} row and j^{th} column **9.** For two matrices of the same size, the sum (difference) is the matrix obtained by adding (subtracting) the corresponding entries of the two matrices. **10.** For two matrices A and B, where the number of columns of A is the same as the number of rows of B, the matrix AB is the matrix having the same number of rows as A and the same number of columns as B whose ij^{th} entry is obtained by adding the products of the corresponding entries of the i^{th} row of A with the j^{th} column of B. **11.** The *scalar product* of the number c and the matrix A is the matrix obtained by multiplying each element of A by c. **12.** The *inverse* of the square matrix A is the matrix

whose product with A is an identity matrix. **13.** The inverse of $\begin{bmatrix} a & b \\ c & d \end{bmatrix}$ is $\frac{1}{D}\begin{bmatrix} d & -b \\ -c & a \end{bmatrix}$, where $D = ad - bc$ and $D \neq 0$. **14.** Write the matrix form ($AX = B$) of the system of linear equations. If the matrix A has an inverse, then the solution of the system of linear equations is given by the entries of the matrix $A^{-1}B$. **15.** Adjoin an identity matrix to the right of the matrix A and then apply the Gauss–Jordan elimination method to the entire matrix until its left side is an identity matrix if possible. The new right side of the matrix will be the inverse of A. **16.** A square matrix whose ij^{th} entry is the amount of input from the i^{th} industry required to produce one unit of the j^{th} industry; A column matrix whose i^{th} element is the amount of units demanded from the i^{th} industry **17.** If A is an input–output matrix and D is a consumer-demand matrix, then the i^{th} entry of the matrix $(I - A)^{-1}D$ gives the amount of input required from the i^{th} industry to meet the final demand.

Chapter 2: Review Exercises, page 93

1. $\begin{bmatrix} 1 & -2 & \frac{1}{3} \\ 0 & 8 & \frac{16}{3} \end{bmatrix}$ **2.** $\begin{bmatrix} 1 & 0 & 1 \\ 2 & 1 & 0 \\ -12 & 0 & 7 \end{bmatrix}$ **3.** $x = 4, y = 5$ **4.** $x = 50, y = 2, z = -12$ **5.** $x = -1, y = \frac{3}{2}, z = \frac{3}{5}$ **6.** No solution

7. z = any value, $x = 1 - 3z$, $y = 4z$, $w = 5$ **8.** $x = 7, y = 3$ **9.** $\begin{bmatrix} 5 \\ 3 \\ 7 \end{bmatrix}$ **10.** $\begin{bmatrix} 6 & 17 \\ 12 & 26 \end{bmatrix}$ **11.** $\begin{bmatrix} 6 & -\frac{9}{2} \\ \frac{3}{2} & 0 \end{bmatrix}$ **12.** $\begin{bmatrix} .6 & -10 \\ 4 & 11 \\ -1 & 3 \end{bmatrix}$

13. 5 **14.** 4 **15.** $x = -2, y = 3$ **16.** **(a)** $x = 13, y = 23, z = 19$ **(b)** $x = -4, y = 13, z = 14$

17. $\begin{bmatrix} 1 & -1 \\ \frac{1}{2} & -1 \end{bmatrix}$

18. $\begin{bmatrix} 5 & -1 & -1 \\ -3 & 1 & 0 \\ -1 & 0 & 1 \end{bmatrix}$ **19.** Corn: 500 acres; wheat: 0 acres; soybeans: 500 acres **20.** **(a)** $\begin{bmatrix} 5455 \\ 5275 \end{bmatrix}$; total month's costs for each store **(b)** $\begin{bmatrix} 6600 \\ 6360 \end{bmatrix}$; total month's revenue for each store **(c)** $\begin{bmatrix} 35 \\ 15 \\ 40 \end{bmatrix}$; profit for each piece of equipment **(d)** $\begin{bmatrix} 1145 \\ 1085 \end{bmatrix}$; total month's profit for each store

21. **(a)** [10,100 8230 4670]; total amount invested in bonds, stocks, and the conservative fixed income fund, respectively **(b)** [522.40 1807.30]; total returns on the investments for one year and five years, respectively **(c)** [10,000 16,000 20,000]; the result of doubling the amounts invested **(d)** The total amount invested in stocks is \$8230. **(e)** The total return after one year is \$522.40.

22. **(a)** $AB = \begin{bmatrix} 328 \\ 336 \\ 323 \\ 326 \end{bmatrix}$; Sara earned \$328, Quinn earned \$336, Tamia earned \$323, and Zack earned \$326. **(b)** Most: Quinn; least: Tamia **(c)** Quinn and Zack both earned \$329. **(d)** 30 hours **23.** 4 apples, 9 bananas, 5 oranges **24.** **(a)** *A*: 9400, 8980; *B*: 7300, 7510 **(b)** *A*: 10,857, 12,082; *B*: 6571, 5959 **25.** Industry I: 20; industry II: 20 **26.** 4 **27.** **(a)** True **(b)** False **(c)** True **28.** **(a)** True **(b)** False