

# Chapter 4 Answers

## Practice 4-1

1.  $3 \times 1; -3$  2.  $3 \times 4; 5$  3.  $2 \times 3; 12$  4.  $3 \times 3; q$   
 5.  $3 \times 2; 4$  6.  $1 \times 4; -4$   
 7.  $\begin{bmatrix} 17.6 & 8.3 & 5.4 & 8.7 & 4.0 & 6.6 & 3.5 \\ 9.5 & 5.1 & 4.5 & 6.4 & 2.6 & 5.1 & 2.7 \end{bmatrix}$   
 8.  $2 \times 7$  9. 9.5; percent unemployment in construction in June, 1996 10. 6.6; percent unemployment in services in June, 1992 11. Answers may vary.

Sample:  $M = \begin{bmatrix} 3900 & 3300 \\ 400 & 150 \\ 100 & 50 \end{bmatrix}$  12.  $3 \times 2$

13. number of days lost to strikes per 1,000 employees in Greece in the given years 14. number of days lost to strikes per 1,000 employees in the United States from 1990 to 1994

## Practice 4-2

1.  $a = 5; b = -\frac{7}{2}; c = 12; d = 7$  2.  $c = \frac{5}{3}; y = -7;$   
 $x = 4; z = \frac{7}{2}; a = -3; b = 0$  3.  $x = 3; z = -2$

4.  $M = \begin{bmatrix} 37 & 56 \\ 0 & 76 \\ 87 & 102 \\ 6 & 27 \end{bmatrix}; F = \begin{bmatrix} 23 & 58 \\ 93 & 82 \\ 0 & 34 \\ 18 & 29 \end{bmatrix}$

5.  $M - F = \begin{bmatrix} 14 & -2 \\ -93 & -6 \\ 87 & 68 \\ -12 & -2 \end{bmatrix}$  6.  $\begin{bmatrix} -2 & 3 \\ 2 & 0 \end{bmatrix}$

7.  $\begin{bmatrix} 8 & -5 & -6 \\ 3 & -8 & 12 \\ 4 & -12 & -18 \end{bmatrix}$  8.  $\begin{bmatrix} -2 & 2 \\ -6 & 5 \\ -4 & -2 \end{bmatrix}$  9.  $\begin{bmatrix} -7 \\ -4 \\ 23 \end{bmatrix}$

10.  $\begin{bmatrix} 8 & 11 \\ 13 & 14 \\ 4 & 11 \end{bmatrix}$  11.  $\begin{bmatrix} -27 & 101 & -2 \\ -19 & 93 & -1 \\ -8 & -1 & 20 \end{bmatrix}$  12.  $\begin{bmatrix} -1 & -4 \\ 0 & 4 \end{bmatrix}$

13.  $\begin{bmatrix} 0 & -4 & 3 \\ -4 & -2 & 5 \end{bmatrix}$  14. not equal; dimensions are different

15. equal; dimensions and corresponding elements are equal

## Practice 4-3

1. product undefined 2.  $\begin{bmatrix} 6 & -2 \\ 6 & 0 \end{bmatrix}$  3.  $\begin{bmatrix} 4 & 1 \\ -3 & 7 \end{bmatrix}$

4. difference undefined 5.  $\begin{bmatrix} 4 & -1 \\ 3 & 1 \end{bmatrix}$  6.  $\begin{bmatrix} 1 & -1 \\ 3 & -2 \end{bmatrix}$

7. product undefined 8.  $\begin{bmatrix} 0 & 2 \\ -2 & 1 \\ -1 & 0 \end{bmatrix}$  9. product undefined

10.  $\begin{bmatrix} 16 \\ 20 \end{bmatrix}$  11.  $\begin{bmatrix} 3 & -3 & -1 \\ 2 & -2 & 4 \end{bmatrix}$

12. product undefined 13.  $\begin{bmatrix} 7 & 3 \\ 0 & 2 \end{bmatrix}$  14.  $\begin{bmatrix} 2 & 0 \\ 0 & 2 \end{bmatrix}$

15. product undefined 16.  $\begin{bmatrix} 0 & 0.4 \\ -0.4 & 0.2 \\ -0.2 & 0 \end{bmatrix}$

17.  $\begin{bmatrix} \frac{3}{4} & -\frac{3}{4} & -\frac{1}{4} \\ \frac{1}{2} & -\frac{1}{2} & 1 \end{bmatrix}$  18.  $\begin{bmatrix} 0.5 & -0.5 & -2.5 \\ 2.5 & -2.5 & -5.5 \end{bmatrix}$

19. product undefined 20. product undefined

21.  $3 \times 4; \begin{bmatrix} 1 & 2 & 3 & 4 \\ 2 & 4 & 6 & 8 \\ 3 & 6 & 9 & 12 \end{bmatrix}$  22.  $2 \times 2; \begin{bmatrix} 71 & 34 \\ 49 & 56 \end{bmatrix}$

23.  $2 \times 2; \begin{bmatrix} 4 & 5 \\ 5 & 4 \end{bmatrix}$  24.  $\begin{bmatrix} 72 & 24 \\ 60 & 72 \\ 0 & -12 \end{bmatrix}$

25.  $\begin{bmatrix} -13 & 19 & -8 \\ -24 & 42 & -14 \\ -5 & 8 & -3 \end{bmatrix}$  26.  $\begin{bmatrix} -1 & 1 & 1 \\ -6 & 5 & 5 \end{bmatrix}$  27.  $\begin{bmatrix} 11 & 10 \\ 11 & 10 \\ 11 & 10 \end{bmatrix}$

28.  $\begin{bmatrix} 8 & 14 & 14 & 12 \\ 16 & 8 & 8 & 10 \\ 18 & 18 & 20 & 14 \end{bmatrix}$  29.  $\begin{bmatrix} 51 & 24 \\ 117 & 55 \end{bmatrix}$  30.  $\begin{bmatrix} -3 & \frac{8}{3} \\ \frac{5}{3} & -2 \end{bmatrix}$

31.  $\begin{bmatrix} 2 & 2 \\ 4 & \frac{20}{3} \end{bmatrix}$

## Practice 4-4

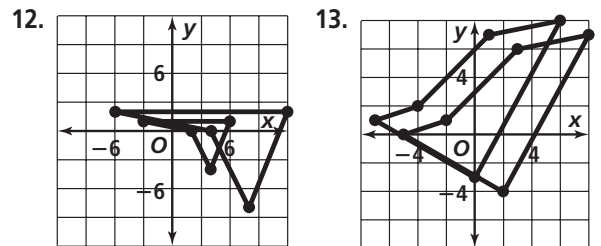
1.  $\begin{bmatrix} 44 & 44 & -33 \\ 22 & -22 & 0 \end{bmatrix}$  2.  $\begin{bmatrix} 5 & 5 & -2 \\ 6 & 2 & 4 \end{bmatrix}$

3.  $\begin{bmatrix} 6 & 6 & -4.5 \\ 3 & -3 & 0 \end{bmatrix}$  4.  $\begin{bmatrix} 6 & 6 & -1 \\ -4 & -8 & -6 \end{bmatrix}$

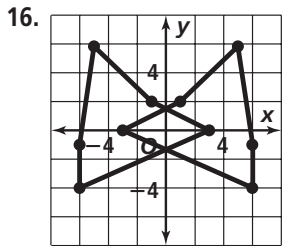
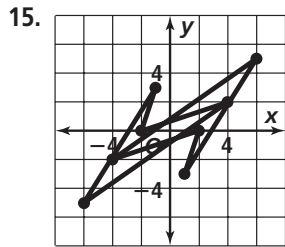
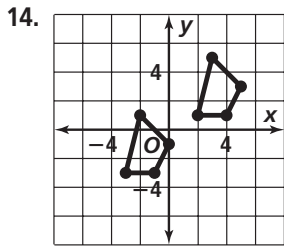
5.  $\begin{bmatrix} 2 & -2 & 0 \\ 4 & 4 & -3 \end{bmatrix}$  6.  $\begin{bmatrix} 2 & -2 & 0 \\ -4 & -4 & 3 \end{bmatrix}$

7.  $\begin{bmatrix} -2 & 2 & 0 \\ 4 & 4 & -3 \end{bmatrix}$  8.  $\begin{bmatrix} 3 & 3 & -4 \\ 0 & -4 & -2 \end{bmatrix}$  9.  $\begin{bmatrix} 1 & 1 & -6 \\ 3 & -1 & 1 \end{bmatrix}$

10.  $\begin{bmatrix} 2 & 2 & -1.5 \\ 1 & -1 & 0 \end{bmatrix}$  11.  $\begin{bmatrix} 4 & 4 & -3 \\ -2 & 2 & 0 \end{bmatrix}$



# Chapter 4 Answers (continued)



17.  $\frac{1}{7} \begin{bmatrix} 21 & 0 & -14 & 0 \\ -14 & -7 & 0 & 7 \end{bmatrix} = \begin{bmatrix} 3 & 0 & -2 & 0 \\ -2 & -1 & 0 & 1 \end{bmatrix}$

18.  $\begin{bmatrix} 2 & 0 & -2 \\ 0 & -2 & 0 \end{bmatrix} + \begin{bmatrix} 0 & 0 & 0 \\ -2 & -2 & -2 \end{bmatrix} = \begin{bmatrix} 2 & 0 & -2 \\ -2 & -4 & -2 \end{bmatrix}$

19.  $\begin{bmatrix} 0 & -1 \\ -1 & 0 \end{bmatrix} \begin{bmatrix} 2 & 0 & -2 \\ 0 & -2 & 0 \end{bmatrix} = \begin{bmatrix} 0 & 2 & 0 \\ -2 & 0 & 2 \end{bmatrix}$

## Practice 4-5

1.  $\begin{bmatrix} 1 & 1 \\ \frac{1}{2} & 1 \end{bmatrix}$  2.  $\begin{bmatrix} \frac{1}{2} & \frac{1}{2} \\ -\frac{1}{2} & \frac{1}{2} \end{bmatrix}$  3.  $\begin{bmatrix} 0 & 1 \\ -1 & 2 \end{bmatrix}$  4.  $\begin{bmatrix} -1 & 3 \\ 1 & -2 \end{bmatrix}$

5.  $\begin{bmatrix} -3 & 4 \\ 1 & -1 \end{bmatrix}$  6.  $\begin{bmatrix} -5 & 7 \\ 3 & -4 \end{bmatrix}$  7.  $\begin{bmatrix} \frac{1}{6} & -\frac{1}{6} \\ \frac{1}{8} & \frac{1}{8} \end{bmatrix}$

8. No inverse; the determinant of the matrix is zero.

9.  $\begin{bmatrix} -2 & 1 \\ \frac{3}{2} & -\frac{1}{2} \end{bmatrix}$  10.  $\begin{bmatrix} -\frac{3}{10} & -\frac{2}{5} \\ -\frac{5}{2} & -3 \end{bmatrix}$

11. no inverse, cannot be solved 12.  $\begin{bmatrix} 1 \\ 2 \end{bmatrix}$  13.  $\begin{bmatrix} 3 \\ 4 \end{bmatrix}$

14. -1 15. -21 16. 14 17. -29 18. 9 19. 36

20. yes 21. yes 22. yes

## Practice 4-6

1.  $\begin{bmatrix} 3 & 10 & 6 \\ -1 & -5 & -3 \\ -2 & -7 & -4 \end{bmatrix}$  2.  $\begin{bmatrix} 3 & -1 & -1 \\ -6 & 3 & 2 \\ 4 & -2 & -1 \end{bmatrix}$

3.  $\begin{bmatrix} -9 & 11 & 19 \\ 1 & -1 & -2 \\ 5 & -6 & -10 \end{bmatrix}$  4. no inverse

5.  $\begin{bmatrix} 0.65 & -1.45 & -0.2 \\ -0.8 & 1.4 & 0.4 \\ 0.4 & -0.2 & -0.2 \end{bmatrix}$  6. no inverse

7.  $\begin{bmatrix} -0.6 & 0 & -0.2 \\ 0 & -0.5 & 0 \\ -0.4 & 0 & 0.2 \end{bmatrix}$  8.  $\begin{bmatrix} -0.\bar{4} & -0.\bar{4} & -0.\bar{1} \\ 0.\bar{2} & 0.\bar{5} & 0.\bar{2} \\ -0.\bar{1} & 0.\bar{2} & -0.\bar{1} \end{bmatrix}$

9.  $\begin{bmatrix} 4 \\ -5 \\ 3 \end{bmatrix}$  10.  $\begin{bmatrix} -3 \\ 1 \\ -2 \end{bmatrix}$  11. no inverse, cannot be solved

12. 39 13. -47 14. -7 15. 9 16. 26 17. -42

18. no 19. yes

## Practice 4-7

1. (0.251, 0.3, 0.07) 2. (0.7, -0.3, -0.2) 3. (1, 5, -5)  
4. (2, 1) 5. (2, 1, -9) 6. (3, 2) 7. (-5, 15, 21) 8. (-1, 0)  
9. (0, 6, 2.8) 10. (-2, -1) 11. (-1, 7, -3) 12. (4, 2, -8)

	coefficient	variable	constant
13.	$\begin{bmatrix} 6 & 9 \\ 4 & 13 \end{bmatrix}$	$\begin{bmatrix} x \\ y \end{bmatrix}$	$= \begin{bmatrix} 36 \\ 2 \end{bmatrix}$

14.	$\begin{bmatrix} 3 & -4 \\ 0 & 7 \end{bmatrix}$	$\begin{bmatrix} x \\ y \end{bmatrix}$	$= \begin{bmatrix} -9 \\ 24 \end{bmatrix}$
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15.	$\begin{bmatrix} 4 & 0 & -1 \\ 12 & 2 & 0 \\ 1 & -1 & 12 \end{bmatrix}$	$\begin{bmatrix} x \\ y \\ z \end{bmatrix}$	$= \begin{bmatrix} 9 \\ 17 \\ 3 \end{bmatrix}$
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16.  $\begin{cases} x + y = 548,303 \\ 0.2553415x + 0.1167209y = 110,017 \end{cases}$   
(331,975.0482, 216,327.9518); about 331,975 doctors

17.  $\begin{cases} x + y = 50 \\ 425x + 550y = 25,000 \end{cases}$ ; (20, 30);  
20 one-bedroom and 30 two-bedroom apartments

18.  $\left(\frac{3}{17}, -\frac{33}{17}\right)$  19.  $\left(8, \frac{4}{3}\right)$  20. no unique solution

21. (4, -32) 22.  $\det A = 10$ , has a unique solution

23.  $\det A = 0$ , no unique solution 24.  $\det A = -5$ , has a unique solution

## Practice 4-8

1.  $\begin{cases} 4x - 2y = 3 \\ 6x + 11y = 9 \end{cases}$  2.  $\begin{cases} 12x + 6y = -4 \\ -x = 2 \end{cases}$

3.  $\begin{cases} -2x + 9y - 2z = 20 \\ 3x - y + 2z = 29 \\ 6x + 5y + 5z = -4 \end{cases}$  4. (2, -3) 5. (6, 2)

6. (-3, 2) 7. (0.9, 0.08, 0.3) 8. (0.25, 0.75, 0.5) 9. (3, 1, -2)

10.  $\begin{bmatrix} -3 & 4 & -8 \\ 2 & -8 & 16 \end{bmatrix}$  11.  $\begin{bmatrix} 1 & 3 & -30 \\ 4 & 1 & 1 \end{bmatrix}$

12.  $\begin{bmatrix} 1 & -4 & 1 \\ 3 & 2 & -3 \\ 4 & 0 & 2 \end{bmatrix} \begin{bmatrix} -9 \\ 9 \\ -4 \end{bmatrix}$  13. (-6, -8, 14) 14. (9, -3, -6)

15. (7, 1, 0) 16. (2, 6, -4) 17. (-1, 7, 0.5) 18. (-4, 3, 9)

19. (5, 8, -2) 20. (1, 7, -9) 21. (-2, 3, 5)

# Chapter 4 Answers (continued)

## Reteaching 4-1

- Answers may vary. Check students' work.
- Trial 1 2 3 4  
Left  $\begin{bmatrix} 36 & 24 & 26 & 55 \end{bmatrix}$   
Right  $\begin{bmatrix} 15 & 43 & 22 & 46 \end{bmatrix}$
- Check students' work.

## Reteaching 4-2

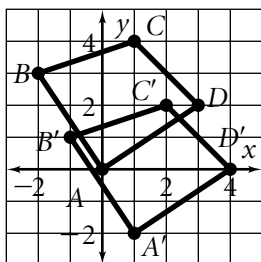
- $\begin{bmatrix} -2 & 3 \\ 14 & -2 \end{bmatrix}$  2.  $\begin{bmatrix} -5 & 1 \\ 1 & 2 \end{bmatrix}$  3.  $\begin{bmatrix} -1 & -1 \\ 1 & -2 \end{bmatrix}$
- $\begin{bmatrix} 1 & 1 & -1 \\ -3 & 1 & -5 \end{bmatrix}$  5.  $\begin{bmatrix} -16 & -1 & -4 \\ 7 & -7 & -6 \end{bmatrix}$  6.  $\begin{bmatrix} 4.5 & 5.5 \\ 3 & 11.5 \end{bmatrix}$
- $\begin{bmatrix} -9 & -6 \\ 0 & 1 \\ 8 & 5 \end{bmatrix}$  8.  $\begin{bmatrix} 5 & 5 \\ 12 & 4 \\ -17 & -2 \end{bmatrix}$  9.  $\begin{bmatrix} -9 & 7 \\ 3.5 & -6.5 \\ 1.5 & 0 \\ -3.5 & 5 \end{bmatrix}$
- $\begin{bmatrix} -5 & -3 & 8 \\ 3 & -2 & -4 \\ 7 & -5 & 6 \end{bmatrix}$

## Reteaching 4-3

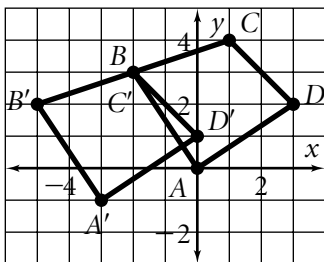
- $\begin{bmatrix} 1 & 3 \\ -6 & 17 \end{bmatrix}$  2.  $\begin{bmatrix} 0 & 26 \\ -8 & 3 \\ -13 & 33 \\ -7 & 32 \end{bmatrix}$  3.  $[8 \ 5 \ 4]$

## Reteaching 4-4

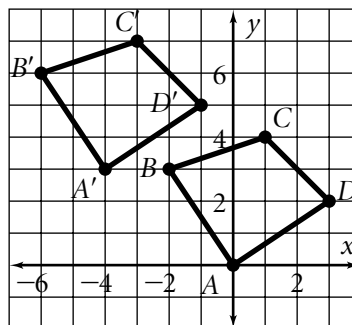
- $A'B'C'D' = \begin{bmatrix} 1 & -1 & 2 & 4 \\ -2 & 1 & 2 & 0 \end{bmatrix}$



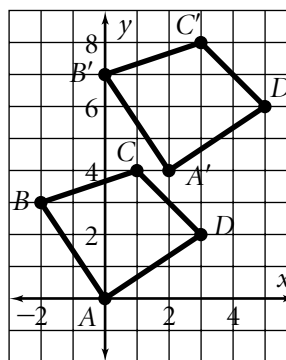
- $A'B'C'D' = \begin{bmatrix} -3 & -5 & -2 & 0 \\ -1 & 2 & 3 & 1 \end{bmatrix}$



$$3. A'B'C'D' = \begin{bmatrix} -4 & -6 & -3 & -1 \\ 3 & 6 & 7 & 5 \end{bmatrix}$$



$$4. A'B'C'D' = \begin{bmatrix} 2 & 0 & 3 & 5 \\ 4 & 7 & 8 & 6 \end{bmatrix}$$



## Reteaching 4-5

- $\begin{bmatrix} 3 & 2 \\ 7 & 5 \end{bmatrix}$  2.  $\begin{bmatrix} -1 & 2 \\ -5 & 9 \end{bmatrix}$  3.  $\begin{bmatrix} 7 & -4 \\ -5 & 3 \end{bmatrix}$  4. no inverse
- $\begin{bmatrix} -8 & 17 \\ 1 & 2 \end{bmatrix}$  6.  $\begin{bmatrix} 1 & -2 \\ -3 & 7 \end{bmatrix}$  7.  $\begin{bmatrix} 1/4 & 3/4 \\ 1/4 & 7/4 \end{bmatrix}$
- no inverse 9.  $\begin{bmatrix} -3 & 2 \\ 5 & -3 \end{bmatrix}$

## Reteaching 4-6

- 6 2. -21 3. 14 4. -50 5. 17 6. -3

## Reteaching 4-7

- (2, 1) 2. (2, 1) 3. (-1, 0) 4. no unique solution

## Reteaching 4-8

- (-1, -1) 2. (-1, -2) 3. (-4, -14)

## Enrichment 4-1

I think and think for months and years. Ninety-nine times, the conclusion is false. The hundredth time I am right.  
—Albert Einstein

# Chapter 4 Answers (continued)

## Enrichment 4-2

EUCLID OHIO

$$\begin{bmatrix} 3 & 0 \\ 4 & -7 \\ 2 & -8 \end{bmatrix}; \begin{bmatrix} 1 & 5 & 11 \\ -1 & 4 & 6 \\ 0 & 3 & 5 \end{bmatrix}; \begin{bmatrix} -1 & 6 & -2 \\ 0 & 10 & -2 \end{bmatrix};$$

$$\begin{bmatrix} 3 & -6 & 8 & 5 \\ 2 & 4 & 4 & 2 \\ 0 & -3 & 11 & -4 \end{bmatrix}; \begin{bmatrix} -4 & -3 & 0 & 2 \\ 5 & 5 & 2 & -1 \\ 1 & 1 & -6 & -6 \end{bmatrix};$$

$$\begin{bmatrix} -1 & -2 & 0 \\ 1 & -1 & -1 \\ 10 & -2 & -1 \end{bmatrix}; \begin{bmatrix} 4 & -2 & -4 & -3 & 7 \\ 7 & 1 & 0 & -3 & 10 \\ 2 & 3 & -3 & 1 & 1 \end{bmatrix};$$

$$\begin{bmatrix} 4 & 3 & -7 & 4 \\ 3 & -2 & 0 & -2 \\ 4 & 9 & -3 & 6 \end{bmatrix}; \begin{bmatrix} -2 & 1 & 3 \\ -7 & -2 & 2 \\ 5 & 0 & -3 \end{bmatrix};$$

$$\begin{bmatrix} -1 & 5 & 0 & -4 \\ 2 & -5 & -1 & 5 \\ 5 & -4 & 3 & 2 \end{bmatrix}$$

## Enrichment 4-3

1. The number of rows must be the same as the number of columns; so it can be multiplied by itself;

$$\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}; \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}; \text{A nonzero matrix may be nilpotent.}$$

$$2. \begin{bmatrix} a^2 + bc & ab + bd \\ ac + cd & bc + d^2 \end{bmatrix}$$

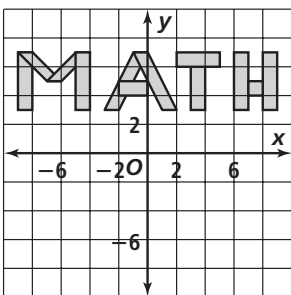
$$3. a^2 + bc = 0; ab + bd = 0; ac + cd = 0; bc + d^2 = 0$$

$$4. b(a + d) = 0 \quad 5. b = 0; a + d = 0$$

$$6. a^2 = 0, \text{ so } a = 0; d^2 = 0, \text{ so } d = 0$$

$$7. A = \begin{bmatrix} 0 & 0 \\ c & 0 \end{bmatrix}; A^2 = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix} \quad 8. \begin{bmatrix} 0 & b \\ 0 & 0 \end{bmatrix}$$

## Enrichment 4-4



## Enrichment 4-5

$$1. ad - bc \quad 2. eh - fg \quad 3. adeh + bcfg - bceh - adfg$$

$$4. \begin{bmatrix} ae + bg & af + bh \\ ce + dg & cf + dh \end{bmatrix}$$

$$5. (ae + bg)(cf + dh) - (af + bh)(ce + dg) = adeh + bcfg - bceh - adfg$$

$$6. \det(AB) = \det A \cdot \det B$$

7. The determinant of the product of two matrices is equal to the product of the determinants.

8.  $\det I; 1; \frac{1}{\det A}$  9. The determinant of the inverse of a matrix is equal to the reciprocal (inverse) of the determinant of the original matrix.

## Enrichment 4-6

$$1. \det A = a_1(b_2c_3 - b_3c_2) - b_1(a_2c_3 - a_3c_2) + c_1(a_2b_3 - a_3b_2) \\ = a_1b_2c_3 - a_1b_3c_2 - a_2b_1c_3 + a_3b_1c_2 + a_2b_3c_1 - a_3b_2c_1 \\ = a_1b_2c_3 + a_2b_3c_1 + a_3b_1c_2 - (a_1b_3c_2 + a_2b_1c_3 + a_3b_2c_1)$$

$$2. 25 \quad 3. 0 \quad 4. \text{Answers may vary. Sample: } \begin{bmatrix} 1 & 2 & 3 \\ 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix}; 0$$

$$5. \text{Answers may vary. Sample: } \begin{bmatrix} 1 & 2 \\ 1 & 2 \end{bmatrix}; 0$$

6. Its determinant is zero.

## Enrichment 4-7

1. Let  $b$  equal the weight of the bread in the sandwich. Let  $m$  equal the weight of the meat in the sandwich. Let  $c$  equal the weight of the cheese in the sandwich. The three equations are:

$$\begin{cases} b + m + c = 12 \\ 0.6b + 3m + 1.5c = 1.50(12) \\ 10b + 50m + 40c = 30(12) \end{cases}$$

5 lb bread; 3 lb meat; 4 lb cheese

2. Let  $c$ ,  $r$ , and  $s$  represent the number of pounds of chicken, rice and shellfish, respectively. The three equations are:

$$\begin{cases} c + r + s = 18 \\ 1c + 0.5r + 3s = 19 \\ 100c + 20r + 50s = 850 \end{cases}$$

10 lb rice; 5 lb chicken; 3 lb shellfish

3. Let  $y$ ,  $t$ , and  $b$  represent the price per pound of frozen yogurt, topping, and bananas, respectively.

The three equations are:

$$\begin{cases} 2b + 3t + 4y = 19 \\ -t + y = 1 \\ -4b - \frac{1}{2}t + y = 0 \end{cases}$$

frozen yogurt: \$3.00/lb; topping: \$2.00/lb; bananas: \$.50/lb

4. Let  $b$ ,  $y$ , and  $t$  represent the number of calories per pound in bananas, frozen yogurt, and topping, respectively. The three equations are:

$$\begin{cases} 2b + 3t + 4y = 5400 \\ \frac{1}{2}t - y = 0 \\ 5b - 2t + 2y = 0 \end{cases}$$

frozen yogurt: 500 cal; topping: 1000 cal; bananas: 200 cal

# Chapter 4 Answers (continued)

## Enrichment 4-8

1a. 2600, 2400

1b.  $\begin{cases} 1.01x + y = 5000 \\ 3x - 2y = 3000 \end{cases}; 2589.64, 2384.46$

1c.  $\begin{cases} x + 0.99y = 5000 \\ 3x - 2y = 3000 \end{cases}; 2609.66, 2414.49$

1d.  $\begin{cases} x + y = 5000 \\ 3.03x - 2y = 3000 \end{cases}; 2584.49, 2415.51$

1e.  $\begin{cases} x + y = 5000 \\ 3x - 2.02y = 3000 \end{cases}; 2609.56, 2390.44$

1f. well-conditioned

2a. 1, 5000

2b.  $\begin{cases} 1.01x + y = 5001 \\ 3x - 2y = -9997 \end{cases}; 1.00, 4999.99$

2c.  $\begin{cases} x + 0.99y = 5001 \\ 3x - 2y = -9997 \end{cases}; 21.12, 5030.18$

2d.  $\begin{cases} x + y = 5001 \\ 3.03x - 2y = -9997 \end{cases}; 0.99, 5000.01$

2e.  $\begin{cases} x + y = 5001 \\ 3x - 2.02y = -9997 \end{cases}; 20.92, 4980.08$

2f. ill-conditioned

## Chapter Project

### Activity 1: Organizing

	B	T	E	X	
1	$\begin{bmatrix} 0.06 \\ 0.06 \\ 0.35 \\ 0.22 \\ 0.11 \end{bmatrix}$	$\begin{bmatrix} 0.95 \\ 1.05 \\ 6 \\ 0.19 \\ 0.82 \end{bmatrix}$	$\begin{bmatrix} 0.9 \\ 0.73 \\ 5.6 \\ 2 \\ 2.5 \end{bmatrix}$	$\begin{bmatrix} 18.5 \\ 13.5 \\ 49 \\ 19.5 \\ 26 \end{bmatrix}$	; Check students' work.
2					
3					
4					
5					

### Activity 2: Calculating

combined amounts (mg/kg): 20.41, 15.34, 60.95, 21.91, 29.43

	B	T	E	X
1	$\begin{bmatrix} 0.01 \\ 0.01 \\ 0.30 \\ 0.17 \\ 0.06 \end{bmatrix}$	$\begin{bmatrix} 0.90 \\ 1.00 \\ 5.95 \\ 0.14 \\ 0.77 \end{bmatrix}$	$\begin{bmatrix} 0.85 \\ 0.68 \\ 5.55 \\ 1.95 \\ 2.45 \end{bmatrix}$	$\begin{bmatrix} 18.45 \\ 13.45 \\ 48.95 \\ 19.45 \\ 25.95 \end{bmatrix}$
2				
3				
4				
5				

### Activity 3: Researching

Check students' work.

## ✓ Checkpoint Quiz 1

1.  $2 \times 2; 4$  2.  $1 \times 3; 6$  3.  $3 \times 3; 0$

4.  $\begin{bmatrix} 12 & -1 \\ 10 & 5 \\ -5 & 4 \end{bmatrix}$  5.  $\begin{bmatrix} -20 & 10 \\ -15 & -5 \end{bmatrix}$  6.  $\begin{bmatrix} 15 & -3 \\ 21 & 18 \\ -6 & 0 \end{bmatrix}$

7.  $\begin{bmatrix} 24 & -2 \\ 20 & 10 \\ -10 & 8 \end{bmatrix}$  8.  $\begin{bmatrix} -16 & 12 \\ 3 & 14 \end{bmatrix}$  9.  $\begin{bmatrix} -2 & -1 \\ 4 & 7 \\ 1 & -4 \end{bmatrix}$  10. C

## ✓ Checkpoint Quiz 2

1.  $A' (5, -5); B' (6, -1); C' (1, -4)$

2.  $A' (4, -12); B' (8, 4); C' (-12, -8)$

3.  $A' (1, 3); B' (2, -1); C' (-3, 2)$

4.  $A' (-3, -1); B' (1, -2); C' (-2, 3)$

5.  $\begin{bmatrix} -\frac{7}{4} & -\frac{1}{4} \\ \frac{5}{2} & \frac{1}{2} \end{bmatrix}$  6.  $\begin{bmatrix} \frac{1}{6} & -\frac{1}{3} \\ \frac{5}{6} & -\frac{2}{3} \end{bmatrix}$  7. no inverse 8.  $\begin{bmatrix} -2 \\ 3 \end{bmatrix}$

9.  $\begin{bmatrix} 5 & 4 \\ 0 & 1 \end{bmatrix}$  10.  $\begin{bmatrix} 4 \\ \frac{1}{2} \\ -\frac{1}{2} \end{bmatrix}$

## Chapter Test, Form A

1a.  $\begin{bmatrix} 85 & -34 \\ 104 & -27 \\ 107 & 7 \\ 98 & 30 \\ 103 & -18 \\ 111 & 29 \end{bmatrix}; 6 \times 2$  1b. 30 2.  $\begin{bmatrix} 2 & 7 \\ 2 & -4 \end{bmatrix}$

3.  $\begin{bmatrix} 23 & 20 & -2 \\ 29 & 12 & 30 \\ 21 & 24 & 3 \end{bmatrix}$  4.  $\begin{bmatrix} 5 & 14 \\ 6 & 12 \\ 18 & 52 \end{bmatrix}$  5.  $\begin{bmatrix} -9 & -30 \\ -63 & 12 \end{bmatrix}$

6. product undefined 7.  $\begin{bmatrix} 8 & 3 \\ 0 & 0 \end{bmatrix}$

8a.  $\begin{bmatrix} 1 & 3 & 0 \\ 1 & 4 & -5 \end{bmatrix}$  8b.  $\left(\frac{1}{2}, \frac{1}{2}\right), \left(\frac{3}{2}, 2\right), \left(0, -\frac{5}{2}\right)$

8c. (4, 3), (6, 6), (3, -3) 8d. (-1, -1), (-3, -4), (0, 5)

8e. (1, 1), (4, 3), (-5, 0) 9. -13 10. -1 11. 52

12.  $\begin{bmatrix} \frac{1}{3} & -\frac{1}{3} \\ -\frac{1}{2} & 1 \end{bmatrix}$  13. no inverse

14.  $\begin{bmatrix} -1 & -1 & 4 \\ 1 & 2 & -5 \\ 0 & -1 & 2 \end{bmatrix}$  15. no inverse 16.  $\begin{bmatrix} -11 \\ 9 \end{bmatrix}$

17.  $\begin{bmatrix} -2 & 1 \\ -2 & 1 \end{bmatrix}$  18.  $\begin{bmatrix} 7 & -2 & -6 \\ 15 & 1 & -2 \end{bmatrix}$  19.  $\begin{bmatrix} -20 & 1 \\ 26 & -1 \end{bmatrix}$

20.  $\begin{bmatrix} \frac{1}{4} & \frac{1}{2} \\ \frac{1}{2} & 1 \end{bmatrix}$  21.  $\begin{bmatrix} -\frac{3}{4} & \frac{1}{4} \\ 1 & -1 \end{bmatrix}$  22. (0, -2)

23. (-2, -3, 4) 24. (-2, -2) 25. (0, 1, 3) 26. Answers may vary. Check students' work 27. Yes; Check students' work 28.  $2 \times 4$  29. \$.75, \$1.00

# Chapter 4 Answers (continued)

## Chapter Test, Form B

1a.  $\begin{bmatrix} -80 & 100 \\ -45 & 134 \\ -2 & 109 \\ -51 & 112 \\ -50 & 116 \\ -58 & 120 \end{bmatrix}$  1b.  $6 \times 2$  1c.  $-45$

2.  $\begin{bmatrix} 2 & -5 \\ -3 & 30 \end{bmatrix}$  3.  $\begin{bmatrix} -5 & -7 \\ 5 & 2 \end{bmatrix}$

4. product undefined 5.  $\begin{bmatrix} 2 & 3 \\ 4 & 0 \end{bmatrix}$

6a.  $\begin{bmatrix} 3 & 3 & -4 \\ 1 & -8 & 1 \end{bmatrix}$  6b.  $\left(\frac{3}{4}, \frac{1}{4}\right), \left(\frac{3}{4}, -2\right), \left(-1, \frac{1}{4}\right)$

6c.  $(-1, -1), (-1, -10), (-8, -1)$

6d.  $(-1, 3), (8, 3), (-1, -4)$

6e.  $(-1, -3), (8, -3), (-1, 4)$  7.  $-2$  8. 56

9.  $\begin{bmatrix} \frac{3}{2} & -\frac{5}{8} \\ -1 & \frac{1}{2} \end{bmatrix}$  10. no inverse

11.  $\begin{bmatrix} -6 & 15 & 8 \\ 2 & -1 & 3 \end{bmatrix}$  12.  $\begin{bmatrix} -1 & -5 \\ 16 & 9 \end{bmatrix}$  13.  $\begin{bmatrix} 9 & 2 \\ -7 & -3 \end{bmatrix}$

14.  $\begin{bmatrix} -23 \\ 31 \end{bmatrix}$  15. A 16. H 17. D

18.  $\begin{bmatrix} -8 & 10 \\ 10 & -14 \end{bmatrix}; \begin{bmatrix} 1 & -7 \\ 5 & -23 \end{bmatrix};$  no

19. the identity matrix with the same dimensions

20. J 21. Child's ticket: \$8; Adult's ticket: \$12

## Alternative Assessment, Form C

### TASK 1 Scoring Guide:

- 3 Matrix is constructed correctly. Student discussion is detailed enough to indicate a clear understanding of the properties of matrices. Addition, subtraction, and multiplication operations are performed with no mistakes. Inverse matrix is correct or, if none exists, explanation is provided.
- 2 Matrix is constructed correctly. Student discussion is detailed. Addition, subtraction, and multiplication of matrices are mostly correct but contain minor errors. Inverse matrix contains minor errors or explanation is not sufficiently detailed if no inverse exists.
- 1 Matrix contains minor errors. Operations are attempted but include major errors. Inverse is not included, or explanation as to why no inverse exists is not included.
- 0 Student makes no attempt, or no response is given.

### TASK 2 Scoring Guide:

a.  $\begin{bmatrix} a & b & c & d \\ 1 & 2 & 2 & 1 \\ 4 & 4 & 3 & 3 \end{bmatrix}$  b.  $\begin{bmatrix} -2 & -2 & -2 & -2 \\ -1 & -1 & -1 & -1 \end{bmatrix}$

- c. matrix addition
- d.  $a'(-1, 3), b'(0, 3), c'(0, 2), d'(-1, 2)$
- e.  $a'(2, 8), b'(4, 8), c'(4, 6), d'(2, 6)$
- 3 Student organizes vertices correctly into matrix. Matrix of the translation is written correctly. Correct answers are provided to all questions.
- 2 Student organizes vertices correctly into matrix. Matrix of the translation is written correctly and correct answers are provided to three of the last four questions.
- 1 Student organizes vertices correctly into matrix. Translation matrix contains significant errors. Two or three of the last three questions are answered incorrectly.
- 0 Student makes no attempt, or no response is given.

### TASK 3 Scoring Guide:

a.  $\begin{bmatrix} 1 & -a \\ -\frac{1}{a^2} & \frac{2}{a} \end{bmatrix}$  b.  $A^{-1}A = AA^{-1} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

- c. No; matrix multiplication is not commutative.
- 3 Inverse matrix is correct. Multiplication of  $AA^{-1}$  and  $A^{-1}A$  gives  $I$ . Student indicates that multiplication of matrices is not commutative. Student discussion is detailed and clear enough to indicate a clear understanding of the properties of matrices.
- 2 Inverse matrix and multiplication are mostly correct but contain minor errors. Student discussion is detailed.
- 1 Inverse matrix and multiplication include errors. Two or three questions are answered incorrectly.
- 0 Student makes no attempt, or no response is given.

# Chapter 4 Answers (continued)

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## TASK 4 Scoring Guide:

a.  $(1.25, -2)$  b.  $(-3, 1.5)$  c.  $(-9, 13, 6)$  d.  $(13, 8, 12)$

- 3 Student solves all systems correctly using inverse matrices. Student shows the process for calculating the inverse and multiplying to solve  $X = A^{-1}B$ .
- 2 Student solves two systems correctly and makes minor errors in the solutions to the other systems. Student shows the process and all calculations.
- 1 Student solves one system correctly, while the others contain major errors.
- 0 Student makes no attempt, or no response is given.

## Cumulative Review

1. C 2. H 3. A 4. F 5. C 6. G 7. D 8. G 9. D 10. J

11. C 12. J 13. C 14. J 15a.  $(0, 0)$  15b.  $\left(-\frac{4}{5}, 0\right)$

16a.  $-28$  16b.  $12$  17. Answers may vary. Sample:  
preimage:  $(8, 4), (16, 8), (0, 0)$ ; image:  $(4, 2), (8, 4), (0, 0)$

18. Check students' work.