Answers for Lesson 4-1 Exercises

1. 3×3 **2.** 3×1 **3.** 1×2

4. 2×3 **5.** 4×1 **6.** 1.5

7. -3 **8.** 7 **9.** $\frac{1}{2}$

10. -2 **11.** -1

12.

	Novels	Biogr.	Sci-Fi.	Non-fiction
Week 1	175	100	93	100
Week 2	154	93	81	104
Week 3	201	110	114	103
Week 4	180	92	100	110

13.

	Week 1	Week 2	Week 3	Week 4
Novels	175	154	201	180
Biogr.	100	93	110	92
Sci-Fi.	93	81	114	100
Nonfiction	100	104	103	110

14. a.

$H =$

	Computer Instruction	Book Discussion	Parenting Skills	Employment Guidance
Urban	68	56	28	31
Suburban	59	50	24	18
Rural	49	34	15	12

b. 24; percent of suburban libraries offering parenting skills programs

15.

	1998	1999	2000	2001	2002	2003
CDs	847.0	938.9	942.5	881.9	803.3	745.9
DVDs	0.5	2.5	3.3	7.9	10.7	17.5

3.3; number of DVDs shipped in 2000

16.

	CDs	DVDs
1998	847.0	0.5
1999	938.9	2.5
2000	942.5	3.3
2001	881.9	7.9
2002	803.3	10.7
2003	745.9	17.5

881.9; number of CDs shipped in 2001

17. 2×6, 6×2

18. The student identified the data in column 3, row 2 when he or she should have looked at row 3, column 2.

19. You must include what the columns and rows represent.

20. $3 \times 3; -7$ **21.** $2 \times 3; 1$ **22.** $3 \times 3; 0$

23. $1 \times 3; 12$ **24.** $3 \times 1; 3$ **25.** $2 \times 2; 8$

26. a. Estimates may vary. Sample:

Types of CDs	Wk 1	Wk 2	Wk 3	Wk 4
Rock	165	150	200	180
R&B	100	94	110	98
Rap	96	90	110	100
Classical	98	97	97	102

b.

	Wk 1	Wk 2	Wk 3	Wk 4
Rock	165	150	200	180
R&B	100	94	110	98
Rap	96	90	110	100
Classical	98	97	97	102

Columns represent the weeks in August and rows are the type of CDs sold.

27. a.

	Job	No Job
9th gr. boys	5	95
9th gr. girls	15	90

	Job	No Job
10th gr. boys	35	65
10th gr. girls	30	55

	Job	No Job
11th gr. boys	65	35
11th gr. girls	75	30

	Job	No Job
12th gr. boys	70	25
12th gr. girls	65	45

b. 175

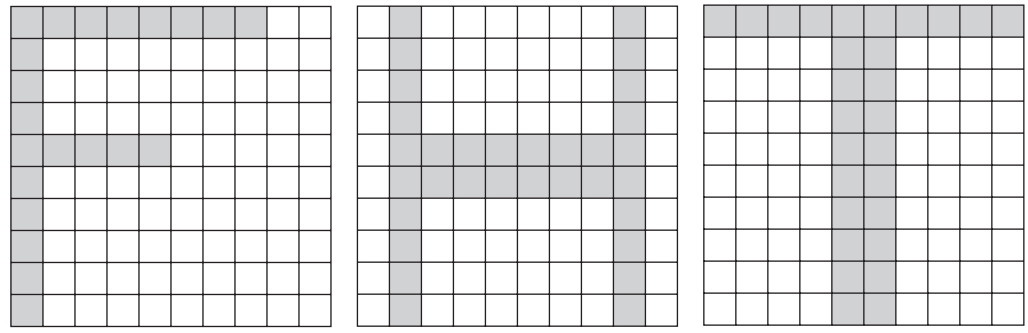
c. 185

d. about 51.4%

28.

	Atl.	Bos.	Chi.	Denv.
Atl.	0	19	12	23
Bos.	19	0	10	21
Chi.	12	10	0	15
Denv.	23	21	15	0

29. a. Answers may vary. Sample:



b. Answers may vary. Sample:

$$F = \begin{bmatrix} 1&1&1&1&1&1&1&1&0&0 \\ 1&0&0&0&0&0&0&0&0&0 \\ 1&0&0&0&0&0&0&0&0&0 \\ 1&0&0&0&0&0&0&0&0&0 \\ 1&1&1&1&1&0&0&0&0&0 \\ 1&0&0&0&0&0&0&0&0&0 \\ 1&0&0&0&0&0&0&0&0&0 \\ 1&0&0&0&0&0&0&0&0&0 \\ 1&0&0&0&0&0&0&0&0&0 \\ 1&0&0&0&0&0&0&0&0&0 \end{bmatrix} \quad T = \begin{bmatrix} 1&1&1&1&1&1&1&1&1&1 \\ 0&0&0&0&1&1&0&0&0&0 \\ 0&0&0&0&1&1&0&0&0&0 \\ 0&0&0&0&1&1&0&0&0&0 \\ 0&0&0&0&1&1&0&0&0&0 \\ 0&0&0&0&1&1&0&0&0&0 \\ 0&0&0&0&1&1&0&0&0&0 \\ 0&0&0&0&1&1&0&0&0&0 \\ 0&0&0&0&1&1&0&0&0&0 \\ 0&0&0&0&1&1&0&0&0&0 \end{bmatrix}$$

$$H = \begin{bmatrix} 0&1&0&0&0&0&0&0&1&0 \\ 0&1&0&0&0&0&0&0&1&0 \\ 0&1&0&0&0&0&0&0&1&0 \\ 0&1&0&0&0&0&0&0&1&0 \\ 0&1&1&1&1&1&1&1&1&0 \\ 0&1&1&1&1&1&1&1&1&0 \\ 0&1&0&0&0&0&0&0&1&0 \\ 0&1&0&0&0&0&0&0&1&0 \\ 0&1&0&0&0&0&0&0&1&0 \\ 0&1&0&0&0&0&0&0&1&0 \end{bmatrix}$$

Answers for Lesson 4-2 Exercises

1. a.

	Anita Allen		Mary Beth Iagorashvili
Shooting	952	Shooting	760
Fencing	720	Fencing	832
Swimming	1108	Swimming	1252
Riding	1172	Riding	1144
Running	1044	Running	1064

b. 4996; 5052

2. $\begin{bmatrix} 2 & -3 & 4 \\ 5 & 6 & -7 \end{bmatrix}$ **3.** $\begin{bmatrix} 1 & 3 \\ 4 & 0 \end{bmatrix}$ **4.** $\begin{bmatrix} 3.9 & -2.3 \\ -0.6 & 9.1 \end{bmatrix}$

5. $\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$ **6.** $\begin{bmatrix} 4 & 3 & 2 \\ 0 & -3 & 5 \end{bmatrix}$ **7.** $\begin{bmatrix} 0 & -2 & 0 \\ -2 & 0 & -2 \end{bmatrix}$

8. $\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$ **9.** $\begin{bmatrix} -6.8 & 1.3 \\ -2.1 & -1 \end{bmatrix}$ **10.** $\begin{bmatrix} 4 & -8 \\ -1 & -1 \\ 11 & 1 \end{bmatrix}$

11. $\begin{bmatrix} -9 & -2 & 12 \\ -15 & 11 & -7 \end{bmatrix}$ **12.** $\begin{bmatrix} 6 & 2 \\ -1 & 3 \end{bmatrix}$ **13.** $\begin{bmatrix} -4 & -1 \\ -1 & -2 \end{bmatrix}$

14. Yes; $-2 = 2(-1)$, $3 = 2(1.5)$, $5 = 2(2.5)$, and $0 = 2(0)$ are all correct.

15. No; the matrices have different dimensions.

16. $x = -2, y = 3, z = 1$

17. $x = 2, t = \frac{3}{5}$

18. $\begin{bmatrix} 0 & 5 \\ 8 & -6 \\ 0 & 5 \end{bmatrix}$

19. $B + D$ cannot be added because they do not have the same dimensions.

20. $\begin{bmatrix} 6 & 3 \\ -3 & 3 \end{bmatrix}$ **21.** $\begin{bmatrix} -6 & -3 \\ -4 & -2 \\ -2 & 5 \end{bmatrix}$ **22.** $\begin{bmatrix} -4 & 1 \\ -3 & -1 \end{bmatrix}$

23. B

24. $\begin{bmatrix} 4 & -1 & 11 \\ -8 & -1 & 2 \end{bmatrix}$ **25.** $\begin{bmatrix} 9 & 62 \\ 125 & -11 \end{bmatrix}$

26. a. $\begin{bmatrix} 124.6 \\ 113.3 \\ 71.6 \\ 87.2 \end{bmatrix}$ **b.** $\begin{bmatrix} -6.2 \\ -4.7 \\ 9.4 \\ 3.6 \end{bmatrix}$

c. Yes, order matters because subtraction is not commutative.

27. a.

	Plant 1		Plant 2	
	Plastic	Rubber	Plastic	Rubber
1-color	1000	1400	1200	3600
3-color	2600	3800	1800	4800

b. Plant 1 — Plant 2

	Plastic	Rubber
1-color	−200	−2200
3-color	800	−1000

Plant 1; Plant 2

28. a. To find $A + B$ you would add the corresponding elements. To find $A - B$ you would subtract the corresponding elements in B from A.

b. Matrix C will have the same dimensions as A. Its elements will be the opposites of the corresponding elements in A.

29. $a = 2, b = \frac{9}{4}, c = -1, d = 0, f = \frac{1}{2}, g = -4$

30. $x = \pm 3, y = 0$ or 5

31. $c = \frac{5}{2}, d = \frac{2}{5}, f = 7, g = 5, h = -1$

32. $\begin{bmatrix} 5 \\ 4 \\ 2 \end{bmatrix}$

33. Consider any two 2×2 matrices, $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$ and $B = \begin{bmatrix} w & x \\ y & z \end{bmatrix}$. By the def. of matrix addition and the Comm. Prop. of Add., $A + B = \begin{bmatrix} a & b \\ c & d \end{bmatrix} + \begin{bmatrix} w & x \\ y & z \end{bmatrix} =$

$$\begin{bmatrix} a + w & b + x \\ c + y & d + z \end{bmatrix} = \begin{bmatrix} w + a & x + b \\ y + c & z + d \end{bmatrix} = B + A$$

34. Consider any three 2×2 matrices $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$, $B = \begin{bmatrix} e & f \\ g & h \end{bmatrix}$, and $C = \begin{bmatrix} w & x \\ y & z \end{bmatrix}$

By the definition of matrix addition and the Assoc. Prop. of Add.,

$$A + (B + C) = \begin{bmatrix} a & b \\ c & d \end{bmatrix} + \left(\begin{bmatrix} e & f \\ g & h \end{bmatrix} + \begin{bmatrix} w & x \\ y & z \end{bmatrix} \right)$$

$$= \begin{bmatrix} a & b \\ c & d \end{bmatrix} + \begin{bmatrix} e + w & f + x \\ g + y & h + z \end{bmatrix}$$

$$= \begin{bmatrix} a + (e + w) & b + (f + x) \\ c + (g + y) & d + (h + z) \end{bmatrix}$$

$$= \begin{bmatrix} (a + e) + w & (b + f) + x \\ (c + g) + y & (d + h) + z \end{bmatrix}$$

$$= \begin{bmatrix} a + e & b + f \\ c + g & d + h \end{bmatrix} + \begin{bmatrix} w & x \\ y & z \end{bmatrix} = (A + B) + C$$

Answers for Lesson 4-3 Exercises

1. $\begin{bmatrix} 9 & 12 \\ 18 & -6 \\ 3 & 0 \end{bmatrix}$ **2.** $\begin{bmatrix} -12 & 4 \\ 8 & -16 \\ -4 & 20 \end{bmatrix}$ **3.** $\begin{bmatrix} -3 & -6 \\ 9 & -3 \end{bmatrix}$

4. $\begin{bmatrix} -5 & -1 \\ 0 & -2 \end{bmatrix}$ **5.** $\begin{bmatrix} 9 & 2 \\ 2 & 6 \\ 3 & -10 \end{bmatrix}$ **6.** $\begin{bmatrix} 3 & 14 \\ 22 & -14 \\ 1 & 10 \end{bmatrix}$

7. $\begin{bmatrix} 19 & 11 \\ -12 & 10 \end{bmatrix}$ **8.** $\begin{bmatrix} 21 & 3 \\ 2 & 16 \\ 7 & -25 \end{bmatrix}$ **9.** $\begin{bmatrix} 8 & -2.5 \\ -1.5 & -1 \end{bmatrix}$

10. $\begin{bmatrix} 0.34 & -0.46 \\ -1.18 & 0.9 \end{bmatrix}$ **11.** $\begin{bmatrix} 5 & -12 \\ 9 & -6 \end{bmatrix}$ **12.** $\begin{bmatrix} -3 & 4 \\ -21 & 2 \end{bmatrix}$

13. $\begin{bmatrix} -8 & 0 \\ 0 & -8 \end{bmatrix}$ **14.** $[34]$ **15.** $[34 \quad 0]$

16. $[0 \quad 34]$ **17.** $\begin{bmatrix} -15 & 0 \\ 25 & 0 \end{bmatrix}$ **18.** $\begin{bmatrix} -1 & 0 \\ 1 & 5 \\ 0 & -3 \end{bmatrix}$

19. a.

	Lilies	Carnations	Daisies
Arrangement 1	3	0	0
Arrangement 2	3	4	0
Arrangement 3	0	3	4

b.

	Cost
Lilies	2.15
Carnations	0.90
Daisies	1.30

c.

	Cost
Arrangement 1	6.45
Arrangement 2	10.05
Arrangement 3	7.90

20. defined **21.** defined **22.** defined

23. undefined **24.** defined **25.** undefined

26. undefined **27.** defined **28.** defined

29. defined **30.** $\begin{bmatrix} -2 & 8 \\ 4 & 10 \end{bmatrix}$ **31.** $\begin{bmatrix} -9 & 7 & 4 \\ 8 & 2 & -3 \end{bmatrix}$

32. $\begin{bmatrix} 1.5 & 7 \\ 3.5 & -2 \end{bmatrix}$ **33.** $\begin{bmatrix} 1 & 0 & -1 \\ 0 & 1 & -1 \end{bmatrix}$ **34.** $\begin{bmatrix} -1 & 0 \\ 0 & 1 \end{bmatrix}$

35. B **36.** 3×2; $\begin{bmatrix} 17 & 2 \\ \frac{7}{5} & -\frac{11}{5} \\ -\frac{2}{3} & -\frac{14}{3} \end{bmatrix}$

37. 4×4; $\begin{bmatrix} a & 0 & b & 0 \\ a - 2e & 0 & b & -2f \\ 2e & 0 & 0 & 2f \\ -a + e & 0 & -b & f \end{bmatrix}$

38. $\begin{bmatrix} 1 & -6 & -5 \\ 6 & 1 & -5 \\ -3 & -12 & 0 \end{bmatrix}$ **39.** $\begin{bmatrix} 9 & -6 \\ 15 & -3 \\ -6 & -12 \end{bmatrix}$ **40.** $\begin{bmatrix} 17 & -24 \\ -33 & -7 \\ 69 & -18 \end{bmatrix}$

41. $\begin{bmatrix} 17 & -24 \\ -33 & -7 \\ 69 & -18 \end{bmatrix}$ **42.** $\begin{bmatrix} -3 & 12 & -1 \\ -2 & 3 & 5 \\ -4 & -3 & -4 \end{bmatrix}$ **43.** $\begin{bmatrix} 34 & -1 \\ 6 & -13 \\ -7 & 16 \end{bmatrix}$

44. $\begin{bmatrix} 16 & 8 & -15 \\ 15 & -9 & -15 \\ 2 & 11 & -5 \end{bmatrix}$ **45.** $\begin{bmatrix} -90 & 0 \\ -78 & 42 \\ -30 & -30 \end{bmatrix}$

46. **a.** [59 132 103]; the elements are the total sales for the three items at each store.

b. Add the elements of the product matrix in part (a).

c. $115

47. Answers may vary. Sample: Multiply the elements in each row of the first matrix by the elements in each column of the second matrix. Then add to get the corresponding entry in the resultant matrix.

48. Answers may vary. Sample: $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ and $\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$

49. No; AB will be a 2×2 matrix and BA will be a 3×3 matrix, and equal matrices must have the same dimensions. Answers may vary. Sample: Let A be the matrix $\begin{bmatrix} 0 & 1 & 2 \\ 3 & 0 & 0 \end{bmatrix}$, and let B be the matrix $\begin{bmatrix} 1 & 0 \\ 2 & 4 \\ 3 & 1 \end{bmatrix}$. Then $AB = \begin{bmatrix} 8 & 6 \\ 3 & 0 \end{bmatrix}$ and $BA = \begin{bmatrix} 0 & 1 & 2 \\ 12 & 2 & 4 \\ 3 & 3 & 6 \end{bmatrix}$.

50.

	Thursday	Friday	Saturday
Revenue	[2100	1950	2570]

51. $x = -3, y = -9$

52. $x = -2, y = -3$

53. yes

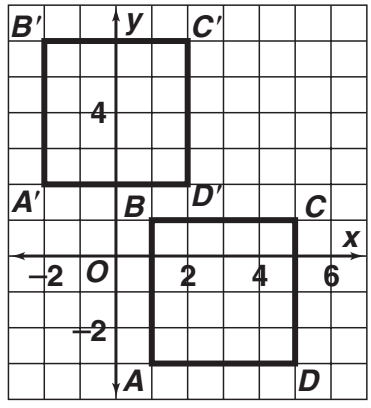
54. yes

55. yes

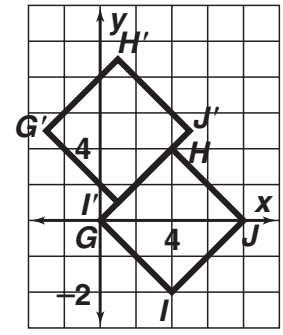
56. yes

Answers for Lesson 4-4 Exercises

1. $\begin{bmatrix} -2 & -2 & 2 & 2 \\ 2 & 6 & 6 & 2 \end{bmatrix}$



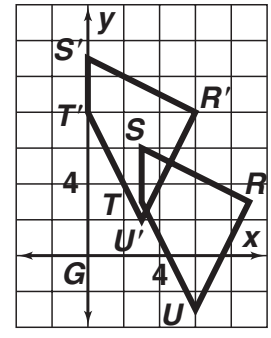
2. $\begin{bmatrix} -3 & 1 & 1 & 5 \\ 5 & 9 & 1 & 5 \end{bmatrix}$



3. $\begin{bmatrix} -13 & -19 & 9 \\ 7 & a+5 & 0 \end{bmatrix}$

graph not possible

4. $\begin{bmatrix} 6 & 0 & 0 & 3 \\ 8 & 11 & 8 & 2 \end{bmatrix}$



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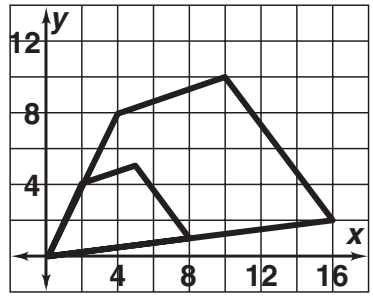

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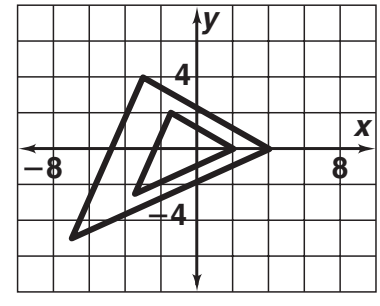

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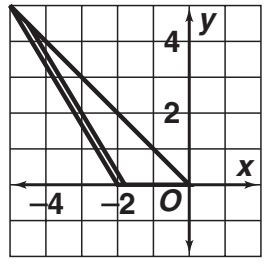

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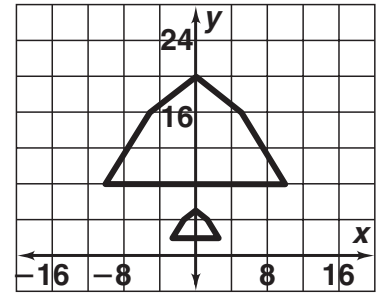

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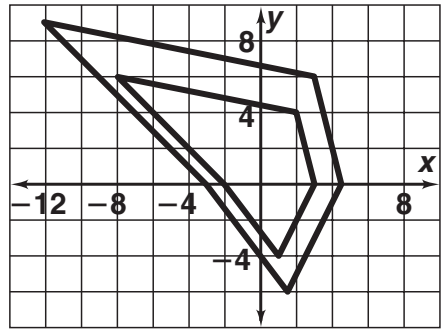

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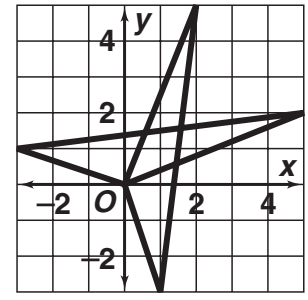

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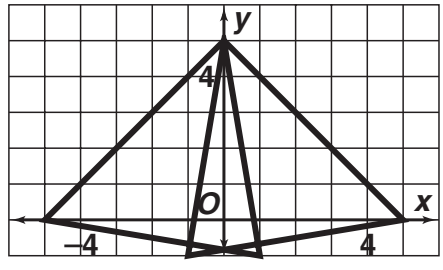
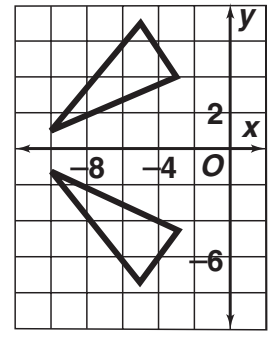


12.



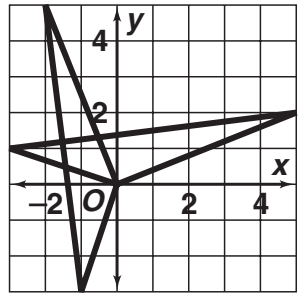
13. $\begin{bmatrix} 3 & -3 & -3 & 3 \\ -3 & -6 & -3 & -6 \end{bmatrix}$

14. $\begin{bmatrix} 0 & 4 & 8 & 6 \\ 0 & -4 & -4 & -2 \end{bmatrix}$

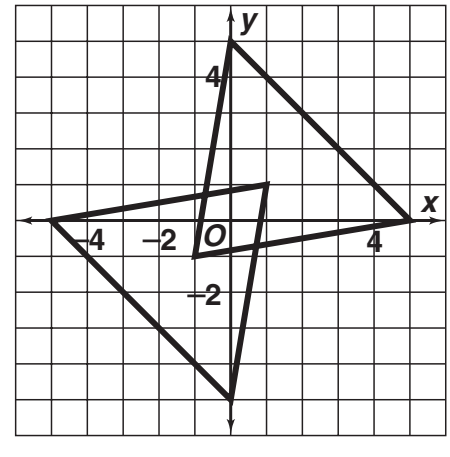
15. $\begin{bmatrix} 3 & 2 & 2 & 3 & 5 \\ 1 & 2 & 3 & 4 & 2.5 \end{bmatrix}$

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

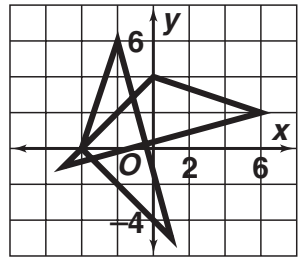
17.



18.



19.



20. $\begin{bmatrix} -3 & 3 & 3 & -3 \\ -3 & -6 & -3 & -6 \end{bmatrix}$

21. $\begin{bmatrix} 0 & 4 & 8 & 6 \\ 0 & 4 & 4 & 2 \end{bmatrix}$

22. $\begin{bmatrix} -1 & -2 & -3 & -4 & -2.5 \\ -3 & -2 & -2 & -3 & -5 \end{bmatrix}$

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

24. $\begin{bmatrix} -8 & -8 & -3 & -3 \\ -1 & -3 & -1 & -3 \end{bmatrix}$

25. $\begin{bmatrix} -8 & -5 & -2 & -5 \\ -8 & -5 & -8 & -11 \end{bmatrix}$

26. $\begin{bmatrix} -5 & -4 & -9 \\ 1 & 4 & 6 \end{bmatrix}$

27. $\begin{bmatrix} -12 & 4 & -4 \\ 4 & 8 & 16 \end{bmatrix}$

28. $\begin{bmatrix} -5 & -1 & -3 \\ -2 & -1 & 1 \end{bmatrix}$

29. $\begin{bmatrix} -1.5 & 0.5 & -0.5 \\ 0.5 & 1 & 2 \end{bmatrix}$

30. $\begin{bmatrix} -2 & 2 & 0 \\ 8 & 9 & 11 \end{bmatrix}$

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

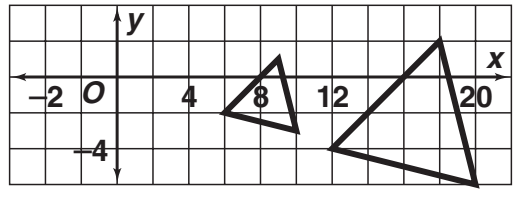
32. $\begin{bmatrix} 1 & 2 & 4 \\ -3 & 1 & -1 \end{bmatrix}$

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

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

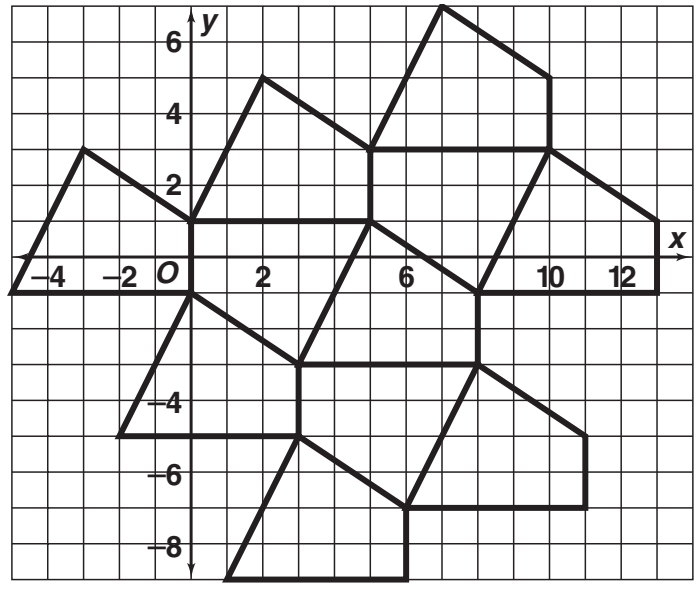
35. A

36.



Answers may vary. Sample: It enlarges or shrinks a figure and moves it farther from or closer to the origin.

37.



38. Check students' work.

39. $f: \begin{bmatrix} 1 & 2 & 4 & 5 & 2 \\ 2 & 1 & 2 & 5 & 4 \end{bmatrix}$, $g: \begin{bmatrix} 2 & 4 & 8 & 10 & 4 \\ 4 & 2 & 4 & 10 & 8 \end{bmatrix}$; dilation

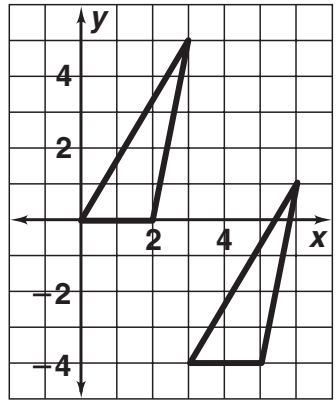
40. $f: \begin{bmatrix} -5 & -3 & -2 & -1 & 1 & -1 & -2 & -3 \\ 2 & 1 & -1 & 1 & 2 & 3 & 5 & 3 \end{bmatrix}$,

$g: \begin{bmatrix} -3 & -1 & 0 & 1 & 3 & 1 & 0 & -1 \\ -2 & -3 & -5 & -3 & -2 & -1 & 1 & -1 \end{bmatrix}$; translation

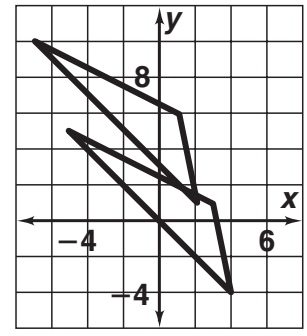
41. $f: \begin{bmatrix} -5 & -2 & 1 \\ 3 & 0 & 3 \end{bmatrix}$, $g: \begin{bmatrix} -1 & 2 & 5 \\ 1 & -2 & 1 \end{bmatrix}$; translation

42. $f: \begin{bmatrix} 0 & 4 & 4 \\ 0 & 2 & 4 \end{bmatrix}$, $g: \begin{bmatrix} 0 & -4 & -4 \\ 0 & -2 & -4 \end{bmatrix}$; rotation

43.



44.



45. **a.** Check students' work.

b. Translate the vertices of $ABCD$ down 12 units.

$$\begin{bmatrix} 0 & 0 & 0 & 0 \\ -12 & -12 & -12 & -12 \end{bmatrix};$$

coordinates of pre-image: (5, 8), (6, 8), (6, 9), (5, 9),
coordinates of image: (5, −4), (6, −4), (6, −3), (5, −3)

c. $\begin{bmatrix} 11 & 12 & 12 & 11 \\ 2 & 2 & 3 & 3 \end{bmatrix}$

d. Translate the vertices of $ABCD$ left 12 units.

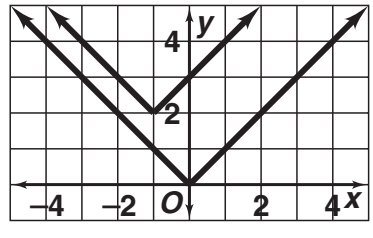
46. $\begin{bmatrix} -6 & 1 & -10 \\ 0 & 6 & 6 \end{bmatrix}$

47. $\begin{bmatrix} 0 & 2 & 0 \\ -4 & -7 & -10 \end{bmatrix}$

48. $\begin{bmatrix} 5 & 10 & 2 & 6 \\ 17 & 6 & 6 & 2 \end{bmatrix}$

49. $\begin{bmatrix} -3 & -1.5 & -2 & -4 \\ 3 & 4.5 & 5 & 3.5 \end{bmatrix}$

50. **a.** 3 2 1 0 1 2 3



b. Answers may vary. Sample: The addition represents a translation of the pt. (x, y) 1 unit to the left and 2 units up.

Answers for Lesson 4-5 Exercises

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

$$\begin{bmatrix} 3(3) + 2(-4) & 3(-2) + 2(3) \\ 4(3) + 3(-4) & 4(-2) + 3(3) \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

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

$$\begin{bmatrix} -3(-5) + 7(-2) & -3(7) + 7(3) \\ -2(-5) + 5(-2) & -2(7) + 5(3) \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

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

$$\begin{bmatrix} \frac{1}{5}(5) + (-\frac{1}{10})(0) & \frac{1}{5}(2) + (-\frac{1}{10})(4) \\ 0(5) + \frac{1}{4}(0) & 0(2) + \frac{1}{4}(4) \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

4. -21 **5.** 0 **6.** -0.75

7. $-\frac{11}{40}$ **8.** -17 **9.** 2

10. 11 **11.** 13 **12.** -3

13. -6

14. yes; $\begin{bmatrix} 0 & 1 \\ -1 & 2 \end{bmatrix}$ **15.** yes; $\begin{bmatrix} -1 & 3 \\ 1 & -2 \end{bmatrix}$

16. yes; $\begin{bmatrix} 2 & -1.5 \\ -1 & 1 \end{bmatrix}$ **17.** yes; $\begin{bmatrix} 0 & \frac{1}{2} \\ \frac{1}{3} & -\frac{1}{6} \end{bmatrix}$

18. no

19. yes; $\begin{bmatrix} -\frac{1}{8} & -\frac{1}{2} \\ \frac{3}{16} & \frac{1}{4} \end{bmatrix}$

20. yes; $\begin{bmatrix} \frac{2}{27} & \frac{4}{9} \\ \frac{10}{27} & \frac{2}{9} \end{bmatrix}$

21. yes; $\begin{bmatrix} 0 & \frac{1}{3} \\ -\frac{1}{2} & \frac{1}{6} \end{bmatrix}$

22. $\begin{bmatrix} -15 & -17 \\ 26 & 29 \end{bmatrix}$

23. No solutions; the determinant of $\begin{bmatrix} 0 & -4 \\ 0 & -1 \end{bmatrix}$ is 0.

24. $\begin{bmatrix} 10 \\ 15 \end{bmatrix}$

25. a.

		From: No Cable	From: Cable
To	No Cable	0.98	0.005
	Cable	0.02	0.995

b. about 20,100 people

c. about 19,897 people

26. 36

27. −120

28. 0

29. 2

30. 9

31. yes

32. No; answers may vary. Sample: The product is $\begin{bmatrix} 23 & 8 \\ -46 & -16 \end{bmatrix}$.

33. No; answers may vary. Sample: The product is $\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$.

34. yes; $\begin{bmatrix} -3 & 4 \\ 1 & -1 \end{bmatrix}$

35. yes; $\begin{bmatrix} -5 & 7 \\ 3 & -4 \end{bmatrix}$

36. yes; $\begin{bmatrix} 7 & 11 \\ 2 & 3 \end{bmatrix}$

37. yes; $\begin{bmatrix} 0.5 & 0 \\ 0 & 0.5 \end{bmatrix}$

38. yes; $\begin{bmatrix} 0 & \frac{1}{3} \\ \frac{1}{3} & 0 \end{bmatrix}$

39. yes; $\begin{bmatrix} 0 & \frac{1}{2} \\ \frac{1}{3} & \frac{1}{6} \end{bmatrix}$

40. yes; $\begin{bmatrix} -\frac{1}{3} & \frac{2}{3} \\ \frac{2}{3} & -\frac{1}{3} \end{bmatrix}$

41. No; the determinant is 0.

42. $\begin{bmatrix} 1 & -3 \\ 0 & 1 \end{bmatrix}$

43. $\begin{bmatrix} 8 & -2 \\ -6 & 1 \end{bmatrix}$

44. Answers may vary. Sample: Form a new matrix by switching the element in row 1, column 1 with the element in row 2, column 2. Then replace the other two elements with their opposites. Finally divide each element by the determinant of the original matrix.

45. a.

		From	
		No DVD	DVD
To	No DVD	0.83	0
	DVD	0.17	1

b. about 10,910 people

c. about 2289 people

d. The student used $\begin{bmatrix} 0.17 & 1 \\ 0.83 & 0 \end{bmatrix}$ for the transition matrix.

46. Answers may vary. Sample: $a = \pm 1, d = \pm 1, b = c = 0$

47. $\begin{bmatrix} -3 & 2 \\ -5 & 8 \end{bmatrix}$

48. $\begin{bmatrix} -1 & -1 \\ 0 & 0 \end{bmatrix}$

49. Multiplicative inverses are only defined for square matrices because square matrices have an equal number of rows and columns.

50. $\det M = ad - bc$ and $\det N = eh - fg$. Next,

$MN = \begin{bmatrix} ae + bg & af + bh \\ ce + dg & cf + dh \end{bmatrix}$, and $\det MN =$

$(ae + bg)(cf + dh) - (af + bh)(ce + dg) =$

$acef + adeh + bcfg + bdgh - acef - adfg - bceh -$

$bdgh = adeh - bceh + bcfg - adfg$. But

$\det M \cdot \det N = (ad - bc)(eh - fg) = adeh - bceh -$

$adfg + bcfg$. So $\det M \cdot \det N = \det MN$.

51. **a.** 6 units^2

b. 6; it is the same.

c. They are the same.

d. Check students' work.

Answers for Lesson 4-6 Exercises

1. 20 **2.** -5 **3.** -14

4. 106 **5.** 1 **6.** 6

7. -7314.14 **8.** yes **9.** no

10. $\begin{bmatrix} 3 \\ -2 \\ 2 \end{bmatrix}$ **11.** $\begin{bmatrix} 5 \\ 8 \\ 2 \end{bmatrix}$

12. AUTUMN **13.** PORTRAIT

14. D

15. a. $\begin{bmatrix} 1 & 1 & 1 \\ 0 & 1 & 1 \\ 0 & 0 & 1 \end{bmatrix}$

b. $\begin{bmatrix} 38 & 56 & 27 & 34 \\ 24 & 30 & 20 & 15 \\ 24 & 12 & 12 & 15 \end{bmatrix}$

c. Check students' work.

16. -30 **17.** -3 **18.** 25 **19.** 1

20. $\begin{bmatrix} -4 & -3.5 & 2 \\ -5 & -5 & 3 \\ 2 & 2 & -1 \end{bmatrix}$ **21.** $\begin{bmatrix} 0.4 & 0.4 & 0.2 \\ -0.6 & -0.6 & 0.2 \\ -0.2 & 0.8 & 0.4 \end{bmatrix}$

22. $\begin{bmatrix} 0 & \frac{1}{7} & \frac{2}{7} \\ \frac{1}{4} & \frac{3}{14} & -\frac{1}{14} \\ \frac{1}{2} & 0 & 0 \end{bmatrix}$ **23.** no inverse

24. **a.** 0

b. 0

c. 0

d. 0

Answers may vary. Sample: When the top row and bottom row are identical and the middle row has the same numbers as both rows, then the determinant is zero.

25. MORNING GRACE

26. THE CHAMBERED NAUTILUS

27. $\begin{bmatrix} 10 \\ 3 \\ -2 \end{bmatrix}$

28. $\begin{bmatrix} -1 & 2 & 6 \\ 0 & 0 & 5 \\ 8 & -1 & 0 \end{bmatrix}$

Answers for Lesson 4-7 Exercises

1. $\begin{bmatrix} 1 & 1 \\ 1 & -2 \end{bmatrix}\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 5 \\ -4 \end{bmatrix}$; coefficient matrix is $\begin{bmatrix} 1 & 1 \\ 1 & -2 \end{bmatrix}$, variable matrix is $\begin{bmatrix} x \\ y \end{bmatrix}$, constant matrix is $\begin{bmatrix} 5 \\ -4 \end{bmatrix}$.

2. $\begin{bmatrix} -3 & 1 \\ 1 & 0 \end{bmatrix}\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} -7 \\ 2 \end{bmatrix}$; coefficient matrix is $\begin{bmatrix} -3 & 1 \\ 1 & 0 \end{bmatrix}$, variable matrix is $\begin{bmatrix} x \\ y \end{bmatrix}$, constant matrix is $\begin{bmatrix} -7 \\ 2 \end{bmatrix}$.

3. $\begin{bmatrix} 3 & 5 \\ 1 & 1 \end{bmatrix}\begin{bmatrix} a \\ b \end{bmatrix} = \begin{bmatrix} 0 \\ 2 \end{bmatrix}$; coefficient matrix is $\begin{bmatrix} 3 & 5 \\ 1 & 1 \end{bmatrix}$, variable matrix is $\begin{bmatrix} a \\ b \end{bmatrix}$, constant matrix is $\begin{bmatrix} 0 \\ 2 \end{bmatrix}$.

4. $\begin{bmatrix} 1 & 3 & -1 \\ 1 & 0 & 2 \\ 0 & 2 & -1 \end{bmatrix}\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 2 \\ 8 \\ 1 \end{bmatrix}$; coefficient matrix is $\begin{bmatrix} 1 & 3 & -1 \\ 1 & 0 & 2 \\ 0 & 2 & -1 \end{bmatrix}$, variable matrix is $\begin{bmatrix} x \\ y \\ z \end{bmatrix}$, constant matrix is $\begin{bmatrix} 2 \\ 8 \\ 1 \end{bmatrix}$.

5. $\begin{bmatrix} 1 & -1 & 1 \\ 2 & 0 & 1 \\ 0 & 1 & 3 \end{bmatrix}\begin{bmatrix} r \\ s \\ t \end{bmatrix} = \begin{bmatrix} 150 \\ 425 \\ 0 \end{bmatrix}$; coefficient matrix is $\begin{bmatrix} 1 & -1 & 1 \\ 2 & 0 & 1 \\ 0 & 1 & 3 \end{bmatrix}$, variable matrix is $\begin{bmatrix} r \\ s \\ t \end{bmatrix}$, constant matrix is $\begin{bmatrix} 150 \\ 425 \\ 0 \end{bmatrix}$.

6. $\begin{bmatrix} 1 & 2 \\ 2 & 3 \end{bmatrix}\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 11 \\ 18 \end{bmatrix}$; coefficient matrix is $\begin{bmatrix} 1 & 2 \\ 2 & 3 \end{bmatrix}$, variable matrix is $\begin{bmatrix} x \\ y \end{bmatrix}$, constant matrix is $\begin{bmatrix} 11 \\ 18 \end{bmatrix}$.

7. $(2, 1)$ **8.** $(-1, 0)$ **9.** $\left(\frac{1}{2}, 20\right)$

10. $(1, -1)$ **11.** $(3, 2)$ **12.** $(-8, 7)$

13. $(2, -1, 3)$ **14.** $(-3, -2, 18)$ **15.** $(1, 2, -2)$

16. a. x is the number of pounds of almonds, y is the number of pounds of peanuts, and z is the number of pounds of raisins that must be bought. The first equation states that the total weight will be 9 pounds. The second equation states that the total cost will be \$15. The third equation states that the combined weights of almonds and peanuts should be double the weight of the raisins.

b. $(2.5, 3.5, 3)$

17. yes **18.** yes **19.** yes

20. yes **21.** no **22.** yes

23. $(6, 2)$ **24.** no unique solution

25. $(16, -22)$ **26.** $(-2, -1)$

27. $(2, 4)$ **28.** $(-1, 0)$

29. $(4, 1, 3)$ **30.** $(5, 0, 1)$

31. $(-19, 22, 13)$ **32.** $(1, 0, 3)$

33. $(2, -1, 3)$ **34.** $(1, 1, 1, 1)$

35. $(2, 0, 2, 0)$ **36.** $(2, 3)$

37. length = 280 ft, width = 140 ft **38.** 14

39. Answers may vary. Sample: 0, 0

40. Answers may vary. Sample: 0, 1

41. The tea temperature was 126°F and the milk temperature was 36°F.

42. **a.** Let c = lb of chicken, r = lb of rice, and s = lb of shellfish.

$$\begin{cases} c + r + s = 18 \\ 1.50c + 0.40r + 6.00s = 29.50 \\ 100c + 20r + 50s = 850 \end{cases}$$

b. (5, 10, 3); 5 lb of chicken, 10 lb of rice, 3 lb of shellfish

1. $(2, 0)$ **2.** $(3, 1)$ **3.** $(3, 1)$

4. $(6, 1, 1)$ **5.** $(3, -1, 2)$

6. $\left[\begin{array}{cc|c} 3 & -4 & 17 \\ 8 & 1 & -3 \end{array}\right]$

7. $\left[\begin{array}{ccc|c} 3 & -7 & 3 & -3 \\ 1 & 1 & 2 & -3 \\ 2 & -3 & 5 & -8 \end{array}\right]$

8. $\left[\begin{array}{cc|c} -1 & 5 & -1 \\ 1 & -2 & 1 \end{array}\right]$

9. $\begin{cases} 5x + y = -3 \\ -2x + 2y = 4 \end{cases}$

10. $\begin{cases} -x + 2y = -6 \\ x + y = 7 \end{cases}$

11. $\begin{cases} 2x + y + z = 1 \\ x + y + z = 2 \\ x - y + z = -2 \end{cases}$

12. $(5, -2.5)$ **13.** $(-2, -6)$ **14.** $(-3, 3)$

15. $(6.25, -6.25)$ **16.** $(0, 3)$ **17.** $\left(\frac{4}{3}, -\frac{1}{3}\right)$

18. $(1, 1, 0)$ **19.** $(3, 1, 1)$

20. no unique solution **21.** no unique solution

22. no unique solution **23.** no unique solution

24. $(2, 4)$ **25.** $(-3, 5)$ **26.** $(-10, -15)$

27. $(4, 8)$ **28.** $(-4, 5, 1)$ **29.** $(1, 1, -1)$

30. $(0, 2, -2)$ **31.** $(4, 0, 1)$

32. one eraser = \$.03, one pencil = \$.04

33. C **34.** Check students' work.

35. $(2, 0, 3)$ **36.** $(1, 0, -1)$

37. no unique solution

38. a. Let r = price of 1 pt of red and let y = price of 1 pt of yellow.

$$\begin{cases} 2r + 6y = 25 \\ 5r + 3y = 28 \end{cases}$$

b. (3.875, 2.875)

c. A quart of red paint = \$7.75 and a quart of yellow paint = \$5.75.

39. almonds: \$2/lb, pecans: \$4/lb, pistachios: \$6/lb

40. (8, 2)

41. (5, −10)

42. (1, 1, 1, 0)

43. (0, 1, 0, 2)

44. a. Let a, b, and c be the number of portions per day of food sources A, B, and C.

$$10a + 4b + 12c = 120$$
$$11a + 77b = 220$$
$$4a + b + 16c = 80$$

b. about (7.8, 1.7, 3.0)

c. Answers may vary. Sample: Adding 12 more portions of food A would compensate for C running out.

45. a. Let x = the width of the rectangle, let y = the length of the rectangle, and let z = the length of the diagonal.

$$\begin{cases} 2x + 2y = 28 \\ x + y + z = 24 \\ x - z = -2 \end{cases}$$

b. $\begin{cases} 2x + 2y = 28 \\ 2x + y = 22 \end{cases}$

c. $\left[\begin{array}{cc|c} 2 & 2 & 28 \\ 2 & 1 & 22 \end{array}\right]$

d. 6 cm × 8 cm

e. 10 cm