Lesson 7.1.1

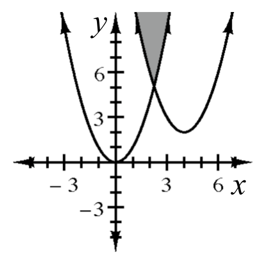
7-8. **a: Their y- and z-coordinates are zero. b: Answers vary.**

7-9. $x = -2$, $y = 5$

7-10. **a: 9; b: $4N - 3$, arithmetic**

7-11. **a: $x \approx 1.204$, b: $x \approx 1.613$, c: $x = 6$, d: $x \approx 2.004$**

7-12. **a: $\frac{1}{25}$, b: $\frac{x}{y^2}$, c: $\frac{1}{x^2y^2}$, d: $\frac{b^{10}}{a}$**



7-13. **See graph at right. It is shifted to the right 4 units and up 2 units.**

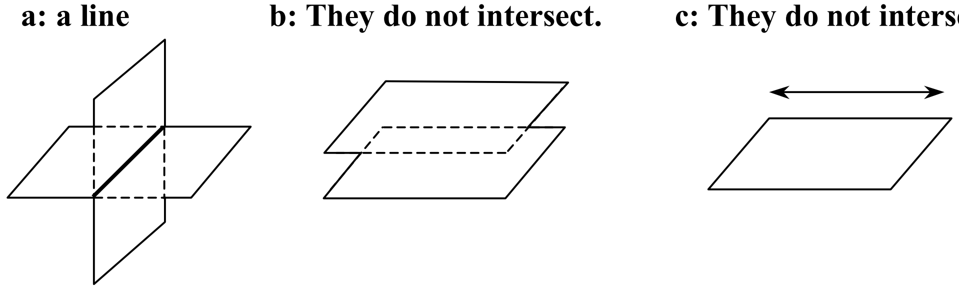
7-14. **a: $\frac{1}{2}$; b: -2; c: The product of the slopes is -1, or they are negative reciprocals of each other.**

7-15. **Heather is correct, because a 4% decrease does not cancel out a 4% increase.**

Lesson 7.1.2

7-21. **a: $(0, 10, 0)$, $(0, 0, 4)$; b: $(8, 0, 0)$, $(0, 6, 0)$, $(0, 0, 12)$; c: $(0, 0, 5)$, $(0, 0, -5)$, $(2, 0, 0)$, $(-8, 0, 0)$; d: $(0, 0, 6)$**

7-22. **a: a line** **b: They do not intersect.** **c: They do not intersect.**



7-23. **a: $y = -2(x+4)^2 + 2$, b: $y = \frac{1}{x-2}$, c: $y = -x^3 + 3$**

7-24. **It is not the parent. The second equation does not have a vertical asymptote, and it has a maximum value while $y = \frac{1}{x}$ does not (or there is no way to get the graph of $y - \frac{1}{x^2+7}$ by shifting or stretching the graph of $y = \frac{1}{x}$).**

7-25. **a: $x = \frac{b}{3}$, b: $x = \frac{b}{5a}$, c: $x = \frac{b}{1+a}$**

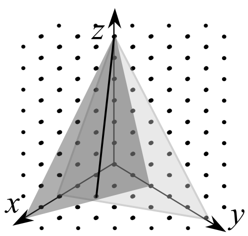
7-26. a: No, input equals output only if $x \geq 0$.
b: The output is the absolute value of the input value.
c: $n+2$, $n+2$, n^2-4, $|n|$
d: because $\sqrt{x^2} = |x|$

7-27. a: $\frac{1}{4}$, b: $\frac{1}{4}$, c: $\frac{1}{2}$

7-28. a: –7, b: –102, c: –102, d: –132

Lesson 7.1.3

7-34.



7-35. yes

7-36. Sample answer: Yes, because if the numbers are the same, the exponent you would use to get them should be the same, given the same base.

7-37. $y \leq -x+4$, $y \geq \frac{1}{3}x$

7-38. $x = \frac{b}{1-a}$

7-39. $y = (x+2)^2 - 11$

7-40. $x = 62$

7-41. a: $(5x-1)(5x+1)$, b: $5x(x+5)(x-5)$, c: $(x+9)(x-8)$, d: $x(x-6)(x+3)$

7-42. $x = 3$, $y = 1$, $z = 3$

Lesson 7.1.4

7-50. $(1, -2, 4)$

7-51. a: $y = -\frac{1}{2}x + 12$, b: $y = \frac{2}{3}x - 15$

7-52. $y \le -\frac{3}{4}x + 3$, $y \ge -\frac{3}{4}x - 3$, $x \le 3$, $x \ge -3$

7-53. $x = 7$

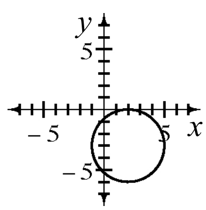
7-54. a: They both equal 16, but this is a special case (for example, $5^3 \ne 3^5$).
b: Yes, because $\log 16 = \log 16$.
c: Yes; one possible response is that they have the same solutions.
d: Yes; one possible response is that they have the same solutions.

7-55. a: $x = 6.5$, b: $x = -3.75$ or $x = 5$

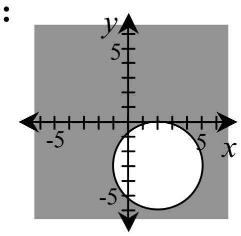
7-56. a: $y = \frac{1}{3}x + 5$, b: $y = 2x + 5$, c: $y = -\frac{1}{2}x + \frac{15}{2}$, d: $y = 2x$

7-57. a: $y = -x^2 + 4x$, b: $y = 5 \pm \sqrt{x - 3}$

7-58. a:



b:



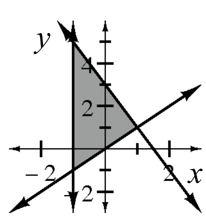
7-59. 384 feet

Lesson 7.1.5

7-71. $x = -1$, $y = 3$, $z = 5$

7-72. $y = 3x^2 - 5x + 7$

7-73. a:



b: 6 square units

7-74. a: $y + \frac{x}{2}$, b: $2b + 4a^2$, c: $6x - 1$, d: xy

7-75. a: $x = 12^y$, b: $y^x = 17$, c: $2x = \log_{1.75} y$, d: $7 = \log_x 3y$

7-76. $x = 14$

7-77. a: $30°$, b: $22.6°$

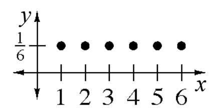
7-78. a: 2^4, b: 2^{-3}, c: $2^{1/2}$, d: $2^{2/3}$

7-79. $x = -1$, $y = 3$, $z = 6$

7-80. $y = 2x^2 - 3x + 5$

7-81. a: $24 = b^a$, b: $7 = (2y)^{3x}$, c: $5x = \log_2 3y$, d: $6 = \log_{2q} 4p$

7-82. domain: 1, 2, 3, 4, 5, 6;
range: $\frac{1}{6}$;
no x- or y-intercepts, no asymptotes, not continuous;
The graph is 6 points on the line $y = \frac{1}{6}$. See graph at right.



7-83. Yes, Hannah is correct; $4(x-3)^2 - 29 = 4x^2 - 24x + 7$ and $4(x-3)^2 - 2 = 4x^2 - 24 + 34$.

7-84. a: $y = 2(x-2)^2 - 1$, vertex $(2, -1)$, axis of symmetry $x = 2$;
b: $y = 5(x-1)^2 - 2$, vertex $(1, -2)$, axis of symmetry $x = 1$

7-85. a: $2a^2 - 4$, b: $18a^2 - 4$, c: $2a^2 + 4ab + 2b^2 - 4$, d: $2x^2 + 28x + 94$,
e: $50x^2 + 60x + 14$, f: $10x^2 - 17$

7-86. First row of area model: $\frac{3}{8}$, $\frac{3}{12} = \frac{1}{4}$, and $\frac{1}{8}$; second row: $\frac{1}{8}$, $\frac{1}{12}$, and $\frac{1}{24}$;
a: $\frac{3}{8} + \frac{1}{4} + \frac{1}{8} + \frac{1}{8} + \frac{1}{12} + \frac{1}{24} = 1$; b: $\frac{1}{2} + \frac{1}{3} + \frac{1}{6} = 1$ and $\frac{3}{4} + \frac{1}{4} = 1$; c: $1 \cdot 1 = 1$

Lesson 7.2.1

7-94. Missing values in left column: 0, 1, 3, 5; right column: 81, 729, 2187, 6561;
equation: $y = \log_3 x$

7-95. In $2 = 1.04^x$ the variable is the exponent, but in $56 = x^8$ the exponent is known so you can take the 8^{th} root.

7-96. $x > 100$

7-97. a: $\frac{x^2}{x-1}$, b: $\frac{b+a}{a-a^2b}$

7-98. a: $\frac{1}{8}$; b: $\frac{1}{x}$; c: $m \approx 1.586$; d: $n = 2.587$; e: Answers vary, $x = b^{1/a}$.

7-99. $2^{1/2} = \sqrt{2}$ and $2^{-1} = \frac{1}{2}$

7-100. a: $-3 < x < 3$, b: $-2 < x < 1$, c: $x \le -2$ or $x \ge 1$

7-101. $x = 17$

7-102. a: $x = -3$, $y = 5$, $z = 10$
b: infinitely many solutions
c: The planes intersect in a line.

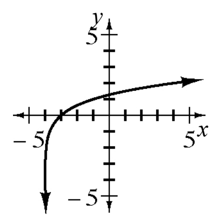
Lesson 7.2.2

7-111. a: 5.717, b: 11.228

7-112. Answers vary, but students should recognize that $0 < b < 1$.

7-113. $\frac{\log 5\ 7}{\log 5\ 2}$

7-114. It is the $\log_3(x)$ graph shifted 4 units to the left.
See graph at right.



7-115. 16.5 months; 99.2 months

7-116. They are correct. Vertex: $(2.5, -23.75)$,
line of symmetry: $x = 2.5$.

7-117. a: $f(x) = 4(x - 1.5)^2 - 3$, vertex (1.5, –3), line of symmetry $x = 1.5$
b: $g(x) = 2(x + 3.5)^2 - 20.5$, vertex $(-3.5, -20.5)$, line of symmetry $x = -3.5$

7-118. a: Consider only $x \ge -2$ or $x \le -2$.
b: Depending on the original domain restriction, $y = \sqrt{\frac{x+7}{3}} - 2$ or $y = -\sqrt{\frac{x+7}{3}} - 2$.
c: $x \ge -7$ and $y \ge -2$ or $x \ge -7$ and $y \le -2$

7-119. a: 20, 100, 500; b: $n = 7$; c: No, because there are no terms between the 6th term (62,500) and the 7th term (312,500).

7-120. a: –6; b: 3; c: –2, 3; d: 6

7-121. a: True, because of the definition of division as multiplication by the reciprocal and the Distributive Property. Both can be written as $\frac{1}{5}(x + 3)$.
b: False, because if $x = 2$, then $1 \ne \frac{5}{2} + \frac{5}{3}$.

7-122. $\frac{6}{7}$

Lesson 7.2.3

7-127. a: $y = 40(1.5)^x$; b: when $x = -9$, or 9 days before the last day of October (exact date: October 22)

7-128. possible answer: $4^{(x+1)} = 6$

7-129. Sample solutions: a: $\frac{2}{3}\log(8)$, $\frac{1}{3}\log(8^2)$, $2\log(\sqrt[3]{8})$; b: $\log 5^{-2}$, $-\log 25$, $2\log\frac{1}{5}$; c: $o\log n^b a^b$, $b\log(na)^o$, bologna

7-130. The graph should show a decreasing exponential function that will have an asymptote at room temperature. The temperature of the drink would not drop below the temperature of the room.

7-131. a: $\frac{b-a}{b+a}$, b: xy

7-132. a: $x \geq \frac{1}{2}$ and $y \geq 3$, b: $g(x) = \frac{(x-3)^2+1}{2}$, c: $x \geq 3$ and $y \geq \frac{1}{2}$, d: x, e: x (They are the same, because f and g are inverses.)

7-133. a: $x \approx 6.24$, b: $x = 5$

7-134. a: $(x-1)^2 + y^2 = 9$, b: $(x+3)^2 + (y-4)^2 = 4$

7-135. a: $x+5$, b: $a+5$, c: $x-y$, d: $\frac{x^2+1}{x^2-1}$

7-136. a: 16; b: 12; c: $12^4 = 20736$; d: 54; e: No, they are not inverses (if they were, then the answers to parts (c) and (d) would have to be 2).

Lesson 7.2.4

7-138. a: Decreasing by 20% means you multiply by 0.8 each time, and the presence of a multiplier implies exponential; b: $y = 23500(0.8^x)$; c: \$9625.60; d: ≈6.12 years; e: \$42,926.44.

7-139. a: $x = \frac{1}{2}$, b: any number except 0, c: $x = 10^{23}$

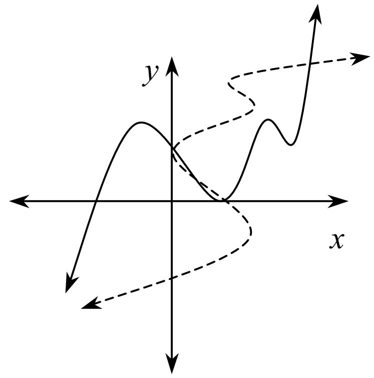
7-140. a: 2.236, b: 4.230, c: 0.316, d: 2.021, e: 3.673

7-141. a: $p^{-1}(x) = \sqrt[3]{(\frac{x}{3} - 6)}$, b: $k^{-1}(x) = \sqrt[3]{(\frac{x-6}{3})}$, c: $h^{-1}(x) = \frac{x+1}{x-1}$, d: $j^{-1}(x) = \frac{3x-2}{x} = -\frac{2}{x} + 3$

7-142. Square it and subtract 5; he dropped in a 76.

7-143. $c(x) = x^2 - 5$

7-144. a: yes; b: graph shown at right (it is not a function); c: not necessarily; d: Functions that have inverse functions have no repeated outputs; a horizontal line can intersect the graph in no more than one place; e: Yes; for example, a sleeping parabola is not a function, but its inverse is a function.



7-145. a: $x = \pm 2\sqrt{3}$, b: $x = 2$, c: $x = \frac{2}{9}$, d: $x = \frac{-1 \pm \sqrt{13}}{6}$ or $x \approx 0.434$ or $x \approx -0.768$

7-146. a: ≈ 0.0488 grams, b: roughly between 4600 and 6700 depending on how the base is rounded, c: never

7-147. a: ≈ $140,809.30, b: ≈ 24.2 years, c: ≈ $164,706.25

Lesson 7.3.1

7-155. a: –4, b: 3-by-4, c: $\begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$, d: $-G = \begin{bmatrix} -16 & -3 & 4 & -21 \\ -19 & -31 & -12 & -17 \\ -25 & 6 & -8 & -11 \end{bmatrix}$

7-156. a: It represents ingredients for each cake with frosting (matrix $C + F$ at right).
b: It represents ingredients needed to make three of each cake (matrix $3C$ at right).
c: $LC = \begin{bmatrix} 3 & 2 \end{bmatrix} \begin{bmatrix} 6 & 1 & 5 \\ 3 & 1.5 & 4 \end{bmatrix} = \begin{bmatrix} 24 & 6 & 23 \end{bmatrix}$

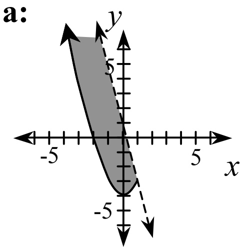
$$C + F = \begin{matrix} \\ af \\ df \end{matrix} \begin{matrix} e & s & b \\ \begin{bmatrix} 8 & 2 & 7 \\ 4 & 3.5 & 8 \end{bmatrix} \end{matrix}$$

$$3C = \begin{matrix} \\ af \\ df \end{matrix} \begin{matrix} e & s & b \\ \begin{bmatrix} 18 & 3 & 15 \\ 9 & 4.5 & 12 \end{bmatrix} \end{matrix}$$

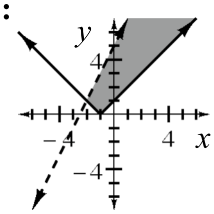
7-157. $(-1, \frac{1}{2}, 2)$

7-158. a: $y = 2(x - \frac{7}{2})^2 - \frac{23}{2}$, domain: all real numbers, range: $y \geq -\frac{23}{2}$, function
b: $x = 2(y - 1.5)^2 - 15.5$, domain: $x \geq -\frac{31}{2}$, range: all real numbers, not a function

7-159. a:



b:



7-160. There is no real solution, because a radical cannot be equal to a negative value. If students miss this, they are likely to find the incorrect solution $x = -2$, but should recognize that it is incorrect when they substitute it back in to check.

7-161. a: 41.41°, b: 28.30°

7-162. Most solving strategies will yield $x = 8$ or $x = 1$, but $x = 1$ does not check, so it is extraneous.

7-163. a: domain: $x \geq -3$, range: $y \geq 0$; b: $f(g(x) = \sqrt{x-7}$; c: domain: $x \geq 7$, range: $y \geq 0$; d: no, $g(f(x)) = \sqrt{x+3} - 10$ and $\sqrt{x+3} - 10 \neq \sqrt{x-7}$

7-164. a: $y = 3 \cdot 6^x$, b: $y = -2(0.5)^x$

Lesson 7.3.2

7-171. a: 6
b: They all make 17 bouquets.
c: See matrix at right.
d: 5*E*

$$\begin{array}{c} \\ A \\ B \\ C \end{array} \begin{array}{c} \begin{array}{ccc} \#1 & \#2 & \#3 \end{array} \\ \begin{bmatrix} 30 & 20 & 35 \\ 20 & 40 & 25 \\ 25 & 30 & 30 \end{bmatrix} \end{array}$$

7-172. a:

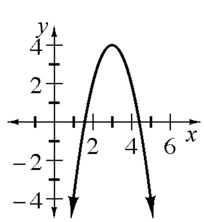
$$B = \begin{array}{c} \\ \#1 \\ \#2 \\ \#3 \end{array} \begin{array}{c} \begin{array}{ccc} L & R & D \end{array} \\ \begin{bmatrix} 5 & 4 & 3 \\ 4 & 3 & 3 \\ 4 & 6 & 6 \end{bmatrix} \end{array}$$

b: bouquets-by-flowers matrix

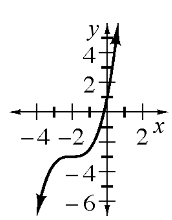
7-173. See matrix at right. *EB* makes sense. It represents the number of flowers each employee will use in a day. Notice that (employees by bouquets) · (bouquets by flowers) = (employees by flowers).

$$EB = \begin{array}{c} \\ A \\ B \\ C \end{array} \begin{array}{c} \begin{array}{ccc} L & R & D \end{array} \\ \begin{bmatrix} 74 & 78 & 72 \\ 72 & 70 & 66 \\ 73 & 74 & 69 \end{bmatrix} \end{array}$$

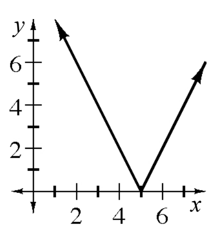
7-174. a:



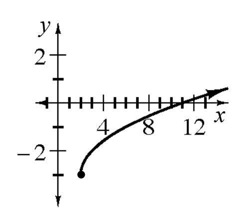
b:



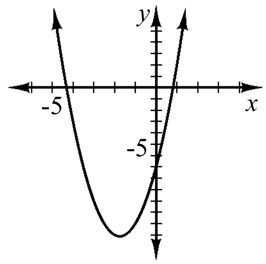
c:



d:

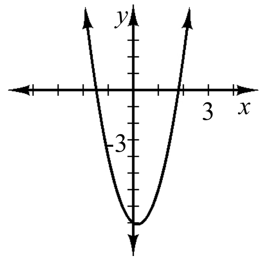


7-175. a: $y = 2(x + \frac{7}{4})^2 - \frac{105}{8}$, graph:



vertex $(-\frac{7}{4}, -\frac{105}{8})$
axis of symmetry $x = -\frac{7}{4}$

b: $y = 3(x - \frac{1}{6})^2 - \frac{97}{12}$, graph:



vertex $(\frac{1}{6}, -\frac{97}{12})$
axis of symmetry $x = \frac{1}{6}$

7-176. a: $x = \pm\sqrt{\frac{3}{5}}$; b: $x = 4, -1$; c: $x = 4$

7-177. a: $x = -4$ or $x = \frac{5}{2}$; b: $x = -4, 2,$ or 3; c: $x = 0, -1, \frac{7}{2}, -\frac{4}{3}, 13,$ or -7;
d: Set each of the factors equal to zero and solve the corresponding equations.

7-178. $y = x^2 - 6x + 8$

Lesson 7.3.3

7-185. $\begin{bmatrix} 33 \\ 26 \end{bmatrix}$

7-186. 2 by 1

7-187. a: $\begin{bmatrix} 4a + 9b + 2c \\ 6a + 5c \end{bmatrix}$ b: $\begin{bmatrix} 9 & 18 & 1 \\ 12 & 4 & -9 \end{bmatrix}$

c: The operation is impossible because the number of entries in the rows of the first does not match the number of entries in the columns of the second.
d: The operation is impossible because the dimensions are not the same.

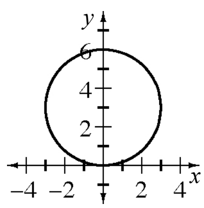
7-188. a: 11, b: 5 by d

7-189. a: $\log 6 = \log 3 + \log 2 \approx 0.7781$, b: $\log 15 = \log 3 + \log 5 \approx 1.1761$,
c: $\log 9 = 2 \log 3 \approx 0.9542$, d: $\log 50 = 2 \log 5 + \log 2 \approx 1.6990$

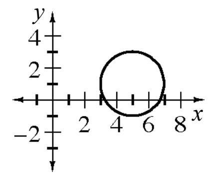
7-190. $x = 5$; a: Squaring still left a radical.

7-191. a: Set each factor equal to zero to get $x = 0, \frac{1}{2}$, or 3.
b: Factor to get $x(x-1)(2x+3) = 0$; $x = 0, 1$, or $-\frac{3}{2}$.

7-192. a:



b:



7-193. a: $\frac{x+3}{2x-1}$, b: $\frac{1}{(x-3)}$

Lesson 7.3.4

7-200. a: $\begin{bmatrix} 9 & -1 \\ 4 & 10 \end{bmatrix}$, b: $\begin{bmatrix} 20 & -5 \\ 35 & 10 \end{bmatrix}$, c: $\begin{bmatrix} -23 & 8 \\ -29 & -16 \end{bmatrix}$, d: $\begin{bmatrix} -20 & 5 \\ -44 & -19 \end{bmatrix}$

7-201. $\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$

7-202. a: $\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}\begin{bmatrix} p \\ q \end{bmatrix} = \begin{bmatrix} 7 \\ 11 \end{bmatrix}$, b: $\begin{bmatrix} 4 & -5 \\ -3 & 4 \end{bmatrix}\begin{bmatrix} m \\ n \end{bmatrix} = \begin{bmatrix} -2 \\ 9 \end{bmatrix}$, c: $\begin{bmatrix} 4 & -1 & 1 \\ 2 & 2 & 3 \\ 5 & -2 & 6 \end{bmatrix}\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} -5 \\ 10 \\ 1 \end{bmatrix}$,

d: $\begin{bmatrix} 7 & -3 & 0 & 2 \\ -2 & 1 & 0 & -1 \\ 4 & 0 & 1 & -2 \\ 1 & 0 & 0 & -3 \end{bmatrix}\begin{bmatrix} w \\ x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 41 \\ -13 \\ 12 \\ 1 \end{bmatrix}$

7-203. a:

	Pc	Pn
Juan	3	2
Huang	4	5
Danusha	6	4

b:

	$
Pc	0.10
Pn	0.25

c:

	$
Juan	0.80
Huang	1.65
Danusha	1.60

Interpretation of 2, 1 entry: Huang's pencils and pens are worth $1.65.

7-204. $\begin{bmatrix} a & b \\ c & d \\ e & f \end{bmatrix}\begin{bmatrix} g \\ h \end{bmatrix} = \begin{bmatrix} ag+bh \\ cg+dh \\ eg+fh \end{bmatrix}$

7-205. x^{-1}

7-206. a: $\frac{6x-21}{x^2-3x-4}$, b: $\frac{5}{x^2-9}$

7-207. $x = 1$ only; $x = 681$ does not check.

7-208. a: $x = 2, 3$; b: $x = \frac{1}{3}, -4$

Lesson 7.3.5

7-218. a and b: Students should show that they multiply to give $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$.

7-219. a: $p = -3$, $q = 5$; b: $m = 37$, $n = 30$

7-220. a: matrix shown at right
b: 15
c: impossible because there is no third column

$P = \begin{bmatrix} -7 & 15 \\ 12 & -1 \end{bmatrix}$

7-221. a: impossible, since M is not square b: $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ c: $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$

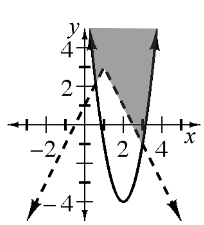
7-222. a: $a+b$, b: $2c$, c: $a+2b$, d: $3a+c$

7-223. a: $x \approx 2.657$, b: $x \approx 0.936$, c: $x \approx -0.711$

7-224. $x = 7$ only; $x = \frac{13}{16}$ does not check.

7-225. a: $\frac{3}{x+1}$, b: $\frac{x-4}{x^2-3x+2}$

7-226. a:



b: