IM2 Book 1 Selected Answers

IM2 Dream Team

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1. $x = -3$

2. $-$

3. (a) $x(x+4)$

   (b) $3x(x-5)$

   (c) $-x(2x+7)$

4. (a) $x = 0, 4$

   (b) $x = 0, 5$

   (c) $x = 0, -\frac{7}{2}$

5.

$2 \le x$	$-$	all values that are at least 2	$-$
$-4 < x < 0$	$-$	$-$	$(-4, 0)$
$x < 1$	$-$	all values that are less than 1	$(-\infty, 1)$

6. Answers may vary. Soln: $(0, 5)$. Non-soln: $(0, 0)$.

7. $4a^2, 2a^2$

8. (a) $-$

   (b) $24 \le x$

9. $(x+4)(x+1)$. 4 and 1 add to 5 and multiply to 4.

10. $x^2 + (q+p)x + pq$. $\nabla = (q+p)$. $\Delta = pq$.

11. (a) $-$

    (b) $37 \le 37$

    (c) $-$

    (d) $x \ge 18$

12. $x = 1, -4, \frac{3}{2}$

13. (a) Answers may vary.
    System soln: $(2, 4)$
    Soln to one eqn but not the other: $(0, 0)$
    Not a system soln: $(0, 0)$

(b) –

(c) One solution.

14. Answers may vary.

$$\begin{cases} y = x \\ y = x + 1 \end{cases}$$

15. Answers may vary.

$$\begin{cases} y = x \\ 2y = 2x \end{cases}$$

16. $(3x)^2$

17. $x > -5$

18. (a) $x \le -10$

(b) $x \le -10$

19. (a) $x = -4$

(b) $x = 3, 5$

(c) $x = -1, 7$

20. (a) $\left(\frac{1}{2}, \frac{1}{3}\right)$

(b) $(1, -2)$

21. (a) –

(b) $y = x^2$

22. (a) $f(2) = 5$
$f(-4) = -1$

(b) x = -1

23. (a) $2x + y = 3$

(b) No solutions

24.

Words	Function Formula
	$f(x) = 2x$
	$f(x) = 5x - 1$
divide the input by 2 and add 5	

25. (a) $f(-3) = 3$
$f(0) = 0$
$f(2) = 2$

(b) $x = \pm 4$

26. (a) –

   (b) 6

   (c) $x = \pm 10$

27. $(3x + 4)(x - 3)$

28. (a) $-7 \le x$

   (b) $x < 4$

29. (a) 5

   (b) 12

   (c) $|x - y|$

30. No

31. $x \ge 0$

32. $|a - b| = |b - a|$

33. $(4x + 1)(x + 5)$

34. (a) 9 and 4

   (b) 9 and -4

   (c) x and 7

   (d) x and 0

35. (a) –

   (b) $|x| > 6$

   (c) –

36.

	–	all values that are 2 units away from -5	–	$x = -3, -7$
	$|x| = 5|$	–	–	$x = -5, 5$
	$|x + 1| = 2$	all values that are 2 units away from -1	–	$x = -3, 1$

37. (a) All values that are 5 units away from 2.

   (b) All values that are 10 units away from -4.

38. $A = (2a + b)(a + 3b)$

39. (a) $(x - 2)(x - 6)$

   (b) $(3x - 2)(2x + 3)$

   (c) $2x(3x - 1)$

40. $BC = 8$, $AC = 15$, and $AB = 17$

41. (a) $x^2 - 16$

   (b) $x^2 - 49$

(c) $9x^2 - 4$

(d) $x^2 - a^2$

42. (a) $(x - 8)(x + 8)$

(b) $(x - c)(x + c)$

(c) $(2x - 5)(2x + 5)$

(d) $(ax - c)(ax + c)$

43.

–	all values that are at most 2 units away from -5	–	$-7 \le x \le -3$
$|x| \ge 6$	–	–	$x < -6$ or $x > 6$
$|x - 1| \le 4$	all values that are at most 4 units away from 1	–	–

44. (a) –

(b) $(0,0)$

(c) $(-\infty, \infty)$

(d) $y = 0$

(e) $[0, \infty)$

45. $y = -x$, $y = x$

$$|x| = \begin{cases} -x \text{ if } x < 0 \\ x \text{ if} x \ge 0 \end{cases}$$

46. $x = 12$

47. (a) All values at most 2 units away from 7.

(b) $x > -2$ or $x < -8$

48. $(-2, 2)$
$(3, 7)$

49. (a) –

(b) $|x - 52| \le 3$

50. $|x - y| = 12$. Infinite.

51. (a) $3x(x + 4)$

(b) $(x + 5)(x + 3)$

(c) $2(x + 1)(x - 3)$

(d) $9(x - 2)(x + 2)$

52. 120

53.

$$|x + 2| = \begin{cases} -x + 2 \text{ if } x < -2 \\ x + 2 \text{ if } x \ge -2 \end{cases}$$

54.   (a) $x = -5, 5$

     (b) blob $= -5, 5$

55. Yes

56. $f(x) = |x|$

57.   (a) 77 blocks

     (b) 19 blocks

     (c) $-$

     (d) $y = |x - 91|$

58. $-$

59. $|l - 12| \leq 0.01$

60.   (a) $(-28, 12)$

     (b) $(-\infty, 0] \cup [8, \infty)$

61.   (a) $a = -1, -6$

     (b) $x = \frac{-19}{2}, \frac{9}{2}$

62. $-1 \leq a \leq 6$

63. $|x| = 3$
    $x = -3$ or $x = 3$

64. No

65.   (a) $-$

     (b) $y = |x - 34|$

     (c) $x = 18, 50$

66. $x = -4, 4$

67.   (a) $-$

     (b) vertex: $(4, 0)$
        domain: $(-\infty, \infty)$
        range: $[0, \infty)$
        minimum value: $y = 0$

     (c) $x = 4$

68.   (a) Shift $f(x)$ left by 5

     (b) $(-5, 0)$. Shift it left by 5.

69. $x = 6, 1$

70.
$$|x - 7| = \begin{cases} x - 7 \text{ if } x \geq 7 \\ -x + 7 \text{ if } x < 7 \end{cases}$$

71. $(10, 3)$

72. $x = 4, -6$

73. $x = -1, -4$

74. Shift it right by 3

75. $g(x) = |x - h|$

76.

x	$|x|$	$|x| - 2$
-3	3	1
-2	2	0
-1	1	-1
0	0	-2
1	1	-1
2	2	0
3	3	1

Translate $f(x)$ down by 2.

77. (a) $\left(-\frac{4}{3}, \frac{4}{3}\right)$
    (b) $\left(-\infty, -\frac{84}{5}\right] \cup \left[\frac{56}{5}, \infty\right)$
    (c) $\left[-\frac{1}{2}, \frac{13}{2}\right]$

78. (a) $x = -5, -4$
    (b) $x = -\frac{7}{2}, 3$
    (c) $x = -9, 9$
    (d) $x = -\frac{1}{4}, 4$

79. Left graph: $y = |x|$
    Right graph: $y = |x - 3|$

80. Shift/translate the graph up by 3
    Shift/translate the graph down by 5.

81. $f(x) = |x - 3|$

82. n^2

83. $x = -2, 4$
    $x \in [-2, 4]$

84. (a) Shift/translate the graph up by k

6

(b) $(0, k)$

Shift/translate $(0,0)$ up by k

85.

x	$|x|$	$-|x|$
-3	3	-3
-2	2	-2
-1	1	-1
0	0	0
1	1	-1
2	2	-2
3	3	-3

You can reflect $y = |x|$ over the x-axis.

86. $(2, 0)$; $(-2, 0), (2, 0)$

87.
$$g(x) = \begin{cases} -x - 2 \text{ if } x \leq 0 \\ x - 2 \text{ if } x > 0 \end{cases}$$

88. Shift $f(x)$ to the right h and up k. Vertex: (h, k).

89.

x	$|x|$	$2|x|$	$0.5|x|$
-3	3	6	1.5
-2	2	4	1
-1	1	2	0.5
0	0	0	0
1	1	2	0.5
2	2	4	1
3	3	6	1.5

You can vertically stretch $|x|$ by a factor of 2 to get $2|x|$. You can vertically compress $|x|$ by a factor of 2 to get $0.5|x|$.

90. (a) Vertically stretch $|x|$ by a factor of a.

(b) Vertically stretch $|x|$ by a factor of a and then reflect it over the x-axis.

91. 320, 210

92. $\begin{bmatrix} 320 & 98 & 135 \\ 405 & 110 & 120 \end{bmatrix}$

93. $(0, |h| + k)$

94. Vertex: $(0, 0)$

Vertex: $(0, 6)$. x-intercepts: $(-2, 0), (2, 0)$

95. (a) Shift $|x|$ right by 1. Vertically stretch it by a factor of 2. Shift it down by 6.

(b) –

(c) Vertex: $(1, -6)$
Domain: $(-\infty, \infty)$
Range: $[-6, \infty)$
Minimum-value: $y = -6$

(d) $(-2, 0), (4, 0)$

96. (a) Shift $f(x)$ right by 3. Reflect it over the x-axis. Shift it up by 5.

(b) –

(c) Vertex: $(3, 5)$
Domain: $(-\infty, \infty)$
Range: $(-\infty, 5]$
Maximum value: 5

(d) $(-2, 0), (8, 0)$

97. $a = -3$

98.

x	$|x|$	x^2
-2	2	4
-1	1	1
$-\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{4}$
1	1	1
2	2	4

Vertex: $(0, 0)$
Domain: $(-\infty, \infty)$
Range: $[0, \infty)$
Minimum value: 0
Axis of symmetry: $x = 0$

99. (a) $y = |x - 1| + 2$

(b) $y = -|x| + 1$

(c) $y = 2|x + 3| - 1$

100. $A + B = \begin{bmatrix} -1 & 3 \\ 6 & -2 \end{bmatrix} + \begin{bmatrix} 7 & 0 \\ 2 & -4 \end{bmatrix} = \begin{bmatrix} 6 & 3 \\ 8 & -6 \end{bmatrix}$

$A - B = \begin{bmatrix} -1 & 3 \\ 6 & -2 \end{bmatrix} - \begin{bmatrix} 7 & 0 \\ 2 & -4 \end{bmatrix} = \begin{bmatrix} -8 & 3 \\ 4 & 2 \end{bmatrix}$

101. Vertex: $(5, -3)$
Domain: $(-\infty, \infty)$
Range: $[-3, \infty)$
Minimum: -3
x-intercepts: $(\frac{1}{2}, 0), (\frac{19}{2}, 0)$

$$y = \begin{cases} \frac{2}{3}(x-5) - 3, & x \geq 5 \\ -\frac{2}{3}(x-5) - 3 & x < 5 \end{cases}$$

102. Two: $(0, h - k), (0, h + k)$

103.

x	x^2	$x^2 + 1$	$x^2 - 5$
-2	4	5	-1
-1	1	2	-4
0	0	1	-5
1	1	2	-4
2	4	5	-1

$g(x)$: shift $f(x)$ up by 1
$f(x)$: shift $f(x)$ down by 5

104. (a) 3

(b) -9

105. Intersections: $(1, 2), (5, 2)$
$Area = 8$

106. (a) $x = -1, 5$

(b) $(-\infty, -1] \cup [5, \infty)$

107. (a) $[0, 100]$

(b) The midpoint of the road between Salina and Green River

(c) $y = -|x - 50| + 50$

(d) $d = -\frac{5}{6}|t - 60| + 50$

108.

x	x^2	$-x^2$
-3	9	-9
-2	4	-4
-1	1	-1
0	0	0
1	1	-1
2	4	-4

Reflect $f(x)$ over the x-axis.

109.

x	x^2	$2x^2$	$0.5x^2$
-3	9	18	4.5
-2	4	8	2
-1	1	2	0.5
0	0	0	0
1	1	2	0.5
2	4	8	2

$g(x)$: Vertically stretch $f(x)$ by a factor of 2.
$h(x)$: Vertically compress $f(x)$ by a factor of 2.

110. (a) Friday: \$2,250
Saturday: \$7,100
Sunday: \$5,650

(b) $[120, 210] \cdot [10, 5] = 120(10) + 210(5) = \$2,250$

111. Shift $f(x)$ up by c.
Vertex: $(0, c)$
Range: $[c, \infty)$
Minimum: c

112. (a) $-$

(b) $(32, 55)$

(c) $(21, 55]$

(d) $[45, 65]$

113. Vertically stretch the graph by a factor of 3.
Shift it up by 6.

114. (a)

x	x^2
-3	9
-2	4
-1	1
0	0
1	1
2	4
3	9

x	$\sqrt{x}$
0	0
1	1
4	2
9	3
16	4

The values of x^2 are useful as inputs for the $g(x) = \sqrt{x}$ table.

(b) Vertex: None
Domain: $[0, \infty)$
Range: $[0, \infty)$
Min: 0
It does not have an axis of symmetry.

115. $a = \frac{3}{2}$

116. It's the total revenue that the zoo made on Sunday.

117.
$$\begin{bmatrix} 120(10) + 210(5) \\ 400(10) + 620(5) \\ 320(10) + 490(5) \end{bmatrix} = \begin{bmatrix} 2,250 \\ 7,100 \\ 5,650 \end{bmatrix}$$

10

118. Vertex: $(0,0)$
Max: 64
Axis of symmetry: $x = 0$
x-intercepts: $(-4, 0), (0, 4)$

119. Skip

120. Highest: $y = x^2 + 1$
Middle: $y = \frac{1}{2}x^2$
Lowest: $y = -x^2 - 2$

121. Shift the graph right by h

122. Shift $f(x)$ right by 3
Domain of f: $[0, \infty)$
Domain of g: $[3, \infty)$

123.
$$\begin{bmatrix} 16 \\ 20 \end{bmatrix}$$

124.
$$\begin{bmatrix} 5x - 2y \\ 3x + 4y \end{bmatrix}$$

125. No. The number of columns in A must equal the number of rows in B.

126. (a) $(1, 9), (7, 9)$

(b) $x = 1, 7$

127. –

128. –

129. $h(x) = -2(x + 2)^2$

130. $x = -2$
$(-4, 4)$

131. (a) $(x + 5)(x + 5) = (x + 5)^2$, $5 = \frac{10}{2}, \sqrt{25}$

(b) $(x + 6)(x + 6) = (x + 6)^2$, $6 = \frac{12}{2}, \sqrt{36}$

(c) $(x - 7)(x - 7) = (x - 7)^2$, $-7 = \frac{-14}{2}, -\sqrt{49}$

132.
$$\begin{bmatrix} 1 & 6 \\ -7 & -3 \end{bmatrix}$$

133. (a) Shift $f(x)$ down by 4.

(b) $h(x) = -(x + 2)^2 - 7$

134. (a) $x = 1, 4$

    (b) $(1, 3), (4, 6)$

    (c) –

135. Domain: $[4, \infty)$
Range: $[3, \infty)$

136. $a = -\frac{1}{2}$

137. –

138. $\left(-\frac{4}{3}, \frac{7}{3}\right), \left(\frac{8}{3}, -\frac{1}{3}\right)$

139. (a) $x^2 - 16x + 64 = (x - 8)^2$

    (b) $x^2 + 10x + 25 = (x + 5)^2$

    (c) $x^2 - 5x + \frac{25}{4} = \left(x - \frac{5}{2}\right)^2$

140. $(-4, 0), (2, 0)$

141. (a) $2x(x - 4)(x + 4)$

    (b) $(x + 12)^2$

    (c) $(3x + 1)(3x - 2)$

142. Sum: $\begin{bmatrix} 8 & -2 \\ 1 & 2 \end{bmatrix}$

    Product: $\begin{bmatrix} 12 & 2 \\ 2 & -3 \end{bmatrix}$

143. $(5, 0), (0, 1)$

144. Domain: $(-\infty, 0]$
Range: $[0, \infty)$

145. –

146. (a) $x = 3 \pm \sqrt{11}$

    (b) $x = 3 \pm \sqrt{11}$

    (c) $x = 3 \pm \sqrt{11}$

147. $x = 2 \pm \sqrt{6}$

148. No

149.
$$\begin{bmatrix} 1 & 2 \\ 3 & 3 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 5 \\ 6 \end{bmatrix}$$

150. (a) $x = 0, 10$

 (b) A.O.S.: $x = 5$
  Vertex: $(5, -25)$

 (c) –

151. $x = 5$

152. (a) $(0,0), (0,4), (-2,-4)$

  (b) $(0,0), (3,0), (\frac{3}{2}, -\frac{9}{2})$

  (c) $(0,0), (-\frac{7}{2}, 0), (-\frac{7}{4}, \frac{49}{8})$

153. $x = h \pm \sqrt{-\frac{k}{a}}$

154. (a) $x = 4 \pm \sqrt{19}$

  (b) $x = -11, 1$

  (c) $x = \frac{5}{2} \pm \frac{1}{2}\sqrt{33}$

155. $x = -\frac{3}{5} \pm \sqrt{\frac{14}{25}}$

156. (a)
$$\begin{bmatrix} 2 & 3 \\ -1 & 5 \end{bmatrix}$$

  (b)
$$\begin{bmatrix} 2 & 3 \\ -1 & 5 \end{bmatrix}$$

157.
$$\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

158. (a) $0 = a(0^2) + b(0) + c$

  (b) $a = 1$
   $b = 1$

  (c) $y = x^2 + x$

159. Greatest height: 3 units above the ground
  Distance: 12 units away

160. x-intercepts: $(-2, 0), (4, 0)$
  Axis of symmetry: $x = 1$
  The axis of symmetry runs through the midpoint of the x-intercepts.

161. (a) x-intercepts: $(0,0), (-\frac{b}{a}, 0)$
   Axis of symmetry: $x = -\frac{b}{2a}$

  (b) Translate it up by c
   Axis of symmetry: $x = -\frac{b}{2a}$

162. $2(x-2)^2 - 7$

163. $3(x + \frac{2}{3})^2 - \frac{7}{3}$

164. (a) $x = -\frac{1}{2}, 3$

   (b) $x = -\frac{1}{2}, 3$

165. The multiplicative inverse of $\frac{2}{3}$ is $\frac{3}{2}$.
   No, zero doesn't have a multiplicative inverse.

166.
$$\begin{bmatrix} -1 & 2 \\ -3 & 5 \end{bmatrix}$$

167. $y = x^2 - 2x + 3$ is $y = x^2 - 2x$ translated up by 3.

168. $y = 2x^2 - 6x + 2$

169. (a) $y = -0.002x(x - 250)$

   (b) 250 yards away
       Domain: $x \in [0, 250]$

   (c) $\frac{125}{4}$ yards

170. $x = -\frac{b}{2} \pm \sqrt{\frac{b^2}{4} - c}$

171. (a) $p^2(p - 2)(p + 2)$

   (b) $w(w - 5)(w + 3)$

   (c) $y(4 - 3z)(4 + 3z)$

   (d) $2(x + 5)^2$

172. (a) $x = 7 \pm \sqrt{3}$

   (b) $x = -\frac{5}{3}, -2$

   (c) $x = \pm\sqrt{6}$

173. $\left(\frac{m+n}{2}, -\frac{a}{4}(m - n)^2\right)$

174.
$$\begin{bmatrix} 3 & 4 \\ 1 & 2 \end{bmatrix}^{-1} = \begin{bmatrix} 1 & -2 \\ -\frac{1}{2} & \frac{3}{2} \end{bmatrix}$$

175. (a) $x = 1 \pm \sqrt{10}$

   (b) $x = -1, 3$

   (c) $x \in [-1, 3]$

176. x-intercepts: $(-7, 0), (-5, 0)$
   vertex: $(-6, -1)$

177. (a) –

    (b) $(4, 1), (5, 1)$. These are the two solutions to the system.

178. $a = \frac{2}{3}$

179. $y = \frac{3}{16}x(x - 8)$

180. $y = 2x^2 + 3x - 4$

181. (a) 2

    (b) 1

    (c) 10

182. Step $1 \to 2$ uses the multiplicative inverse. Step $2 \to 3$ uses the multiplicative identity.

183. (a) Because they're multiplicative inverses

    (b) Because it's the multiplicative identity

    (c) $(x, y) = (2, 1)$

    (d) –

184.

$$\begin{bmatrix} 4 \\ 7 \end{bmatrix}$$

185. Not necessarily

186. $x^2 - 14x + 43 = 0$

187. –

188. Factored form. $y = -\frac{2}{3}(x + 2)(x - 3)$

189. $(-1 + \sqrt{2}, -1 + 2\sqrt{2}), (-1 - \sqrt{2}, -1 - 2\sqrt{2})$

190. Answers may vary. $(5, 0), (0, 5), (-5, 0), (0, -5), (3, 4)$

191. Answers may vary. $(0, 2), (4, 4), (-4, 4)$

192. Parabola. Vertex: $(\frac{b}{2}, \frac{b^2}{4})$

193. $x^2 - 4x - 1$. Yes.

194.

$$\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 5 \\ -1 \end{bmatrix}$$

195. There are no solutions. Not every matrix has an inverse.

196. Answers may vary. $35, -35, 16$. There are nine examples.

197. Answers may vary. $0, 3, 4$. There are infinite examples.

198. $x^2 + y^2 = 25$. No, it doesn't represent a function of y in terms of x.

199. Answers may vary. $(0, 1), (2, 2), (-2, 2)$.

202. $x = -4, 6$

203. (a) $x = -4 \pm \sqrt{23}$
    (b) $x = -20, 8$
    (c) $x = -7, 3$
    (d) $x = -5, \frac{1}{3}$

206. (a) $A = (10, 0), B = (-8, 6)$
    (b) $C = (-8, -6)$