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) $x \leq -10$

(b) $x \leq -10$

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

	Words	Function Formula
24.		$f(x) = 2x$
		$f(x) = 5x - 1$
	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.

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

4

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

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

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

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) $x = -5 \pm \sqrt{36}$
    (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. –

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