

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

$2 \leq x$	$-$	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) $24 \leq x$

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) $37 \leq 37$
(c) $-$
(d) $x \geq 18$

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) $(\frac{1}{2}, \frac{1}{3})$
 (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
	$f(x) = 2x$
divide the input by 2 and add 5	$f(x) = 5x - 1$

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) $-7 \leq x$
 (b) $x < 4$
29. (a) 5
 (b) 12
 (c) $|x - y|$
30. No
31. $x \geq 0$
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) –
- | | | | |
|---------------|--|---|--------------|
| – | 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 | – | $x = -3, 1$ |
36. (a) All values that are 5 units away from 2.
 (b) All values that are 10 units away from -4.
37. $A = (2a + b)(a + 3b)$
38. (a) $(x - 2)(x - 6)$
 (b) $(3x - 2)(2x + 3)$
 (c) $2x(3x - 1)$
39. $BC = 8$, $AC = 15$, and $AB = 17$
40. (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) $(ax - c)(ax + c)$

—	all values that are at most 2 units away from -5	—	$-7 \leq x \leq -3$
$ x \geq 6$	—	—	$x < -6$ or $x > 6$
$ x - 1 \leq 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. $y = -x, y = x$

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

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) $|x - 52| \leq 3$

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.

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

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

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) $(-\frac{4}{3}, \frac{4}{3})$

(b) $(-\infty, -\frac{84}{5}] \cup [\frac{56}{5}, \infty)$

(c) $[-\frac{1}{2}, \frac{13}{2}]$

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

	x	$ x $	$- x $
85.	-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) .

	x	$ x $	$2 x $	$0.5 x $
89.	-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. $a = -3$

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: $(0, h-k), (0, h+k)$

	x	x^2	$x^2 + 1$	$x^2 - 5$
103.	-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: $(1, 2), (5, 2)$

$\text{Area} = 8$

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

	x	x^2	$-x^2$
108.	-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.

	x	x^2	$2x^2$	$0.5x^2$
109.	-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.

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

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

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

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

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

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 \rightarrow 2 uses the multiplicative inverse. Step 2 \rightarrow 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) $C = (-8, -6)$