

# 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	$-$
5.	$-4 < x < 0$	$-$	$-$	$(-4, 0)$
	$x < 1$	$-$	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
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)  $-7 \leq x$   
 (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 $-5$	$-$	$x = -3, -7$
36.	$ 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	–	$-7 \leq x \leq -3$
	$ 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)  $\text{blob} = -5, 5$
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  $k$

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

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

103.

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

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

108.

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

$x$	$x^2$	$2x^2$	$0.5x^2$
-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

109.

$g(x)$ : 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.  $(-\frac{4}{3}, \frac{7}{3}), (\frac{8}{3}, -\frac{1}{3})$
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)  $C = (-8, -6)$