

## IM1H Book 2 Selected Answers

IM1H Dream Team

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1.
  - (a)  $\angle 2, \angle 3, \angle 5, \angle 8$
  - (b)  $\angle 1, \angle 4, \angle 6, \angle 7$
  - (c)  $\angle 3, \angle 5$   
 $\angle 2, \angle 8$
  - (d)  $\angle 4, \angle 6$   
 $\angle 1, \angle 7$
  - (e) Answers may vary.  $\angle 1, \angle 5$
2.
  - (a)  $\angle 2 + \angle 4 = 180^\circ$
  - (b)  $\angle 2 + \angle 1 + \angle 3 = 180^\circ$
  - (c)  $\angle 4 = \angle 1 + \angle 3$
  - (d) –
  - (e) –
3.
  - (a) If  $P$  is not equidistant from the coordinate axes, then  $P$  is not on the line  $y = x$ .
  - (b) Yes. Always.
4. –
5. Exactly one
6. –
7.
  - (a)  $\angle AHK \cong \angle HKD$
  - (b)  $\angle AHK \cong \angle EHB$
  - (c)  $\angle EHB \cong \angle HKD$
  - (d) If two lines are cut by a transversal such that two corresponding angles are congruent, then the lines are parallel.
  - (e)  $\angle KHB + \angle HKD = 180^\circ$
8.
  - (a)  $\overline{RU} \parallel \overline{AT}$
  - (b) None

- (c)  $\overline{RU} \parallel \overline{AT}$   
 $\overline{RN} \parallel \overline{OT}$
  - (d)  $\overline{RU} \parallel \overline{AT}$   
 $\overline{AU} \parallel \overline{NT}$
  - (e)  $\overline{AU} \parallel \overline{NT}$
  - (f) None
  - (g)  $\overline{AU} \parallel \overline{NT}$
  - (h) None
9. –
10. –
11. No. Two lines on the same plane that never intersect.
12. It's constant. No.
13. –
14. (a)  $\angle a + \angle b + \angle c = 180^\circ$   
(b)  $\angle x = \angle a$   
 $\angle y = \angle b$
15. (a)  $B(6, 0, 0)$   
 $C(6, 3, 0)$   
 $D(0, 3, 0)$   
 $E(0, 0, 2)$   
 $F(6, 0, 2)$   
 $H(0, 3, 2)$   
(b)  $\overline{AH} = \sqrt{13}$   
 $\overline{AC} = 3\sqrt{5}$   
 $\overline{AF} = 2\sqrt{10}$   
 $\overline{AG} = 7$
16. (a)  $\overline{FD} \parallel \overline{BC}$   
 $\overline{AG} \parallel \overline{CD}$   
(b)  $\overline{HS} \parallel \overline{YO}$   
 $\overline{XO} \parallel \overline{SN}$
17. (a)  $0 < x < 110$   
(b)  $81 < x < 143$
18. –
19. –
20. –

21. –
22. (a)  $\overline{AB} : y = -\frac{1}{3}x$   
 $\overline{BC} : y = -2x$   
 (b)  $\overline{KA} = 5$   
 $\overline{KB} = 5$   
 $\overline{KC} = 5$   
 (c) –  
 (d) –  
 (e) Find the intersection of the perpendicular bisectors of any two side lengths.
23. (a)  $4\sqrt{6}$   
 (b)  $4\sqrt{5}$
24. (a)  $\vec{w} = [7, 6]$   
 (b)  $\vec{w} = [-5, 8]$
25. (a)  $\overrightarrow{AB} = [3, 4]$   
 $\overrightarrow{BC} = [9, -9]$   
 $\overrightarrow{AB} + \overrightarrow{BC} = [12, -5]$   
 (b)  $\overrightarrow{AC} = \overrightarrow{AB} + \overrightarrow{BC}$
26. (a)  $\sqrt{17}$   
 (b)  $\sqrt{a^2 + b^2 + c^2}$
27.  $[1, 2, 3]$   
 $l = \sqrt{14}$
28. (a)  $4 \times 5 \times 3$   
 (b)  $5\sqrt{2}$
29.  $15^\circ$
30. (a) 12  
 (b) 48  
 (c)  $y = \frac{1}{3}x$   
 (d)  $y = -3x + 24$   
 (e)  $F = (\frac{36}{5}, \frac{12}{5})$   
 (f)  $\frac{12}{5}\sqrt{10}$   
 (g) 96  
 (h) It's twice the area because it's base times height.  
 (i)  $\frac{12}{5}\sqrt{10}$

31. (a)  $y = \frac{3}{7}(x + 2)$   
 (b)  $y = -\frac{3}{5}(x - 6)$   
 (c)  $G = (\frac{8}{3}, 2)$   
 (d) Yes,  $M$ ,  $G$ , and  $C$  are collinear.  
 (e) –
32. –
33. (a)  $x = 98^\circ$   
 (b)  $y = 73^\circ$   
 (c)  $w = 108^\circ$   
 (d)  $u = 26^\circ$
34. (a)  $x = 0$   
 $y = -\frac{2}{3}x + 4$   
 $y = x + 4$   
 (b)  $(0, 4)$
35. –
36. (a) –  
 (b) –  
 (c)  $K$  is equidistant from all three vertices.  
 (d) Yes, they are.
37.  $x = \pm 6$
38. (a) –  
 (b) By C.P.C.T.C.,  $\overline{DP} \cong \overline{DQ}$ , so  $D$  is equidistant from  $\overline{AB}$  and  $\overline{BC}$ .  
 Since we showed this for an arbitrary point  $D$  on the angle bisector,  
 it must be true for any point on the angle bisector.
39.  $\angle ABC = 68^\circ$   
 $\angle BCA = 56^\circ$
40. –

41.

$$a = 124^\circ$$

$$b = 56^\circ$$

$$c = 56^\circ$$

$$d = 38^\circ$$

$$e = 38^\circ$$

$$f = 76^\circ$$

$$g = 66^\circ$$

$$h = 104^\circ$$

$$k = 76^\circ$$

$$n = 86^\circ$$

42. (a) –

(b)  $\overline{AB} \parallel \overline{CD}$  by A.I.A.T.

(c) –

(d)  $\overline{AD} \parallel \overline{BC}$  by A.I.A.T.

(e) If both pairs of opposite sides in a quadrilateral are congruent, then the quadrilateral is a parallelogram.

(f) If a quadrilateral is a parallelogram, then both pairs of opposite sides are congruent.

43. If a quadrilateral is a parallelogram, then its diagonals bisect each other.

44.  $3 = \sqrt{x^2 + y^2 + z^2}$  or  $9 = x^2 + y^2 + z^2$ . The configuration of all such points is a sphere centered at the origin with a radius of 3.

45. –

46. –

47. The sum of the three exterior angles is  $360^\circ$ .

48. If both pairs of opposite angles in a quadrilateral are congruent, the quadrilateral is a parallelogram.

49. If all adjacent angles in a quadrilateral are supplementary, then the quadrilateral is a parallelogram.

50. (a)  $107^\circ$

(b)  $107^\circ$

(c)  $107^\circ$

51. (a)  $D = (1, -2)$

(b) It appears to be a parallelogram.

(c) If a quadrilateral has a pair of opposite, congruent, and parallel sides, it's a parallelogram

52. –

53. –

54.

$$\vec{u} + \vec{v} = [6, -1]$$

$$\vec{u} - \vec{v} = [4, 5]$$

$$\vec{u} + 2\vec{v} = [7, -4]$$

$$2\vec{u} - 3\vec{v} = [7, 13]$$

55.  $\overline{AB} \parallel \overline{DC}$   
 $\overline{AD} \cong \overline{BC}$

56. –

57.  $(90 - \frac{r}{2})^\circ$

58. No, they intersect in a way that creates one acute angle and one obtuse angle. In #57, we saw that those angles are  $(90 - \frac{r}{2})^\circ$  and  $(90 + \frac{r}{2})^\circ$ . The only way for them to intersect perpendicularly is for  $r$  to equal  $0^\circ$  which is impossible in a triangle.

59. –

60. –

61. –

62. (a)  $\overrightarrow{BA} = -\vec{u}$

(b)  $\overrightarrow{CA} = -\vec{u} - \vec{v}$

(c)  $\overrightarrow{MN} = \frac{1}{2}\vec{u} + \frac{1}{2}\vec{v}$

63.  $[5, -3, 6] \cdot [3, 7, 1] = 15 - 21 + 6 = 0$

64. (a)  $\overrightarrow{AC} = \vec{u} + \vec{v}$

(b)  $\overrightarrow{CX} = -\frac{1}{2}\vec{u} - \frac{1}{2}\vec{v}$

(c)  $\overrightarrow{DB} = \vec{u} - \vec{v}$

(d)  $\overrightarrow{XM} = \frac{1}{2}\vec{v}$

65. (a)  $\overrightarrow{PS} = [c, d]$   
 $\overrightarrow{PQ} = [a, b]$

- (b)  $R = (a + c, b + d)$
66. A  $3 \times 4$  rectangle.
67.  $C = (10, 5)$   
 $C = (-4, 3)$
68. Yes, there is. Draw diagonals  $\overline{AC}$  and  $\overline{PR}$ . You can show that they create two pairs of congruent triangles across the two quadrilaterals.
69.  $[5, -3, 6] \cdot [3, 7, 1] = 15 - 21 + 6 = 0$
70.  $[4, 0, -5]$
71.  $\left[\frac{7}{\sqrt{10}}, -\frac{21}{\sqrt{10}}, 0\right]$
72.  $-$
73. (a)  $x = 50^\circ$   
 $y = 95^\circ$
- (b)  $x = 60^\circ$   
 $y = 140^\circ$
- (c)  $x = 30^\circ$   
 $y = 30^\circ$
- (d)  $x = 9$
- (e)  $x = 7$   
 $y = -3$
- (f)  $x = 6$   
 $y = 4$
- (g)  $x = 50^\circ$
- (h)  $x = 51^\circ$   
 $y = 112^\circ$
- (i)  $x = 30$   
 $y = 10$
- (j)  $x = 6$
- (k)  $x = 50^\circ$
- (l)  $x = -1, 10$

74.

$$\angle 1 = 80^\circ$$

$$\angle 2 = 165^\circ$$

$$\angle 3 = 15^\circ$$

$$\angle 4 = 25^\circ$$

$$\angle 5 = 75^\circ$$

$$\angle 6 = 65^\circ$$

$$\angle 7 = 40^\circ$$

$$\angle 8 = 140^\circ$$

$$\angle 9 = 100^\circ$$

$$\angle 10 = 80^\circ$$

75. (a)  $\overrightarrow{AB} + \overrightarrow{BC}$   
 (b)  $\overrightarrow{AB} + \overrightarrow{AD}$   
 (c)  $-\overrightarrow{AB} + \overrightarrow{AD}$

76.  $\overrightarrow{PQ} = -\vec{v} + \vec{w}$   
 $\overrightarrow{BC} = -3\vec{v} + 3\vec{w}$

77. (a)  $\vec{a} + \vec{c}$   
 (b)  $-\vec{b} + \vec{c}$   
 (c)  $\vec{a} + \vec{b} + \vec{c}$   
 (d)  $-\vec{a} + \vec{b} + \vec{c}$

78.  $22^\circ$

79.  $90^\circ$

80.  $-$

81.  $-$

82. (a)  $-$   
 (b)  $-$   
 (c) Yes

83. (a) 60  
 (b) 30  
 (c) 20

84. No



85.  $36^\circ$

86.  $36^\circ - 36^\circ - 108^\circ$   
 $45^\circ - 45^\circ - 90^\circ$   
 $36^\circ - 72^\circ - 72^\circ$

87. (a)  $360^\circ$   
(b)

Polygon	Sketch	Number of sides	Number of diagonals from 1 vertex	Number of triangles	Interior angle sum
Triangle	—	3	0	1	$180^\circ$
Quadrilateral	—	4	1	2	$360^\circ$
Pentagon	—	5	2	3	$540^\circ$
Hexagon	—	6	3	4	$720^\circ$
Heptagon	—	7	4	5	$900^\circ$
Octagon	—	8	5	6	$1,080^\circ$
Decagon	—	10	7	8	$1,440^\circ$
Dodecagon	—	12	9	10	$1,800^\circ$
$n$ -gon	—	$n$	$n - 3$	$n - 2$	$180^\circ(n - 2)$

88. (a) Multiply  $180^\circ$  by the number of sides minus 2.  
(b)  $3,240^\circ$

89.  $75^\circ$

90. —

91. (a)  $\overrightarrow{BC} = \vec{v} - \vec{u}$   
 $\overrightarrow{MN} = \frac{1}{2}\vec{v} - \frac{1}{2}\vec{u}$   
(b)  $\overrightarrow{MN} = \frac{1}{2}\overrightarrow{BC} \implies \overline{MN} \parallel \overline{BC}$

92.  $360^\circ$

93. (a)  $(12, 4, 3)$   
(b)  $(\frac{60}{13}, \frac{20}{13}, \frac{15}{13})$

94. —

95.  $90^\circ$

96. (a)  $30^\circ$   
(b) Yes

97.  $x = \frac{240}{7}$

98. –
99. One
100. (a)  $x = 8$   
 $y = 10$   
 $z = 10$   
 (b)  $x = 10$   
 (c)  $x = 60^\circ$   
 $y = 140^\circ$   
 (d)  $x = 6$   
 $y = \frac{13}{2}$   
 (e)  $z = 65^\circ$   
 (f)  $x = 40$
101. Interior angles:  $140^\circ$   
 $\angle PAN = 100^\circ$
102. –
103.  $104^\circ$
104. One of them must be  $90^\circ$ .
105. It's the converse of the result in #104.
106.  $360^\circ$
107.  $360^\circ$
108. –
109. (a)  $36^\circ, 36^\circ, 108^\circ$   
 (b) –
110. 20
111. 15
112. 17
113. 20
114. 15
115. 18
116.  $20^\circ$
117. (a)  $\angle ANB = 84^\circ$   
 $\angle NBF = 6^\circ$

- (b)  $\angle ANB = 96^\circ$   
 $\angle NBF = 6^\circ$
118.  $60^\circ$
119. Yes, it's regular.
120. (a)  $\overline{GM} \cong \overline{MP}$   
 $\overline{BM} \cong \overline{MC}$   
 (b) –
121. 4, 7, 9, 12, 15
122. –
123. It's a parallelogram in both cases.
124.  $[3, 1 - \frac{9}{4}]$
125.  $360^\circ$
126. (a)  $36^\circ$   
 (b) 10
127. (3, 2)
128. (a) –  
 (b) Parallelogram  
 (c)  $\overline{PC}, \overline{GQ}$   
 (d) –  
 (e) –
129. (a)  $\frac{15}{2}, \frac{3}{2}\sqrt{73}, 3\sqrt{13}$   
 (b)  $5, \sqrt{73}, 2\sqrt{13}$
130. Length of medians:  $3\sqrt{3}$   
 Distance from centroid to vertices:  $2\sqrt{3}$
131. (a)  $(8, \frac{19}{3})$   
 (b)  $(\frac{a+b+c}{3}, \frac{p+q+r}{3})$
132.  $(0, \frac{-7}{3})$
133. (a) –  
 (b) 8 in.  
 (c)  $104 \text{ in.}^2$
134. Yes,  $\triangle APQ$  is equilateral.

135. No, the proofs are identical.
136.  $90^\circ$
137.  $\frac{120}{17}$
138.  $-$
139. (a)  $\frac{16}{3}$   
(b)  $\frac{25}{4}$
140. (a)  $-$   
(b) If a quadrilateral's diagonals are the same length, it is a rectangle.  
(c) No
141. (a)  $\frac{1}{2}\vec{v} - \vec{u}$   
(b)  $\frac{1}{2}\vec{u} + \frac{1}{2}\vec{v}$   
(c)  $\frac{1}{3}\vec{v} + \frac{1}{3}\vec{u}$   
(d) We just proved it with vectors.
142. No
143. Yes
144.  $2\sqrt{5}$
145. (a)  $-$   
(b)  $-$   
(c) Yes
146. (a) The diagonals must have the same length.  
(b) The diagonals must be perpendicular.
147.  $4 < d < 42$
148. (a)  $\angle B \cong \angle C$   
 $\angle A \cong \angle D$   
(b) Yes
149. Yes
150. 12
151. (a) 8  
(b)  $\frac{75}{8}$
152.  $-$
153. Yes, rectangle

154. Yes, it's an isosceles trapezoid.

155. —

156. 0

157. No

158. It must be a parallelogram.

159. 15

160. (d)

161. Kite

162. Rhombus

163. (c)

164. (a) 0

(b) 1; No

(c) 2; 5

(d) 5; 20

(e)  $n - 3$ ;  $\frac{(n-3)n}{2}$

165. —

166. —

167. (a)  $4\sqrt{3}$

(b)  $2\sqrt{3}$

168. (a) Rectangle

(b) Rectangle

(c) Rhombus

(d) Kite

(e) Isosceles trapezoid

(f) Quadrilateral

169. 6

170. —

171. No

172.  $x = 90^\circ$

$y = 55^\circ$

173.  $x = 6$   
 $y = 3$

174. —

175. —

176. —

177. (a) Sometimes  
(b) Sometimes  
(c) Sometimes  
(d) Always  
(e) Always  
(f) Sometimes  
(g) Sometimes  
(h) Always  
(i) Sometimes  
(j) Sometimes  
(k) Always  
(l) Never  
(m) Sometimes  
(n) Always  
(o) Always