

# 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)  $\frac{\overline{RU}}{\overline{RN}} \parallel \frac{\overline{AT}}{\overline{OT}}$

(d)  $\frac{\overline{RU}}{\overline{AU}} \parallel \frac{\overline{AT}}{\overline{NT}}$

(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)  $\frac{\overline{FD}}{\overline{AG}} \parallel \frac{\overline{BC}}{\overline{CD}}$

(b)  $\frac{\overline{HS}}{\overline{XO}} \parallel \frac{\overline{YO}}{\overline{SN}}$

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.

$$\begin{aligned}a &= 124^\circ \\b &= 56^\circ \\c &= 56^\circ \\d &= 38^\circ \\e &= 38^\circ \\f &= 76^\circ \\g &= 66^\circ \\h &= 104^\circ \\k &= 76^\circ \\n &= 86^\circ\end{aligned}$$

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.  $\frac{\overline{AB}}{\overline{AD}} \parallel \frac{\overline{DC}}{\overline{BC}}$

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.

$$\begin{aligned}\angle 1 &= 80^\circ \\ \angle 2 &= 165^\circ \\ \angle 3 &= 15^\circ \\ \angle 4 &= 25^\circ \\ \angle 5 &= 75^\circ \\ \angle 6 &= 65^\circ \\ \angle 7 &= 40^\circ \\ \angle 8 &= 140^\circ \\ \angle 9 &= 100^\circ \\ \angle 10 &= 80^\circ\end{aligned}$$

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

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

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)  $\frac{\overline{GM}}{\overline{BM}} \cong \frac{\overline{MP}}{\overline{MC}}$   
(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) (a) is true  
(b) is false

146. (a) The diagonals must be the same length.  
(b) The diagonals must intersect perpendicularly.

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