

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°
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° .

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°

(b) 107°

(c) 107°

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° 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 3×4 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°

79. 90°

80. –

81. –

82. (a) –
(b) –
(c) Yes

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

84. No

85. 36°

86. $36^\circ - 36^\circ - 108^\circ$

$45^\circ - 45^\circ - 90^\circ$

$36^\circ - 72^\circ - 72^\circ$

87. (a) 360°

(b)

Polygon	Sketch	Number of sides	Number of diagonals from 1 vertex	Number of triangles	Interior angle sum
Triangle	—	3	0	1	180°
Quadrilateral	—	4	1	2	360°
Pentagon	—	5	2	3	540°
Hexagon	—	6	3	4	720°
Heptagon	—	7	4	5	900°
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° by the number of sides minus 2.

(b) $3,240^\circ$

89. 75°

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°

93. (a) $(12, 4, 3)$

(b) $(\frac{60}{13}, \frac{20}{13}, \frac{15}{13})$

94. —

95. 90°

96. (a) 30°

(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°

$$\angle PAN = 100^\circ$$

102. –

103. 104°

104. One of them must be 90° .

105. It's the converse of the result in #104.

106. 360°

107. 360°

108. –

109. (a) $36^\circ, 36^\circ, 108^\circ$

(b) –

110. 20

111. 15

112. 17

113. 20

114. 15

115. 18

116. 20°

117. (a) $\angle ANB = 84^\circ$

$$\angle NBF = 6^\circ$$

- (b) $\angle ANB = 96^\circ$
 $\angle NBF = 6^\circ$
118. 60°
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°
126. (a) 36°
(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 in.^2
134. Yes, $\triangle APQ$ is equilateral.

135. No, the proofs are identical.

136. 90°

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. $x = 90^\circ$

$y = 55^\circ$

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

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