Answers for Lesson 5-1, pp. 262–264 Exercises

1. 9 **2.** 7 **3.** 14 **4.** $23\frac{1}{2}$

5. 11 **6.** 2 **7.** 40 **8.** 50

9. 160 **10.** 80

11. $\overline{UW} \parallel \overline{TX}; \overline{UY} \parallel \overline{VX}; \overline{YW} \parallel \overline{TV}$

12. $\overline{GJ} \parallel \overline{FK}; \overline{JL} \parallel \overline{HF}; \overline{GL} \parallel \overline{HK}$

13. **a.** $\overline{ST} \parallel \overline{PR}; \overline{SU} \parallel \overline{QR}; \overline{UT} \parallel \overline{PQ}$

b. $m\angle QPR = 40$

14. $\overline{FE}$ **15.** $\overline{FG}$ **16.** $\overline{AB}$

17. $\overline{EG}$ **18.** $\overline{AC}$ **19.** $\overline{CB}$

20. **a.** 1050 ft

b. 437.5 ft

21. **a.** 114 ft 9 in.

b. Answers may vary. Sample: The highlighted segment is the midsegment of the triangular face of the building.

22. 60 **23.** 45 **24.** 100 **25.** 55

26. **a.** $H(2, 0); J(4, 2)$

b. Slope of $\overline{HJ} = \frac{2}{2} = 1$; slope of $\overline{EF} = \frac{4}{4} = 1$; therefore $\overline{HJ} \parallel \overline{EF}$.

c. $HJ = \sqrt{2^2 + 2^2} = \sqrt{8} = 2\sqrt{2}; EF = \sqrt{4^2 + 4^2} = \sqrt{32} = 4\sqrt{2}$; therefore $HJ = \frac{1}{2}EF$.

27. $18\frac{1}{2}$ **28.** 37 **29.** C **30.** 60

31. 50 **32.** 10 **33.** $x = 6; y = 6\frac{1}{2}$

34. 52 **35.** $x = 3; DF = 24$ **36.** $x = 9; EC = 26$

37. Answers may vary. Sample: Draw $\overline{CA}$ and extend $\overrightarrow{CA}$ to P so that $CA = AP$. Find B, the midpt. of $\overline{PD}$. Then, by the $\triangle$ Midsegment Thm., $\overline{AB} \parallel \overline{CD}$ and $AB = \frac{1}{2}CD$.

38. $G(4, 4)$; $H(0, 2)$; $J(8, 0)$

39. $\triangle UTS$; Proofs may vary. Sample: $\overline{VS} \cong \overline{SY}$, $\overline{YT} \cong \overline{TZ}$, and $\overline{VU} \cong \overline{UZ}$ because S, T, and U are midpts. of the respective sides; $ST = \frac{1}{2}VZ$ so $\overline{ST} \cong \overline{VU} \cong \overline{UZ}$; $SU = \frac{1}{2}YZ$ so $\overline{SU} \cong \overline{YT} \cong \overline{TZ}$; and $TU = \frac{1}{2}VY$ so $\overline{TU} \cong \overline{SY} \cong \overline{SV}$; therefore $\triangle YST \cong \triangle TUZ \cong \triangle SVU \cong \triangle UTS$ by SSS.

Answers for Lesson 5-2, pp. 267–270 Exercises

1. $\overline{AC}$ is the $\perp$ bis. of $\overline{BD}$.

2. 15 **3.** 18 **4.** 8

5. The set of points equidistant from H and S is the $\perp$ bis. of $\overline{HS}$.

6. $x = 12; JK = 17; JM = 17$

7. $y = 3; ST = 15; TU = 15$

8. 27; 27

9. $\overrightarrow{HL}$ is the $\angle$ bis. of $\angle KHF$ because a point on $\overrightarrow{HL}$ is equidistant from $\overrightarrow{HK}$ and $\overrightarrow{HF}$.

10. 9

11. 54; 54

12. 5 **13.** 10 **14.** 10

15. Isosceles; it has 2 $\cong$ sides.

16. equidistant; $RT = RZ$

17. A point is on the $\perp$ bis. of a segment if and only if it is equidistant from the endpts. of the segment.

18. 12 **19.** 4 **20.** 4 **21.** 16

22. 5 **23.** 10 **24.** 7 **25.** 14

26. isosceles; $CS = CT$ and $CT = CY$ by the $\angle$ Bis. Thm.

27. Answers may vary. Sample: The student needs to know that $\overline{QS}$ bisects $\overline{PR}$.

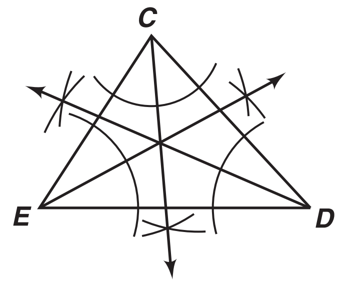
28. No; A is not equidistant from the sides of $\angle X$.

29. Yes; AX bis. $\angle TXR$.

30. Yes; A is equidistant from the sides of $\angle X$.

31. the pitcher's plate

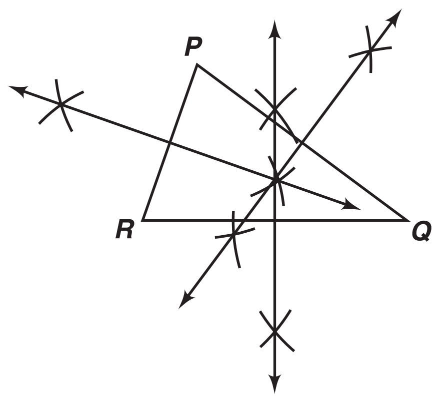
32. a.



b. The ∠ bisectors intersect at the same point.

c. Check students' work.

33. a.



b. The ⊥ bisectors intersect at the same point.

c. Check students' work.

34–39. Answers may vary. Samples are given.

34. $C(0, 2), D(1, 2); AC = BC = 2, AD = BD = \sqrt{5}$

35. $C(3, 2), D(3, 0); AC = BC = 3, AD = BD = \sqrt{13}$

36. $C(3, 0), D(0, 0); AC = BC = 3, AD = BD = 3\sqrt{2}$

37. $C(0, 0), D(1, 1); AC = BC = 3, AD = BD = \sqrt{5}$

38. $C(2, 2), D(4, 3); AC = BC = \sqrt{5}, AD = BD = \sqrt{10}$

39. $C\left(\frac{5}{2}, \frac{5}{2}\right), D(5, 3); AC = BC = \frac{\sqrt{26}}{2}, AD = BD = \sqrt{13}$

40. $\overline{AC} \cong \overline{BC}$ by definition of bisector. $\overleftrightarrow{CD} \perp \overline{AB}$, so $\angle DCA$ and $\angle DCB$ are right $\angle$s. Therefore, $\angle DCA \cong \angle DCB$ because all rt. $\angle$s are $\cong$. $\overline{DC} \cong \overline{DC}$ by the Reflexive Property of Congruence. Therefore, $\triangle CDA \cong \triangle CDB$ by Side-Angle-Side. $\overline{DA} \cong \overline{DB}$ because CPCTC, so $DA = DB$.

41. $\triangle ABP$ and $\triangle ABQ$ are right triangles with a common leg and congruent hypotenuses. Thus, $\triangle BAP \cong \triangle BAQ$ by the HL Theorem. $\overline{PB} \cong \overline{BQ}$ using CPCTC, so $\overline{AB}$ bisects $\overline{PQ}$ by the definition of bisector. Hence, $\overline{AB}$ is the perpendicular bisector of $\overline{PQ}$.

42. **a.** $\ell: y = -\frac{3}{4}x + \frac{25}{2}; m: x = 10$

b. (10, 5)

c. $CA = CB = 5$

d. C is equidist. from $\overrightarrow{OA}$ and $\overrightarrow{OB}$.

43. $\overline{BP} \perp \overrightarrow{AB}$ and $\overline{PC} \perp \overrightarrow{AC}$, thus $\angle ABP$ and $\angle ACP$ are rt. $\angle$s. Since $\overrightarrow{AP}$ bisects $\angle BAC$, $\angle BAP \cong \angle CAP$. $\overline{AP} \cong \overline{AP}$ by the Reflexive Prop. of $\cong$. Thus $\triangle ABP \cong \triangle ACP$ by AAS and $\overline{PB} \cong \overline{PC}$ by CPCTC. Therefore, $PB = PC$.

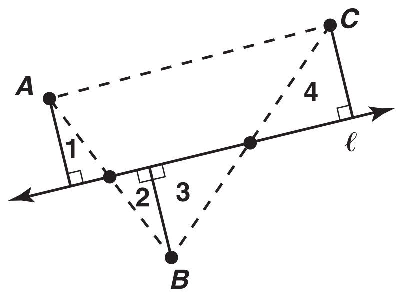
44.

1. $\overline{SP} \perp \overrightarrow{QP}$; $\overline{SR} \perp \overrightarrow{QR}$	**1.** Given
2. $\angle QPS$ and $\angle QRS$ are rt. $\angle$s.	**2.** Def. of $\perp$
3. $\angle QPS \cong \angle QRS$	**3.** All rt. $\angle$s are $\cong$.
4. $SP = SR$	**4.** Given
5. $\overline{QS} \cong \overline{QS}$	**5.** Refl. Prop. of $\cong$
6. $\triangle QPS \cong \triangle QRS$	**6.** HL
7. $\angle PQS \cong \angle RQS$	**7.** CPCTC
8. $\overrightarrow{QS}$ bisects $\angle PQR$.	**8.** Def. of $\angle$ bis

45. D

46. $y = 2$ **47.** $y = -(x - 2)$ **48.** $y = -\frac{1}{2}x + 4$

49. Line ℓ through the midpoints of 2 sides of $\triangle ABC$ is equidistant from A, B, and C. This is because $\triangle 1 \cong \triangle 2$ and $\triangle 3 \cong \triangle 4$ by ASA.



50. a. A point on the $\perp$ bis. of a segment is equidistant from endpoints of the segment ($\perp$ Bis. Thm.), so $MA = MB$ and $MB = MC$.

b. $MA = MB = MC$ by part a. $\angle EMA$, $\angle EMB$, and $\angle EMC$ are rt. $\angle$s by def. of line $\perp$ plane (page 49, Exercise 36). $\overline{MG} \cong \overline{MG}$ by the Refl. Prop. of $\cong$, so $\triangle EAM \cong \triangle EBM \cong \triangle ECM$ by SAS.

Answers for Lesson 5-3, pp. 275–278 Exercises

1. $(-2, -3)$ **2.** $(0, 0)$ **3.** $\left(1\frac{1}{2}, 1\right)$ **4.** $\left(2, -1\frac{1}{2}\right)$

5. $\left(-3, 1\frac{1}{2}\right)$ **6.** $\left(-3, -4\frac{1}{2}\right)$ **7.** $\left(3\frac{1}{2}, 3\right)$ **8.** C

9. Z

10. Find the $\perp$ bisectors of the sides of the $\triangle$ formed by the tennis court, the playground, and the volleyball court. That point will be equidistant from the vertices of the $\triangle$.

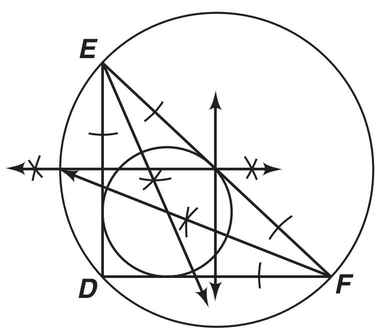
11. $TY = 18$; $TW = 27$ **12.** $ZY = 4\frac{1}{2}$; $ZU = 13\frac{1}{2}$

13. $VY = 6$; $YX = 3$ **14.** Median; A is a midpt.

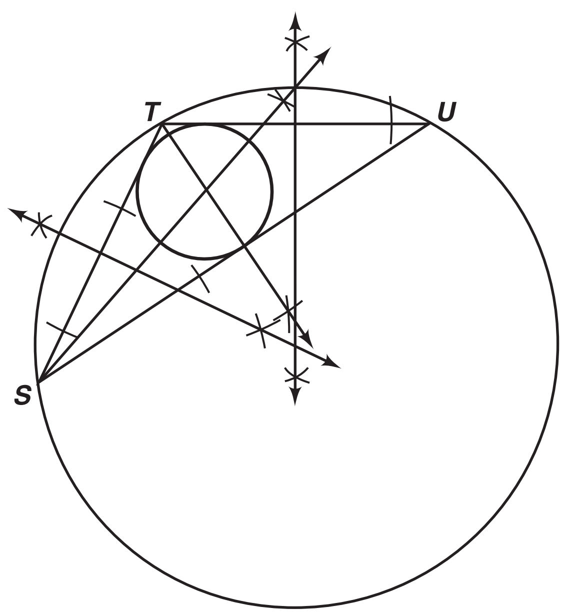
15. Neither; it's not a segment drawn from a vertex.

16. Altitude; $\overline{AB}$ is a segment drawn from a vertex of a $\triangle$ perp. to the opp. side.

17.



18.



19. $\overline{BE}$ **20.** $\overline{FC}$ **21.** $\overrightarrow{CA}$ **22.** $\overline{DG}$

23. 1:2 or 2:1

24. Find the circumcenter of the △ formed by the three pines.

25–26. Check students' work.

27. D

28. **a.** ∠ bisector; it bisects an ∠.

b. None of these; it is a midsegment.

c. Altitude; $\overline{AB}$ is ⊥ to a side from a vertex.

29. **a.** $\overline{AB}$

b. $\overline{BC}$

c. XC

d. ⊥ bis.

30. It is given that X is on line ℓ and line m. By the ∠ Bisect. Thm., $XD = XE$ and $XE = XF$. By the Trans. Prop. of =, $XD = XE = XF$. X is on ray n by the Conv. of the Bis. Thm.

31. A right triangle; check students' explanations.

32. **a.** $L(1, 3)$; $M(5, 3)$; $N(4, 0)$

b. $\overleftrightarrow{AM}: y = \frac{3}{5}x$; $\overleftrightarrow{BN}: y = -3x + 12$; $\overleftrightarrow{CL}: y = -\frac{3}{7}x + \frac{24}{7}$

c. $\left(\frac{10}{3}, 2\right)$

d. $-\frac{3}{7}\left(\frac{10}{3}\right) + \frac{24}{7} = -\frac{10}{7} + \frac{24}{7} = \frac{14}{7} = 2$

e. $AM = \sqrt{34}$; $AP = \sqrt{\frac{136}{9}} = \frac{2}{3}\sqrt{34}$; $BN = \sqrt{40} = 2\sqrt{10}$;
$BP = \sqrt{\frac{160}{9}} = \frac{4}{3}\sqrt{10}$; $CL = \sqrt{58}$; $CP = \sqrt{\frac{232}{9}} = \frac{2}{3}\sqrt{58}$

33. I-D; II-B; III-C; IV-A

34. I-A; II-C; III-B; IV-D

35. Answers may vary. Sample: Let $\triangle ABC$ be isosc. with base $\angle$s B and C. If $\overline{AD}$ bisects $\angle A$, then it is $\perp$ to $\overline{BC}$, and therefore the altitude from $\angle A$. So, $\overleftrightarrow{AD}$ contains the circumcenter, incenter, centroid, and orthocenter.

36. $\angle$ bisectors

1. Two angles are not congruent.

2. You are sixteen years old.

3. The angle is obtuse.

4. The soccer game is not on Friday.

5. The figure is not a triangle.

6. $m\angle A \geq 90$

7. **a.** If you don't eat all of your vegetables, then you won't grow.

b. If you won't grow, then you don't eat all of your vegetables.

8. **a.** If a figure is not a square, then at least one of its angles is not a right angle.

b. If at least one of the angles is not a right angle, then the figure is not a square.

9. **a.** If a figure isn't a rectangle, then it doesn't have four sides.

b. If a figure doesn't have four sides, then it isn't a rectangle.

10. Assume that it is not raining outside.

11. Assume that $\angle J$ is a right angle.

12. Assume that $\triangle PEN$ is not isosceles.

13. Assume that none of the angles is obtuse.

14. Assume that $\overline{XY} \not\cong \overline{AB}$.

15. Assume that $m\angle 2 \leq 90$.

16. I and II

17. I and II

18. I and III

19. II and III

20. **a.** 20 or more

b. the Debate Club and the Chess Club have fewer than 20 members

c. the Debate Club has fewer than 10 members

21. **a.** right angle

b. right angles

c. 90

d. 180

e. 90

f. 90

g. 0

h. more than one right angle

i. at most one right angle

22. Assume $\angle A \cong \angle B$. Then $\overline{BC} \cong \overline{AC}$ since if the base $\angle$s are $\cong$, the sides opp. them are $\cong$. But this contradicts the given $BC > AC$. Thus $\angle A \ncong \angle B$.

23. Assume one base $\angle$ is a right $\angle$. Then the other base $\angle$ is also a right $\angle$ since the base $\angle$s of an isosceles $\triangle$ are congruent. But a $\triangle$ can have at most one right $\angle$. So neither base $\angle$ is a right $\angle$.

24. **a.** If you don't live in El Paso, then you don't live in Texas; false

b. If you don't live in Texas, then you don't live in El Paso; true

25. a. If four points aren't collinear, then they aren't coplanar; false

b. If four points aren't coplanar, then they aren't collinear; true

26–29. Answers may vary. Samples are given.

26. If a figure is a square, then it has four right angles.

27. If today is Sunday, then tomorrow is Monday.

28. Not possible; a conditional and its contrapositive have the same truth value.

29. If two sides of a triangle are congruent, then the triangle is isosceles.

30. Assume that the driver did not apply the brakes. Then there would be no skid marks. This contradicts the fact that fresh skid marks appear. Thus the green car applied the brakes is a true statement.

31. Assume that the temperature outside is more than 32°F. Then ice would not be forming on the sidewalk. This contradicts the fact that ice is forming. Thus the statement that the temperature must be 32°F or less is true.

32. Assume that an obtuse triangle can contain a right angle. Then the sum of the measures of the obtuse angle and the right angle is more than 180. This contradicts the fact that the sum of the 3 angles of a triangle is 180. Thus the statement that an obtuse triangle cannot contain a right angle is true.

33. Assume $\overleftrightarrow{XY}$ and $\overleftrightarrow{XZ}$ are two different lines $\perp$ to $\overleftrightarrow{AX}$, with Y and Z on the same side of $\overleftrightarrow{AX}$. If B is on $\overleftrightarrow{AX}$ opp. pt. A from X, then $m\angle AXY + m\angle YXZ + m\angle ZXB = 180$. But $m\angle AXY = m\angle ZXB = 90$, so $m\angle YXZ = 0$. Thus X, Y, and Z are collinear.

34. If the animal is a kitten, then it is a cat. If the animal isn't a cat, then it's not a kitten.

35. If the angle measures 120, then it is obtuse. If the angle isn't obtuse, then it doesn't measure 120.

36. If a number is a whole number, then it is an integer. If a number isn't an integer, then it isn't a whole number.

37. Angie assumed that the inverse of the statement was true, but a conditional and its inverse may not have the same truth value.

38. **a.** Earl proves that it's later than 5:00.

b. He starts with the assumption that it is before 5:00.

c. It is not noisy.

39. The culprit entered the room through a hole in the roof; the other possibilities were eliminated.

40. Check students' work.

41. Assume $\overline{XB} \perp \overline{AC}$. Then $\angle AXB$ and $\angle CXB$ are right $\angle$s. Since $m\angle ABX = m\angle CBX = 36$, then $\angle A \cong \angle C$ because if two $\angle$s of a $\triangle$ are $\cong$, the third $\angle$s are $\cong$. Then $AB = BC$ since sides opp. $\cong$ $\angle$s are $\cong$ and $\triangle ABC$ is an isosceles $\triangle$. But this contradicts the given statement that $\triangle ABC$ is scalene. Thus, $\overline{XB}$ is not $\perp$ to $\overline{AC}$.

Answers for Lesson 5-5, pp. 292–294 Exercises

1. $\angle 3 \cong \angle 2$ because they are vertical $\angle$s and $m\angle 1 > m\angle 3$ by Corollary to the Ext. $\angle$ Thm. So, $m\angle 1 > m\angle 2$ by subst.

2. An ext. $\angle$ of a $\triangle$ is larger than either remote int. $\angle$.

3. $m\angle 1 > m\angle 4$ by Corollary to the Ext. $\angle$ Thm. and $\angle 4 \cong \angle 2$ because if $\parallel$ lines, then alt. int. $\angle$s are $\cong$.

4. $\angle M, \angle L, \angle K$

5. $\angle D, \angle C, \angle E$

6. $\angle G, \angle H, \angle I$

7. $\angle A, \angle B, \angle C$

8. $\angle E, \angle F, \angle D$

9. $\angle Z, \angle X, \angle Y$

10. $\overline{MN}, \overline{ON}, \overline{MO}$

11. $\overline{FH}, \overline{GF}, \overline{GH}$

12. $\overline{TU}, \overline{UV}, \overline{TV}$

13. $\overline{AC}, \overline{AB}, \overline{CB}$

14. $\overline{EF}, \overline{DE}, \overline{DF}$

15. $\overline{ZY}, \overline{XZ}, \overline{XY}$

16. No; $2 + 3 \not> 6$.

17. Yes; $11 + 12 > 15$; $12 + 15 > 11$; $11 + 15 > 12$.

18. No; $8 + 10 \not> 19$.

19. Yes; $1 + 15 > 15$; $15 + 15 > 1$.

20. Yes; $2 + 9 > 10$; $9 + 10 > 2$; $2 + 10 > 9$.

21. No; $4 + 5 \not> 9$.

22. $4 < s < 20$

23. $11 < s < 21$

24. $0 < s < 12$

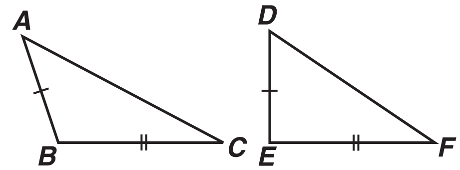
25. $5 < s < 41$

26. $3 < s < 11$

27. $15 < s < 55$

28. Answers may vary. Sample: If Y is the distance between Wichita and Topeka, then $20 < Y < 200$.

29. Let the distance between the peaks be d and the distances from the hiker to each of the peaks be a and b. Then $d + a > b$ and $d + b > a$. Thus, $d > b - a$ and $d > a - b$.

30. **a.** 

b. The third side of the 1st $\triangle$ is longer than the third side of the 2nd $\triangle$.

c. See diagram in part (a).

d. The included $\angle$ of the first $\triangle$ is greater than the included $\angle$ of the second $\triangle$.

31. Answers may vary. Sample: The shortcut across the grass is shorter than the sum of the two paths.

32. $\overline{AB}$

33. **a.** $m\angle OTY$

b. $m\angle 3$

c. Base $\angle$s of an isosc. $\triangle$ are $\cong$.

d. $\angle$ Add. Post.

e. Comparison Prop. of Ineq.

f. Subst. (step 2)

g. An ext. $\angle$ of a $\triangle$ is greater than either remote int. $\angle$.

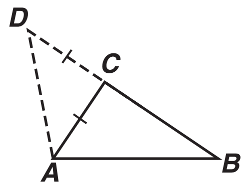
h. Trans. Prop. of Ineq.

34. $\angle T$ is the largest $\angle$ in $\triangle PTA$. Thus $PA > PT$ because the longest side of a $\triangle$ is opp. the largest $\angle$.

35. $\overline{RS}$ **36.** $\overline{CD}$ **37.** $\overline{XY}$ **38.** $\frac{1}{2}$

39. (2, 4), (2, 5), (2, 6), (3, 3), (3, 4), (3, 6), (3, 7), (4, 3), (4, 4), (4, 5), (4, 6), (4, 7), (4, 8)

40. $\frac{5}{18}$

41. 

$CD = AC$ was given so $\triangle ACD$ is isos. by def. of isos. $\triangle$. This means $m\angle D = m\angle CAD$. Then $m\angle DAB > m\angle CAD$ by the Comparison Prop. of Ineq. So by subst., $m\angle DAB > m\angle D$ and by Thm. 5-11 $DB > AB$. Since $DC + CB = DB$, by subst. $DC + CB > AB$. Using subst. again, $AC + CB > AB$.