Student Journal Answers

Chapter 1

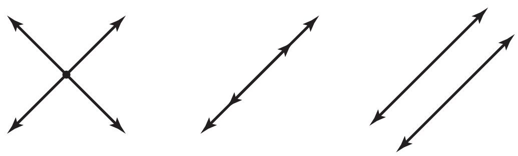
Maintaining Mathematical Proficiency

1. 4	**2.** 1
3. 2	**4.** 10
5. 4	**6.** 22
7. 9	**8.** 10
9. 11	**10.** 120 cm^2
11. 36 ft^2	**12.** 139.5 km^2

1.1 Explorations

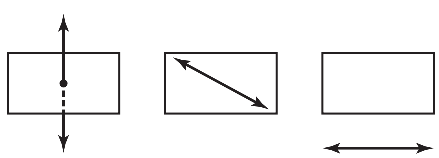
1. A line extends infinitely in each direction, a line segment has two endpoints, and a ray has one endpoint and extends infinitely in one direction.

2. a. Two lines can intersect at a point, overlap, or not intersect.



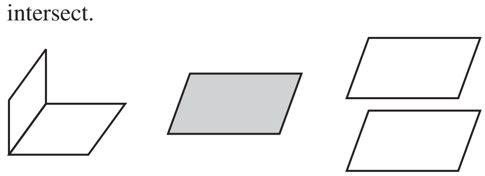
Sample answer: The line formed by the floor and front wall intersects the line formed by the front wall and side wall; The line formed by the bottom of the front wall overlaps the line formed by the front edge of the floor; The line formed by the front wall and the floor does not intersect the line formed by the side wall and back wall.

b. A line and a plane can intersect at a point, overlap, or not intersect.



Sample answer: A line formed by two walls intersects the floor at a point; A line formed by a wall and the floor overlaps the floor; A line formed by a wall and the floor does not intersect the ceiling.

c. Two planes can intersect in a line, overlap, or not intersect.



Sample answer: The floor and a wall intersect in a line; The door and the wall overlap; the floor and the ceiling do not intersect.

3. *Sample answer:* A segment bisector is a point, ray, line, line segment, or plane that intersects the segment at its midpoint.

4. You can draw geometric shapes and figures and explore their characteristics.

1.1 Extra Practice

1. $\overleftrightarrow{DC}$, line m

2. *Sample answer:* plane ABE

3. A, C, B; *Sample answer:* E

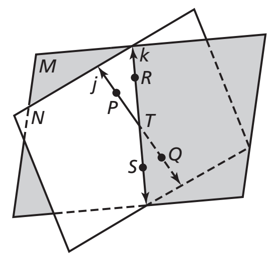
4. D

5. $\overleftrightarrow{QP}$

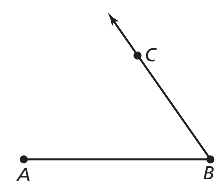
6. $\overleftrightarrow{SR}$

7. $\overrightarrow{TP}$, $\overrightarrow{TS}$, $\overrightarrow{TR}$, $\overrightarrow{TQ}$; $\overrightarrow{TP}$ and $\overrightarrow{TQ}$ are opposite rays; $\overrightarrow{TR}$ and $\overrightarrow{TS}$ are opposite rays

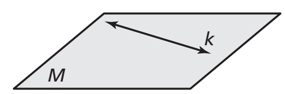
8. *Sample answer:*



9. *Sample answer:*



10. *Sample answer:*



1.2 Explorations

1. a. Check students' work.

b. $4\frac{4}{5}$ paper clips; Sliding the paper clip end-to-end, the 6-inch segment is just less than 5 lengths of the paper clip.

c. $1\frac{1}{4}$; $\frac{4}{5}$

d. Use the pencil and straightedge to draw a segment longer than 6 inches. Starting at one end, measure about $4\frac{4}{5}$ paper clips. Mark the endpoint.

2. a. Check students' work.

b. about 5.8 in.

c. $2\frac{2}{5} \times 4$ paper clips

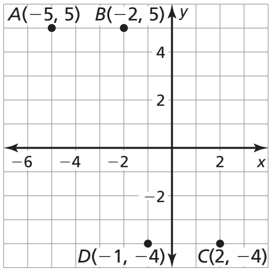
d. about 4.7 paper clips; yes; The Pythagorean Theorem states a relationship between lengths, regardless of how they are measured.

3. *Sample answer:* For a height of 60 inches, about 10.3 diags; Divide the height in inches by 5.8.

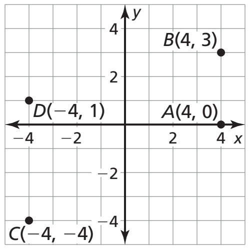
4. Use a ruler or a straightedge and a measuring tool.

1.2 Extra Practice

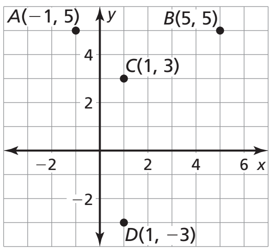
1. yes



2. no



3. yes



4. 23

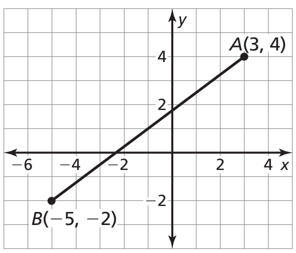
5. 12

6. 75

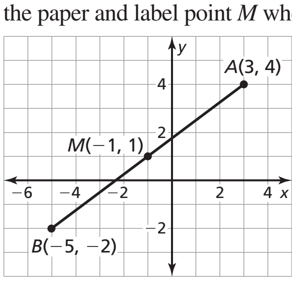
7. 3.5 km

1.3 Explorations

1. a.



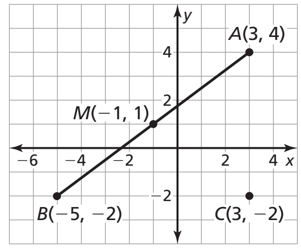
b. *Sample answer:* Fold the graph paper diagonally so that B is on top of A and both halves of $\overline{AB}$ overlap. Unfold the paper and label point M where the crease intersects $\overline{AB}$.



c. $(-1, 1)$

d. The x-coordinate of M is halfway between the x-coordinates of B and A. The y-coordinate of M is halfway between the y-coordinates of B and A. The x-coordinate of M equals the average of the x-coordinates of B and A. The y-coordinates of M equals the average of the y-coordinates of B and A.

2. a.



b. 10 cm

c. 10 cm

d. $AM = MB = 5$; *Sample answer:* The Pythagorean Theorem can be used to find the length of any line segment on the coordinate plane.

3. *Sample answer:* Find the averages of the x-coordinates and the y-coordinates; Use the Pythagorean Theorem.

4. a. $M(2, 1)$, $DE = 26$

b. $M\left(\frac{5}{2}, 4\right)$, $FG = \sqrt{233}$

1.3 Extra Practice

1. M; 26

2. $\overrightarrow{MC}$; 16

3. line ℓ; 52

4. $\overrightarrow{MT}$; 12

5. line m; 36

6. M; 16

7. $M(-2, 4)$

8. $M(4, 2)$

9. $M(6, -9)$

10. $K(-5, -6)$

11. $K(-5, 0)$

12. $K(-11, -2)$

1.4 Explorations

1. a. Check students' work.

b. 20 cm

c. yes; The slopes of $\overline{AB}$ and $\overline{CD}$ are $\frac{3}{4}$, and the slopes of $\overline{BC}$ and $\overline{AD}$ are $-\frac{4}{3}$. Because $\frac{3}{4}\left(-\frac{4}{3}\right) = -1$, the sides are perpendicular.

d. a quadrilateral with four congruent sides and four right angles; yes; $AB = BC = CD = DA = 5$, and all four angles are right angles; $A = 25\text{ cm}^2$

2. a. *BPA:* $B(-3, 1)$, $P(1, 1)$, $A(1, 4)$

AQD: $A(1, 4)$, $Q(1, 0)$, $D(4, 0)$

DRC: $D(4, 0)$, $R(0, 0)$, $C(0, -3)$

CSB: $C(0, -3)$, $S(0, 1)$, $B(-3, 1)$

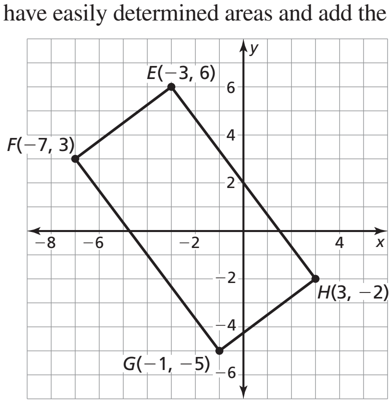
PQRS: $P(1, 1)$, $Q(1, 0)$, $R(0, 0)$, $S(0, 1)$

b. 6 cm^2; 6 cm^2; 6 cm^2; 6 cm^2; 1 cm^2

c. yes; $6 + 6 + 6 + 6 + 1 = 25\text{ cm}^2$

3. Use the Distance Formula to find the lengths of the sides and add the lengths together. Use the appropriate area formula and the dimensions of the figure, or partition the figure into shapes that have easily determined areas and add the areas together.

4. a.



b. 30 cm

c. yes; The slopes of $\overline{EF}$ and $\overline{GH}$ are $\frac{3}{4}$, and the slopes of $\overline{FG}$ and $\overline{EH}$ are $-\frac{4}{3}$. Because $\frac{3}{4}\left(-\frac{4}{3}\right) = -1$, the sides are perpendicular.

d. a quadrilateral with four congruent sides and four right angles; no; All four sides are not congruent; $A = 50 \text{ cm}^2$

1.4 Extra Practice

1. pentagon; concave
2. octagon; convex
3. octagon; concave
4. dodecagon; convex
5. 14.3 units, 6 square units
6. 12.2 units, 5 square units
7. 26 units, 30 square units
8. 12 units, 9 square units
9. 18.8 units
10. 16 units
11. 22.8 units
12. 15 square units
13. 12 square units
14. 27 square units

1.5 Explorations

1. **a.** 35°; acute
   b. 65°; acute
   c. 30°; acute
   d. 110°; obtuse
   e. 80°; acute
   f. 45°; acute
   g. 75°; acute
   h. 145°; obtuse
2. **a.** Check students' work.
   b. Check students' work.
   c. yes; $180(6 - 2) = 180(4) = 720°$ and $120(6) = 720°$
   d. 720°, 720°, 1080°; no; The first two hexagons split up angles in the hexagon, but the third hexagon adds six angles in the center of the hexagon.
3. Use a protractor; When the measure is greater than 0° and less than 90°, the angle is acute. When the measure is equal to 90°, the angle is right. When the measure is greater than 90° and less than 180°, the angle is obtuse. When the measure is equal to 180°, the angle is straight.

1.5 Extra Practice

1. $\angle EFG$; $\angle GFH$; $\angle EFH$
2. $\angle QRT$; $\angle TRS$; $\angle QRS$
3. $\angle LMN$; $\angle NMK$; $\angle LMK$
4. 116°
5. 22°
6. 100°, 80°
7. 18°, 72°
8. 46°, 46°
9. 70°, 140°

1.6 Explorations

1. **a.** $x°$ and $y°$ make a straight angle together; $y°$ and $z°$ make a straight angle together; $x°$ and $z°$ appear to be congruent.
   b. 72°; 108°; 72°; 72°; 36°; $x = 180 - 108 = 72$; $y = 180 - 72 = 108$; $z = 180 - 108 = 72$; $w = 180 - 108 = 72$; $v = 180 - (72 + 72) = 36$
2. **a.** $a°$ and $b°$ make a right angle together, $c°$ and $d°$ make a straight angle together, $c°$ and $e°$ are congruent angles
   b. 90°; 90°; 90°; $c = 180 - 90 = 90$; $d = 180 - c = 180 - 90 = 90$; $e = 180 - 90 = 90$
3. When two lines intersect, four angles and two pairs of opposite rays are formed. The angles that are next to each other have measures that add up to 180°. The angles that are across from each other are congruent and have the same measure.
4. Complementary angle measures add up to 90°; Supplementary angle measures add up to 180°; Vertical angles have the same measure.

1.6 Extra Practice

1. $\angle TOS$ and $\angle TOP$
2. $\angle LJM$ and $\angle TOP$; $\angle LJM$ and $\angle QOR$
3. 54°
4. 63°
5. $m\angle BAC = 42°$; $m\angle CAD = 48°$
6. $m\angle EFH = 55°$; $m\angle HFG = 125°$
7. $\angle 1$ and $\angle 2$; $\angle 1$ and $\angle 4$
8. $\angle 1$ and $\angle 3$; $\angle 2$ and $\angle 4$; $\angle 5$ and $\angle 8$; $\angle 6$ and $\angle 9$; $\angle 7$ and $\angle 10$
9. no; The noncommon sides of $\angle 6$ and $\angle 7$ are not opposite rays.

Chapter 2

Maintaining Mathematical Proficiency

1. $a_n = 6n - 1$; $a_{20} = 119$
2. $a_n = 12n + 10$; $a_{20} = 250$
3. $a_n = 13n - 26$; $a_{20} = 234$
4. $a_n = 0.5n - 5$; $a_{20} = 5$
5. $a_n = -15n + 55$; $a_{20} = -245$
6. $a_n = n - \frac{3}{2}$; $a_{20} = \frac{37}{2}$, or $18\frac{1}{2}$
7. $x = 3y + 4$
8. $x = 4y - 10$
9. $x = 5y - 2$
10. $x = -\frac{1}{9}y + 2$
11. $x = \dfrac{10y - 1}{3z + 2}$
12. $x = \dfrac{7z}{2y + 1}$

2.1 Explorations

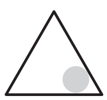
1. **a.** true; Thursday always follows Wednesday.
   b. false; 30° is only one example of an acute angle.
   c. false; June is only one of the months that has 30 days.
   d. true; All even numbers are divisible by 2 and 9 is not a perfect cube. Because both the hypothesis and conclusion are false, the conditional statement is true.
2. **a.** true; $\overline{AB}$ is a vertical segment, and $\overline{BC}$ is a horizontal segment. So, they are perpendicular.
   b. false; $\overline{BC}$ is longer than the other two sides.
   c. true; $BD = CD$ because both have endpoints that are the same distance from the origin.
   d. true; $\overline{AD} \parallel \overline{BC}$ because they are both horizontal segments.
   e. false; $\overline{AB}$ is vertical, but $\overline{CD}$ is not. So, they are not parallel.
3. **a.** true; The Pythagorean Theorem is valid for all right triangles.
   b. false; Two angles are complementary when the sum of their measures is 90°.
   c. false; The sum of the angle measures of a quadrilateral is always 360°.
   d. true; This is the definition of collinear.
   e. true; Every pair of intersecting lines forms two pairs of opposite rays and therefore two pairs of vertical angles.
4. A conditional statement is only false when a true hypothesis produces a false conclusion. Otherwise, it is true.
5. *Sample answer:* If the measure of an angle is greater than 0° and less than 90°, then it is an acute angle; If polygon *ABCD* is a trapezoid, then it is a rectangle; The first statement is true because it is the definition of an acute angle. The second statement is false because trapezoids only have one pair of parallel sides, but rectangles have two pairs of parallel sides.

2.1 Extra Practice

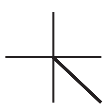
1. If $x = -1$, then $13x - 5 = -18$.
2. If a polygon is a triangle, then the sum of the measures of its interior angles is 180°.
3. conditional: If quadrilateral *ABCD* is a rectangle, then the sum of its angle measures is 360°; true
   converse: If the sum of the angle measures is 360°, then quadrilateral *ABCD* is a rectangle; false
   inverse: If quadrilateral *ABCD* is not a rectangle, then the sum of the angle measures is not 360°; false
   contrapositive: If the sum of the angle measures is not 360°, then quadrilateral *ABCD* is not a rectangle; true
4. true; The bisector symbol in the diagram indicates that $\overline{JR} \cong \overline{RK}$.
5. false; There is no right angle symbol in the diagram to indicate that $\angle JRL$ is a right angle.
6. true; $\angle MRQ$ and $\angle PRL$ are two nonadjacent angles formed by line *PQ* intersecting with line *LM*. The pair of $\angle MRQ$ and $\angle PRL$ fits the definition of vertical angles. So, $\angle MRQ$ and $\angle PRL$ are congruent.

2.2 Explorations

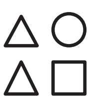
1. **a.** The circle is rotating from one vertex in the triangle to the next in a clockwise direction.



   b. The pattern alternates between a curve in an odd quadrant and a line segment with a negative slope in an even quadrant. The quadrants with a curve or a line segment follow the pattern I, IV, III, II, and the curves follow the pattern of two concave down and two concave up.

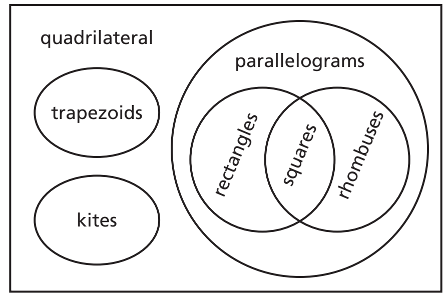


   c. The pattern alternates between the first three arrangements, then their respective mirror images.



2. **a.** true; Because all of Property B is inside Property A, all items with Property B must also have Property A.
   b. false; There is a region for items that have Property A but not B.
   c. false; There is a region for items that have Property A but not C.
   d. true; There is a region for items that have Property A but not B.
   e. true; There is no intersection of the regions for Properties C and B.
   f. true; There is a region that is the intersection of Properties A and C.
   g. false; There is no intersection of the regions for Properties B and C.

3.

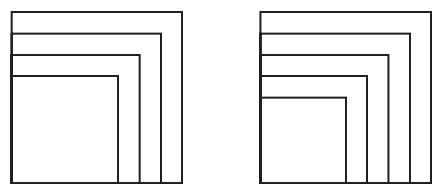


Sample answer: If a quadrilateral is a kite, then it is not a trapezoid. If a quadrilateral is a rectangle, then it is a parallelogram. If a quadrilateral is a square, then it is a rhombus, a rectangle, and a parallelogram. If a polygon is a rhombus, then it is a quadrilateral.

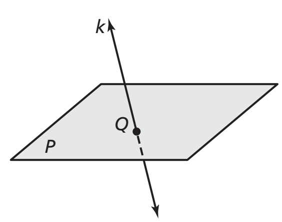
4. You can look for a pattern and then use a "rule" based on that pattern to predict what will happen if the pattern continues.
5. *Sample answer:* You noticed that you did much better on your math tests when you were able to study for at least one hour the night before as opposed to when you were only able to study for less than an hour. So now you make sure that you study for at least one hour the night before a test.

2.2 Extra Practice

1. The difference between two numbers is one more than the difference between the previous two numbers; 5, -1
2. The list items are prime numbers that have alternating positive and negative signs; -13, 17
3. The list items are letters in alphabetical order with every other letter skipped; M, O
4. This is a sequence of squares, each square having one more smaller square than the previous one.



5. The sum of any two negative integers is a negative integer.
   Sample answer: $-3 + (-3) = -6$. $-41 + (-50) = -91$, $-100 + (-900) = -1000$
6. The product of three consecutive nonzero integers is an even number.
   Sample answer:
   $2 \cdot 3 \cdot 4 = 24$, $-27 \cdot (-26) \cdot (-25) = -17{,}550$,
   $99 \cdot 100 \cdot 101 = 999{,}900$
7. $\left(\frac{3}{2}\right)^2 = \frac{3}{2} \cdot \frac{3}{2} = \frac{9}{4} > \frac{3}{2}$
8. Line *k* and plane *P* can intersect at point *Q* at any angle.



9. Each angle measure of $\triangle ABC$ is 60°.
10. not possible
11. If it does not rain, then I will wear my walking shoes.

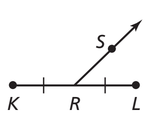
12. If $x > 1$, then $(3x)^2 > 9$.

2.3 Explorations

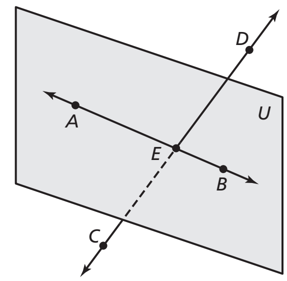
1. The lines appear perpendicular from all angles, including when you look at the lines from a view that is perpendicular to both lines.
2. a. true; They all lie in the same plane.
   b. false; There is not a line shown that connects all three of them.
   c. true; All three points are on $\overleftrightarrow{AH}$.
   d. true; $\angle GFH$ is marked as a right angle.
   e. true; These two angles are adjacent and form a straight angle.
   f. false; The angles formed by these two lines are not marked. So, you do not know whether or not the lines are perpendicular.
   g. false; Even though they appear to be parallel, you cannot tell for sure.
   h. true; Both lines are in the same plane.
   i. false; Even though they appear to be parallel, you cannot tell for sure.
   j. true; They intersect at point C.
   k. false; $\overleftrightarrow{EG}$ is perpendicular to $\overleftrightarrow{AH}$, and it could not be perpendicular to two different lines that intersect.
   l. true; These angles form two pairs of opposite rays.
   m. true; Points A, C, F, and H are all on the same line, which can be named using any two points on the line.
3. You can assume intersecting lines, opposite rays, vertical angles, linear pairs, adjacent angles, coplanar (points, lines, rays, etc.), collinear points, which point is between two other points, and which points are in the interior of an angle. You have to have a label for identifying angle measures, segment lengths, perpendicular lines, parallel lines, and congruent segments or angles.
4. *Sample answer:* $\angle ACD$ and $\angle DCF$ form a linear pair, because these angles share a vertex and a side but no common interior points and $\angle ACF$ is a straight angle. $\angle CFE$ and $\angle GFH$ are vertical angles, because $\overleftrightarrow{FG}$ and $\overleftrightarrow{FE}$ are opposite rays as well as $\overleftrightarrow{FC}$ and $\overleftrightarrow{FH}$; $\angle DCF$ is a right angle, which cannot be assumed because angle measurements have to be marked. $\overline{BC} \cong \overline{CD}$, which cannot be assumed because lengths of segments have to be labeled.

2.3 Extra Practice

1. Two Point Postulate (Post. 2.1)
2. Plane-Line Postulate (Post 2.6)
3. *Sample answer:* Through points B and C, there is exactly one line ℓ.
4. *Sample answer:* Line ℓ contains at least two points.
5. *Sample answer:* Plane P contains at least three noncollinear points.
6. *Sample answer:* The intersection of plane P and plane Q is line k.
7. *Sample answer:*



8. *Sample answer:*



9. yes
10. yes
11. yes
12. yes
13. no
14. yes

2.4 Explorations

1. Distributive Property; Simplify; Subtraction Property of Equality; Simplify; Subtraction Property of Equality; Simplify; Division Property of Equality; Simplify; Symmetric Property of Equality
2. The diamond represents multiplication, because $0 \times 5 = 0$; The circle represents addition, because $0 + 5 = 5$; Commutative Property of Multiplication; Commutative Property of Addition; Associative Property of Multiplication; Associative Property of Addition; Zero Property of Multiplication; Identity Property of Addition; Identity Property of Multiplication; Distributive Property
3. Algebraic properties are used to isolate the variable on one side of the equation.
4.

Equation	Reason
$3(x + 1) - 1 = -13$	Write the equation.
$3x + 3 - 1 = -13$	Distributive Property
$3x + 2 = -13$	Simplify.
$3x + 2 - 2 = -13 - 2$	Subtraction Property of Equality
$3x = -15$	Simplify.
$\frac{3x}{3} = \frac{-15}{3}$	Division Property of Equality
$x = -5$	Simplify.

2.4 Extra Practice

1.

Equation	Explanation and Reason
$3x - 7 = 5x - 19$	Write the equation; Given
$3x - 7 - 5x = 5x - 19 - 5x$	Subtract $5x$ from each side; Subtraction Property of Equality
$-2x - 7 = -19$	Combine like terms; Simplify.
$-2x - 7 + 7 = -19 + 7$	Add 7 to each side; Addition Property of Equality
$-2x = -12$	Combine constant terms; Simplify.
$x = 6$	Divide each side by -2; Division Property of Equality

2. Equation | **Explanation and Reason**

Equation	Explanation and Reason
$20 - 2(3x - 1) = x - 6$	Write the equation; Given
$20 - 6x + 2 = x - 6$	Multiply; Distributive Property
$20 - 6x + 2 - x = x - 6 - x$	Subtract x from each side; Subtraction Property of Equality
$-7x + 22 = -6$	Combine like terms; Simplify.
$-7x + 22 - 22 = -6 - 22$	Subtract 22 from each side; Subtraction Property of Equality
$-7x = -28$	Combine constant terms; Simplify.
$x = 4$	Divide each side by -4; Division Property of Equality

3.

Equation	Explanation and Reason
$-5(2u + 10) = 2(u - 7)$	Write the equation; Given
$-10u - 50 = 2u - 14$	Multiply; Distributive Property
$-10u - 50 - 2u = 2u - 14 - 2u$	Subtract $2u$ from each side; Subtraction Property of Equality
$-12u - 50 = -14$	Combine like terms; Simplify.
$-12u - 50 + 50 = -14 + 50$	Add 50 to each side; Addition Property of Equality
$-12u = 36$	Combine constant terms; Simplify.
$u = -3$	Divide each side by -12; Division Property of Equality

4.

Equation	Explanation and Reason
$9x + 2y = 5$	Write the equation; Given
$9x + 2y - 9x = 5 - 9x$	Subtract $9x$ from each side; Subtraction Property of Equality
$2y = 5 - 9x$	Combine like terms; Simplify.
$y = \frac{5 - 9x}{2}$	Divide each side by 2; Division Property of Equality

5.

Equation	Explanation and Reason
$\frac{1}{15}s - \frac{2}{3}t = -2$	Write the equation; Given
$\frac{1}{15}s - \frac{2}{3}t + \frac{2}{3}t = -2 + \frac{2}{3}t$	Add $\frac{2}{3}t$ to each side; Addition Property of Equality
$\frac{1}{15}s = -2 + \frac{2}{3}t$	Combine like terms; Simplify.
$s = 15\left(-2 + \frac{2}{3}t\right)$	Divide each side by $\frac{1}{15}$; Division Property of Equality
$s = -30 + 10t$ or $s = 10t - 30$	Multiply; Distributive Property

6.

Equation	Explanation and Reason
$S = \pi r^2 + \pi rs$	Write the equation; Given
$S - \pi r^2 = \pi r^2 + \pi rs - \pi r^2$	Subtract πr^2 from each side; Subtraction Property of Equality
$S - \pi r^2 = \pi rs$	Combine like terms; Simplify.
$\frac{S - \pi r^2}{\pi r} = s$	Divide each side by πr; Division Property of Equality
$\frac{S}{\pi r} - r = s$ or $s = \frac{S}{\pi r} - r$	Rewrite the expression; Simplify.
$s \approx 3.0$ ft	

2.5 Explorations

1. Segment Addition Postulate (Post. 1.2); Transitive Property of Equality; Subtraction Property of Equality
2. $m\angle 1 = m\angle 3$; $m\angle 1 + m\angle 2$; $m\angle CBD$; $m\angle EBA = m\angle CBD$
3. You can use deductive reasoning to make statements about a given situation and use math definitions, postulates, and theorems as your reason or justification for each statement.
4.

STATEMENTS	REASONS
1. B is the midpoint of $\overline{AC}$. C is the midpoint of $\overline{BD}$.	1. Given
2. $\overline{AB} \cong \overline{BC}$, $\overline{BC} \cong \overline{CD}$	2. Definition of midpoint
3. $AB = BC$, $BC = CD$	3. Definition of congruent segments
4. $AB = CD$	4. Transitive Property of Equality

2.5 Extra Practice

1. Definition of segment bisector; Transitive Property of Equality; Definition of congruent segments; $AB = AM + BM$; Substitution Property of Equality
2. $m\angle AEB + m\angle BEC = 90°$; Angle Addition Postulate; Transitive Property of Equality; $m\angle AED + 90° = 180°$; Subtraction Property of Equality
3. Transitive Property of Angle Congruence (Thm. 2.2)
4. Symmetric Property of Segment Congruence (Thm. 2.1)
5.

STATEMENTS	REASONS
1. M is the midpoint of $\overline{RT}$.	1. Given
2. $\overline{RM} \cong \overline{MT}$	2. Definition of midpoint
3. $RM = RS + SM$	3. Segment Addition Postulate
4. $\overline{MT} \cong \overline{RM}$	4. Symmetric Property of Segment Congruence
5. $MT = RS + SM$	5. Substitution Property of Equality

2.6 Explorations

1. B; A; C; D
2. E; A or D; C; F; A or D; B

3. Use boxes and arrows to show the flow of a logical argument.
4. The flowchart proof, unlike the two-column proof, allows you to show explicitly which statement leads to which, but the two-column proof has a uniform, predictable shape and style and has each statement right below the previous one to allow for easy comparison. Both allow you to provide a logical argument and justification for why something is true.

2.6 Extra Practice

1. Definition of supplementary angles; $m\angle ACB + m\angle ACD = m\angle EGF + m\angle ACD$; $\angle EGF$ and $\angle ACD$ are supplementary; Definition of supplementary angles; Definition of congruent angles

STATEMENTS	REASONS
1. $\angle ACB$ and $\angle ACD$ are supplementary. $\angle EGF$ and $\angle ACD$ are supplementary.	1. Given
2. $m\angle ACB + m\angle ACD = 180°$ $m\angle EGF + m\angle ACD = 180°$	2. Definition of supplementary angles
3. $m\angle ACB + m\angle ACD = m\angle EGF + m\angle ACD$	3. Transitive Property of Equality
4. $m\angle ACB = m\angle EGF$	4. Subtraction Property of Equality
5. $\angle ACB \cong \angle EGF$	5. Definition of congruent angles

Chapter 3

Maintaining Mathematical Proficiency

1. $m = -\frac{5}{3}$
2. undefined
3. $m = \frac{3}{2}$
4. $m = -\frac{4}{5}$
5. $m = 0$
6. $m = -\frac{1}{3}$
7. $y = \frac{3}{5}x - 8$
8. $y = \frac{1}{3}x + 4\frac{1}{3}$
9. $y = 5x - 11$

3.1 Explorations

1. a. zero
   b. one
   c. infinitely many
2. a. intersecting; They intersect at point B.
   b. parallel; They are coplanar and will never intersect.
   c. coincident; Points E, I, and H are collinear.
   d. skew; They are not coplanar and will never intersect.
   e. skew; They are not coplanar and will never intersect.
   f. parallel; They both lie on plane ABG, which is not drawn, and they will never intersect.
3. a. $\angle 1$ and $\angle 3$, $\angle 2$ and $\angle 4$, $\angle 5$ and $\angle 7$, $\angle 6$ and $\angle 8$; Two pairs of opposite rays are formed by each of these pairs of angles.
   b. $\angle 1$ and $\angle 2$, $\angle 2$ and $\angle 3$, $\angle 3$ and $\angle 4$, $\angle 1$ and $\angle 4$, $\angle 5$ and $\angle 6$, $\angle 6$ and $\angle 7$, $\angle 7$ and $\angle 8$, $\angle 5$ and $\angle 8$; One pair of opposite rays is formed by each of these pairs of angles.
4. Parallel lines are coplanar and never intersect. Intersecting lines are coplanar and intersect at exactly one point. Coincident lines are coplanar and share all the same points because they are the same line. Skew lines are not coplanar and never intersect.
5. *Sample answer:* $\overleftrightarrow{DH}$ and $\overleftrightarrow{CG}$ are parallel because they are coplanar and will never intersect. $\overleftrightarrow{BF}$ and $\overleftrightarrow{AB}$ are intersecting because they intersect at point B. $\overleftrightarrow{FG}$ and $\overleftrightarrow{AE}$ are skew because they are in different planes and will never intersect.

3.1 Extra Practice

1. $\overleftrightarrow{BC}$ and $\overleftrightarrow{BD}$
2. $\overleftrightarrow{BG}$
3. $\overleftrightarrow{AB}$
4. plane ABC
5. $\overleftrightarrow{WX}$ and $\overleftrightarrow{YZ}$, $\overleftrightarrow{QR}$ and $\overleftrightarrow{UV}$
6. $\overleftrightarrow{UV}$ and $\overleftrightarrow{ST}$, $\overleftrightarrow{QR}$ and $\overleftrightarrow{ST}$
7. no; They are intersecting lines.
8. yes; There is exactly one line through V perpendicular to $\overleftrightarrow{ST}$.
9. $\angle 1$ and $\angle 5$; $\angle 1$ and $\angle 9$; $\angle 2$ and $\angle 6$; $\angle 2$ and $\angle 10$; $\angle 3$ and $\angle 7$; $\angle 3$ and $\angle 11$; $\angle 4$ and $\angle 8$; $\angle 4$ and $\angle 12$; $\angle 5$ and $\angle 10$; $\angle 6$ and $\angle 12$; $\angle 7$ and $\angle 9$; $\angle 8$ and $\angle 11$
10. $\angle 2$ and $\angle 7$; $\angle 3$ and $\angle 10$; $\angle 4$ and $\angle 5$; $\angle 4$ and $\angle 9$; $\angle 7$ and $\angle 12$; $\angle 8$ and $\angle 10$
11. $\angle 1$ and $\angle 12$; $\angle 2$ and $\angle 11$; $\angle 1$ and $\angle 8$; $\angle 3$ and $\angle 6$; $\angle 5$ and $\angle 11$; $\angle 6$ and $\angle 9$
12. $\angle 2$ and $\angle 5$; $\angle 3$ and $\angle 9$; $\angle 4$ and $\angle 7$; $\angle 4$ and $\angle 10$; $\angle 7$ and $\angle 10$; $\angle 8$ and $\angle 12$

3.2 Explorations

1. $m\angle 1 = m\angle 3 = m\angle 5 = m\angle 7$, $m\angle 2 = m\angle 4 = m\angle 6 = m\angle 8$, and any odd-numbered angle is supplementary to any even-numbered angle.
2. a. Corresponding angles are congruent when they are formed by two parallel lines and a transversal.
   b. Alternate interior angles are congruent when they are formed by two parallel lines and a transversal.
   c. Alternate exterior angles are congruent when they are formed by two parallel lines and a transversal.
   d. Consecutive interior angles are supplementary when they are formed by two parallel lines and a transversal.
3. corresponding angles, alternate interior angles, and alternate exterior angles
4. $m\angle 2 = 100°$, $m\angle 3 = 80°$, $m\angle 4 = 100°$, $m\angle 5 = 80°$, $m\angle 6 = 100°$, $m\angle 7 = 80°$, $m\angle 8 = 100°$

3.2 Extra Practice

1. $m\angle 1 = 110°$ by Alternate Interior Angles Theorem (Thm. 3.2); $m\angle 2 = 110°$ by Vertical Angles Congruence Theorem (Thm. 2.6)
2. $m\angle 1 = 63°$ by Corresponding Angles Theorem (Thm. 3.1); $m\angle 2 = 117°$ by Consecutive Interior Angles Theorem (Thm. 3.4)
3. $m\angle 1 = 95°$ by Vertical Angles Congruence Theorem (Thm. 2.6); $m\angle 2 = 95°$ by Alternate Exterior Angles Theorem (Thm. 3.3)
4. $m\angle 1 = 101°$ by Vertical Angles Congruence Theorem (Thm. 2.6); $m\angle 2 = 101°$ by Alternate Interior Angles Theorem (Thm. 3.2)
5. 98; $(x + 12)° = 110°$
$$x = 98$$

6. 10; $(10x - 55)° = 45°$
$$10x = 100$$
$$x = 10$$
7. 32; $m\angle 6 + 4x° = 180°$
$$52° + 4x° = 180°$$
$$4x = 128$$
$$x = 32$$
8. 15; $(2x - 3)° = 27°$
$$2x = 30$$
$$x = 15$$

3.3 Explorations

1. **a.** If two lines are cut by a transversal so that the corresponding angles are congruent, then the lines are parallel; The converse is true; Answers will vary.
   b. If two lines are cut by a transversal so that the alternate interior angles are congruent, then the lines are parallel; The converse is true; Answers will vary.
   c. If two lines are cut by a transversal so that the alternate exterior angles are congruent, then the lines are parallel; The converse is true; Answers will vary.
   d. If two lines are cut by a transversal so that the consecutive interior angles are supplementary, then the lines are parallel; The converse is true; Answers will vary.
2. The converse is true for all four of these theorems.
3. If you assume the converse of the Corresponding Angles Theorem (Thm. 3.1), then you can use it to prove the converse of the other three theorems.

3.3 Extra Practice

1. $x = 5$; Lines m and n are parallel when the marked corresponding angles are congruent.
$$(8x + 55)° = 95°$$
$$8x = 40$$
$$x = 5$$
2. $x = 35$; Lines m and n are parallel when the marked alternate exterior angles are congruent.
$$(200 - 2x)° = 130°$$
$$-2x = -70$$
$$x = 35$$
3. yes; Corresponding Angles Converse (Thm. 3.5)
4. no
5. no
6. yes; Alternate Exterior Angles Converse (Thm. 3.7)

3.4 Explorations

1. **a.** $\overline{AB} \perp \overline{CD}$; $\overline{AB}$ is parallel to the horizontal edge of the paper because points A, O, and B are all the same distance from the edge. Similarly, $\overline{CD}$ is parallel to the vertical edge of the paper because points C, O, and D are the same distance from the edge. The horizontal and vertical edges form right angles in the corners. So, lines parallel to them will also be perpendicular.
   b. $\overline{AO} \cong \overline{OB}$; Point O must be the midpoint of $\overline{AB}$ because the paper was folded in half. So, $\overline{AO}$ and $\overline{OB}$ are congruent by definition of midpoint.
2. **a.** Check students' work.
   b. They are all right angles.
3. **a.** Check students' work.
   b. Check students' work.
   c. Check students' work; $\overline{CD}$ is perpendicular to $\overline{AB}$, and point O is the midpoint of $\overline{AB}$. Point C is the same distance from A as it is from B, and D is the same distance from A as it is from B. So, the segment connecting C and D contains all the points that are equidistant from points A and B.
4. *Sample answer:* If you have a segment, and you fold it in half so that both halves match, the fold will be perpendicular to the segment. When lines are perpendicular, all four angles are right angles. If two lines intersect to form a linear pair of congruent angles, then the lines are perpendicular. In a plane, if a transversal is perpendicular to one of the two parallel lines, then it is perpendicular to the other line. Finally, in a plane, if two lines are perpendicular to the same line, then they are parallel to each other.
5. $AO = OB = 2$ units

3.4 Extra Practice

1. about 2.8 units
2. about 8.5 units
3. about 4.5 units
4. about 2.2 units
5. none; The only thing that can be concluded in this diagram is that $p \perp s$. In order to say that lines are parallel, you need to know something about both of the intersections between the transversal and the two lines.
6. $p \parallel q$; Because $p \perp r$ and $q \perp r$, lines p and q are parallel by the Lines Perpendicular to a Transversal Theorem (Thm. 3.12). The other lines may or may not be parallel.
7. $j \parallel k$ and $m \parallel n$; Because $j \perp m$ and $k \perp m$, lines j and k are parallel by the Lines Perpendicular to a Transversal Theorem (Thm. 3.12). Because $j \parallel k$ and $n \perp k$, lines n and j are perpendicular by the Perpendicular Transversal Theorem (Thm. 3.11). Because $m \perp j$ and $n \perp j$, lines m and n are parallel by the Lines Perpendicular to a Transversal Theorem (Thm. 3.12).
8. $s \parallel t$ and $m \parallel n$; Because $\angle 1 \cong \angle 2$, lines n and s are perpendicular by the Linear Pair Perpendicular Theorem (Thm. 3.10). Because $n \perp s$ and $n \perp t$, lines s and t are parallel by the Lines Perpendicular to a Transversal Theorem (Thm. 3.12). Because $m \perp s$ and $n \perp s$, lines m and n are parallel by the Lines Perpendicular to a Transversal Theorem (Thm. 3.12).

3.5 Explorations

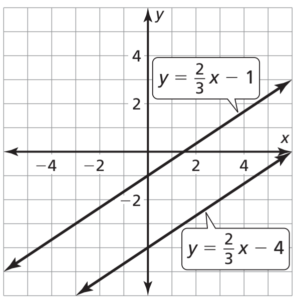
1. **a.** $y = \frac{3}{2}x + 2$; The slopes are equal.
   b. $y = -\frac{2}{3}x + 1$; The slopes are opposite reciprocals and have a product of -1.
   c. $y = \frac{1}{2}x - 3$; The slopes are equal.
   d. $y = -2x + 1$; The slopes are opposite reciprocals and have a product of -1.
   e. $y = -2x - 2$; The slopes are equal.
   f. $y = \frac{1}{2}x - 2$; The slopes are opposite reciprocals and have a product of -1.
2. **a.** $y = 2x + 3$; $y = 2x - 2$
   b. $y = \frac{1}{2}x + 2$; $y = -2x - 3$

3. For a line parallel to a given line, the slopes will be the same. For a line perpendicular to the given line, the slopes will be opposite reciprocals. Find the y-intercept of a line by substituting the slope and the given point into the slope-intercept form of a line, $y = mx + b$, and solving for b. Once you know the slope and y-intercept of a line, you can get the equation of the line by substituting them into $y = mx + b$.

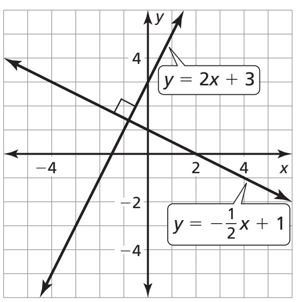
4. **a.** $y = 3x - 5$
   b. $y = -\frac{1}{3}x - \frac{5}{3}$

3.5 Extra Practice

1. $P(-3.5, 2.5)$
2. $P(5, -0.2)$
3. $p \parallel q$; $r \parallel t$; $s \perp p$; $s \perp q$
4. perpendicular; Because $m_1m_2 = \left(-\frac{2}{4}\right)\left(\frac{6}{3}\right) = -1$, lines 1 and 2 are perpendicular.
5. $y = \frac{2}{3}x - 4$



6. $y = -\frac{1}{2}x + 1$



7. about 3.2 units

Chapter 4

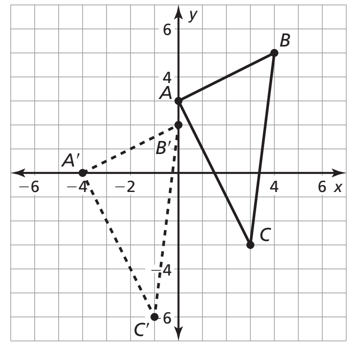
Maintaining Mathematical Proficiency

1. rotation
2. reflection
3. dilation
4. translation
5. yes; The corresponding angles are congruent and the corresponding side lengths are proportional.
6. no; $\frac{24}{12} = 2 \neq \frac{7}{5}$
   The corresponding side lengths are not proportional.

4.1 Explorations

1. **a.** Check students' work.
   b. Check students' work.
   c. The x-values of each of the three vertices in the image can be attained by adding the same amount (positive or negative) to the corresponding x-values of the vertices in the original figure. The same is true for the y-values.
   d. The side lengths and angle measures of the original figure are equal to the corresponding side lengths and angle measures of the image.

2. **a.** $x + a$; $y + b$
   b. $A'(-4, 0)$, $B'(0, 2)$, $C'(-1, -6)$
   c.

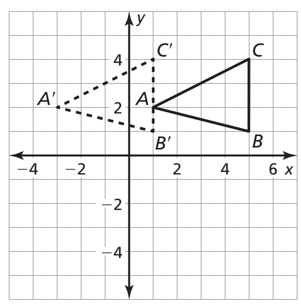


   yes; Use the Distance Formula to find the lengths.

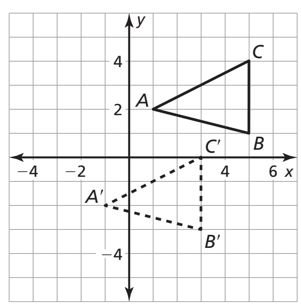
3. **a.** yes; $(AB)^2 + (AC)^2 = (BC)^2$
   b. yes; The side lengths of the image are the same as the original figure.
   c. yes; The image is congruent to the original figure, so the corresponding angles will be congruent.
4. Move each vertex the same number of units left or right, and up or down. Connect the vertices with a straightedge.
5. $A''(-1, 4)$, $B''(3, 6)$, $C''(2, -2)$; Each vertex of the image is 1 unit left and 1 unit up from the corresponding vertex in the original triangle.

4.1 Extra Practice

1. $\overrightarrow{MN}$; $\langle 4, 6\rangle$
2. $\overrightarrow{BA}$; $\langle -5, -1\rangle$
3. $\overrightarrow{KJ}$; $\langle -5, 3\rangle$
4.



5.



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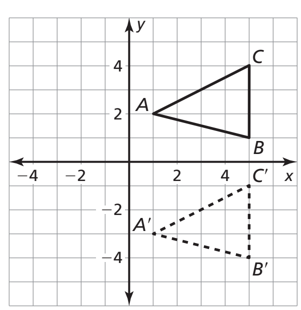

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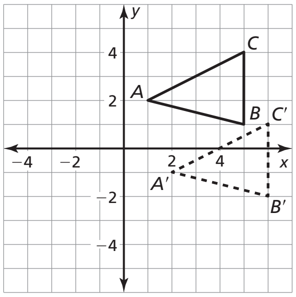


8. $(x, y) \rightarrow (x + 4, y + 3)$ **9.** $(x, y) \rightarrow (x + 1, y - 3)$

10. $J'(10, 2)$ **11.** $R''(6, -8)$

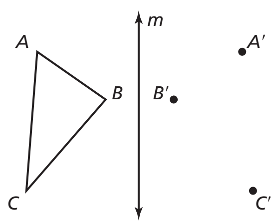
12. $(x, y) \rightarrow (x - 3, y + 4)$

4.2 Explorations

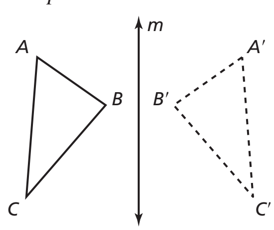
1. a. Check students' work.

b. Check students' work.

c. *Sample answer:*



d. *Sample answer:*

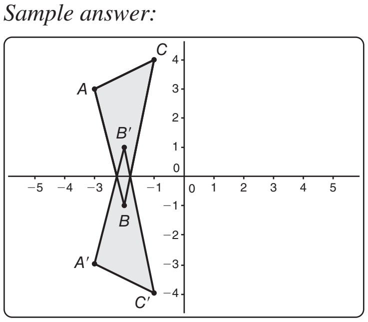


2. a. Check students' work.

b. Each vertex of $\triangle A'B'C'$ has the same y-value as its corresponding vertex of $\triangle ABC$. The x-value of each vertex of $\triangle A'B'C'$ is the opposite of the x-value of its corresponding vertex of $\triangle ABC$.

c. The corresponding sides and corresponding angles are congruent.

d. *Sample answer:*

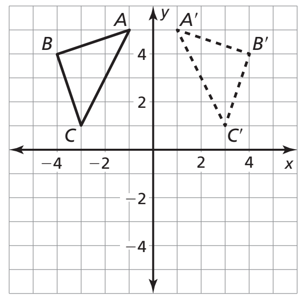


Each vertex of $\triangle A'B'C'$ has the same x-value as its corresponding vertex of $\triangle ABC$. The y-value of each vertex of $\triangle A'B'C'$ is the opposite of the y-value of its corresponding vertex of $\triangle ABC$; The corresponding sides and corresponding angles are congruent.

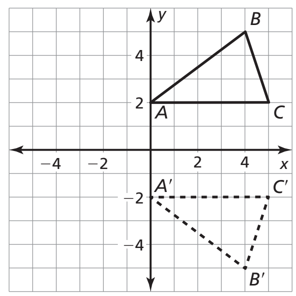
3. If a figure is reflected in the y-axis, then each pair of corresponding vertices will have the same y-value and opposite x-values. If a figure is reflected in the x-axis, then each pair of corresponding vertices will have the same x-value and opposite y-values.

4.2 Extra Practice

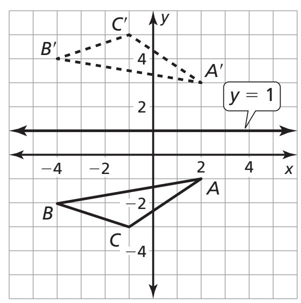
1.



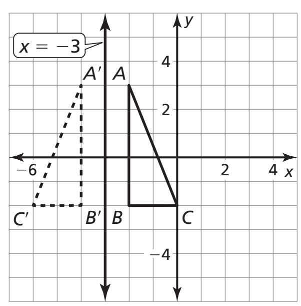
2.



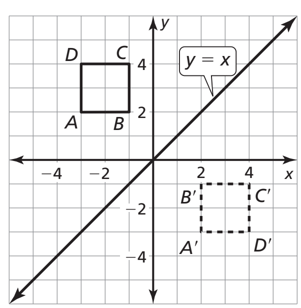
3.

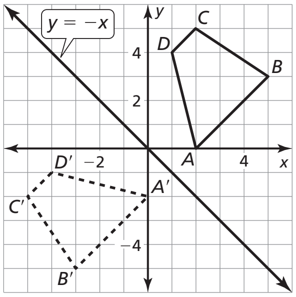


4.



5.



6.


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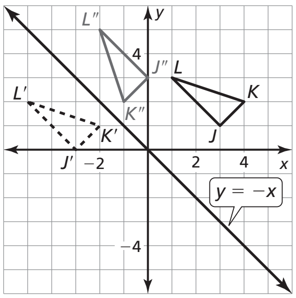

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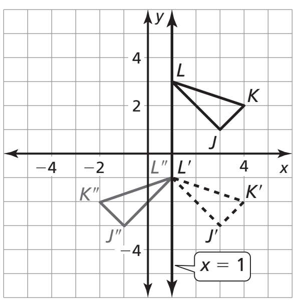


9. none

10.


11.


12.


13. *Sample answer:* Reflect A in line w to obtain A'. Then draw $\overline{BA'}$. Label the intersection of $\overline{BA'}$ and line w as C. Because BA' is the shortest distance between B and A' and $AC = A'C$, place the power strip at point C to minimize the length of the connecting cables.

4.3 Explorations

1. **a.** Check students' work.

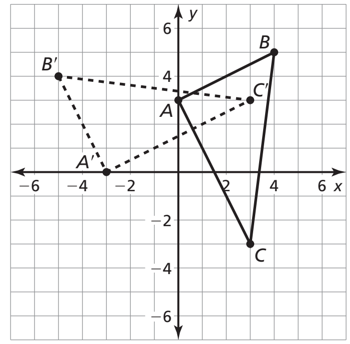
   b. Check students' work.

   c. The x-value of each vertex of $\triangle A'B'C'$ is the opposite of the y-value of its corresponding vertex in $\triangle ABC$. The y-value of each vertex of $\triangle A'B'C'$ is equal to the x-value of its corresponding vertex in $\triangle ABC$.

   d. The side lengths and angle measures of the original figure are equal to the corresponding side lengths and angle measures of the image. For example, $AB = A'B'$ and $m\angle A = m\angle A'$.

2. **a.** $(x, y) \rightarrow (-y, x)$

   b. $A'(-3, 0)$, $B'(-5, 4)$, $C'(3, 3)$

   c.


   yes; Use the Distance Formula to find the lengths.

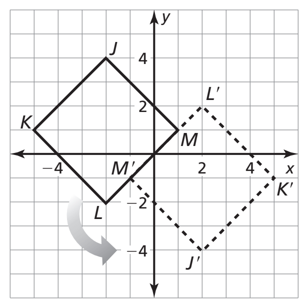
3. **a.** $-x$; $-y$; When a point is rotated 180°, the x-value and y-value of the image are the opposite of the x-value and y-value of the original point.

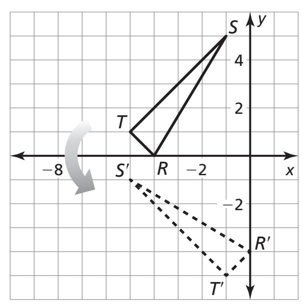
   b. $A'(0, -3)$, $B'(-4, -5)$, $C'(-3, 3)$

4. *Sample answer:* Put your pencil on the origin and rotate the graph the given number of degrees. Record the coordinates of the image in this orientation. Then return the coordinate plane to its original orientation, and draw the image using the coordinates you recorded.

5. $A''(0, 3)$, $B''(4, 5)$, $C''(3, -3)$; The coordinates of each vertex are the same as the corresponding vertex of the original triangle.

4.3 Extra Practice

1.


2.


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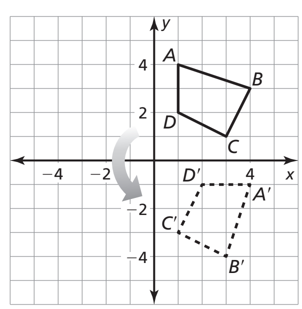
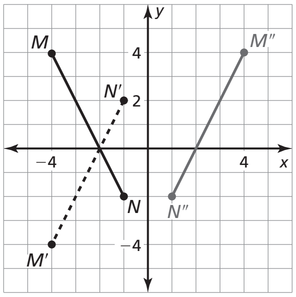
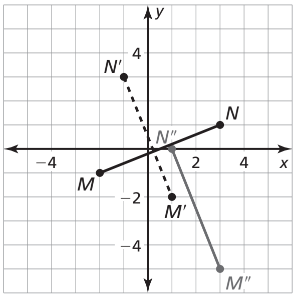


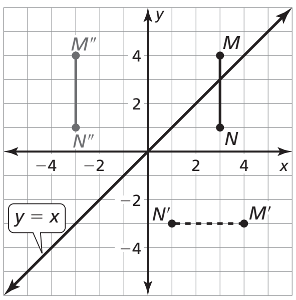
4.



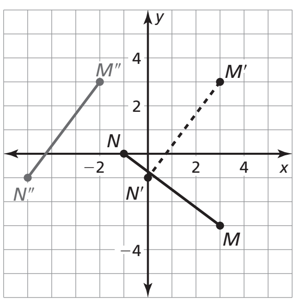
5.



6.



7.



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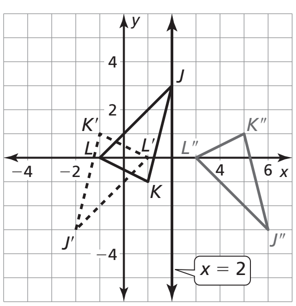
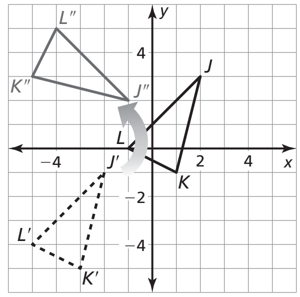


9.



10. yes; Rotations of 36°, 72°, 108°, 144°, and 180° about the center map the figure onto itself.

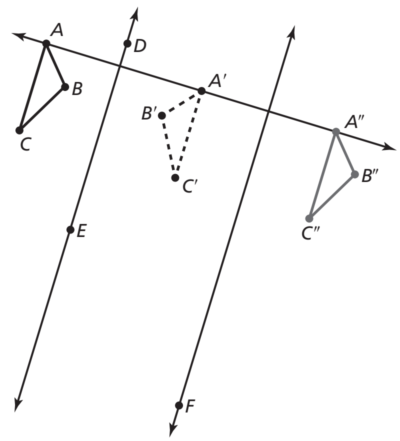
11. no

4.4 Explorations

1. a. Check student's work.

b. Check student's work.

c. *Sample answer:*



The line passes through A' and A''.

d. The distance between A and A'' is twice the distance between the parallel lines.

e. yes; $\triangle A''B''C''$ is a translation of $\triangle ABC$.

f. If two lines are parallel, and a preimage is reflected in the first line and then in the second, the final image is a translation of the preimage. The distance between each point in the preimage and its corresponding point in the final image is twice the distance between the parallel lines.

2. a. Check student's work.

b. Check student's work.

c. *Sample answer:* 50°

d. The final image after the reflections is the same as a rotation about point D using an angle that is twice the measure of the angle of intersection.

3. The image of a figure reflected in two lines is congruent to the preimage. The image of a figure reflected in two parallel lines is a translation of the preimage. The image of a figure reflected in two lines that intersect in point D is a rotation in point D of the preimage.

4. 6.4 in.

4.4 Extra Practice.

1. $\square ABCD \cong \square MNOP$, $\square STUV \cong \square EFGH$, $\triangle PQR \cong \triangle JKL$; $\square MNOP$ is a translation 5 units left and 2 units down of $\square ABCD$. $\square STUV$ is a reflection of $\square EFGH$ in the line $y = x$. $\triangle JKL$ is a 90° rotation of $\triangle PQR$.

2. *Sample answer:* translation 5 units up followed by a 180° rotation about the origin

3. *Sample answer:* reflection in the line $x = 1$ followed by a translation 2 units right and 5 units down

4. yes; $\triangle DEF$ is a reflection of $\triangle ABC$ in the x-axis.

5. no; M and N are translated 4 units left and 4 units down of their corresponding vertices, I and J, but K and L are translated 5 units left and 4 units down of their corresponding vertices, G and H. So, this is not a rigid motion.

6. $\overline{U''V''}$

7. line k and line m

8. line k and line m are parallel

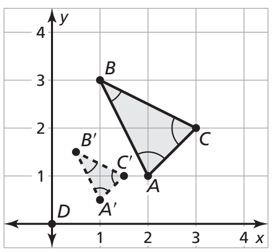
9. 10 in.

10. 120°

4.5 Explorations

1. a. Check students' work. The x-value of each vertex of $\triangle A'B'C'$ is twice the x-value of its corresponding vertex of $\triangle ABC$, and the y-value of each vertex of $\triangle A'B'C'$ is twice the y-value of its corresponding vertex of $\triangle ABC$. Each side of $\triangle A'B'C'$ is twice as long as its corresponding side of $\triangle ABC$. Each angle of $\triangle A'B'C'$ is congruent to its corresponding angle of $\triangle ABC$.

   b. *Sample answer:*



   The x-value of each vertex of $\triangle A'B'C'$ is half of the x-value of its corresponding vertex of $\triangle ABC$, and the y-value of each vertex of $\triangle A'B'C'$ is half of the y-value of its corresponding vertex of $\triangle ABC$. Each side of $\triangle A'B'C'$ is half as long as its corresponding side of $\triangle ABC$. Each angle of $\triangle A'B'C'$ is congruent to its corresponding angle of $\triangle ABC$.

   c. The x-value of each vertex of $\triangle A'B'C'$ is k times the x-value of its corresponding vertex of $\triangle ABC$, and the y-value of each vertex of $\triangle A'B'C'$ is k times the y-value of its corresponding vertex of $\triangle ABC$. Each side of $\triangle A'B'C'$ is k times as long as its corresponding side of $\triangle ABC$. Each angle of $\triangle A'B'C'$ is congruent to its corresponding angle of $\triangle ABC$.

2. a. The image is a line that coincides with $\overleftrightarrow{AB}$.

   b. The image is a line that is parallel to $\overleftrightarrow{AC}$. The x- and y-intercepts of the image are each three times the x- and y-intercepts of $\overleftrightarrow{AC}$.

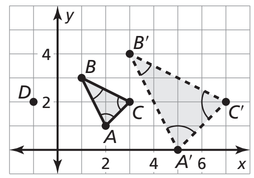
   c. The image of $\overleftrightarrow{AB}$ is a line that coincides with $\overleftrightarrow{AB}$. The image of $\overleftrightarrow{AC}$ is a line that is parallel to $\overleftrightarrow{AC}$. The x- and y-intercepts of the image are each one-fourth of the x- and y-intercepts of $\overleftrightarrow{AC}$.

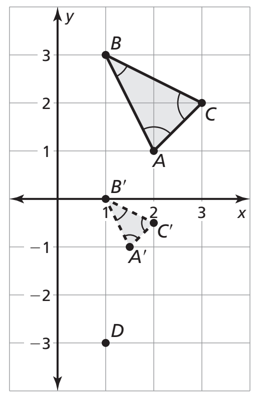
   d. When you dilate an image that passes through the center of dilation, the image coincides with the preimage. When you dilate a line that does not pass through the center of dilation, the image is parallel to the preimage, and the image has intercepts that can be found by multiplying the intercepts of the preimage by the constant of dilation.

3. to reduce or enlarge a figure so that the image is proportional to the preimage

4. The difference between the x-value of each vertex of $\triangle A'B'C'$ and the x-value of the center of dilation is equal to k times the difference between its corresponding x-value of $\triangle ABC$ and the x-value of the center of dilation. The difference between the y-value of each vertex of $\triangle A'B'C'$ and the y-value of the center of dilation is equal to k times the difference between its corresponding y-value of $\triangle ABC$ and the y-value of the center of dilation. Each side of $\triangle A'B'C'$ is k times as long as its corresponding side of $\triangle ABC$. Each angle of $\triangle A'B'C'$ is congruent to its corresponding angle of $\triangle ABC$.

   Sample answer:





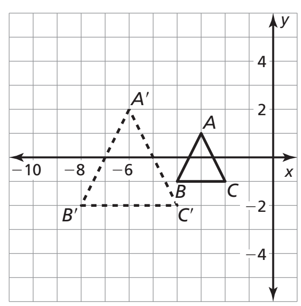
4.5 Extra Practice

1. $\frac{1}{2}$; reduction

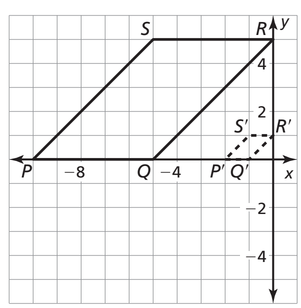
2. $\frac{5}{4}$; enlargement

3. 3; enlargement

4.



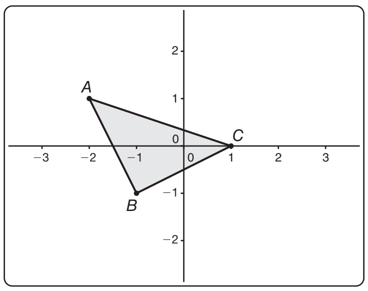
5.



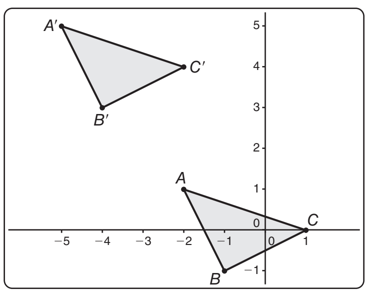
6. $A'(18, -6)$, $B'(24, 6)$, $C'(12, 6)$
7. $P'(2, -1)$, $Q'(-5, 2)$, $R'(-4, -1)$, $S'(0, -3)$
8. 4
9. 0.8 cm

4.6 Explorations

1. **a.** Check students' work.
   b. Check students' work; yes; Each side of $\triangle A'B'C'$ is three times as long as its corresponding side of $\triangle ABC$. The corresponding angles are congruent. Because the corresponding sides are proportional and the corresponding angles are congruent, the image is similar to the original triangle.
2. **a.** *Sample answer:*

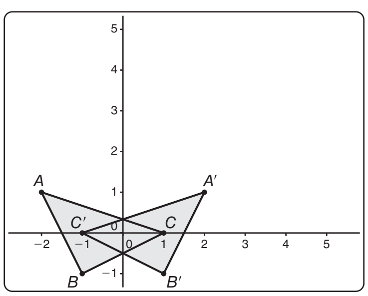


   b. *Sample answer:*



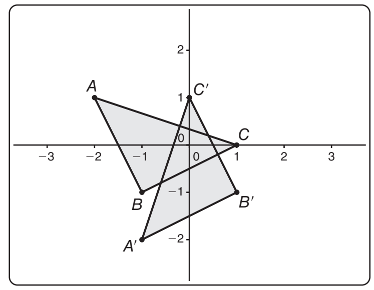
   yes; Because the corresponding sides are congruent and the corresponding angles are congruent, the image is similar to the original triangle.

   c. *Sample answer:*



   yes; Because the corresponding sides are congruent and the corresponding angles are congruent, the image is similar to the original triangle.

   d. *Sample answer:*

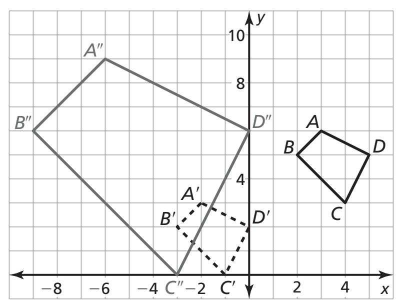


   yes; Because the corresponding sides are congruent and the corresponding angles are congruent, the image is similar to the original triangle.

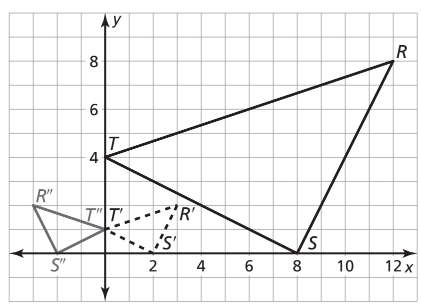
3. yes; The corresponding sides are always congruent or proportional, and the corresponding angles are always congruent.
4. yes; According to Composition Theorem (Thm. 4.1), the composition of two or more rigid motions is a rigid motion. Also, a dilation preserves angle measures and results in an image with lengths proportional to the preimage lengths. So, a composition of rigid motions or dilations will result in an image that has angle measures congruent to the corresponding angle measures of the original figure, and sides that are either congruent or proportional to the corresponding sides of the original figure.

4.6 Extra Practice

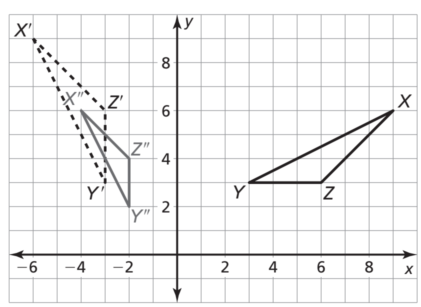
1.



2.



3.



4. *Sample answer:* dilation with center at the origin and a scale factor of $\frac{1}{2}$ followed by a translation 4 units right and 1 unit down
5. *Sample answer:* reflection in the y-axis followed by a dilation with center at the origin and a scale factor of 2
6. *Sample answer:* dilation with center at the origin and a scale factor of $\frac{1}{3}$ followed by a 90° rotation about the origin

Chapter 5

Maintaining Mathematical Proficiency

1. $M(4, 3)$; about 4.5 units
2. $M(4, -5)$; about 8.2 units
3. $M(-3, -1)$; about 12.2 units
4. $M\left(\frac{17}{2}, -7\right)$; 5 units
5. $x = 3$
6. $r = 5$
7. $n = -2$
8. $t = \frac{1}{2}$

5.1 Explorations

1. a. Check students' work.
   b. Check students' work.
   c. 180°
   d. Check students' work; The sum of the measures of the interior angles of a triangle is 180°.
2. a. Check students' work.
   b. Check students' work.
   c. Check students' work.
   d. Check students' work; The sum is equal to the measure of the exterior angle.
   e. Check students' work; The measure of an exterior angle of a triangle is equal to the sum of the measures of the two nonadjacent interior angles.
3. The sum of the measures of the interior angles of a triangle is 180°, and the measure of an exterior angle of a triangle is equal to the sum of the measures of the two nonadjacent interior angles.
4. The sum of the measures of the two nonadjacent interior angles is 32°, and the measure of the adjacent interior angle is 148°; These are known because of the conjectures made in Explorations 1 and 2.

5.1 Extra Practice

1. obtuse scalene
2. right scalene
3. acute isosceles
4. scalene; right
5. 106°
6. 155°
7. 10°, 80°

5.2 Explorations

1. translation, reflection, rotation; A rigid motion maps each part of a figure to a corresponding part of its image. Because rigid motions preserve length and angle measure, corresponding parts of congruent figures are congruent. In congruent triangles, this means that the corresponding sides and corresponding angles are congruent, which is sufficient to say that the triangles are congruent.
2. a. *Sample answer:* a translation 3 units right followed by a reflection in the x-axis
   b. *Sample answer:* a 180° rotation about the origin
   c. *Sample answer:* a 270° counterclockwise rotation about the origin followed by a translation 3 units down
   d. *Sample answer:* a 270° clockwise rotation about the origin followed by a reflection in the x-axis
3. Look at the orientation of the original triangle and decide which rigid motion or composition of rigid motions will result in the same orientation as the second triangle. Then, if necessary, use a translation to move the first triangle so that it coincides with the second.
4. *Sample answer:* a reflection in the y-axis followed by a translation 3 units right and 2 units down

5.2 Extra Practice

1. Corresponding angles: $\angle P \cong \angle S$, $\angle Q \cong \angle T$, $\angle R \cong \angle U$;
   Corresponding sides: $\overline{PQ} \cong \overline{ST}$, $\overline{QR} \cong \overline{TU}$, $\overline{RP} \cong \overline{US}$;
   Sample answer: $\triangle RQP \cong \triangle UTS$
2. Corresponding angles: $\angle A \cong \angle E$, $\angle B \cong \angle F$, $\angle C \cong \angle G$, $\angle D \cong \angle H$;
   Corresponding sides: $\overline{AB} \cong \overline{EF}$, $\overline{BC} \cong \overline{FG}$, $\overline{CD} \cong \overline{GH}$ $\overline{AD} \cong \overline{EH}$;
   Sample answer: $BCDA \cong FGHE$
3. $x = 25$, $y = 2$
4. $x = 6$, $y = 10$
5. From the diagram, $\overline{AB} \cong \overline{BC}$ and $\overline{AD} \cong \overline{CD}$, and $\overline{BD} \cong \overline{BD}$ by the Reflexive Property of Congruence (Thm. 2.1). Also from the diagram, $\angle DAB \cong \angle DCB$, $\angle ADB \cong \angle CDB$, and $\angle DBA \cong \angle DBC$. Because all corresponding parts are congruent, $\triangle ABD \cong \triangle CBD$.
6. From the diagram, $\overline{KL} \cong \overline{GH}$, $\overline{LM} \cong \overline{HI}$, $\overline{MN} \cong \overline{IJ}$, and $\overline{NK} \cong \overline{JG}$. Also from the diagram, $\angle K \cong \angle N \cong \angle G \cong \angle J$, $\angle L \cong \angle H$, and $\angle M \cong \angle I$. Because all corresponding parts are congruent, $KLMN \cong GHIJ$.
7. 33°
8. 46°

5.3 Explorations

1. a. Check students' work.
   b. Check students' work.
   c. $BC \approx 1.95$, $m\angle B \approx 98.79°$, $m\angle C \approx 41.21°$
   d. Check students' work; If two sides and the included angle of a triangle are congruent to two sides and the included angle of another triangle, then the triangles are congruent.
2. The triangles are congruent.
3. Start with two triangles so that two sides and the included angle of one triangle are congruent to two sides and the included angle of another triangle. Then show that one triangle can be translated until it coincides with the other triangle by a composition of rigid motions.

5.3 Extra Practice

1.

STATEMENTS	REASONS
1. $\overline{AD} \cong \overline{CD}$	1. Given
2. $\overline{BD} \perp \overline{AC}$	2. Given
3. $\angle BDA \cong \angle BDC$	3. Linear Pair Perpendicular Theorem (Thm. 3.10)
4. $\overline{BD} \cong \overline{BD}$	4. Reflexive Property of Congruence (Thm. 2.1)
5. $\triangle ABD \cong \triangle CBD$	5. SAS Congruence Theorem (Thm. 5.5)

2.

STATEMENTS	REASONS
1. $\overline{JN} \cong \overline{MN}$	1. Given
2. $\overline{NK} \cong \overline{NL}$	2. Given
3. $\angle JNK \cong \angle MNL$	3. Vertical Angles Congruence Theorem (Thm. 2.6)
4. $\triangle JNK \cong \triangle MNL$	4. SAS Congruence Theorem (Thm. 5.5)

3. $\triangle EPF \cong \triangle GPH$; Because all points on a circle are the same distance from the center, $\overline{PE} \cong \overline{PG}$ and $\overline{PF} \cong \overline{PH}$. It is given that $\angle EPF \cong \angle GPH$. So, $\triangle EPF \cong \triangle GPH$ by the SAS Congruence Theorem (Thm. 5.5).
4. $\triangle ACF \cong \triangle DBE$; Because the sides of the regular hexagon are congruent $\overline{AF} \cong \overline{DE}$ and $\overline{CF} \cong \overline{BE}$. Also, because the interior angles of the regular hexagon are congruent and $\overline{CF}$ and $\overline{BE}$ are angle bisectors of $\angle F$ and $\angle E$ respectively, $\angle AFC \cong \angle DEB$. So, $\triangle ACF \cong \triangle DBE$ by the SAS Congruence Theorem (Thm. 5.5).
5. Because $\overline{PS} \parallel \overline{QR}$, you know that $\angle SPR \cong \angle PRQ$ by the Alternate Interior Angles Theorem (Thm. 3.2). Also, by the Reflexive Property of Congruence (Thm 2.1), $\overline{PR} \cong \overline{PR}$. It is given that $\overline{PS} \cong \overline{QR}$, so $\triangle PQR \cong \triangle RST$ by the SAS Congruence Theorem (Thm. 5.5).

5.4 Explorations

1. a. Check students' work.
   b. Check students' work.
   c. Because all points on a circle are the same distance from the center, $\overline{AB} \cong \overline{AC}$.
   d. $\angle B \cong \angle C$
   e. Check students' work; If two sides of a triangle are congruent, then the angles opposite them are congruent.
   f. If two angles of a triangle are congruent, then the sides opposite them are congruent; yes
2. In an isosceles triangle, two sides are congruent, and the angles opposite them are congruent.
3. Draw the angle bisector of the included angle between the congruent sides to divide the given isosceles triangle into two triangles. Use the SAS Congruence Theorem (Thm. 5.5) to show that these two triangles are congruent. Then, use properties of congruent triangles to show that the two angles opposite the shared sides are congruent.

   For the converse, draw the angle bisector of the angle that is not congruent to the other two. This divides the given triangle into two triangles that have two pairs of corresponding congruent angles. The third pair of angles are congruent by the Third Angles Theorem (Thm. 5.4). Also, the angle bisector is congruent to itself by the Reflexive Property of Congruence (Thm. 2.1). So, the triangles are congruent, and the sides opposite the congruent angles in the original triangle are congruent.

5.4 Extra Practice

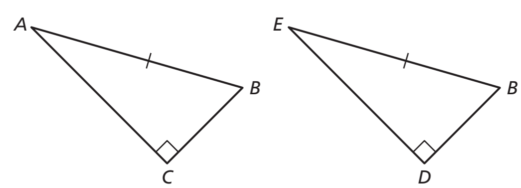
1. J, M; Base Angles Theorem (Thm. 5.6)
2. M, MNL; Base Angles Theorem (Thm. 5.6)
3. NK, NM; Converse of Base Angles Theorem (Thm. 5.7)
4. LJ, LN; Converse of Base Angles Theorem (Thm. 5.7)
5. $x = 31$
6. $x = 30$
7. $x = 50$, $y = 75$
8. $x = 70$, $y = 20$

5.5 Explorations

1. a. Check students' work
   b. Check students' work.
   c. $AB = 2$ because $\overline{AB}$ has one endpoint at the origin and one endpoint on a circle with a radius of 2 units. $AC = 3$ because $\overline{AC}$ has one endpoint at the origin and one endpoint on a circle with a radius of 3 units. $BC = 4$ because it was created that way.
   d. $m\angle A = 104.43°$, $m\angle B = 46.61°$, $m\angle C = 28.96°$
   e. Check students' work; If two triangles have three pairs of congruent sides, then they will have three pairs of congruent angles.
2. The corresponding angles are also congruent.
3. Use rigid transformations to map triangles.

5.5 Extra Practice

1. yes; You are given that $\overline{AB} \cong \overline{ED}$, $\overline{BC} \cong \overline{DC}$, and $\overline{CA} \cong \overline{CE}$. So, $\triangle ABC \cong \triangle EDC$ by the SSS Congruence Theorem (Thm. 5.8).
2. yes; You are given that $\overline{KG} \cong \overline{HJ}$ and $\overline{GH} \cong \overline{JK}$. Also, $\overline{HK} \cong \overline{HK}$ by the Reflexive Property of Congruence (Thm. 2.1). So, $\triangle KGH \cong \triangle HJK$ by the SSS Congruence Theorem (Thm. 5.8).
3. no; You are given that $\overline{UV} \cong \overline{YX}$, $\overline{VW} \cong \overline{XZ}$, and $\overline{WU} \cong \overline{ZY}$. So, $\triangle UVW \cong \triangle YXZ$ by the SSS Congruence Theorem (Thm. 5.8).
4. yes; You are given that $\overline{RS} \cong \overline{RP}$, $\overline{ST} \cong \overline{PQ}$, and $\overline{TR} \cong \overline{QR}$. So, $\triangle RST \cong \triangle RPQ$ by the SSS Congruence Theorem (Thm. 5.8).
5. yes; The diagonal supports in this figure form triangles with fixed side lengths. By the SSS Congruence Theorem (Thm. 5.8), these triangles cannot change shape, so the figure is stable.
6.



STATEMENTS	REASONS
1. B is the midpoint of $\overline{CD}$, $\overline{AB} \cong \overline{EB}$, $\angle C$ and $\angle D$ are right angles.	1. Given
2. $\overline{BC} \cong \overline{BD}$	2. Definition of midpoint
3. $\triangle ABC$ and $\triangle EBD$ are right triangles.	3. Definition of a right triangle
4. $\triangle ABC \cong \triangle EBD$	4. HL Congruence Theorem (Thm. 5.9)

7.

STATEMENTS	REASONS
1. $\overline{IE} \cong \overline{EJ} \cong \overline{JL} \cong \overline{LH} \cong \overline{HK} \cong \overline{KI} \cong \overline{EK} \cong \overline{KF} \cong \overline{FH} \cong \overline{HG} \cong \overline{GL} \cong \overline{LE}$	**1.** Given
2. $EF = EK + KF$, $FG = FH + HG$, $GE = GL + LE$, $HI = HK + KI$, $IJ = IE + EJ$, $JH = JL + LH$	**2.** Segment Addition Postulate (Post. 1.2)
3. $EF = 2EK$, $FG = 2EK$, $GE = 2EK$, $HI = 2EK$, $IJ = 2EK$, $JH = 2EK$	**3.** Substitution Property of Equality
4. $\overline{HI} \cong \overline{EF}$, $\overline{IJ} \cong \overline{FG}$, $\overline{JH} \cong \overline{GE}$	**4.** Transitive Property of Congruence (Thm. 2.1)
5. $\triangle EFG \cong \triangle HIJ$	**5.** SSS Congruence Theorem (Thm. 5.8)

5.6 Explorations

1. **a.** Check students' work.

b. Check students' work.

c. $\overline{AB} \cong \overline{AB}$, $\overline{BD} \cong \overline{BC}$, and $\angle A \cong \angle A$

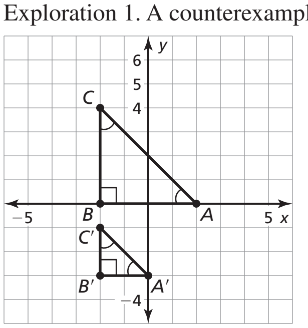
d. no; The third pair of sides are not congruent.

e. no; These two triangles provide a counterexample for SSA. They have two pairs of congruent sides and a pair of nonincluded congruent angles, but the triangles are not congruent.

2.

Possible congruence theorem	Valid or not valid?
SSS	Valid
SSA	Not valid
SAS	Valid
AAS	Valid
ASA	Valid
AAA	Not valid

Sample answer: A counterexample for SSA is given in Exploration 1. A counterexample for AAA is shown here.



In this example, each pair of corresponding angles is congruent, but the corresponding sides are not congruent.

3. In order to determine that two triangles are congruent, one of the following must be true.

All three pairs of corresponding sides are congruent (SSS).

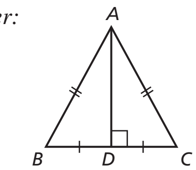
Two pairs of corresponding sides and the pair of included angles are congruent (SAS).

Two pairs of corresponding angles and the pair of included sides are congruent (ASA).

Two pairs of corresponding angles and one pair of nonincluded sides are congruent (AAS).

The hypotenuses and one pair of corresponding legs of two right triangles are congruent (HL).

4. yes; *Sample answer:*



In the diagram, $\triangle ABD \cong \triangle ACD$ by the HL Congruence Theorem (Thm. 5.9), the SSS Congruence Theorem (Thm. 5.8), and the SAS Congruence Theorem (Thm. 5.5).

5.6 Extra Practice

1. yes; AAS Congruence Theorem (Thm. 5.11)

2. yes; ASA Congruence Theorem (Thm. 5.10)

3. no

4. yes; AAS Congruence Theorem (Thm. 5.11)

5. yes; $\triangle LMN \cong \triangle PQR$ by the AAS Congruence Theorem (Thm. 5.11)

6. no; $\angle L$ and $\angle R$ do not correspond.

7.

STATEMENTS	REASONS
1. $\overline{AC}$ bisects $\angle DAB$ and $\angle DCB$.	**1.** Given
2. $\angle CAB \cong \angle CAD$	**2.** Definition of angle bisector
3. $\angle ACB \cong \angle ACD$	**3.** Definition of angle bisector
4. $\overline{AC} \cong \overline{AC}$	**4.** Reflexive Property of Congruence (Thm. 2.2)
5. $\triangle ABC \cong \triangle ADC$	**5.** ASA Congruence Theorem (Thm. 5.10)

8.

STATEMENTS	REASONS
1. O is the center of the circle	**1.** Given
2. $\overline{ON} \cong \overline{OM} \cong \overline{OQ} \cong \overline{OP}$	**2.** All points on a circle are the same distance from the center.
3. $\angle M \cong \angle N \cong \angle P \cong \angle Q$	**3.** Base Angles Theorem (Thm. 5.6)
4. $\triangle MNO \cong \triangle PQO$	**4.** AAS Congruence Theorem (Thm. 5.11)

5.7 Explorations

1. a. The surveyor can measure $\overline{DE}$, which will have the same measure as the distance across the river (AB). Because $\triangle ABC \cong \triangle DEC$ by the ASA Congruence Theorem (Thm. 5.10), the corresponding parts of the two triangles are also congruent.

   b.

STATEMENTS	REASONS
1. $\overline{AC} \cong \overline{CD}$, $\angle A$ and $\angle D$ are right angles.	1. Given
2. $\angle A \cong \angle D$	2. Right Angles Congruence Theorem (Thm. 2.3)
3. $\angle ACB \cong \angle DCE$	3. Vertical Angles Congruence Theorem (Thm. 2.6)
4. $\triangle ABC \cong \triangle DEC$	4. ASA Congruence Theorem (Thm. 5.10)
5. $\overline{AB} \cong \overline{DE}$	5. Corresponding parts of congruent triangles are congruent.
6. $AB = DE$	6. Definition of congruent segments

   c. By creating a triangle on land that is congruent to a triangle that crosses the river, you can find the distance across the river by measuring the distance of the corresponding congruent segment on land.

2. a. The officer's height stays the same, he is standing perpendicular to the ground the whole time, and he tipped his hat the same angle in both directions. So, $\triangle DEF \cong \triangle DEG$ by the ASA Congruence Theorem (Thm 5.10). Because corresponding parts of the two triangles are also congruent, $\overline{EG} \cong \overline{EF}$. By the definition of congruent segments, EG equals EF, which is the width of the river.

   b.

STATEMENTS	REASONS
1. $\angle EDG \cong \angle EDF$, $\angle DEG$ and $\angle DEF$ are right angles.	1. Given
2. $\angle DEG \cong \angle DEF$	2. Right Angles Congruence Theorem (Thm. 2.3)
3. $\overline{DE} \cong \overline{DE}$	3. Reflexive Property of Congruence (Thm. 2.1)
4. $\triangle DEF \cong \triangle DEG$	4. ASA Congruence Theorem (Thm. 5.10)
5. $\overline{EG} \cong \overline{EF}$	5. Corresponding parts of congruent triangles are congruent.
6. $EG = EF$	6. Definition of congruent segments

   c. By standing perpendicular to the ground and using the tip of your hat to gaze at two different points in such a way that the direction of your gaze makes the same angle with your body both times, you can create two congruent triangles, which ensures that you are the same distance from both points.

3. By creating a triangle that is congruent to a triangle with an unknown side length or angle measure, you can measure the created triangle and use it to find the unknown measure indirectly.

4. You do not actually measure the side length or angle measure you are trying to find. You measure the side length or angle measure of a triangle that is congruent to the one you are trying to find.

5.7 Extra Practice

1. From the diagram, $\angle T \cong \angle W$ and $\overline{TV} \cong \overline{WV}$. Also, $\angle UVT \cong \angle XVW$ by the Vertical Angles Congruence Theorem (Thm. 2.6). So, by the ASA Congruence Theorem (Thm. 5.10), $\triangle TUV \cong \triangle WXV$. Because corresponding parts of congruent triangles are congruent, $\overline{UV} \cong \overline{XV}$.

2. The hypotenuses and one pair of legs of the two right triangles are congruent. So, by the HL Congruence Theorem (Thm. 5.9), $\triangle RST \cong \triangle URV$. Because corresponding parts of congruent triangles are congruent, $\overline{TS} \cong \overline{VR}$.

3. From the diagram, $\angle J \cong \angle M$, $\overline{LJ} \cong \overline{LM}$, and $\overline{JK} \cong \overline{MN}$. So, by the SAS Congruence Theorem (Thm. 5.5), $\triangle LJK \cong \triangle LMN$. Because corresponding parts of congruent triangles are congruent, $\angle JLK \cong \angle MLN$.

4. Use the AAS Congruence Theorem (Thm. 5.11) to prove that $\triangle FGI \cong \triangle HIG$. Then, state that $\overline{FG} \cong \overline{HI}$ because corresponding parts of congruent triangles are congruent. Use the ASA Congruence Theorem (Thm. 5.10) to prove that $\triangle FGJ \cong \triangle HIJ$. So $\angle 1 \cong \angle 2$.

5. Use the SSS Congruence Theorem (Thm. 5.8) to prove that $\triangle ABC \cong \triangle ADC$. Then, state that $\angle ACB \cong \angle ACD$ because corresponding parts of congruent triangles are congruent. Use the SAS Congruence Theorem (Thm. 5.5) to prove that $\triangle BCE \cong \triangle DCE$. So, $\angle 1 \cong \angle 2$.

6.

STATEMENTS	REASONS
1. $\overline{AB} \cong \overline{AC}$, $\overline{BD} \cong \overline{CD}$	1. Given
2. $\overline{AD} \cong \overline{AD}$	2. Reflexive Property of Congruence (Thm. 2.1)
3. $\triangle ABD \cong \triangle ACD$	3. SSS Congruence Theorem (Thm. 5.8)
4. $\angle BAD \cong \angle CAD$	4. Corresponding parts of congruent triangles are congruent.

5.8 Explorations

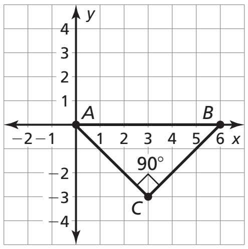
1. a. Check students' work.

   b. Check students' work.

   c. Check students' work.

   d. Using the Distance Formula, $AC = \sqrt{9 + y^2}$ and $AB = \sqrt{9 + y^2}$. $\overline{AC} \cong \overline{BC}$, so $\triangle ABC$ is an isosceles triangle.

2. **a.** Check students' work.
   b. Check students' work.
   c. Check students' work; $AC = 3\sqrt{2}$, $m_{\overline{AC}} = 1$, $BC = 3\sqrt{2}$, and $m_{\overline{BC}} = -1$. So, $AC \perp BC$ and $\triangle ABC$ is a right isosceles triangle.
   d. $C(3, -3)$



   e. If C lies on the line $x = 3$, then the coordinates are $C(3, y)$. Because $\triangle ABC$ is an isosceles triangle,

   $m_{\overline{AC}} = \frac{y}{3}$, and $m_{\overline{BC}} = \frac{y}{-3}$.

   $\triangle ABC$ is a right triangle, so it must have a right angle. Because $\overline{AC}$ and $\overline{BC}$ are the congruent legs of $\triangle ABC$, $\angle A$ and $\angle B$ are the congruent base angles by the Base Angles Theorem (Thm. 5.6). The vertex angle, $\angle C$, must be the right angle, which means that $\overline{AC} \perp \overline{BC}$ by definition of perpendicular lines. By the Slopes of Perpendicular Lines Theorem (Thm. 3.14),

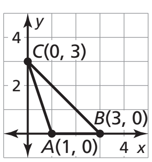
   $\frac{y}{3} \cdot \frac{y}{-3} = -1$ and $y = \pm 3$.

   So, the coordinates of C must be $(3, 3)$ or $(3, -3)$.

3. You can position the figure in a coordinate plane and then use deductive reasoning to show that what you are trying to prove must be true based on the coordinates of the figure.
4. Using the Distance Formula, $AC = 6$, $AB = 6$, and $BC = 6$. $\overline{AC} \cong \overline{AB} \cong \overline{BC}$, so $\triangle ABC$ is an equilateral triangle.

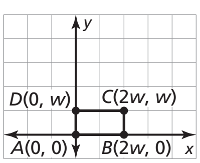
5.8 Extra Practice

1. *Sample answer:*



   It is easy to find the lengths of horizontal and vertical segments and distances from the origin.

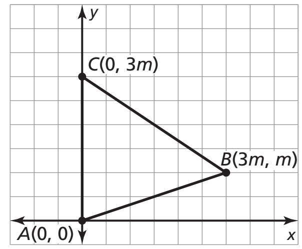
2. *Sample answer:*



   It is easy to find the lengths of horizontal and vertical segments and distances from the origin.

3. Find the lengths of $\overline{RO}$, $\overline{OP}$, $\overline{PQ}$, and $\overline{QR}$ to show that $\overline{RO} \cong \overline{PQ}$ and $\overline{OP} \cong \overline{QR}$.
4. Find the lengths of $\overline{AB}$, $\overline{BD}$, $\overline{OB}$, and $\overline{BC}$ to show that $\overline{AB} \cong \overline{BD}$ and $\overline{OB} \cong \overline{BC}$.

5.



   $AC = 3m$, $m_{\overline{AC}} =$ undefined, $M_{\overline{AC}} = \left(0, \frac{3m}{2}\right)$, $BC = m\sqrt{13}$, $m_{\overline{BC}} = -\frac{2}{3}$, $M_{\overline{BC}} = \left(\frac{3m}{2}, 2m\right)$, $AB = m\sqrt{10}$, $m_{\overline{AB}} = \frac{1}{3}$, $M_{\overline{AB}} = \left(\frac{3m}{2}, \frac{m}{2}\right)$; no; no; Because $m_{\overline{BC}} \cdot m_{\overline{AB}} \neq -1$, $\overline{BC}$ is not perpendicular to $\overline{AB}$ (Thm. 3.14). So $\angle ABC$ is not a right angle. None of the sides are congruent because $AB \neq BC \neq CA$. There are not two or more equal side lengths so $\triangle ABC$ is not an isosceles triangle.

6. $OE = \sqrt{h^2 + k^2}$, $OG = \sqrt{h^2 + k^2}$; $EF = \sqrt{9h^2 + k^2}$, $GF = \sqrt{9h^2 + k^2}$; $FO = 4h$
   So, $\overline{OE} \cong \overline{OG}$, $\overline{EF} \cong \overline{GF}$, $\overline{FO} \cong \overline{FO}$. By SSS Congruence Theorem (Thm. 5.8), $\triangle OEF \cong \triangle OGF$.

Chapter 6

Maintaining Mathematical Proficiency

1. $y = -\frac{1}{2}x + 4\frac{1}{2}$	2. $y = -\frac{1}{6}x + 2\frac{2}{3}$
3. $y = \frac{1}{3}x - \frac{5}{3}$	4. $y = -\frac{1}{3}x + \frac{1}{3}$
5. $y = -x + 13$	6. $y = -4x + 19$
7. $4 \le g \le 12$	8. $2 < r < 7$
9. $q \le 6$ or $q > 1$	10. $p < 17$ or $p \ge 5$
11. $-4 \le k < 1$	

6.1 Explorations

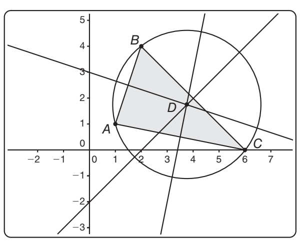
1. **a.** Check students' work.
   b. Check students' work.
   c. Check students' work (for sample in text, $CA \approx 1.97$, $CB \approx 1.97$); For all locations of C, $\overline{CA}$ and $\overline{CB}$ have the same measure.
   d. Every point on the perpendicular bisector of a segment is equidistant from the endpoints of the segment.
2. **a.** Check students' work.
   b. Check students' work.
   c. Check students' work (for sample in text, $DE \approx 1.24$, $DF \approx 1.24$); For all locations of D on the angle bisector, $\overline{ED}$ and $\overline{FD}$ have the same measure.
   d. Every point on an angle bisector is equidistant from both sides of the angle.
3. If a point is on the perpendicular bisector of a segment, then it is equidistant from the endpoints of the segment. Every point on the bisector of an angle is equidistant from the sides of the angle.
4. 5 units; Point D is on the angle bisector, so it is equidistant from either side of the angle.

6.1 Extra Practice

1. 9; Because $BD = DC$ and $\overleftrightarrow{AD} \perp \overleftrightarrow{BC}$, point A is on the perpendicular bisector of $\overline{BC}$. So, by the Perpendicular Bisector Theorem (Thm. 6.1), $AB = AC = 9$.
2. 6; Because point F is equidistant from E and G, point F is on the perpendicular bisector of $\overline{EG}$ by the Converse of the Perpendicular Bisector Theorem (Thm. 6.2). So, by definition of segment bisector, $EH = HG = 3$ and $EG = 3 + 3 = 6$.
3. 6; Because $\overleftrightarrow{RU} \perp \overleftrightarrow{ST}$ and point R is equidistant from S and T, point R is on the perpendicular bisector of $\overline{ST}$ by the Converse of the Perpendicular Bisector Theorem (Thm.6.2). By definition of segment bisector, $SU = UT$. So, $2x + 2 = 3x$ and the solution is $x = 2$. So, $SU = 2x + 2 = 2(2) + 2 = 6$.
4. $y = -\frac{1}{2}x + \frac{1}{2}$
5. 40°; Because point D is equidistant from $\overrightarrow{AB}$ and $\overrightarrow{AC}$, $\overrightarrow{AD}$ bisects $\angle CAB$ by the Converse of the Angle Bisector Theorem (Thm. 6.4). So, $m\angle CAD = m\angle DAB = 20°$, which means that $m\angle CAB = 20° + 20° = 40°$.
6. 5; $\overrightarrow{AD}$ is an angle bisector of $\angle BAC$, $\overline{CD} \perp \overrightarrow{AC}$, and $\overline{DB} \perp \overrightarrow{AB}$. So, by the Angle Bisector Theorem (Thm. 6.3). $CD = BD = 5$.
7. 4; $\overrightarrow{AD}$ is an angle bisector of $\angle BAC$, $\overline{CD} \perp \overrightarrow{AC}$, and $\overline{DB} \perp \overrightarrow{AB}$. So, by the Angle Bisector Theorem (Thm. 6.3), $BD = DC$. This means that $3x + 1 = 5x - 1$, and the solution is $x = 1$. So, $BD = 3x + 1 = 3(1) + 1 = 4$.

6.2 Explorations

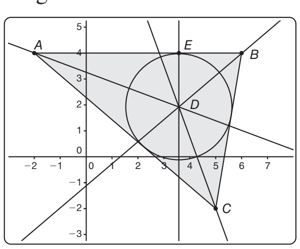
1. **a–c.** *Sample answer:*



   a. The perpendicular bisectors all intersect at one point.

   c. The circle passes through all three vertices of $\triangle ABC$.

2. **a–c.** *Sample answer:*



   a. The angle bisectors all intersect at one point.

   c. distance ≈ 2.06; The circle passes through exactly one point of each side of $\triangle ABC$.

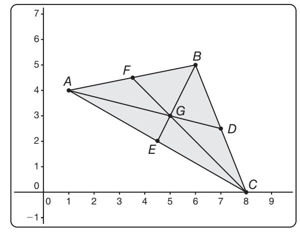
3. The perpendicular bisectors of the sides of a triangle meet at a point that is the same distance from each vertex of the triangle. The angle bisectors of a triangle meet at a point that is the same distance from each side of the triangle.

6.2 Extra Practice

1. 1	**2.** 4
3. 7	**4.** 13
5. 8	**6.** 10
7. 2	**8.** (2, 1)
9. (6, 3)	**10.** (−1, −5)

6.3 Explorations

1. **a.** *Sample answer:*

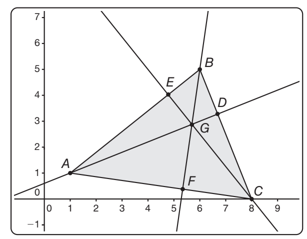


   b. The medians of a triangle are concurrent at a point inside the triangle.

   c. 2 : 3; yes; The ratio is the same for each median and does not change when you change the triangle.

2. **a.** Check students' work.

   b. *Sample answer:*



   They meet at the same point.

   c. The altitudes of a triangle meet at a point that may be inside, on, or outside of the triangle.

3. The medians meet at a point inside the triangle that divides each median into two segments whose lengths have the ratio 1 : 2. The altitudes meet at a point inside, on, or outside the triangle depending on whether the triangle is acute, right, or obtuse.
4. 1 in. and 2 in.

6.3 Extra Practice

1. $QP = 11$, $PN = 22$	**2.** $QP = 15$, $PN = 30$
3. $QP = 13$, $PN = 26$	**4.** $CD = 14$, $CE = 21$
5. $CD = 24$, $CE = 36$	**6.** (1, 2)
7. (−3, 2)	**8.** (12, 5)
9. on; (3, 0)	**10.** on; (1, 1)
11. inside; (9, 2)	

6.4 Explorations

1. **a.** Check students' work.

   b. *Sample answer:* The slopes are the same (−0.43). Because $3.81 = \frac{1}{2}(7.62)$, $DE = \frac{1}{2}AC$.

   c. The segment connecting the midpoints of two sides of a triangle is parallel to the third side and is half as long as that side.

2. **a.** Check students' work.

   b. The triangle formed by the midsegments of a triangle, $\triangle EFD$, is similar to the original triangle, $\triangle ABC$, and has a scale factor of $\frac{1}{2}$.

3. Each midsegment is parallel to a side of the triangle and is half as long as that side.
4. 24

6.4 Extra Practice

1. 14
2. 30
3. 9
4. $(-1, 7), (-2, 1), (2, 2)$
5. 48
6. 13
7. 12 cm^2
8. **a.** 7 ft 6 in.
   b. 8 ft 6 in.

6.5 Explorations

1. **a.** Check students' work. (For sample in text, $AB \approx 4.47$, $AC \approx 6.08$, $BC \approx 3.61$, $m\angle A \approx 36.03°$, $m\angle B \approx 97.13°$, and $m\angle C \approx 46.85°$.)
   b. Check students' work. (For sample in text, $BC < AB < AC$ and $m\angle A < m\angle C < m\angle B$.); The shortest side is across from the smallest angle, and the longest side is across from the largest angle.
   c. *Sample answer:*

A(*x*, *y*)	*B*(*x*, *y*)	*C*(*x*, *y*)	*AB*	*AC*	*BC*
A(5, 1)	*B*(7, 4)	*C*(2, 4)	3.61	4.24	5
A(2, 4)	*B*(4, −2)	*C*(7, 6)	6.32	5.39	8.54
A(1, 0)	*B*(7, 0)	*C*(1, 7)	6	7	9.22

$m\angle A$	$m\angle B$	$m\angle C$
78.69°	56.31°	45°
93.37°	38.99°	47.64°
90°	49.4°	40.6°

If one side of a triangle is longer than another side, then the angle opposite the longer side is larger than the angle opposite the shorter side. Similarly, if one angle of a triangle is larger than another angle, then the side opposite the larger angle is longer than the side opposite the smaller angle.

2. **a.** Check students' work. (For sample in text, $AB \approx 3.61$, $AC \approx 5.10$, and $BC = 5$.)
   b. For the sample in the text, $BC = 5 < 8.71 = AC + AB$, $AC = 5.10 < 8.61 = BC + AB$, and $AB = 3.61 < 10.10 = BC + AC$.
   c. *Sample answer:*

A(*x*, *y*)	*B*(*x*, *y*)	*C*(*x*, *y*)	*AB*	*AC* + *BC*	*AC*
A(5, 1)	*B*(7, 4)	*C*(2, 4)	3.61	9.24	4.24
A(2, 4)	*B*(4, −2)	*C*(7, 6)	6.32	13.93	5.39
A(1, 0)	*B*(7, 0)	*C*(1, 7)	6	16.22	7
A(1, 0)	*B*(7, 0)	*C*(5, 1)	6	6.36	4.12

AB + *BC*	*BC*	*AB* + *AC*
8.61	5	7.85
14.86	8.54	11.71
15.22	9.22	13
8.24	2.24	10.12

The length of each side is less than the sum of the other two.

3. The largest angle is opposite the longest side, and the smallest angle is opposite the shortest side; The sum of any two side lengths is greater than the third side length.
4. no; The sum $3 + 4$ is not greater than 10, and it is not possible to form a triangle when the sum of the lengths of the two sides is less than the length of the third side.

6.5 Extra Practice

1. Assume temporarily that in a certain class, all the students are above average.
2. Assume temporarily that there are numbers *a* and *b* such that $a = \frac{b}{0}$.
3. Assume temporarily that there are integers *a* and *b* such that $\frac{a}{b} = \sqrt{2}$ in simplest form.
4. A and B; If $\triangle LMN$ is equilateral, it cannot have two sides of unequal length.
5. A and C; If $\triangle ABC$ is a right triangle, it cannot contain an obtuse angle.
6. $\angle C, \angle A, \angle B$
7. $\angle D, \angle E, \angle F$
8. $\angle H, \angle J, \angle G$
9. no; $17 > (3 + 12)$
10. no; $21 = (5 + 16)$
11. yes
12. yes
13. 8 in. $< x <$ 18 in.

6.6 Explorations

1. **a.** Check students' work.
   b. Check students' work.
   c. Check students' work.
   d. $\overline{AC} \cong \overline{DC}$, because all points on a circle are equidistant from the center; $\overline{BC} \cong \overline{BC}$ by the Reflexive Property of Congruence (Thm. 2.1).
   e. $AB > DB$; $m\angle ACB > m\angle DCB$; yes; The triangle with the longer third side has the larger angle opposite the third side.
   f. *Sample answer:*

D	*AC*	*BC*	*AB*	*BD*	$m\angle ACB$	$m\angle BCD$
1. (4.75, 2.03)	2	3	3.61	2.68	90°	61.13°
2. (4.94, 2.5)	2	3	3.61	3.16	90°	75.6°
3. (5, 3)	2	3	3.61	3.61	90°	90°
4. (4.94, 3.5)	2	3	3.61	4	90°	104.45°
5. (3.85, 4.81)	2	3	3.61	4.89	90°	154.93°

   g. If two sides of one triangle are congruent to two sides of another triangle, and the included angle of the first is larger than the included angle of the second, then the third side of the first is longer than the third side of the second.

2. If the included angle of one is larger than the included angle of the other, then the third side of the first is longer than the third side of the second. If the included angles are congruent, then you already know that the triangles are congruent by the SAS Congruence Theorem (Thm. 5.5). Therefore the third sides are congruent because corresponding parts of congruent triangles are congruent.

3. Because the sides of the hinge do not change in length, the angle of the hinge can model the included angle and the distance between the opposite ends of the hinge can model the third side. When the hinge is open wider, the angle is larger and the ends of the hinge are farther apart. If the hinge is open less, the ends are closer together.

6.6 Extra Practice

1. <; By the Hinge Theorem (Thm. 6.12), because $\overline{BC}$ is the third side of the triangle with the smaller included angle, it is shorter than $\overline{EF}$.
2. >; By the Hinge Theorem (Thm. 6.12), because $\overline{BC}$ is the third side of the triangle with the larger included angle, it is longer than $\overline{EF}$.
3. =; The triangles are congruent by the SAS Congruence Theorem (Thm. 5.5). So, $BC = EF$ because corresponding parts of congruent triangles are congruent.
4. =; The triangles are congruent by the SSS Congruence Theorem (Thm. 5.8). So, $\angle A \cong \angle D$ because corresponding parts of congruent triangles are congruent.
5. <; By the Converse of the Hinge Theorem (Thm. 6.13), because $\angle A$ is the included angle in the triangle with the shorter third side, its measure is less than that of $\angle D$.
6. >; By the Converse of the Hinge Theorem (Thm. 6.13), because $\angle A$ is the included angle in the triangle with the longer third side, its measure is greater than that of $\angle D$.
7. >; By the Hinge Theorem (Thm. 6.12) because $\overline{AB}$ is the third side of the triangle with the larger included angle, it is longer than $\overline{AC}$.
8. =; The triangles are congruent by the SAS Congruence Theorem (Thm. 5.5). So, $AB = CD$ because corresponding parts of congruent triangles are congruent.
9. >; By the Converse of the Hinge Theorem (Thm. 6.13), because $\angle 1$ is the included angle in the triangle with the longer third side, its measure is greater than that of $\angle 2$.
10. $\overline{XY} \cong \overline{YZ}$ (given); $WX > WZ$ (given); $\overline{WY} \cong \overline{WY}$ by the Reflexive Property of Congruence (Thm. 2.1); $m\angle WYX > m\angle WYZ$ by the Converse of the Hinge Theorem (Thm. 6.13).
11. $\overline{AD} \cong \overline{BC}$ (given); $m\angle DAC > m\angle ACB$ (given); $\overline{AC} \cong \overline{AC}$ by the Reflexive Property of Congruence (Thm. 2.1); $DC > AB$ by the Hinge Theorem (Thm. 6.12).
12. When the angle between the scissor blades becomes greater, the rubber band that constitutes the third side of the triangle is stretched to become longer.
13. The first crow: Because $135° > 90°$, the first crow's distance from Crow Valley is greater than the second crow's distance by the Hinge Theorem (Thm. 6.12).

Chapter 7

Maintaining Mathematical Proficiency

1. $x = -10$
2. $x = -14$
3. $x = -6$
4. $c \parallel d$; $a \perp c$; $a \perp d$
5. $a \perp b$; $c \perp d$
6. $a \parallel c$; $b \perp d$
7. When you factor out a negative from the second quantity in parentheses, you can simplify $4(x - 9) + 5(9 - x) = 11$ to

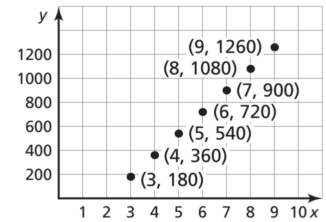
$$\begin{aligned} 4(x-9) + 5 \cdot -1(x-9) &= 11 \\ 4(x-9) - 5(x-9) &= 11 \\ -(x-9) &= 11; \\ x &= -2 \end{aligned}$$

7.1 Explorations

1. a. 360°, 540°

   b. 180°, 360°, 540°, 720°, 900°, 1080°, 1260°

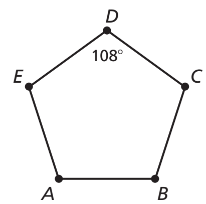
   c.



   d. $S = (n - 2) \cdot 180$; Let $n =$ the number of sides of the polygon. If you subtract 2 and multiply the difference by 180°, then you get the sum of the measures of the interior angles of a polygon.

2. a. $S = \dfrac{(n-2) \cdot 180}{n}$

   b. 108°



   c.

Number of Sides, *n*	3	4	5	6
Sum of Angle Measures, *S*	180°	360°	540°	720°
Interior Angle	60°	90°	108°	120°

Number of Sides, *n*	7	8	9
Sum of Angle Measures, *S*	900°	1080°	1260°
Interior Angle	128.57°	135°	140°

3. The sum S of the measures of the interior angles of a polygon with n sides is given by $S = (n - 2)180$.
4. 150°

7.1 Extra Practice

1. 1080°
2. 2340°
3. 3960°
4. heptagon
5. undecagon (11-gon)
6. 18-gon
7. $x = 155$
8. $x = 90$
9. $x = 140$
10. $x = 20$

7.2 Explorations

1. a. Check students' work; Construct $\overleftrightarrow{AB}$ and a line parallel to $\overleftrightarrow{AB}$ through point C. Construct $\overleftrightarrow{BC}$ and a line parallel to $\overleftrightarrow{BC}$ through point A. Construct a point D at the intersection of the line drawn parallel to $\overleftrightarrow{AB}$ and the line drawn parallel to $\overleftrightarrow{BC}$. Finally, construct $\overline{AB}$, $\overline{BC}$, $\overline{CD}$, and $\overline{DA}$ by removing the rest of the parallel lines drawn.

   b. Check students' work. (For sample in text, $m\angle A = m\angle C = 63.43°$ and $m\angle B = m\angle D = 116.57°$.); Opposite angles are congruent, and consecutive angles are supplementary.

c. Check students' work. (For sample in text, $AB = CD = 2.24$ and $BC = AD = 4$.); Opposite sides are congruent.

d. Check students' work; Opposite angles of a parallelogram are congruent. Consecutive angles of a parallelogram are supplementary. Opposite sides of a parallelogram are congruent.

2. **a.** Check students' work.

b. Check students' work.

c. Check student's work. (For sample in text, $\overline{AE} = \overline{CE} = 1.58$ and $BE = DE = 2.55$.); Point E bisects $\overline{AC}$ and $\overline{BD}$.

d. The diagonals of a parallelogram bisect each other.

3. A parallelogram is a quadrilateral where both pairs of opposite sides are congruent and parallel, opposite angles are congruent, consecutive angles are supplementary, and the diagonals bisect each other.

7.2 Extra Practice

1. $x = 10, y = 40$ **2.** $x = 21.5, y = 415$

3. $x = 6, y = 8$

4. 24; By the Parallelogram Opposite Sides Theorem (Thm. 7.3), $MN = PO$.

5. 14; By the Parallelogram Diagonals Theorem (Thm. 7.6), $MQ = OQ$.

6. 26; By the Parallelogram Opposite Sides Theorem (Thm. 7.3), $MP = NO$.

7. 20.7; By the Parallelogram Diagonals Theorem (Thm. 7.6), $NQ = PQ$.

8. 112°; By the Parallelogram Consecutive Angles Theorem (Thm. 7.5), $\angle PMN$ and $\angle MNO$ are supplementary. So, $m\angle PMN = 180° - 68°$.

9. 112°, By the Parallelogram Consecutive Angles Theorem (Thm. 7.5), $\angle NOP$ and $\angle MNO$ are supplementary. So, $m\angle NOP = 180° - 68°$.

10. 68°; By the Parallelogram Opposite Angles Theorem (Thm. 7.4), $m\angle OPM = m\angle MNO$.

11. 59°; By the Alternate Interior Angles Theorem (Thm. 3.2), $m\angle NMO = m\angle POM$.

7.3 Explorations

1. **a.** Check students' work.

b. yes; Because they have the same slope, opposite sides are parallel.

c. Check students' work. If the opposite sides of a quadrilateral are congruent, then the quadrilateral is a parallelogram.

d. If a quadrilateral is a parallelogram, then its opposite sides are congruent; yes; This is the Parallelogram Opposite Sides Theorem (Thm. 7.3).

2. **a.** Check students' work.

b. yes; Because they have the same slope, opposite sides are parallel.

c. Check students' work. If the opposite angles of a quadrilateral are congruent, then the quadrilateral is a parallelogram.

d. If a quadrilateral is a parallelogram, then its opposite angles are congruent; yes; This is the Parallelogram Opposite Angles Theorem (Thm. 7.4).

3. Show that the opposite sides or opposite angles are congruent.

4. yes; The opposite angles are congruent.

7.3 Extra Practice

1. Opposite Sides Parallel and Congruent Theorem (Thm. 7.9)

2. Parallelogram Opposite Angles Converse (Thm. 7.8)

3. Parallelogram Diagonals Converse (Thm. 7.10)

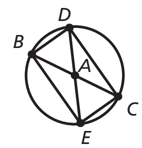
4. $x = 40, y = 25$ **5.** $x = 5, y = 1$

6. $x = 8, y = 106$ **7.** $x = 17, y = 17$

7.4 Explorations

1. **a.** Check students' work. **b.** Check students' work.

c.

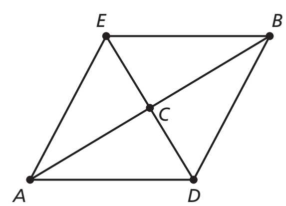


d. yes; yes; no; no; Because all points on a circle are the same distance from the center, $\overline{AB} \cong \overline{AE} \cong \overline{AC} \cong \overline{AD}$. So, the diagonals of quadrilateral $BDCE$ bisect each other, which means it is a parallelogram by the Parallelogram Diagonals Converse (Thm. 7.10). Because all 4 angles of $BDCE$ are right angles, it is a rectangle. $BDCE$ is neither a rhombus nor a square because $\overline{BD}$ and $\overline{EC}$ are not necessarily the same length as $\overline{BE}$ and $\overline{DC}$.

e. Check students' work; The quadrilateral formed by the endpoints of two diameters is a rectangle (and a parallelogram). In other words, a quadrilateral is a rectangle if and only if its diagonals are congruent and bisect each other.

2. **a.** Check students' work.

b.



c. yes; no; yes; no; Because the diagonals bisect each other, $AEBD$ is a parallelogram by the Parallelogram Diagonals Converse (Thm. 7.10). Because $EB = BD = AD = AE$, $AEBD$ is a rhombus. $AEBD$ is neither a rectangle nor a square because its angles are not necessarily right angles.

d. Check students' work; A quadrilateral is a rhombus if and only if the diagonals are perpendicular bisectors of each other.

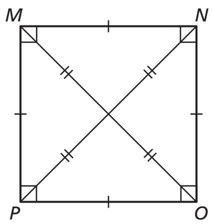
3. Because rectangles, rhombuses, and squares are all parallelograms, their diagonals bisect each other by the Parallelogram Diagonals Theorem (Thm. 7.6). The diagonals of a rectangle are congruent. The diagonals of a rhombus are perpendicular. The diagonals of a square are congruent and perpendicular.

4. yes; no; yes; no; $RSTU$ is a parallelogram because the diagonals bisect each other. $RSTU$ is not a rectangle because the diagonals are not congruent. $RSTU$ is a rhombus because the diagonals are perpendicular. $RSTU$ is not a square because the diagonals are not congruent.

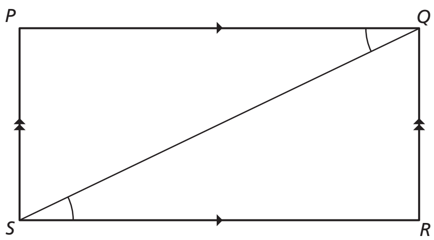
5. rectangle

7.4 Extra Practice

1. sometimes; Some rhombuses are squares.



2. always; By definition, a rectangle is a parallelogram, and because opposite sides are parallel, the alternate interior angles formed by the diagonal as a transversal are congruent.



3. 9
4. 14
5. 92°
6. 59°
7. 17
8. 59°
9. $\frac{1}{2}$
10. 90°
11. 45°

7.5 Explorations

1. **a.** Check students' work.
   b. yes; $AD = BC$
   c. If the base angles of a trapezoid are congruent, the trapezoid is isosceles.
2. **a.** Check students' work.
   b. $\angle B \cong \angle C$
   c. If a quadrilateral is a kite, it has exactly one pair of congruent opposite angles.
3. A trapezoid that has congruent base angles is isosceles; A kite has exactly one pair of congruent opposite angles.
4. yes; When the base angles are congruent, the opposite sides are also congruent.
5. no; In a kite, only one pair of opposite angles is congruent.

7.5 Extra Practice

1. slope of $\overline{QT}$ = slope of $\overline{RS}$ and slope of $\overline{RQ} \neq$ slope of $\overline{ST}$; $\overline{QT} = \overline{RS}$, so $QRST$ is an isosceles trapezoid; 6.36
2. $m\angle K = 157°, m\angle L = 23°$
3. $m\angle K = m\angle L = 70°$
4. 24
5. 3
6. 9
7. 100

Chapter 8

Maintaining Mathematical Proficiency

1. no
2. yes
3. no
4. no
5. yes
6. yes
7. $k = \frac{5}{3}$
8. $k = \frac{1}{3}$

8.1 Explorations

1. **a.** The corresponding angles are congruent.
   b. The ratios are equal to the scale factor.
   c. yes
2. **a.** The perimeter of $\triangle A'B'C'$ is equal to k times the perimeter of $\triangle ABC$.
   b. The area of $\triangle A'B'C'$ is equal to k^2 times the area of $\triangle ABC$.
   c. yes
3. Corresponding angles are congruent, and corresponding side lengths are proportional.
4. 9 in.^{2}

8.1 Extra Practice

1. $\frac{14}{3}$
2. 10
3. $\frac{3}{2}$
4. $\frac{2}{3}$
5. $x = \frac{3}{2}, y = \frac{9}{2}\sqrt{2}, z = 45°$
6. $6 + 3\sqrt{2}, 9 + \frac{9}{2}\sqrt{2}$
7. 2 : 3
8. 4 : 9

8.2 Explorations

1. **a.** Check students' work.
   b, d, and e. *Sample answer for columns 4, 5, and 6:*

	1.	2.	3.	4.	5.	6.
$m\angle A, m\angle D$	106°	88°	40°	45°	90°	15°
$m\angle B, m\angle E$	31°	42°	65°	90°	60°	150°
$m\angle C$	43°	50°	75°	45°	30°	15°
$m\angle F$	43°	50°	75°	45°	30°	15°
AB	2	2	3	2	2	2
DE	4	3	5	6	4	3.16
BC	2.82	2.61	2	2	4	2
EF	5.64	3.91	3.33	6	8	3.16
AC	1.51	1.75	2.81	2.83	3.46	3.86
DF	3.02	2.62	4.69	8.49	6.93	6.11

   c. yes; Corresponding angles are congruent, and the corresponding side lengths are proportional.
   e. no
   f. Two triangles with two pairs of congruent corresponding angles are similar.
2. They are similar.
3. $RS = 4$

8.2 Extra Practice

1. yes; $\angle A \cong \angle E$ and $\angle B \cong \angle F$, so $\triangle ABC \sim \triangle EFD$.
2. no; $m\angle A = 34°$
3. $\angle A \cong \angle CBD$ and $\angle E \cong \angle CDB$, so $\triangle ACE \sim \triangle BCD$.
4. $\angle SQR \cong \angle QSP$ and $\angle QSR \cong \angle SQP$, so $\triangle PQS \sim \triangle RSQ$.
5. 27°
6. 27°
7. 63°
8. $3\sqrt{5}$
9. 3
10. $\frac{3}{2}$

11. $\frac{3}{2}$ **12.** $\frac{3\sqrt{5}}{2}$

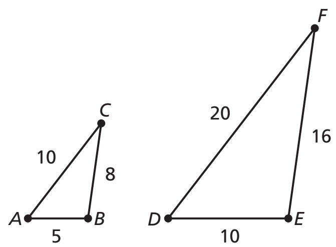
13. $\triangle DGF$

14. $\triangle EFG \sim \triangle EDG$, $\triangle EFG \sim \triangle BAG$, $\triangle EFG \sim \triangle BCG$

15. no; $m\angle J = 34°$ so the triangles cannot have two congruent pairs of angles.

8.3 Explorations

1. a.



b, d, and g. *Sample answer for column 7:*

	1.	2.	3.	4.
AB	5	5	6	15
BC	8	8	8	20
AC	10	10	10	10
DE	10	15	9	12
EF	16	24	12	16
DF	20	30	15	8
$m\angle A$	52.41°	52.41°	53.13°	104.48°
$m\angle B$	97.9°	97.9°	90°	28.96°
$m\angle C$	29.69°	29.69°	36.87°	46.57°
$m\angle D$	52.41°	52.41°	53.13°	104.48°
$m\angle E$	97.9°	97.9°	90°	28.96°
$m\angle F$	29.69°	29.69°	36.87°	46.57°

	5.	6.	7.
AB	9	24	3
BC	12	18	5
AC	8	16	6
DE	12	8	9
EF	15	6	15
DF	10	8	18
$m\angle A$	89.6°	48.59°	56.25°
$m\angle B$	41.81°	41.81°	93.82°
$m\angle C$	48.59°	89.6°	29.93°
$m\angle D$	85.46°	44.05°	56.25°
$m\angle E$	41.65°	67.98°	93.82°
$m\angle F$	52.89°	67.98°	29.93°

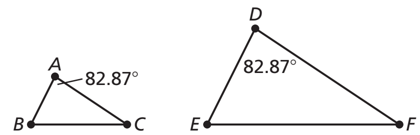
c. yes; Corresponding angles are congruent.

d. The triangles are similar in columns 2–4 because corresponding angles are congruent. The triangles are not similar in columns 5 and 6 because corresponding angles are not congruent.

e. They are proportional; no

f. If the corresponding side lengths of two triangles are proportional, then the triangles are similar.

2. a. *Sample answer:*



b. yes; Corresponding angles are congruent.

c. The triangles are similar in each case.

3. If all three pairs of corresponding side lengths of two triangles are proportional, then the triangles are similar. If an angle of one triangle is congruent to an angle of a second triangle and the lengths of the sides including these angles are proportional, then the triangles are similar.

8.3 Extra Practice

1. not similar **2.** similar

3. $x = -3$ **4.** $\frac{28}{12} = \frac{35}{15} = \frac{56}{24} = \frac{7}{3}$

5. $\frac{35}{2}, \frac{45}{2}$ **6.** $4, \frac{14}{3}$

8.4 Explorations

1. a. Check students' work.

b. $\frac{AD}{BD} = \frac{AE}{CE}$

c. Check students' work; $\frac{AD}{BD} = \frac{AE}{CE}$

d. Check students' work; If $\overline{DE} \parallel \overline{AC}$ in $\triangle ABC$, then $\frac{AD}{BD} = \frac{AE}{CE}$.

2. a. Check students' work.

b. $\frac{AD}{DC} = \frac{BA}{BC}$

c. Check students' work; If $\overline{BD}$ bisects $\angle B$ in $\triangle ABC$, $\frac{AD}{DC} = \frac{BA}{BC}$.

3. If a ray bisects an angle of a triangle, then the opposite segments are proportional to the lengths of the other two sides. If a line parallel to one side of a triangle intersects the other two sides, then it divides the two sides proportionally.

4. $\frac{BD}{DA} = \frac{BE}{EC}$

8.4 Extra Practice

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

3. no **4.** yes

5. XZ **6.** UV

7. ZX **8.** $x = 3$

9. $b = 8$

Chapter 9

Maintaining Mathematical Proficiency

1. $10\sqrt{5}$	**2.** $3\sqrt{21}$
3. $6\sqrt{7}$	**4.** $\frac{4\sqrt{3}}{3}$
5. $\frac{11\sqrt{5}}{5}$	**6.** $4\sqrt{2}$
7. $x = 6$	**8.** $x = 11.25$
9. $x = 9$	**10.** $x = 8.1$
11. $x = \frac{86}{9}$	**12.** $x = 4$

13. no; You can use the Product Property of Radicals to simplify products of square roots because square roots have to do with factors, but you cannot use the rule to simplify sums (or differences).

9.1 Explorations

1. a. Check students' work.

b. Check students' work.

c. $\frac{1}{2}ab + \frac{1}{2}ab + \frac{1}{2}ab + \frac{1}{2}ab + c^2 = 2ab + c^2$

d. Check students' work.

e. $ab + ab + a^2 + b^2 = 2ab + a^2 + b^2$

f. The equations from parts (c) and (e) both describe the area of the same square. So, they are equal, $2ab + c^2 = 2ab + a^2 + b^2$, and by the Subtraction Property of Equality, $c^2 = a^2 + b^2$.

2. a. Check students' work.

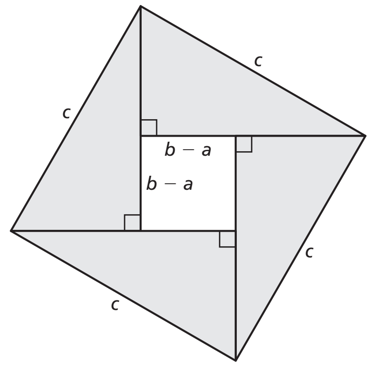
b. $\triangle CBD \sim \triangle ABC$ by the AA Similarity Theorem (Thm. 8.3) because both triangles have a right angle, and both triangles include $\angle B$. $\triangle ACD \sim \triangle ABC$ by the AA Similarity Theorem (Thm. 8.3) because both triangles have a right angle, and both triangles include $\angle A$. $\triangle ACD \sim \triangle CBD$ by the AA Similarity Theorem (Thm. 8.3) because both triangles have a right angle, and both $\angle B$ and $\angle ACD$ are complementary to $\angle BCD$, so $\angle B \cong \angle ACD$.

c.

STATEMENTS	REASONS
1. $\triangle ABC \sim \triangle ACD \sim \triangle CBD$	**1.** Given
2. $\frac{c}{b} = \frac{b}{c-d}, \frac{c}{a} = \frac{a}{d}$	**2.** Corresponding sides of similar figures are proportional.
3. $c(c - d) = b^2, cd = a^2$	**3.** Cross Products Property
4. $c^2 - cd = b^2$	**4.** Distributive Property
5. $c^2 - a^2 = b^2$	**5.** Substitution Property of Equality
6. $c^2 = a^2 + b^2$	**6.** Addition Property of Equality
7. $a^2 + b^2 = c^2$	**7.** Symmetric Property of Equality

3. You can create a physical model, a drawing, or a formal proof.

4. *Sample answer:* Arrange the same triangles from method 1 as shown below. The area of the large square is c^2. The area of the small square is $(b - a)^2 = b^2 - 2ab + a^2$, or it can be written as the area of the large square minus the area of the triangles: $c^2 - 4\left(\frac{1}{2}ab\right) = c^2 - 2ab$. Set these two expressions equal to each other to get $b^2 - 2ab + a^2 = c^2 - 2ab$, which becomes $a^2 + b^2 = c^2$, when $2ab$ is added to each side.



9.1 Extra Practice

1. $x = 135$; yes	**2.** $x = 4\sqrt{3} \approx 6.9$; no
3. $x = 25$; yes	
4. $x = 2\sqrt{34} \approx 11.7$; no	
5. $x = 22\sqrt{6} \approx 53.9$; no	
6. $x = 102$; yes	**7.** 0.4 mi
8. yes; right	**9.** yes; obtuse

9.2 Explorations

1. a. Check students' work.

b. 45° and 45°; 45°-45°-90° describes the angle measures.

c. $\sqrt{2}$; $\sqrt{2}$; 1

d. Check students' work; The ratio of the length of each leg to the length of the hypotenuse is $\sqrt{2}$. The ratio of the length of one leg to the other is 1.

2. a. Check students' work.

b. $\frac{2}{\sqrt{3}}$; 2; $\sqrt{3}$

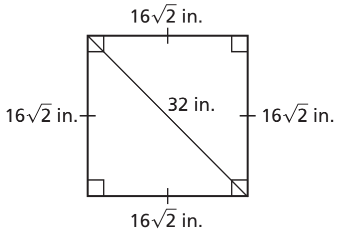
c. Check students' work; The ratio of the length of the hypotenuse to the length of the longer leg is $\frac{2}{\sqrt{3}}$. The ratio of the length of the hypotenuse to the length of the shorter leg is 2. The ratio of the length of the longer leg to the length of the shorter leg is $\sqrt{3}$.

3. In a 45°-45°-90° triangle, the legs are the same length, and the length of the hypotenuse is $\sqrt{2}$ times as long as each leg. In a 30°-60°-90° triangle, the hypotenuse is twice as long as the shorter leg, and the longer leg is $\sqrt{3}$ times as long as the shorter leg.

9.2 Extra Practice

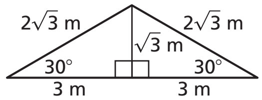
1. $x = 10\sqrt{2}$	**2.** $x = 1$
3. $x = 8$	**4.** $x = 6\sqrt{2}$
5. $x = 15\sqrt{3}, y = 30$	
6. $x = 11\sqrt{3}, y = 11$	
7. $x = 3\sqrt{3}, y = 6\sqrt{3}$	

8.



$64\sqrt{2} \approx 90.5$ in.

9.



6 m

10. $98\sqrt{3} \approx 169.7$ m^2

9.3 Explorations

1. **a.** Check students' work.

b. $\dfrac{AD}{CD} = \dfrac{CD}{BD}$; By the Corollary to the Triangle Sum Theorem (Cor. 5.1), two pairs of angles are complementary, $\angle A$ and $\angle ACD$ as well as $\angle B$ and $\angle BCD$. Also, because adjacent angles $\angle ACD$ and $\angle BCD$ form a right angle, they are complementary. Then, by the Congruent Complements Theorem (Thm. 2.5), $\angle A \cong \angle BCD$ and $\angle B \cong \angle ACD$. So, $\triangle ACD \sim \triangle BCD$ by the AA Similarity Theorem (Thm. 8.3). Then, because corresponding sides of similar figures are proportional, $\dfrac{AD}{CD} = \dfrac{CD}{BD}$.

c. about 4.24 units

d. In a right triangle, $\triangle ABC$, where $\overline{AB}$ is the hypotenuse, the altitude, $\overline{CD}$, from the right angle to the hypotenuse, divides the hypotenuse into two segments, $\overline{AD}$ and $\overline{BD}$. The length of the altitude is the geometric mean of the lengths of the two segments of the hypotenuse: $\dfrac{AD}{CD} = \dfrac{CD}{BD}$.

2.

	A	B	C	D
1	a	b	Arithmetic Mean	Geometric Mean
2	3	4	3.5	3.464
3	4	5	4.5	4.472
4	6	7	6.5	6.481
5	0.5	0.5	0.5	0.5
6	0.4	0.8	0.6	0.566
7	2	5	3.5	3.162
8	1	4	2.5	2
9	9	16	12.5	12
10	10	100	55	31.623

Sample answer: The geometric mean is always less than or equal to the arithmetic mean. If the pair of positive numbers are closer together, so are the two means. If the pair of positive numbers are equal, they are also equal to each mean.

3. In a right triangle, the altitude from the right angle to the hypotenuse divides the hypotenuse into two segments. The length of the altitude is the geometric mean of the lengths of the two segments of the hypotenuse.

9.3 Extra Practice

1. $\triangle JIK \sim \triangle HIJ \sim \triangle HJK$

2. $\triangle MNP \sim \triangle ONM \sim \triangle OMP$

3. $2\sqrt{3} \approx 3.46$

4. 15

5. $x = 12$

6. $y = 3\sqrt{11} \approx 9.95$

7. $t = 343$

8. $a = 8$

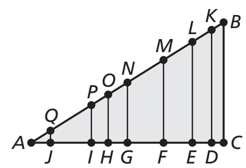
9.4 Explorations

1. **a.** Check students' work.

b. 0.75, 0.75, 0.75, 0.75, 0.75, 0.75, 0.75, 0.75; In all of the similar triangles for which $m\angle A = 36.87°$, $\tan A = 0.75$.

2. $\tan A \approx 0.7500027913$; Because the angle measure used was rounded to 2 decimal places, the answer did not come out to 0.75 exactly, but when you consider the level of accuracy of the angle measure, they are essentially equivalent.

3. *Sample answer:*



Ratio	$\dfrac{BC}{AC}$	$\dfrac{KD}{AD}$	$\dfrac{LE}{AE}$	$\dfrac{MF}{AF}$
Tan *A*	0.625	0.6253	0.6254	0.6255

Ratio	$\dfrac{NG}{AG}$	$\dfrac{OH}{AH}$	$\dfrac{PI}{AI}$	$\dfrac{QJ}{AJ}$
Tan *A*	0.625	0.625	0.624	0.625

When the side lengths used are approximate decimal values, the calculated ratios are approximate as well. In this case, all the ratios are equivalent to about 0.625.

4. You can use a right triangle to find the tangent of an acute angle by calculating the ratio of the length of the opposite leg to the length of the adjacent leg; no

9.4 Extra Practice

1. $\tan R = \frac{45}{24} = 1.8750$, $\tan S = \frac{24}{45} \approx 0.5333$

2. $\tan J = \frac{7}{5} = 1.4000$, $\tan L = \frac{5}{7} \approx 0.7143$

3. $\tan A = \sqrt{2} \approx 1.4142$, $\tan C = \dfrac{\sqrt{2}}{2} \approx 0.7071$

4. $x \approx 28.4$

5. $x \approx 26.7$

6. $x \approx 39.9$

7. $\tan D = \frac{3}{4}$

8. **a.** about 83.9 ft

b. about 39.6 ft

9. about 97.5 ft

10. about 59.5 units

9.5 Explorations

1. **a.** Check students' work.

b. $\sin A$: 0.6, 0.6, 0.6, 0.6, 0.6, 0.6, 0.6, 0.6;
$\cos A$: 0.8, 0.8, 0.8, 0.8, 0.8, 0.8, 0.8, 0.8;
In all of the similar right triangles for which $m\angle A = 36.87°$, $\sin A = 0.6$ and $\cos A = 0.8$.

2. You use a right triangle to find the sine of an acute angle by calculating the ratio of the length of the opposite leg to the length of the hypotenuse. You use a right triangle to find the cosine of an acute angle by calculating the ratio of the length of the adjacent leg to the length of the hypotenuse; no

3. $\angle A$ and $\angle B$ are complementary; $\sin B = 0.8$, $\cos B = 0.6$; $\sin A = \cos B$, $\cos A = \sin B$; The leg that is opposite $\angle A$ is the same leg that is adjacent to $\angle B$ and vice versa, but the length of the hypotenuse stays the same. So, the sine of one angle is equal to the cosine of its complementary angle.

9.5 Extra Practice

1. $\sin F = \frac{12}{13} \approx 0.9231$, $\sin G = \frac{5}{13} \approx 0.3846$, $\cos F = \frac{5}{13} \approx 0.3846$, $\cos G = \frac{12}{13} \approx 0.9231$
2. $\sin F = \frac{65}{97} \approx 0.6701$, $\sin G = \frac{72}{97} \approx 0.7423$, $\cos F = \frac{72}{97} \approx 0.7423$, $\cos G = \frac{65}{97} \approx 0.6701$
3. $\sin F = \frac{\sqrt{2}}{2} \approx 0.7071$, $\sin G = \frac{\sqrt{2}}{2} \approx 0.7071$, $\cos F = \frac{\sqrt{2}}{2} \approx 0.7071$, $\cos G = \frac{\sqrt{2}}{2} \approx 0.7071$
4. cos 81°
5. cos 60°
6. cos 13°
7. sin 75°
8. sin 7°
9. sin 45°
10. $x \approx 2.5$, $y \approx 8.7$
11. $m \approx 15.5$, $n \approx 47.6$
12. $c \approx 10.7$, $d \approx 14.7$
13. $a \approx 13.1$, $b \approx 30.9$
14. **a.** about 110.3 ft
    b. about 181.3 ft

9.6 Explorations

1. **a.** $\sin A = \cos A = \sin B = \cos B = \frac{\sqrt{2}}{2}$; $m\angle A = m\angle B = 45°$
   b. $\sin A = \cos B = \frac{\sqrt{3}}{2}$, $\cos A = \sin B = \frac{1}{2}$; $m\angle A = 60°$, $m\angle B = 30°$
2. **a.** $m\angle A \approx 59.0°$, $m\angle B \approx 31.0°$
   b. $m\angle A \approx 63.4°$, $m\angle B \approx 26.6°$
3. You can find the ratio of two side lengths that gives the value of the sine, cosine, or tangent of an angle. If you recognize the ratio from a special right triangle, then you can find the measure of the angle that way. Otherwise, you can use the inverse sine, cosine, or tangent feature of your calculator to approximate the measure of the angle.
4. about 67.4°, about 22.6°

9.6 Extra Practice

1. $\angle F$
2. $\angle E$
3. about 11.5°
4. 45°
5. about 70.7°
6. about 62.9°
7. $AC = 6\sqrt{5}$, $m\angle A \approx 63.4°$, $m\angle C \approx 26.6°$
8. $ED = 72$, $m\angle C \approx 73.7°$, $m\angle D \approx 16.3°$
9. $LM \approx 1.8$, $MN \approx 2.4$, $m\angle N = 38°$
10. $YZ \approx 37.1$, $XZ \approx 32.5$, $m\angle Y = 61°$
11. about 28.7°

9.7 Explorations

1. **a.** 29.74°, 3.16, 0.157, 97.13°, 6.32, 0.157, 53.13°, 5.1, 0.157; $\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$
   b. Check students' work; In any given triangle, the ratio of the sine of an angle measure to the length of the opposite side is the same as the ratio of the sine of any other angle measure to the length of its opposite side.
2. **a.** 5.1, 26.0, 3.16, 9.99, 6.32, 39.94, 53.13°, 26.0; $a^2 + b^2 - 2ab \cos C = c^2$
   b. Check students' work; In any given triangle, the length of one side squared, c^2, equals $a^2 + b^2 - 2ab \cos C$, where a and b are the lengths of the other two sides, and $\angle C$ is the angle opposite side c.
3. For any triangle with sides of length a, b, and c, where the angles opposite each of the respective sides are $\angle A$, $\angle B$, and $\angle C$, the Law of Sines (Thm. 9.9) is $\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$, and the Law of Cosines (Thm. 9.10) is $c^2 = a^2 + b^2 - 2ab \cos C$. Both of these equations can be manipulated to solve for different values.
4. Use the Law of Sines (Thm. 9.9) to solve a triangle when you know the measures of two angles and any side, or when you know two sides and one nonincluded angle. Use the Law of Cosines (Thm. 9.10) when you know the measures of two sides and their included angle, or when you know the measures of all three sides.

9.7 Extra Practice

1. about -0.7071
2. about -0.3584
3. about -9.5144
4. about 61.8 square units
5. about 85 square units
6. $m\angle C = 100°$, $a \approx 33.7$, $c \approx 43.3$
7. $m\angle B \approx 39.3°$, $m\angle C \approx 58.7°$, $c \approx 21.6$
8. $m\angle A \approx 38.2°$, $m\angle B = 120°$, $m\angle C \approx 21.8°$

Chapter 10

Maintaining Mathematical Proficiency

1. $x^2 - 13x + 36$
2. $k^2 - k - 42$
3. $y^2 - 8y - 65$
4. $6r^2 + 11r + 3$
5. $-12m^2 + 23m - 10$
6. $42w^2 + 29w - 5$
7. $x \approx -7.36$, $x \approx 1.36$
8. $p \approx -0.35$, $p \approx 14.35$
9. $z \approx -15.55$, $z \approx -0.45$
10. $z \approx -5.37$, $z \approx 0.37$
11. $x \approx -3.45$, $x \approx 1.45$
12. $c \approx -0.62$, $c \approx 1.62$

10.1 Explorations

1. segment with endpoints on the circle; line that intersects a circle at two points; line in the plane of a circle that intersects the circle at exactly one point; segment whose endpoints are the center and any point on a circle; chord that contains the center of the circle
2. **a. and b.** Check students' work.
   c. The distance is the radius and half the diameter.
3. A chord is a segment with endpoints that lie on a circle. A diameter is a chord that passes through the center of a circle. A radius is a segment with one endpoint on the center of a circle and one endpoint on the circle. A secant line is a line that passes through two points on a circle. A tangent line is a line that passes through only one point on a circle.
4. diameters; A diameter is a chord that passes through the center of a circle.
5. Use two pencils tied together with a string that is 4 inches long.

10.1 Extra Practice

1. Answers may include $\overline{AB}$, $\overline{AD}$, $\overline{AF}$

2. Answers may include $\overline{CE}$, $\overline{DF}$

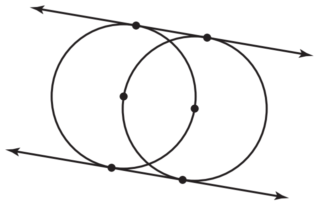
3. $\overline{DF}$

4. $\overleftrightarrow{DE}$

5. line through point B

6. point B

7. 2



8. Both tangents are external.

9. $BD = \sqrt{10^2 - 5.5^2} \approx 8.4$

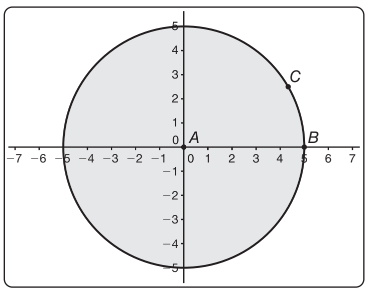
10. $x \approx 0.6$

10.2 Explorations

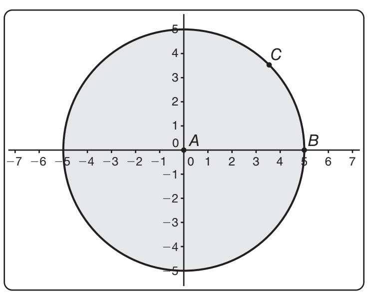
1. a. 36.87° b. 53.13°
   c. 16.26° d. 106.26°

2. by their central angles

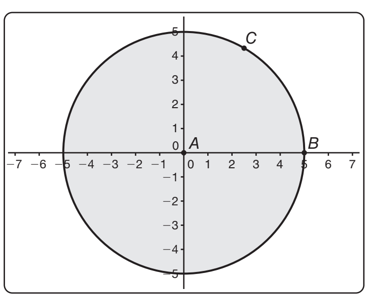
3. a.



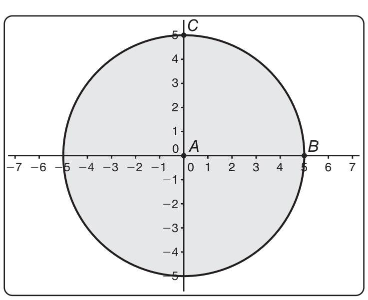
b.



c.



d.

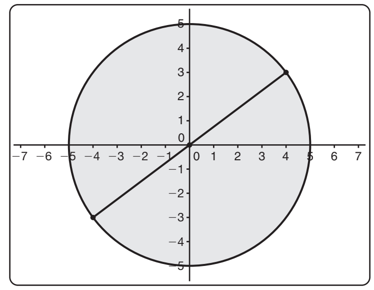


10.2 Extra Practice

1. minor arc; 90°
2. semicircle; 180°
3. major arc; 220°
4. minor arc; 90°
5. major arc; 270°
6. major arc; 230°
7. minor arc; 140°
8. minor arc; 40°
9. yes; $\widehat{ABC} \cong \widehat{ADC}$, because AC is a diameter.
10. 125°
11. $x = 25$; 125°

10.3 Explorations

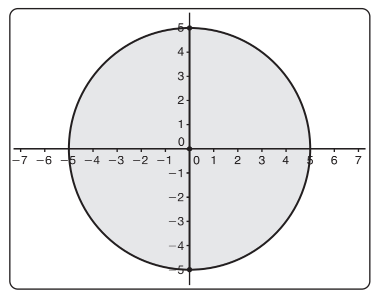
1. a.



;

It passes through the center.

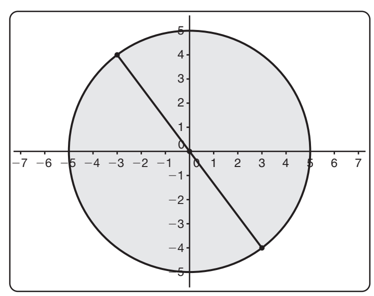
b.



;

It passes through the center.

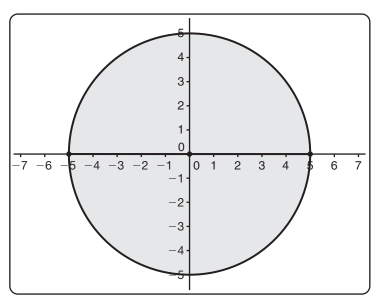
c.



;

It passes through the center.

d.



;

It passes through the center.

2. Check students' work; The perpendicular bisector is a diameter; yes; A perpendicular bisector of a chord is a diameter of the circle.

3. Check students' work; $DF = EF$; yes; If a chord is perpendicular to a diameter of a circle, then the diameter is a perpendicular bisector of the chord.

4. when it is a perpendicular bisector of a chord or passes through the center of the circle

10.3 Extra Practice

1. 42°
2. 3.6
3. 9.2
4. 138°
5. $x = 3.6$
6. $x = 6$
7. 5
8. 12.2

10.4 Explorations

1. **a.** Check students' work.
   b. The inscribed angle is half of the intercepted arc.
   c. Check students' work; The measure of an inscribed angle is equal to half the measure of the intercepted arc.
2. **a.** Check students' work.
   b. *Sample answer:* The angles sum to 360°; Opposite angles sum to 180°.
   c. Check students' work; Opposite angles of an inscribed quadrilateral sum to 180°.
3. Inscribed angles are half of the intercepted arc; Opposite angles of an inscribed quadrilateral are supplementary.
4. 100°; $\angle E$ and $\angle G$ are supplementary.

10.4 Extra Practice

1. 90°
2. 62°
3. 8.3
4. 56°
5. 124°
6. $\angle ABD \cong \angle ACD$, $\angle BAC \cong \angle BDC$
7. $m = 115$, $n = 80$

10.5 Explorations

1. **a.** Check students' work.
   b. *Sample answer:* 50°, 130°
   c. *Sample answer:* 100°, 260°
   d. Check students' work; The measure of each angle between a chord and a tangent is half of its intercepted arc.
2. **a.** Check students' work.
   b. *Sample answer:* 60°
   c. *Sample answer:* 40°, 80°; The angle measure is half of the sum of the measures of the intercepted arcs.
   d. Check students' work; The measure of an angle between two chords is half of the sum of the measure of the arcs intercepted by the angle and its vertical angle.
3. When a chord intersects a tangent line, the angle formed is half of the measure of the intercepted arc. When a chord intersects another chord, the measure of the angle is half of the sum of the measures of the arcs intercepted by the angle and its vertical angle.
4. 74°
5. 110°

10.5 Extra Practice

1. 110°
2. 140°
3. 220°
4. 140°
5. 49°
6. $x = 71$
7. $x = 20$
8. $x = 148$
9. $x = 50$

10.6 Explorations

1. **a.** Check students' work.
   b. *Sample answer:*

BF	*CF*	*BF* • *CF*
7.5	13.2	99
DF	***EF***	***DF* • *EF***
6.6	15	99

   The products are equal.
   c. If two chords intersect inside a circle, then the product of the lengths of the segments of one chord is equal to the product of the lengths of the segments of the other chord.
2. **a.** Check students' work.
   b. *Sample answer:*

BE	*BC*	*BE* • *BC*
17.6	35.9	631.84
BF	***BD***	***BF* • *BD***
22	28.72	631.84

   The products are equal.
   c. If two secants intersect outside a circle with a common endpoint, then the product of the lengths of the segments of one secant is equal to the product of the lengths of the segments of the other secant.
3. The products of the lengths of the segments of one chord or secant is equal to the product of the lengths of the segments of the other chord or secant.
4. 4

10.6 Extra Practice

1. 5
2. 6
3. 1
4. 5

10.7 Explorations

1. **a.** *Sample answer:*

Radius	Equation of Circle
1	$x^2 + y^2 = 1$
2	$x^2 + y^2 = 4$
3	$x^2 + y^2 = 9$
5	$x^2 + y^2 = 25$
6	$x^2 + y^2 = 36$
9	$x^2 + y^2 = 81$

   b. $x^2 + y^2 = r^2$

2. a. *Sample answer:*

Center	Equation of Circle
(0, 0)	$x^2 + y^2 = 4$
(2, 0)	$(x - 2)^2 + y^2 = 4$
(0, 3)	$x^2 + (y - 3)^2 = 4$
(2, −3)	$(x - 2)^2 + (y + 3)^2 = 4$
(−1, 4)	$(x + 1)^2 + (y - 4)^2 = 4$
(−3, −6)	$(x + 3)^2 + (y + 6)^2 = 4$

b. $(x - h)^2 + (y - k)^2 = 4$

c. $(x - h)^2 + (y - k)^2 = r^2$

3. $\sqrt{(x - h)^2 + (y - k)^2} = d$; $(x - h)^2 + (y - k)^2 = d^2$; If $d = r$, then the equations are the same.

4. $(x - h)^2 + (y - k)^2 = r^2$

5. $(x - 4)^2 + (y + 1)^2 = 9$

10.7 Extra Practice

1. $x^2 + y^2 = 64$

2. $(x - 2)^2 + (y - 2)^2 = 16$

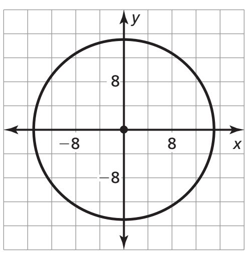
3. $x^2 + y^2 = \frac{1}{9}$

4. $(x + 3)^2 + (y + 5)^2 = 64$

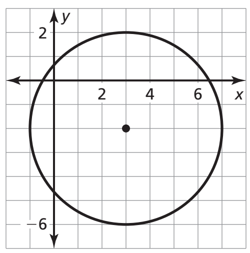
5. $x^2 + y^2 = 25$

6. $(x - 4)^2 + (y - 5)^2 = 25$

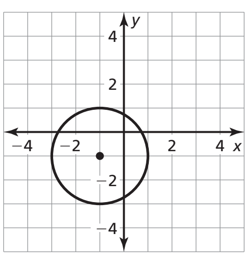
7. center: (0, 0), radius: 15



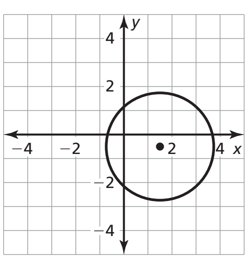
8. center: (3, −2), radius: 4



9. center: (−1, −1), radius: 2



10. center: $\left(\frac{3}{2}, -\frac{1}{2}\right)$, radius: $\sqrt{5}$



11. The radius of the circle is 6. $\sqrt{(-4 - 0)^2 + (4 - 0)^2} = 4\sqrt{2}$, so (−4, 4) does not lie on the circle.

12. The radius of the circle is $3\sqrt{2}$. $\sqrt{(-4 + 1)^2 + (-1 - 2)^2} = 3\sqrt{2}$, so (−1, 2) does lie on the circle.

Chapter 11

Maintaining Mathematical Proficiency

1. 160 in.^{2}

2. 660 cm^2

3. $\frac{5}{2}$ in.

4. 8 cm

11.1 Explorations

1. a. $8\pi \approx 25.13$ units

b. $2\pi \approx 6.28$ units

c. $\frac{10}{3}\pi \approx 10.47$ units

d. $\frac{15}{4}\pi \approx 11.78$ units

2. no; *Sample answer:* One-half revolution of the tire is about 3.27 feet.

3. Multiply the fraction of the circle the arc represents by the circumference of the circle.

4. about 56.55 in.

11.1 Extra Practice

1. about 3.18 in.

2. about 18.85 cm

3. about 1.275 ft

4. about 7.54 m

5. about 3.66 in.

6. $\frac{\pi}{3}$ rad

7. 150°

11.2 Explorations

1. a. about 113.10 square units

b. about 28.27 square units

c. about 11.00 square units

d. about 134.04 square units

2. about 167,552 m^2

3. Multiply the fraction of the circle the sector represents by the area of the circle.

4. about 13,963 m^2

11.2 Extra Practice

1. about 19.63 cm^2

2. about 153.94 m^2

3. about 2.54 in.^{2}

4. about 3.57 ft

5. about 4.55 cm

6. about 116.90 yd^2

7. about 19.55 cm^2; about 30.72 cm^2

8. 59.04 ft^2

9. about 25 people/mi^2

11.3 Explorations

1. a. about 1.15 units; 6.9 square units

b. about 2.75 units; 27.5 square units

c. about 3.46 units; 41.52 square units

d. about 4.83 units; 77.28 square units

Sample answer: Find the center of the regular n-gon by finding the center of its circumscribed circle. Then find the apothem. Use the center to divide the n-gon into n congruent triangles, each with a base that is a side of the n-gon and a height that is the apothem. Find the area of one triangle and multiply by n to find the area of the regular n-gon.

2. $A = \frac{1}{2}aP$, where a is the apothem and P is the perimeter

3. *Sample answer:* Find the perimeter and apothem and substitute the values in the formula $A = \frac{1}{2}aP$.

4. 61.95 m^2

11.3 Extra Practice

1. 140 in.^{2}

2. 16 cm^2

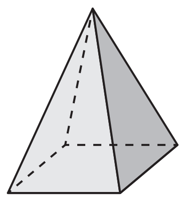
3. 45°

4. 9 sides

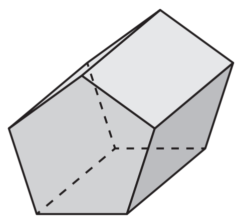
5. **a.** about 3.7 in. **b.** about 27.8 in.^{2}
6. **a.** about 11.5 units, about 11.5 units
   b. about 346.4 square units

11.4 Explorations

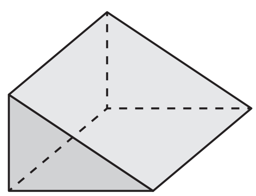
1. 4, 6, 4; 8, 12, 6; 6, 12, 8; 20, 30, 12; 12, 30, 20
2. $V - E + F = 2$
3. *Sample answer:*



5 vertices, 8 edges, 5 faces; $5 - 8 + 5 = 2$



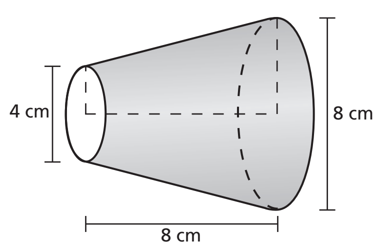
10 vertices, 15 edges, 7 faces; $10 - 15 + 7 = 2$



6 vertices, 9 edges, 5 faces; $6 - 9 + 5 = 2$

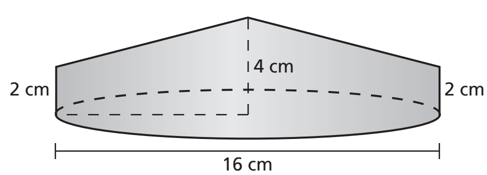
11.4 Extra Practice

1. yes, octahedron
2. no
3. square
4. triangle
5. trapezoid
6. heptagon
7.



bottom section of a cone

8.



a cone superimposed on a cylinder

11.5 Explorations

1. **a.** 32 in.^{3}
   b. no; *Sample answer:* The amount of paper is the same.
   c. *Sample answer:* If two solids have the same height and the same cross-sectional area at every level, then they have the same volume.
   d. 32 in.^{3}
2. **a.** about 37.70 in.^{3}
   b. about 1178.10 cm^3
3. *Sample answer:* Multiply the area of a base by the vertical height.
4. no; *Sample answer:* Each piece of paper would still have the same area.

11.5 Extra Practice

1. 11.25 cm^3
2. 40 in.^{3}
3. about 137.4 in.^{3}
4. about 138.2 cm^3
5. about 10 in.
6. $6\frac{2}{3}$ cm^2
7. 10.5 cm
8. about 2 in.

11.6 Explorations

1. $V = \frac{1}{3}Bh$
2. about 10.39 in.^{3}
3. Use the formula $V = \frac{1}{3}Bh$.
4. *Sample answer:* Use a cone and cylinder with the same height and circular base and determine how many cones of sand are needed to fill the cylinder.

11.6 Extra Practice

1. 36 cm^3
2. 96 in.^{3}
3. 48 yd^3
4. 385 m^3
5. 45 cm^3
6. 8 ft^3
7. 8 in.
8. 4 ft
9. 4 cm
10. 37 in.^{3}

11.7 Explorations

1. **a.** *Sample answer:* The points on the base are all the same distance from the point on the same plane directly below the vertex of the cone; 5π in.; 2.5 in.
   b. 9π in.^{2}; 7.5π in.^{2}
   c. a circle with a radius of 2.5 in. and a sector which is $\frac{5}{6}$ of a circle with a radius of 3 in.; 13.75π in.^{2}
2. $V = \frac{1}{3}\pi r^2 h$
3. *Sample answer:* $S = \pi r^2 + \pi r\ell$; $V = \frac{1}{3}\pi r^2 h$
4. *Sample answer:* As the radius decreases, the total surface area decreases.

11.7 Extra Practice

1. about 75.4 cm^2
2. about 11.4 in.^{2}
3. about 37.7 cm^3
4. about 314.2 ft^3
5. about 13.0 in.
6. about 14.0 m
7. about 2093.8 cm^3
8. about 79.59 in.^{3}

11.8 Explorations

1. $4\pi r^2$
2. $2\pi r^3$; $\frac{4}{3}\pi r^3$
3. *Sample answer:* $S = 4\pi r^2$, $V = \frac{4}{3}\pi r^3$
4. **a.** about 113.10 in.^{2}; about 113.10 in.^{3}
   b. about 50.27 cm^2; about 33.51 cm^3

11.8 Extra Practice

1. about 314.2 cm^2
2. about 254.5 in.^{2}
3. about 6.3 ft^2
4. about 788.2 m^2
5. about 1767.2 in.^{3}
6. about 9202.8 cm^3
7. about 179.6 cm^3
8. about 523.6 in.^{3}
9. 12 cm
10. about 2144.7 in.^{3}
11. about 4188.8 ft^3