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Chapter 7 Resource Masters

Geometry

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Consumable Workbooks Many of the worksheets contained in the Chapter Resource Masters are available as consumable workbooks in both English and Spanish.

	ISBN10	ISBN13
Study Guide and Intervention Workbook	0-07-890848-5	978-0-07-890848-4
Homework Practice Workbook	0-07-890849-3	978-0-07-890849-1
Spanish Version		
Homework Practice Workbook	0-07-890853-1	978-0-07-890853-8

Answers for Workbooks The answers for Chapter 7 of these workbooks can be found in the back of this Chapter Resource Masters booklet.

StudentWorks Plus™ This CD-ROM includes the entire Student Edition test along with the English workbooks listed above.

TeacherWorks Plus™ All of the materials found in this booklet are included for viewing, printing, and editing in this CD-ROM.

Spanish Assessment Masters (ISBN10: 0-07-890856-6, ISBN13: 978-0-07-890856-9) These masters contain a Spanish version of Chapter 7 Test Form 2A and Form 2C.

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Teacher's Guide to Using the *Chapter 7 Resource Masters*

The *Chapter 7 Resource Masters* includes the core materials needed for Chapter 7. These materials include worksheets, extensions, and assessment options. The answers for these pages appear at the back of this booklet.

All of the materials found in this booklet are included for viewing and printing on the *TeacherWorks Plus™* CD-ROM.

Chapter Resources

Student-Built Glossary (pages 1–2) These masters are a student study tool that presents up to twenty of the key vocabulary terms from the chapter. Students are to recording definitions and/or examples for each term. You may suggest that student highlight or star the terms with which they are not familiar. Give to students before beginning Lesson 7-1. Encourage them to add these pages to their mathematics study notebooks. Remind them to complete the appropriate words as they study each lesson.

Anticipation Guide (pages 3–4) This master presented in both English and Spanish is a survey used before beginning the chapter to pinpoint what students may or may not know about the concepts in the chapter. Students will revisit this survey after they complete the chapter to see if their perceptions have changed.

Lesson Resources

Study Guide and Intervention These masters provide vocabulary, key concepts, additional worked-out examples and Check Your Progress exercises to use as a reteaching activity. It can also be used in conjunction with the Student Edition as an instructional tool for students who have been absent.

Skills Practice This master focuses more on the computational nature of the lesson. Use as an additional practice option or as homework for second-day teaching of the lesson.

Practice This master closely follows the types of problems found in the Exercises section of the Student Edition and includes word problems. Use as an additional practice option or as homework for second-day teaching of the lesson.

Word Problem Practice This master includes additional practice in solving word problems that apply the concepts of the lesson. Use as an additional practice or as homework for second-day teaching of the lesson.

Enrichment These activities may extend the concepts of the lesson, offer a historical or multicultural look at the concepts, or widen students' perspectives on the mathematics they are learning. They are written for use with all levels of students.

Graphing Calculator, TI-Nspire, or Spreadsheet Activities These activities present ways in which technology can be used with the concepts in some lessons of this chapter. Use as an alternative approach to some concepts or as an integral part of your lesson presentation.

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Assessment Options

The assessment masters in the *Chapter 7 Resource Masters* offer a wide range of assessment tools for formative (monitoring) assessment and summative (final) assessment.

Student Recording Sheet This master corresponds with the standardized test practice at the end of the chapter.

Extended-Response Rubric This master provides information for teachers and students on how to assess performance on open-ended questions.

Quizzes Four free-response quizzes offer assessment at appropriate intervals in the chapter.

Mid-Chapter Test This 1-page test provides an option to assess the first half of the chapter. It parallels the timing of the Mid-Chapter Quiz in the Student Edition and includes both multiple-choice and free-response questions.

Vocabulary Test This test is suitable for all students. It includes a list of vocabulary words and 10 questions to assess students' knowledge of those words. This can also be used in conjunction with one of the leveled chapter tests.

Leveled Chapter Tests

- ***Form 1*** contains multiple-choice questions and is intended for use with below grade level students.
- ***Forms 2A and 2B*** contain multiple-choice questions aimed at on grade level students. These tests are similar in format to offer comparable testing situations.
- ***Forms 2C and 2D*** contain free-response questions aimed at on grade level students. These tests are similar in format to offer comparable testing situations.
- ***Form 3*** is a free-response test for use with above grade level students.

All of the above mentioned tests include a free-response Bonus question.

Extended-Response Test Performance assessment tasks are suitable for all students. Sample answers and a scoring rubric are included for evaluation.

Standardized Test Practice These three pages are cumulative in nature. It includes three parts: multiple-choice questions with bubble-in answer format, griddable questions with answer grids, and short-answer free-response questions.

Answers

- The answers for the Anticipation Guide and Lesson Resources are provided as reduced pages.
- Full-size answer keys are provided for the assessment masters.

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7 Student-Built Glossary

This is an alphabetical list of the key vocabulary terms you will learn in Chapter 7. As you study the chapter, complete each term's definition or description. Remember to add the page number where you found the term. Add these pages to your Geometry Study Notebook to review vocabulary at the end of the chapter.

Vocabulary Term	Found on Page	Definition/Description/Example
cross products		
dilation		
enlargement		
means		
midsegment of a triangle		
proportion		

(continued on the next page)

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7 Student-Built Glossary *(continued)*

Vocabulary Term	Found on Page	Definition/Description/Example
ratio		
reduction		
scale drawing		
scale factor		
scale model		
similar polygons		
similarity transformation		

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7 Anticipation Guide

Proportions and Similarity

Step 1 ***Before you begin Chapter 7***

- Read each statement.
- Decide whether you Agree (A) or Disagree (D) with the statement.
- Write A or D in the first column OR if you are not sure whether you agree or disagree, write NS (Not Sure).

STEP 1 A, D, or NS	Statement	STEP 2 A or D
	1. Ratios are always written as fractions.	
	2. A proportion is an equation stating that two ratios are equal.	
	3. Two ratios are in proportion to each other only if their cross products are equal.	
	4. If $\frac{a}{b} = \frac{c}{d}$, then $ad = bc$.	
	5. The ratio of the lengths of the sides of similar figures is called the scale factor for the two figures.	
	6. If one angle in a triangle is congruent to an angle in another triangle, then the two triangles are similar.	
	7. If a line is parallel to one side of a triangle and intersects the other two sides in two distinct points, then the line separates the two sides into congruent segments.	
	8. A segment whose endpoints are the midpoints of two sides of a triangle is parallel to the third side of the triangle.	
	9. If two triangles are similar then their perimeters are equal.	
	10. The medians of two similar triangles are in the same proportion as corresponding sides.	

Step 2 ***After you complete Chapter 7***

- Reread each statement and complete the last column by entering an A or a D.
- Did any of your opinions about the statements change from the first column?
- For those statements that you mark with a D, use a piece of paper to write an example of why you disagree.

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7 Ejercicios preparatorios

Proporciones y Semejanzas

Paso 1 ***Antes de comenzar el Capítulo 7***

- Lee cada enunciado.
- Decide si estás de acuerdo (A) o en desacuerdo (D) con el enunciado.
- Escribe A o D en la primera columna O si no estás seguro(a) de la respuesta, escribe NS (No estoy seguro(a).

PASO 1 A, D o NS	Enunciado	PASO 2 A o D
	1. Las razones se escriben siempre como fracciones.	
	2. Una proporción es una ecuación que establece que dos razones son iguales.	
	3. Dos razones son proporcionales entre sí sólo si sus productos cruzados son iguales.	
	4. Si $\frac{a}{b} = \frac{c}{d}$, entonces $ad = bc$.	
	5. La razón de las longitudes de los lados de figuras semejantes se llama factor de escala para las dos figuras.	
	6. Si un ángulo de un triángulo es congruente a un ángulo de otro triángulo, entonces los dos triángulos son semejantes.	
	7. Si una recta es paralela a un lado del triángulo e interseca los otros dos lados en dos puntos diferentes, entonces la recta separa los dos lados en segmentos congruentes.	
	8. Un segmento cuyos extremos son los puntos medios de dos lados de un triángulo es paralelo al tercer lado del triángulo.	
	9. Si dos triángulos son semejantes, éstos tienen el mismo perímetro.	
	10. Las medianas de dos triángulos semejantes están en la misma proporción que los lados correspondientes.	

Paso 2 ***Después de completar el Capítulo 7***

- Vuelve a leer cada enunciado y completa la última columna con una A o una D.
- ¿Cambió cualquiera de tus opiniones sobre los enunciados de la primera columna?
- En una hoja de papel aparte, escribe un ejemplo de por qué estás en desacuerdo con los enunciados que marcaste con una D.

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7-1 Study Guide and Intervention

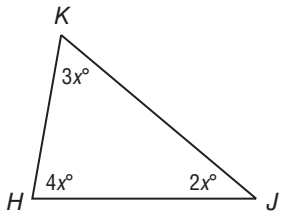
Ratios and Proportions

Write and Use Ratios A **ratio** is a comparison of two quantities by divisions. The ratio a to b, where b is not zero, can be written as $\frac{a}{b}$ or $a:b$.

Example 1 **In 2007 the Boston RedSox baseball team won 96 games out of 162 games played. Write a ratio for the number of games won to the total number of games played.**

To find the ratio, divide the number of games won by the total number of games played. The result is $\frac{96}{162}$, which is about 0.59. The Boston RedSox won about 59% of their games in 2007.

Example 2 **The ratio of the measures of the angles in $\triangle JHK$ is 2:3:4. Find the measures of the angles.**



The extended ratio 2:3:4 can be rewritten $2x:3x:4x$.

Sketch and label the angle measures of the triangle.
Then write and solve an equation to find the value of x.

$2x + 3x + 4x = 180$ Triangle Sum Theorem

$9x = 180$ Combine like terms.

$x = 20$ Divide each side by 9.

The measures of the angles are 2(20) or 40, 3(20) or 60, and 4(20) or 80.

Exercises

1. In the 2007 Major League Baseball season, Alex Rodriguez hit 54 home runs and was at bat 583 times. What is the ratio of home runs to the number of times he was at bat?

2. There are 182 girls in the sophomore class of 305 students. What is the ratio of girls to total students?

3. The length of a rectangle is 8 inches and its width is 5 inches. What is the ratio of length to width?

4. The ratio of the sides of a triangle is 8:15:17. Its perimeter is 480 inches. Find the length of each side of the triangle.

5. The ratio of the measures of the three angles of a triangle is 7:9:20. Find the measure of each angle of the triangle.

Lesson 7-1

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7-1 Study Guide and Intervention *(continued)*

Ratios and Proportions

Use Properties of Proportions A statement that two ratios are equal is called a **proportion**. In the proportion $\frac{a}{b} = \frac{c}{d}$, where b and d are not zero, the values a and d are the **extremes** and the values b and c are the **means**. In a proportion, the product of the means is equal to the product of the extremes, so $ad = bc$. This is the Cross Product Property.

$$\frac{a}{b} = \frac{c}{d}$$
$$a \cdot d = b \cdot c$$
extremes, means

Example 1 **Solve $\frac{9}{16} = \frac{27}{x}$.**

$\frac{9}{16} = \frac{27}{x}$

$9 \cdot x = 16 \cdot 27$ Cross Products Property

$9x = 432$ Multiply.

$x = 48$ Divide each side by 9.

Example 2 **POLITICS Mayor Hernandez conducted a random survey of 200 voters and found that 135 approve of the job she is doing. If there are 48,000 voters in Mayor Hernandez's town, predict the total number of voters who approve of the job she is doing.**

Write and solve a proportion that compares the number of registered voters and the number of registered voters who approve of the job the mayor is doing.

$\frac{135}{200} = \frac{x}{48{,}000}$ ← voters who approve / ← all voters

$135 \cdot 48{,}000 = 200 \cdot x$ Cross Products Property

$6{,}480{,}000 = 200x$ Simplify.

$32{,}400 = x$ Divide each side by 200.

Based on the survey, about 32,400 registered voters approve of the job the mayor is doing.

Exercises

Solve each proportion.

1. $\frac{1}{2} = \frac{28}{x}$

2. $\frac{3}{8} = \frac{y}{24}$

3. $\frac{x + 22}{x + 2} = \frac{30}{10}$

4. $\frac{3}{18.2} = \frac{9}{y}$

5. $\frac{2x + 3}{8} = \frac{5}{4}$

6. $\frac{x + 1}{x - 1} = \frac{3}{4}$

7. If 3 DVDs cost $44.85, find the cost of one DVD.

8. BOTANY Bryon is measuring plants in a field for a science project. Of the first 25 plants he measures, 15 of them are smaller than a foot in height. If there are 4000 plants in the field, predict the total number of plants smaller than a foot in height.

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7-1 Skills Practice

Ratios and Proportions

1. FOOTBALL A tight end scored 6 touchdowns in 14 games. Find the ratio of touchdowns per game.

2. EDUCATION In a schedule of 6 classes, Marta has 2 elective classes. What is the ratio of elective to non-elective classes in Marta's schedule?

3. BIOLOGY Out of 274 listed species of birds in the United States, 78 species made the endangered list. Find the ratio of endangered species of birds to listed species in the United States.

4. BOARD GAMES Myra is playing a board game. After 12 turns, Myra has landed on a blue space 3 times. If the game will last for 100 turns, predict how many times Myra will land on a blue space.

5. SCHOOL The ratio of male students to female students in the drama club at Campbell High School is 3:4. If the number of male students in the club is 18, predict the number of female students?

Solve each proportion.

6. $\frac{2}{5} = \frac{x}{40}$ **7.** $\frac{7}{10} = \frac{21}{x}$ **8.** $\frac{20}{5} = \frac{4x}{6}$

9. $\frac{5x}{4} = \frac{35}{8}$ **10.** $\frac{x+1}{3} = \frac{7}{2}$ **11.** $\frac{15}{3} = \frac{x-3}{5}$

12. The ratio of the measures of the sides of a triangle is 3:5:7, and its perimeter is 450 centimeters. Find the measures of each side of the triangle.

13. The ratio of the measures of the sides of a triangle is 5:6:9, and its perimeter is 220 meters. What are the measures of the sides of the triangle?

14. The ratio of the measures of the sides of a triangle is 4:6:8, and its perimeter is 126 feet. What are the measures of the sides of the triangle?

15. The ratio of the measures of the sides of a triangle is 5:7:8, and its perimeter is 40 inches. Find the measures of each side of the triangle.

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7-1 Practice

Ratios and Proportions

1. **NUTRITION** One ounce of cheddar cheese contains 9 grams of fat. Six of the grams of fat are saturated fats. Find the ratio of saturated fats to total fat in an ounce of cheese.

2. **FARMING** The ratio of goats to sheep at a university research farm is 4:7. The number of sheep at the farm is 28. What is the number of goats?

3. **QUALITY CONTROL** A worker at an automobile assembly plant checks new cars for defects. Of the first 280 cars he checks, 4 have defects. If 10,500 cars will be checked this month, predict the total number of cars that will have defects.

Solve each proportion.

4. $\frac{5}{8} = \frac{x}{12}$ **5.** $\frac{x}{1.12} = \frac{1}{5}$ **6.** $\frac{6x}{27} = 43$

7. $\frac{x+2}{3} = \frac{8}{9}$ **8.** $\frac{3x-5}{4} = \frac{-5}{7}$ **9.** $\frac{x-2}{4} = \frac{x+4}{2}$

10. The ratio of the measures of the sides of a triangle is 3:4:6, and its perimeter is 104 feet. Find the measure of each side of the triangle.

11. The ratio of the measures of the sides of a triangle is 7:9:12, and its perimeter is 84 inches. Find the measure of each side of the triangle.

12. The ratio of the measures of the sides of a triangle is 6:7:9, and its perimeter is 77 centimeters. Find the measure of each side of the triangle.

13. The ratio of the measures of the three angles is 4:5:6. Find the measure of each angle of the triangle.

14. The ratio of the measures of the three angles is 5:7:8. Find the measure of each angle of the triangle.

15. BRIDGES A construction worker is placing rivets in a new bridge. He uses 42 rivets to build the first 2 feet of the bridge. If the bridge is to be 2200 feet in length, predict the number of rivets that will be needed for the entire bridge.

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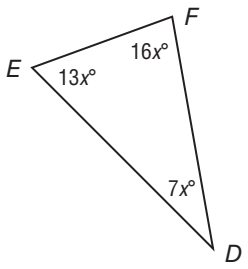
7-1 Word Problem Practice

Ratios and Proportions

1. TRIANGLES The ratios of the measures of the angles in $\triangle DEF$ is 7:13:16.



Find the measure of the angles.

2. RATIONS Sixteen students went on a week-long hiking trip. They brought with them 320 specially baked, protein-rich, cookies. What is the ratio of cookies to students?

3. CLOVERS Nathaniel is searching for a four-leaf clover in a field. He finds 2 four-leaf clovers during the first 12 minutes of his search. If Nathaniel spends a total of 180 minutes searching in the field, predict the number of four-leaf clovers Nathaniel will find.

4. CARS A car company builds two versions of one of its models—a sedan and a station wagon. The ratio of sedans to station wagons is 11:2. A freighter begins unloading the cars at a dock. Tom counts 18 station wagons and then overhears a dock worker call out, "Okay, that's all of the wagons . . . bring out the sedans!" How many sedans were on the ship?

5. DISASTER READINESS The town of Oyster Bay is conducting a survey of 80 households to see how prepared its citizens are for a natural disaster. Of those households surveyed, 66 have a survival kit at home.

a. Write the ratio of people with survival kits in the survey.

b. Write the ratio of people without survival kits in the survey.

c. There are 29,000 households in Oyster Bay. If the town wishes to purchase survival kits for all households that do not currently have one, predict the number of kits it will have to purchase.

Lesson 7-1

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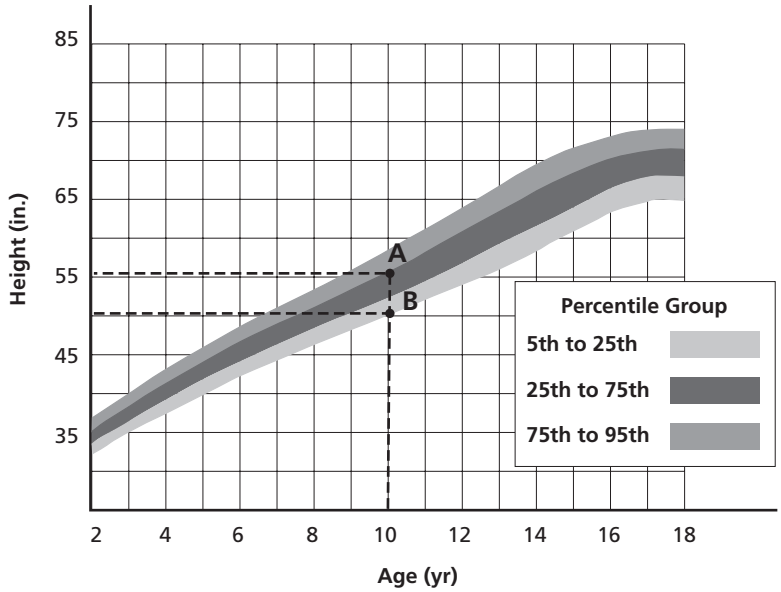
7-1 Enrichment

Growth Charts

It is said that when a child has reached the age of 2 years, he is roughly half of his adult height. The growth chart below shows the growth according to percentiles for boys.



1. Use the chart to determine the approximate height for a boy at age 2 if he is in the 75th to 95th percentile.

2. Using the rule that the height at age 2 is approximately half of his adult height, set up a proportion to solve for the adult height of the boy in Exercise 1. Solve your proportion.

3. Use the chart to approximate the height at age 18 for a boy if he is in the 75th to 95th percentile. How does this answer compare to the answer to problem 1?

4. Repeat this process for a boy who is in the 5th to 25th percentile.

5. Is using the rule that a boy is half of his adult height at age 2 years a good approximation? Explain.

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7-1 Graphing Calculator Activity

Solving Proportions

You can use a calculator to solve proportions.

Example **Solve the proportion by using cross products. Round your answer to the nearest hundredth.**

$\frac{55.6}{16.9} = \frac{45.8}{x}$

Multiply 16.9 by 45.8. Divide the product by 55.6.

Enter: 16.9 [×] 45.8 [÷] 55.6 [ENTER] 13.92122302

The solution is approximately 13.92

Solve each proportion by using cross products. Round your answers to the nearest hundredth.

1. $\frac{13.9}{39.8} = \frac{10.5}{x}$

2. $\frac{25.9}{37.7} = \frac{24.3}{x}$

3. $\frac{19.6}{54.3} = \frac{27.7}{x}$

4. $\frac{66.8}{43.4} = \frac{x}{16.9}$

5. $\frac{75.4}{37.2} = \frac{x}{32.4}$

6. $\frac{x}{46.2} = \frac{29.7}{36.4}$

7. $\frac{x}{14.9} = \frac{16.8}{24.6}$

8. $\frac{35.8}{x} = \frac{32.9}{27.8}$

9. $\frac{46.9}{x} = \frac{15.7}{99.9}$

10. $\frac{34.9}{21.1} = \frac{x}{36.6}$

11. $\frac{x}{99.8} = \frac{32.2}{45.3}$

12. $\frac{68.9}{x} = \frac{44.3}{86.4}$

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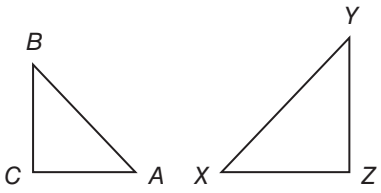
7-2 Study Guide and Intervention

Similar Polygons

Identify Similar Polygons Similar polygons have the same shape but not necessarily the same size.

Example 1 **If $\triangle ABC \sim \triangle XYZ$, list all pairs of congruent angles and write a proportion that relates the corresponding sides.**



Use the similarity statement.

Congruent angles: $\angle A \cong \angle X$, $\angle B \cong \angle Y$, $\angle C \cong \angle Z$

Proportion: $\frac{AB}{XY} = \frac{BC}{YZ} = \frac{CA}{ZX}$

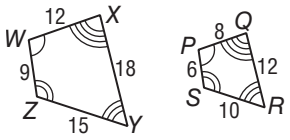
Example 2 **Determine whether the pair of figures is similar. If so, write the similarity statement and scale factor. Explain your reasoning.**

Step 1 Compare corresponding angles.

$\angle W \cong \angle P$, $\angle X \cong \angle Q$, $\angle Y \cong \angle R$, $\angle Z \cong \angle S$

Corresponding angles are congruent.

Step 2 Compare corresponding sides.

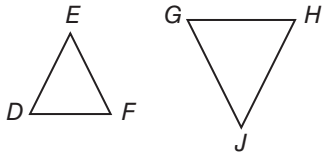


$\frac{WX}{PQ} = \frac{12}{8} = \frac{3}{2}$, $\frac{XY}{QR} = \frac{18}{12} = \frac{3}{2}$, $\frac{YZ}{RS} = \frac{15}{10} = \frac{3}{2}$, and $\frac{ZW}{SP} = \frac{9}{6} = \frac{3}{2}$. Since corresponding sides are proportional, $WXYZ \sim PQRS$. The polygons are similar with a scale factor of $\frac{3}{2}$.

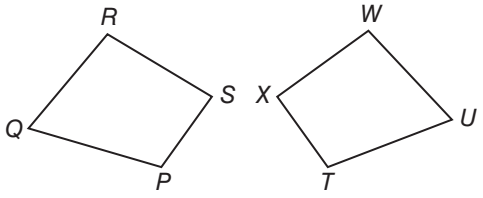
Exercises

List all pairs of congruent angles, and write a proportion that relates the corresponding sides for each pair of similar polygons.

1. $\triangle DEF \sim \triangle GHJ$

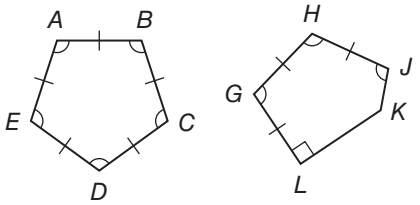


2. $PQRS \sim TUWX$

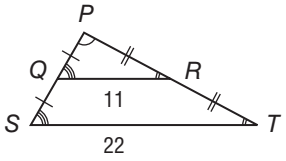


Determine whether each pair of figures is similar. If so, write the similarity statement and scale factor. If not, explain your reasoning.

3.



4.



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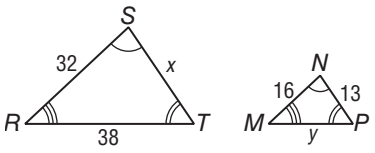
7-2 Study Guide and Intervention *(continued)*

Similar Polygons

Use Similar Figures You can use scale factors and proportions to find missing side lengths in similar polygons.

Example 1 **The two polygons are similar. Find x and y.**



Use the congruent angles to write the corresponding vertices in order.

$\triangle RST \sim \triangle MNP$

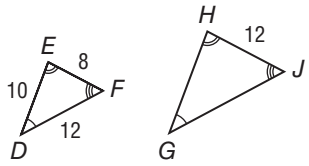
Write proportions to find x and y.

$\frac{32}{16} = \frac{x}{13}$ $\qquad$ $\frac{38}{y} = \frac{32}{16}$

$16x = 32(13)$ $\qquad$ $32y = 38(16)$

$x = 26$ $\qquad$ $y = 19$

Example 2 **If $\triangle DEF \sim \triangle GHJ$, find the scale factor of $\triangle DEF$ to $\triangle GHJ$ and the perimeter of each triangle.**



The scale factor is $\frac{EF}{HJ} = \frac{8}{12} = \frac{2}{3}$.

The perimeter of $\triangle DEF$ is $10 + 8 + 12$ or 30.

$\frac{2}{3} = \frac{\text{Perimeter of } \triangle DEF}{\text{Perimeter of } \triangle GHJ}$ Theorem 7.1

$\frac{2}{3} = \frac{30}{x}$ Substitution

$(3)(30) = 2x$ Cross Products Property

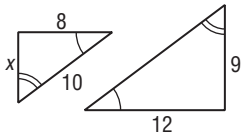
$45 = x$ Solve.

So, the perimeter of $\triangle GHJ$ is 45.

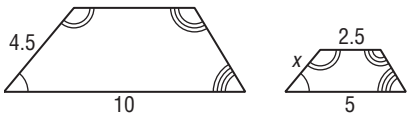
Exercises

Each pair of polygons is similar. Find the value of x.

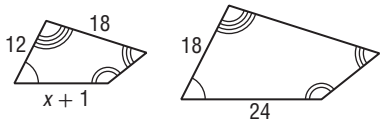
1.



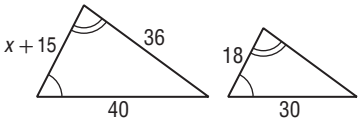
2.



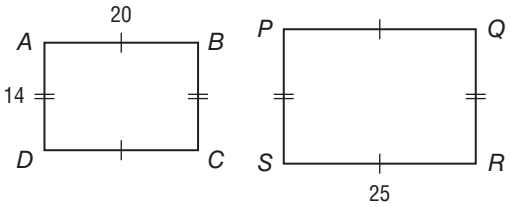
3.



4.



5. If $ABCD \sim PQRS$, find the scale factor of $ABCD$ to $PQRS$ and the perimeter of each polygon.



Lesson 7-2

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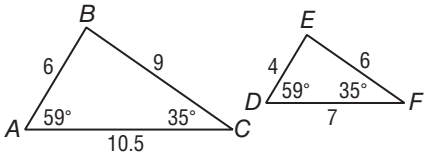
7-2 Skills Practice

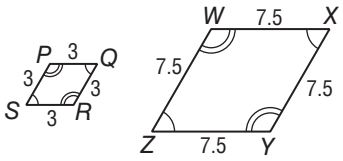
Similar Polygons

Determine whether each pair of figures is similar. If so, write the similarity statement and scale factor. If not, explain your reasoning.

1.

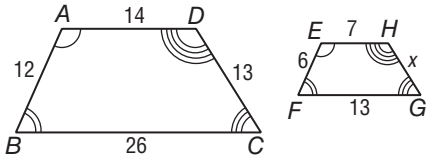


2.

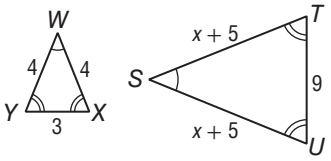


Each pair of polygons is similar. Find the value of x.

3.



4.



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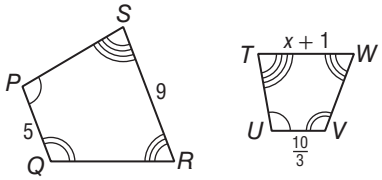

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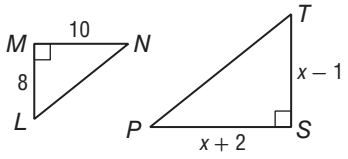

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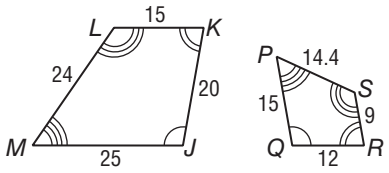
7-2 Practice

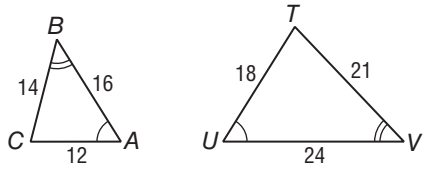
Similar Polygons

Determine whether each pair of figures is similar. If so, write the similarity statement and scale factor. If not, explain your reasoning.

1.

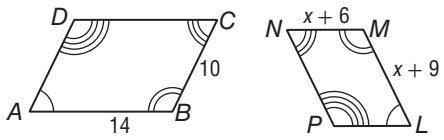


2.

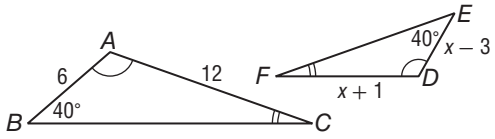


Each pair of polygons is similar. Find the value of x.

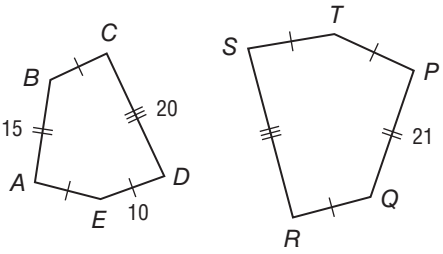
3.



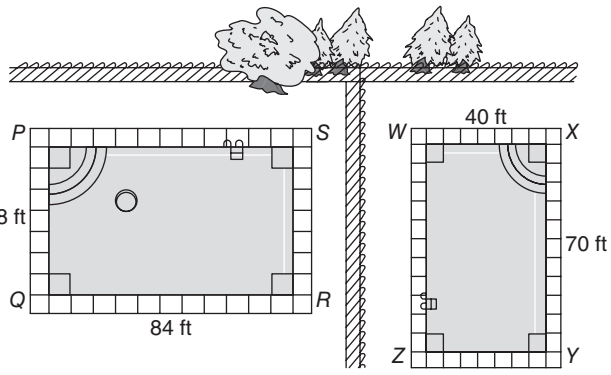
4.



5. PENTAGONS If $ABCDE \sim PQRST$, find the scale factor of $ABCDE$ to $PQRST$ and the perimeter of each polygon.



6. SWIMMING POOLS The Minnitte family and the neighboring Gaudet family both have in-ground swimming pools. The Minnitte family pool, $PQRS$, measures 48 feet by 84 feet. The Gaudet family pool, $WXYZ$, measures 40 feet by 70 feet. Are the two pools similar? If so, write the similarity statement and scale factor.



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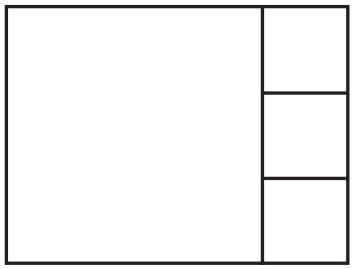
7-2 Word Problem Practice

Similar Polygons

1. PANELS When closed, an entertainment center is made of four square panels. The three smaller panels are congruent squares.

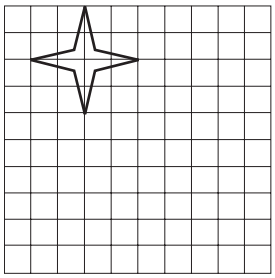


What is the scale factor of the larger square to one of the smaller squares?

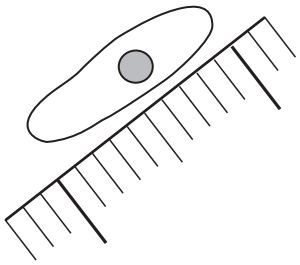
2. WIDESCREEN TELEVISIONS An electronics company manufactures widescreen television sets in several different sizes. The rectangular viewing area of each television size is similar to the viewing areas of the other sizes. The company's 42-inch widescreen television has a viewing area perimeter of approximately 144.4 inches. What is the viewing area perimeter of the company's 46-inch widescreen television?

3. ICE HOCKEY An official Olympic-sized ice hockey rink measures 30 meters by 60 meters. The ice hockey rink at the local community college measures 25.5 meters by 51 meters. Are the ice hockey rinks similar? Explain your reasoning.

4. ENLARGING Camille wants to make a pattern for a four-pointed star with dimensions twice as long as the one shown. Help her by drawing a star with dimensions twice as long on the grid below.



5. BIOLOGY A paramecium is a small single-cell organism. The paramecium magnified below is actually one tenth of a millimeter long.



a. If you want to make a photograph of the original paramecium so that its image is 1 centimeter long, by what scale factor should you magnify it?

b. If you want to make a photograph of the original paramecium so that its image is 15 centimeters long, by what scale factor should you magnify it?

c. By approximately what scale factor has the paramecium been enlarged to make the image shown?

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7-2 Enrichment

Constructing Similar Polygons

Here are four steps for constructing a polygon that is similar to and with sides twice as long as those of an existing polygon.

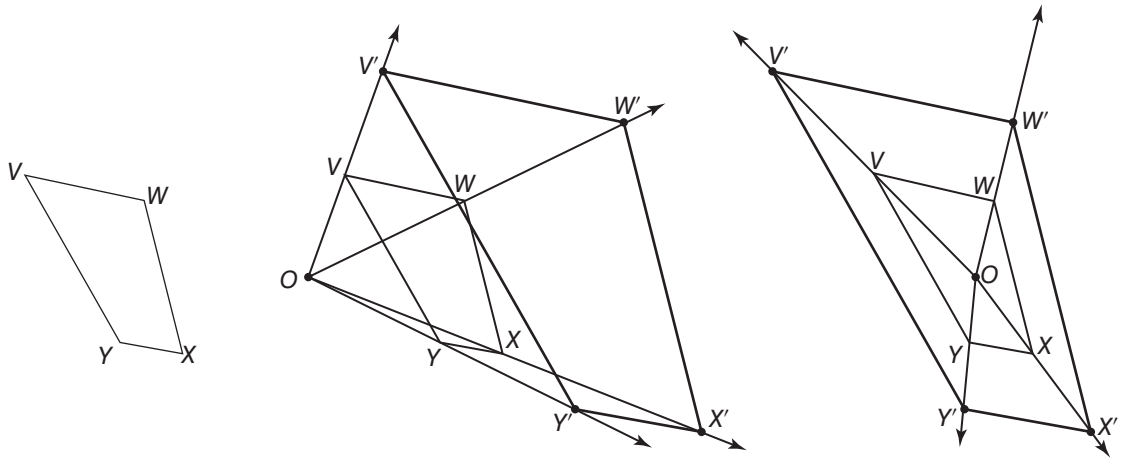
Step 1 Choose any point either inside or outside the polygon and label it O.

Step 2 Draw rays from O through each vertex of the polygon.

Step 3 For vertex V, set the compass to length OV. Then locate a new point V' on ray OV such that $VV' = OV$. Thus, $OV' = 2(OV)$.

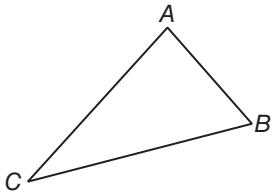
Step 4 Repeat Step 3 for each vertex. Connect points V', W', X' and Y' to form the new polygon.

Two constructions of polygons similar to and with sides twice those of $VWXY$ are shown below. Notice that the placement of point O does not affect the size or shape of $V'W'X'Y'$, only its location.

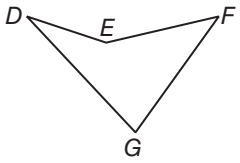


Trace each polygon. Then construct a similar polygon with sides twice as long as those of the given polygon.

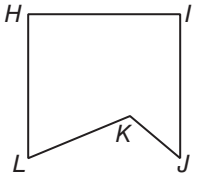
1.



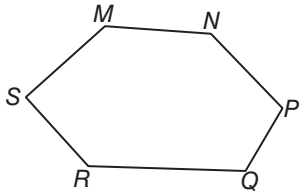
2.



3. Explain how to construct a similar polygon with sides three times the length of those of polygon $HIJKL$. Then do the construction.



4. Explain how to construct a similar polygon $1\frac{1}{2}$ times the length of those of polygon $MNPQRS$. Then do the construction.



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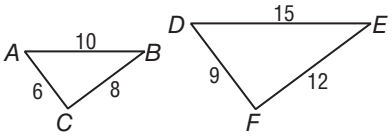
7-3 Study Guide and Intervention

Similar Triangles

Identify Similar Triangles Here are three ways to show that two triangles are similar.

AA Similarity	Two angles of one triangle are congruent to two angles of another triangle.
SSS Similarity	The measures of the corresponding side lengths of two triangles are proportional.
SAS Similarity	The measures of two side lengths of one triangle are proportional to the measures of two corresponding side lengths of another triangle, and the included angles are congruent.

Example 1 **Determine whether the triangles are similar.**



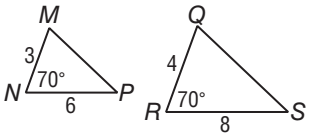
$\frac{AC}{DF} = \frac{6}{9} = \frac{2}{3}$

$\frac{BC}{EF} = \frac{8}{12} = \frac{2}{3}$

$\frac{AB}{DE} = \frac{10}{15} = \frac{2}{3}$

$\triangle ABC \sim \triangle DEF$ by SSS Similarity.

Example 2 **Determine whether the triangles are similar.**



$\frac{3}{4} = \frac{6}{8}$, so $\frac{MN}{QR} = \frac{NP}{RS}$.

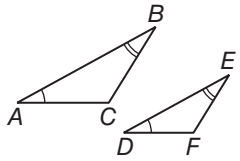
$m\angle N = m\angle R$, so $\angle N \cong \angle R$.

$\triangle NMP \sim \triangle RQS$ by SAS Similarity.

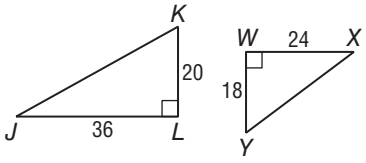
Exercises

Determine whether the triangles are similar. If so, write a similarity statement. Explain your reasoning.

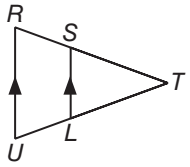
1.



2.



3.



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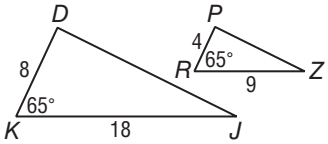

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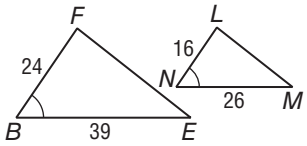
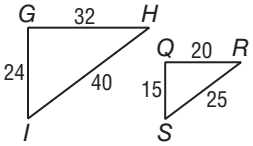


6.



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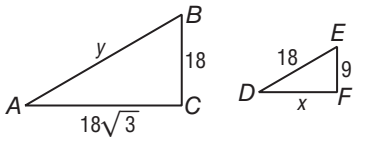
7-3 Study Guide and Intervention *(continued)*

Similar Triangles

Use Similar Triangles

Similar triangles can be used to find measurements.

Example 1 **$\triangle ABC \sim \triangle DEF$. Find the values of x and y.**



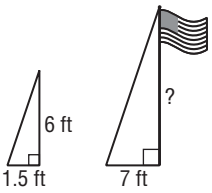
$$\frac{AC}{DF} = \frac{BC}{EF} \qquad \frac{AB}{DE} = \frac{BC}{EF}$$

$$\frac{18\sqrt{3}}{x} = \frac{18}{9} \qquad \frac{y}{18} = \frac{18}{9}$$

$$18x = 9(18\sqrt{3}) \qquad 9y = 324$$

$$x = 9\sqrt{3} \qquad y = 36$$

Example 2 **A person 6 feet tall casts a 1.5-foot-long shadow at the same time that a flagpole casts a 7-foot-long shadow. How tall is the flagpole?**

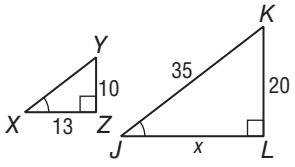


The sun's rays form similar triangles.
Using x for the height of the pole, $\frac{6}{x} = \frac{1.5}{7}$,
so $1.5x = 42$ and $x = 28$.
The flagpole is 28 feet tall.

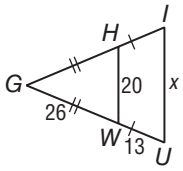
Exercises

ALGEBRA Identify the similar triangles. Then find each measure.

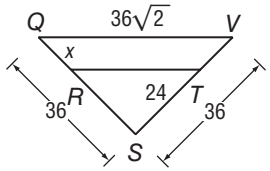
1. *JL*



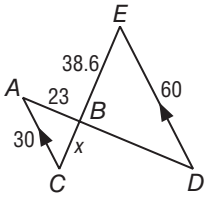
2. *IU*



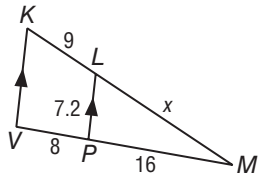
3. *QR*



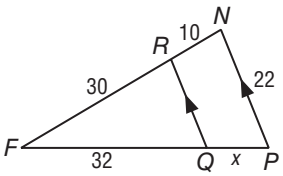
4. *BC*



5. *LM*



6. *QP*



7. The heights of two vertical posts are 2 meters and 0.45 meter. When the shorter post casts a shadow that is 0.85 meter long, what is the length of the longer post's shadow to the nearest hundredth?

Lesson 7-3

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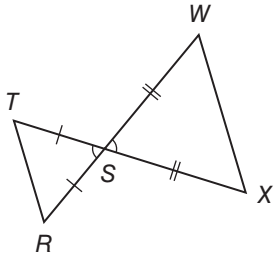
7-3 Skills Practice

Similar Triangles

Determine whether each pair of triangles is similar. If so, write a similarity statement. If not, what would be sufficient to prove the triangles similar? Explain your reasoning.

1.



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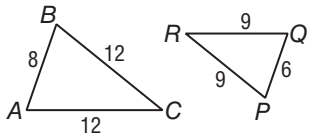

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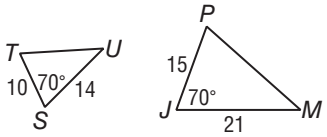

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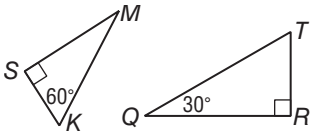
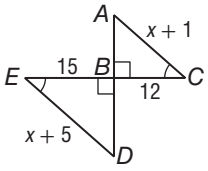
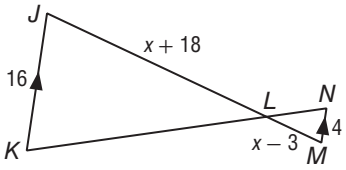


ALGEBRA Identify the similar triangles. Then find each measure.

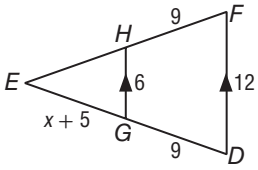
5. *AC*



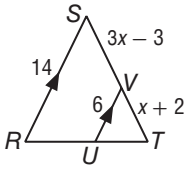
6. *JL*



7. *EH*



8. *VT*



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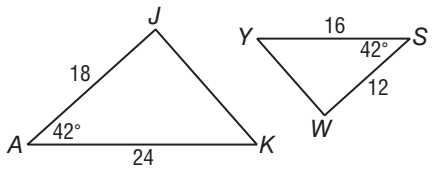
7-3 Practice

Similar Triangles

Determine whether the triangles are similar. If so, write a similarity statement. If not, what would be sufficient to prove the triangles similar? Explain your reasoning.

1.



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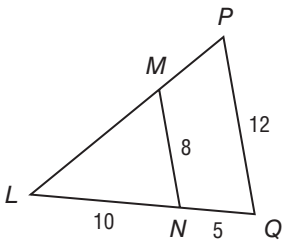
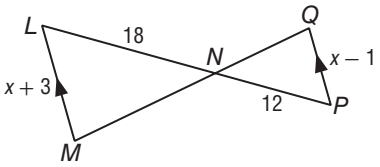
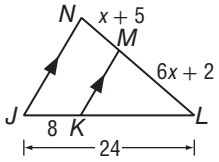


ALGEBRA Identify the similar triangles. Then find each measure.

3. *LM*, *QP*



4. *NL*, *ML*



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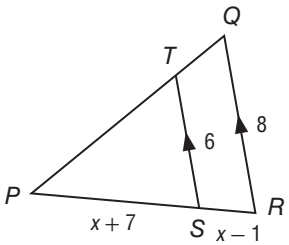

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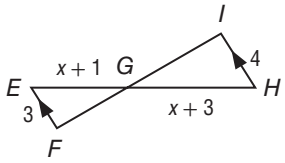

7. INDIRECT MEASUREMENT A lighthouse casts a 128-foot shadow. A nearby lamppost that measures 5 feet 3 inches casts an 8-foot shadow.

a. Write a proportion that can be used to determine the height of the lighthouse.

b. What is the height of the lighthouse?

Lesson 7-3

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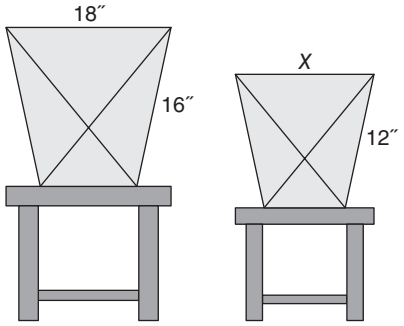
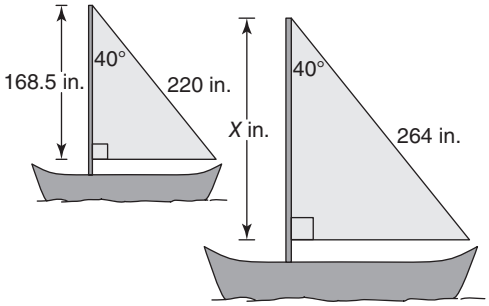
7-3 Word Problem Practice

Similar Triangles

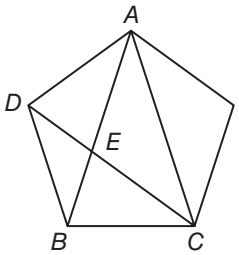
1. CHAIRS A local furniture store sells two versions of the same chair: one for adults, and one for children. Find the value of x such that the chairs are similar.



2. BOATING The two sailboats shown are participating in a regatta. Find the value of x.

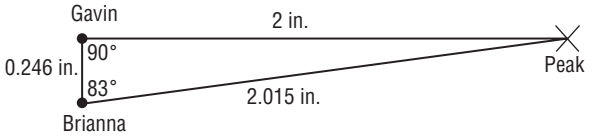


3. GEOMETRY Georgia draws a regular pentagon and starts connecting its vertices to make a 5-pointed star. After drawing three of the lines in the star, she becomes curious about two triangles that appear in the figure, $\triangle ABC$ and $\triangle CEB$. They look similar to her. Prove that this is the case.



4. SHADOWS A radio tower casts a shadow 8 feet long at the same time that a vertical yardstick casts a shadow half an inch long. How tall is the radio tower?

5. MOUNTAIN PEAKS Gavin and Brianna want to know how far a mountain peak is from their houses. They measure the angles between the line of site to the peak and to each other's houses and carefully make the drawing shown.



The actual distance between Gavin and Brianna's houses is $1\frac{1}{2}$ miles.

a. What is the actual distance of the mountain peak from Gavin's house? Round your answer to the nearest tenth of a mile.

b. What is the actual distance of the mountain peak from Brianna's house? Round your answer to the nearest tenth of a mile.

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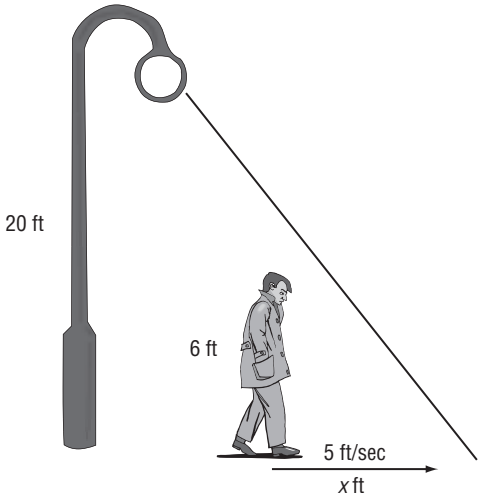
7-3 Enrichment

Moving Shadows

Have you ever watched your shadow as you walked along the street at night and observed how its shape changes as you move? Suppose a man who is 6 feet tall is standing below a lamppost that is 20 feet tall. The man is walking away from the lamppost at a rate of 5 feet per second.



1. If the man is moving at a rate of 5 feet per second, make a conjecture as to the rate that his shadow is moving.

2. How far away from the lamppost is the man after 8 seconds?

3. How far is the end of his shadow from the bottom of the lamppost after 8 seconds? Use similar triangles to solve this problem.

4. After 3 more seconds, how far from the lamppost is the man? How far from the lamppost is his shadow?

5. How many feet did the man move in 3 seconds? How many feet did the shadow move in 3 seconds?

6. The man is moving at a rate of 5 feet/second. What rate is his shadow moving? How does this rate compare to the conjecture you made in Exercise 1? Make a conjecture as to why the results are like this.

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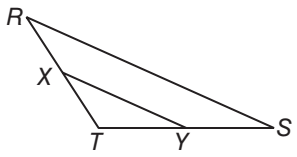
7-4 Study Guide and Intervention

Parallel Lines and Proportional Parts

Proportional Parts within Triangles In any triangle, a line parallel to one side of a triangle separates the other two sides proportionally. This is the Triangle Proportionality Theorem. The converse is also true.

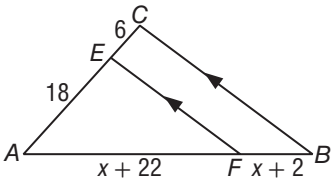


If $\overleftrightarrow{XY} \parallel \overleftrightarrow{RS}$, then $\frac{RX}{XT} = \frac{SY}{YT}$. If $\frac{RX}{XT} = \frac{SY}{YT}$, then $\overleftrightarrow{XY} \parallel \overleftrightarrow{RS}$.

If X and Y are the midpoints of $\overline{RT}$ and $\overline{ST}$, then $\overline{XY}$ is a **midsegment** of the triangle. The Triangle Midsegment Theorem states that a midsegment is parallel to the third side and is half its length.

If $\overline{XY}$ is a midsegment, then $\overleftrightarrow{XY} \parallel \overleftrightarrow{RS}$ and $XY = \frac{1}{2}RS$.

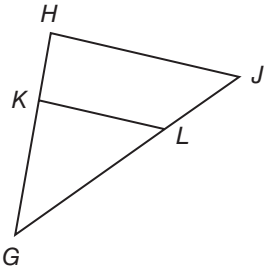
Example 1 **In $\triangle ABC$, $\overline{EF} \parallel \overline{CB}$. Find x.**



Since $\overline{EF} \parallel \overline{CB}$, $\frac{AF}{FB} = \frac{AE}{EC}$.

$$\frac{x + 22}{x + 2} = \frac{18}{6}$$
$$6x + 132 = 18x + 36$$
$$96 = 12x$$
$$8 = x$$

Example 2 **In $\triangle GHJ$, $HK = 5$, $KG = 10$, and JL is one-half the length of $\overline{LG}$. Is $\overline{HK} \parallel \overline{KL}$?**



Using the converse of the Triangle Proportionality Theorem, show that $\frac{HK}{KG} = \frac{JL}{LG}$.

Let $JL = x$ and $LG = 2x$.

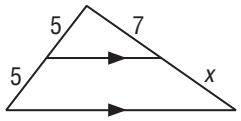
$\frac{HK}{KG} = \frac{5}{10} = \frac{1}{2}$ $\quad$ $\frac{JL}{LG} = \frac{x}{2x} = \frac{1}{2}$

Since $\frac{1}{2} = \frac{1}{2}$, the sides are proportional and $\overline{HJ} \parallel \overline{KL}$.

Exercises

ALGEBRA Find the value of x.

1.



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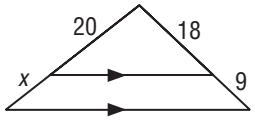

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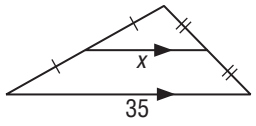

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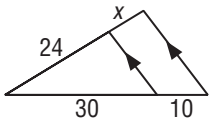

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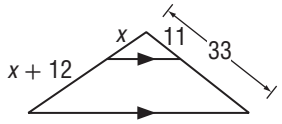

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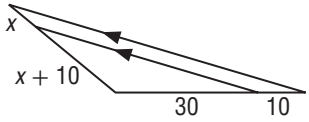

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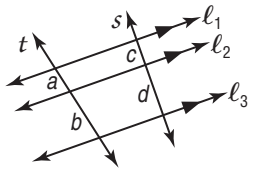
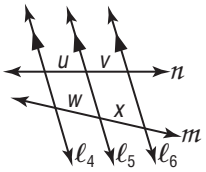
7-4 Study Guide and Intervention *(continued)*

Parallel Lines and Proportional Parts

Proportional Parts with Parallel Lines When three or more parallel lines cut two transversals, they separate the transversals into proportional parts. If the ratio of the parts is 1, then the parallel lines separate the transversals into congruent parts.





If $\ell_1 \parallel \ell_2 \parallel \ell_3$, then $\frac{a}{b} = \frac{c}{d}$.

If $\ell_4 \parallel \ell_5 \parallel \ell_6$ and $\frac{u}{v} = 1$, then $\frac{w}{x} = 1$.

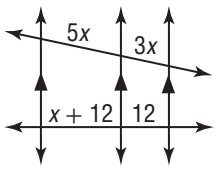
Example **Refer to lines ℓ_1, ℓ_2, and ℓ_3 above. If $a = 3$, $b = 8$, and $c = 5$, find d.**

$\ell_1 \parallel \ell_2 \parallel \ell_3$ so $\frac{3}{8} = \frac{5}{d}$. Then $3d = 40$ and $d = 13\frac{1}{3}$.

Exercises

ALGEBRA Find x and y.

1.



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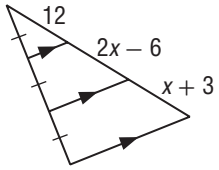

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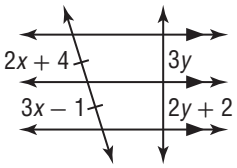

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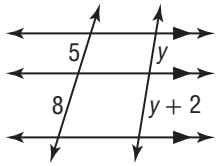

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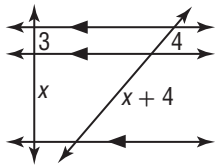

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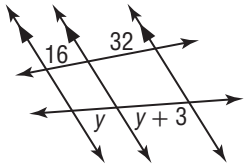

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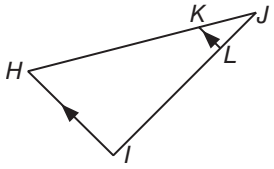
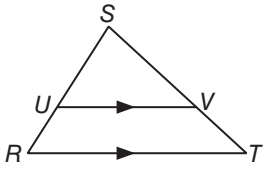
7-4 Skills Practice

Parallel Lines and Proportional Parts

1. If $JK = 7$, $KH = 21$, and $JL = 6$, find LI.



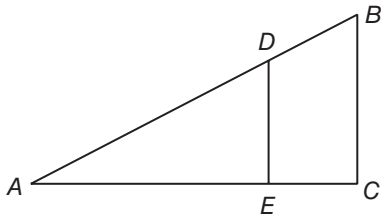
2. If $RU = 8$, $US = 14$, $TV = x - 1$, and $VS = 17.5$, find x and TV.



Determine whether $\overline{BC} \parallel \overline{DE}$. Justify your answer.

3. $AD = 15$, $DB = 12$, $AE = 10$, and $EC = 8$

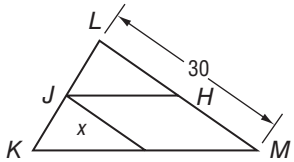
4. $BD = 9$, $BA = 27$, and $CE = \frac{1}{3}EA$



5. $AE = 30$, $AC = 45$, and $AD = 2DB$

$\overline{JH}$ is a midsegment of $\triangle KLM$. Find the value of x.

6.



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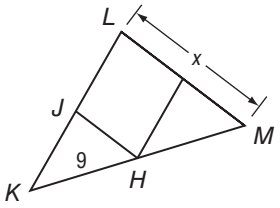
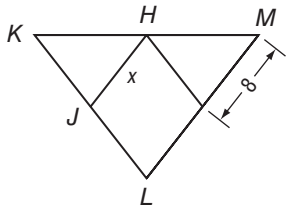
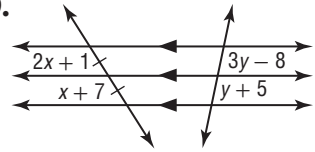


8.

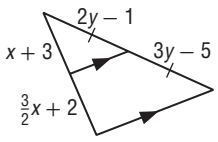


ALGEBRA Find x and y.

9.



10.



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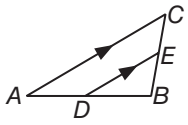
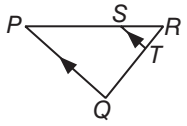
7-4 Practice

Parallel Lines and Proportional Parts

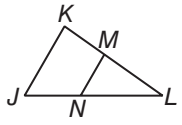
1. If $AD = 24$, $DB = 27$, and $EB = 18$, find CE.



2. If $QT = x + 6$, $SR = 12$, $PS = 27$, and $TR = x - 4$, find QT and TR.



Determine whether $\overline{JK} \parallel \overline{NM}$. Justify your answer.

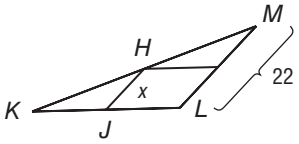


3. $JN = 18$, $JL = 30$, $KM = 21$, and $ML = 35$

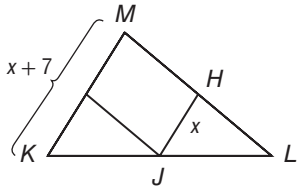
4. $KM = 24$, $KL = 44$, and $NL = \frac{5}{6}JN$

$\overline{JH}$ is a midsegment of $\triangle KLM$. Find the value of x.

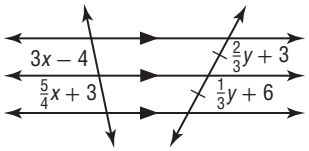
5.



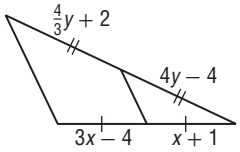
6.



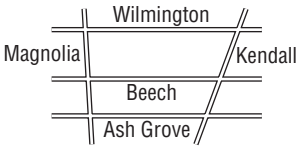
7. Find x and y.



8. Find x and y.



9. MAPS On a map, Wilmington Street, Beech Drive, and Ash Grove Lane appear to all be parallel. The distance from Wilmington to Ash Grove along Kendall is 820 feet and along Magnolia, 660 feet. If the distance between Beech and Ash Grove along Magnolia is 280 feet, what is the distance between the two streets along Kendall?



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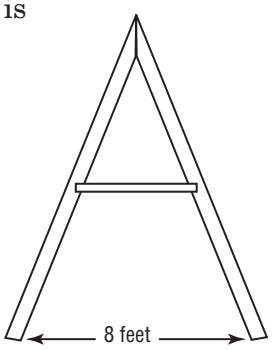
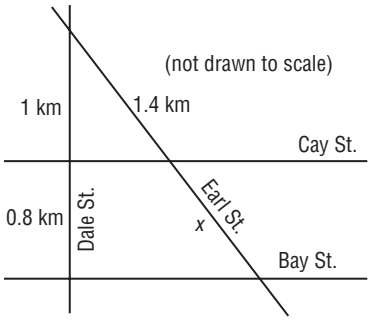
7-4 Word Problem Practice

Parallel Lines and Proportional Parts

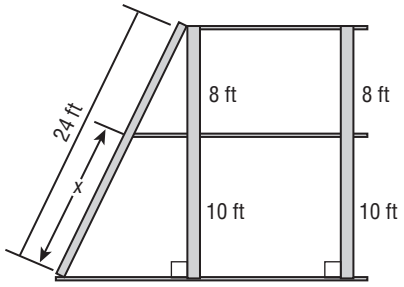
1. CARPENTRY Jake is fixing an A-frame. He wants to add a horizontal support beam halfway up and parallel to the ground. How long should this beam be?



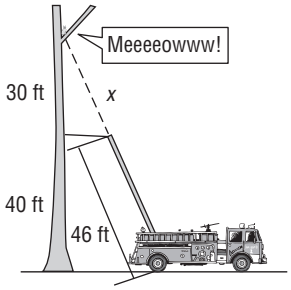
2. STREETS In the diagram, Cay Street and Bay Street are parallel. Find x.



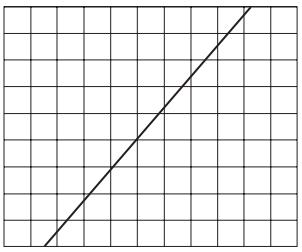
3. JUNGLE GYMS Prassad is building a two-story jungle gym according to the plans shown. Find x.



4. FIREMEN A cat is stuck in a tree and firemen try to rescue it. Based on the figure, if a fireman climbs to the top of the ladder, how far away is the cat?



5. EQUAL PARTS Nick has a stick that he would like to divide into 9 equal parts. He places it on a piece of grid paper as shown. The grid paper is ruled so that vertical and horizontal lines are equally spaced.



a. Explain how he can use the grid paper to help him find where he needs to cut the stick.

b. Suppose Nick wants to divide his stick into 5 equal parts utilizing the grid paper. What can he do?

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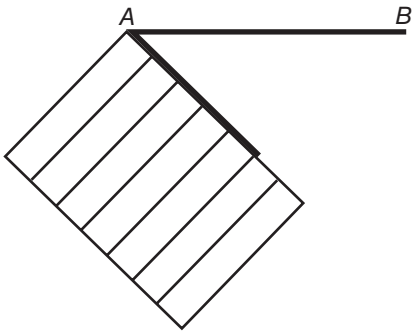
7-4 Enrichment

Parallel Lines and Congruent Parts

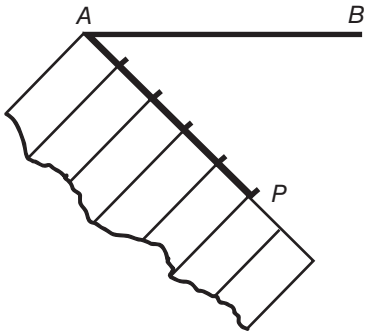
There is a theorem stating that if three parallel lines cut off congruent segments on one transversal, then they cut off congruent segments on any transversal. This can be shown for any number of parallel lines. The following drafting technique uses this fact to divide a segment into congruent parts.

$\overline{AB}$ to be separated into five congruent parts. This can be done very accurately without using a ruler. All that is needed is a compass and a piece of notebook paper.

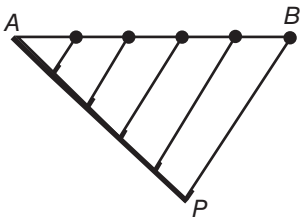
Step 1 Hold the corner of a piece of notebook paper at point A.



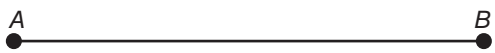
Step 2 From point A, draw a segment along the paper that is five spaces long. Mark where the lines of the notebook paper meet the segment. Label the fifth point P.

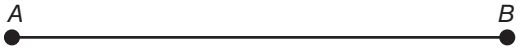


Step 3 Draw $\overline{PB}$. Through each of the other marks on $\overline{AP}$, construct a line parallel to $\overline{BP}$. The points where these lines intersect $\overline{AB}$ will divide $\overline{AB}$ into five congruent segments.



Use a compass and a piece of notebook paper to divide each segment into the given number of congruent parts.

1. six congruent parts 

2. seven congruent parts 

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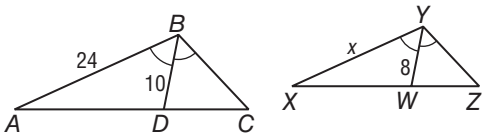
7-5 Study Guide and Intervention

Parts of Similar Triangles

Special Segments of Similar Triangles When two triangles are similar, corresponding altitudes, angle bisectors, and medians are proportional to the corresponding sides.

Example **In the figure, $\triangle ABC \sim \triangle XYZ$, with angle bisectors as shown. Find x.**



Since $\triangle ABC \sim \triangle XYZ$, the measures of the angle bisectors are proportional to the measures of a pair of corresponding sides.

$$\frac{AB}{XY} = \frac{BD}{WY}$$

$$\frac{24}{x} = \frac{10}{8}$$

$$10x = 24(8)$$

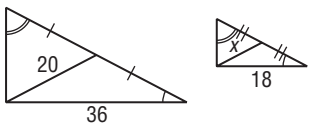
$$10x = 192$$

$$x = 19.2$$

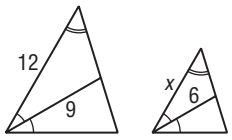
Exercises

Find x.

1.



2.



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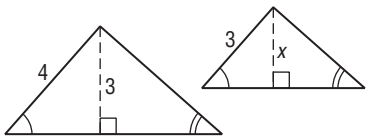

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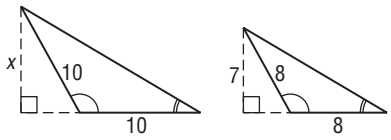

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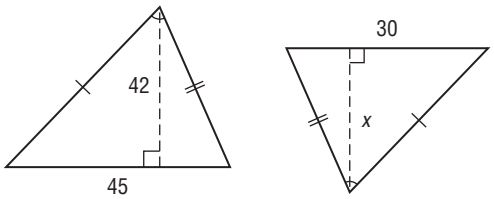
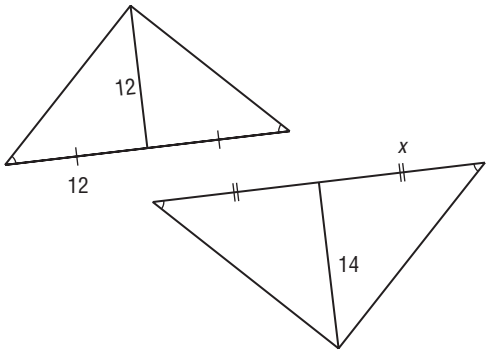


6.



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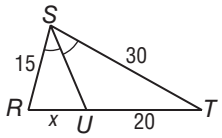
7-5 Study Guide and Intervention *(continued)*

Parts of Similar Triangles

Triangle Angle Bisector Theorem An angle bisector in a triangle separates the opposite side into two segments that are proportional to the lengths of the other two sides.

Example **Find x.**



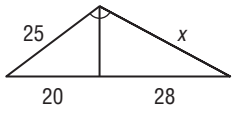
Since $\overline{SU}$ is an angle bisector, $\frac{RU}{TU} = \frac{RS}{TS}$.

$$\frac{x}{20} = \frac{15}{30}$$
$$30x = 20(15)$$
$$30x = 300$$
$$x = 10$$

Exercises

Find the value of each variable.

1.



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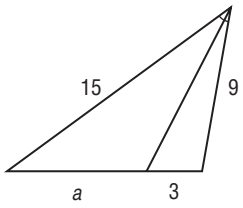

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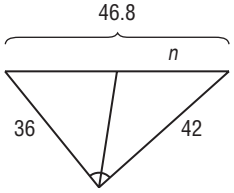

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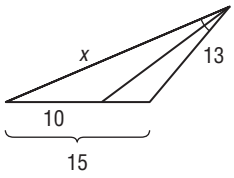

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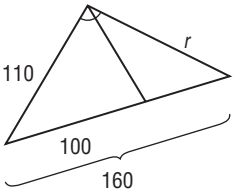

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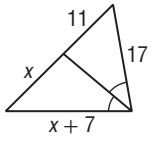

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Lesson 7-5

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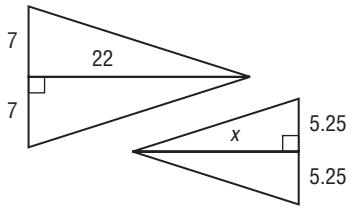
7-5 Skills Practice

Parts of Similar Triangles

Find x.

1.



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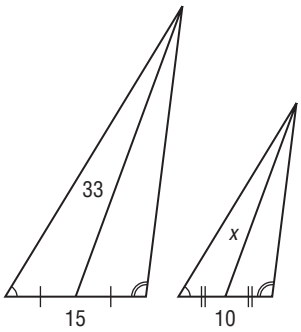

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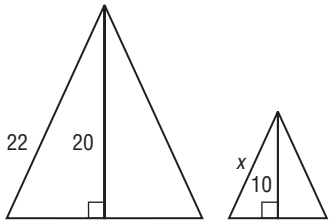
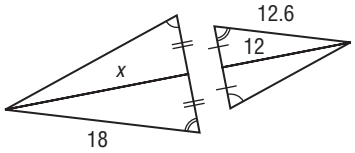
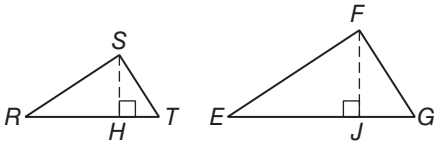


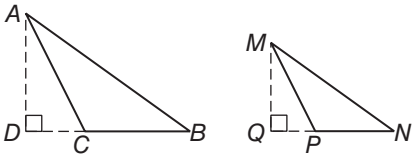
4.



5. If $\triangle RST \sim \triangle EFG$, $\overline{SH}$ is an altitude of $\triangle RST$, $\overline{FJ}$ is an altitude of $\triangle EFG$, $ST = 6$, $SH = 5$, and $FJ = 7$, find FG.

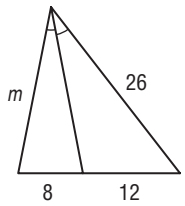


6. If $\triangle ABC \sim \triangle MNP$, $\overline{AD}$ is an altitude of $\triangle ABC$, $\overline{MQ}$ is an altitude of $\triangle MNP$, $AB = 24$, $AD = 14$, and $MQ = 10.5$, find MN.

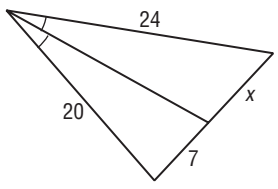


Find the value of each variable.

7.



8.



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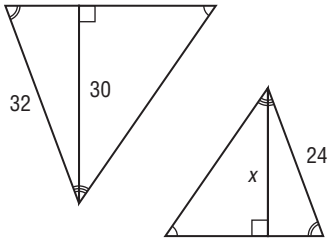
7-5 Practice

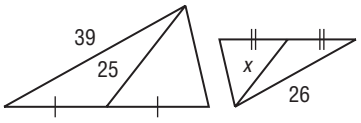
Parts of Similar Triangles

ALGEBRA Find x.

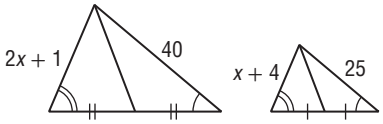
1.



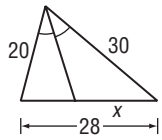
2.



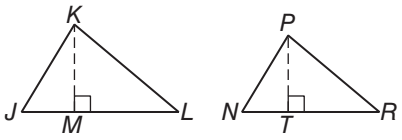
3.



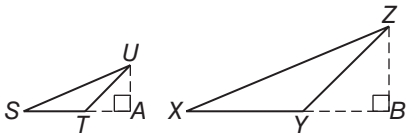
4.



5. If $\triangle JKL \sim \triangle NPR$, $\overline{KM}$ is an altitude of $\triangle JKL$, $\overline{PT}$ is an altitude of $\triangle NPR$, $KL = 28$, $KM = 18$, and $PT = 15.75$, find PR.



6. If $\triangle STU \sim \triangle XYZ$, $\overline{UA}$ is an altitude of $\triangle STU$, $\overline{ZB}$ is an altitude of $\triangle XYZ$, $UT = 8.5$, $UA = 6$, and $ZB = 11.4$, find ZY.



7. PHOTOGRAPHY Francine has a camera in which the distance from the lens to the film is 24 millimeters.

a. If Francine takes a full-length photograph of her friend from a distance of 3 meters and the height of her friend is 140 centimeters, what will be the height of the image on the film? (*Hint*: Convert to the same unit of measure.)

b. Suppose the height of the image on the film of her friend is 15 millimeters. If Francine took a full-length shot, what was the distance between the camera and her friend?

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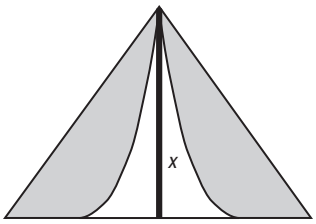
7-5 Word Problem Practice

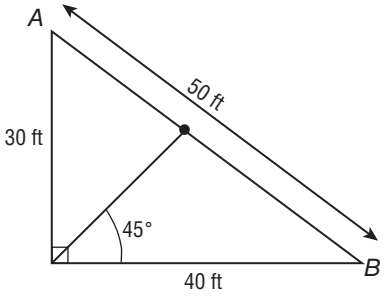
Parts of Similar Triangles

1. FLAGS An oceanliner is flying two similar triangular flags on a flag pole. The altitude of the larger flag is three times the altitude of the smaller flag. If the measure of a leg on the larger flag is 45 inches, find the measure of the corresponding leg on the smaller flag.

2. TENTS Jana went camping and stayed in a tent shaped like a triangle. In a photo of the tent, the base of the tent is 6 inches and the altitude is 5 inches. The actual base was 12 feet long. What was the height of the actual tent?

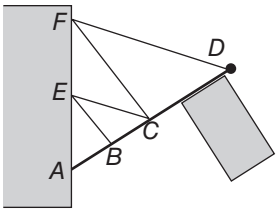


3. PLAYGROUND The playground at Hank's school has a large right triangle painted in the ground. Hank starts at the right angle corner and walks toward the opposite side along an angle bisector and stops when he gets to the hypotenuse.



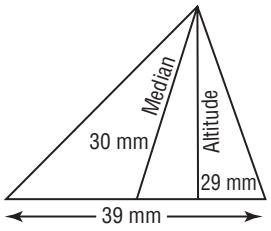
How much farther from Hank is point B versus point A?

4. FLAG POLES A flag pole attached to the side of a building is supported with a network of strings as shown in the figure.



The rigging is done so that $AE = EF$, $AC = CD$, and $AB = BC$. What is the ratio of CF to BE?

5. COPIES Gordon made a photocopy of a page from his geometry book to enlarge one of the figures. The actual figure that he copied is shown below.



The photocopy came out poorly. Gordon could not read the numbers on the photocopy, although the triangle itself was clear. Gordon measured the base of the enlarged triangle and found it to be 200 millimeters.

a. What is the length of the drawn altitude of the enlarged triangle? Round your answer to the nearest millimeter.

b. What is the length of the drawn median of the enlarged triangle? Round your answer to the nearest millimeter.

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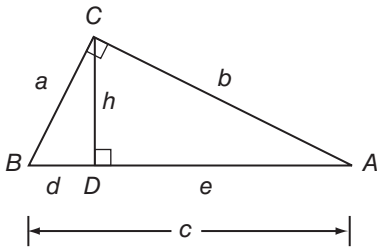
7-5 Enrichment

A Proof of Pythagorean Theorem

1. For right triangle ABC with right angle C, and altitude $\overline{CD}$ as shown at the right, name three similar triangles.



2. List the three similar triangles as headings in the table below. Use the figure to complete the table to list the corresponding parts of the three similar right triangles.

Short Leg			
Long Leg			
Hypotenuse			

3. Use the corresponding parts of these similar triangles and their proportions to complete the statements in the proof and algebraically prove the Pythagorean Theorem.

Statements	Reasons
1. Right triangle ABC with altitude $\overline{CD}$.	**1.** Given
2. _____	**2.** Corresponding parts of similar triangles are in the same ratio.
3. _____	**3.** Cross Products Property
4. _____	**4.** Addition Property of Equality
5. _____	**5.** Substitution
6. _____	**6.** Distributive Property
7. _____	**7.** Segment addition
8. $a^2 + b^2 = c^2$	**8.** Substitution

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7-5 Spreadsheet Activity

Fractals

You can use a spreadsheet to create a Sierpinski triangle.

Example **Use a spreadsheet to create a Sierpinski triangle.**

Step 1 In cell A2, enter 1. In cell A3, enter an equals sign followed by A2 + 1 . This will return the number of iterations. Click on the bottom right corner of cell A2 and drag it through cell A500 to get 500 iterations.

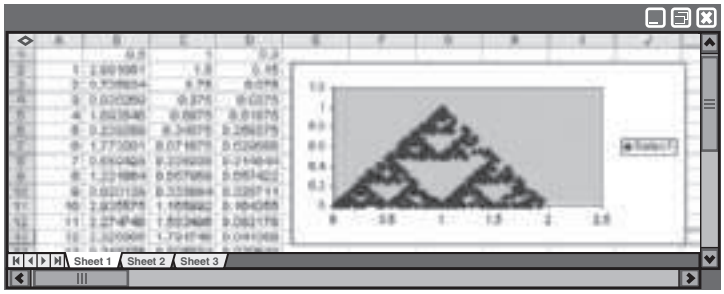
Step 2 In cell B1, enter 0.5. This indicates the midpoints of the segments.

Step 3 In cell C1, enter 1 and in cell D1, enter 0.3.

Step 4 In cell B2, enter an equals sign followed by 3*RAND(). Click on the bottom right corner of cell B2 and drag in through cell B500 to get 500 iterations.

Step 5 In cell C2, enter an equals sign followed by the recursive formula IF(B2<1,(12$B$1)*C1,IF(B2<2,(1−$B$1)*C1+$B$1,(1−$B$1)*C1+2*$B$1)). This will return the x values of the points to be graphed. Click on the bottom right corner of cell C2 and drag through cell C500.

Step 6 In cell D2, enter an equals sign followed by the recursive formula IF(B2<1,(1−$B$1)*D1,IF(B2<2,(1−$B$1)*D1+$B$1,(1−$B$1)*D1)). This will return the y values of the points to be graphed. Click on the bottom right corner of cell D2 and drag through cell D500.



Step 7 To graph the values in columns C and D, first highlight all of the data in the two columns. Next, choose the chart wizard from the toolbar. Select XY (Scatter). Press Next, Next. Then select the Gridlines tab and uncheck the Major gridlines. Then press Next and Finish. This will return the Sierpinski triangle.

Exercises

Analyze your drawing.

1. What happens to your drawing if you have more iterations? Try 1000, 2000, and 5000.

2. Change the 0.5 to 2/3 in cell B1. (*Hint*: You may need to enter 0.666666 for 2/3.) How does this change the picture?

3. Change 0.3 to 0.6 in cell D1. How does this change the drawing?

4. Enter the following into a new spreadsheet and describe what you see.

Step 1: In cell A2, enter the formula = A1.
Step 2: In cell B2, enter the formula = A1 + B1.
Step 3: Click on the bottom right corner of cell B2 and drag through cell L2.
Step 4: First, click on the 2 next to cell A2. Then, click on the bottom left corner of 2 and drag down through cell 12.
Step 5: In cell A1, enter a 1 and press ENTER.

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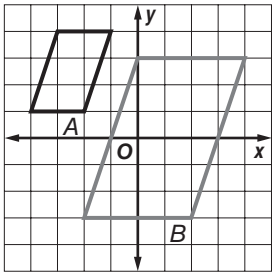
7-6 Study Guide and Intervention

Similarity Transformations

Identify Similarity Transformations A **dilation** is a transformation that enlarges or reduces the original figure proportionally. The **scale factor of a dilation**, k, is the ratio of a length on the image to a corresponding length on the preimage. A dilation with $k > 1$ is an **enlargement**. A dilation with $0 < k < 1$ is a **reduction**.

Example **Determine whether the dilation from *A* to *B* is an *enlargement* or a *reduction*. Then find the scale factor of the dilation.**

a.

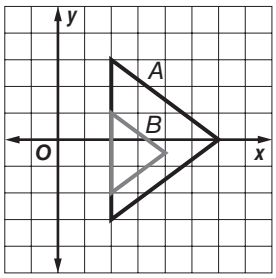


B is larger than *A*, so the dilation is an enlargement.

The distance between the vertices at (−3, 4) and (−1, 4) for *A* is 2. The distance between the vertices at (0, 3) and (4, 3) for *B* is 4.

The scale factor is $\frac{4}{2}$ or 2.

b.



B is smaller than *A*, so the dilation is a reduction.

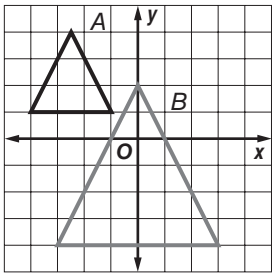
The distance between the vertices at (2, 3) and (2, −3) for *A* is 6. The distance between the vertices at (2, 1) and (2, −2) for *B* is 3.

The scale factor is $\frac{3}{6}$ or $\frac{1}{2}$.

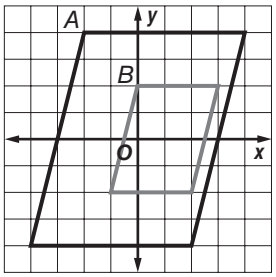
Exercises

Determine whether the dilation from *A* to *B* is an *enlargement* or a *reduction*. Then find the scale factor of the dilation.

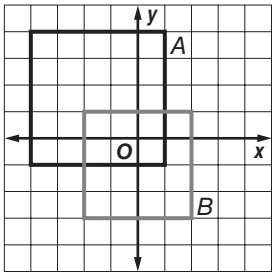
1.



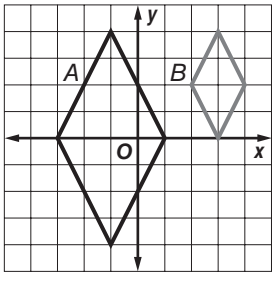
2.



3.



4.



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7-6 Study Guide and Intervention *(continued)*

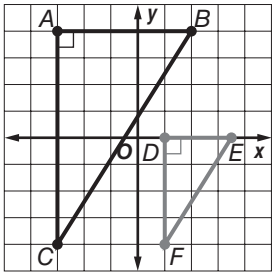
Similarity Transformations

Verify Similarity You can verify that a dilation produces a similar figure by comparing the ratios of all corresponding sides. For triangles, you can also use SAS Similarity.

Example **Graph the original figure and its dilated image. Then verify that the dilation is a similarity transformation.**

a. original: $A(-3, 4)$, $B(2, 4)$, $C(-3, -4)$
image: $D(1, 0)$, $E(3.5, 0)$, $F(1, -4)$

Graph each figure. Since $\angle A$ and $\angle D$ are both right angles, $\angle A \cong \angle D$. Show that the lengths of the sides that include $\angle A$ and $\angle D$ are proportional to prove similarity by SAS.



Use the coordinate grid to find the lengths of vertical segments AC and DF and horizontal segments AB and DE.

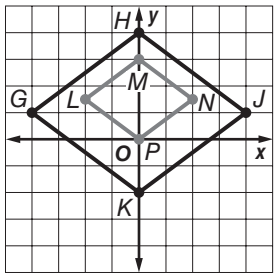
$\frac{AC}{DF} = \frac{8}{4} = 2$ and $\frac{AB}{DE} = \frac{5}{2.5} = 2$,

so $\frac{AC}{DF} = \frac{AB}{DE}$.

Since the lengths of the sides that include $\angle A$ and $\angle D$ are proportional, $\triangle ABC \sim \triangle DEF$ by SAS similarity.

b. original: $G(-4, 1)$, $H(0, 4)$, $J(4, 1)$, $K(0, -2)$
image: $L(-2, 1.5)$, $M(0, 3)$, $N(2, 1.5)$, $P(0, 0)$

Use the distance formula to find the length of each side.



$GH = \sqrt{4^2 + 3^2} = \sqrt{25} = 5$
$HJ = \sqrt{4^2 + 3^2} = \sqrt{25} = 5$
$JK = \sqrt{4^2 + 3^2} = \sqrt{25} = 5$
$KG = \sqrt{4^2 + 3^2} = \sqrt{25} = 5$
$LM = \sqrt{2^2 + 1.5^2} = \sqrt{6.25} = 2.5$
$MN = \sqrt{2^2 + 1.5^2} = \sqrt{6.25} = 2.5$
$NP = \sqrt{2^2 + 1.5^2} = \sqrt{6.25} = 2.5$
$PL = \sqrt{2^2 + 1.5^2} = \sqrt{6.25} = 2.5$

Find and compare the ratios of corresponding sides.

$\frac{GH}{LM} = \frac{5}{2.5} = 2$, $\frac{HJ}{MN} = \frac{5}{2.5} = 2$,

$\frac{JK}{NP} = \frac{5}{2.5} = 2$, $\frac{KC}{PL} = \frac{5}{2.5} = 2$.

Since $\frac{GH}{LM} = \frac{HJ}{MN} = \frac{JK}{NP} = \frac{KC}{PL}$, $GHJK \sim LMNP$.

Exercises

Graph the original figure and its dilated image. Then verify that the dilation is a similarity transformation.

1. $A(-4, -3)$, $B(2, 5)$, $C(2, -3)$, $D(-2, -2)$, $E(1, 3)$, $F(1, -2)$

2. $P(-4, 1)$, $Q(-2, 4)$, $R(0, 1)$, $S(-2, -2)$, $W(1, -1.5)$, $X(2, 0)$, $Y(3, -1.5)$, $Z(2, -3)$

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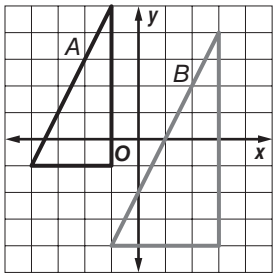
7-6 Skills Practice

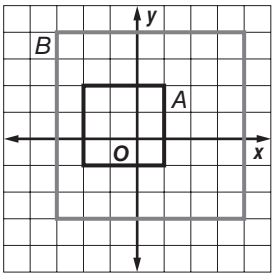
Similarity Transformations

Determine whether the dilation from *A* to *B* is an *enlargement* or a *reduction*. Then find the scale factor of the dilation.

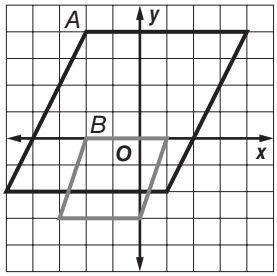
1.



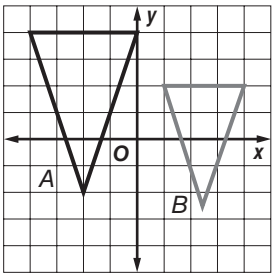
2.



3.

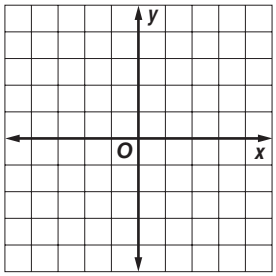


4.

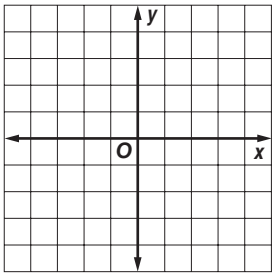


Graph the original figure and its dilated image. Then verify that the dilation is a similarity transformation.

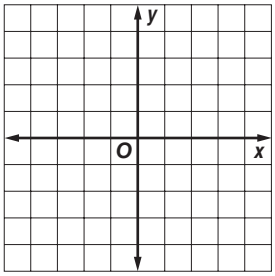
5. $A(-3, 4)$, $B(3, 4)$, $C(-3, -2)$; $A'(-2, 3)$, $B'(0, 3)$, $C'(-2, 1)$



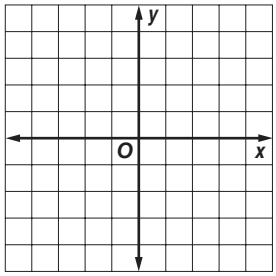
6. $F(-3, 4)$, $G(2, 4)$, $H(2, -2)$, $J(-3, -2)$; $F'(-1.5, 3)$, $G'(1, 3)$, $H'(1, 0)$, $J'(-1.5, 0)$



7. $P(-3, 1)$, $Q(-1, 1)$, $R(-1, -3)$; $P'(-1, 4)$, $Q'(3, 4)$, $R'(3, -4)$



8. $A(-5, -1)$, $B(0, 1)$, $C(5, -1)$, $D(0, -3)$; $A'(1, -1.5)$, $B'(2, 0)$, $C'(3, -1.5)$, $D'(2, -3)$



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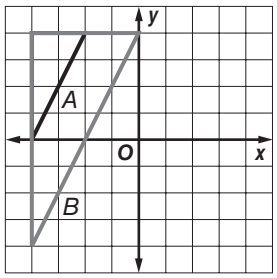
7-6 Practice

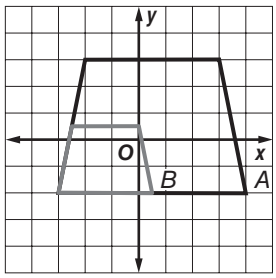
Similarity Transformations

Determine whether the dilation from *A* to *B* is an *enlargement* or a *reduction*. Then find the scale factor of the dilation.

1.



2.



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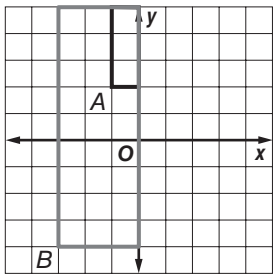
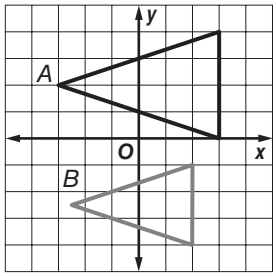
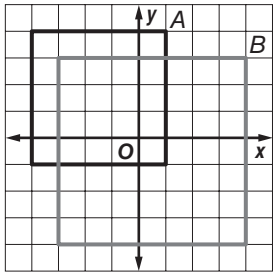


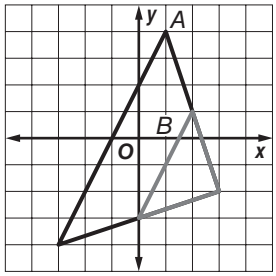
4.



5.



6.



Graph the original figure and its dilated image. Then verify that the dilation is a similarity transformation.

7. $Q(1, 4)$, $R(4, 4)$, $S(4, -1)$, $X(-4, 5)$, $Y(2, 5)$, $Z(2, -5)$

8. $A(-4, 2)$, $B(0, 4)$, $C(4, 2)$, $D(0, -2)$, $F(-2, 1)$, $G(0, 2)$, $H(2, 1)$, $J(0, -1)$

9. FABRIC Ryan buys an 8-foot-long by 6-foot-wide piece of fabric as shown. He wants to cut a smaller, similar rectangular piece that has a scale factor of $k = \frac{1}{4}$. If point $A(-4, 3)$ is the top left-hand vertex of both the original piece of fabric and the piece Ryan wishes to cut out, what are the coordinates of the vertices for the piece Ryan will cut?

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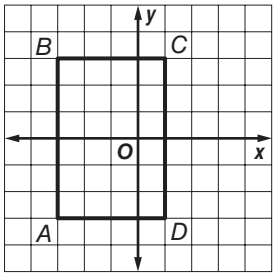
7-6 Word Problem Practice

Similarity Transformations

1. CITY PLANNING The standard size of a city block in Manhattan is 264 feet by 900 feet. The city planner of Mechlinburg wants to build a new subdivision using similar blocks so the dimensions of a standard Manhattan block are enlarged by 2.5 times. What will be the new dimensions of each enlarged block?

2. STORAGE SHED A local home improvement store sells different sizes of storage sheds. The most expensive shed has a footprint that is 15 feet wide by 21 feet long. The least expensive shed has a footprint that is 10 feet wide by 14 feet long. Are the footprints of the two sheds similar? If so, tell whether the footprints of the least expensive shed is an enlargement or a reduction, and find the scale factor from the most expensive shed to the least expensive shed.

3. FIND THE ERROR Jeremy and Elisa are constructing dilations of rectangle *ABCD* for their geometry class. Jeremy draws an enlargement *FGHJ* that contains the points $F(-3, 3)$ and $J(3, -6)$. Elisa draws a reduction *KLMN* that contains the points $L(-3, 3)$ and $N(-2, 2)$. Which person made an error in their dilation? Explain.



4. BANNERS The Bayside High School Spirit Squad is making a banner to take to away games. The banner they use for home games is shown below. If the new banner is to be a reduction of the home game banner with a scale factor of $\frac{1}{2}$, what will be the height of the new banner?

5. REASONING Consider the image *QRST* of a rectangle *WXYZ*.

a. Is it possible that point *Q* and point *W* could have the same coordinates? If so, what must be true about point *Q*?

b. Is it possible that both points *R* and *X* could have the same coordinates if points *T* and *Z* have the same coordinates? If so, what are the possible values of the scale factor *k* for the dilation?

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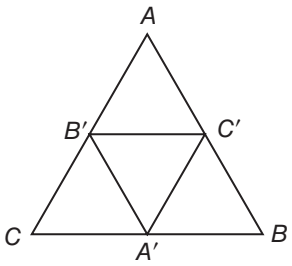
7-6 Enrichment

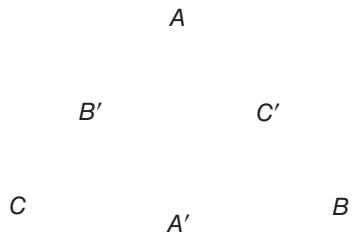
Medial and Orthic Triangles

The **medial triangle** is the triangle formed by connecting the midpoints of each side of the triangle. The triangle formed by A', B', and C' is the medial triangle of triangle ABC.

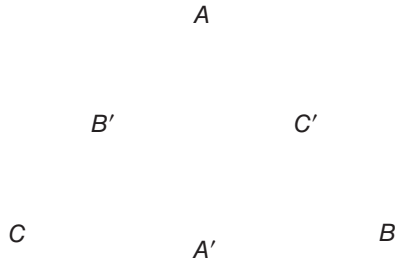


Use a ruler and compass. Draw the medial triangle for each triangle below.

1.

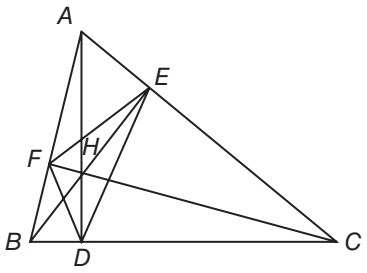


2.



3. Use the triangles you have created to show that the medial triangle is similar to the original triangle.

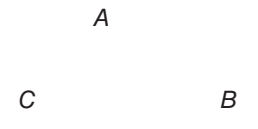
The **orthic triangle** is the triangle formed by connecting the endpoints of each of the altitudes of the triangle. The triangle formed by F, D, and, E is the orthic triangle of triangle ABC.



Use a ruler and compass. Draw the orthic triangle for each triangle below.

1.

2.



3. Use the triangles you have created to show that the orthic triangle is similar to the original triangle.

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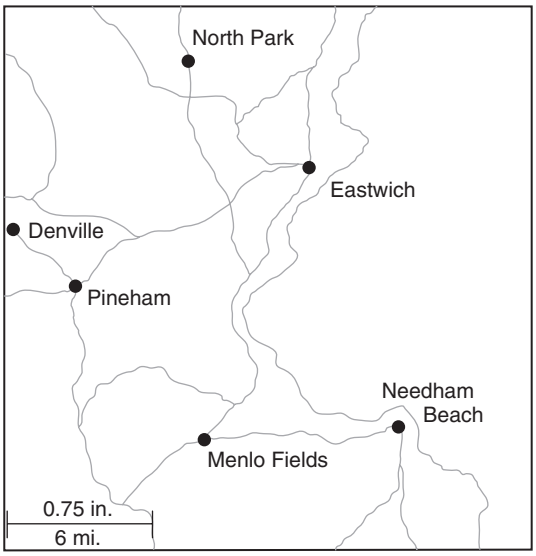
7-7 Study Guide and Intervention

Scale Drawings and Models

Scale Models A **scale model** or a **scale drawing** is an object or drawing with lengths proportional to the object it represents. The **scale** of a model or drawing is the ratio of the length of the model or drawing to the actual length of the object being modeled or drawn.

Example **MAPS The scale on the map shown is 0.75 inches : 6 miles. Find the actual distance from Pineham to Menlo Fields.**

Use a ruler. The distance between Pineham and Menlo Fields is about 1.25 inches.



Method 1: Write and solve a proportion.

Let x represent the distance between cities.

$\frac{0.75 \text{ in.}}{6 \text{ mi}} = \frac{1.25 \text{ in.}}{x \text{ mi}}$ ⟵ map ⟵ actual

$0.75 \cdot x = 6 \cdot 1.25$ Cross Products Property

$x = 10$ Simplify.

Method 2: Write and solve an equation.

Let a = actual distance and m = map distance in inches. Write the scale as $\frac{6 \text{ mi}}{0.75 \text{ in.}}$, which is $6 \div 0.75$ or 8 miles per inch.

$a = 8 \cdot m$ Write an equation.

$= 8 \cdot 1.25$ $m = 1.25$ in.

$= 10$ Solve.

The distance between Pineham and Menlo Fields is 10 miles.

Exercises

Use the map above and a customary ruler to find the actual distance between each pair of cities. Measure to the nearest sixteenth of an inch.

1. Eastwich and Needham Beach

2. North Park and Menlo Fields

3. North Park and Eastwich

4. Denville and Pineham

5. Pineham and Eastwich

Lesson 7-7

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7-7 Study Guide and Intervention *(continued)*

Scale Drawings and Models

Use Scale Factors The **scale factor** of a drawing or scale model is the scale written as a unitless ratio in simplest form. Scale factors are always written so that the model length in the ratio comes first.

Example **SCALE MODEL** **A doll house that is 15 inches tall is a scale model of a real house with a height of 20 feet.**

a. What is the scale of the model?

To find the scale, write the ratio of a model length to an actual length.

$$\frac{\text{model length}}{\text{actual length}} = \frac{15 \text{ in.}}{20 \text{ ft}} \text{ or } \frac{3 \text{ in.}}{4 \text{ ft}}$$

The scale of the model is 3 in.:4 ft

b. How many times as tall as the actual house is the model?

Multiply the scale factor of the model by a conversion factor that relates inches to feet to obtain a unitless ratio.

$$\frac{3 \text{ in.}}{4 \text{ ft}} = \frac{3 \text{ in.}}{4 \text{ ft}} \cdot \frac{1 \text{ ft}}{12 \text{ in.}} = \frac{3}{48} \text{ or } \frac{1}{16}$$

The scale factor is 1:16. That is, the model is $\frac{1}{16}$ as tall as the actual house.

Exercises

1. **MODEL TRAIN** The length of a model train is 18 inches. It is a scale model of a train that is 48 feet long. Find the scale factor.

2. **ART** An artist in Portland, Oregon, makes bronze sculptures of dogs. The ratio of the height of a sculpture to the actual height of the dog is 2:3. If the height of the sculpture is 14 inches, find the height of the dog.

3. **BRIDGES** The span of the Benjamin Franklin suspension bridge in Philadelphia, Pennsylvania, is 1750 feet. A model of the bridge has a span of 42 inches. What is the ratio of the span of the model to the span of the actual Benjamin Franklin Bridge?

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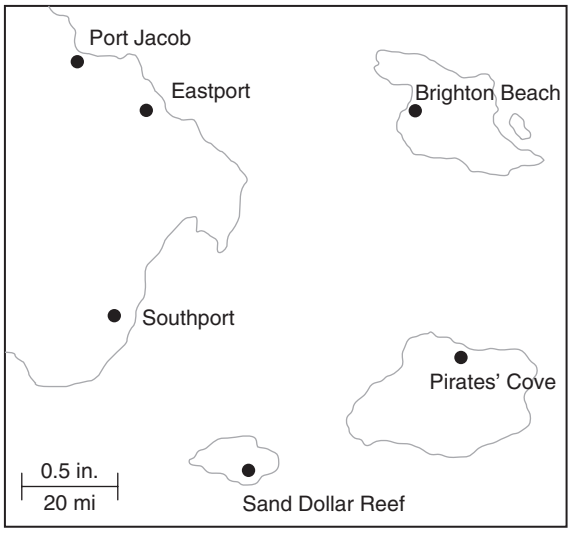
7-7 Skills Practice

Scale Drawings and Models

MAPS **Use the map shown and a customary ruler to find the actual distance between each pair of cities. Measure to the nearest sixteenth of an inch.**



1. Port Jacob and Southport

2. Port Jacob and Brighton Beach

3. Brighton Beach and Pirates' Cove

4. Eastport and Sand Dollar Reef

5. SCALE MODEL Sanjay is making a 139 centimeters long scale model of the Parthenon for his World History class. The actual length of the Parthenon is 69.5 meters long.

a. What is the scale of the model?

b. How many times as long as the actual Parthenon is the model?

6. ARCHITECTURE An architect is making a scale model of an office building he wishes to construct. The model is 9 inches tall. The actual office building he plans to construct will be 75 feet tall.

a. What is the scale of the model?

b. What scale factor did the architect use to build his model?

7. WHITE HOUSE Craig is making a scale drawing of the White House on an 8.5-by-11-inch sheet of paper. The White House is 168 feet long and 152 feet wide. Choose an appropriate scale for the drawing and use that scale to determine the drawing's dimensions.

8. GEOGRAPHY Choose an appropriate scale and construct a scale drawing of each rectangular state to fit on a 3-by-5-inch index card.

a. The state of Colorado is approximately 380 miles long (east to west) and 280 miles wide (north to south).

b. The state of Wyoming is approximately 365 miles long (east to west) and 265 miles wide (north to south).

Lesson 7-7

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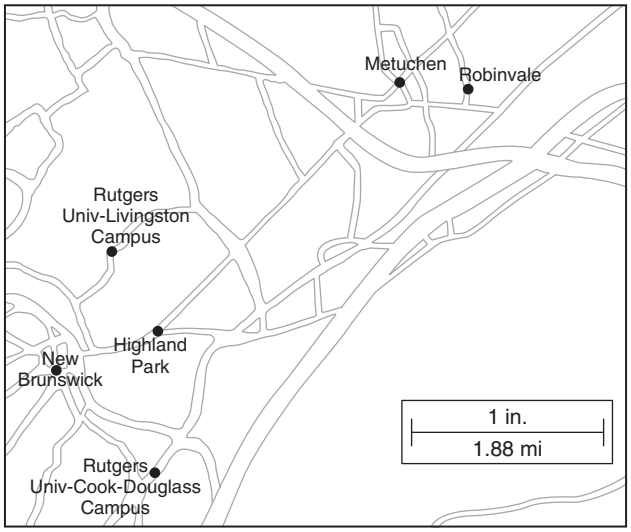
7-7 Practice

Scale Drawings and Models

MAPS Use the map of Central New Jersey shown and an inch ruler to find the actual distance between each pair of cities. Measure to the nearest sixteenth of an inch.



1. Highland Park and Metuchen

2. New Brunswick and Robinvale

3. Rutgers University Livingston Campus and Rutgers University Cook–Douglass Campus

4. AIRPLANES William is building a scale model of a Boeing 747–400 aircraft. The wingspan of the model is approximately 8 feet $10\frac{1}{16}$ inches. If the scale factor of the model is approximately 1:24, what is the actual wingspan of a Boeing 747–400 aircraft?

5. ENGINEERING A civil engineer is making a scale model of a highway on ramp. The length of the model is 4 inches long. The actual length of the on ramp is 500 feet.

a. What is the scale of the model?

b. How many times as long as the actual on ramp is the model?

c. How many times as long as the model is the actual on ramp?

6. MOVIES A movie director is creating a scale model of the Empire State Building to use in a scene. The Empire State Building is 1250 feet tall.

a. If the model is 75 inches tall, what is the scale of the model?

b. How tall would the model be if the director uses a scale factor of 1:75?

7. MONA LISA A visitor to the Louvre Museum in Paris wants to sketch a drawing of the *Mona Lisa,* a famous painting. The original painting is 77 centimeters by 53 centimeters. Choose an appropriate scale for the replica so that it will fit on a 8.5-by-11-inch sheet of paper.

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7-7 Word Problem Practice

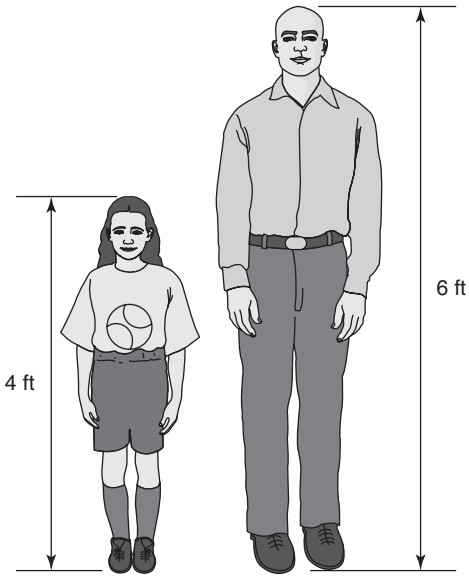
Scale Drawings and Models

1. MODELS Luke wants to make a scale model of a Boeing 747 jetliner. He wants every foot of his model to represent 50 feet. Complete the following table.

Part	Actual length (in.)	Model length (in.)
Wing Span	2537	
Length	2782	
Tail Height	392	

(**Source:** Boeing)

2. PHOTOGRAPHS Tracy is 4 feet tall and her father is 6 feet tall. In a photograph of the two of them standing side by side, Tracy's image is 2 inches tall.



Although their images are much smaller, the ratio of their heights remains the same. How tall is Tracy's father's image in the photo? What is the scale of the photo?

3. TOWERS The Tokyo Tower in Japan is currently the world's tallest self-supporting steel tower. It is 333 meters tall.

a. Heero builds a model of the Tokyo Tower that is 2775 millimeters tall. What is the scale of Heero's model?

b. How many times as tall as the actual tower is the model?

4. PUPPIES Meredith's new Pomeranian puppy is 7 inches tall and 9 inches long. She wants to make a drawing of her new Pomeranian to put in her locker. If the sheet of paper she is using is 3 inches by 5 inches, find an appropriate scale factor for Meredith to use in her drawing.

5. MAPS Carlos makes a map of his neighborhood for a presentation. The scale of his map is 1 inch:125 feet.

a. How many feet do 4 inches represent on the map?

b. Carlos lives 250 feet away from Andrew. How many inches separate Carlos' home from Andrew's on the map?

c. During a practice run in front of his parents, Carlos realizes that his map is far too small. He decides to make his map 5 times as large. What would be the scale of the larger map?

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7-7 Enrichment

Area and Volume of Scale Models and Drawings

You have already learned about changes of length measures between scale models and the object that is being modeled. The areas and volumes of scale models and drawings also change, but by multiples different than the "scale factor."

Example **Yuan is making a scale model of a cylinder. The actual cylinder has a radius of r inches and a height of h inches. The scale factor of the model is 1:2. What is the ratio of volumes of the model cylinder to the actual cylinder?**

The volume formula for a cylinder is $V = \pi r^2 h$. The actual cylinder's volume is $\pi r^2 h$.

If the cylinder is scaled down by a factor of 1:2, the new radius will be $\frac{1}{2} r$ and the new height will be $\frac{1}{2} h$.

$$V = \pi\left(\frac{1}{2} r\right)^2 \left(\frac{1}{2} h\right)$$
$$= \frac{1}{8}\pi r^2 h$$

The model's volume is $\frac{1}{8}$ of the actual volume.

Exercises

1. Consider a painting on a 22-inch-by-28-inch canvas. Suppose you wish to make a 1:2 scale model of the painting for art class. What is the ratio of areas of the model painting to the actual painting?

(Area = Length × Width)

2. The Parks and Recreation Office is planning a new circular playground with a radius of 30 feet. Before they can construct the playground, they ask an architect to create a 1:20 scale model of the proposed playground such that the new radius is 1.5 feet. What is the ratio of areas of the model playground to the proposed actual playground?

(Area = $\pi \times$ (radius)^2)

3. A refrigerator manufacturer uses a 7-foot-by-3-foot-by-3-foot box for its standard model. The marketing team suggests the manufacturer start selling a smaller, lower-priced refrigerator with a scale factor of 4:5 to the standard model. If the box is reduced by a similar scale, what is the ratio of volumes of the new, smaller box to the current box?

(Volume = length × width × height)

4. Consider a cube with side lengths x. If each side of the cube is scaled by a factor of 1:y, what is the ratio of volumes of the model cube to the actual cube?

(Volume = length × width × height)

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7 Student Recording Sheet

Use this recording sheet with pages 610–611 of the Student Edition.

Multiple Choice

Read each question. Then fill in the correct answer.

1. Ⓐ Ⓑ Ⓒ Ⓓ

2. Ⓕ Ⓖ Ⓗ Ⓙ

3. Ⓐ Ⓑ Ⓒ Ⓓ

4. Ⓕ Ⓖ Ⓗ Ⓙ

5. Ⓐ Ⓑ Ⓒ Ⓓ

6. Ⓕ Ⓖ Ⓗ Ⓙ

7. Ⓐ Ⓑ Ⓒ Ⓓ

Short Response/Gridded Response

Record your answer in the blank.

For gridded response questions, also enter your answer in the grid by writing each number or symbol in a box. Then fill in the corresponding circle for that number or symbol.

8. _____ *(grid in)*

9. _____

10. _____

11. _____

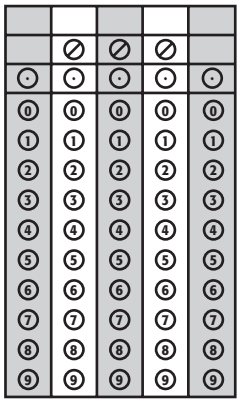
12. _____

13. _____

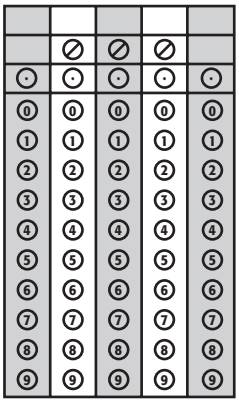
14. _____ *(grid in)*

15. _____

8.



14.



Extended Response

Record your answers for Question 16 on the back of this paper.

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7 Rubric for Extended-Response

SCORE _____

General Scoring Guidelines

- If a student gives only a correct numerical answer to a problem but does not show how he or she arrived at the answer, the student will be awarded only 1 credit. All extended-response questions require the student to show work.
- A fully correct answer for a multiple-part question requires correct responses for all parts of the question. For example, if a question has three parts, the correct response to one or two parts of the question that required work to be shown is *not* considered a fully correct response.
- Students who use trial and error to solve a problem must show their method. Merely showing that the answer checks or is correct is not considered a complete response for full credit.

Exercise 11 Rubric

Score	Specific Criteria
4	An understanding that using proportional parts created by parallel lines is shown by the student creating the proportion $\frac{XQ}{QZ} = \frac{YR}{RZ}$. The correct substitutions are made for part **b** to determine the length of $\overline{RZ}$, or 16 units. The correct substitutions are made for part **c** to determine the length of $\overline{XY}$, or 9.5 units.
3	A generally correct solution, but may contain minor flaws in reasoning or computation.
2	A partially correct interpretation and/or solution to the problem.
1	A correct solution with no evidence or explanation.
0	An incorrect solution indicating no mathematical understanding of the concept or task, or no solution is given.

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7 Chapter 7 Quiz 1

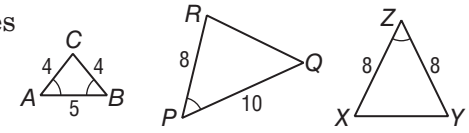
SCORE _____

(Lessons 7-1 and 7-2)

1. The ratios of measures of the angles in $\triangle ABC$ is 4:13:19. Find the measures of the angles. **1.** _____

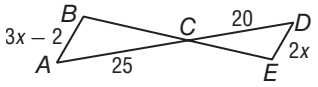
2. SCHOOL ELECTIONS Henrietta conducted a random survey of 60 students and found that 36 are planning to vote for her as class president. If there are 460 students in Henrietta's class, predict the total number of students who will vote for her as class president. **2.** _____

3. Are any of the three triangles similar? If so, write the appropriate similarity statement.



3. _____

4. If $\triangle ABC \sim \triangle DEC$, find x and the scale factor of $\triangle ABC$ to $\triangle DEC$.



4. _____

5. MULTIPLE CHOICE In a rectangle, the ratio of the length to the width is 5:2, and its perimeter is 126 centimeters. Find the width of the rectangle.

A 9 cm **B** 18 cm **C** 45 cm **D** 50.4 cm **5.** _____

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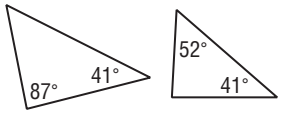
7 Chapter 7 Quiz 2

SCORE _____

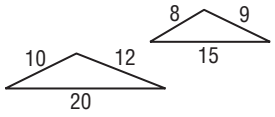
(Lessons 7-3 and 7-4)

For Questions 1 and 2, determine whether each pair of triangles is similar. Justify your answer.

1.



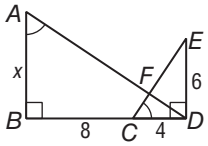
2.



1. _____

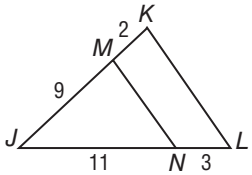
2. _____

3. Identify the similar triangles in the figure, then find the value of x.



3. _____

4. Determine whether $\overline{MN} \parallel \overline{KL}$ Justify your answer.



4. _____

5. In $\triangle ABC$, $\overline{DE}$ is parallel to $\overline{AC}$ and $DE = 10$. Find the length of $\overline{AC}$ if $\overline{DE}$ is the midsegment of $\triangle ABC$. **5.** _____

NAME _____ DATE _____ PERIOD _____

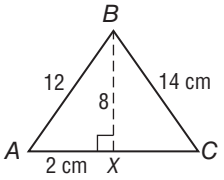
7 Chapter 7 Quiz 3

SCORE _____

(Lessons 7-5 and 7-6)

For Questions 1–3 $\triangle ABC \sim \triangle DEF$, and $\overline{BE}$ bisects $\angle ABC$.

1. Find the length of $\overline{XC}$ to the nearest tenth.

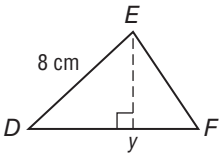


1. _____

2. What is the relationship between the corresponding altitudes $\overline{BX}$ and $\overline{EY}$?

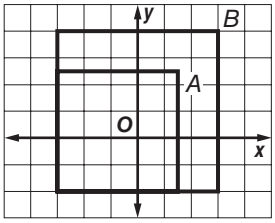
2. _____

3. Find the length of $\overline{EY}$ to the nearest tenth.



3. _____

4. Determine if the dilation from A and B is an *enlargement* or *reduction*. Then find the scale factor of the dilation.



4. _____

5. Graph the original figure and its dilated image. Then verify that the dilation is a similarity transformation. original: $A(-1, 4)$, $B(1, 4)$, $C(4, -2)$, $D(-4, -2)$ image: $F(-3, 0)$, $G\left(-\frac{7}{3}, 0\right)$, $H\left(-\frac{4}{3}, -2\right)$, $J(-4, -2)$

5.

NAME _____ DATE _____ PERIOD _____

7 Chapter 7 Quiz 4

SCORE _____

(Lesson 7-7)

1. GARDENS The model of a circular garden is 8 inches in diameter. The actual garden will be 20 feet in diameter. Find the ratio of the diameter of the model to the diameter of the actual garden.

1. _____

2. PHOTOS A 4-inch by 6-inch photograph, set vertically, is enlarged to make a poster 22 inches wide. How tall is the poster?

2. _____

3. TICKETS Sofia is making a copy of a ticket from the school play to put in her memory album. The original ticket is 7 inches long and 5 inches wide. Her copy is 2 inches long. What is the scale of the copy of the ticket?

3. _____

4. MULTIPLE CHOICE An NCAA regulation size lacrosse field measures 110 yards long by 60 yards wide. Which of the following would be an appropriate scale to construct a scale drawing of a lacrosse field so it would best fit on a 8.5-by-11-inch sheet of paper? (1 yd = 36 in.)

A 1:250 **B** 1:255 **C** 1:355 **D** 1:365

4. _____

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7 Chapter 7 Mid-Chapter Test

SCORE _____

(Lessons 7-1 through 7-4)

Assessment

Part I ***Write the letter for the correct answer in the blank at the right of each question.***

1. Polygon $ABCD$ is similar to polygon $PQRS$. Which proportion must be true?

A $\frac{AC}{AD} = \frac{PQ}{PS}$ **B** $\frac{BC}{CD} = \frac{QR}{RS}$ **C** $\frac{AB}{BD} = \frac{PQ}{QR}$ **D** $\frac{CD}{AB} = \frac{PQ}{RS}$ **1.** _____

2. This fall, 126 students participated in the soccer program, while 54 played volleyball. What was the ratio of soccer players to volleyball players?

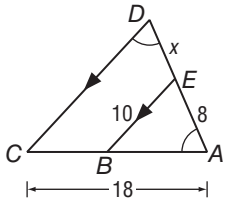
F $\frac{3}{4}$ **G** $\frac{3}{7}$ **H** $\frac{4}{3}$ **J** $\frac{7}{3}$ **2.** _____

3. The ratio of the measures of the angles of a triangle is 2:3:10. What is the least angle measure?

A 12 **B** 15 **C** 24 **D** 36 **3.** _____

4. Find the value of x.

F 2
G 4.8
H 6
J 6.4



4. _____

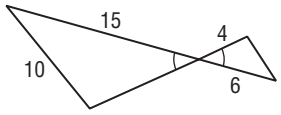
5. Rectangle $ABCD \sim$ rectangle $EFGH$, the perimeter of $ABCD$ is 54 centimeters and the perimeter of $EFGH$ is 36 centimeters. What is the scale factor of $ABCD$ to $EFGH$?

A $\frac{2}{3}$ **B** $\frac{3}{2}$ **C** $\frac{3}{5}$ **D** $\frac{5}{3}$ **5.** _____

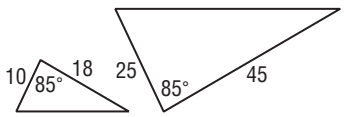
Part II

For Questions 6 and 7, determine whether each pair of triangles is similar. Justify your answer.

6.



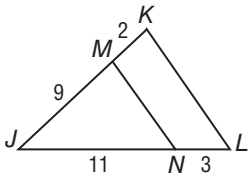
7.



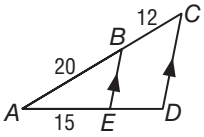
6. _____

7. _____

8. Determine whether $\overline{MN} \parallel \overline{KL}$. Justify your answer.



9. Find DE.



8. _____

9. _____

10. RECTANGLES A rectangle has a perimeter of 14 inches. A similar rectangle has a perimeter of 10 inches. If the length of the larger rectangle is 4 inches, what is the length of the smaller rectangle? Round to the nearest tenth.

10. _____

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7 Chapter 7 Vocabulary Test

SCORE _____

cross products	midsegment of a triangle	scale drawing
dilation	proportion	scale factor
enlargement	ratio	scale model
extremes	reduction	similar polygons
means	scale	similarity transformation

Choose the correct term to complete each sentence.

1. If there are 15 girls and 9 boys in an art class, the (*ratio*, *scale factor*) of girls to boys in the class is 5:3. **1.** _____

2. If $\triangle ABC \sim \triangle DEF$, $AB = 10$, and $DE = 2.5$, then the (*scale factor*, *proportion*) of $\triangle ABC$ to $\triangle DEF$ is 4:1. **2.** _____

Choose from the terms above to complete each sentence.

3. In $\triangle LMN$, P lies on $\overline{LM}$ and Q lies on $\overline{LN}$. If $PQ = \frac{1}{2}MN$, $\overline{PQ}$ is called a(n) ___?___. **3.** _____

4. The product of the ___?___ in the equation $\frac{3}{x} = \frac{24}{30}$ is 90. **4.** _____

5. The product of the ___?___ in the equation $\frac{3}{x} = \frac{24}{30}$ is $24x$. **5.** _____

Write whether each sentence is *true* or *false*. If false, replace the underlined term to make a true sentence.

6. If quadrilaterals $ABCD$ and $WXYZ$ have corresponding angles congruent and corresponding sides proportional, they are called <u>cross products</u>. **6.** _____

7. The equation $\frac{3}{x} = \frac{24}{30}$ is called a(n) <u>scale factor</u>. **7.** _____

8. In a proportion, the cross products of the <u>extremes</u> equals the cross product of the means. **8.** _____

Define each term in your own words.

9. equality of cross products **9.** _____

10. midsegment **10.** _____

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7 Chapter 7 Test, Form 1

SCORE _____

Write the letter for the correct answer in the blank at the right of each question.

1. There are 15 plums and 9 apples in a fruit bowl. What is the ratio of apples to plums?

A 3:5 **B** 3:8 **C** 5:3 **D** 8:3 **1.** _____

2. The scale drawing of a porch is 8 inches wide by 12 inches long. If the actual porch is 12 feet wide, what is the length of the porch?

F 8 ft **G** 10 ft **H** 16 ft **J** 18 ft **2.** _____

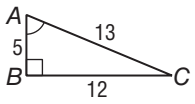
3. Solve $\frac{5}{6} = \frac{4}{x}$.

A 4.6 **B** 4.8 **C** 5 **D** 7 **3.** _____

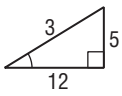
4. A quality control technician checked a sample of 30 bulbs. Two of the bulbs were defective. If the sample was representative, find the number of bulbs expected to be defective in a case of 450.

F 24 **G** 30 **H** 36 **J** 45 **4.** _____

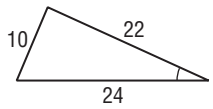
5. Find the triangle similar to $\triangle ABC$ at the right.



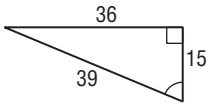
A



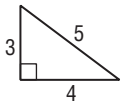
C



B

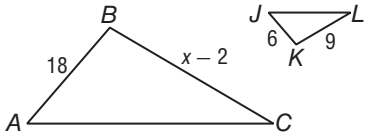


D



5. _____

6. Find the value of x if $\triangle ABC \sim \triangle JKL$.



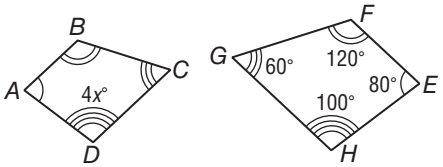
F 10 **H** 25

G 14 **J** 29 **6.** _____

7. Quadrilateral $ABCD \sim$ quadrilateral $PQRS$. If $AB = 10$, $BC = 6$, $PS = 12$, and $QR = 4$, find the scale factor of $ABCD$ to $PQRS$.

A $\frac{1}{2}$ **B** $\frac{3}{2}$ **C** $\frac{5}{3}$ **D** $\frac{5}{6}$ **7.** _____

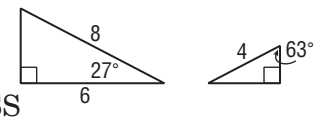
8. Quadrilateral $ABCD \sim$ quadrilateral $EFGH$. Find the value of x.



F 15 **H** 25

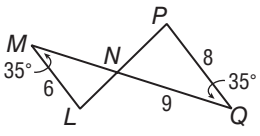
G 20 **J** 30 **8.** _____

9. Which theorem or postulate can be used to prove that these two triangles are similar?



A AA **B** SAS **C** SSA **D** SSS **9.** _____

10. Find MN.



F $5\frac{1}{3}$ **G** $6\frac{3}{4}$ **H** 7 **J** 12 **10.** _____

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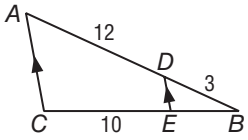
7 Chapter 7 Test, Form 1 *(continued)*

11. A 5-foot tall student cast a 4-foot shadow. If the tree next to her cast a 44-foot shadow, what is the height of the tree?

A $35\frac{1}{5}$ ft **B** 45 ft **C** $51\frac{1}{2}$ ft **D** 55 ft **11.** ____

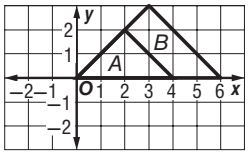
12. In $\triangle ABC$, $\overline{DE} \parallel \overline{AC}$. If $AD = 12$, $BD = 3$, and $CE = 10$, find BE.



F 1 **H** 2

G $1\frac{1}{2}$ **J** $2\frac{1}{2}$ **12.** ____

13. What is the scale factor of the dilation of A to B?



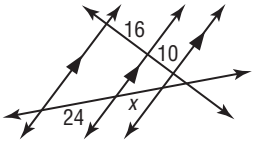
A 1 **C** 2

B $\frac{3}{2}$ **D** 6 **13.** ____

14. $\triangle FGH \sim \triangle PQR$, $FG = 6$, $PQ = 10$, and the perimeter of $\triangle PQR$ is 35. What is the perimeter of $\triangle FGH$?

F 21 **G** 27 **H** 31 **J** $58\frac{1}{3}$ **14.** ____

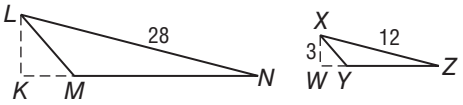
15. Find the value of x.



A 14 **C** 16

B 15 **D** 18 **15.** ____

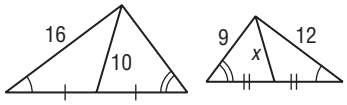
16. $\triangle LMN \sim \triangle XYZ$ with altitudes $\overline{KL}$ and $\overline{WX}$. Find KL.



F 6 **H** 9

G 7 **J** 19 **16.** ____

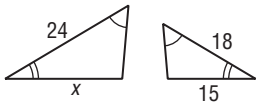
17. Find the value of x.



A 5 **C** $6\frac{1}{2}$

B 6 **D** $7\frac{1}{2}$ **17.** ____

18. Find the value of x.



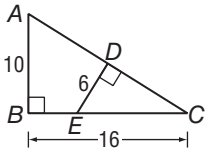
F 16 **H** 20

G 18 **J** 21 **18.** ____

19. Nathan is building a model of his father's sailboat with a scale factor of $\frac{1}{32}$. The actual sail is in the shape of a right triangle with a base of 8 meters and a hypotenuse of 13 meters. What will be the approximate perimeter of the sail on the model boat?

A 32 cm **B** 48.81 cm **C** 65.62 cm **D** 97.65 cm **19.** ____

Bonus In $\triangle ABC$, $AB = 10$, $BC = 16$, $\overline{DE} \perp \overline{AC}$, and $DE = 6$. Find CD.



B: _____

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7 Chapter 7 Test, Form 2A

SCORE _____

Assessment

Write the letter for the correct answer in the blank at the right of each question.

1. Of the 240 students eating lunch, 96 purchased their lunch and the rest brought a bag lunch. What is the ratio of students purchasing lunch to students bringing a bag lunch?

A 2:3 **B** 2:5 **C** 3:2 **D** 5:2 **1.** _____

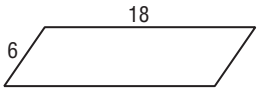
2. In a rectangle, the ratio of the width to the length is 4:5. If the rectangle is 40 centimeters long, find its width.

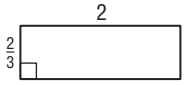
F 32 cm **G** 36 cm **H** 44 cm **J** 50 cm **2.** _____

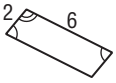
3. A postage stamp 25 millimeters wide and 40 millimeter tall is enlarged to make a poster. The poster is 4 feet wide. Find the height of the poster.

A 2.5 ft **B** 5.25 ft **C** 5.8 ft **D** 6.4 ft **3.** _____

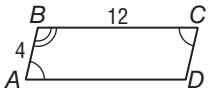
4. Find the polygon that is similar to *ABCD*.

F 

G 

H 

J

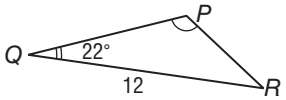


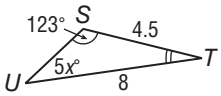
4. _____

5. If $\triangle PQR \sim \triangle STU$, find the value of x.

A 4.4 **C** 24.6

B 7 **D** 35



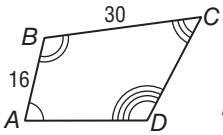


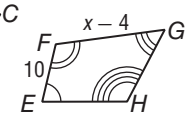
5. _____

6. If $ABCD \sim EFGH$, find the value of x.

F 18.75 **H** 22.75

G 20 **J** 28





6. _____

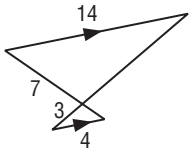
7. $\triangle ABC \sim \triangle LMN$, $AB = 18$, $BC = 12$, $LN = 9$, and $LM = 6$. What is the scale factor of $\triangle ABC$ to $\triangle LMN$?

A $\frac{9}{2}$ **B** $\frac{3}{2}$ **C** $\frac{3}{1}$ **D** $\frac{2}{1}$ **7.** _____

8. Name the theorem or postulate that can be used to prove that these triangles are similar.

F AA Similarity **H** SAS Similarity

G SSS Similarity **J** SSA Similarity



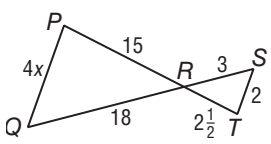
8. _____

For Questions 9 and 10, refer to the figure at the right.

9. Identify the true statement.

A $\triangle PQR \sim \triangle RST$ **C** $\triangle PQR \sim \triangle TSR$

B $\triangle PQR \sim \triangle STR$ **D** $\triangle PQR \sim \triangle TRS$



9. _____

10. Find the value of x.

F $2\frac{1}{2}$ **G** 3 **H** $3\frac{1}{2}$ **J** 4 **10.** _____

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7 Chapter 7 Test, Form 2A *(continued)*

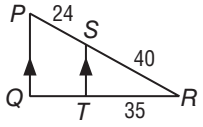
11. A 24-foot flagpole cast a 20-foot shadow. At the same time, the building next to it cast an 85-foot shadow. Find the height of the building.

A $70\frac{5}{6}$ ft **B** 89 ft **C** $96\frac{1}{6}$ ft **D** 102 ft **11.** ____

12. Find QT.

F 15 **H** 19

G 17 **J** 21

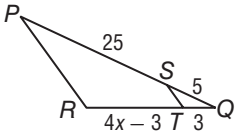


12. ____

13. Find the value of x so that $\overline{ST} \parallel \overline{PR}$.

A 4 **C** 6

B $4\frac{1}{2}$ **D** $6\frac{1}{2}$

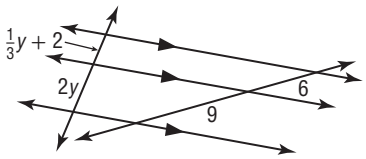


13. ____

14. Find the value of y.

F $\frac{4}{3}$ **H** $\frac{7}{3}$

G 2 **J** 3

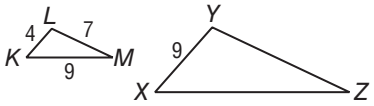


14. ____

15. If $\triangle KLM \sim \triangle XYZ$, find the perimeter of $\triangle XYZ$.

A 40 **C** 45

B 42 **D** 48

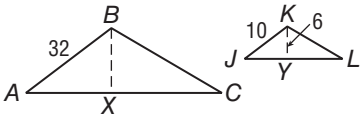


15. ____

16. $\triangle ABC \sim \triangle JKL$ with altitudes $\overline{BX}$ and $\overline{KY}$. Find BX.

F 19.2 **H** 24.6

G 21 **J** 28

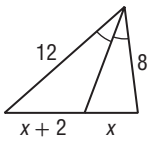


16. ____

17. Find the value of x.

A 4 **C** 6

B 5 **D** 8

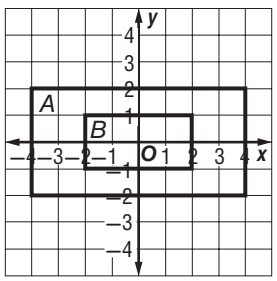


17. ____

18. What is the scale factor of the dilation of A to B?

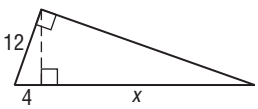
F 2 **H** 1

G $\frac{3}{2}$ **J** $\frac{1}{2}$



18. ____

Bonus Find the value of x.



B: _____

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7 Chapter 7 Test, Form 2B

SCORE _____

Assessment

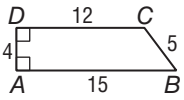
Write the letter for the correct answer in the blank at the right of each question.

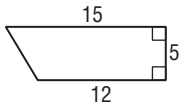
1. Given the choice between doing an oral and a written report, 18 of the 28 students chose to do an oral report. Find the ratio of written to oral reports.
A 5:9 **B** 9:5 **C** 9:14 **D** 14:9 **1.** ____

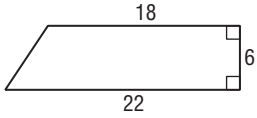
2. A model of a lighthouse has diameter 8 inches and height 18 inches. If the actual diameter of the lighthouse is 20 feet, find its actual height.
F 30 ft **G** 35 ft **H** 45 ft **J** 50 ft **2.** ____

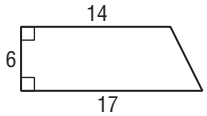
3. The three sides of a triangle are in the ratio 2:4:5. If the shortest side of the triangle is 4 meters long, find the perimeter.
A 17 m **B** 22 m **C** 32 m **D** 40 m **3.** ____

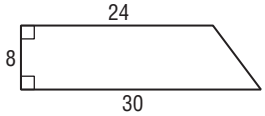
4. Find the polygon that is similar to *ABCD*.



F


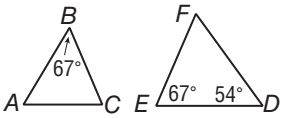
H


G


J


4. ____

5. If $\triangle ABC \sim \triangle DEF$, find $m\angle C$.
A 54 **C** 67
B 59 **D** 69

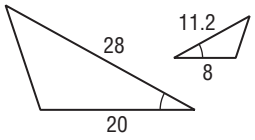


5. ____

6. Quadrilateral *JKLM* ~ quadrilateral *WXYZ*, *JK* = 15, *LM* = 10, *XY* = 6, and *WX* = 9. Find *KL*.
F 8 **G** 10 **H** 11 **J** 12 **6.** ____

7. $\triangle LMN \sim \triangle RST$, *LN* = 21, *MN* = 28, and the scale factor of $\triangle RST$ to $\triangle LMN$ is $\frac{4}{3}$. Find *ST*.
A $15\frac{3}{4}$ **B** 21 **C** 28 **D** $37\frac{1}{3}$ **7.** ____

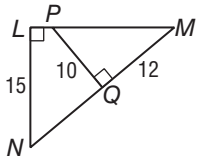
8. Name the theorem or postulate that can be used to prove that these triangles are similar.
F AA Similarity **H** SSA Similarity
G SAS Similarity **J** SSS Similarity



8. ____

For Questions 9 and 10, refer to the figure at the right.

9. Identify the similar triangles.
A $\triangle LMN \sim \triangle MPQ$ **C** $\triangle LMN \sim \triangle QPM$
B $\triangle LMN \sim \triangle QMP$ **D** $\triangle LMN \sim \triangle PQM$



9. ____

10. Find *LM*.
F 16 **G** 17 **H** 18 **J** 20 **10.** ____

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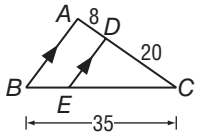
7 Chapter 7 Test, Form 2B *(continued)*

11. A 6-foot-tall fence post cast a $2\frac{1}{2}$-foot shadow. At the same time, a nearby clock tower cast a 35-foot shadow. What is the height of the tower?

A $37\frac{1}{2}$ ft **B** 71 ft **C** 78 ft **D** 84 ft **11.** ____

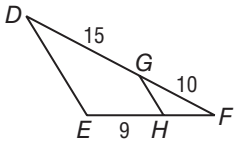
12. Find *CE*.



F 25 **H** 27

G 26 **J** 28 **12.** ____

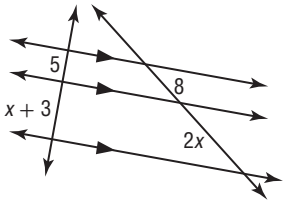
13. Find *FH* so that $\overline{GH} \parallel \overline{DE}$.



A 4 **C** 6

B 5 **D** 7 **13.** ____

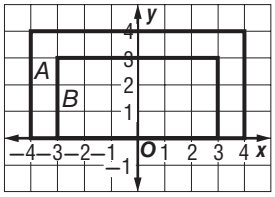
14. Find the value of *x*.



F 4 **H** 9

G 6 **J** 12 **14.** ____

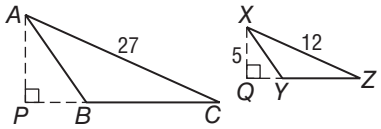
15. What is the scale factor of the dilation of *A* to *B*?



A $\frac{1}{2}$ **C** $\frac{4}{3}$

B $\frac{3}{4}$ **D** 2 **15.** ____

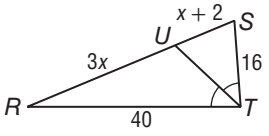
16. $\triangle ABC \sim \triangle XYZ$ with altitudes $\overline{AP}$ and $\overline{XQ}$. Find *AP*.



F $11\frac{1}{4}$ **H** $15\frac{1}{4}$

G 14 **J** 20 **16.** ____

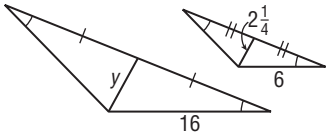
17. Find the value of *x*.



A 7 **C** 9

B 8 **D** 10 **17.** ____

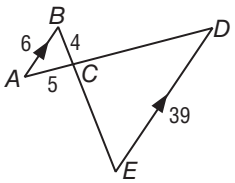
18. Find the value of *y*.



F $3\frac{3}{4}$ **H** 6

G 4 **J** $7\frac{1}{2}$ **18.** ____

Bonus Find *CE*.



B: _____

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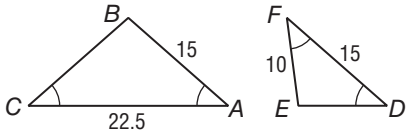
7 Chapter 7 Test, Form 2C

SCORE _____

Assessment

1. Of the 300 television sets sold at an electronics store last month, 90 were flat-screen TVs. What is the ratio of flat-screen TVs to other TVs sold last month? **1.** _____

2. Determine whether $\triangle ABC \sim \triangle DEF$. Justify your answer.



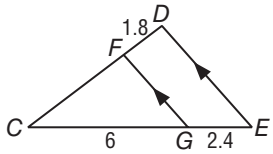
2. _____

3. When a 5-foot vertical pole casts a 3-foot 4-inch shadow, an oak tree casts a 20-foot shadow. Find the height of the tree. **3.** _____

4. Quadrilateral $ABCD \sim$ quadrilateral $WXYZ$, $AB = 15$, $BC = 27$, $BC = 27$, and the scale factor of $WXYZ$ to $ABCD$ is $\frac{2}{3}$. Find XY. **4.** _____

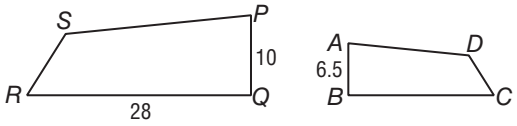
5. The blueprint for a swimming pool is 8 inches by $2\frac{1}{2}$ inches. The actual pool is 136 feet long. Find the width of the pool. **5.** _____

6. Find CD.



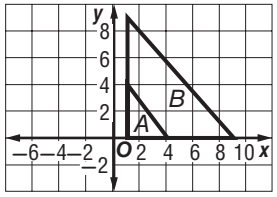
6. _____

7. If quadrilateral $ABCD \sim$ quadrilateral $PQRS$, find BC.



7. _____

8. Is the dilation a similarity transformation? Verify your answer.



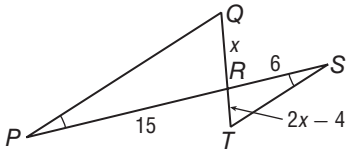
8. _____

9. $\triangle ABC \sim \triangle XYZ$, $AB = 12$, $AC = 16$, $BC = 20$, and $XZ = 24$. Find the perimeter of $\triangle XYZ$. **9.** _____

For Questions 10 and 11, use the figure.

10. Identify the similar triangles. **10.** _____

11. Find the value of x. **11.** _____



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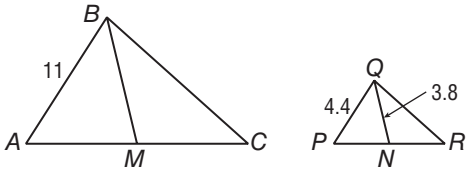
7 Chapter 7 Test, Form 2C *(continued)*

12. If $\triangle ABC \sim \triangle PQR$ and $\overline{BM}$ and $\overline{QN}$ are medians, find BM.

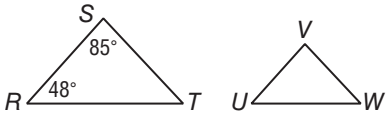


12. _____

13. The ratio of the measures of the three sides of a triangle is 3:4:6. If the perimeter is 91, find the length of the longest side.

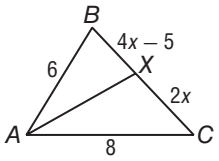
13. _____

14. If $\triangle RST \sim \triangle UVW$, find $m\angle W$.



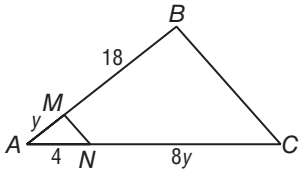
14. _____

15. In $\triangle ABC$, $\overline{AX}$ bisects $\angle BAC$. Find the value of x.



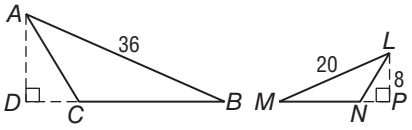
15. _____

16. Find the value of y so that $\overline{MN} \parallel \overline{BC}$.



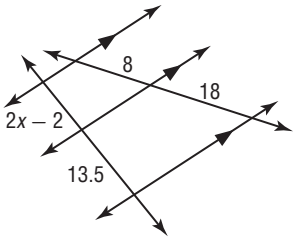
16. _____

17. $\triangle ABC \sim \triangle LMN$, and $\overline{AD}$ and $\overline{LP}$ are altitudes. Find AD.



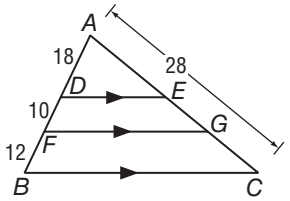
17. _____

18. Find the value of x.



18. _____

Bonus Find EG.



B: _____

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NAME _____ DATE _____ PERIOD _____

7 Chapter 7 Test, Form 2D

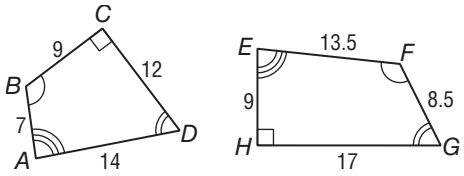
SCORE _____

Assessment

1. Of the 112 students in the marching band, 35 were in the drum section. What is the ratio of drummers to other musicians in the band?

1. _____

2. Determine whether quadrilateral $ABCD \sim$ quadrilateral $EFGH$. Justify your answer.



2. _____

3. When a 9-foot tall garden shed cast a 5-foot 3-inch shadow, a house cast a 28-foot shadow. Find the height of the house.

3. _____

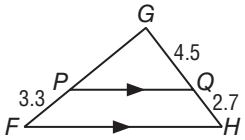
4. $\triangle ABC \sim \triangle FGH$, $AB = 24$, $AC = 16$, $GH = 9$, and $FH = 12$. Find the scale factor of $\triangle ABC$ to $\triangle FGH$.

4. _____

5. The model of a suspension bridge is 18 inches long and 2 inches tall. If the length of the actual bridge is 1650 feet, find its height.

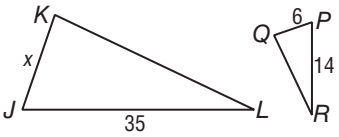
5. _____

6. Find GP.



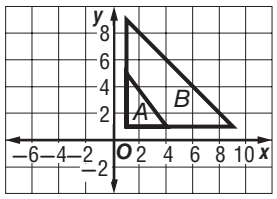
6. _____

7. If $\triangle JKL \sim \triangle PQR$, find the value of x.



7. _____

8. Is the dilation a similarity transformation? Verify your answer.

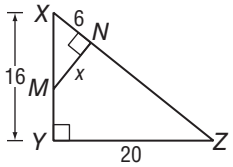


8. _____

9. $\triangle ABC \sim \triangle PQR$, $AB = 18$, $BC = 20$, $AC = 22$, and $QR = 25$. Find the perimeter of $\triangle PQR$.

9. _____

For Questions 10 and 11, use the figure.



10. Identify the similar triangles.

10. _____

11. Find MN.

11. _____

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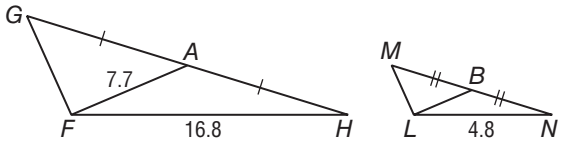
7 Chapter 7 Test, Form 2D *(continued)*

12. If $\triangle FGH \sim \triangle LMN$ and $\overline{AF}$ and $\overline{BL}$ are medians, find BL.

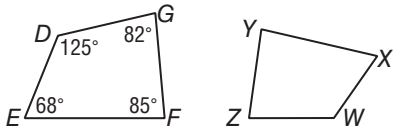


12. _____

13. The ratio of the measures of the three angles of a triangle is 3:4:8. Find the measure of the largest angle.

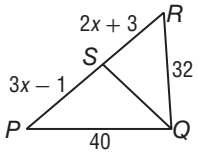
13. _____

14. If quadrilateral $DEFG \sim$ quadrilateral $WXYZ$, find $m\angle Y$.



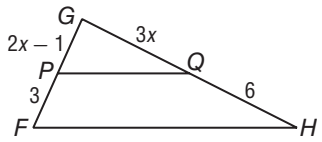
14. _____

15. In $\triangle PQR$, $\overline{QS}$ bisects $\angle PQR$. Find the value of x.



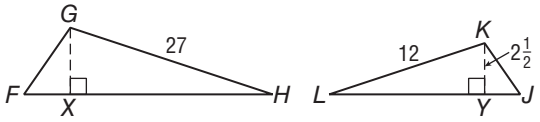
15. _____

16. Find the value of x so that $\overline{PQ} \parallel \overline{FH}$.



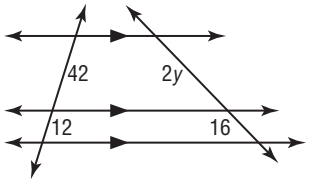
16. _____

17. If $\triangle FGH \sim \triangle JKL$, find GX.



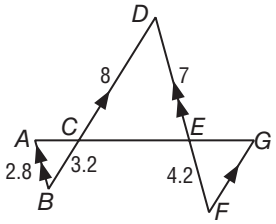
17. _____

18. Find the value of y.



18. _____

Bonus Find FG.



B: _____

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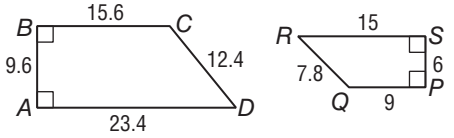
7 Chapter 7 Test, Form 3

SCORE _____

Assessment

1. In an orchard of apple and peach trees, $\frac{3}{7}$ of the trees are peaches. What is the ratio of apple trees to peach trees? **1.** _____

2. Determine whether trapezoid $ABCD \sim$ trapezoid $PQRS$. Justify your answer.

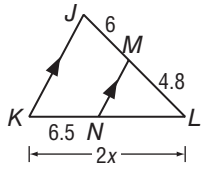


2. _____

3. In $\triangle ABC$, $m\angle A = 51$, $AB = 14$, and $AC = 20$. In $\triangle DEF$, $m\angle D = 51$, $DE = 16.8$, and $DF = 24$. Determine whether $\triangle ABC \sim \triangle DEF$. Justify your answer. **3.** _____

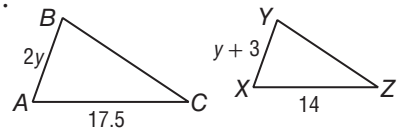
4. A painting that is 48 inches by 12 inches is reduced to fit on a canvas that is 30 centimeters by 10 centimeters. Find the maximum dimensions of the reduced painting. **4.** _____

5. Find the value of x.



5. _____

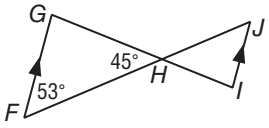
6. If $\triangle ABC \sim \triangle XYZ$, find y.



6. _____

7. The ratio of the measures of the sides of a triangle is 2:5:6. If the length of the longest side is 48 inches, find the perimeter. **7.** _____

8. Find $m\angle I$.

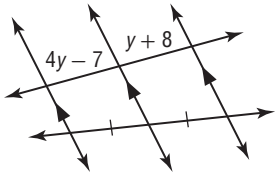


8. _____

9. $\triangle ABC \sim \triangle DEF$, $AB = 8$, $BC = 13$, $AC = 15$, and $DF = 20$. Find the perimeter of $\triangle DEF$. **9.** _____

10. $\triangle ABC \sim \triangle JKL$, $AB = 12$, $BC = 18.4$, $KL = 6.9$, and $JL = 5.6$. Find the scale factor of $\triangle ABC$ to $\triangle JKL$. **10.** _____

11. Find the value of y.



11. _____

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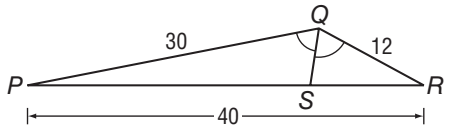
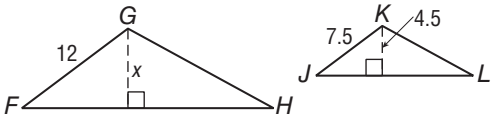
7 Chapter 7 Test, Form 3 *(continued)*

12. Find SR.



12. _____

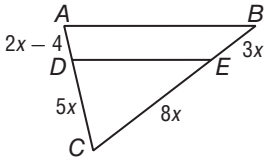
For Questions 13 and 14, $\triangle FGH \sim \triangle JKL$.



13. Find the value of x. **13.** _____

14. Find the ratio of the perimeter of $\triangle FGH$ to the perimeter of $\triangle JKL$. **14.** _____

15. Find AD so that $\overline{DE} \parallel \overline{AB}$.

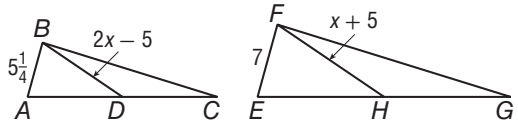


15. _____

16. A triangle with coordinates $A(0, 0)$, $B(4, 0)$, and $C(0, 4)$ is enlarged by a factor of 2. What are the coordinates of the image? **16.** _____

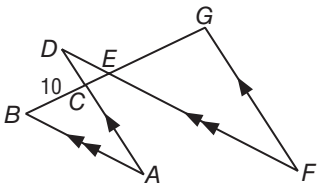
17. When a 15-foot tall climbing wall cast a 20-foot shadow, a building cast a 32-foot shadow. Find the height of the building. **17.** _____

18. If $\triangle ABC \sim \triangle EFG$ and $\overline{BD}$ and $\overline{FH}$ are medians, find BD.



18. _____

Bonus The ratio of the lengths of the sides of $\triangle ABC$ is $5:2\frac{1}{2}:4$. The scale factor of $\triangle ABC$ to $\triangle DEC$ is 5:2, and the scale factor of $\triangle DEC$ to $\triangle FEG$ is 1:4. $\overline{BC}$ is the shortest side and $\overline{AB}$ is the longest side of $\triangle ABC$. Find FG.



B: _____

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7 Chapter 7 Extended-Response Test

SCORE _____

Demonstrate your knowledge by giving a clear, concise solution to each problem. Be sure to include all relevant drawings and justify your answers. You may show your solution in more than one way or investigate beyond the requirements of the problem.

1. Write a possible proportion if the extremes are 3 and 10.

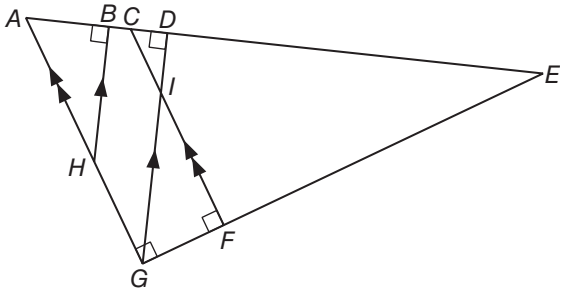
2. $\triangle ABC$ and $\triangle WXY$ are isosceles triangles.

a. Write a possible ratio for the sides of $\triangle ABC$ if its perimeter is 42 inches.

b. Name possible measures for the sides of $\triangle ABC$ using your answer to part **a**.

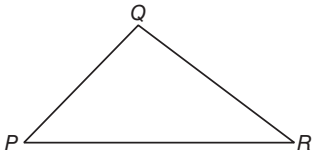
c. If $\triangle WXY$ has a perimeter of 28 and $\triangle ABC$ has sides with the measures you gave in part **b**, what must be the measure of the sides of $\triangle WXY$ so that $\triangle WXY \sim \triangle ABC$?

3. Write as many triangle similarity statements as possible for the figure below. How do you know that these triangles are similar?



4. Sketch two triangles that are *not* similar, but have one pair of corresponding angles congruent and two pairs of corresponding sides proportional. Label the corresponding angles and the proportional sides.

5. Draw $\triangle XYZ$ inside $\triangle PQR$ with half the perimeter of $\triangle PQR$. Explain your process and why it works.



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7 Standardized Test Practice

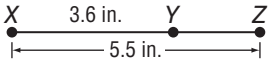
SCORE _____

(Chapters 1-7)

Part 1: Multiple Choice

Instructions: Fill in the appropriate circle for the best answer.

1. Find the length of $\overline{YZ}$. (Lesson 1-2)



A 1.9 in. **C** 7.2 in.
B 5.3 in. **D** 12.5 in.

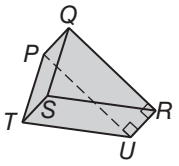
1. Ⓐ Ⓑ Ⓒ Ⓓ

2. **Given:** $3b + 4 < 16$
Conjecture: $b > 0$
Which of the following would be a counterexample? (Lesson 2-1)

F $b = -1$ **G** $b = 0$ **H** $b = 3.5$ **J** $b = 4$

2. Ⓕ Ⓖ Ⓗ Ⓙ

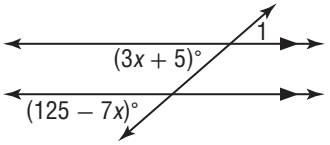
3. Find the plane that is parallel to plane PTU. (Lesson 3-1)



A plane QRU **C** plane PQS
B plane QRS **D** plane SPU

3. Ⓐ Ⓑ Ⓒ Ⓓ

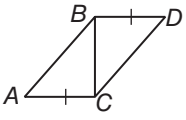
4. Find $m\angle 1$. (Lesson 3-2)



F 5 **H** 41
G 12 **J** 44

4. Ⓕ Ⓖ Ⓗ Ⓙ

5. Which statement *must* be true in order to prove $\triangle ABC \cong \triangle DCB$ by SAS? (Lesson 4-4)



A $\overline{CB}$ bisects $\angle ABD$.
B $\angle BCA \cong \angle CBD$
C $\angle BDC \cong \angle CAB$
D $\overline{AB} \cong \overline{BC}$

5. Ⓐ Ⓑ Ⓒ Ⓓ

6. In an indirect proof, you assume that the conclusion is false and then find a(n) ___?___. (Lesson 5-4)

F assumption **H** truth value
G contradiction **J** conditional statement

6. Ⓕ Ⓖ Ⓗ Ⓙ

7. Demont and Tony are competing to see whose house is the tallest. Early in the afternoon, Tony, who is 4 feet tall, measured his shadow to be 9.6 inches and the shadow of his house to be 62.4 inches. Later in the day, Demont, who is 5 feet tall, measured his shadow to be 15.6 inches and the shadow of his house to be 62.4 inches. Who lives in the taller house? (Lesson 7-3)

A Demont
B Both houses are the same height.
C Tony
D There is not enough information.

7. Ⓐ Ⓑ Ⓒ Ⓓ

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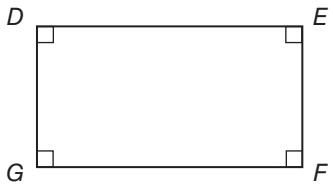
7 Standardized Test Practice *(continued)*

8. Find the coordinates of the midpoint of $\overline{AB}$ for $A(-24, 15)$ and $B(13, -31)$. (Lesson 1-3)

F $(-18.5, -23)$ **G** $(-11, -16)$ **H** $(-5.5, -8)$ **J** $(10.5, 23)$ **8.** Ⓕ Ⓖ Ⓗ Ⓙ

For Questions 9 and 10, use the figure at the right.



9. The perimeter of rectangle $DEFG$ is 176, $EF = h$, and $DE = 7h$. What is the value of h? (Lesson 1-6)

A 11 **C** 22
B 15 **D** 77

9. Ⓐ Ⓑ Ⓒ Ⓓ

10. What is the area of the rectangle $DEFG$? (Lesson 1-6)

F 88 units^2 **G** 225 units^2 **H** 513 units^2 **J** 847 units^2 **10.** Ⓕ Ⓖ Ⓗ Ⓙ

11. What is the slope-intercept form for the line $y + 7 = 4(x-10)$? (Lesson 3-4)

A $y = 4x - 47$ **B** $4x - y = 47$ **C** $4x = y + 17$ **D** $4\frac{x}{y} = 17$ **11.** Ⓐ Ⓑ Ⓒ Ⓓ

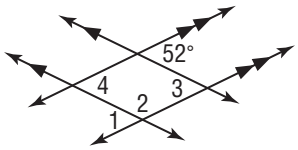
12. Which of the following is the equation of a line parallel to the line passing through $(4, -3)$ and $(8, 5)$? (Lesson 3-4)

F $y = x + 2$ **G** $2y = 9x + 4$ **H** $2y = 2x + 4$ **J** $y = 2x + 9$ **12.** Ⓕ Ⓖ Ⓗ Ⓙ

Part 2: Gridded Response

Instructions: Enter your answer by writing each digit of the answer in a column box and then shading in the appropriate circle that corresponds to that entry.

13. Find $m\angle 2$. (Lesson 3-2)



13.

	⊘	⊘	⊘	
⊙	⊙	⊙	⊙	⊙
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

14. $\triangle LMN$ is equilateral, LM is one more than three times a number, MN is nine less than five times the number, and NL is eleven more than the number. Find LM. (Lesson 4-1)

14.

	⊘	⊘	⊘	
⊙	⊙	⊙	⊙	⊙
0	0	0	0	0
1	1	1	1	1
2	2	2	2	2
3	3	3	3	3
4	4	4	4	4
5	5	5	5	5
6	6	6	6	6
7	7	7	7	7
8	8	8	8	8
9	9	9	9	9

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7 Standardized Test Practice *(continued)*

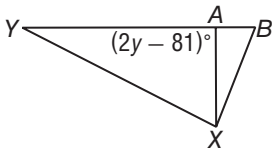
Part 3: Short Response

Instructions: Write your answers in the spaces provided.

15. Solve $\frac{-16}{40} = \frac{4x + 10}{5}$. (Lesson 7-1)

15. _____

16. $\overline{XA}$ is an altitude of $\triangle XYB$. Find the value of y. (Lesson 5-2)

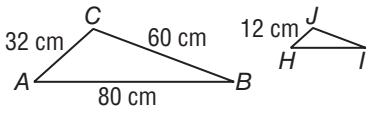


16. _____

17. Two sides of a triangle measure 21 inches and 32 inches, and the third side measures x inches. Find the range for the value of x. (Lesson 5-5)

17. _____

18. If $\triangle ABC \sim \triangle HIJ$, find the perimeter of $\triangle HIJ$. (Lesson 7-2)



18. _____

19. Given $T(3, -1)$, $U(1, -7)$, $V(8, -5)$, $W(2, 6)$, $X(-4, 8)$, and $Y(-2, 1)$, determine whether $\triangle TUV \cong \triangle WXY$. Explain. (Lesson 4-4)

19. _____

20. Two parallel lines are cut by a transversal, $\angle 1$ and $\angle 2$ are adjacent angles, $m\angle 1 = 12y + 10$, and $m\angle 2 = 20y - 34$. Find $m\angle 1$ and $m\angle 2$. (Lesson 3-2)

20 _____

21. Use points $S(-5, 7)$, $T(1, 9)$, $P(12, -1)$, and $R(3, 26)$.

a. Find the lengths of $\overline{ST}$ and $\overline{PR}$ to the nearest hundredth. (Lesson 1-3)

21a. _____

b. Determine the slope of $\overline{ST}$ and of $\overline{PR}$. (Lesson 3-3)

21b. _____

c. Are $\overline{ST}$ and $\overline{PR}$ *parallel*, *perpendicular*, or *neither*? (Lesson 3-3)

21c. _____

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7 Anticipation Guide

Proportions and Similarity

Step 1 ***Before you begin Chapter 7***

- Read each statement.
- Decide whether you Agree (A) or Disagree (D) with the statement.
- Write A or D in the first column OR if you are not sure whether you agree or disagree, write NS (Not Sure).

STEP 1 A, D, or NS	Statement	STEP 2 A or D
	1. Ratios are always written as fractions.	D
	2. A proportion is an equation stating that two ratios are equal.	A
	3. Two ratios are in proportion to each other only if their cross products are equal.	A
	4. If $\frac{a}{b} = \frac{c}{d}$, then $ad = bc$.	D
	5. The ratio of the lengths of the sides of similar figures is called the scale factor for the two figures.	A
	6. If one angle in a triangle is congruent to an angle in another triangle, then the two triangles are similar.	D
	7. If a line is parallel to one side of a triangle and intersects the other two sides in two distinct points, then the line separates the two sides into congruent segments.	D
	8. A segment whose endpoints are the midpoints of two sides of a triangle is parallel to the third side of the triangle.	A
	9. If two triangles are similar then their perimeters are equal.	D
	10. The medians of two similar triangles are in the same proportion as corresponding sides.	A

Step 2 ***After you complete Chapter 7***

- Reread each statement and complete the last column by entering an A or a D.
- Did any of your opinions about the statements change from the first column?
- For those statements that you mark with a D, use a piece of paper to write an example of why you disagree.

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7-1 Study Guide and Intervention

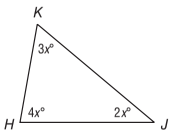
Ratios and Proportions

Write and Use Ratios A **ratio** is a comparison of two quantities by divisions. The ratio a to b, where b is not zero, can be written as $\frac{a}{b}$ or $a:b$.

Example 1 **In 2007 the Boston RedSox baseball team won 96 games out of 162 games played. Write a ratio for the number of games won to the total number of games played.**

To find the ratio, divide the number of games won by the total number of games played. The result is $\frac{96}{162}$, which is about 0.59. The Boston RedSox won about 59% of their games in 2007.

Example 2 **The ratio of the measures of the angles in $\triangle JHK$ is 2:3:4. Find the measures of the angles.**



The extended ratio 2:3:4 can be rewritten $2x:3x:4x$.

Sketch and label the angle measures of the triangle.
Then write and solve an equation to find the value of x.

$2x + 3x + 4x = 180$ Triangle Sum Theorem

$9x = 180$ Combine like terms.

$x = 20$ Divide each side by 9.

The measures of the angles are 2(20) or 40, 3(20) or 60, and 4(20) or 80.

Exercises

1. In the 2007 Major League Baseball season, Alex Rodriguez hit 54 home runs and was at bat 583 times. What is the ratio of home runs to the number of times he was at bat?
   $\frac{54}{583}$ or about 0.0926
2. There are 182 girls in the sophomore class of 305 students. What is the ratio of girls to total students?
   $\frac{182}{305}$
3. The length of a rectangle is 8 inches and its width is 5 inches. What is the ratio of length to width?
   $\frac{8}{5}$
4. The ratio of the sides of a triangle is 8:15:17. Its perimeter is 480 inches. Find the length of each side of the triangle.
   96 in., 180 in., 204 in.
5. The ratio of the measures of the three angles of a triangle is 7:9:20. Find the measure of each angle of the triangle.
   35, 45, 100

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Answers (Anticipation Guide and Lesson 7-1)

Answers

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7-1 Study Guide and Intervention *(continued)*

Ratios and Proportions

Use Properties of Proportions A statement that two ratios are equal is called a **proportion**. In the proportion $\frac{a}{b} = \frac{c}{d}$, where b and d are not zero, the values a and d are the **extremes** and the values b and c are the **means**. In a proportion, the product of the means is equal to the product of the extremes, so $ad = bc$. This is the Cross Product Property.

$$\frac{a}{b} = \frac{c}{d}$$
$$a \cdot d = b \cdot c$$
extremes, means

Example 1 Solve $\frac{9}{16} = \frac{27}{x}$.

$\frac{9}{16} = \frac{27}{x}$

$9 \cdot x = 16 \cdot 27$ Cross Products Property

$9x = 432$ Multiply.

$x = 48$ Divide each side by 9.

Example 2 **POLITICS Mayor Hernandez conducted a random survey of 200 voters and found that 135 approve of the job she is doing. If there are 48,000 voters in Mayor Hernandez's town, predict the total number of voters who approve of the job she is doing.**

Write and solve a proportion that compares the number of registered voters and the number of registered voters who approve of the job the mayor is doing.

$\frac{135}{200} = \frac{x}{48{,}000}$ ← voters who approve / ← all voters

$135 \cdot 48{,}000 = 200 \cdot x$ Cross Products Property

$6{,}480{,}000 = 200x$ Simplify.

$32{,}400 = x$ Divide each side by 200.

Based on the survey, about 32,400 registered voters approve of the job the mayor is doing.

Exercises

Solve each proportion.

1. $\frac{1}{2} = \frac{28}{x}$ **56**
2. $\frac{3}{8} = \frac{y}{24}$ **9**
3. $\frac{x+22}{x+2} = \frac{30}{10}$ **8**
4. $\frac{3}{18.2} = \frac{9}{y}$ **54.6**
5. $\frac{2x+3}{8} = \frac{5}{4}$ **3.5**
6. $\frac{x+1}{x-1} = \frac{3}{4}$ **−7**
7. If 3 DVDs cost $44.85, find the cost of one DVD. **$14.95**
8. **BOTANY** Bryon is measuring plants in a field for a science project. Of the first 25 plants he measures, 15 of them are smaller than a foot in height. If there are 4000 plants in the field, predict the total number of plants smaller than a foot in height.
   2400 plants

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7-1 Skills Practice

Ratios and Proportions

1. **FOOTBALL** A tight end scored 6 touchdowns in 14 games. Find the ratio of touchdowns per game.
   0.43:1
2. **EDUCATION** In a schedule of 6 classes, Marta has 2 elective classes. What is the ratio of elective to non-elective classes in Marta's schedule?
   1:2
3. **BIOLOGY** Out of 274 listed species of birds in the United States, 78 species made the endangered list. Find the ratio of endangered species of birds to listed species in the United States.
   39:137
4. **BOARD GAMES** Myra is playing a board game. After 12 turns, Myra has landed on a blue space 3 times. If the game will last for 100 turns, predict how many times Myra will land on a blue space.
   25
5. **SCHOOL** The ratio of male students to female students in the drama club at Campbell High School is 3:4. If the number of male students in the club is 18, predict the number of female students?
   24

Solve each proportion.

6. $\frac{2}{5} = \frac{x}{40}$ **16**
7. $\frac{7}{10} = \frac{21}{x}$ **30**
8. $\frac{20}{5} = \frac{4x}{6}$ **6**
9. $\frac{5x}{4} = \frac{35}{8}$ **3.5**
10. $\frac{x+1}{3} = \frac{7}{2}$ **9.5**
11. $\frac{15}{3} = \frac{x-3}{5}$ **28**
12. The ratio of the measures of the sides of a triangle is 3:5:7, and its perimeter is 450 centimeters. Find the measures of each side of the triangle.
    90 cm, 150 cm, 210 cm
13. The ratio of the measures of the sides of a triangle is 5:6:9, and its perimeter is 220 meters. What are the measures of the sides of the triangle?
    55 m, 66 m, 99 m
14. The ratio of the measures of the sides of a triangle is 4:6:8, and its perimeter is 126 feet. What are the measures of the sides of the triangle?
    28 ft, 42 ft, 56 ft
15. The ratio of the measures of the sides of a triangle is 5:7:8, and its perimeter is 40 inches. Find the measures of each side of the triangle.
    10 in., 14 in., 16 in.

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7-1 Practice

Ratios and Proportions

1. **NUTRITION** One ounce of cheddar cheese contains 9 grams of fat. Six of the grams of fat are saturated fats. Find the ratio of saturated fats to total fat in an ounce of cheese.
   2:3

2. **FARMING** The ratio of goats to sheep at a university research farm is 4:7. The number of sheep at the farm is 28. What is the number of goats?
   16

3. **QUALITY CONTROL** A worker at an automobile assembly plant checks new cars for defects. Of the first 280 cars he checks, 4 have defects. If 10,500 cars will be checked this month, predict the total number of cars that will have defects.
   150 cars

Solve each proportion.

4. $\frac{5}{8} = \frac{x}{12}$ **7.5**

5. $\frac{x}{1.12} = \frac{1}{5}$ **0.224**

6. $\frac{6x}{27} = 43$ **193.5**

7. $\frac{x+2}{3} = \frac{8}{9}$ $\frac{2}{3}$

8. $\frac{3x-5}{4} = \frac{-5}{7}$ $\frac{5}{7}$

9. $\frac{x-2}{4} = \frac{x+4}{2}$ **−10**

10. The ratio of the measures of the sides of a triangle is 3:4:6, and its perimeter is 104 feet. Find the measure of each side of the triangle.
    24 ft, 32 ft, 48 ft

11. The ratio of the measures of the sides of a triangle is 7:9:12, and its perimeter is 84 inches. Find the measure of each side of the triangle.
    21 in., 27 in., 36 in.

12. The ratio of the measures of the sides of a triangle is 6:7:9, and its perimeter is 77 centimeters. Find the measure of each side of the triangle.
    21 cm, 24.5 cm, 31.5 cm

13. The ratio of the measures of the three angles is 4:5:6. Find the measure of each angle of the triangle.
    48, 60, 72

14. The ratio of the measures of the three angles is 5:7:8. Find the measure of each angle of the triangle.
    45, 63, 72

15. **BRIDGES** A construction worker is placing rivets in a new bridge. He uses 42 rivets to build the first 2 feet of the bridge. If the bridge is to be 2200 feet in length, predict the number of rivets that will be needed for the entire bridge.
    46,200 rivets

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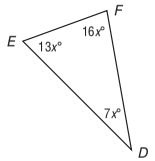
7-1 Word Problem Practice

Ratios and Proportions

1. **TRIANGLES** The ratios of the measures of the angles in $\triangle DEF$ is 7:13:16.



   Find the measure of the angles.
   35, 65, 80

2. **RATIONS** Sixteen students went on a week-long hiking trip. They brought with them 320 specially baked, protein-rich, cookies. What is the ratio of cookies to students?
   20:1

3. **CLOVERS** Nathaniel is searching for a four-leaf clover in a field. He finds 2 four-leaf clovers during the first 12 minutes of his search. If Nathaniel spends a total of 180 minutes searching in the field, predict the number of four-leaf clovers Nathaniel will find.
   30 clovers

4. **CARS** A car company builds two versions of one of its models—a sedan and a station wagon. The ratio of sedans to station wagons is 11:2. A freighter begins unloading the cars at a dock. Tom counts 18 station wagons and then overhears a dock worker call out, "Okay, that's all of the wagons . . . bring out the sedans!" How many sedans were on the ship?
   99

5. **DISASTER READINESS** The town of Oyster Bay is conducting a survey of 80 households to see how prepared its citizens are for a natural disaster. Of those households surveyed, 66 have a survival kit at home.

   a. Write the ratio of people with survival kits in the survey.
      $\frac{33}{40}$ **or 0.825**

   b. Write the ratio of people without survival kits in the survey.
      $\frac{7}{40}$ **or 0.175**

   c. There are 29,000 households in Oyster Bay. If the town wishes to purchase survival kits for all households that do not currently have one, predict the number of kits it will have to purchase.
      about 5075 kits

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Answers

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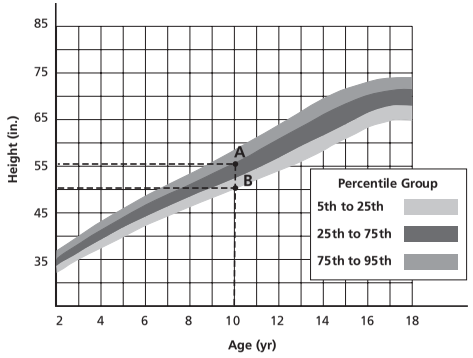
7-1 Enrichment

Growth Charts

It is said that when a child has reached the age of 2 years, he is roughly half of his adult height. The growth chart below shows the growth according to percentiles for boys.



1. Use the chart to determine the approximate height for a boy at age 2 if he is in the 75th to 95th percentile.

   35–37 inches

2. Using the rule that the height at age 2 is approximately half of his adult height, set up a proportion to solve for the adult height of the boy in Exercise 1. Solve your proportion.

   $\frac{36}{x} = \frac{1}{2}$; **72 inches**

3. Use the chart to approximate the height at age 18 for a boy if he is in the 75th to 95th percentile. How does this answer compare to the answer to problem 1?

   72–74 inches: the two answers are very close

4. Repeat this process for a boy who is in the 5th to 25th percentile.

   32–34 inches; 66 inches; 65–68 inches

5. Is using the rule that a boy is half of his adult height at age 2 years a good approximation? Explain.

   Yes, it appears to be a good approximation.

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7-1 Graphing Calculator Activity

Solving Proportions

You can use a calculator to solve proportions.

Example **Solve the proportion by using cross products. Round your answer to the nearest hundredth.**

$\frac{55.6}{16.9} = \frac{45.8}{x}$

Multiply 16.9 by 45.8. Divide the product by 55.6.

Enter: 16.9 × 45.8 ÷ 55.6 ENTER 13.92122302

The solution is approximately 13.92

Solve each proportion by using cross products. Round your answers to the nearest hundredth.

1. $\frac{13.9}{39.8} = \frac{10.5}{x}$ **x ≈ 30.06**

2. $\frac{25.9}{37.7} = \frac{24.3}{x}$ **x ≈ 35.37**

3. $\frac{19.6}{54.3} = \frac{27.7}{x}$ **x ≈ 76.74**

4. $\frac{66.8}{43.4} = \frac{x}{16.9}$ **x ≈ 26.01**

5. $\frac{75.4}{37.2} = \frac{x}{32.4}$ **x ≈ 65.67**

6. $\frac{x}{46.2} = \frac{29.7}{36.4}$ **x ≈ 37.70**

7. $\frac{x}{14.9} = \frac{16.8}{24.6}$ **x ≈ 10.18**

8. $\frac{35.8}{x} = \frac{32.9}{27.8}$ **x ≈ 30.25**

9. $\frac{46.9}{x} = \frac{15.7}{99.9}$ **x ≈ 298.43**

10. $\frac{34.9}{21.1} = \frac{x}{36.6}$ **x ≈ 60.54**

11. $\frac{x}{99.8} = \frac{32.2}{45.3}$ **x ≈ 70.94**

12. $\frac{68.9}{x} = \frac{44.3}{86.4}$ **x ≈ 134.38**

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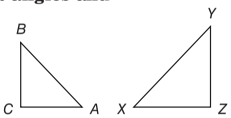
7-2 Study Guide and Intervention

Similar Polygons

Identify Similar Polygons Similar polygons have the same shape but not necessarily the same size.

Example 1 **If $\triangle ABC \sim \triangle XYZ$, list all pairs of congruent angles and write a proportion that relates the corresponding sides.**



Use the similarity statement.

Congruent angles: $\angle A \cong \angle X$, $\angle B \cong \angle Y$, $\angle C \cong \angle Z$

Proportion: $\frac{AB}{XY} = \frac{BC}{YZ} = \frac{CA}{ZX}$

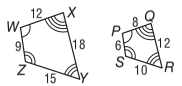
Example 2 **Determine whether the pair of figures is similar. If so, write the similarity statement and scale factor. Explain your reasoning.**

Step 1 Compare corresponding angles.

$\angle W \cong \angle P$, $\angle X \cong \angle Q$, $\angle Y \cong \angle R$, $\angle Z \cong \angle S$

Corresponding angles are congruent.

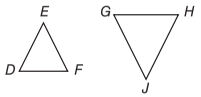
Step 2 Compare corresponding sides.



$\frac{WX}{PQ} = \frac{12}{8} = \frac{3}{2}$, $\frac{XY}{QR} = \frac{18}{12} = \frac{3}{2}$, $\frac{YZ}{RS} = \frac{15}{10} = \frac{3}{2}$, and $\frac{ZW}{SP} = \frac{9}{6} = \frac{3}{2}$. Since corresponding sides are proportional, $WXYZ \sim PQRS$. The polygons are similar with a scale factor of $\frac{3}{2}$.

Exercises

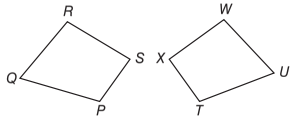
List all pairs of congruent angles, and write a proportion that relates the corresponding sides for each pair of similar polygons.



1. $\triangle DEF \sim \triangle GHJ$

   $\angle D \cong \angle G$, $\angle E \cong \angle J$, $\angle F \cong \angle H$; $\frac{DE}{GJ} = \frac{EF}{HJ} = \frac{FD}{HG}$

2. $PQRS \sim TUWX$

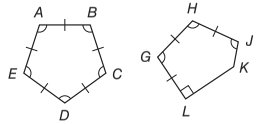


   $\angle P \cong \angle T$, $\angle Q \cong \angle U$, $\angle R \cong \angle W$, $\angle S \cong \angle X$;

   $\frac{PQ}{TU} = \frac{QR}{UW} = \frac{RS}{WX} = \frac{SP}{XT}$

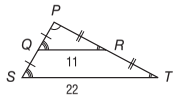
Determine whether each pair of figures is similar. If so, write the similarity statement and scale factor. If not, explain your reasoning.

3.



no, $\angle L \ncong \angle E$

4.



$\triangle PQR \sim \triangle PST$; scale factor $\frac{1}{2}$

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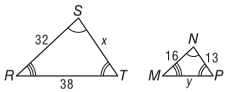
7-2 Study Guide and Intervention *(continued)*

Similar Polygons

Use Similar Figures You can use scale factors and proportions to find missing side lengths in similar polygons.

Example 1 **The two polygons are similar. Find x and y.**



Use the congruent angles to write the corresponding vertices in order.

$\triangle RST \sim \triangle MNP$

Write proportions to find x and y.

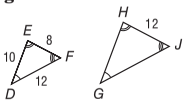
$\frac{32}{16} = \frac{x}{13}$ $\qquad$ $\frac{38}{y} = \frac{32}{16}$

$16x = 32(13)$ $\qquad$ $32y = 38(16)$

$x = 26$ $\qquad$ $y = 19$

Example 2 **If $\triangle DEF \sim \triangle GHJ$, find the scale factor of $\triangle DEF$ to $\triangle GHJ$ and the perimeter of each triangle.**

The scale factor is $\frac{EF}{HJ} = \frac{8}{12} = \frac{2}{3}$.



The perimeter of $\triangle DEF$ is $10 + 8 + 12$ or 30.

$\frac{2}{3} = \frac{\text{Perimeter of } \triangle DEF}{\text{Perimeter of } \triangle GHJ}$ Theorem 7.1

$\frac{2}{3} = \frac{30}{x}$ Substitution

$(3)(30) = 2x$ Cross Products Property

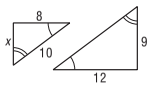
$45 = x$ Solve.

So, the perimeter of $\triangle GHJ$ is 45.

Exercises

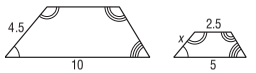
Each pair of polygons is similar. Find the value of x.

1.



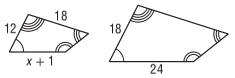
$x = 6$

2.



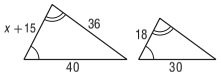
$x = 2.25$

3.



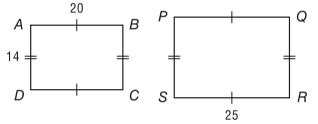
$x = 15$

4.



$x = 9$

5. If $ABCD \sim PQRS$, find the scale factor of $ABCD$ to $PQRS$ and the perimeter of each polygon.



scale factor $\frac{4}{5}$; perimeter $ABCD = 68$; perimeter $PQRS = 85$;

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Answers

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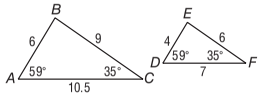
7-2 Skills Practice

Similar Polygons

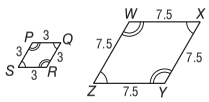
Determine whether each pair of figures is similar. If so, write the similarity statement and scale factor. If not, explain your reasoning.

1.



$\triangle ABC \sim \triangle DEF$; $\angle A \cong \angle D$, $\angle C \cong \angle F$, and $\angle B \cong \angle E$ by the Third Angle Theorem, and $\frac{AB}{DE} = \frac{BC}{EF} = \frac{CA}{FD}$; scale factor: $\frac{3}{2}$.

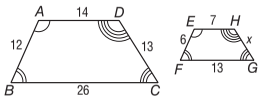
2.



rhombus $PQRS \sim$ rhombus $WXYZ$; $\angle P \cong \angle W$, $\angle Q \cong \angle X$, $\angle R \cong \angle Y$, $\angle S \cong \angle Z$; $\frac{PQ}{WX} = \frac{QR}{XY} = \frac{RS}{YZ} = \frac{SP}{ZW}$; scale factor: $\frac{3}{7.5} = 0.4$

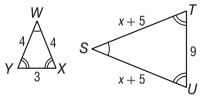
Each pair of polygons is similar. Find the value of x.

3.



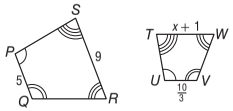
6.5

4.



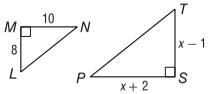
7

5.



5

6.



13

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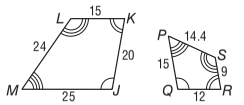
7-2 Practice

Similar Polygons

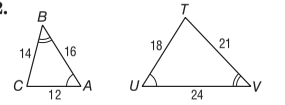
Determine whether each pair of figures is similar. If so, write the similarity statement and scale factor. If not, explain your reasoning.

1.



$JKLM \sim QRSP$; $\angle J \cong \angle Q$, $\angle K \cong \angle R$, $\angle L \cong \angle S$, $\angle M \cong \angle P$, and $\frac{JK}{QR} = \frac{KL}{RS} = \frac{LM}{SP} = \frac{MJ}{PQ} = \frac{5}{3}$ or 1.67

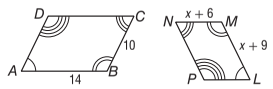
2.



$\triangle ABC \sim \triangle UVT$; $\angle A \cong \angle U$, $\angle B \cong \angle V$, and $\angle C \cong \angle T$ by the Third Angle Theorem and $\frac{AB}{UV} = \frac{BC}{VT} = \frac{CA}{TU} = \frac{2}{3}$.

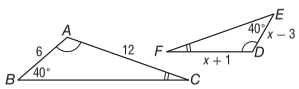
Each pair of polygons is similar. Find the value of x.

3.



$\frac{3}{2}$

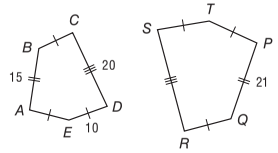
4.



7

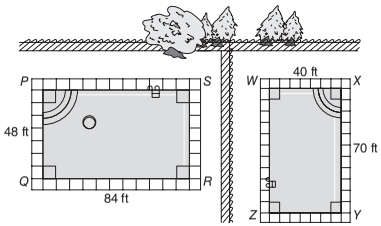
5. PENTAGONS If $ABCDE \sim PQRST$, find the scale factor of $ABCDE$ to $PQRST$ and the perimeter of each polygon.

scale factor $\frac{5}{7}$; perimeter $ABCDE = 65$; perimeter $PQRST = 91$



6. SWIMMING POOLS The Minnitte family and the neighboring Gaudet family both have in-ground swimming pools. The Minnitte family pool, $PQRS$, measures 48 feet by 84 feet. The Gaudet family pool, $WXYZ$, measures 40 feet by 70 feet. Are the two pools similar? If so, write the similarity statement and scale factor.

yes; $PQRS \sim WXYZ$; scale factor $\frac{6}{5}$



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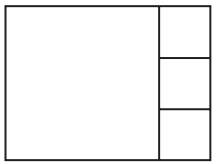
7-2 Word Problem Practice

Similar Polygons

1. **PANELS** When closed, an entertainment center is made of four square panels. The three smaller panels are congruent squares.

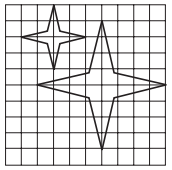


What is the scale factor of the larger square to one of the smaller squares?
3

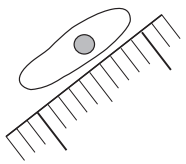
2. **WIDESCREEN TELEVISIONS** An electronics company manufactures widescreen television sets in several different sizes. The rectangular viewing area of each television size is similar to the viewing areas of the other sizes. The company's 42-inch widescreen television has a viewing area perimeter of approximately 144.4 inches. What is the viewing area perimeter of the company's 46-inch widescreen television?
about 158.2 inches

3. **ICE HOCKEY** An official Olympic-sized ice hockey rink measures 30 meters by 60 meters. The ice hockey rink at the local community college measures 25.5 meters by 51 meters. Are the ice hockey rinks similar? Explain your reasoning.
Yes; the ratio of the longer dimensions of the rinks is $\frac{20}{17}$ and the ratio of the smaller dimensions of the rinks is $\frac{20}{17}$.

4. **ENLARGING** Camille wants to make a pattern for a four-pointed star with dimensions twice as long as the one shown. Help her by drawing a star with dimensions twice as long on the grid below.



5. **BIOLOGY** A paramecium is a small single-cell organism. The paramecium magnified below is actually one tenth of a millimeter long.



a. If you want to make a photograph of the original paramecium so that its image is 1 centimeter long, by what scale factor should you magnify it?
100

b. If you want to make a photograph of the original paramecium so that its image is 15 centimeters long, by what scale factor should you magnify it?
1500

c. By approximately what scale factor has the paramecium been enlarged to make the image shown?
400

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7-2 Enrichment

Constructing Similar Polygons

Here are four steps for constructing a polygon that is similar to and with sides twice as long as those of an existing polygon.

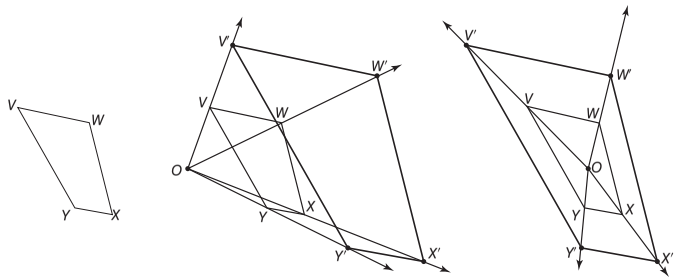
Step 1 Choose any point either inside or outside the polygon and label it O.

Step 2 Draw rays from O through each vertex of the polygon.

Step 3 For vertex V, set the compass to length OV. Then locate a new point V' on ray OV such that $VV' = OV$. Thus, $OV' = 2(OV)$.

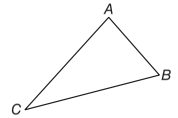
Step 4 Repeat Step 3 for each vertex. Connect points V', W', X' and Y' to form the new polygon.

Two constructions of polygons similar to and with sides twice those of $VWXY$ are shown below. Notice that the placement of point O does not affect the size or shape of $V'W'X'Y'$, only its location.

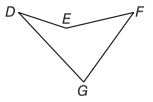


Trace each polygon. Then construct a similar polygon with sides twice as long as those of the given polygon. **See students' constructions.**

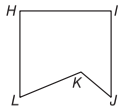
1.



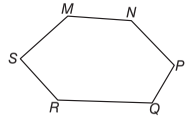
2.



3. Explain how to construct a similar polygon with sides three times the length of those of polygon $HIJKL$. Then do the construction. **See students' work.**



4. Explain how to construct a similar polygon $1\frac{1}{2}$ times the length of those of polygon $MNPQRS$. Then do the construction. **See students' work.**



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Answers

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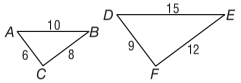
7-3 Study Guide and Intervention

Similar Triangles

Identify Similar Triangles Here are three ways to show that two triangles are similar.

AA Similarity	Two angles of one triangle are congruent to two angles of another triangle.
SSS Similarity	The measures of the corresponding side lengths of two triangles are proportional.
SAS Similarity	The measures of two side lengths of one triangle are proportional to the measures of two corresponding side lengths of another triangle, and the included angles are congruent.

Example 1 **Determine whether the triangles are similar.**



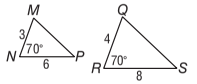
$\frac{AC}{DF} = \frac{6}{9} = \frac{2}{3}$

$\frac{BC}{EF} = \frac{8}{12} = \frac{2}{3}$

$\frac{AB}{DE} = \frac{10}{15} = \frac{2}{3}$

$\triangle ABC \sim \triangle DEF$ by SSS Similarity.

Example 2 **Determine whether the triangles are similar.**



$\frac{3}{4} = \frac{6}{8}$, so $\frac{MN}{QR} = \frac{NP}{RS}$.

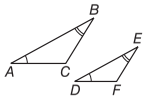
$m\angle N = m\angle R$, so $\angle N \cong \angle R$.

$\triangle NMP \sim \triangle RQS$ by SAS Similarity.

Exercises

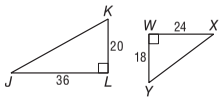
Determine whether the triangles are similar. If so, write a similarity statement. Explain your reasoning.

1.



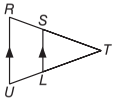
yes; $\triangle ABC \sim \triangle DEF$; AA Similarity

2.



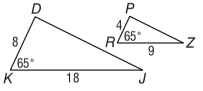
no; $\frac{36}{24} \neq \frac{20}{18}$

3.



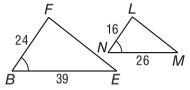
yes; $\triangle RTU \sim \triangle STL$; AA Similarity

4.



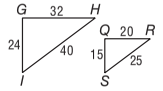
yes; $\triangle KDJ \sim \triangle RPZ$; SAS Similarity

5.



yes; $\triangle BFE \sim \triangle NLM$; SAS Similarity

6.



yes; $\triangle IGH \sim \triangle SQR$; SSS Similarity

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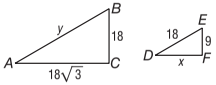
7-3 Study Guide and Intervention *(continued)*

Similar Triangles

Use Similar Triangles Similar triangles can be used to find measurements.

Example 1 **$\triangle ABC \sim \triangle DEF$. Find the values of x and y.**



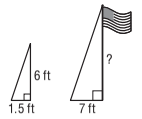
$\frac{AC}{DF} = \frac{BC}{EF}$ $\qquad$ $\frac{AB}{DE} = \frac{BC}{EF}$

$\frac{18\sqrt{3}}{x} = \frac{18}{9}$ $\qquad$ $\frac{y}{18} = \frac{18}{9}$

$18x = 9(18\sqrt{3})$ $\qquad$ $9y = 324$

$x = 9\sqrt{3}$ $\qquad$ $y = 36$

Example 2 **A person 6 feet tall casts a 1.5-foot-long shadow at the same time that a flagpole casts a 7-foot-long shadow. How tall is the flagpole?**



The sun's rays form similar triangles.

Using x for the height of the pole, $\frac{6}{x} = \frac{1.5}{7}$,

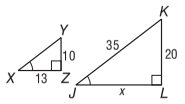
so $1.5x = 42$ and $x = 28$.

The flagpole is 28 feet tall.

Exercises

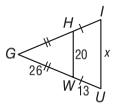
ALGEBRA Identify the similar triangles. Then find each measure.

1. JL



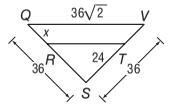
$\triangle XYZ \sim \triangle JKL$; 26

2. IU



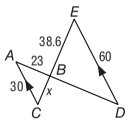
$\triangle GIU \sim \triangle GHW$; 30

3. QR



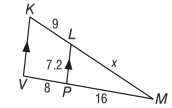
$\triangle SQV \sim \triangle SRT$; 12

4. BC



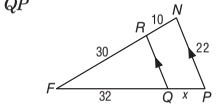
$\triangle BED \sim \triangle BCA$; 19.3

5. LM



$\triangle KVM \sim \triangle LPM$; 18

6. QP



$\triangle FRQ \sim \triangle FNP$; $10\frac{2}{3}$

7. The heights of two vertical posts are 2 meters and 0.45 meter. When the shorter post casts a shadow that is 0.85 meter long, what is the length of the longer post's shadow to the nearest hundredth? **3.78 m**

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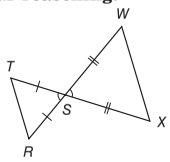
7-3 Skills Practice

Similar Triangles

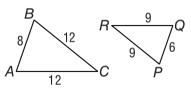
Determine whether each pair of triangles is similar. If so, write a similarity statement. If not, what would be sufficient to prove the triangles similar? Explain your reasoning.

1.



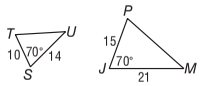
Yes; $\triangle RST \sim \triangle WSX$ (or $\triangle XSW$) SAS Similarity

2.



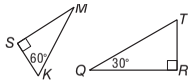
Yes; $\triangle ABC \sim \triangle PQR$ (or $\triangle QPR$) by SSS Similarity

3.



Yes; $\triangle STU \sim \triangle JPM$ by SAS Similarity

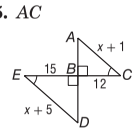
4.



Yes; $\triangle SKM \sim \triangle RTQ$ by AA Similarity

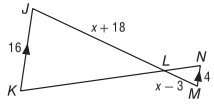
ALGEBRA Identify the similar triangles. Then find each measure.

5. AC



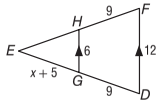
$\triangle ABC \sim \triangle DBE$; 16

6. JL



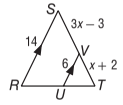
$\triangle JKL \sim \triangle MNL$; 28

7. EH



$\triangle DEF \sim \triangle GEH$; 9

8. VT



$\triangle RST \sim \triangle UVT$; 5.4

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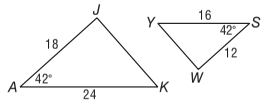
7-3 Practice

Similar Triangles

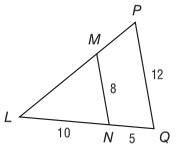
Determine whether the triangles are similar. If so, write a similarity statement. If not, what would be sufficient to prove the triangles similar? Explain your reasoning.

1.



yes; $\triangle JAK \sim \triangle WSY$; SAS Similarity

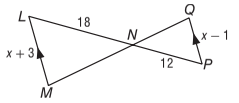
2.



No. The triangles would be similar by SAS or AA. If $\overline{MN} \parallel \overline{PQ}$.

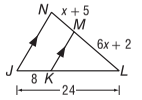
ALGEBRA Identify the similar triangles. Then find each measure.

3. LM, QP



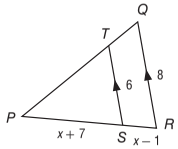
$\triangle LMN \sim \triangle PQN$; $ML = 12$; $QP = 8$

4. NL, ML



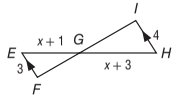
$\triangle JLN \sim \triangle KLM$; $LN = 21$; $LM = 14$

5.



$\triangle TPS \sim \triangle QPR$; $PS = 12$; $PR = 16$

6.



$\triangle EGF \sim \triangle HGI$; $EG = 6$; $HG = 8$

7. INDIRECT MEASUREMENT A lighthouse casts a 128-foot shadow. A nearby lamppost that measures 5 feet 3 inches casts an 8-foot shadow.

a. Write a proportion that can be used to determine the height of the lighthouse.

Sample answer: If x = height of lighthouse, $\frac{x}{5.25} = \frac{128}{8}$.

b. What is the height of the lighthouse? **84 ft**

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Answers

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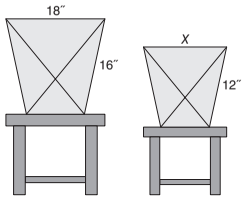
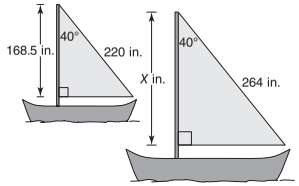
7-3 Word Problem Practice

Similar Triangles

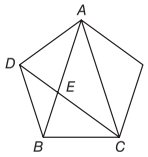
1. **CHAIRS** A local furniture store sells two versions of the same chair: one for adults, and one for children. Find the value of x such that the chairs are similar. **13.5 in.**



2. **BOATING** The two sailboats shown are participating in a regatta. Find the value of x. **202.2 in.**



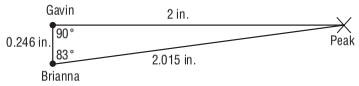
3. **GEOMETRY** Georgia draws a regular pentagon and starts connecting its vertices to make a 5-pointed star. After drawing three of the lines in the star, she becomes curious about two triangles that appear in the figure, $\triangle ABC$ and $\triangle CEB$. They look similar to her. Prove that this is the case.



Sample answer: $m\angle ADB = 108$, so $m\angle DBA = 36$ (base of isosceles $\triangle ABD$). Thus, $m\angle ABC = 72$. Similarly, $m\angle DCB = 36$ and $m\angle ACB = 72$. So, $m\angle BEC = 72$ and $m\angle BAC = 36$. Therefore, $\triangle ABC$ and $\triangle BCE$ are similar.

4. **SHADOWS** A radio tower casts a shadow 8 feet long at the same time that a vertical yardstick casts a shadow half an inch long. How tall is the radio tower?
576 ft

5. **MOUNTAIN PEAKS** Gavin and Brianna want to know how far a mountain peak is from their houses. They measure the angles between the line of site to the peak and to each other's houses and carefully make the drawing shown.



The actual distance between Gavin and Brianna's houses is $1\frac{1}{2}$ miles.

a. What is the actual distance of the mountain peak from Gavin's house? Round your answer to the nearest tenth of a mile.
12.2 mi

b. What is the actual distance of the mountain peak from Brianna's house? Round your answer to the nearest tenth of a mile.
12.3 mi

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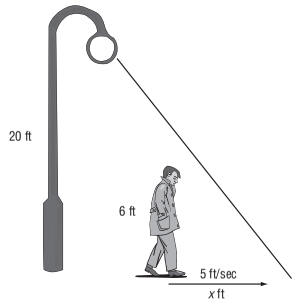
7-3 Enrichment

Moving Shadows

Have you ever watched your shadow as you walked along the street at night and observed how its shape changes as you move? Suppose a man who is 6 feet tall is standing below a lamppost that is 20 feet tall. The man is walking away from the lamppost at a rate of 5 feet per second.



1. If the man is moving at a rate of 5 feet per second, make a conjecture as to the rate that his shadow is moving.
Sample answer: His shadow is moving more quickly than he is.

2. How far away from the lamppost is the man after 8 seconds?
40 ft

3. How far is the end of his shadow from the bottom of the lamppost after 8 seconds? Use similar triangles to solve this problem.
57.14 ft

4. After 3 more seconds, how far from the lamppost is the man? How far from the lamppost is his shadow?
55 ft; 78.57 ft

5. How many feet did the man move in 3 seconds? How many feet did the shadow move in 3 seconds?
15 ft; 21.43 ft

6. The man is moving at a rate of 5 feet/second. What rate is his shadow moving? How does this rate compare to the conjecture you made in Exercise 1? Make a conjecture as to why the results are like this.
7.14 ft/s; Sample answer: The answer is consistent with the conjecture from Exercise 1. His shadow is getting longer as he moves further away from the lamppost.

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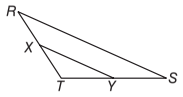
7-4 Study Guide and Intervention

Parallel Lines and Proportional Parts

Proportional Parts within Triangles In any triangle, a line parallel to one side of a triangle separates the other two sides proportionally. This is the Triangle Proportionality Theorem. The converse is also true.

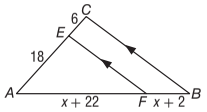


If $\overleftrightarrow{XY} \parallel \overleftrightarrow{RS}$, then $\frac{RX}{XT} = \frac{SY}{YT}$. If $\frac{RX}{XT} = \frac{SY}{YT}$, then $\overleftrightarrow{XY} \parallel \overleftrightarrow{RS}$.

If X and Y are the midpoints of $\overline{RT}$ and $\overline{ST}$, then $\overline{XY}$ is a **midsegment** of the triangle. The Triangle Midsegment Theorem states that a midsegment is parallel to the third side and is half its length.

If $\overline{XY}$ is a midsegment, then $\overleftrightarrow{XY} \parallel \overleftrightarrow{RS}$ and $XY = \frac{1}{2}RS$.

Example 1 **In $\triangle ABC$, $\overline{EF} \parallel \overline{CB}$. Find x.**



Since $\overline{EF} \parallel \overline{CB}$, $\frac{AF}{FB} = \frac{AE}{EC}$.

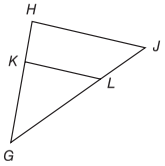
$\frac{x + 22}{x + 2} = \frac{18}{6}$

$6x + 132 = 18x + 36$

$96 = 12x$

$8 = x$

Example 2 **In $\triangle GHJ$, $HK = 5$, $KG = 10$, and JL is one-half the length of $\overline{LG}$. Is $\overline{HK} \parallel \overline{KL}$?**



Using the converse of the Triangle Proportionality Theorem, show that $\frac{HK}{KG} = \frac{JL}{LG}$.

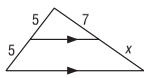
Let $JL = x$ and $LG = 2x$.

$\frac{HK}{KG} = \frac{5}{10} = \frac{1}{2}$ $\quad$ $\frac{JL}{LG} = \frac{x}{2x} = \frac{1}{2}$

Since $\frac{1}{2} = \frac{1}{2}$, the sides are proportional and $\overline{HJ} \parallel \overline{KL}$.

Exercises

ALGEBRA Find the value of x.

1. 

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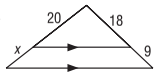
2. 

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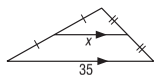
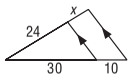
3. 

17.5

4. 

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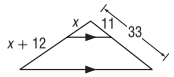
5. 

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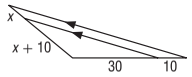
6. 

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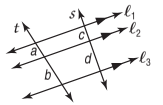
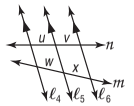
7-4 Study Guide and Intervention *(continued)*

Parallel Lines and Proportional Parts

Proportional Parts with Parallel Lines When three or more parallel lines cut two transversals, they separate the transversals into proportional parts. If the ratio of the parts is 1, then the parallel lines separate the transversals into congruent parts.





If $\ell_1 \parallel \ell_2 \parallel \ell_3$, then $\frac{a}{b} = \frac{c}{d}$.

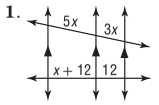
If $\ell_4 \parallel \ell_5 \parallel \ell_6$ and $\frac{u}{v} = 1$, then $\frac{w}{x} = 1$.

Example **Refer to lines ℓ_1, ℓ_2, and ℓ_3 above. If $a = 3$, $b = 8$, and $c = 5$, find d.**

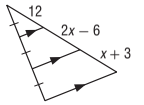
$\ell_1 \parallel \ell_2 \parallel \ell_3$ so $\frac{3}{8} = \frac{5}{d}$. Then $3d = 40$ and $d = 13\frac{1}{3}$.

Exercises

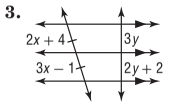
ALGEBRA Find x and y.

1. 

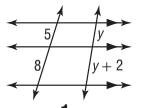
$x = 8$

2. 

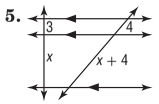
$x = 9$

3. 

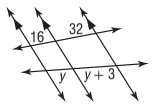
$x = 5; y = 2$

4. 

$y = 3\frac{1}{3}$

5. 

$x = 12$

6. 

$y = 3$

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Answers

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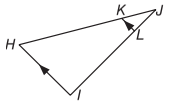
7-4 Skills Practice

Parallel Lines and Proportional Parts

1. If $JK = 7$, $KH = 21$, and $JL = 6$, find LI.



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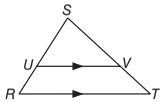
2. If $RU = 8$, $US = 14$, $TV = x - 1$, and $VS = 17.5$, find x and TV.



11; 10

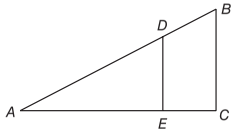
Determine whether $\overline{BC} \parallel \overline{DE}$. Justify your answer.

3. $AD = 15$, $DB = 12$, $AE = 10$, and $EC = 8$

yes; $\frac{AD}{DB} = \frac{AE}{EC} = \frac{5}{4}$

4. $BD = 9$, $BA = 27$, and $CE = \frac{1}{3}EA$

no; $\frac{BD}{DA} \neq \frac{CE}{EA}$

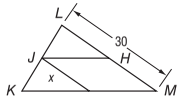


5. $AE = 30$, $AC = 45$, and $AD = 2DB$

yes; $\frac{AE}{EC} = \frac{AD}{DB} = \frac{2}{1}$

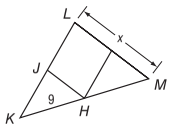
$\overline{JH}$ is a midsegment of $\triangle KLM$. Find the value of x.

6.



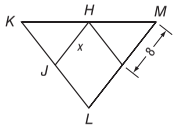
15

7.



18

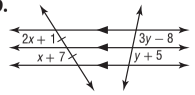
8.



8

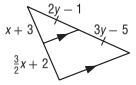
ALGEBRA Find x and y.

9.



$x = 6$, $y = 6.5$

10.



$x = 2$, $y = 4$

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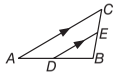
7-4 Practice

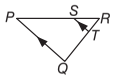
Parallel Lines and Proportional Parts

1. If $AD = 24$, $DB = 27$, and $EB = 18$, find CE.



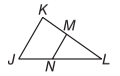
16

2. If $QT = x + 6$, $SR = 12$, $PS = 27$, and $TR = x - 4$, find QT and TR.



$QT = 18$; $TR = 8$

Determine whether $\overline{JK} \parallel \overline{NM}$. Justify your answer.



3. $JN = 18$, $JL = 30$, $KM = 21$, and $ML = 35$

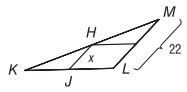
no; $\frac{18}{12} \neq \frac{21}{35}$

4. $KM = 24$, $KL = 44$, and $NL = \frac{5}{6}JN$

yes; $\frac{24}{20} = \frac{6}{5}$

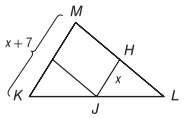
$\overline{JH}$ is a midsegment of $\triangle KLM$. Find the value of x.

5.



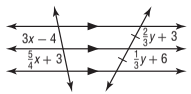
11

6.



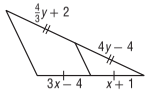
7

7. Find x and y.



$x = 4$, $y = 9$

8. Find x and y.



$x = \frac{5}{2}$, $y = \frac{9}{4}$

9. MAPS On a map, Wilmington Street, Beech Drive, and Ash Grove Lane appear to all be parallel. The distance from Wilmington to Ash Grove along Kendall is 820 feet and along Magnolia, 660 feet. If the distance between Beech and Ash Grove along Magnolia is 280 feet, what is the distance between the two streets along Kendall?

about 348 ft

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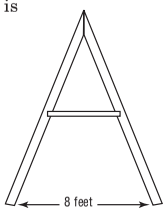
7-4 Word Problem Practice

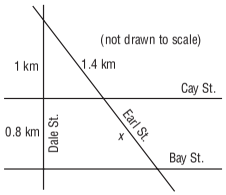
Parallel Lines and Proportional Parts

1. **CARPENTRY** Jake is fixing an A-frame. He wants to add a horizontal support beam halfway up and parallel to the ground. How long should this beam be?



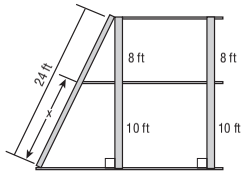
4 ft

2. **STREETS** In the diagram, Cay Street and Bay Street are parallel. Find x.



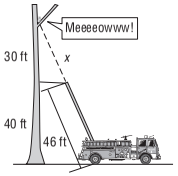
1.12 km

3. **JUNGLE GYMS** Prassad is building a two-story jungle gym according to the plans shown. Find x.



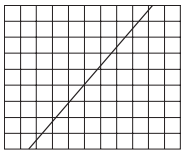
13 ft 4 in.

4. **FIREMEN** A cat is stuck in a tree and firemen try to rescue it. Based on the figure, if a fireman climbs to the top of the ladder, how far away is the cat?



34.5 ft

5. **EQUAL PARTS** Nick has a stick that he would like to divide into 9 equal parts. He places it on a piece of grid paper as shown. The grid paper is ruled so that vertical and horizontal lines are equally spaced.



a. Explain how he can use the grid paper to help him find where he needs to cut the stick.

Because he positioned the stick so that its ends are touching horizontal lines that are 9 units apart, he can cut the stick wherever other horizontal lines intersect it.

b. Suppose Nick wants to divide his stick into 5 equal parts utilizing the grid paper. What can he do?

He can rotate the stick so it touches horizontal lines 5 units apart and apply the same method.

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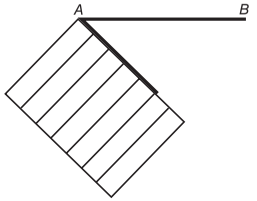
7-4 Enrichment

Parallel Lines and Congruent Parts

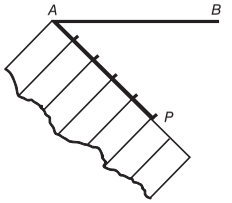
There is a theorem stating that if three parallel lines cut off congruent segments on one transversal, then they cut off congruent segments on any transversal. This can be shown for any number of parallel lines. The following drafting technique uses this fact to divide a segment into congruent parts.

$\overline{AB}$ to be separated into five congruent parts. This can be done very accurately without using a ruler. All that is needed is a compass and a piece of notebook paper.

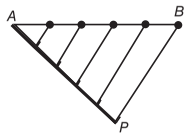
Step 1 Hold the corner of a piece of notebook paper at point A.



Step 2 From point A, draw a segment along the paper that is five spaces long. Mark where the lines of the notebook paper meet the segment. Label the fifth point P.



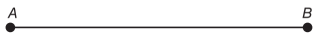
Step 3 Draw $\overline{PB}$. Through each of the other marks on $\overline{AP}$, construct a line parallel to $\overline{BP}$. The points where these lines intersect $\overline{AB}$ will divide $\overline{AB}$ into five congruent segments.



Use a compass and a piece of notebook paper to divide each segment into the given number of congruent parts.

See students' work.

1. six congruent parts

2. seven congruent parts 

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Answers

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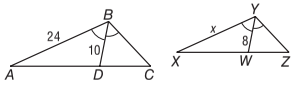
7-5 Study Guide and Intervention

Parts of Similar Triangles

Special Segments of Similar Triangles When two triangles are similar, corresponding altitudes, angle bisectors, and medians are proportional to the corresponding sides.

Example **In the figure, $\triangle ABC \sim \triangle XYZ$, with angle bisectors as shown. Find x.**



Since $\triangle ABC \sim \triangle XYZ$, the measures of the angle bisectors are proportional to the measures of a pair of corresponding sides.

$\frac{AB}{XY} = \frac{BD}{WY}$

$\frac{24}{x} = \frac{10}{8}$

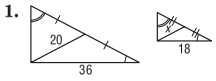
$10x = 24(8)$

$10x = 192$

$x = 19.2$

Exercises

Find x.

1. 

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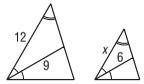
2. 

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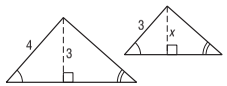
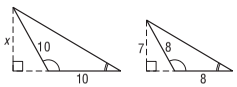
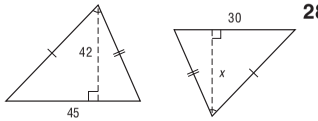
3. 

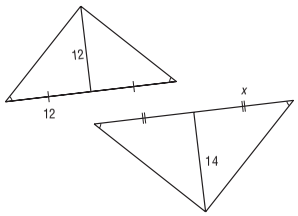
2.25

4. 

8.75

5. 

28

6. 

14

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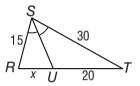
7-5 Study Guide and Intervention *(continued)*

Parts of Similar Triangles

Triangle Angle Bisector Theorem An angle bisector in a triangle separates the opposite side into two segments that are proportional to the lengths of the other two sides.

Example **Find x.**



Since $\overline{SU}$ is an angle bisector, $\frac{RU}{TU} = \frac{RS}{TS}$.

$\frac{x}{20} = \frac{15}{30}$

$30x = 20(15)$

$30x = 300$

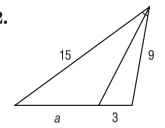
$x = 10$

Exercises

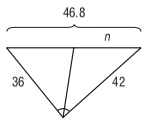
Find the value of each variable.

1.

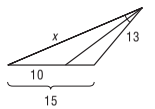
35

2. 

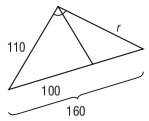
5

3. 

25.2

4. 

26

5. 

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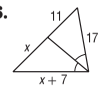
6. 

$12\frac{5}{6}$

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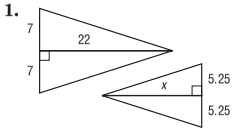
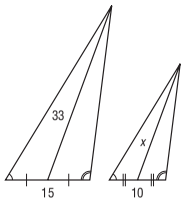
7-5 Skills Practice

Parts of Similar Triangles

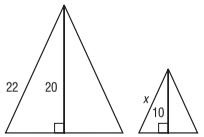
Find x.

1. 

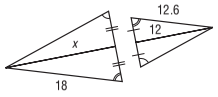
16.5

2. 

22

3. 

11

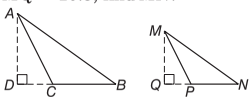
4. 

17.1

5. If $\triangle RST \sim \triangle EFG$, $\overline{SH}$ is an altitude of $\triangle RST$, $\overline{FJ}$ is an altitude of $\triangle EFG$, $ST = 6$, $SH = 5$, and $FJ = 7$, find FG.

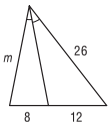
8.4

6. If $\triangle ABC \sim \triangle MNP$, $\overline{AD}$ is an altitude of $\triangle ABC$, $\overline{MQ}$ is an altitude of $\triangle MNP$, $AB = 24$, $AD = 14$, and $MQ = 10.5$, find MN.

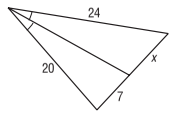


18

Find the value of each variable.

7. 

$17\frac{1}{3}$

8. 

8.4

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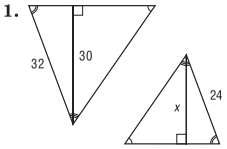
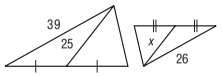
7-5 Practice

Parts of Similar Triangles

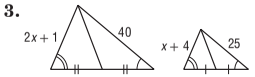
ALGEBRA Find x.

1. 

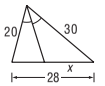
22.5

2. 

16.7

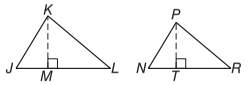
3. 

13.5

4. 

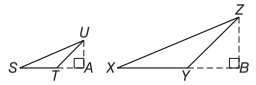
16.8

5. If $\triangle JKL \sim \triangle NPR$, $\overline{KM}$ is an altitude of $\triangle JKL$, $\overline{PT}$ is an altitude of $\triangle NPR$, $KL = 28$, $KM = 18$, and $PT = 15.75$, find PR.



24.5

6. If $\triangle STU \sim \triangle XYZ$, $\overline{UA}$ is an altitude of $\triangle STU$, $\overline{ZB}$ is an altitude of $\triangle XYZ$, $UT = 8.5$, $UA = 6$, and $ZB = 11.4$, find ZY.



16.15

7. **PHOTOGRAPHY** Francine has a camera in which the distance from the lens to the film is 24 millimeters.

   a. If Francine takes a full-length photograph of her friend from a distance of 3 meters and the height of her friend is 140 centimeters, what will be the height of the image on the film? (*Hint*: Convert to the same unit of measure.) **11.2 mm**

   b. Suppose the height of the image on the film of her friend is 15 millimeters. If Francine took a full-length shot, what was the distance between the camera and her friend? **2.24 m**

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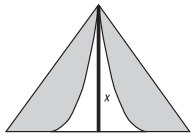
7-5 Word Problem Practice

Parts of Similar Triangles

1. **FLAGS** An oceanliner is flying two similar triangular flags on a flag pole. The altitude of the larger flag is three times the altitude of the smaller flag. If the measure of a leg on the larger flag is 45 inches, find the measure of the corresponding leg on the smaller flag.

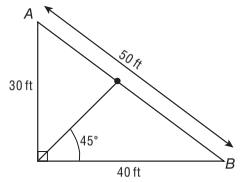
15 inches

2. **TENTS** Jana went camping and stayed in a tent shaped like a triangle. In a photo of the tent, the base of the tent is 6 inches and the altitude is 5 inches. The actual base was 12 feet long. What was the height of the actual tent?



10 ft

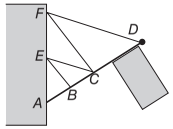
3. **PLAYGROUND** The playground at Hank's school has a large right triangle painted in the ground. Hank starts at the right angle corner and walks toward the opposite side along an angle bisector and stops when he gets to the hypotenuse.



How much farther from Hank is point B versus point A?

$7\frac{1}{7}$ ft

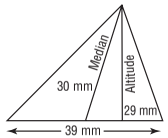
4. **FLAG POLES** A flag pole attached to the side of a building is supported with a network of strings as shown in the figure.



The rigging is done so that $AE = EF$, $AC = CD$, and $AB = BC$. What is the ratio of CF to BE?

2:1

5. **COPIES** Gordon made a photocopy of a page from his geometry book to enlarge one of the figures. The actual figure that he copied is shown below.



The photocopy came out poorly. Gordon could not read the numbers on the photocopy, although the triangle itself was clear. Gordon measured the base of the enlarged triangle and found it to be 200 millimeters.

a. What is the length of the drawn altitude of the enlarged triangle? Round your answer to the nearest millimeter.

149 mm

b. What is the length of the drawn median of the enlarged triangle? Round your answer to the nearest millimeter.

154 mm

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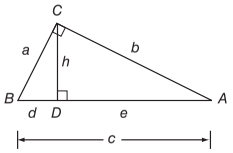
7-5 Enrichment

A Proof of Pythagorean Theorem

1. For right triangle ABC with right angle C, and altitude $\overline{CD}$ as shown at the right, name three similar triangles.

$\triangle ABC \sim \triangle ACD \sim \triangle CBD$



2. List the three similar triangles as headings in the table below. Use the figure to complete the table to list the corresponding parts of the three similar right triangles.

	$\triangle ABC$	$\triangle ACD$	$\triangle CBD$
Short Leg	a	h	d
Long Leg	b	e	h
Hypotenuse	c	b	a

3. Use the corresponding parts of these similar triangles and their proportions to complete the statements in the proof and algebraically prove the Pythagorean Theorem.

Statements	Reasons
1. Right triangle ABC with altitude $\overline{CD}$.	1. Given
2. $\frac{a}{c} = \frac{d}{a}, \frac{b}{c} = \frac{e}{b}$	2. Corresponding parts of similar triangles are in the same ratio.
3. $a^2 = cd, b^2 = ce$	3. Cross Products Property
4. $a^2 + b^2 = cd + b^2$	4. Addition Property of Equality
5. $a^2 + b^2 = cd + ce$	5. Substitution
6. $a^2 + b^2 = c(d + e)$	6. Distributive Property
7. $d + e = c$	7. Segment addition
8. $a^2 + b^2 = c^2$	8. Substitution

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7-5 Spreadsheet Activity

Fractals

You can use a spreadsheet to create a Sierpinski triangle.

Example **Use a spreadsheet to create a Sierpinski triangle.**

Step 1 In cell A2, enter 1. In cell A3, enter an equals sign followed by A2 + 1 . This will return the number of iterations. Click on the bottom right corner of cell A2 and drag it through cell A500 to get 500 iterations.

Step 2 In cell B1, enter 0.5. This indicates the midpoints of the segments.

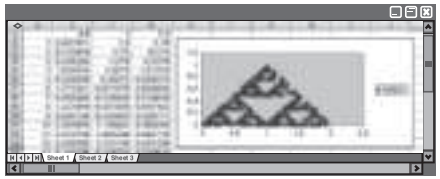
Step 3 In cell C1, enter 1 and in cell D1, enter 0.3.

Step 4 In cell B2, enter an equals sign followed by 3*RAND(). Click on the bottom right corner of cell B2 and drag in through cell B500 to get 500 iterations.

Step 5 In cell C2, enter an equals sign followed by the recursive formula IF(B2<1,(12$B$1)*C1,IF(B2<2,(1−$B$1)*C1+$B$1,(1−$B$1)*C1+2*$B$1)). This will return the x values of the points to be graphed. Click on the bottom right corner of cell C2 and drag through cell C500.

Step 6 In cell D2, enter an equals sign followed by the recursive formula IF(B2<1,(1−$B$1)*D1,IF(B2<2,(1−$B$1)*D1+$B$1,(1−$B$1)*D1)). This will return the y values of the points to be graphed. Click on the bottom right corner of cell D2 and drag through cell D500.

Step 7 To graph the values in columns C and D, first highlight all of the data in the two columns. Next, choose the chart wizard from the toolbar. Select XY (Scatter). Press Next, Next. Then select the Gridlines tab and uncheck the Major gridlines. Then press Next and Finish. This will return the Sierpinski triangle.



Exercises

Analyze your drawing.

1. What happens to your drawing if you have more iterations? Try 1000, 2000, and 5000.
   The picture looks sharper with more iterations.

2. Change the 0.5 to 2/3 in cell B1. (*Hint*: You may need to enter 0.666666 for 2/3.) How does this change the picture? **See students' work.**

3. Change 0.3 to 0.6 in cell D1. How does this change the drawing? **See students' work.**

4. Enter the following into a new spreadsheet and describe what you see.
   Step 1: In cell A2, enter the formula = A1.
   Step 2: In cell B2, enter the formula = A1 + B1.
   Step 3: Click on the bottom right corner of cell B2 and drag through cell L2.
   Step 4: First, click on the 2 next to cell A2. Then, click on the bottom left corner of 2 and drag down through cell 12.
   Step 5: In cell A1, enter a 1 and press ENTER. **Pascal's triangle**

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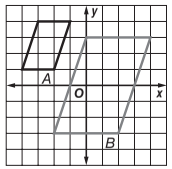
7-6 Study Guide and Intervention

Similarity Transformations

Identify Similarity Transformations A **dilation** is a transformation that enlarges or reduces the original figure proportionally. The **scale factor of a dilation**, k, is the ratio of a length on the image to a corresponding length on the preimage. A dilation with $k > 1$ is an **enlargement**. A dilation with $0 < k < 1$ is a **reduction**.

Example **Determine whether the dilation from A to B is an *enlargement* or a *reduction*. Then find the scale factor of the dilation.**

a.

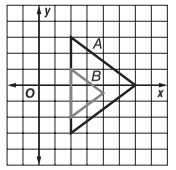


B is larger than A, so the dilation is an enlargement.

The distance between the vertices at $(-3, 4)$ and $(-1, 4)$ for A is 2. The distance between the vertices at $(0, 3)$ and $(4, 3)$ for B is 4.

The scale factor is $\frac{4}{2}$ or 2.

b.



B is smaller than A, so the dilation is a reduction.

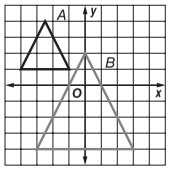
The distance between the vertices at (2, 3) and (2, −3) for A is 6. The distance between the vertices at (2, 1) and (2, −2) for B is 3.

The scale factor is $\frac{3}{6}$ or $\frac{1}{2}$.

Exercises

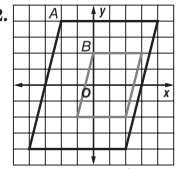
Determine whether the dilation from A to B is an *enlargement* or a *reduction*. Then find the scale factor of the dilation.

1.



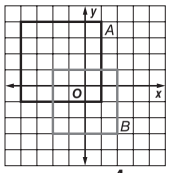
enlargement; 2

2.



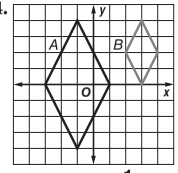
reduction; $\frac{1}{2}$

3.



reduction; $\frac{4}{5}$

4.



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

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Answers

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7-6 Study Guide and Intervention *(continued)*

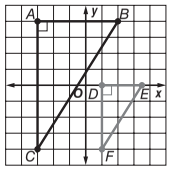
Similarity Transformations

Verify Similarity You can verify that a dilation produces a similar figure by comparing the ratios of all corresponding sides. For triangles, you can also use SAS Similarity.

Example **Graph the original figure and its dilated image. Then verify that the dilation is a similarity transformation.**

a. original: $A(-3, 4)$, $B(2, 4)$, $C(-3, -4)$
image: $D(1, 0)$, $E(3.5, 0)$, $F(1, -4)$

Graph each figure. Since $\angle A$ and $\angle D$ are both right angles, $\angle A \cong \angle D$. Show that the lengths of the sides that include $\angle A$ and $\angle D$ are proportional to prove similarity by SAS.



Use the coordinate grid to find the lengths of vertical segments AC and DF and horizontal segments AB and DE.

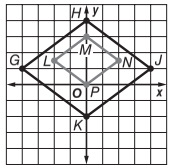
$\frac{AC}{DF} = \frac{8}{4} = 2$ and $\frac{AB}{DE} = \frac{5}{2.5} = 2$,

so $\frac{AC}{DF} = \frac{AB}{DE}$.

Since the lengths of the sides that include $\angle A$ and $\angle D$ are proportional, $\triangle ABC \sim \triangle DEF$ by SAS similarity.

b. original: $G(-4, 1)$, $H(0, 4)$, $J(4, 1)$, $K(0, -2)$
image: $L(-2, 1.5)$, $M(0, 3)$, $N(2, 1.5)$, $P(0, 0)$

Use the distance formula to find the length of each side.



$GH = \sqrt{4^2 + 3^2} = \sqrt{25} = 5$
$HJ = \sqrt{4^2 + 3^2} = \sqrt{25} = 5$
$JK = \sqrt{4^2 + 3^2} = \sqrt{25} = 5$
$KG = \sqrt{4^2 + 3^2} = \sqrt{25} = 5$
$LM = \sqrt{2^2 + 1.5^2} = \sqrt{6.25} = 2.5$
$MN = \sqrt{2^2 + 1.5^2} = \sqrt{6.25} = 2.5$
$NP = \sqrt{2^2 + 1.5^2} = \sqrt{6.25} = 2.5$
$PL = \sqrt{2^2 + 1.5^2} = \sqrt{6.25} = 2.5$

Find and compare the ratios of corresponding sides.

$\frac{GH}{LM} = \frac{5}{2.5} = 2$, $\frac{HJ}{MN} = \frac{5}{2.5} = 2$,

$\frac{JK}{NP} = \frac{5}{2.5} = 2$, $\frac{KC}{PL} = \frac{5}{2.5} = 2$.

Since $\frac{GH}{LM} = \frac{HJ}{MN} = \frac{JK}{NP} = \frac{KC}{PL}$, $GHJK \sim LMNP$.

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Exercises

Graph the original figure and its dilated image. Then verify that the dilation is a similarity transformation.

See students' work.

1. $A(-4, -3)$, $B(2, 5)$, $C(2, -3)$, $D(-2, -2)$, $E(1, 3)$, $F(1, -2)$

2. $P(-4, 1)$, $Q(-2, 4)$, $R(0, 1)$, $S(-2, -2)$, $W(1, -1.5)$, $X(2, 0)$, $Y(3, -1.5)$, $Z(2, -3)$

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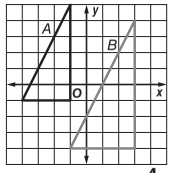
7-6 Skills Practice

Similarity Transformations

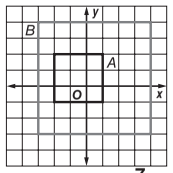
Determine whether the dilation from A to B is an *enlargement* or a *reduction*. Then find the scale factor of the dilation.

1.



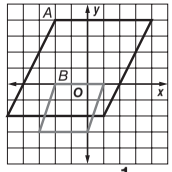
enlargement; $\frac{4}{3}$

2.



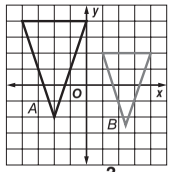
enlargement; $\frac{7}{3}$

3.



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

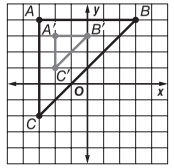
4.



reduction; $\frac{3}{4}$

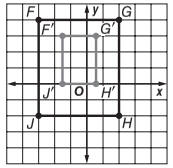
Graph the original figure and its dilated image. Then verify that the dilation is a similarity transformation.

5. $A(-3, 4)$, $B(3, 4)$, $C(-3, -2)$; $A'(-2, 3)$, $B'(0, 3)$, $C'(-2, 1)$



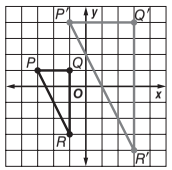
similar by SAS

6. $F(-3, 4)$, $G(2, 4)$, $H(2, -2)$, $J(-3, -2)$; $F'(-1.5, 3)$, $G'(1, 3)$, $H'(1, 0)$, $J'(-1.5, 0)$



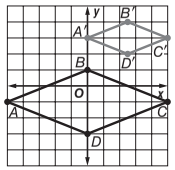
similar by proportional sides

7. $P(-3, 1)$, $Q(-1, 1)$, $R(-1, -3)$; $P'(-1, 4)$, $Q'(3, 4)$, $R'(3, -4)$



similar by SAS

8. $A(-5, -1)$, $B(0, 1)$, $C(5, -1)$, $D(0, -3)$; $A'(1, -1.5)$, $B'(2, 0)$, $C'(3, -1.5)$, $D'(2, -3)$



similar by proportional sides

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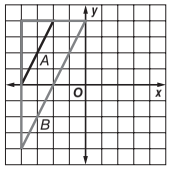
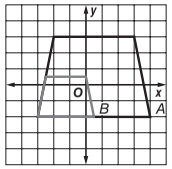
7-6 Practice

Similarity Transformations

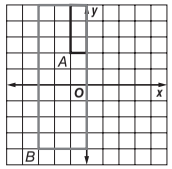
Determine whether the dilation from A to B is an *enlargement* or a *reduction*. Then find the scale factor of the dilation.

1. 

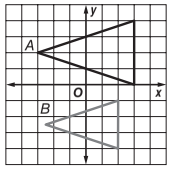
enlargement; 2

2. 

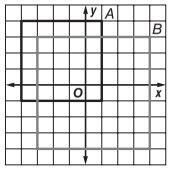
reduction; $\frac{1}{2}$

3. 

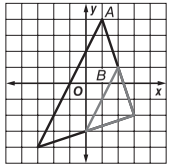
enlargement; 3

4. 

reduction; $\frac{3}{4}$

5. 

enlargement; $\frac{7}{5}$

6. 

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

Graph the original figure and its dilated image. Then verify that the dilation is a similarity transformation. **See students' work.**

7. $Q(1, 4)$, $R(4, 4)$, $S(4, -1)$, $X(-4, 5)$, $Y(2, 5)$, $Z(2, -5)$
Similar by SAS

8. $A(-4, 2)$, $B(0, 4)$, $C(4, 2)$, $D(0, -2)$, $F(-2, 1)$, $G(0, 2)$, $H(2, 1)$, $J(0, -1)$
Similar by proportional sides

9. **FABRIC** Ryan buys an 8-foot-long by 6-foot-wide piece of fabric as shown. He wants to cut a smaller, similar rectangular piece that has a scale factor of $k = \frac{1}{4}$. If point $A(-4, 3)$ is the top left-hand vertex of both the original piece of fabric and the piece Ryan wishes to cut out, what are the coordinates of the vertices for the piece Ryan will cut?
(−2, 3), (−2, 1.5), (−4, 1.5)

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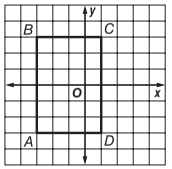
7-6 Word Problem Practice

Similarity Transformations

1. **CITY PLANNING** The standard size of a city block in Manhattan is 264 feet by 900 feet. The city planner of Mechlinburg wants to build a new subdivision using similar blocks so the dimensions of a standard Manhattan block are enlarged by 2.5 times. What will be the new dimensions of each enlarged block?
660 feet by 2250 feet

2. **STORAGE SHED** A local home improvement store sells different sizes of storage sheds. The most expensive shed has a footprint that is 15 feet wide by 21 feet long. The least expensive shed has a footprint that is 10 feet wide by 14 feet long. Are the footprints of the two sheds similar? If so, tell whether the footprints of the least expensive shed is an enlargement or a reduction, and find the scale factor from the most expensive shed to the least expensive shed.
yes; reduction; $\frac{2}{3}$

3. **FIND THE ERROR** Jeremy and Elisa are constructing dilations of rectangle $ABCD$ for their geometry class. Jeremy draws an enlargement $FGHJ$ that contains the points $F(-3, 3)$ and $J(3, -6)$. Elisa draws a reduction $KLMN$ that contains the points $L(-3, 3)$ and $N(-2, 2)$. Which person made an error in their dilation? Explain.



Elisa made the error; *KLMN* is not similar to the original *ABCD*.

4. **BANNERS** The Bayside High School Spirit Squad is making a banner to take to away games. The banner they use for home games is shown below. If the new banner is to be a reduction of the home game banner with a scale factor of $\frac{1}{2}$, what will be the height of the new banner?

1.75 ft

5. **REASONING** Consider the image $QRST$ of a rectangle $WXYZ$.

   a. Is it possible that point Q and point W could have the same coordinates? If so, what must be true about point Q?
   yes, point *Q* is the center of dilation.

   b. Is it possible that both points R and X could have the same coordinates if points T and Z have the same coordinates? If so, what are the possible values of the scale factor k for the dilation?
   yes; $k = 1$

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Answers

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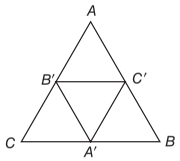
7-6 Enrichment

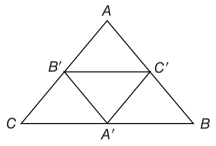
Medial and Orthic Triangles

The **medial triangle** is the triangle formed by connecting the midpoints of each side of the triangle. The triangle formed by A', B', and C' is the medial triangle of triangle ABC.

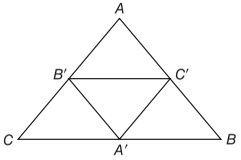


Use a ruler and compass. Draw the medial triangle for each triangle below.

1.



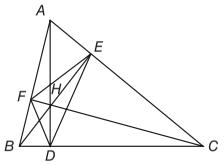
2.



3. Use the triangles you have created to show that the medial triangle is similar to the original triangle.

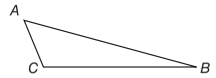
See students' work.

The **orthic triangle** is the triangle formed by connecting the endpoints of each of the altitudes of the triangle. The triangle formed by F, D, and, E is the orthic triangle of triangle ABC.

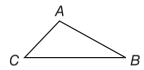


Use a ruler and compass. Draw the orthic triangle for each triangle below.

1.



2.



3. Use the triangles you have created to show that the orthic triangle is similar to the original triangle.

See students' work.

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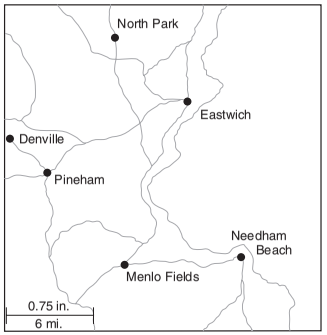
7-7 Study Guide and Intervention

Scale Drawings and Models

Scale Models A **scale model** or a **scale drawing** is an object or drawing with lengths proportional to the object it represents. The **scale** of a model or drawing is the ratio of the length of the model or drawing to the actual length of the object being modeled or drawn.

Example **MAPS The scale on the map shown is 0.75 inches : 6 miles. Find the actual distance from Pineham to Menlo Fields.**

Use a ruler. The distance between Pineham and Menlo Fields is about 1.25 inches.



Method 1: Write and solve a proportion.

Let x represent the distance between cities.

$\frac{0.75 \text{ in.}}{6 \text{ mi}} = \frac{1.25 \text{ in.}}{x \text{ mi}}$ ← map / ← actual

$0.75 \cdot x = 6 \cdot 1.25$ Cross Products Property

$x = 10$ Simplify.

Method 2: Write and solve an equation.

Let a = actual distance and m = map distance in inches. Write the scale as $\frac{6 \text{ mi}}{0.75 \text{ in.}}$, which is $6 \div 0.75$ or 8 miles per inch.

$a = 8 \cdot m$ Write an equation.

$= 8 \cdot 1.25$ $m = 1.25$ in.

$= 10$ Solve.

The distance between Pineham and Menlo Fields is 10 miles.

Exercises

Use the map above and a customary ruler to find the actual distance between each pair of cities. Measure to the nearest sixteenth of an inch.

1. Eastwich and Needham Beach **13 miles**
2. North Park and Menlo Fields **18 miles**
3. North Park and Eastwich **8 miles**
4. Denville and Pineham **4 miles**
5. Pineham and Eastwich **13 miles**

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7-7 Study Guide and Intervention *(continued)*

Scale Drawings and Models

Use Scale Factors The **scale factor** of a drawing or scale model is the scale written as a unitless ratio in simplest form. Scale factors are always written so that the model length in the ratio comes first.

Example **SCALE MODEL** **A doll house that is 15 inches tall is a scale model of a real house with a height of 20 feet.**

a. What is the scale of the model?

To find the scale, write the ratio of a model length to an actual length.

$$\frac{\text{model length}}{\text{actual length}} = \frac{15 \text{ in.}}{20 \text{ ft}} \text{ or } \frac{3 \text{ in.}}{4 \text{ ft}}$$

The scale of the model is 3 in.:4 ft

b. How many times as tall as the actual house is the model?

Multiply the scale factor of the model by a conversion factor that relates inches to feet to obtain a unitless ratio.

$$\frac{3 \text{ in.}}{4 \text{ ft}} = \frac{3 \text{ in.}}{4 \text{ ft}} \cdot \frac{1 \text{ ft}}{12 \text{ in.}} = \frac{3}{48} \text{ or } \frac{1}{16}$$

The scale factor is 1:16. That is, the model is $\frac{1}{16}$ as tall as the actual house.

Exercises

1. **MODEL TRAIN** The length of a model train is 18 inches. It is a scale model of a train that is 48 feet long. Find the scale factor. **1:32**

2. **ART** An artist in Portland, Oregon, makes bronze sculptures of dogs. The ratio of the height of a sculpture to the actual height of the dog is 2:3. If the height of the sculpture is 14 inches, find the height of the dog. **21 in.**

3. **BRIDGES** The span of the Benjamin Franklin suspension bridge in Philadelphia, Pennsylvania, is 1750 feet. A model of the bridge has a span of 42 inches. What is the ratio of the span of the model to the span of the actual Benjamin Franklin Bridge? **$\frac{1}{500}$**

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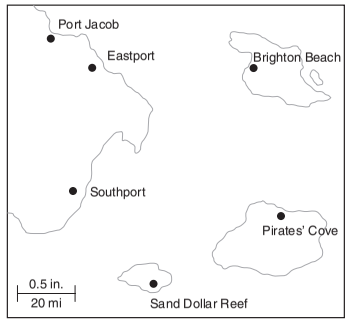
7-7 Skills Practice

Scale Drawings and Models

MAPS **Use the map shown and a customary ruler to find the actual distance between each pair of cities. Measure to the nearest sixteenth of an inch.**



1. Port Jacob and Southport
   $52\frac{1}{2}$ mi
2. Port Jacob and Brighton Beach
   $72\frac{1}{2}$ mi
3. Brighton Beach and Pirates' Cove
   50 mi
4. Eastport and Sand Dollar Reef
   $77\frac{1}{2}$ mi
5. **SCALE MODEL** Sanjay is making a 139 centimeters long scale model of the Parthenon for his World History class. The actual length of the Parthenon is 69.5 meters long.
   a. What is the scale of the model? **2 cm:1 m**
   b. How many times as long as the actual Parthenon is the model? **$\frac{1}{500}$**
6. **ARCHITECTURE** An architect is making a scale model of an office building he wishes to construct. The model is 9 inches tall. The actual office building he plans to construct will be 75 feet tall.
   a. What is the scale of the model? **3 in.:25 ft**
   b. What scale factor did the architect use to build his model? **1:100**
7. **WHITE HOUSE** Craig is making a scale drawing of the White House on an 8.5-by-11-inch sheet of paper. The White House is 168 feet long and 152 feet wide. Choose an appropriate scale for the drawing and use that scale to determine the drawing's dimensions. **1 in.:18 ft; $8\frac{4}{9}$ in. × $9\frac{1}{3}$ in.**
8. **GEOGRAPHY** Choose an appropriate scale and construct a scale drawing of each rectangular state to fit on a 3-by-5-inch index card.
   a. The state of Colorado is approximately 380 miles long (east to west) and 280 miles wide (north to south).
   1 in.:80 mi; drawing should be about 4.75 in. × 3.5 in.
   b. The state of Wyoming is approximately 365 miles long (east to west) and 265 miles wide (north to south).
   1 in.:75 mi; drawing should be about 4.87 in. × 3.53 in.

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Answers

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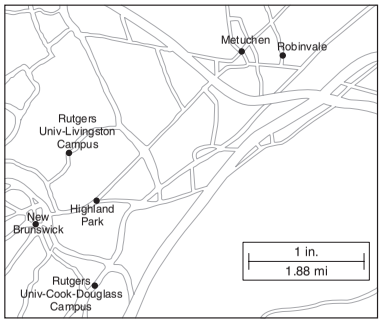
7-7 Practice

Scale Drawings and Models

MAPS Use the map of Central New Jersey shown and an inch ruler to find the actual distance between each pair of cities. Measure to the nearest sixteenth of an inch.



1. Highland Park and Metuchen
   about 4.465 miles

2. New Brunswick and Robinvale
   about 6.11 miles

3. Rutgers University Livingston Campus and Rutgers University Cook–Douglass Campus
   about 3.4075 miles

4. **AIRPLANES** William is building a scale model of a Boeing 747–400 aircraft. The wingspan of the model is approximately 8 feet 10 $\frac{1}{16}$ inches. If the scale factor of the model is approximately 1:24, what is the actual wingspan of a Boeing 747–400 aircraft?
   212.125 feet

5. **ENGINEERING** A civil engineer is making a scale model of a highway on ramp. The length of the model is 4 inches long. The actual length of the on ramp is 500 feet.
   a. What is the scale of the model? **1 in.:125 ft**
   b. How many times as long as the actual on ramp is the model? **1500**
   c. How many times as long as the model is the actual on ramp? **500**

6. **MOVIES** A movie director is creating a scale model of the Empire State Building to use in a scene. The Empire State Building is 1250 feet tall.
   a. If the model is 75 inches tall, what is the scale of the model? **3 in.:50 ft**
   b. How tall would the model be if the director uses a scale factor of 1:75?
      16 feet 8 inches

7. **MONA LISA** A visitor to the Louvre Museum in Paris wants to sketch a drawing of the *Mona Lisa,* a famous painting. The original painting is 77 centimeters by 53 centimeters. Choose an appropriate scale for the replica so that it will fit on a 8.5-by-11-inch sheet of paper. **1 in.:7 cm**

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7-7 Word Problem Practice

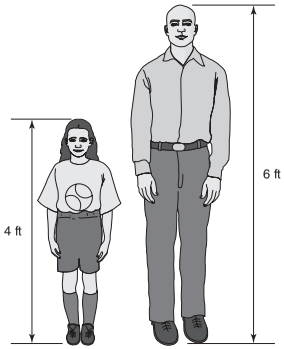
Scale Drawings and Models

1. **MODELS** Luke wants to make a scale model of a Boeing 747 jetliner. He wants every foot of his model to represent 50 feet. Complete the following table.

Part	Actual length (in.)	Model length (in.)
Wing Span	2537	**50.74**
Length	2782	**55.64**
Tail Height	392	**7.84**

(**Source:** Boeing)

2. **PHOTOGRAPHS** Tracy is 4 feet tall and her father is 6 feet tall. In a photograph of the two of them standing side by side, Tracy's image is 2 inches tall.



Although their images are much smaller, the ratio of their heights remains the same. How tall is Tracy's father's image in the photo? What is the scale of the photo?
1:24

3. **TOWERS** The Tokyo Tower in Japan is currently the world's tallest self-supporting steel tower. It is 333 meters tall.
   a. Heero builds a model of the Tokyo Tower that is 2775 millimeters tall. What is the scale of Heero's model?
      25 mm:3 m
   b. How many times as tall as the actual tower is the model? $\frac{1}{120}$

4. **PUPPIES** Meredith's new Pomeranian puppy is 7 inches tall and 9 inches long. She wants to make a drawing of her new Pomeranian to put in her locker. If the sheet of paper she is using is 3 inches by 5 inches, find an appropriate scale factor for Meredith to use in her drawing.
   1:2.5 or 2:5 (answers may vary, but should be at least greater than 1:2.34)

5. **MAPS** Carlos makes a map of his neighborhood for a presentation. The scale of his map is 1 inch:125 feet.
   a. How many feet do 4 inches represent on the map?
      500 ft
   b. Carlos lives 250 feet away from Andrew. How many inches separate Carlos' home from Andrew's on the map?
      2 in.
   c. During a practice run in front of his parents, Carlos realizes that his map is far too small. He decides to make his map 5 times as large. What would be the scale of the larger map?
      1 in.:25 ft

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7-7 Enrichment

Area and Volume of Scale Models and Drawings

You have already learned about changes of length measures between scale models and the object that is being modeled. The areas and volumes of scale models and drawings also change, but by multiples different than the "scale factor."

Example **Yuan is making a scale model of a cylinder. The actual cylinder has a radius of r inches and a height of h inches. The scale factor of the model is 1:2. What is the ratio of volumes of the model cylinder to the actual cylinder?**

The volume formula for a cylinder is $V = \pi r^2 h$. The actual cylinder's volume is $\pi r^2 h$.

If the cylinder is scaled down by a factor of 1:2, the new radius will be $\frac{1}{2}r$ and the new height will be $\frac{1}{2}h$.

$$V = \pi\left(\frac{1}{2}r\right)^2\left(\frac{1}{2}h\right)$$
$$= \frac{1}{8}\pi r^2 h$$

The model's volume is $\frac{1}{8}$ of the actual volume.

Exercises

1. Consider a painting on a 22-inch-by-28-inch canvas. Suppose you wish to make a 1:2 scale model of the painting for art class. What is the ratio of areas of the model painting to the actual painting?
   (Area = Length × Width) **$\frac{1}{4}$**

2. The Parks and Recreation Office is planning a new circular playground with a radius of 30 feet. Before they can construct the playground, they ask an architect to create a 1:20 scale model of the proposed playground such that the new radius is 1.5 feet. What is the ratio of areas of the model playground to the proposed actual playground?
   (Area = π × (radius)^2) **$\frac{1}{400}$**

3. A refrigerator manufacturer uses a 7-foot-by-3-foot-by-3-foot box for its standard model. The marketing team suggests the manufacturer start selling a smaller, lower-priced refrigerator with a scale factor of 4:5 to the standard model. If the box is reduced by a similar scale, what is the ratio of volumes of the new, smaller box to the current box?
   (Volume = length × width × height) **$\frac{64}{125}$**

4. Consider a cube with side lengths x. If each side of the cube is scaled by a factor of 1:y, what is the ratio of volumes of the model cube to the actual cube?
   (Volume = length × width × height) **$\left(\frac{1}{y}\right)^3$**

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Answers

Chapter 7 Assessment Answer Key

Quiz 1 (Lessons 7-1 and 7-2)
Page 51

1. 20, 65, 95

2. 276 students

3. $\triangle BAC \sim \triangle QPR$ or $\triangle ABC \sim \triangle QPR$ by SAS.

4. $x = 4$; scale factor 5:4

5. B

Quiz 2 (Lessons 7-3 and 7-4)
Page 51

1. yes; AA

2. No; the sides are not proportional.

3. $\triangle ABD \sim \triangle CDE$ or $\triangle ADB \sim \triangle CDF$; 8

4. Not parallel because $\frac{JM}{MK} \neq \frac{JN}{NL}$

5. 20

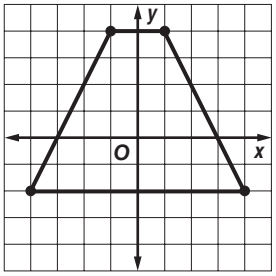
Quiz 3 (Lessons 7-5 and 7-6)
Page 52

1. 2.3 cm

2. corresp. altitudes are proportional to the corresp. sides

3. 5.3 cm

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

5. 

Quiz 4 (Lesson 7-7)
Page 52

1. 2:5

2. 33 in.

3. 1:3.5

4. D

Mid-Chapter Test
Page 53

1. B

2. J

3. C

4. J

5. B

6. No; SAS does not apply.

7. yes; SAS

8. Not parallel because $\frac{JM}{MK} \neq \frac{JN}{LN}$

9. 9

10. 2.9 in.

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Chapter 7 Assessment Answer Key

Vocabulary Test
Page 54

1. ratio
2. scale factor
3. midsegment of a triangle
4. extremes
5. means
6. false; similar polygons
7. false; proportion
8. true
9. Sample answer: product of means is equal to product of extremes
10. Sample answer: a segment with endpoints that are the midpoints of any two sides of a triangle

Form 1
Page 55

1. A
2. J
3. B
4. G
5. B
6. J
7. B
8. H
9. A
10. G

Page 56

11. D
12. J
13. B
14. F
15. B
16. G
17. D
18. H
19. D

B: 9.6

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Chapter 7 Assessment Answer Key

Form 2A

Page 57

1. A
2. F
3. D
4. H
5. B
6. H
7. C
8. F
9. C
10. G

Page 58

11. D
12. J
13. B
14. G
15. C
16. F
17. A
18. J

B: 32

Form 2B

Page 59

1. A
2. H
3. B
4. J
5. B
6. G
7. D
8. G
9. B
10. H

Page 60

11. D
12. F
13. C
14. J
15. B
16. F
17. D
18. H

B: 26

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Chapter 7 Assessment Answer Key

Form 2C

Page 61

1. 3:7
2. Yes; corres. $\measuredangle$s are $\cong$.
3. 30 ft
4. 18
5. 42.5 ft
6. 6.3
7. 18.2
8. Yes. The right angles are congruent. The legs are proportional. By SAS similarity, the triangles are similar.
9. 72
10. $\triangle PQR \sim \triangle STR$
11. $2\frac{1}{2}$

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12. 9.5
13. 42
14. 47
15. 2
16. 3
17. 14.4
18. 4

B: 7

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Chapter 7 Assessment Answer Key

Form 2D
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1. 5:11

2. No; the corresponding sides are not proportional.

3. 48 ft

4. $\frac{4}{3}$

5. $188\frac{1}{3}$ ft

6. 5.5

7. 15

8. No. The legs of the right triangles are not proportional.

9. 75

10. $\triangle XYZ \sim \triangle XNM$

11. 7.5

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12. 2.2

13. 96

14. 85

15. 9.5

16. 2

17. $5\frac{5}{8}$

18. 28

B: 4.8

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Chapter 7 Assessment Answer Key

Form 3

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1. 4:3

2. No; corr. sides are not proportional.

3. yes; SAS

4. 30 cm by 7.5 cm

5. 5.85

6. 5

7. 104 in.

8. 82

9. 48

10. $\frac{8}{3}$

11. 5

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12. $11\frac{3}{7}$

13. 7.2

14. $\frac{8}{5}$

15. 60

16. (0, 0), (8, 0), (0, 8)

17. 24 ft

18. 9

B: 25.6

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Chapter 7 Assessment Answer Key

Extended-Response Test, Page 67
Scoring Rubric

Score	General Description	Specific Criteria
4	**Superior** A correct solution that is supported by well-developed, accurate explanations	• Shows thorough understanding of the concepts of *ratios, properties of proportions, similar figures, similar triangles, dividing segments into parts, proportional parts of triangles, corresponding perimeters and altitudes.* • Uses appropriate strategies to solve problems. • Computations are correct. • Written explanations are exemplary. • Figures are accurate and appropriate. • Goes beyond requirements of some or all problems.
3	**Satisfactory** A generally correct solution, but may contain minor flaws in reasoning or computation	• Shows an understanding of the concepts of *ratios, properties of proportions, similar figures, similar triangles, dividing segments into parts, proportional parts of triangles, corresponding perimeters and altitudes.* • Uses appropriate strategies to solve problems. • Computations are mostly correct. • Written explanations are effective. • Figures are mostly accurate and appropriate. • Satisfies all requirements of problems.
2	**Nearly Satisfactory** A partially correct interpretation and/or solution to the problem	• Shows an understanding of most of the concepts of *ratios, properties of proportions, similar figures, similar triangles, dividing segments into parts, proportional parts of triangles, corresponding perimeters and altitudes.* • May not use appropriate strategies to solve problems. • Computations are mostly correct. • Written explanations are satisfactory. • Figures are mostly accurate. • Satisfies the requirements of most of the problems.
1	**Nearly Unsatisfactory** A correct solution with no supporting evidence or explanation	• Final computation is correct. • No written explanations or work is shown to substantiate the final computation. • Figures may be accurate but lack detail or explanation. • Satisfies minimal requirements of some of the problems.
0	**Unsatisfactory** An incorrect solution indicating no mathematical understanding of the concept or task, or no solution is given	• Shows little or no understanding of most of the concepts of *ratios, properties of proportions, similar figures, similar triangles, dividing segments into parts, proportional parts of triangles, corresponding perimeters and altitudes*. • Does not use appropriate strategies to solve problems. • Computations are incorrect. • Written explanations are unsatisfactory. • Figures are inaccurate or inappropriate. • Does not satisfy requirements of problems. • No answer may be given.

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Chapter 7 Assessment Answer Key

Extended-Response Test, Page 67
Sample Answers

In addition to the scoring rubric found on page A30, the following sample answers may be used as guidance in evaluating open-ended assessment items.

1. $\frac{10}{6} = \frac{5}{3}$ or $\frac{10}{2} = \frac{15}{3}$

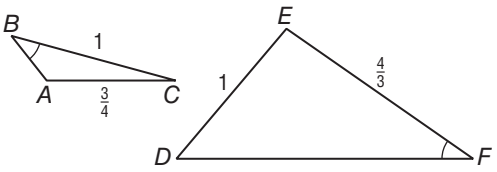
2a. 3:2:2 (Note: Check to be sure that the sum of any two sides of the triangle is greater than the third side. For example, a ratio of 1:1:2 would not be acceptable.)

2b. 18, 12, 12

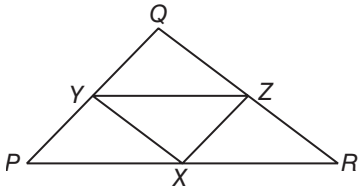
2c. 12, 8, 8

3. $\triangle ABH \sim \triangle CDI \sim \triangle GFI \sim \triangle ADG \sim \triangle GDE \sim \triangle CFE \sim \triangle AGE$ by the AA Postulate.

4.



5. Mark the midpoint of each side of $\triangle PQR$. Connect these points to form $\triangle XYZ$. Since each segment of $\triangle XYZ$ is a midsegment of $\triangle PQR$, its length will be half the corresponding side, and therefore the perimeter will be half the perimeter of $\triangle PQR$.



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Chapter 7 Assessment Answer Key

Standardized Test Practice

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1. ● Ⓑ Ⓒ Ⓓ

2. Ⓕ Ⓖ Ⓗ ●

3. Ⓐ ● Ⓒ Ⓓ

4. Ⓕ Ⓖ ● Ⓙ

5. Ⓐ ● Ⓒ Ⓓ

6. Ⓕ ● Ⓗ Ⓙ

7. Ⓐ Ⓑ ● Ⓓ

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8. Ⓕ Ⓖ ● Ⓙ

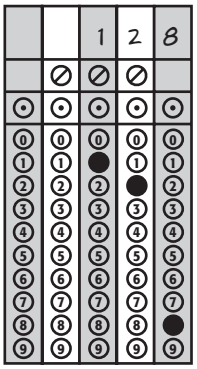
9. ● Ⓑ Ⓒ Ⓓ

10. Ⓕ Ⓖ Ⓗ ●

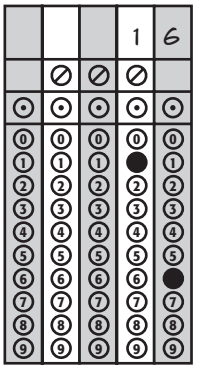
11. ● Ⓑ Ⓒ Ⓓ

12. Ⓕ Ⓖ Ⓗ ●

13.



14.



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Standardized Test Practice *(continued)*
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15. -3

16. 85.5

17. $11 < x < 53$

18. 64.5 cm

19. congruent;
$TU = WX = \sqrt{40}$
$UV = XY = \sqrt{53}$
$VT = YU = \sqrt{41}$

20 $m\angle 1 = 86.5$,
$m\angle 2 = 93.5$

21a. $ST = 6.32$,
$PR = 28.46$

21b. slope of $\overline{ST} = \frac{1}{3}$,
slope of $\overline{PR} = -3$

21c. perpendicular

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