4.1 Apply Triangle Sum Properties

Before You classified angles and found their measures.
Now You will classify triangles and find measures of their angles.
Why? So you can place actors on stage, as in Ex. 40.

Key Vocabulary
- **triangle** scalene, isosceles, equilateral, acute, right, obtuse, equiangular
- **interior angles**
- **exterior angles**
- **corollary to a theorem**

A **triangle** is a polygon with three sides. A triangle with vertices A, B, and C is called "triangle ABC" or "$\triangle ABC$."

COMMON CORE

CC.9-12.G.CO.10 Prove theorems about triangles.

READ VOCABULARY
Notice that an equilateral triangle is also isosceles. An equiangular triangle is also acute.

KEY CONCEPT *For Your Notebook*

Classifying Triangles by Sides

Scalene Triangle	Isosceles Triangle	Equilateral Triangle
No congruent sides	At least 2 congruent sides	3 congruent sides

Classifying Triangles by Angles

Acute Triangle	Right Triangle	Obtuse Triangle	Equiangular Triangle
3 acute angles	1 right angle	1 obtuse angle	3 congruent angles

EXAMPLE 1 **Classify triangles by sides and by angles**

SUPPORT BEAMS Classify the triangular shape of the support beams in the diagram by its sides and by measuring its angles.

Solution

The triangle has a pair of congruent sides, so it is isosceles. By measuring, the angles are 55°, 55°, and 70°. It is an acute isosceles triangle.

(t), Nancy Sheehan/PhotoEdit, Inc.; (b), image 100/©Royalty-Free/Corbis

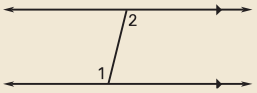
1 PLAN AND PREPARE

Warm-Up Exercises

Also available online

Classify each angle as acute, obtuse, or right.

1. 90° right
2. 72° acute
3. 116° obtuse
4. How do you know that $\angle 1 \cong \angle 2$?



Alt. Int. ∠s Thm.

Notetaking Guide

Available online

Promotes interactive learning and notetaking skills.

Pacing

Basic: 1 day
Average: 1 day
Advanced: 1 day
Block: 0.5 block with next lesson
• See *Teaching Guide/Lesson Plan*.

2 FOCUS AND MOTIVATE

Essential Question

Big Idea 1

How can you find the measure of the third angle of a triangle if you know the measure of the other two angles? **Tell students they will learn how to answer this question by studying the Triangle Sum Theorem and its Corollary.**

COMMON CORE

Standards for Mathematical Content High School

CC.9-12.G.CO.10 Prove theorems about triangles.

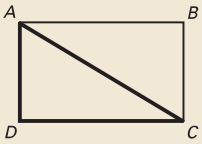
Motivating the Lesson

Ask students to think of pictures they have seen of the pyramids in Egypt. Ask them to imagine that they need to find the measure of the angle at the top of one of the triangular sides of a pyramid. Tell them that in this lesson, they will learn how to find the measure of the top angle by measuring the two angles at the bottom.

3 TEACH

Extra Example 1

Classify the triangle in the gate shown in the diagram by measuring its sides and angles.



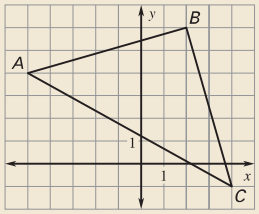
scalene triangle, right triangle

Key Question Example 1

- Are there other kinds of triangles in the diagram? If so, classify them. scalene right triangle, obtuse isosceles triangle

Extra Example 2

Classify $\triangle ABC$ by its sides and by its angles. right isosceles triangle

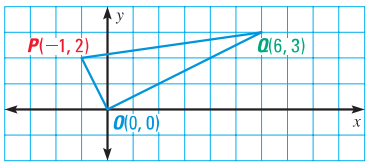


Key Question Example 2

- How would you show $\triangle PQO$ is a right triangle using the lengths of the sides? Note that $(\sqrt{5})^2 + (\sqrt{45})^2 = (\sqrt{50})^2$.

EXAMPLE 2 Classify a triangle in a coordinate plane

Classify $\triangle PQO$ by its sides. Then determine if the triangle is a right triangle.



Solution

STEP 1 **Use** the distance formula to find the side lengths.

$$OP = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} = \sqrt{((-1) - 0)^2 + (2 - 0)^2} = \sqrt{5} \approx 2.2$$

$$OQ = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} = \sqrt{(6 - 0)^2 + (3 - 0)^2} = \sqrt{45} \approx 6.7$$

$$PQ = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} = \sqrt{(6 - (-1))^2 + (3 - 2)^2} = \sqrt{50} \approx 7.1$$

STEP 2 **Check** for right angles. The slope of $\overline{OP}$ is $\frac{2 - 0}{-1 - 0} = -2$. The slope of $\overline{OQ}$ is $\frac{3 - 0}{6 - 0} = \frac{1}{2}$. The product of the slopes is $-2\left(\frac{1}{2}\right) = -1$, so $\overline{OP} \perp \overline{OQ}$ and $\angle POQ$ is a right angle.

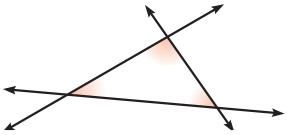
▸ Therefore, $\triangle PQO$ is a right scalene triangle.

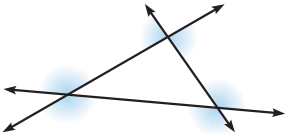
GUIDED PRACTICE for Examples 1 and 2

1. Draw an obtuse isosceles triangle and an acute scalene triangle. See margin.
2. Triangle ABC has the vertices $A(0, 0)$, $B(3, 3)$, and $C(-3, 3)$. Classify it by its sides. Then determine if it is a right triangle. isosceles; right triangle

ANGLES When the sides of a polygon are extended, other angles are formed. The original angles are the **interior angles**. The angles that form linear pairs with the interior angles are the **exterior angles**.

READ DIAGRAMS
Each vertex has a *pair* of congruent exterior angles. However, it is common to show only *one* exterior angle at each vertex.

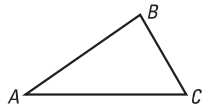

interior angles


exterior angles

THEOREM *For Your Notebook*

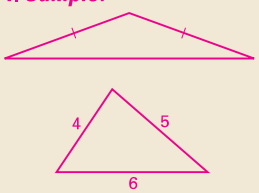
THEOREM 4.1 Triangle Sum Theorem

The sum of the measures of the interior angles of a triangle is 180°.



$m\angle A + m\angle B + m\angle C = 180°$

1. *Sample:*

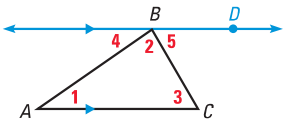


AUXILIARY LINES To prove certain theorems, you may need to add a line, a segment, or a ray to a given diagram. An *auxiliary* line is used in the proof of the Triangle Sum Theorem.

PROOF Triangle Sum Theorem

GIVEN ▶ $\triangle ABC$

PROVE ▶ $m\angle 1 + m\angle 2 + m\angle 3 = 180°$



Plan for Proof

a. Draw an auxiliary line through B and parallel to $\overline{AC}$.

b. Show that $m\angle 4 + m\angle 2 + m\angle 5 = 180°$, $\angle 1 \cong \angle 4$, and $\angle 3 \cong \angle 5$.

c. By substitution, $m\angle 1 + m\angle 2 + m\angle 3 = 180°$.

Plan in Action

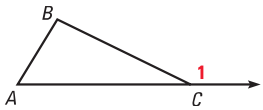
STATEMENTS	REASONS
a. 1. Draw $\overleftrightarrow{BD}$ parallel to $\overline{AC}$.	1. Parallel Postulate
b. 2. $m\angle 4 + m\angle 2 + m\angle 5 = 180°$	2. Angle Addition Postulate and definition of straight angle
3. $\angle 1 \cong \angle 4$, $\angle 3 \cong \angle 5$	3. Alternate Interior Angles Theorem
4. $m\angle 1 = m\angle 4$, $m\angle 3 = m\angle 5$	4. Definition of congruent angles
c. 5. $m\angle 1 + m\angle 2 + m\angle 3 = 180°$	5. Substitution Property of Equality

INEQUALITIES
Theorem 4.2 implies that the following inequalities are true:
$m\angle 1 > m\angle A$
$m\angle 1 > m\angle B$

THEOREM *For Your Notebook*

THEOREM 4.2 Exterior Angle Theorem

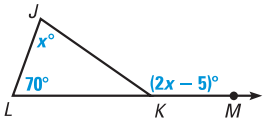
The measure of an exterior angle of a triangle is equal to the sum of the measures of the two nonadjacent interior angles.



$m\angle 1 = m\angle A + m\angle B$

EXAMPLE 3 Find an angle measure

ALGEBRA Find $m\angle JKM$.



Solution

STEP 1 **Write** and solve an equation to find the value of x.

$(2x - 5)° = 70° + x°$ Apply the Exterior Angle Theorem.

$x = 75$ Solve for x.

STEP 2 **Substitute** 75 for x in $2x - 5$ to find $m\angle JKM$.

$2x - 5 = 2 \cdot 75 - 5 = 145$

▶ The measure of $\angle JKM$ is 145°.

Differentiated Instruction

Inclusion To help students think about why the Exterior Angle Theorem is true in **Example 3**, have them review the Angle Addition Postulate and the definition of a straight angle. Have students write an equation to find the value of the third interior angle of the triangle: $180° - (2x - 5)° = m\angle 3$. Then have them use the Triangle Sum Theorem to write another equation to find the value of the third interior angle: $180° - (70 + x)° = m\angle 3$. When comparing the two equations, students should notice that $(2x - 5)° = (70 + x)°$.

See also the *Differentiated Instruction Resources* for more strategies.

Teaching Strategy

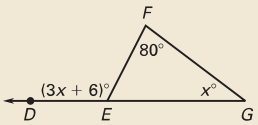
Review the distance formula and slope formula. Remind students that they can use the distance formula to determine whether or not sides are congruent. To decide whether an angle is a right angle, they can use slopes. Slopes must be negative reciprocals for two nonvertical sides to be perpendicular.

Avoiding Common Errors

Example 3 Students may find x but forget to substitute to find $m\angle JKM$. Tell them to look back at the original problem to be sure they have found what was asked for.

Extra Example 3

Find $m\angle DEF$. **117°**

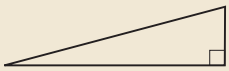


MATHEMATICAL PRACTICES *Key Questions Example 3*

- How can you use the fact that $m\angle JKM = (2x - 5)°$ to write an expression for $m\angle JKL$? **$\angle JKM$ and $\angle JKL$ are supplementary, so $m\angle JKL = 180° - (2x - 5)°$.**
- What expression do you get for $m\angle JKL$ if you use the Triangle Sum Theorem? **$180° - (x° + 70°)$**
- How can you use these expressions to find x? **Solve $180 - (2x - 5) = 180 - (x + 70)$.**

Extra Example 4

The support for the skateboard ramp shown forms a right triangle. The measure of one acute angle in the triangle is five times the measure of the other. Find the measure of each acute angle. **15°, 75°**



Key Question Example 4

- If you use the Triangle Sum Theorem to solve this problem, what equation would you write? What can you do to this equation to get the equation obtained from the corollary? **$x + 2x + 90 = 180$; Subtract 90 from both sides.**

Closing the Lesson

Have students summarize the major points of the lesson and answer the Essential Question: How can you find the measure of the third angle of a triangle if you know the measures of the other two angles?

- **Equilateral triangles have three congruent sides, isosceles triangles have at least two congruent sides, and scalene triangles have no congruent sides.**
- **Equiangular triangles have three congruent angles, acute triangles have three acute angles, obtuse triangles have one obtuse angle, and right triangles have one right angle.**
- **The sum of the measures of the interior angles of a triangle is 180°.**

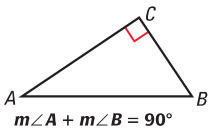
Add the two known angle measures and subtract the result from 180°.

A **corollary to a theorem** is a statement that can be proved easily using the theorem. The corollary below follows from the Triangle Sum Theorem.

COROLLARY *For Your Notebook*

Corollary to the Triangle Sum Theorem

The acute angles of a right triangle are complementary.

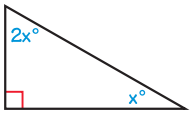


EXAMPLE 4 Find angle measures from a verbal description

ARCHITECTURE The tiled staircase shown forms a right triangle. The measure of one acute angle in the triangle is twice the measure of the other. Find the measure of each acute angle.

Solution

First, sketch a diagram of the situation. Let the measure of the smaller acute angle be $x°$. Then the measure of the larger acute angle is $2x°$. The Corollary to the Triangle Sum Theorem states that the acute angles of a right triangle are complementary.



Use the corollary to set up and solve an equation.

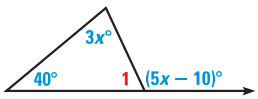
$x° + 2x° = 90°$ Corollary to the Triangle Sum Theorem

$x = 30$ Solve for x.

▸ So, the measures of the acute angles are 30° and $2(30°) = 60°$.

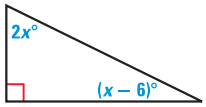
GUIDED PRACTICE for Examples 3 and 4

3. Find the measure of $\angle 1$ in the diagram shown. **65°**



4. Find the measure of each interior angle of $\triangle ABC$, where $m\angle A = x°$, $m\angle B = 2x°$, and $m\angle C = 3x°$. **$m\angle A = 30°$, $m\angle B = 60°$, $m\angle C = 90°$**

5. Find the measures of the acute angles of the right triangle in the diagram shown. **26°, 64°**



6. In Example 4, what is the measure of the obtuse angle formed between the staircase and a segment extending from the horizontal leg? **150°**

Nicolas Sapieha/Corbis

4.1 EXERCISES

HOMEWORK KEY

○ = See **WORKED-OUT SOLUTIONS** Exs. 9, 15, and 41

★ = **STANDARDIZED TEST PRACTICE** Exs. 7, 20, 31, 43, and 51

SKILL PRACTICE

A **VOCABULARY** Match the triangle description with the most specific name.

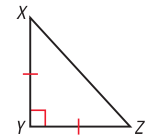
1. Angle measures: 30°, 60°, 90° **C**
2. Side lengths: 2 cm, 2 cm, 2 cm **E**
3. Angle measures: 60°, 60°, 60° **F**
4. Side lengths: 6 m, 3 m, 6 m **A**
5. Side lengths: 5 ft, 7 ft, 9 ft **B**
6. Angle measures: 20°, 125°, 35° **D**

A. Isosceles
B. Scalene
C. Right
D. Obtuse
E. Equilateral
F. Equiangular

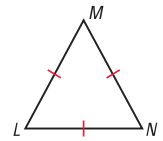
7. ★ **WRITING** Can a right triangle also be obtuse? *Explain* why or why not.
No; in a right triangle, the other two angles are complementary so they are both less than 90°.

EXAMPLE 1 for Exs. 8–10

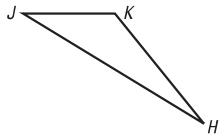
CLASSIFYING TRIANGLES Copy the triangle and measure its angles. Classify the triangle by its sides and by its angles.

8. 

isosceles, right

9. 

equilateral, equiangular

10. 

scalene, obtuse

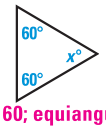
EXAMPLE 2 for Exs. 11–13

COORDINATE PLANE A triangle has the given vertices. Graph the triangle and classify it by its sides. Then determine if it is a right triangle. **11–13. See margin for art.**

11. $A(2, 3)$, $B(6, 3)$, $C(2, 7)$ **isosceles; right triangle**
12. $A(3, 3)$, $B(6, 9)$, $C(6, -3)$ **isosceles; not a right triangle**
13. $A(1, 9)$, $B(4, 8)$, $C(2, 5)$ **scalene; not a right triangle**

EXAMPLE 3 for Exs. 14–19

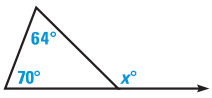
FINDING ANGLE MEASURES Find the value of x. Then classify the triangle by its angles.

14. 

60; equiangular

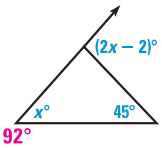
15. 

30; right

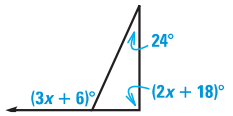
16. 

134; acute

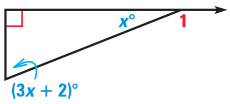
xy **ALGEBRA** Find the measure of the exterior angle shown.

17. 

92°

18. 

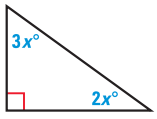
114°

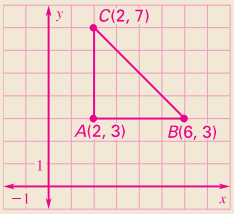
19. 

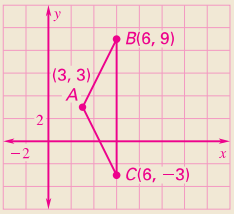
158°

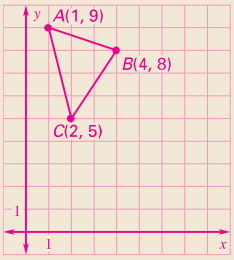
EXAMPLE 4 for Ex. 20

20. ★ **SHORT RESPONSE** *Explain* how to use the Corollary to the Triangle Sum Theorem to find the measure of each angle.
Set $3x + 2x = 90$ and solve for x. Then find the values of $3x$ and $2x$.



11. 

12. 

13. 

4 PRACTICE AND APPLY

Assignment Guide

Answers for all exercises available online

Basic:
Day 1:
Exs. 1–7, 9–19 odd, 21–29, 40–49

Average:
Day 1:
Exs. 1–7, 8–26 even, 27–34, 40–52

Advanced:
Day 1:
Exs. 1–7, 10, 13, 16, 19, 20, 27, 28, 31–40*, 42–53*

Block:
Exs. 1–7, 8–26 even, 27–34, 40–52 (with next lesson)

Differentiated Instruction

See *Differentiated Instruction Resources* for suggestions on addressing the needs of a diverse classroom.

Homework Check

For a quick check of student understanding of key concepts, go over the following exercises:

Basic: 9, 11, 17, 19, 40
Average: 8, 12, 18, 20, 40
Advanced: 10, 13, 19, 20, 40

Extra Practice

- Student Edition
- Chapter Resource Book: Practice levels A, B, C

Practice Worksheet

An easily-readable reduced practice page can be found at the beginning of this chapter.

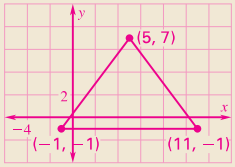
Avoiding Common Errors

Exercises 17–18 Students may add the measure of the exterior angle and the measures of the two nonadjacent interior angles and set the sum equal to 180°. Discuss the difference between the Triangle Sum Theorem and the Exterior Angle Theorem to help them understand why that is not a correct procedure.

Study Strategy

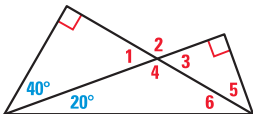
Exercises 32–33, 35 If students have difficulty with these exercises, call attention to the fact that each diagram is marked to show a pair of parallel segments.

39c.



B **ANGLE RELATIONSHIPS** **Find the measure of the numbered angle.**

21. $\angle 1$ 50°
22. $\angle 2$ 130°
23. $\angle 3$ 50°
24. $\angle 4$ 130°
25. $\angle 5$ 40°
26. $\angle 6$ 30°



27. **ALGEBRA** In $\triangle PQR$, $\angle P \cong \angle R$ and the measure of $\angle Q$ is twice the measure of $\angle R$. Find the measure of each angle. $m\angle P = 45°$, $m\angle Q = 90°$, $m\angle R = 45°$

28. **ALGEBRA** In $\triangle EFG$, $m\angle F = 3(m\angle G)$, and $m\angle E = m\angle F - 30°$. Find the measure of each angle. $m\angle E = 60°$, $m\angle F = 90°$, $m\angle G = 30°$

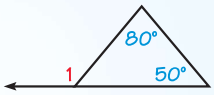
ERROR ANALYSIS **In Exercises 29 and 30, *describe* and correct the error.**

29.

All equilateral triangles are also isosceles. So, if △ABC is isosceles, then it is equilateral as well.

30.

$m\angle 1 + 80° + 50° = 180°$

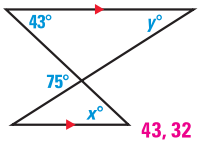


31. ★ **MULTIPLE CHOICE** Which of the following is not possible? B

(A) An acute scalene triangle
(B) A triangle with two acute exterior angles
(C) An obtuse isosceles triangle
(D) An equiangular acute triangle

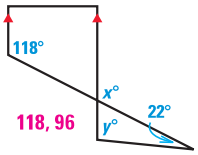
ALGEBRA **In Exercises 32–37, find the values of x and y.**

32.



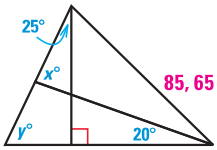
43, 32

33.

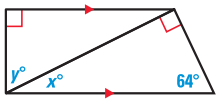


118, 96

34.

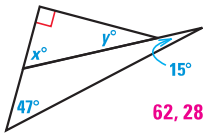


35.



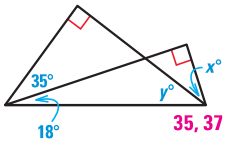
26, 64

36.



62, 28

37.



35, 37

38. **VISUALIZATION** Is there an angle measure that is so small that any triangle with that angle measure will be an obtuse triangle? *Explain*.

39. **CHALLENGE** Suppose you have the equations $y = ax + b$, $y = cx + d$, and $y = ex + f$.

a. When will these three lines form a triangle?

b. Let $c = 1$, $d = 2$, $e = 4$, and $f = -7$. Find values of a and b so that no triangle is formed by the three equations. *Sample answer:* 0, 5

c. Draw the triangle formed when $a = \frac{4}{3}$, $b = \frac{1}{3}$, $c = -\frac{4}{3}$, $d = \frac{41}{3}$, $e = 0$, and $f = -1$. Then classify the triangle by its sides. See margin for art; isosceles.

29. Isosceles does not guarantee the third side is congruent to the two congruent sides; so if △*ABC* is equilateral, then it is isosceles as well.

30. The measure of the exterior angle is equal to the sum of the measures of the two nonadjacent interior angles; $m\angle 1 = 80° + 50° = 130°$.

38. No. *Sample answer:* In a right triangle, the two acute angles are complementary. So, one of the acute angle measures can be as small as desired, while the other angle measure is less than 90°. The largest angle is the right angle, which measures 90°, so the triangle does not need to be obtuse. C

39a. *Sample answer:* They will always form a triangle unless they intersect in one point, or unless at least two lines are parallel.

○ = See WORKED-OUT SOLUTIONS in Student Resources

★ = STANDARDIZED TEST PRACTICE

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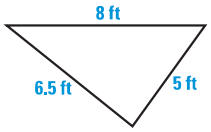
PROBLEM SOLVING

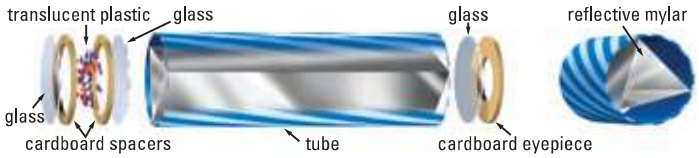
EXAMPLE 1 A for Ex. 40

40. THEATER Three people are standing on a stage. The distances between the three people are shown in the diagram. Classify the triangle formed by its sides. Then copy the triangle, measure the angles, and classify the triangle by its angles. **scalene; acute**



41. KALEIDOSCOPES You are making a kaleidoscope. The directions state that you are to arrange three pieces of reflective mylar in an equilateral and equiangular triangle. You must cut three strips from a piece of mylar 6 inches wide. What are the side lengths of the triangle used to form the kaleidoscope? What are the measures of the angles? *Explain*.

41. 2 in.; 60°; in an equilateral triangle all sides have the same length $\left(\frac{6}{3}\right)$. In an equiangular triangle the angles always measure 60°.



42. SCULPTURE You are bending a strip of metal into an isosceles triangle for a sculpture. The strip of metal is 20 inches long. The first bend is made 6 inches from one end. *Describe* two ways you could complete the triangle. **Bend the strip again at 7 inches or 8 inches from the other end.**

43. ★ MULTIPLE CHOICE Which inequality describes the possible measures of an angle of a triangle? **C**

Ⓐ $0° \le x° \le 180°$ Ⓑ $0° \le x° < 180°$ Ⓒ $0° < x° < 180°$ Ⓓ $0° < x° \le 180°$

SLING CHAIRS The brace of a sling chair forms a triangle with the seat and legs of the chair. Suppose $m\angle 2 = 50°$ and $m\angle 3 = 65°$.

44. Find $m\angle 6$. **115°**

45. Find $m\angle 5$. **115°**

46. Find $m\angle 1$. **130°**

47. Find $m\angle 4$. **65°**

B **48. PROOF** Prove the Corollary to the Triangle Sum Theorem. **See margin.**

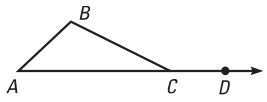
49. MULTI-STEP PROBLEM The measures of the angles of a triangle are $(2\sqrt{2x})°$, $(5\sqrt{2x})°$, and $(2\sqrt{2x})°$.

a. Write an equation to show the relationship of the angles. **$2\sqrt{2x} + 5\sqrt{2x} + 2\sqrt{2x} = 180$**

b. Find the measure of each angle. **40°, 100°, 40°**

c. Classify the triangle by its angles. **obtuse**

50. PROVING THEOREM 4.2 Prove the Exterior Angle Theorem. (*Hint:* Find two equations involving $m\angle ACB$.) **See margin.**



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Mathematical Reasoning

Exercise 42 Have students relate the two ways of completing the triangle to the definition of an isosceles triangle.

48. Statements (Reasons)

1. $\triangle ABC$ is a right triangle. (Given)
2. $m\angle C = 90°$ (Definition of right angle)
3. $m\angle A + m\angle B + m\angle C = 180°$ (Triangle Sum Theorem)
4. $m\angle A + m\angle B + 90° = 180°$ (Substitution Property of Equality)
5. $m\angle A + m\angle B = 90°$ (Subtraction Property of Equality)
6. $\angle A$ and $\angle B$ are complementary. (Definition of complementary angles)

50. Statements (Reasons)

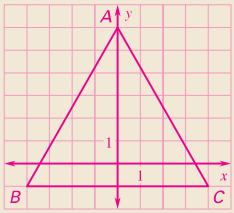
1. $m\angle ACB + m\angle BCD = 180°$ (Linear Pair Postulate and definition of supplementary angles)
2. $m\angle A + m\angle B + m\angle ACB = 180°$ (Triangle Sum Theorem)
3. $m\angle ACB + m\angle BCD = m\angle A + m\angle B + m\angle ACB$ (Transitive Property of Equality)
4. $m\angle BCD = m\angle A + m\angle B$ (Subtraction Property of Equality)

5 ASSESS AND RETEACH

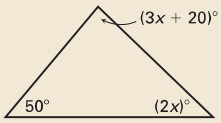
Daily Homework Quiz

Also available online

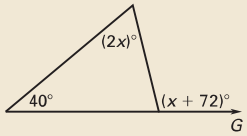
1. Graph $\triangle ABC$ with vertices $A(0, 6)$, $B(-4, -1)$, and $C(4, -1)$. Classify it by its sides. Then determine if it is a right triangle.
isosceles; not a right triangle



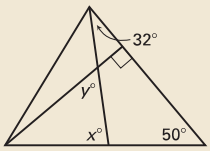
2. Find x. Then classify the triangle by its angles. **22; acute**



3. Find the measure of the exterior angle shown. **104°**



4. Find x and y. **82, 58**



Online Quiz
Available at **my.hrw.com**

Diagnosis/Remediation

- Practice A, B, C in Chapter Resource Book
- Study Guide in Chapter Resource Book
- Practice Workbook
- @HomeTutor

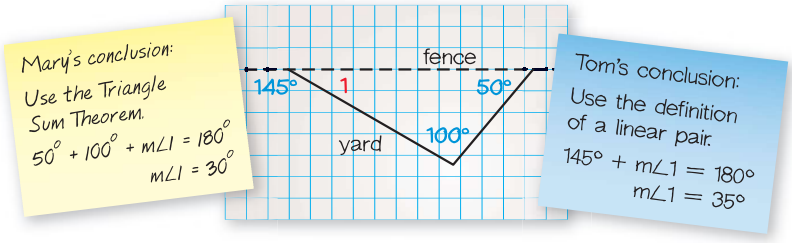
Challenge

Additional challenge is available in the Chapter Resource Book

53. See Additional Answers.

51. *Sample answer:* They both reasoned correctly but their initial plan was incorrect. The measure of the exterior angle should be 150°.

51. ★ **EXTENDED RESPONSE** The figure below shows an initial plan for a triangular flower bed that Mary and Tom plan to build along a fence. They are discussing what the measure of $\angle 1$ should be.



Did Mary and Tom both reason correctly? If not, who made a mistake and what mistake was made? If they did both reason correctly, what can you conclude about their initial plan? *Explain*.

52. xy **ALGEBRA** $\triangle ABC$ is isosceles. $AB = x$ and $BC = 2x - 4$.

a. Find two possible values for x if the perimeter of $\triangle ABC$ is 32. **8, 9**

b. How many possible values are there for x if the perimeter of $\triangle ABC$ is 12? **one value**

C **53. CHALLENGE** Use the diagram to write a proof of the Triangle Sum Theorem. Your proof should be different than the proof of the Triangle Sum Theorem shown in this lesson. **See margin.**