

4.1 EXERCISES

HOMEWORK KEY

⊙ = WORKED-OUT SOLUTIONS on p. WS4 for Exs. 9, 15, and 41

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

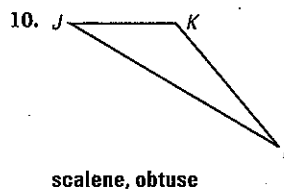
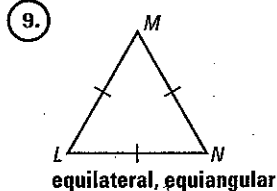
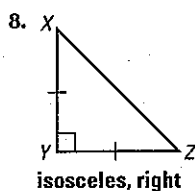
SKILL PRACTICE

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

- | | |
|--|----------------|
| 1. Angle measures: $30^\circ, 60^\circ, 90^\circ$ C | A. Isosceles |
| 2. Side lengths: 2 cm, 2 cm, 2 cm E | B. Scalene |
| 3. Angle measures: $60^\circ, 60^\circ, 60^\circ$ F | C. Right |
| 4. Side lengths: 6 m, 3 m, 6 m A | D. Obtuse |
| 5. Side lengths: 5 ft, 7 ft, 9 ft B | E. Equilateral |
| 6. Angle measures: $20^\circ, 125^\circ, 35^\circ$ D | 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° .

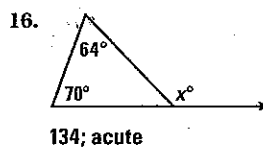
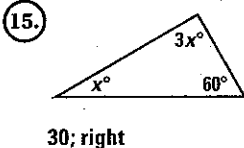
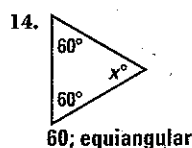
CLASSIFYING TRIANGLES Copy the triangle and measure its angles. Classify the triangle by its sides and by its angles.



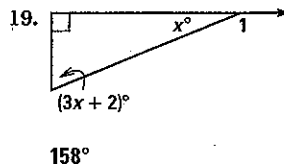
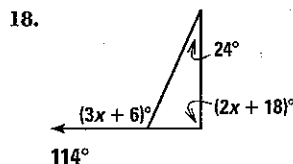
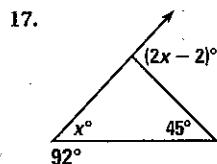
COORDINATE PLANE A triangle has the given vertices. Graph the triangle and classify it by its sides. Then determine if it is a right triangle. 11–13. See margin for art.

- | | | |
|--|---|--|
| 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 |
|--|---|--|

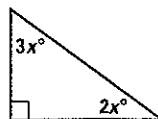
FINDING ANGLE MEASURES Find the value of x . Then classify the triangle by its angles.



ALGEBRA Find the measure of the exterior angle shown.



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 $2x$.



EXAMPLE 1
on p. 217
for Exs. 8–10

EXAMPLE 2
on p. 218
for Exs. 11–13

EXAMPLE 3
on p. 219
for Exs. 14–19

EXAMPLE 4
on p. 220
for Ex. 20

4 PRACTICE AND APPLY

Assignment Guide

Answer Transparencies available for all exercises

Basic:

Day 1: EP p. 896 Exs. 24–29 pp. 221–224
Exs. 1–7, 9–19 odd, 21–29, 40–49, 54, 57, 60, 61

Average:

Day 1: pp. 221–224
Exs. 1–7, 8–26 even, 27–34, 40–52, 55, 58, 62

Advanced:

Day 1: pp. 221–224
Exs. 1–7, 10, 13, 16, 19, 20, 27, 28, 31–40*, 42–53*, 56, 59, 63

Block:

pp. 221–224
Exs. 1–7, 8–26 even, 27–34, 40–52, 55, 58, 62 (with 4.2)

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

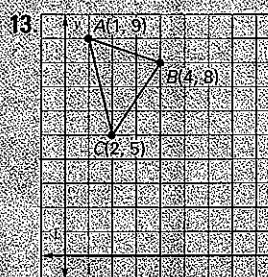
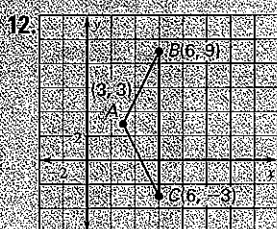
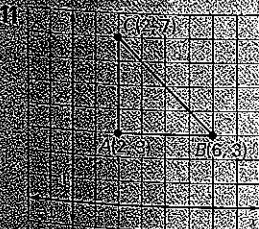
Advanced: 10, 13, 19, 20, 40

Extra Practice

- Student Edition, p. 902
- Chapter Resource Book: Practice levels A, B, C

Practice Worksheet

An easily-readable reduced practice page (with answers) for this lesson can be found on p. 214C.

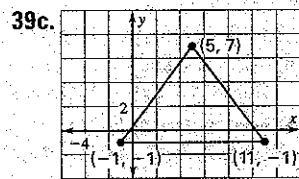


Avoiding Common Errors

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.



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

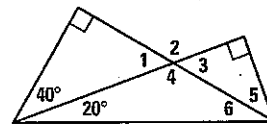
30. The measure of the exterior angle is equal to the sum of the measures of the two nonadjacent interior angles; $m\angle 1 = 80^\circ + 50^\circ = 130^\circ$.

38. **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.

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

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°



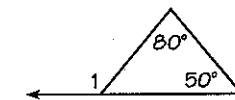
27. **xy ALGEBRA** In $\triangle PQR$, $\angle P \cong \angle R$ and the measure of $\angle Q$ is twice the measure of $\angle R$. Find the measure of each angle. $m\angle P = 45^\circ$, $m\angle Q = 90^\circ$, $m\angle R = 45^\circ$
 28. **xy ALGEBRA** In $\triangle EFG$, $m\angle F = 3(m\angle G)$, and $m\angle E = m\angle F - 30^\circ$. Find the measure of each angle. $m\angle E = 60^\circ$, $m\angle F = 90^\circ$, $m\angle G = 30^\circ$

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

29. All equilateral triangles are also isosceles. So, if $\triangle ABC$ is isosceles, then it is equilateral as well.



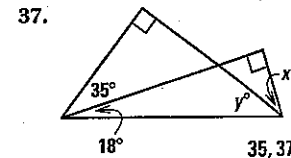
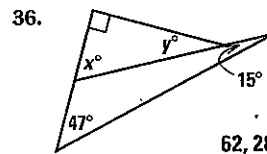
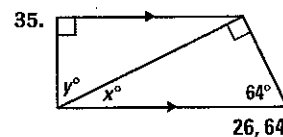
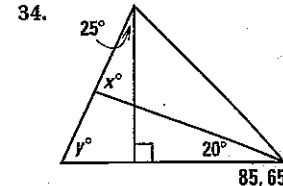
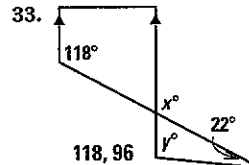
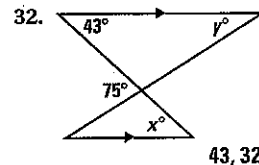
30. $m\angle 1 + 80^\circ + 50^\circ = 180^\circ$



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

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



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 $y = ex + f$.

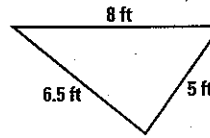
- a. When will these three lines form a triangle?
 b. Let $c = 1$, $d = 2$, $e = 4$, and $f = -7$. Find values of a and b so that no triangle is formed by the three equations. **Sample answer:** 0, 5
 c. Draw the triangle formed when $a = \frac{4}{3}$, $b = \frac{1}{3}$, $c = -\frac{4}{3}$, $d = \frac{41}{3}$, $e = 0$, and $f = -1$. Then classify the triangle by its sides. See margin for art; isosceles.

PROBLEM SOLVING

EXAMPLE 1 **A**
on p. 217
for Ex. 40

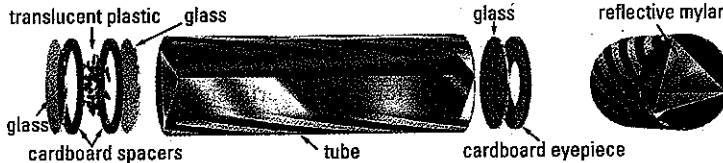
41. 2 in.; 60° ; in an equilateral triangle all sides have the same length ($\frac{6}{3}$). In an equilateral triangle the angles always measure 60° .

- 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*



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- 41. KALEIDOSCOPIES** 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.*



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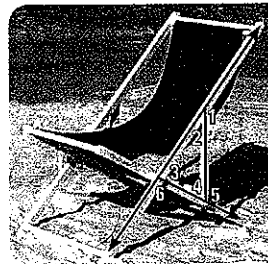
- 42. SCULPTURE** You are bending a strip of metal into an isosceles triangle for a sculpture. The strip of metal is 20 inches long. The first bend is made 6 inches from one end. *Describe* two ways you could complete the triangle. *Bend the strip again at 7 inches or 8 inches from the other end.*

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

(A) $0^\circ \leq x^\circ \leq 180^\circ$ **(B)** $0^\circ \leq x^\circ < 180^\circ$ **(C)** $0^\circ < x^\circ < 180^\circ$ **(D)** $0^\circ < x^\circ \leq 180^\circ$

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

44. Find $m\angle 6$. 115° 45. Find $m\angle 5$. 115°
46. Find $m\angle 1$. 130° 47. Find $m\angle 4$. 65°

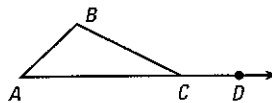


- B** **48. PROOF** Prove the Corollary to the Triangle Sum Theorem on page 220. *See margin.*

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

- 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. $40^\circ, 100^\circ, 40^\circ$
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.*



Mathematical Reasoning

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

48. Statements (Reasons)

- $\triangle ABC$ is a right triangle. (Given)
- $m\angle C = 90^\circ$ (Definition of right angle)
- $m\angle A + m\angle B + m\angle C = 180^\circ$ (Triangle Sum Theorem)
- $m\angle A + m\angle B + 90^\circ = 180^\circ$ (Substitution Property of Equality)
- $m\angle A + m\angle B = 90^\circ$ (Subtraction Property of Equality)
- $\angle A$ and $\angle B$ are complementary. (Definition of complementary angles)

50. Statements (Reasons)

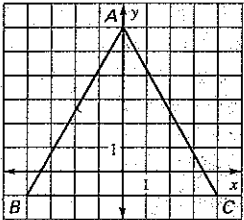
- $m\angle ACB + m\angle BCD = 180^\circ$ (Linear Pair Postulate and definition of supplementary angles)
- $m\angle A + m\angle B + m\angle ACB = 180^\circ$ (Triangle Sum Theorem)
- $m\angle ACB + m\angle BCD = m\angle A + m\angle B + m\angle ACB$ (Transitive Property of Equality)
- $m\angle BCD = m\angle A + m\angle B$ (Subtraction Property of Equality)

5 ASSESS AND RETEACH

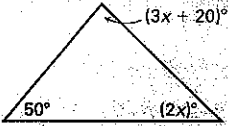
Daily Homework Quiz

Transparency Available

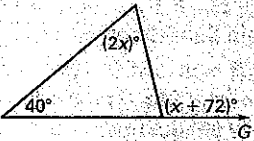
1. Graph $\triangle ABC$ with vertices $A(0, 6)$, $B(-4, -1)$, and $C(4, -1)$. Classify it by its sides. Then determine if it is a right triangle. **isosceles; not a right triangle**



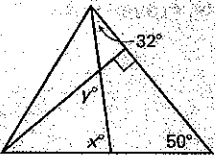
2. Find x . Then classify the triangle by its angles. **22; acute**



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



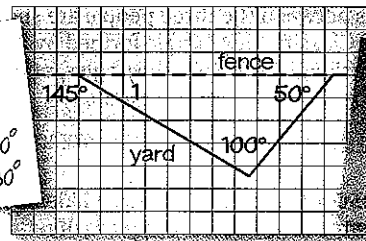
4. Find x and y . **82, 58**



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.

Mary's conclusion:
Use the Triangle Sum Theorem.
 $50^\circ + 100^\circ + m\angle 1 = 180^\circ$
 $m\angle 1 = 30^\circ$

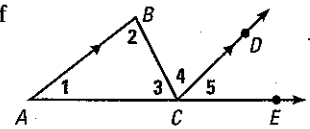


Tom's conclusion:
Use the definition of a linear pair.
 $145^\circ + m\angle 1 = 180^\circ$
 $m\angle 1 = 35^\circ$

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. **49 ALGEBRA** $\triangle ABC$ is isosceles. $AB = x$ and $BC = 2x - 4$.
- Find two possible values for x if the perimeter of $\triangle ABC$ is 32. **8, 9**
 - 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 on page 219.



See margin.

MIXED REVIEW

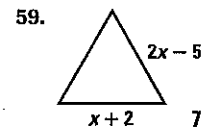
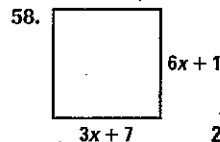
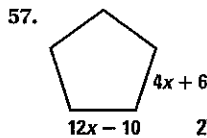
$\angle A$ and $\angle B$ are complementary. Find $m\angle A$ and $m\angle B$. (p. 35)

54. $m\angle A = (3x + 16)^\circ$
 $m\angle B = (4x - 3)^\circ$ **49, 41**
55. $m\angle A = (4x - 2)^\circ$
 $m\angle B = (7x + 4)^\circ$ **30, 60**
56. $m\angle A = (3x + 4)^\circ$
 $m\angle B = (2x + 6)^\circ$ **52, 38**

PREVIEW

Prepare for Lesson 4.2 in Exs. 57–59.

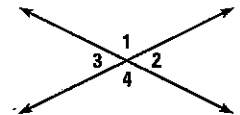
Each figure is a regular polygon. Find the value of x . (p. 42)



60. Use the Symmetric Property of Congruence to complete the statement: If $\underline{\quad} \cong \underline{\quad}$, then $\angle DEF \cong \angle PQR$. (p. 112) **$\angle PQR, \angle DEF$**

Use the diagram at the right. (p. 124)

61. If $m\angle 1 = 127^\circ$, find $m\angle 2$, $m\angle 3$, and $m\angle 4$. **$53^\circ, 53^\circ, 127^\circ$**
62. If $m\angle 4 = 170^\circ$, find $m\angle 1$, $m\angle 2$, and $m\angle 3$. **$170^\circ, 10^\circ, 10^\circ$**
63. If $m\angle 3 = 54^\circ$, find $m\angle 1$, $m\angle 2$, and $m\angle 4$. **$126^\circ, 54^\circ, 126^\circ$**



Online Quiz

Available at classzone.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 beginning on p. AA1.