Interactive Classroom

Glencoe McGraw-Hill

Pre-Algebra

Chapter 9

Real Numbers and Right Triangles

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Chapter Menu

Lesson 9-1 Squares and Square Roots

Lesson 9-2 The Real Number System

Lesson 9-3 Triangles

Lesson 9-4 The Pythagorean Theorem

Lesson 9-5 The Distance Formula

Lesson 9-6 Similar Figures and Indirect Measurement

Lesson Menu

Five-Minute Check (over Chapter 8)

Main Ideas and Vocabulary

Key Concept: Square Root

Example 1: Find Square Roots

Example 2: Find Square Roots with a Calculator

Example 3: Estimate Square Roots

Example 4: Real-World Example

Main Ideas

- Find squares and square roots.
- Estimate square roots.

New Vocabulary

- perfect square
- square root
- radical sign

KEY CONCEPT — *Square Root*

Words A square root of a number is one of its two equal factors.

Symbols If $x^2 = y$, then x is a square root of y.

Example Since $5 \cdot 5$ or $5^2 = 25$, 5 is a square root of 25.
Since $(-5) \cdot (-5)$ or $(-5)^2 = 25$, -5 is a square root of 25.

EXAMPLE 1 Find Square Roots

A. Find $\sqrt{64}$.

$\sqrt{64}$ indicates the *positive* square root of 64.

Since $8^2 = 64, \sqrt{64} = 8$.

Answer: 8

EXAMPLE 1 Find Square Roots

B. Find $-\sqrt{121}$.

$-\sqrt{121}$ indicates the *negative* square root of 121.

Since $11^2 = 121, -\sqrt{121} = -11$.

Answer: –11

EXAMPLE Find Square Roots

1 C. Find $\pm\sqrt{256}$.

$\pm\sqrt{256}$ indicates *both* square roots of 256.

Since $16^2 = 256$, $\sqrt{256} = 16$ and $-\sqrt{256} = -16$.

Answer: +16 and –16

EXAMPLE 1 Find Square Roots

D. Find $\sqrt{z^2}$.

$\sqrt{z^2}$ indicates the positive square root of z^2.

z may be negative, but $|z|$ is positive,

so $\sqrt{z^2} = |z|$.

Answer: $|z|$

Check Your Progress

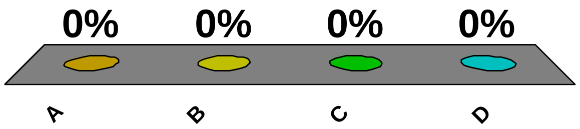
1 **A. Find $\sqrt{25}$.**

A. 624

B. 12.5

C. 5

D. –5



CheckPoint

CHECK Your Progress

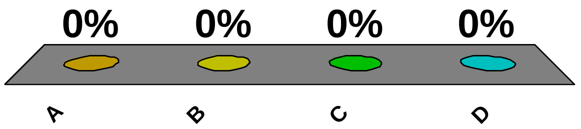
1 B. Find $-\sqrt{144}$.

A. 12

B. –12

C. –72

D. –20,736



CHECK Your Progress

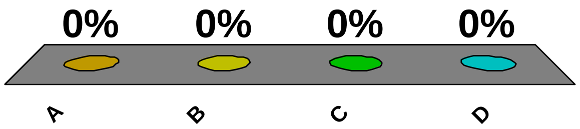
1 **C.** Find $\pm\sqrt{16}$.

A. 4

B. –4

C. 4 and –4

D. 256 and –256



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CHECK Your Progress

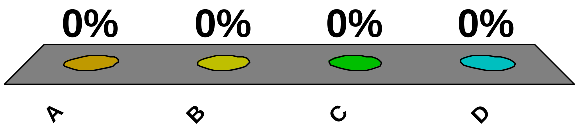
1 D. Find $\sqrt{t^2}$.

A. $|t|$

B. t

C. $-t$

D. t and $-t$



EXAMPLE Find Square Roots with a Calculator

2 A. Use a calculator to find $\sqrt{22}$ to the nearest tenth.

$\boxed{\text{2nd}}$ $[\sqrt{}]$ 22 $\boxed{\text{ENTER}}$ 4.69041575982 Use a calculator.

$\sqrt{22} \approx 4.7$ Round to the nearest tenth.

Answer: 4.7

EXAMPLE Find Square Roots with a Calculator

2 B. Use a calculator to find $-\sqrt{319}$ to the nearest tenth.

$\boxed{\text{2nd}}$ $[\sqrt{\ }]$ 319 $\boxed{\text{ENTER}}$ 17.86057109949

Use a calculator.

$-\sqrt{319} \approx -17.9$

Round to the nearest tenth.

Answer: –17.9

CHECK Your Progress

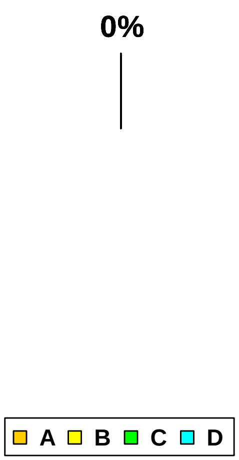
2 **A.** Use a calculator to find $\sqrt{71}$ to the nearest tenth.

A. 8.4

B. 8.43

C. 35.5

D. 5041



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CHECK Your Progress

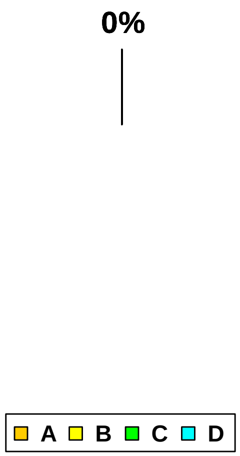
2 B. Use a calculator to find $-\sqrt{38}$ to the nearest tenth.

A. –1444

B. –19

C. –6.2

D. –6.16



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EXAMPLE Estimate Square Roots

3 A. Estimate $\sqrt{22}$ to the nearest whole number.

- The first perfect square less than 22 is 16. $\sqrt{16} = 4$
- The first perfect square greater than 22 is 25. $\sqrt{25} = 5$
- Plot each square on a number line.

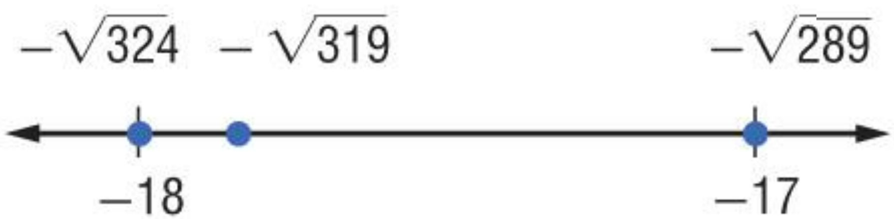
The square root of 22 is between the whole numbers 4 and 5. Since 22 is closer to 25 than 16, you can expect that $\sqrt{22}$ is closer to 5 than 4.

Answer: 5

EXAMPLE Estimate Square Roots

3 B. Estimate $-\sqrt{319}$ to the nearest whole number.

- The first perfect square less than 319 is 289. $\sqrt{289} = 17$
- The first perfect square greater than 319 is 324. $\sqrt{324} = 18$
- Plot each square on a number line.



The negative square root of 319 is between the whole numbers –17 and –18. Since 319 is closer to 324 than 289, you can expect that $-\sqrt{319}$ is closer to –18 than –17.

Answer: –18

CHECK Your Progress

3 **A.** Estimate $\sqrt{54}$ to the nearest whole number.

A. 6

B. 7

C. 8

D. 9

0%

A B C D

CheckPoint

Check Your Progress

3 **B.** Estimate $-\sqrt{152}$ to the nearest whole number.

A. 12

B. –11

C. –12

D. –13

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A B C D

CheckPoint

Real-World EXAMPLE

4 **SKYSCRAPER The tallest building in Houston, Texas is the J.P. Morgan Chase Tower, standing at 1,002 foot tall. How far can a person see from the top floor on a clear day?**

Use the formula $D = 1.22 \times \sqrt{A}$ where D is the distance in miles and A is the altitude, or height, in feet.

$D = 1.22 \times \sqrt{A}$	Write the formula.
$= 1.22 \times \sqrt{1002}$	Replace A with 1002.
$\approx 1.22 \times 31.65$	Evaluate the square root first.

Real-World EXAMPLE

4 ≈ 38.6 Multiply.

Answer: On a clear day, a person could see about 38.6 miles.

CHECK Your Progress

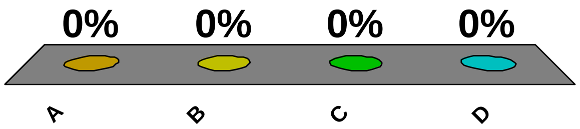
4 **SKYSCRAPER** A skyscraper stands 378 feet high. On a clear day, about how far could an individual standing on the roof of the skyscraper see? Round to the nearest tenth.

A. 23.2 miles

B. 23.3 miles

C. 23.7 miles

D. 24.4 miles



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End of the Lesson

Click the mouse button to return to the Chapter Menu.

Lesson Menu

Five-Minute Check (over Lesson 9-1)

Main Ideas and Vocabulary

Key Concept: Irrational Number

Example 1: Classify Real Numbers

Example 2: Compare Real Numbers on a Number Line

Example 3: Solve Equations

Example 4: Real-World Example

Main Ideas

- Identify and compare numbers in the real number system.
- Solve equations by finding square roots.

New Vocabulary

- irrational numbers
- real numbers

KEY CONCEPT *Irrational Number*

An irrational number is a number that cannot be expressed as $\frac{a}{b}$, where a and b are integers and b does not equal 0.

EXAMPLE 1 Classify Real Numbers

A. Name all of the sets of numbers to which the real number $0.2\overline{46}$ belongs.

Answer: This repeating decimal is a rational number because it is equivalent to $\frac{244}{990}$.

EXAMPLE 1 Classify Real Numbers

B. Name all of the sets of numbers to which the real number $\sqrt{225}$ belongs.

Answer: Since $\sqrt{225} = 15$, this number is a natural number, a whole number, an integer, and a rational number.

EXAMPLE Classify Real Numbers

1 **C. Name all of the sets of numbers to which the real number $-\frac{72}{6}$ belongs.**

Answer : Since $-\frac{72}{6} = -12$, this number is an integer and a rational number.

EXAMPLE **Classify Real Numbers**

1 **D. Name all of the sets of numbers to which the real number $\frac{14}{4}$ belongs.**

Answer : Since $\frac{14}{4} = 3.5$, this number is a terminating decimal and thus a rational number.

CHECK Your Progress

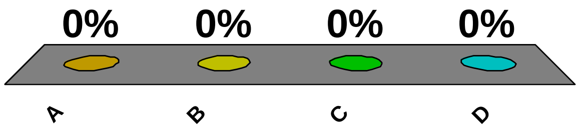
1 **A. Name all the sets of numbers to which the real number $0.3\overline{80}$ belongs.**

A. rational number

B. irrational number

C. integer, rational number

D. natural number



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CHECK Your Progress

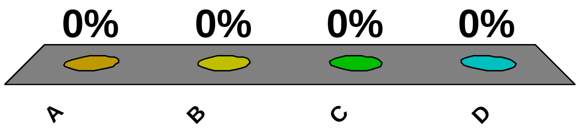
1 **B.** Name all the sets of numbers to which the real number $-\sqrt{81}$ belongs.

A. rational number

B. irrational number

C. integer, rational number

D. natural number



CheckPoint

CHECK Your Progress

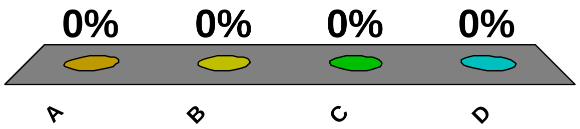
1 **C. Name all the sets of numbers to which the real number $\frac{45}{9}$ belongs.**

A. rational number

B. irrational number

C. integer, rational number

D. natural number, whole number, integer, rational number



CHECK Your Progress

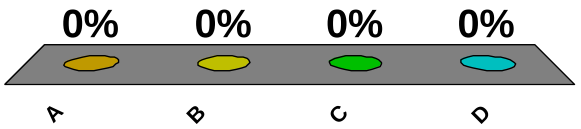
1 D. Name all the sets of numbers to which the real number $\frac{19}{4}$ belongs.

A. rational number

B. irrational number

C. integer, rational number

D. natural number



CheckPoint

EXAMPLE

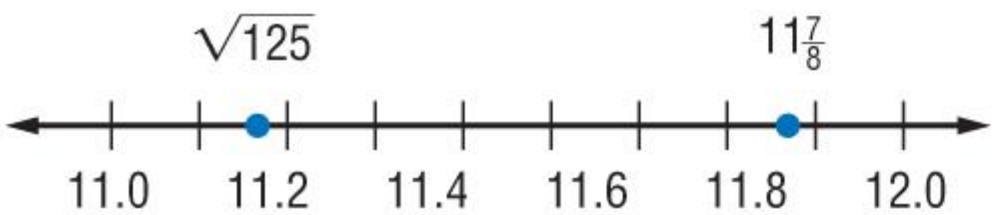
Compare Real Numbers on a Number Line

2 **A. Replace • with <, >, or = to make $\sqrt{125} \bullet 11\frac{7}{8}$ a true statement.**

Express each number as a decimal. Then graph the number.

$$\sqrt{125} = 11.18033989...$$

$$11\frac{7}{8} = 11.875$$



EXAMPLE

Compare Real Numbers on a Number Line

2 **Answer:** Since $\sqrt{125}$ is to the left of $11\frac{7}{8}$, $\sqrt{125} < 11\frac{7}{8}$.

EXAMPLE

Compare Real Numbers on a Number Line

2 B. Order $6\frac{1}{4}, \sqrt{38}, 6.\overline{5},$ and $\sqrt{36}$ from least to greatest.

Express each number as a decimal. Then graph the number.

$$6\frac{1}{4} = 6.25$$

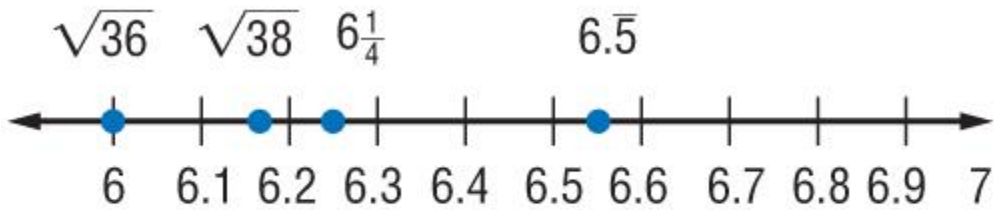
$$\sqrt{38} = 6.164414003\ldots$$

$$6.\overline{5} = 6.5555555\ldots$$

$$\sqrt{36} = 6$$

EXAMPLE Compare Real Numbers on a Number Line

2



Answer : From least to greatest, the order is $\sqrt{36}, \sqrt{38}, 6\frac{1}{4}, 6.\overline{5}$.

CHECK Your Progress

2 A. Replace • with <, >, or = to make $\sqrt{61} \bullet 7\frac{3}{4}$ a true statement.

A. <

B. >

C. =

D. none of the above

0%

A B C D

CheckPoint

CHECK Your Progress

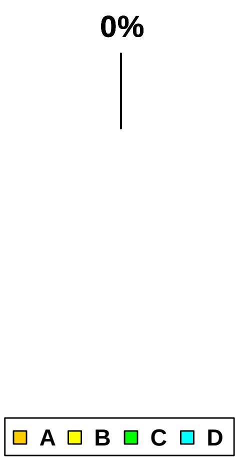
2 B. Order $5\frac{2}{3}$, $\sqrt{26}$, $5.\overline{4}$, and $\sqrt{29}$ from least to greatest.

A. $5\frac{2}{3}, 5.\overline{4}, \sqrt{29}, \sqrt{26}$

B. $\sqrt{26}, \sqrt{29}, 5\frac{2}{3}, 5.\overline{4}$

C. $5\frac{2}{3}, 5.\overline{4}, \sqrt{26}, \sqrt{29}$

D. $\sqrt{26}, \sqrt{29}, 5.\overline{4}, 5\frac{2}{3}$



CheckPoint

EXAMPLE Solve Equations

3 A. Solve $w^2 = 169$. Round to the nearest tenth, if necessary.

$w^2 = 169$	Write the equation.
$\sqrt{w^2} = \sqrt{169}$	Take the square root of each side.
$w = \sqrt{169}$ or $-\sqrt{169}$	Find the positive and negative square root.
$w = 13$ or $w = -13$	

Answer: The solutions are 13 and –13.

EXAMPLE Solve Equations

3 **B. Solve $r^2 = 50$. Round to the nearest tenth, if necessary.**

$r^2 = 50$ Write the equation.

$\sqrt{r^2} = \sqrt{50}$ Take the square root of each side.

$r = \sqrt{50}$ or $-\sqrt{50}$ Find the positive and negative square root.

$r \approx 7.1$ or $r \approx -7.1$ Use a calculator.

Answer: The solutions are 7.1 and –7.1.

CHECK Your Progress

3 A. Solve the equation $m^2 = 81$. Round to the nearest tenth, if necessary.

A. 8

B. 8 and –8

C. 9

D. 9 and –9

0%

A B C D

CheckPoint

CHECK Your Progress

3 **B.** Solve the equation $h^2 = 24$. Round to the nearest tenth, if necessary.

A. 4.899 and –4.899

B. 4.9

C. 4.9 and –4.9

D. 5 and –5

0%

A B C D

CheckPoint

Real-World EXAMPLE

4 HANG GLIDING The formula for aspect ratio R is $R = \frac{s^2}{A}$, where s is the wingspan in feet and A is the area of the wing. What is the aspect ratio of a hang glider if the wingspan is 16 feet and the area of the wing is 40 square feet?

$R = \frac{s^2}{A}$ Write the formula.

$R = \frac{(16)^2}{40}$ Replace s with 16 and A with 40.

$R = \frac{256}{40}$ $16 \bullet 16 = 256$

$R = 6.4$ Divide.

Answer: 6.4

CHECK Your Progress

4 **ELECTRICITY** When a current of *I* amperes flows through a light bulb with resistance *R* ohms, electrical energy is converted to heat at a power of *P* watts. The power is related to the current and resistance by the equation $P = I^2R$. What is the current for a light bulb of power 25 watts and resistance of 7.3 ohms? Round to the nearest hundredth.

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A. 0.47 amps

B. 1.85 amps

C. 2.64 amps

D. 3.42 amps

A B C D

CheckPoint

End of the Lesson

Click the mouse button to return to the Chapter Menu.

Lesson Menu

Five-Minute Check (over Lesson 9-2)

Main Ideas and Vocabulary

Key Concept: Angles of a Triangle

Example 1: Find Angle Measures

Example 2: Use Ratios to Find Angle Measures

Key Concept: Types of Angles

Example 3: Classify Angles

Key Concept: Classify Triangles

Example 4: Classify Triangles

Main Ideas

- Find the missing angle measure of a triangle.
- Classify triangles by properties and attributes.

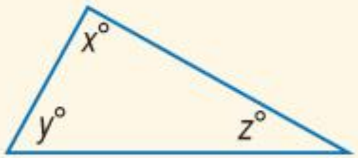
New Vocabulary

- line segment
- triangle
- vertex
- acute angle
- right angle
- obtuse angle
- straight angle
- acute triangle
- obtuse triangle
- right triangle
- congruent
- scalene triangle
- isosceles triangle
- equilateral triangle

KEY CONCEPT — *Angles of a Triangle*

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

Model



Symbols $x + y + z = 180$

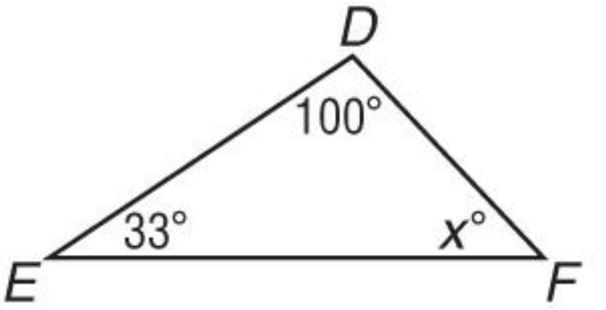
Concepts in Motion

Animation: Triangles

Click here to view!

EXAMPLE Find Angle Measures

1 Find the value of *x* in Δ*DEF*.



$$m\angle D + m\angle E + m\angle F = 180$$

$$100 + 33 + x = 180$$

$$133 + x = 180$$

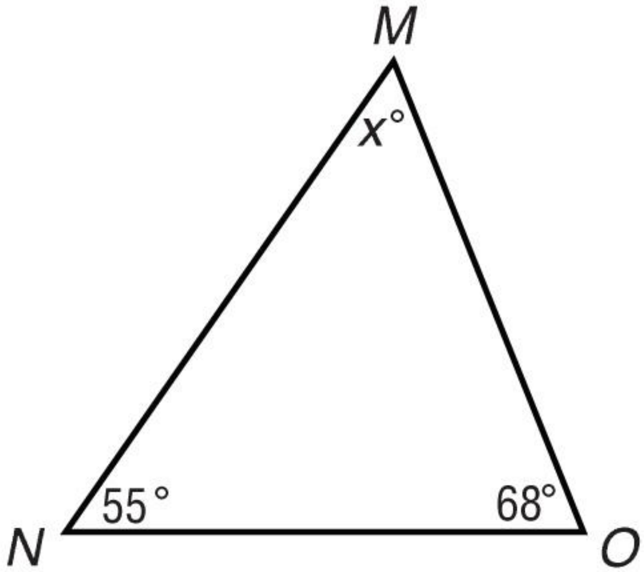
$$133 - 133 + x = 180 - 133$$

$$x = 47$$

Answer: x is 47 and the measure of $\angle F$ is 47°.

CHECK Your Progress

1 Find the value of *x* in ΔMNO.

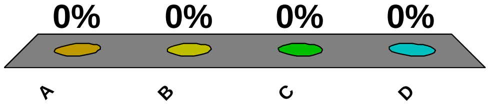


A. 57

B. 123

C. 139

D. 303



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EXAMPLE Use Ratios to Find Angle Measures

2 ALGEBRA The measures of the angles of a certain triangle are in the ratio 2:3:5. What are the measures of the angles?

Words The sum of the measures is 180°.

Variable Let $2x$ represent the measure of the first angle, $3x$ the measure of the second angle, and $5x$ the measure of the third angle.

Equation $2x + 3x + 5x = 180$ The sum of the measures is 180.

EXAMPLE **Use Ratios to Find Angle Measures**

2 $10x = 180$ Combine like terms.

$$\frac{10x}{10} = \frac{180}{10}$$ Divide each side by 10.

$x = 18$ Simplify.

Since $x = 18$, $2x = 2(18)$ or 36, $3x = 3(18)$ or 54, and $5x = 5(18)$ or 90.

Answer: The measures of the angles are 36°, 54°, and 90°.

CHECK Your Progress

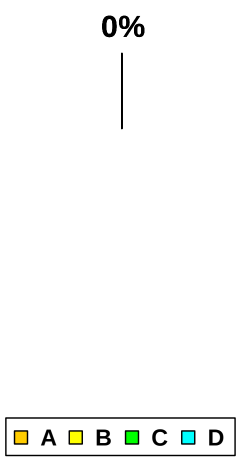
2 ALGEBRA The measures of the angles of a certain triangle are in the ratio 3:5:7. What are the measures of the angles?

A. 12°, 60°, 84°

B. 30°, 50°, 70°

C. 36°, 60°, 84°

D. 40°, 60°, 80°



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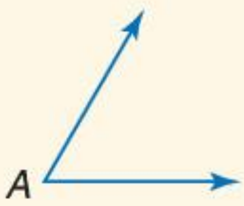
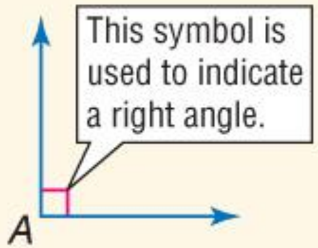
KEY CONCEPT — Types of Angles

Acute Angle



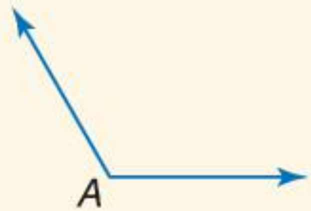
0° < m? A < 90°

Right Angle



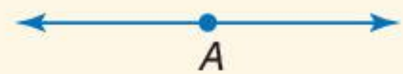
m? A = 90°

Obtuse Angle



90° < m? A < 180°

Straight Angle

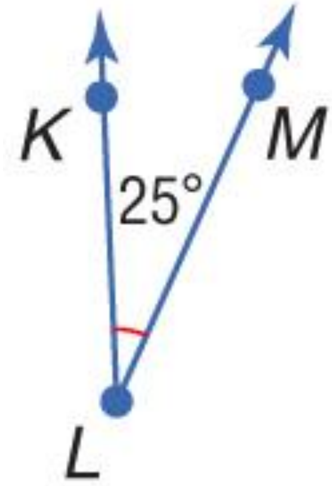


m? A = 180°

EXAMPLE 3 Classify Angles

A. Classify the angle as *acute, obtuse, right,* or *straight.*

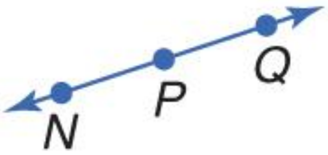
$m\angle KLM < 90$



Answer : $\angle KLM$ is acute.

EXAMPLE Classify Angles

3 **B.** **Classify the angle as *acute, obtuse, right,* or *straight.***

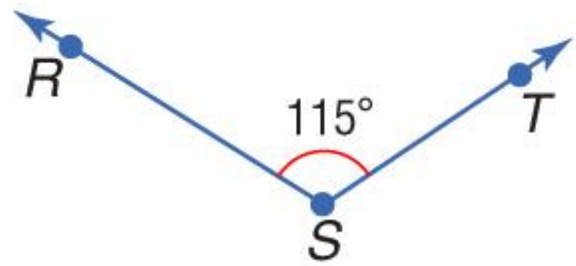


$m\angle NPQ = 180$

Answer : $\angle NPQ$ is straight.

EXAMPLE **Classify Angles**

3 **C. Classify the angle as *acute, obtuse, right,* or *straight.***

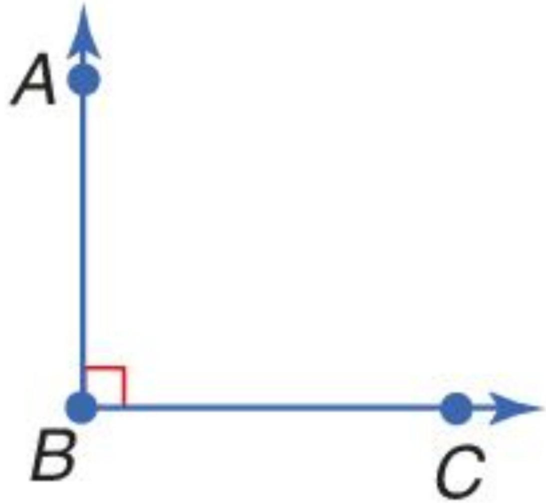


$m\angle RST > 90$

Answer : $\angle RST$ is obtuse.

CHECK Your Progress

3 **A.** **Classify the angle as *acute, obtuse, right,* or *straight.***



A. **acute**

B. **obtuse**

C. **right**

D. **straight**

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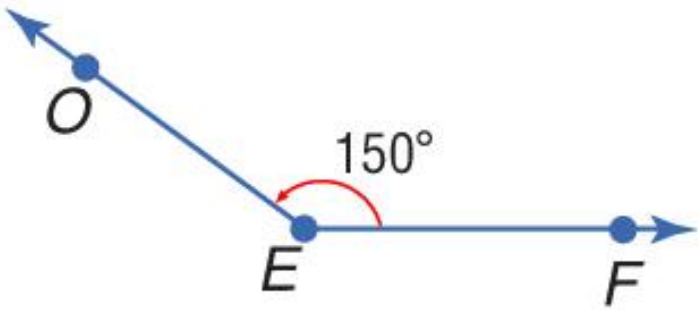
A B C D

CheckPoint

CHECK Your Progress

3 **B.** Classify the angle as *acute, obtuse, right,* or *straight.*



A. acute

B. obtuse

C. right

D. straight

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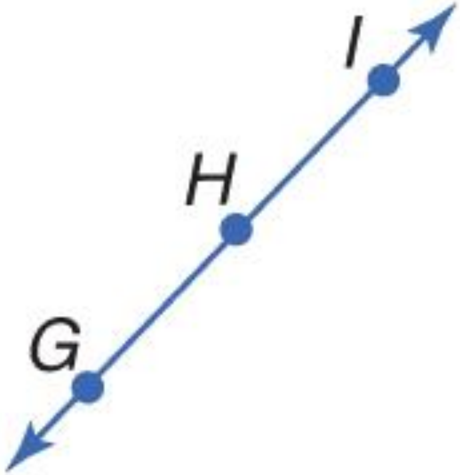
A B C D

CHECK Your Progress

3 **C.** Classify the angle as *acute, obtuse, right,* or *straight.*



A. acute

B. obtuse

C. right

D. straight

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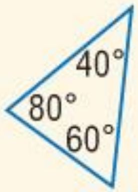
A B C D

CheckPoint

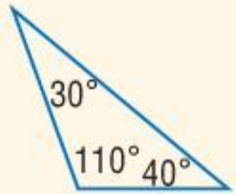
KEY CONCEPT — *Classify Triangles*

Acute Triangle



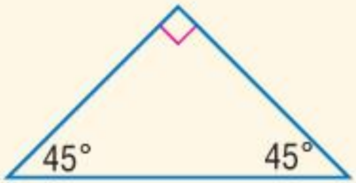
all acute angles

Obtuse Triangle



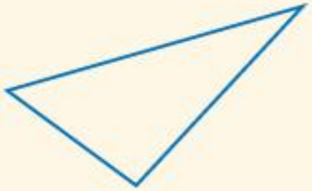
one obtuse angle

Right Triangle



one right angle

Scalene Triangle

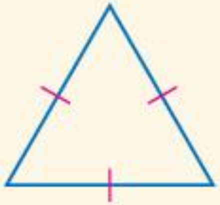


no congruent sides

Isosceles Triangle

at least two sides congruent

Equilateral Triangle



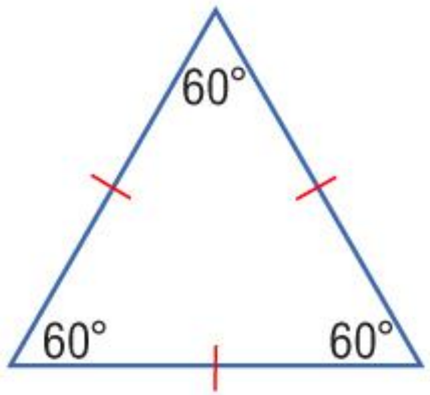
all sides congruent

EXAMPLE Classify Triangles

4 **Classify the triangle by its angles and by its sides.**

Angles All angles are acute.

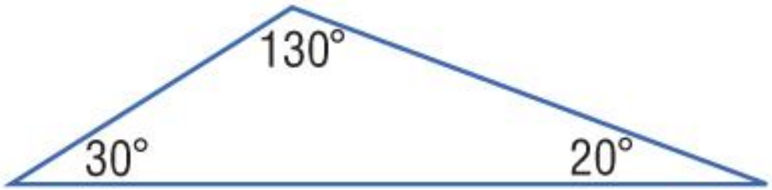
Sides All sides are congruent.



Answer: The triangle is an acute equilateral triangle.

CHECK Your Progress

4 Classify the triangle by its angles and by its sides.

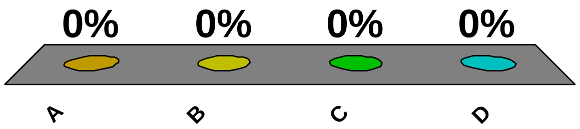


A. acute scalene

B. acute isosceles

C. obtuse scalene

D. obtuse isosceles



CheckPoint

End of the Lesson

Click the mouse button to return to the Chapter Menu.

Lesson Menu

Five-Minute Check (over Lesson 9-3)

Main Ideas and Vocabulary

Key Concept: Pythagorean Theorem

Example 1: Find the Length of the Hypotenuse

Example 2: Solve a Right Triangle

Example 3: Standardized Test Example

Example 4: Identify a Right Triangle

Main Ideas

- Use the Pythagorean Theorem to find the length of the side of a right triangle.
- Use the converse of the Pythagorean Theorem to determine whether a triangle is a right triangle.

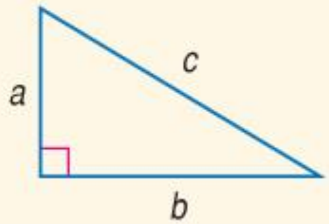
New Vocabulary

- legs
- hypotenuse
- Pythagorean Theorem
- solving a right triangle
- converse

KEY CONCEPT — *Pythagorean Theorem*

Words If a triangle is a right triangle, then the square of the length of the hypotenuse is equal to the sum of the squares of the lengths of the legs.

Model



Symbols $c^2 = a^2 + b^2$

Example

$$5^2 = 3^2 + 4^2$$
$$25 = 9 + 16$$
$$25 = 25$$

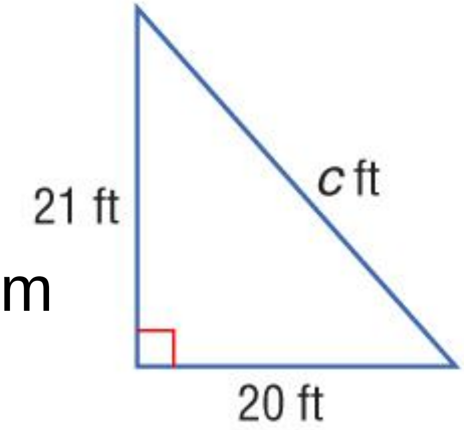
Concepts in Motion

Interactive Lab: Pythagorean Theorem

Click here to view!

EXAMPLE Find the Length of the Hypotenuse

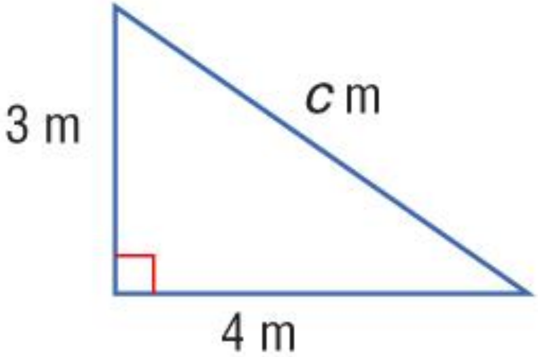
1 Find the length of the hypotenuse of the right triangle.



$c^2 = a^2 + b^2$	Pythagorean Theorem
$c^2 = 21^2 + 20^2$	Replace *a* with 21 and *b* with 20.
$c^2 = 441 + 400$	Evaluate 21^2 and 20^2.
$c^2 = 841$	Add 441 and 400.
$\sqrt{c^2} = \sqrt{841}$	Take the square root of each side.
$c = 29$	

Answer: The length of the hypotenuse is 29 feet.

CHECK Your Progress



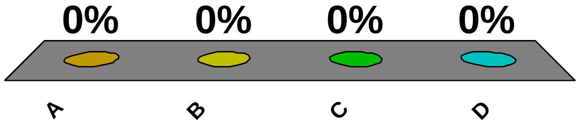
1 Find the length of the hypotenuse of the right triangle in meters.

A. 25

B. 12.5

C. 5

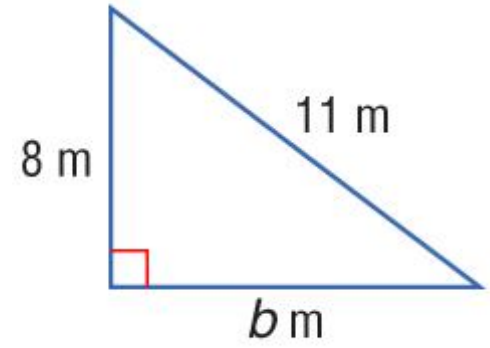
D. 2.6



CheckPoint

EXAMPLE Solve a Right Triangle

2 Find the length of the leg of the right triangle to the nearest tenth.



$c^2 = a^2 + b^2$	Pythagorean Theorem
$11^2 = 8^2 + b^2$	Replace *c* with 11 and *a* with 8.
$121 = 64 + b^2$	Evaluate 11^2 and 8^2.
$121 - 64 = 64 + b^2 - 64$	Subtract 64 from each side.
$57 = b^2$	Simplify.
$\sqrt{57} = \sqrt{b^2}$	Take the square root of each side.

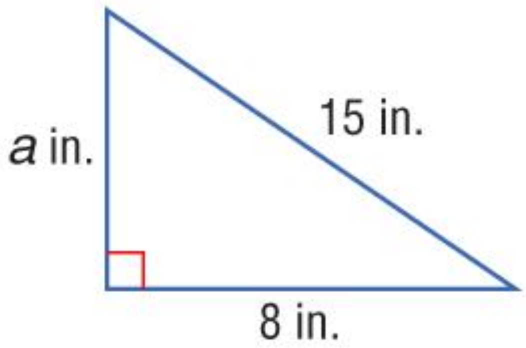
EXAMPLE **Solve a Right Triangle**

2 2nd [$\sqrt{\ }$] 57 ENTER 7.549834435

Answer: Then length of the leg is about 7.5 meters.

CHECK Your Progress

2 Find the length of the leg of the right triangle to the nearest tenth.



A. 7 in.

B. 12.7 in.

C. 13.5 in.

D. 17 in.

0%

A B C D

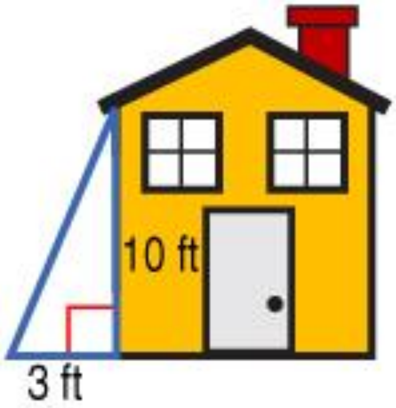
Standardized Test EXAMPLE

3 **A building is 10 feet tall. A ladder is positioned against the building so that the base of the ladder is 3 feet from the building. About how long is the ladder in feet?**

A 10.0 feet **B** 12.4 feet
C 10.4 feet **D** 14.9 feet

Read the Test Item

Make a drawing to illustrate the problem. The ladder, ground, and side of the house form a right triangle.



Solve the Test Item

Use the Pythagorean Theorem to find the length of the ladder.

Standardized Test EXAMPLE

3

$c^2 = a^2 + b^2$	Pythagorean Theorem
$c^2 = 3^2 + 10^2$	Replace *a* with 3 and *b* with 10.
$c^2 = 9 + 100$	Evaluate 3^2 and 10^2.
$c^2 = 109$	Simplify.
$\sqrt{c^2} = \sqrt{109}$	Take the square root of each side.
$c \approx 10.4$	Round to the nearest tenth.

Answer: The ladder is about 10.4 feet tall.

Check Your Progress

3 **MULTIPLE-CHOICE TEST ITEM** An 18-foot ladder is placed against a building which is 14 feet tall. About how far is the base of the ladder from the building?

A. 11.6 feet

B. 10.9 feet

C. 11.3 feet

D. 11.1 feet

0%

A B C D

CheckPoint

EXAMPLE Identify a Right Triangle

4 **A. The measures of three sides of a triangle are given. Determine whether the triangle is a right triangle.**
48 ft, 60 ft, 78 ft

$c^2 = a^2 + b^2$	Pythagorean Theorem
$78^2 \stackrel{?}{=} 48^2 + 60^2$	Replace *c* with 78, *a* with 48, and *b* with 60.
$6084 \stackrel{?}{=} 2304 + 3600$	Evaluate 78^2, 48^2, and 60^2.
$6084 \neq 5904$	Simplify.

The triangle is *not* a right triangle.

Answer: no

EXAMPLE Identify a Right Triangle

4 B. The measures of three sides of a triangle are given. Determine whether the triangle is a right triangle.
24 cm, 70 cm, 74 cm

$c^2 = a^2 + b^2$	Pythagorean Theorem
$74^2 \stackrel{?}{=} 24^2 + 70^2$	Replace *c* with 74, *a* with 24, and *b* with 70.
$5476 \stackrel{?}{=} 576 + 4900$	Evaluate 74^2, 24^2, and 70^2.
$5476 = 5476$	Simplify.

The triangle is a right triangle.

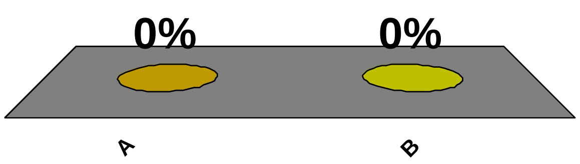
Answer: yes

CHECK Your Progress

4 **A. The measures of three sides of a triangle are given. Determine whether the triangle is a right triangle. 42 in., 61 in., 84 in.**

A. Yes, the triangle is a right triangle.

B. No, the triangle is not a right triangle.

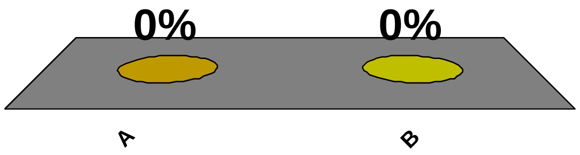


CHECK Your Progress

4 **B.** **The measures of three sides of a triangle are given. Determine whether the triangle is a right triangle.**
16 m, 30 m, 34 m

A. **Yes, the triangle is a right triangle.**

B. **No, the triangle is not a right triangle.**



End of the Lesson

Click the mouse button to return to the Chapter Menu.

Lesson Menu

Five-Minute Check (over Lesson 9-4)

Main Idea and Vocabulary

Key Concept: Distance Formula

Example 1: Use the Distance Formula

Example 2: Use the Distance Formula to Solve a Problem

Example 3: Real-World Example

Main Idea

- Use the Distance Formula to determine lengths on a coordinate plane.

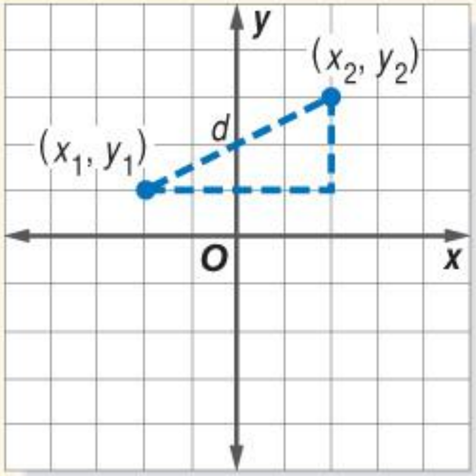
New Vocabulary

- Distance Formula

KEY CONCEPT — Distance Formula

Words The distance d between two points with coordinates (x_1, y_1) and (x_2, y_2), is given by $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$.

Model



EXAMPLE Use the Distance Formula

1 Find the distance between *M*(8, 4) and *N*(–6, –2). Round to the nearest tenth, if necessary.

Use the Distance Formula.

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$ Distance Formula

$$MN = \sqrt{(-6 - 8)^2 + (-2 - 4)^2}$$ $(x_1, y_1) = (8, 4)$, $(x_2, y_2) = (-6, -2)$

$$MN = \sqrt{(-14)^2 + (-6)^2}$$ Simplify.

$$MN = \sqrt{196 + 36}$$ Evaluate $(-14)^2$ and $(-6)^2$.

EXAMPLE **Use the Distance Formula**

1 $MN = \sqrt{232}$ Add 196 and 36.

$MN \approx 15.2$ Take the square root.

Answer: The distance between points *M* and *N* is about 15.2 units.

Check Your Progress

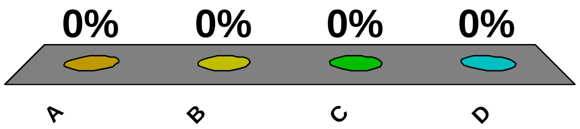
1 **Find the distance between *A*(–4, 5) and *B*(3, –9). Round to the nearest tenth, if necessary.**

A. **4.1**

B. **8.1**

C. **14.0**

D. **15.7**

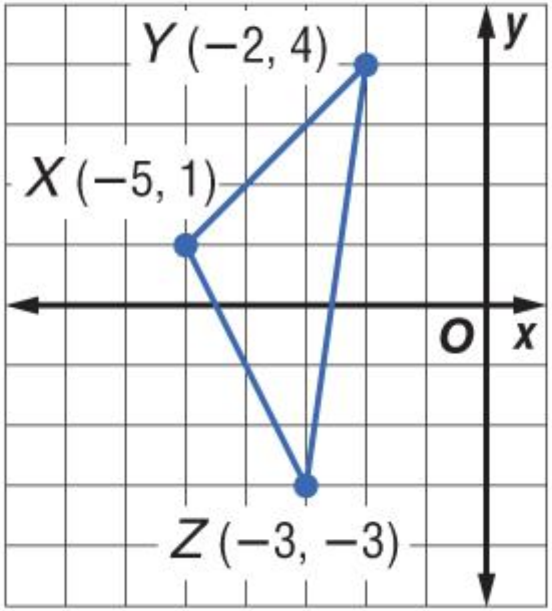


CheckPoint

EXAMPLE

Use the Distance Formula to Solve a Problem

2 **GEOMETRY** **Find the perimeter of Δ*XYZ* to the nearest tenth.**



First, use the Distance Formula to find the length of each side of the triangle.

Side $\overline{XY}$: $X(–5, 1)$, $Y(–2, 4)$

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$ Distance Formula

$$XY = \sqrt{[(-2 - (-5)]^2 + (4 - 1)^2}$$ $(x_1, y_1) = (–5, 1)$, $(x_2, y_2) = (–2, 4)$

EXAMPLE

Use the Distance Formula to Solve a Problem

2 $XY = \sqrt{(3)^2 + (3)^2}$ Simplify.

$XY = \sqrt{9 + 9}$ Evaluate powers.

$XY = \sqrt{18}$ Simplify.

Side $\overline{YZ}$: $Y(-2, 4)$, $Z(-3, -3)$

$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$ Distance Formula

$YZ = \sqrt{[(-3-(-2)]^2 + (-3-4)^2}$ $(x_1, y_1) = (-2, 4)$, $(x_2, y_2) = (-3, -3)$

$YZ = \sqrt{(-1)^2 + (-7)^2}$ Simplify.

EXAMPLE

Use the Distance Formula to Solve a Problem

2 $YZ = \sqrt{1 + 49}$ Evaluate powers.

$YZ = \sqrt{50}$ Simplify.

Side $\overline{ZX}$: $Z(–3, –3)$, $X(–5, 1)$

$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$ Distance Formula

$ZX = \sqrt{[(-5 - (-3)]^2 + [(1 - (-3)]^2}$ $(x_1, y_1) = (–3, –3)$, $(x_2, y_2) = (–5, 1)$

$ZX = \sqrt{(-2)^2 + (4)^2}$ Simplify.

$ZX = \sqrt{4 + 16}$ Evaluate powers.

EXAMPLE **Use the Distance Formula to Solve a Problem**

2 $ZX = \sqrt{20}$ Simplify.

Then add the lengths of the sides to find the perimeter.

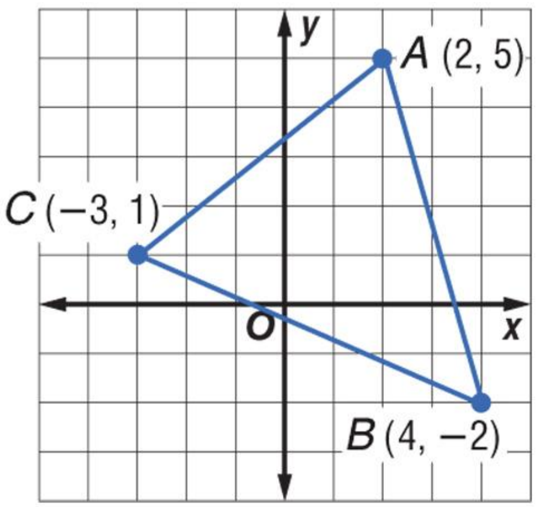
$$\sqrt{18} + \sqrt{50} + \sqrt{20} \approx 4.243 + 7.071 + 4.472$$

$$\approx 15.786$$

Answer: The perimeter is about 15.8 units.

CHECK Your Progress

2 **GEOMETRY** **Find the perimeter of Δ*XYZ* to the nearest tenth.**



A. 21.3 units

B. 14.6 units

C. 13.4 units

D. 10.9 units

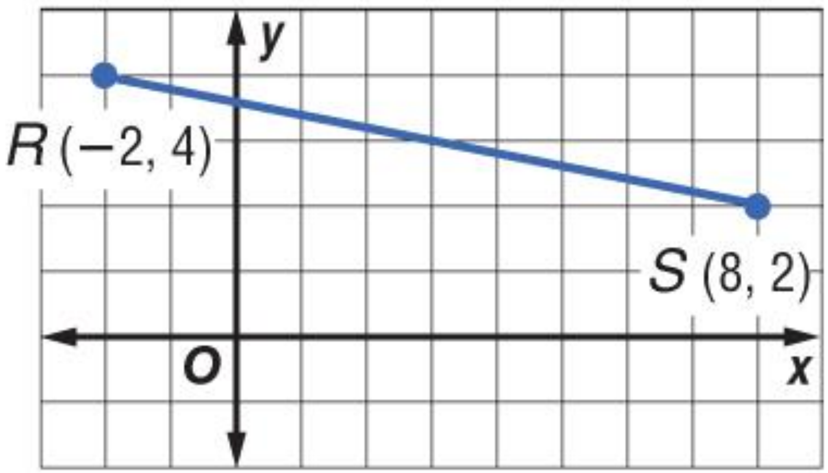
0%

A B C D

CheckPoint

Real-World EXAMPLE

3 Nikki kicks a ball from a position that is 2 yards behind the goal line and 4 yards from the side line (–2, 4). The ball lands 8 yards past the goal line and 2 yards from the same side line (8, 2). What distance, to the nearest tenth, was the ball kicked?



Real-World EXAMPLE

3 Use the distance formula.

$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$ Distance Formula

$d = \sqrt{[8 - (-2)]^2 + (2 - 4)^2}$ $(x_1, y_1) = (-2, 4)$
$(x_2, y_2) = (8, 2)$

$d = \sqrt{10^2 + (-2)^2}$ Simplify.

$d = \sqrt{100 + 4}$ Evaluate powers.

$d = \sqrt{104}$ Simplify.

$d \approx 10.2$

Answer: 10.2 yards

CHECK Your Progress

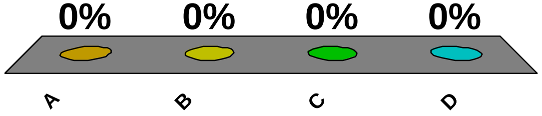
3 **MAPS** The map of a college campus shows Gilmer Hall at (7, 3) and Watson House dormitory at (5, 4). If each unit on the map represents 0.1 mile, what is the distance between these buildings?

A. 0.2 mi

B. 0.5 mi

C. 2.2 mi

D. 5 mi



End of the Lesson

Click the mouse button to return to the Chapter Menu.

Lesson Menu

Five-Minute Check (over Lesson 9-5)

Main Ideas and Vocabulary

Key Concept: Corresponding Parts of Similar Figures

Example 1: Find Measures of Similar Figures

Example 2: Real-World Example

Example 3: Real-World Example

Main Ideas

- Identify corresponding parts and find missing measures of similar figures.
- Solve problems involving indirect measurement using similar triangles.

New Vocabulary

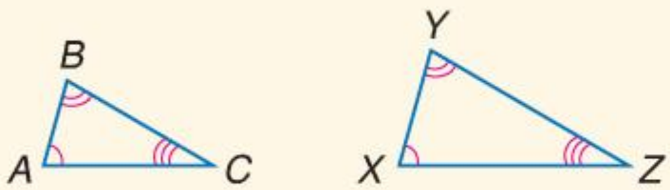
- similar figures
- indirect measurement

KEY CONCEPT — *Corresponding Parts of Similar Figures*

Words If two figures are similar, then

- the corresponding angles have the same measure, and
- the corresponding sides are proportional.

Model



$\triangle ABC \sim \triangle XYZ$

Symbols ? $A \cong$? X, ? $B \cong$? Y, ? $C \cong$? Z and $\frac{AB}{XY} = \frac{BC}{YZ} = \frac{AC}{XZ}$

Concepts in Motion

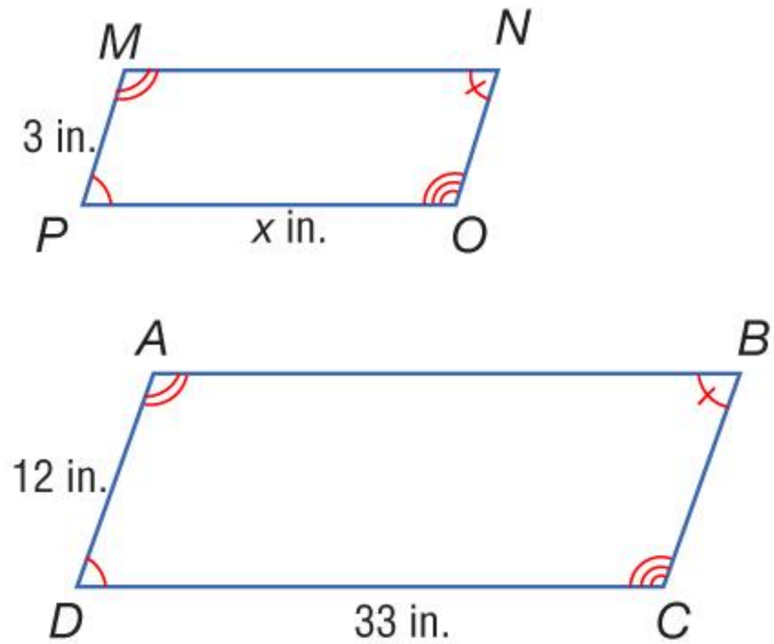
BrainPOP: Similar Triangles

Click here to view!

EXAMPLE Find Measures of Similar Figures

1 The figures are similar. Find the missing measure.

The scale factor that relates *MNOP* to *ABCD* is $\frac{3}{12}$ or $\frac{1}{4}$. Use the scale factor to relate dimensions in *MNOP*, *x*, to dimensions in *ABCD*, *y*.



$y = kx$ Direct variation equation

EXAMPLE **Find Measures of Similar Figures**

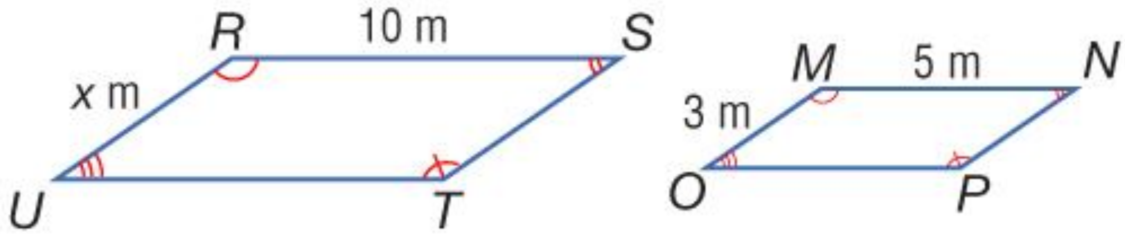
1 $d = \frac{1}{4}(33)$ Substitute.

$d = 8.25$ Multiply.

Answer: The value of *x* is 8.25.

CHECK Your Progress

1 The figures are similar. Find the missing measure.

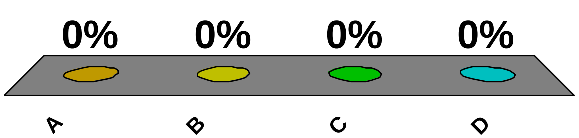


A. 1.5 m

B. 6 m

C. 10 m

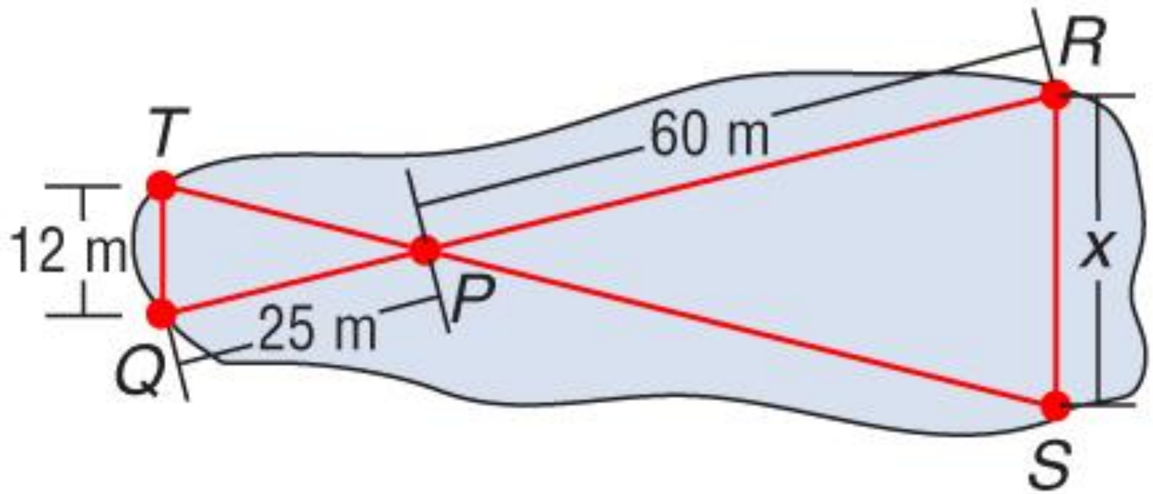
D. 16.7 m



CheckPoint

Real-World EXAMPLE

2 MAPS A surveyor wants to find the distance *RS* across the lake. He constructs Δ*PQT* similar to Δ*PRS* and measures the distances as shown. What is the distance across the lake?



The scale factor that relates Δ*PQT* to Δ*PRS* is $\frac{25}{60}$ or $\frac{5}{12}$.

Real-World EXAMPLE

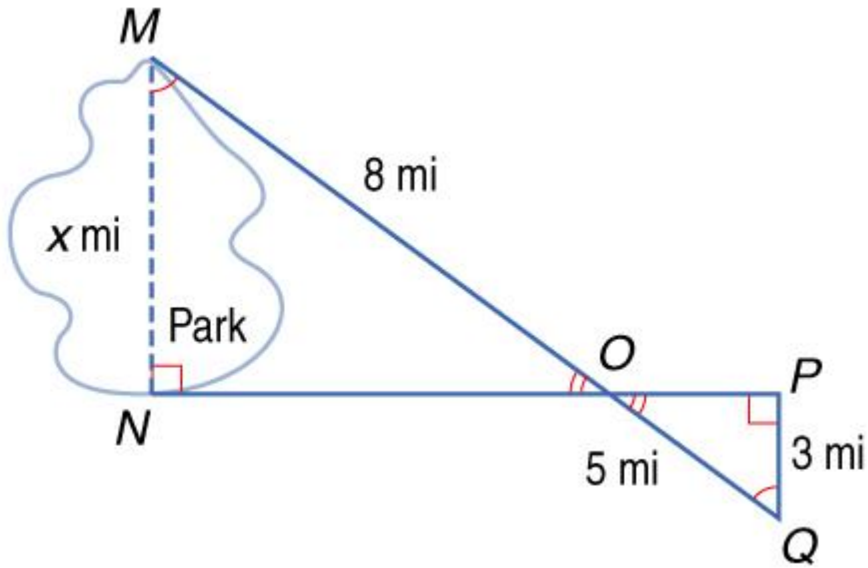
2

$y = kx$	Direct variation equation
$12 = \frac{5}{12}x$	Substitution
$144 = 5x$	Multiply each side by 12.
$\frac{144}{5} = x$	Divide each side by 5.
$28.8 = x$	

Answer: The distance across the lake is 28.8 meters.

CHECK Your Progress

2 **MAPS** In the figure, ΔMNO is similar to ΔQPO. Find the distance across the park.



A. 1.9 mi

B. 3.1 mi

C. 4.8 mi

D. 5.0 mi

0%

A B C D

Real-World EXAMPLE

3 **MONUMENTS** Suppose the San Jacinto Monument in LaPorte, Texas, casts a shadow of 285 feet at the same time a nearby tourist, who is 5 feet tall, casts a 2.5-feet shadow. How tall is the San Jacinto Monument?

Explore You know the lengths of the shadows and the height of the tourist. You need to find the height of the San Jacinto Monument.

Plan Write and solve a proportion.

Solve

$$\frac{2.5}{285} = \frac{5}{h}$$

tourist's shadow → 2.5; 5 ← tourist's height

building's shadow → 285; h ← building's height

Real-World EXAMPLE

3 $2.5 \bullet h = 285 \bullet 5$ Find the cross products.

$2.5h = 1425$ Multiply.

$h = 570$ Divide each side by 2.5.

Answer: The height of the San Jacinto Monument is 570 feet.

CHECK Your Progress

3 **BUILDING** A man standing near a building casts a 2.5-foot shadow at the same time the building casts a 200-foot shadow. If the man is 6 feet tall, how tall is the building?

A. 1200 feet

B. 480 feet

C. 83.3 feet

D. 13.3 feet

0%

A B C D

CheckPoint

End of the Lesson

Click the mouse button to return to the Chapter Menu.

Chapter Resources Menu

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Interactive Lab [Pythagorean Theorem](#)

BrainPOP [Similar Triangles](#)

Five-Minute CHECK

Lesson 9-1 (over Chapter 8)

Lesson 9-2 (over Lesson 9-1)

Lesson 9-3 (over Lesson 9-2)

Lesson 9-4 (over Lesson 9-3)

Lesson 9-5 (over Lesson 9-4)

Lesson 9-6 (over Lesson 9-5)

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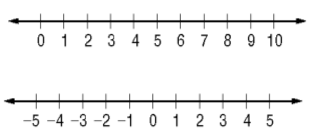
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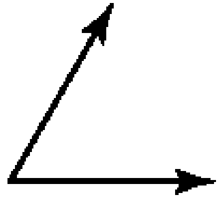
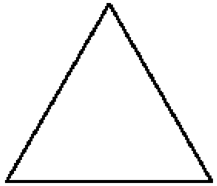
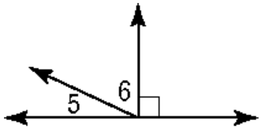
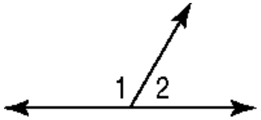
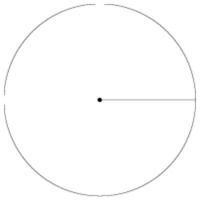
−5 −4 −3 −2 −1 0 1 2 3 4 5

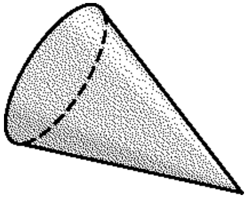


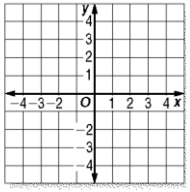


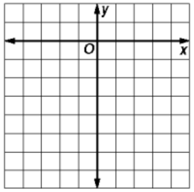

6
5

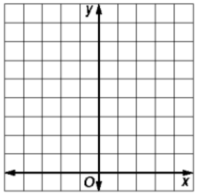

1
2






y
4
3
2
1
−4 −3 −2
O
1 2 3 4 x
−2
−3
−4


y
O
x


y
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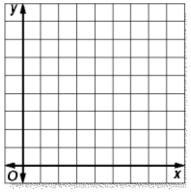
y
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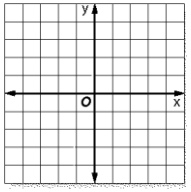
y
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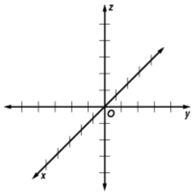
z
O
y
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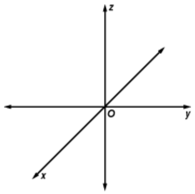
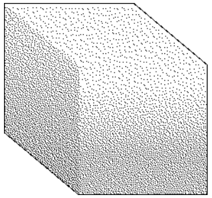
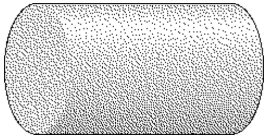
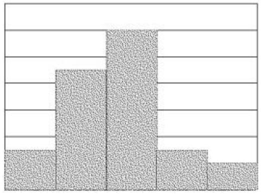
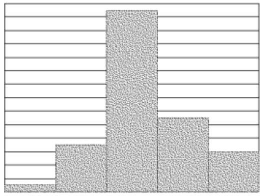
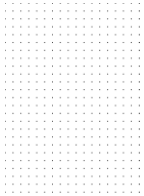

z
O
y
x











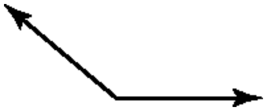


Image Bank

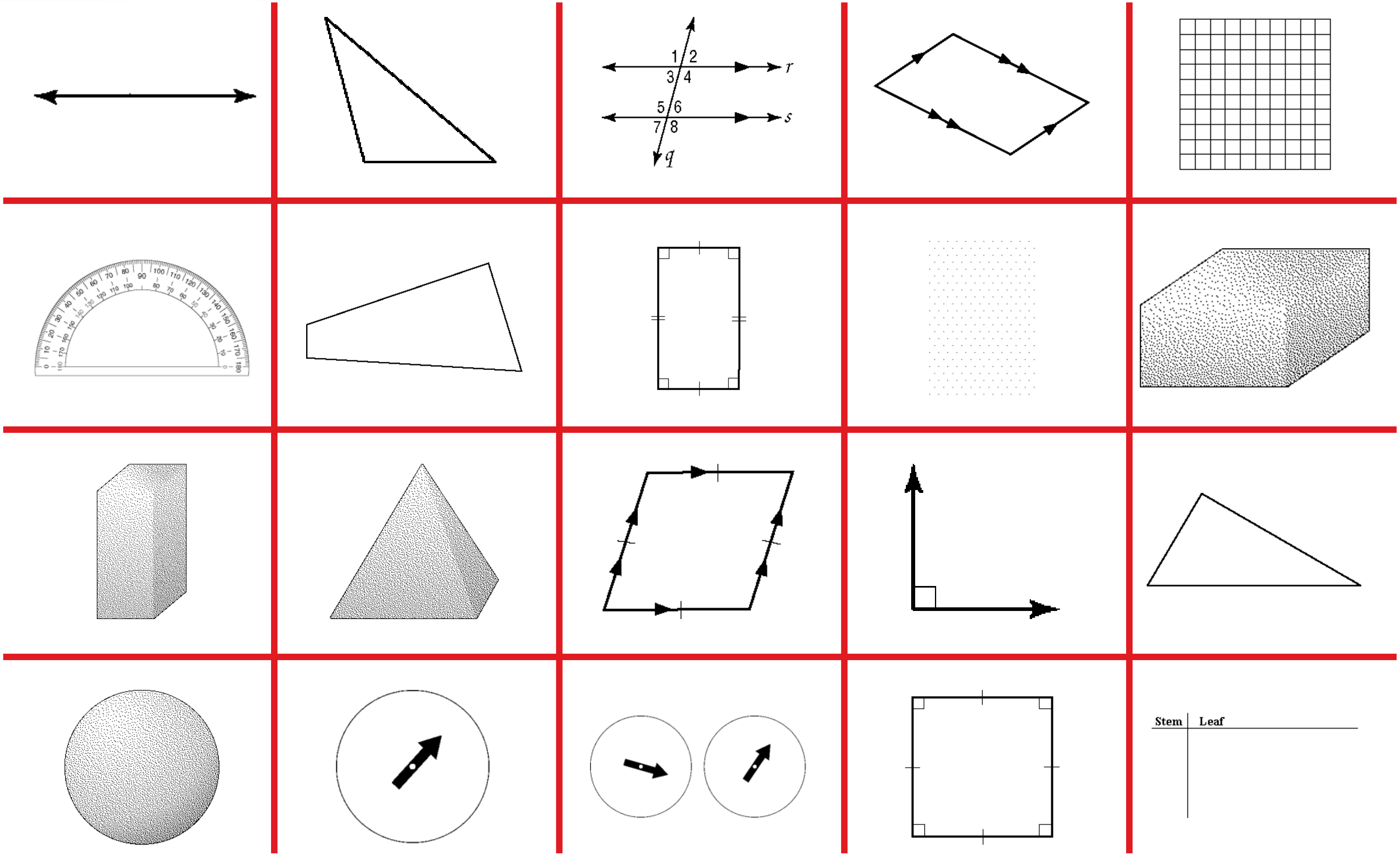
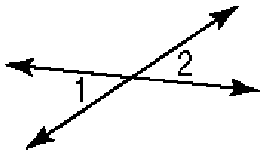
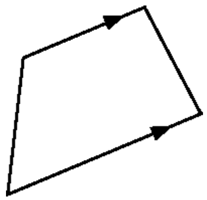
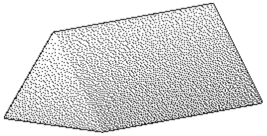
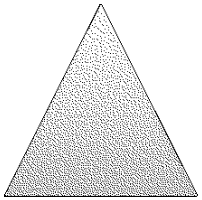


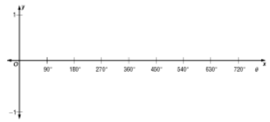
Image Bank

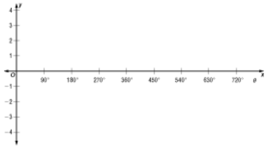


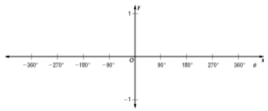


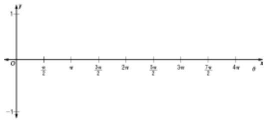


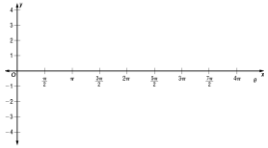


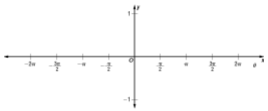












Concepts in Motion Animation

Five-Minute CHECK (over Chapter 8)

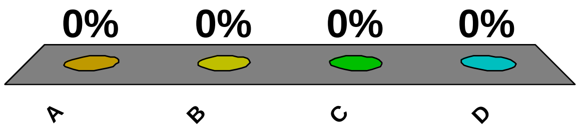
1 Solve $6x = 2x - 24$.

A. 6

B. $\frac{1}{6}$

C. $-\frac{1}{6}$

D. –6



CheckPoint

Five-Minute CHECK (over Chapter 8)

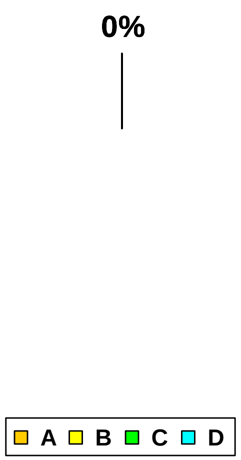
2. Solve $2(4 - 3x) = -4$.

A. 4

B. 2

C. –2

D. –4



Five-Minute CHECK (over Chapter 8)

3 Solve $3(2x - 3) = 15$.

A. 1

B. 3

C. 4

D. 6

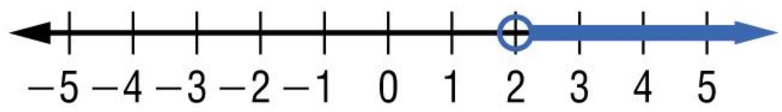
0%

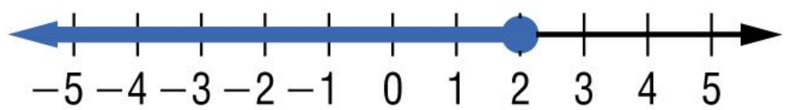
A B C D

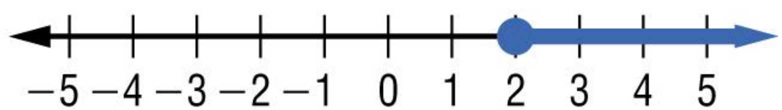
CheckPoint

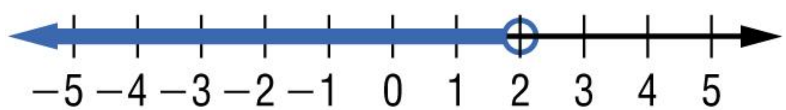
Five-Minute CHECK (over Chapter 8)

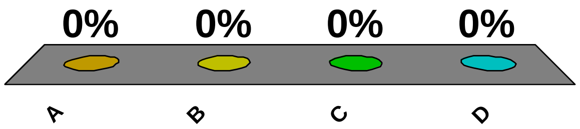
4 **Which of the following shows the solution of $10 - 8x \ge -14 + 4x$ on a number line?**

A. 

B. 

C. 

D. 



CheckPoint

Five-Minute CHECK (over Chapter 8)

5 The perimeter of a rectangle is 48 inches. The length is 3 inches less than twice the width. What are the dimensions of the rectangle?

A. $w = 4$ in., $\ell = 10$ in.

B. $w = 6$ in., $\ell = 9$ in.

C. $w = 18$ in., $\ell = 30$ in.

D. $w = 9$ in., $\ell = 15$ in.

0%

A B C D

Five-Minute CHECK (over Chapter 8)

Standardized Test Practice

6 Austin's scores are shown in the table. Which inequality represents the score he must get in the third game to have an average of more than 150?

Game	Score
1	162
2	135
3	

A. $s > 153$

0%

B. $s \geq 153$

C. $s < 153$

D. $s \leq 153$

A B C D

CheckPoint

Five-Minute CHECK (over Lesson 9-1)

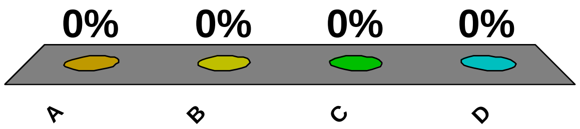
1. Find $\sqrt{49}$.

A. 7

B. 6.5

C. 8

D. not possible



CheckPoint

Five-Minute CHECK (over Lesson 9-1)

2 Find $\sqrt{121}$.

A. 11

B. 10

C. 10.5

D. not possible

0%

A B C D

CheckPoint

Five-Minute CHECK (over Lesson 9-1)

3 Estimate $-\sqrt{85}$ to the nearest whole number without using a calculator.

A. 10

B. 9

C. –9

D. –10

0%

A B C D

CheckPoint

Five-Minute CHECK (over Lesson 9-1)

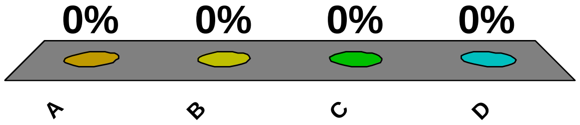
4. Estimate $\sqrt{70}$ to the nearest whole number without using a calculator.

A. –9

B. –8

C. 8

D. 9



CheckPoint

Five-Minute CHECK (over Lesson 9-1)

5 The area of a square is 200 cm^2. Estimate the length of a side of the square.

A. 13 cm

B. 14 cm

C. 15 cm

D. 16 cm

0%

A B C D

CheckPoint

Five-Minute CHECK (over Lesson 9-1)

Standardized Test Practice

6 Between what two integers is $-\sqrt{30}$?

A. between –4 and –5

B. between –5 and –6

C. between 4 or 5

D. between 5 and 6

0%

A B C D

CheckPoint

Five-Minute CHECK (over Lesson 9-2)

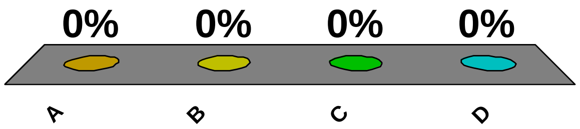
1 Name all of the sets of real numbers to which 0.545454… belongs.

A. Q

B. R

C. Q, R

D. Q, R, S



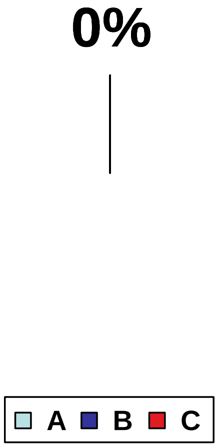
Five-Minute CHECK (over Lesson 9-2)

2. Use <, >, or = to make $\sqrt{38}$ __ $6\frac{1}{4}$ a true statement.

A. <

B. >

C. =



Five-Minute CHECK (over Lesson 9-2)

3 Order $3.22\ldots, \sqrt{10}, 3\frac{1}{5}, \frac{7}{2}$ from least to greatest.

A. $3.22\ldots, \sqrt{10}, \frac{7}{2}, 3\frac{1}{5}$

B. $3.22\ldots, \sqrt{10}, 3\frac{1}{5}, \frac{7}{2}$

C. $\sqrt{10}, 3.22\ldots, 3\frac{1}{5}, \frac{7}{2}$

D. $\sqrt{10}, 3\frac{1}{5}, 3.22\ldots, \frac{7}{2}$

0%

A B C D

CheckPoint

Five-Minute CHECK (over Lesson 9-2)

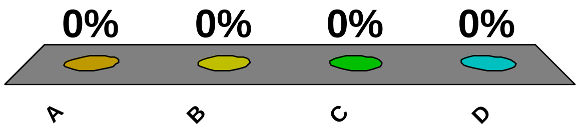
4 Solve $y^2 = 12$. Round to the nearest tenth, if necessary.

A. 3.3, –3.3

B. 3.4, –3.4

C. 3.5, –3.5

D. 3.6, –3.6



Five-Minute CHECK (over Lesson 9-2)

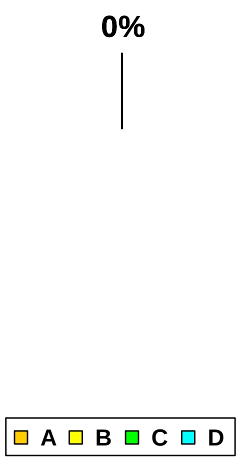
5 Use the formula $r = \sqrt{\frac{A}{\pi}}$ where A is the area of the circle to find the radius of a circle whose area is 145 square feet.

A. 3.8 feet

B. 6.8 feet

C. 12.2 feet

D. 23.1 feet



CheckPoint

Five-Minute CHECK (over Lesson 9-2)

Standardized Test Practice

6 Which number is not irrational?

A. 0.121121112...

B. $\sqrt{55}$

C. $-\sqrt{1}$

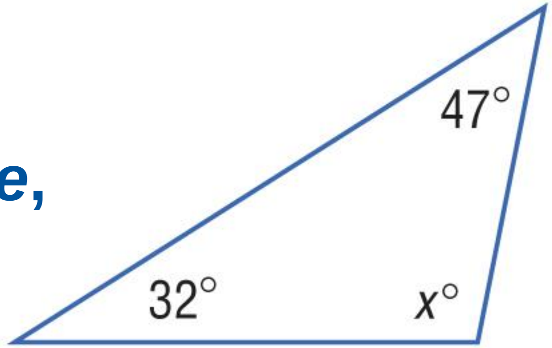
D. –3.14159...

0%

A B C D

CheckPoint

Five-Minute CHECK (over Lesson 9-3)



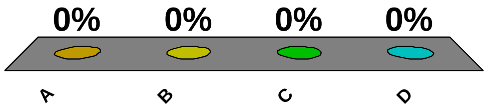
1 Find the value of *x*, and classify the triangle in the image as *acute*, *right*, or *obtuse*.

A. 21; acute

B. 79; acute

C. 90; right

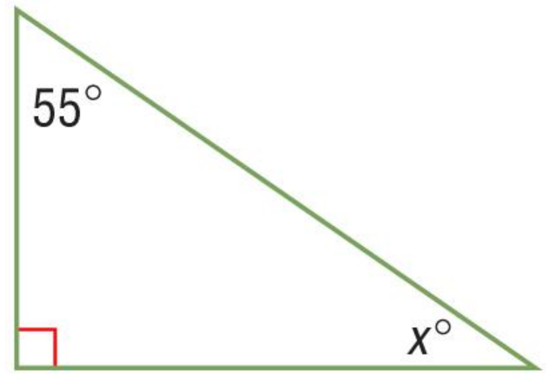
D. 101; obtuse



CheckPoint

Five-Minute CHECK (over Lesson 9-3)

2 **Find the value of *x*, and classify the triangle in the image as *acute*, *right*, or *obtuse*.**

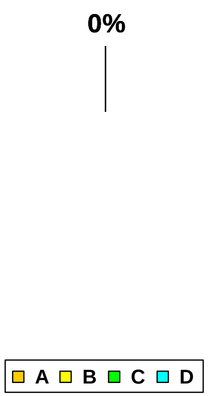


A. 20; acute

B. 35; right

C. 55; acute

D. 90; right



CheckPoint

Five-Minute CHECK (over Lesson 9-3)

3 The measures of the angles of a triangle are in the ratio 2:3:4. What is the measure of each angle?

A. 40°, 60°, 80°

B. 30°, 60°, 90°

C. 30°, 50°, 120°

D. 20°, 40°, 80°

0%

A B C D

CheckPoint

Five-Minute CHECK (over Lesson 9-3)

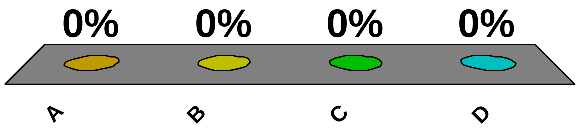
4 The measure of the angles of a triangle are in the ratio 1:1:7. What is the measure of the obtuse angle of the triangle?

A. 70°

B. 105°

C. 120°

D. 140°



CheckPoint

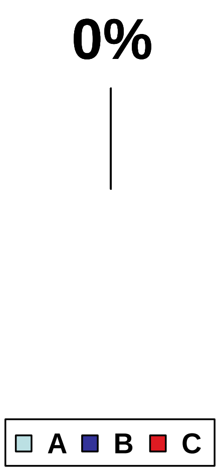
Five-Minute CHECK (over Lesson 9-3)

5 Determine whether the statement is sometimes, always, or never true. A scalene triangle has two congruent sides.

A. sometimes true

B. always true

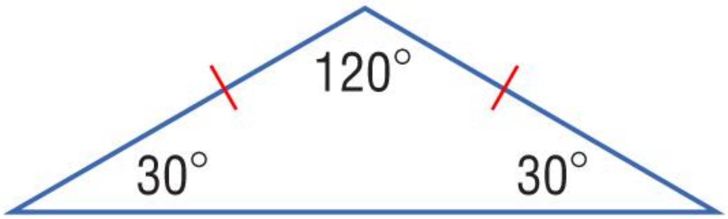
C. never true



Five-Minute CHECK (over Lesson 9-3)

Standardized Test Practice

6 Classify the triangle shown in the figure by its angles and by its sides.



A. obtuse, isosceles

B. obtuse, scalene

C. acute, isosceles

D. acute, scalene

0%

A B C D

CheckPoint

Five-Minute CHECK (over Lesson 9-4)

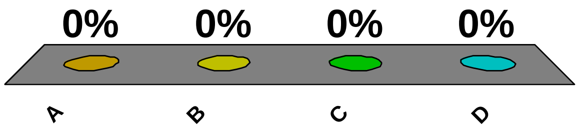
1 If *c* is the measure of the hypotenuse, find *c* when *a* = 8 and *b* = 15. Round to the nearest tenth, if necessary.

A. 15

B. 17

C. 20

D. 23



CheckPoint

Five-Minute CHECK (over Lesson 9-4)

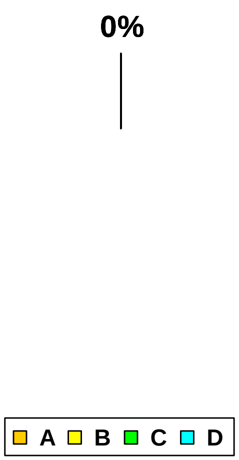
2 If *c* is the measure of the hypotenuse, find *b* when *a* = 6 and *c* = 16. Round to the nearest tenth, if necessary.

A. 17.1

B. 16

C. 14.8

D. 10



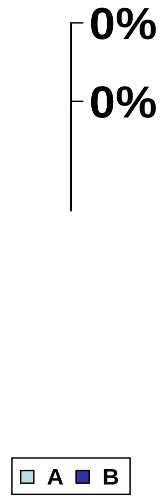
CheckPoint

Five-Minute CHECK (over Lesson 9-4)

3 **Determine whether the triangle is a right triangle, if the lengths of its three sides are given by *a* = 7, *b* = 24, and *c* = 25.**

A. yes

B. no

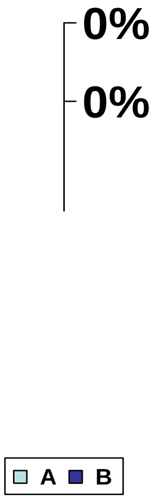


Five-Minute CHECK (over Lesson 9-4)

4 **Determine whether the triangle is a right triangle, if the lengths of its three sides are given by *a* = 10, *b* = 12, and *c* = 15.**

A. yes

B. no



Five-Minute CHECK (over Lesson 9-4)

5 A computer screen has a diagonal of 14 inches. The width of the screen is 11 inches. Find the height of the screen. Round to the nearest tenth, if necessary.

A. 25 in.

B. 17.8 in.

C. 8.7 in.

D. 3 in.

0%

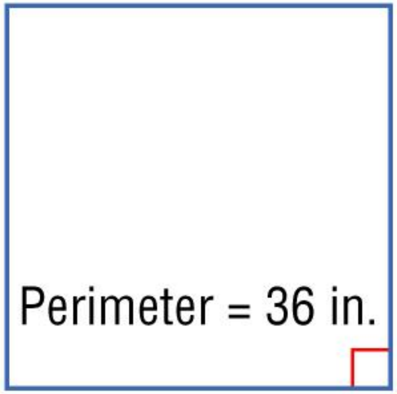
A B C D

CheckPoint

Five-Minute CHECK (over Lesson 9-4)

Standardized Test Practice

6 What is the length of the diagonal of the square shown in the figure?



A. 6 in.

B. 8.5 in.

C. 9 in.

D. 12.7 in.

0%

A B C D

CheckPoint

Five-Minute CHECK (over Lesson 9-5)

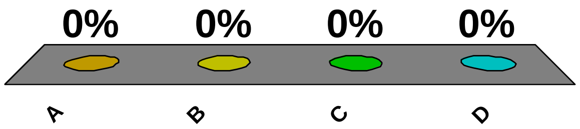
1 **Find the distance between the points *A*(2, –3) and *B*(8, 5). Round to the nearest tenth, if necessary.**

A. 5.2

B. 7

C. 10

D. 12.8



CheckPoint

Five-Minute CHECK (over Lesson 9-5)

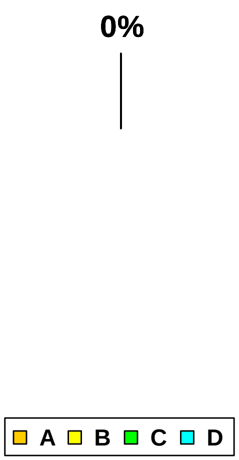
2 Find the distance between the points *C*(4, –1) and *D*(–3, –4). Round to the nearest tenth, if necessary.

A. 9

B. 7.6

C. 5

D. 3.1



CheckPoint

Five-Minute CHECK (over Lesson 9-5)

3 Find the coordinates of the midpoint of the segment with endpoints *G*(–5, 0) and *H*(–1, 6).

A. (2, –3)

B. (–3, 2)

C. (3, –3)

D. (–3, 3)

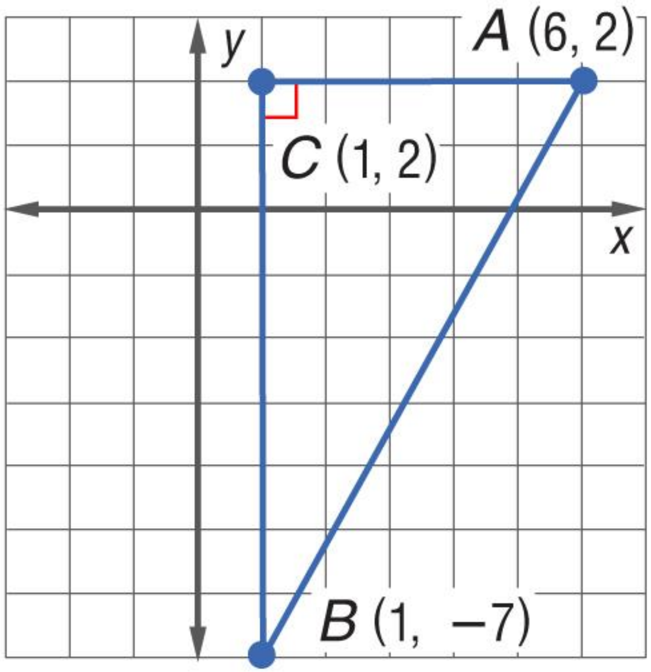
0%

A B C D

CheckPoint

Five-Minute CHECK (over Lesson 9-5)

4 Find the perimeter of the figure shown. Round to the nearest tenth, if necessary.

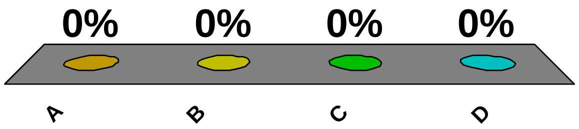


A. 23.3

B. 23.4

C. 24.3

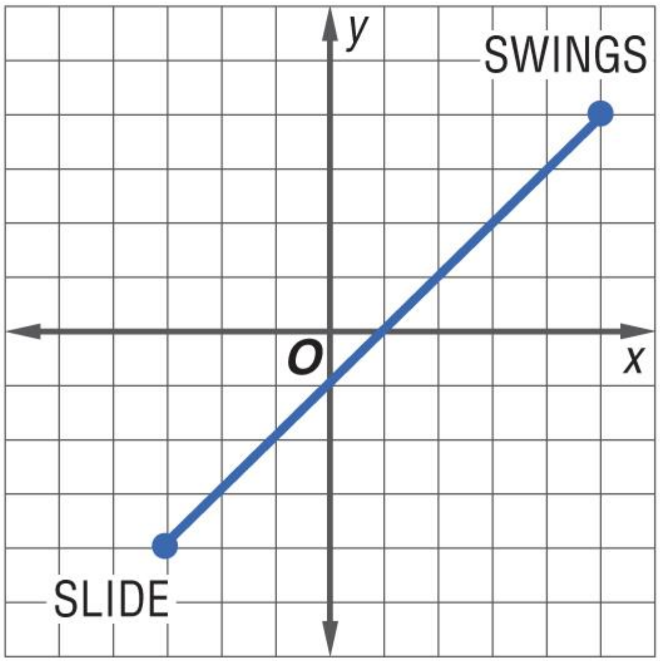
D. 24.4



Five-Minute CHECK (over Lesson 9-5)

Standardized Test Practice

5 The design for a playground is shown on the grid. The water fountain will be placed halfway between the swings and the slide. What will be the coordinates of the water fountain?



A. (1, 0)

B. (4, 0)

C. (0, 1)

D. (1, 4)

0%

A B C D

CheckPoint