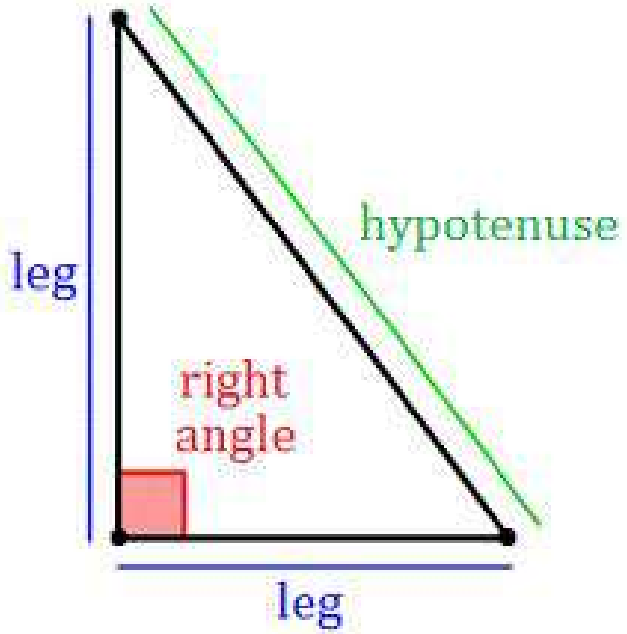
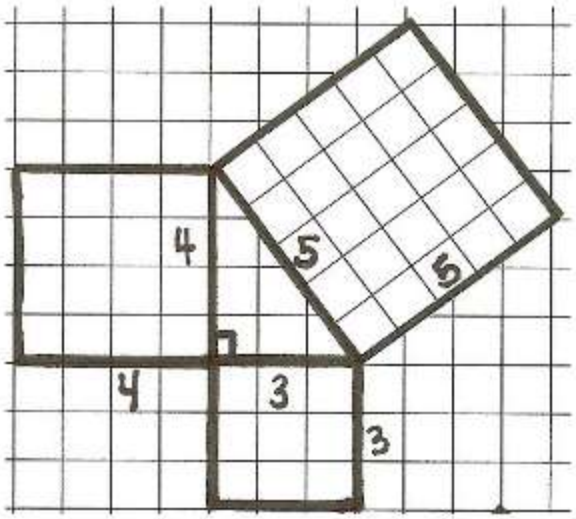
Warm UP

Get a slip of paper from the chair. Follow the directions and answer the questions.



Name: _____

Fill out this sheet and be ready to report back to the class.



What are the lengths of the legs of the right triangle? _____

What is the length of the hypotenuse? _____

What are the areas of the squares off of the legs? _____

What is the sum of those two areas? _____

What is the area of the square off of the hypotenuse? _____

Explain the relationship between the sum of the areas off of the legs and area off of the hypotenuse?

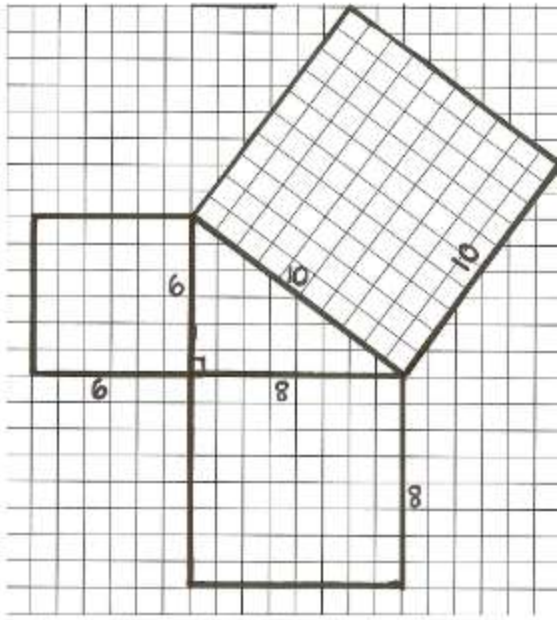
_____

Do you think all right triangles will have lengths that are integers? Explain. _____

_____

Name: _____

Fill out this sheet and be ready to report back to the class.



What are the lengths of the legs of the right triangle? _____

What is the length of the hypotenuse? _____

What are the areas of the squares off of the legs? _____

What is the sum of those two areas? _____

What is the area of the square off of the hypotenuse? _____

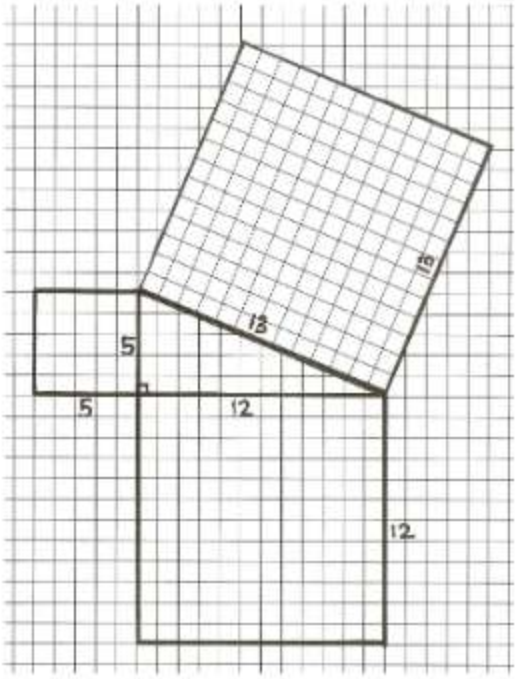
Explain the relationship between the sum of the areas off of the legs and area off of the hypotenuse?

_____

Do you think all right triangles will have lengths that are integers? Explain. _____

Name: _____

Fill out this sheet and be ready to report back to the class.



What are the lengths of the legs of the right triangle? _____

What is the length of the hypotenuse? _____

What are the areas of the squares off of the legs? _____

What is the sum of those two areas? _____

What is the area of the square off of the hypotenuse? _____

Explain the relationship between the sum of the areas off of the legs and area off of the hypotenuse?

_____

Do you think all right triangles will have lengths that are integers? Explain. _____

6-1 The Pythagorean Theorem

Proof Video

The Pythagorean Theorem

Review

Find each value to the nearest tenth.

1. $\sqrt{30}$
2. $\sqrt{14}$
3. $\sqrt{55}$
4. $\sqrt{48}$

The Pythagorean Theorem

- **Essential Question**

How can you use the Pythagorean Theorem to solve problems?

- **Standard**

MCC8.G.7: Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.

Vocabulary

Pythagorean Theorem

leg

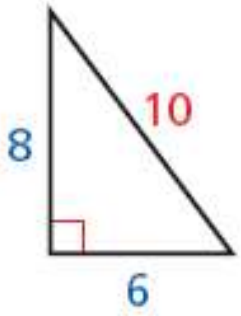
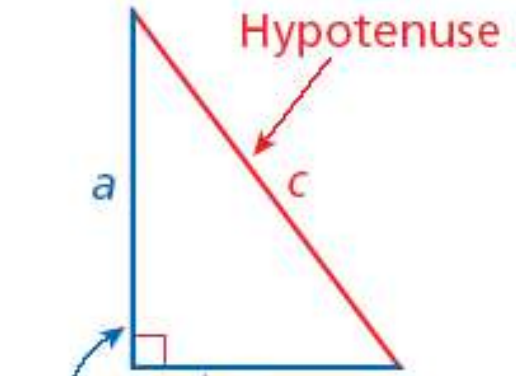
hypotenuse

The Pythagorean Theorem

Pythagoras was born on the Aegean island of Samos. He is best known for the *Pythagorean Theorem*, which relates the side lengths of a right triangle.

The Pythagorean Theorem

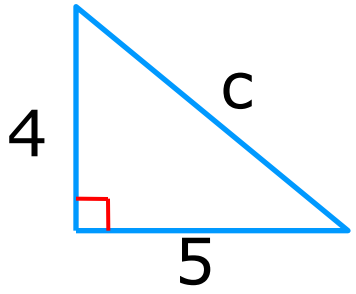
THE PYTHAGOREAN THEOREM

Words	Numbers	Algebra
In any right triangle, the sum of the squares of the lengths of the two **legs** is equal to the square of the length of the **hypotenuse**.	 $6^2 + 8^2 = 10^2$ $36 + 64 = 100$	 $a^2 + b^2 = c^2$

The Pythagorean Theorem

Additional Example 1A: Finding the Length of a Hypotenuse

Find the length of the hypotenuse to the nearest hundredth.



$a^2 + b^2 = c^2$ *Pythagorean Theorem*

$4^2 + 5^2 = c^2$ *Substitute for a and b.*

$16 + 25 = c^2$ *Simplify powers.*

$41 = c^2$

$\sqrt{41} = c$ *Solve for c; $c = \sqrt{c^2}$.*

$6.40 \approx c$

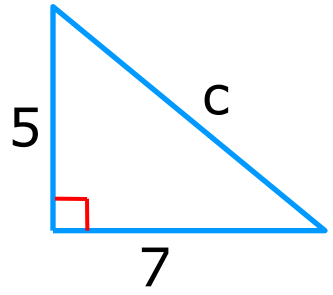
The Pythagorean Theorem

Helpful Hint

When using the Pythagorean Theorem to find length, use only the principal square root.

Check It Out: Example 1A

Find the length of the hypotenuse to the nearest hundredth.



$a^2 + b^2 = c^2$ *Pythagorean Theorem*

$5^2 + 7^2 = c^2$ *Substitute for a and b.*

$25 + 49 = c^2$ *Simplify powers.*

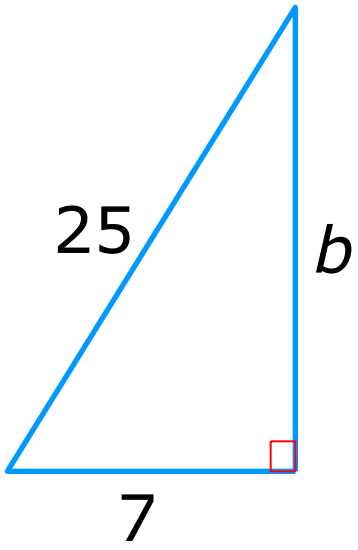
$\sqrt{74} = c$ *Solve for c; $c = \sqrt{c^2}$.*

$8.60 \approx c$

The Pythagorean Theorem

Additional Example 2: Finding the Length of a Leg in a Right Triangle

Solve for the unknown side in the right triangle to the nearest tenth.

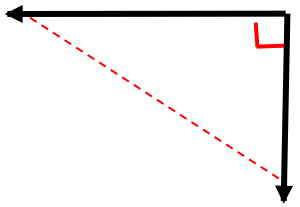


$a^2 + b^2 = c^2$	*Pythagorean Theorem*
$7^2 + b^2 = 25^2$	*Substitute for a and c.*
$49 + b^2 = 625$	*Simplify powers.*
$-49 \quad -49$	*Subtract 49 from each side.*
$b^2 = 576$	
$b = 24$	*Find the positive square root.*

The Pythagorean Theorem

Additional Example 3: Using the Pythagorean Theorem for Measurement

Two airplanes leave the same airport at the same time. The first plane flies to a landing strip 350 miles south, while the other plane flies to an airport 725 miles west. How far apart are the two planes after they land?



$a^2 + b^2 = c^2$ *Pythagorean Theorem*

$350^2 + 725^2 = c^2$ *Substitute for a and b.*

$122{,}500 + 525{,}625 = c^2$ *Simplify powers.*

$648{,}125 = c^2$ *Add.*

$805 \approx c$ *Find the positive square root.*

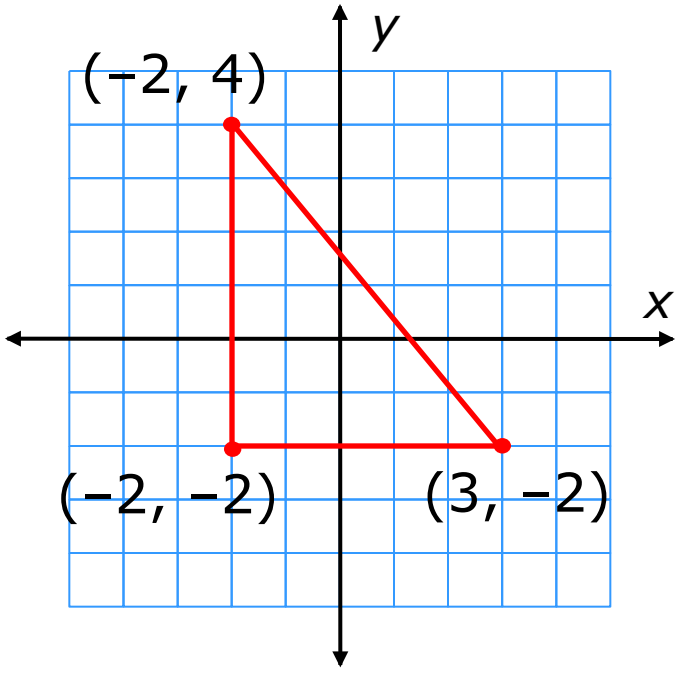
The two planes are approximately 805 miles apart.

The Pythagorean Theorem

Check It Out: Example 1B

Find the length of the hypotenuse to the nearest hundredth.

triangle with coordinates (–2, –2), (–2, 4), and (3, –2)



The points form a right triangle.

$a^2 + b^2 = c^2$ *Pythagorean Theorem*

$6^2 + 5^2 = c^2$ *Substitute for a and b.*

$36 + 25 = c^2$ *Simplify powers.*

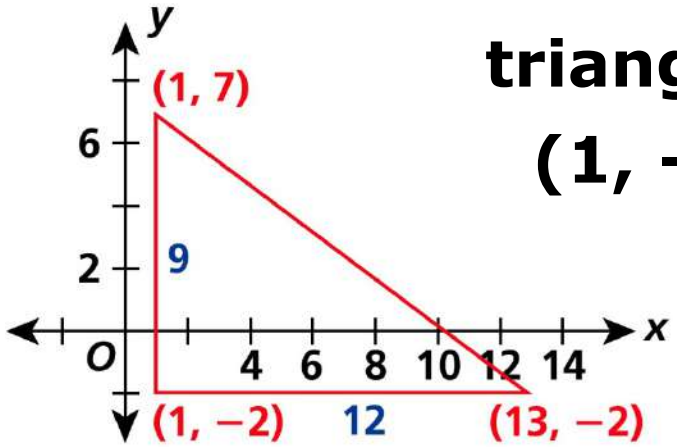
$\sqrt{61} = c$ *Solve for c; $c = \sqrt{c^2}$.*

$7.81 \approx c$

The Pythagorean Theorem

Additional Example 1B: Finding the Length of a Hypotenuse

Find the length of the hypotenuse to the nearest hundredth.



triangle with coordinates (1, –2), (1, 7), and (13, –2)

$a^2 + b^2 = c^2$ *Pythagorean Theorem*

$9^2 + 12^2 = c^2$ *Substitute for a and b.*

$81 + 144 = c^2$ *Simplify powers.*

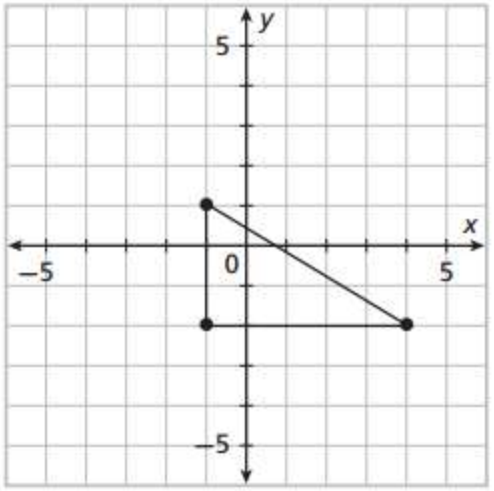
$\sqrt{225} = c$ *Solve for c; $c = \sqrt{c^2}$.*

$15 = c$

MCC8.G.8

2 EXAMPLE Pythagorean Theorem in the Coordinate Plane

Approximate the length of the hypotenuse to the nearest tenth without using a calculator.



Find the length of the vertical leg: _____ units

Find the length of the horizontal leg: _____ units

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

$\square^2 + \square^2 = c^2$ *Substitute into the formula.*

$\square + \square = c^2$ *Simplify.*

$\square = c^2$ *Add.*

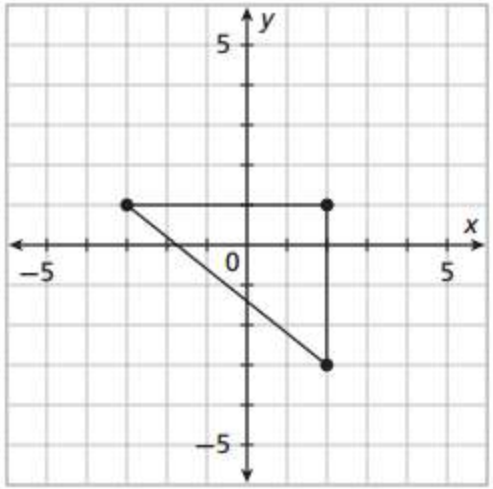
$\sqrt{\square} = c$ *Take the square root of both sides.*

$\sqrt{\square}$ is between _____ and _____, so $\sqrt{\square} \approx \square$.

The hypotenuse is about _____ units long.

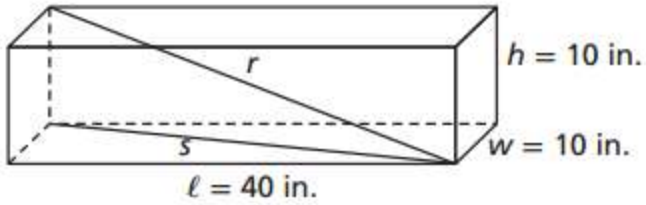
TRY THIS!

2a. Approximate the length of the hypotenuse to the nearest tenth without using a calculator.



3 EXAMPLE Pythagorean Theorem in Three Dimensions

Mr. Woo wants to ship a fishing rod that is 42 inches long to his son. He has a box that measures 10 inches by 10 inches by 40 inches. Will the fishing rod fit in the box?



Will the rod fit in the bottom of the box?

Let s represent the length of the diagonal across the bottom of the box.

$w^2 + \ell^2 = s^2$

$10^2 + \square^2 = s^2$ *Substitute into the formula.*

$\square + \square = s^2$ *Simplify.*

$\square = s^2$ *Add.*

$\sqrt{\square} = s$ *Take the square root of both sides.*

$\square \approx s$ *Use a calculator to round to the nearest tenth.*

Will the rod fit diagonally from one bottom corner to the opposite top corner?

Let r represent the length from a bottom corner to the opposite top corner.

$h^2 + s^2 = r^2$

$\square^2 + \sqrt{\square}^2 = r^2$ *Substitute into the formula. Use the value for s^2.*

$\square + \square = r^2$ *Simplify.*

$\square = r^2$ *Add.*

$\sqrt{\square} = r$ *Take the square root of both sides.*

$\square \approx r$ *Use a calculator to round to the nearest tenth.*

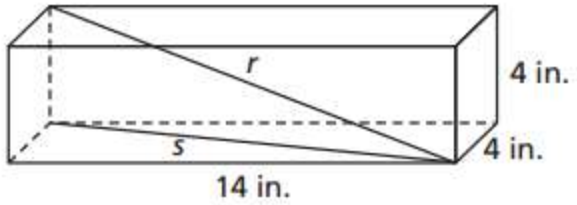
$\sqrt{} = r$ *Take the square root of both sides.*

$\approx r$ *Use a calculator to round to the nearest tenth.*

Explain whether the rod will fit in the box. If so, tell how.

TRY THIS!

3. Tina ordered a replacement part for her desk. It was shipped in a box that measures 4 in. by 4 in. by 14 in. What is the greatest length in whole inches that the part could have been?



The Pythagorean Theorem

Workbook Pg. 142

Scan for answers

Review Video

The Pythagorean Theorem

Day 2

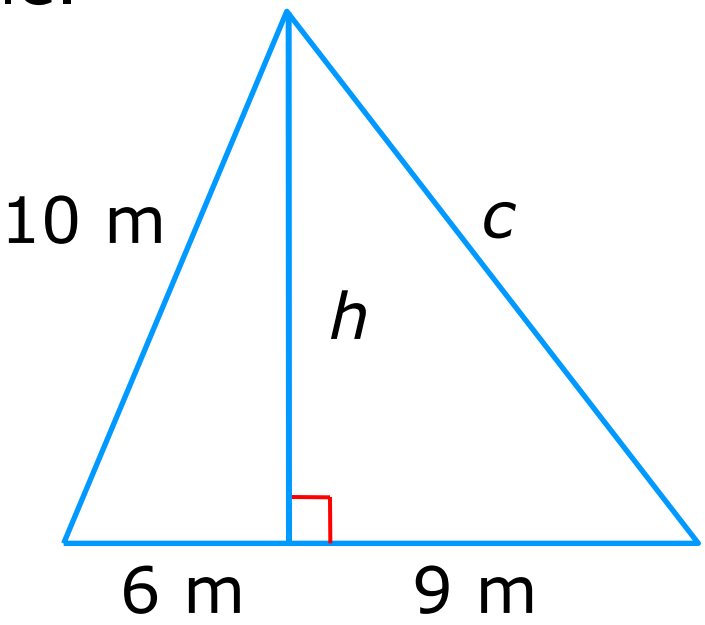
Review

1. Find the height *h* of the triangle.

8 m

2. Find the length of side *c* to the nearest meter.

12 m



The Pythagorean Theorem

- **Essential Question**

How can you use the Pythagorean Theorem to solve problems?

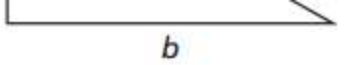
- **Standard**

MCC8.G.7: Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.

6-2 Applying the Pythagorean Theorem and Its Converse

1. Video

"If $a^2 + b^2 = c^2$, then the triangle is a right triangle."



MCC8.G.6

2 EXPLORE Testing the Converse of the Pythagorean Theorem

Decide whether the converse of the Pythagorean Theorem is true.

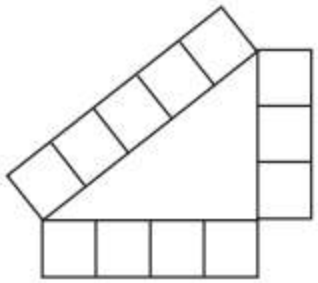
A Verify that the following sets of lengths make the equation $a^2 + b^2 = c^2$ true. Record your results in the table.

a	b	c	Is $a^2 + b^2 = c^2$ true?	Makes a right triangle?
3	4	5		
5	12	13		
7	24	25		
8	15	17		
20	21	29		

B For each set of lengths in the table, cut strips of grid paper with a width of one square and lengths that correspond to the values of a, b, and c.

C For each set of lengths, use the strips of grid paper to try to form a right triangle. An example using the first set of lengths is shown here.

Record your findings in the table.



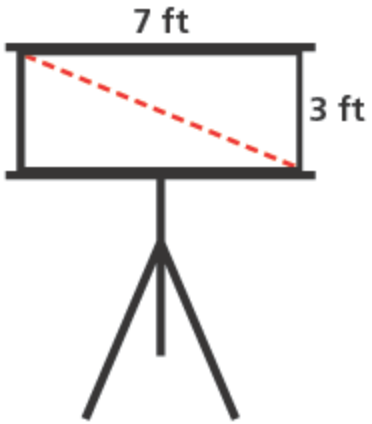
REFLECT

2. Based on your observations, explain whether you think the converse of the Pythagorean Theorem is true.

The Pythagorean Theorem

Additional Example 1: Marketing Application

What is the diagonal length of the projector screen?



$7^2 + 3^2 = c^2$ *Use the Pythagorean Theorem*

$49 + 9 = c^2$ *Simplify.*

$58 = c^2$ *Add.*

$\sqrt{58} = c$

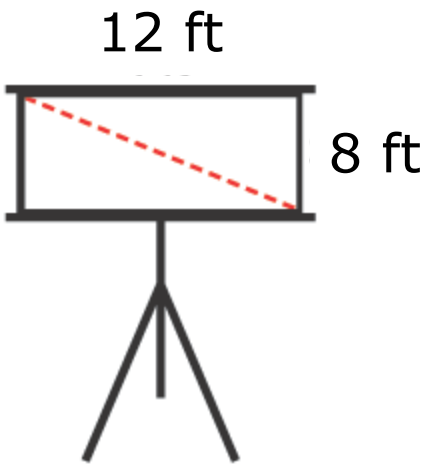
$7.615 \approx c$

The diagonal length should be given as about 7.62 feet.

The Pythagorean Theorem

Check It Out: Example 1

What is the diagonal length of the projector screen?



$12^2 + 8^2 = c^2$ *Use the Pythagorean Theorem*

$144 + 64 = c^2$ *Simplify.*

$208 = c^2$ *Add.*

$\sqrt{208} = c$

$14.42 \approx c$

The diagonal length should be given as about 14.4 feet.

Theorem twice or using the three-dimensional Pythagorean Theorem formula. Which method do you prefer? Why?

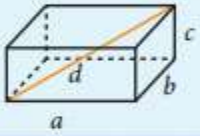
Step 5: Find a rectangular box in your classroom. Measure and record the length, width and height of the box to the nearest tenth of a centimeter.

Step 6: Find the length of the longest stick that can fit in the box using either method in this Explore!

The Pythagorean Theorem in Three Dimensions

In a rectangular prism, the length of the longest diagonal d squared is equal to the sum of the squares of the length a, width b and height c of the prism.

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



EXAMPLE 3

What is the longest object that Simone can put in a rectangular box that is 10 inches wide, 12 inches long and 20 inches tall? Round to the nearest tenth of an inch.

Solution

Write the three-dimensional formula.	$a^2 + b^2 + c^2 = d^2$
Substitute the values of the length, width and height.	$10^2 + 12^2 + 20^2 = d^2$
Simplify by squaring.	$100 + 144 + 400 = d^2$
Add.	$644 = d^2$
Square root both sides of the equation.	$\sqrt{644} = \sqrt{d^2}$
Round to the nearest tenth.	$25.4 \approx d$

The longest object that can fit in the box is about 25.4 inches.

EXERCISES

Draw a diagram and solve for the missing measure. When necessary, round to the nearest tenth.

1. Jeff just bought a house on a triangular lot. The sides measure 85 feet, 132 feet and 157 feet.

11. A rectangular prism is 3 feet long, 4 feet wide and 2 feet tall. What is the length of its longest diagonal?

12. Petra is sending her brother a giant candy cane stick for a gift. She will use a box that measures 10 inches by 6 inches by 2 inches. What is the maximum length the candy cane stick can be to fit in the box?

13. Elena needs to ship a 61 *cm* concert flute to a customer. She has two rectangular boxes. One is 25 *cm* by 25 *cm* by 50 *cm*. The other box is 10 *cm* by 12 *cm* by 58 *cm*.

a. What is the longest object that will fit in the 25 *cm* × 25 *cm* × 50 *cm* rectangular box?

b. What is the longest object that will fit in the 10 *cm* × 12 *cm* × 58 *cm* rectangular box?

c. In which box will the flute best fit?

14. A steel box measures 9 inches by 6 inches by 6 inches. What is the measure of the longest diagonal in the box?

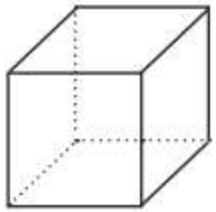
15. A cube has a surface area of 600 square meters.

a. How many faces does a cube have?

b. What is the area of one face of the cube?

c. Find the length of one side of the cube.

d. What is the length of the cube's longest diagonal?



REVIEW

Find the value of *x* in each diagram. If necessary, round to the nearest tenth.

16.

17.

18.

Workbook Practice
Pg. 147

Scan to get answers

Skip #9 for now

The Pythagorean Theorem

Day 3

Amy is making a brochure for the HDTV shown above. The screen is 48 inches wide and 20 inches high. What diagonal length should she use in the brochure?

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Online Video Tutor

Find the length of the diagonal of the TV screen.

$20^2 + 48^2 = c^2$ *Use the Pythagorean Theorem.*

$400 + 2304 = c^2$ *Simplify.*

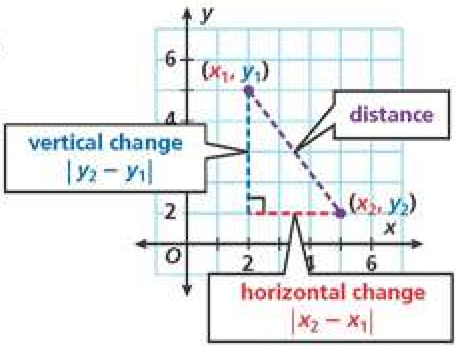
$2704 = c^2$ *Add.*

$\sqrt{2704} = c$

$52 = c$ *Find the square root.*

The diagonal length should be given as 52 inches.

You can use the Pythagorean Theorem to find distance on the coordinate plane. Diagonal distance can be thought of as the hypotenuse of a right triangle. By substituting into the Pythagorean Theorem, you can develop a formula for distance.



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

$$\text{distance}^2 = |x_2 - x_1|^2 + |y_2 - y_1|^2$$

$$d = \sqrt{|x_2 - x_1|^2 + |y_2 - y_1|^2}$$

Because the square of the absolute value is always nonnegative, the absolute value symbols are not needed.

THE DISTANCE FORMULA

The distance between two points (x_1, y_1) and (x_2, y_2) on the coordinate plane is

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

Multilingual Glossary

- Browse Glossary

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COMMON CORE GPS **EXAMPLE 2** MCC8.G.7

Finding Distance on the Coordinate Plane

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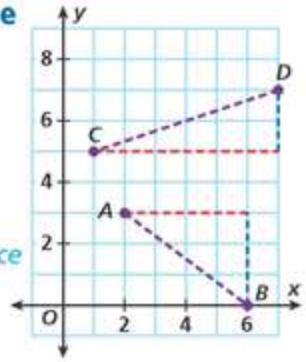
Online Video Tutor

Find the distances between the points to the nearest tenth.



A A and B

Let A be (x_2, y_2) and B be (x_1, y_1).

[redacted]

B C and D

Let D be (x_2, y_2) and C be (x_1, y_1).

[redacted]

The *Converse of the Pythagorean Theorem* states that if a triangle has side lengths a, b, and c and $a^2 + b^2 = c^2$, then the triangle is a right triangle.

COMMON CORE GPS **EXAMPLE 3**

Identifying a Right Triangle