CITYTUTOR DC

Eighth Grade Math Lesson Materials

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Identification of the copyrighted work claimed to have been infringed, or, if multiple copyrighted works allegedly have been infringed, then a representative list of such copyrighted works;

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CITYTUTOR DC

G8 Unit 6:

Pythagorean Theorem and Irrational Numbers

G8 U6 Lesson 1
Find the area of a tilted square

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G8 U6 Lesson 1 - Students will find the area of a tilted square

Warm Welcome (Slide 1): Tutor choice

Frame the Learning/Connect to Prior Learning (Slide 2): Today, we're learning a new way to calculate the area of a square. But here's the twist – the square will be tilted! This might sound tricky, but we'll use a decomposition strategy to make it easy. By the end of this lesson, you'll be able to find the area of any tilted square on a grid.

Let's Review (Slide 3): Let's recall what you remember about area. Possible Student Answers, Key Points:

- Area is the amount of space inside of a shape.
- We can use tiles to find the total area of rectangles.
- We can multiply the length by the width to find the area of rectangles and squares.
- We can cut shapes into smaller shapes, like rectangles, to find the area.
- The area should be measured in square units.

These are all true about the area. Today, we are going to focus on squares. How might we find the area of the square on the screen? Possible Student Answers, Key Points:

- We can add the number of smaller units inside of the square.
- We can count how many units the height and width are and multiply them.
- Since squares have equal side lengths, the height and width can be multiplied.
- The area of a square is s^2 or s x s.
- The area is 16 units squared.

Awesome! You all remember a lot about area and how to find it. Since we are working with squares today, your understanding that squares have the same side lengths and that the area of a square is s^2 will be a great foundation for our lesson.

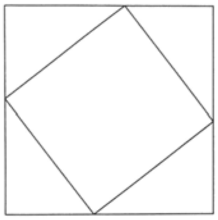
Let's Talk (Slide 4): Now, let's look at another square *(pass out Tilted Square handout).* What do you notice about the first square? Possible Student Answers, Key Points:

- The square is on a grid.
- The square is tilted.

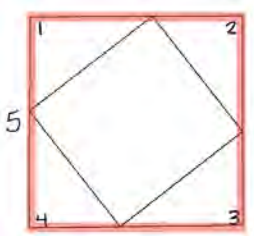
Earlier, you said that to find the area of the square, you must know a side length. If you know the side length, you can find the area of the square by multiplying "s" times "s." How might we find the area of this square that is tilted? Possible Student Answers, Key Points:

- The sides cut across the unit boxes.
- Count the units inside of the square.
- The area is 8 units squared.
- Count all the times and subtract the purple ones.

Let's Think (Slide 5): On the last slide, we saw a tilted square, and it was easy to count the units and measure the side lengths. However, sometimes, when a square is tilted, it doesn't fit neatly into the grid squares. However, we can still find its area by breaking it down into smaller, more manageable shapes.



We are going to find the area of squares that are tilted on grids today (d*raw a tilted square with an enclosing square and tell students to look at Grid #2 on Tilted Square Handout)* First, let's identify some shapes that we see on the grid. Squares! Triangles!



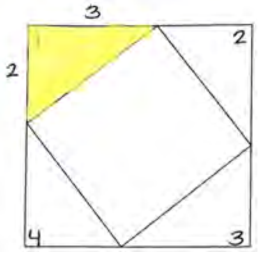
Right! There is a larger square that is not tilted but outlines the tilted square (*trace with fingers*); we call that the enclosing square. We also see four right triangles created by the two squares. We are going to decompose, which means to break down these shapes to help us solve for the area of the red square.

$A = s^2$

$A = 5^2$

$A = 25$ sq units

Let's work through this together. First, we'll find the area of the enclosing square, the bigger square, and afterward, we will find the areas of the triangles outside the square. This is called decomposition. Now let's label the triangle numbers 1 - 4. The enclosing square has a side length of five units (*label the side, 5. Write A =* s^2). That means that its area is five squared or five times five, 25 units squared.



Now, we want to find the area of the triangles made by the squares. To find the area of a triangle, we use the formula ½ x base x height of the triangle *(write formula)*. As we see in Triangle 1, the base is 3, and the height is 2 *(label)*. If we multiply 3 x 2 and divide by 2, our area would equal 3 square units.

$A = \frac{1}{2} \cdot b \cdot h$

$A = \frac{1}{2} \cdot \underbrace{3 \cdot 2}$

$A = \frac{1}{2} \cdot 6 = 3 \text{ units}^2$

For triangle 2, our base is two, and our height is three. We need to use the same formula as before ½ x base x height of the triangle, 2 times 3 divided by 2. The area is three units squared. For triangle 3, our base is 3, and our height is 2. This triangle has the same area as triangle 1. We multiply 3 by 2 and divide by 2. The area is 3 square units. For the last triangle, number 4, we will find the area by multiplying the base by 2, the height by 3, and then dividing by 2. The area is 3 square units, just like the other triangles.

Area of triangles

$3 + 3 + 3 + 3 = 12 \text{ units}^2$

Area of enclosing square $= 25 \text{ units}^2$

$25 - 12 = 13 \text{ units}^2$

$A = 13 \text{ units}^2$

Remember, because we decomposed, we can take the enclosed square's area–the big square (trace)–and subtract the triangles' areas outside the square.

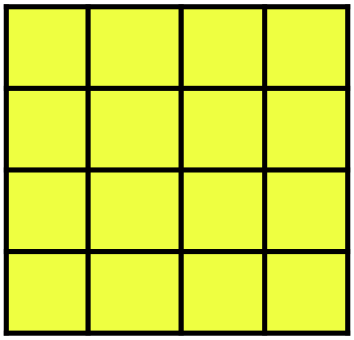
Let's add the area of the 4 triangles, each one was 3. So, 3 + 3 + 3 + 3 = 12 units squared, and the area of the enclosing square is 25 units squared. We can subtract to find the area of the red square: 25 - 12 = 13 units squared. The area of the tilted square is 13 units squared.

Let's Try it (Slides 6): Now, let's practice finding the area of some other tilted squares using the decomposition method. Remember, we find the area of the enclosing square and then we take away the area of all four of the triangles.

WARM WELCOME

Today we will find the area of a tilted square

Let's Review:

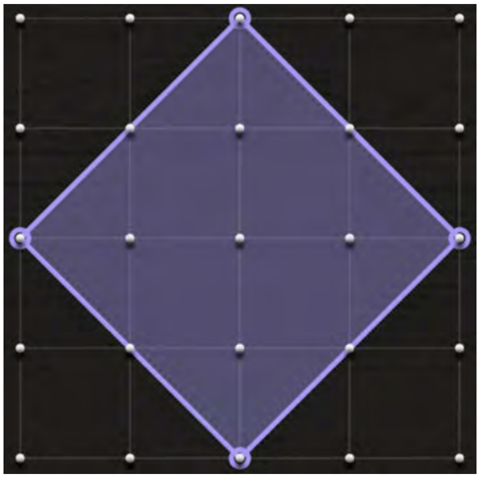


What do you remember about area?

How might we find the area of the given square?

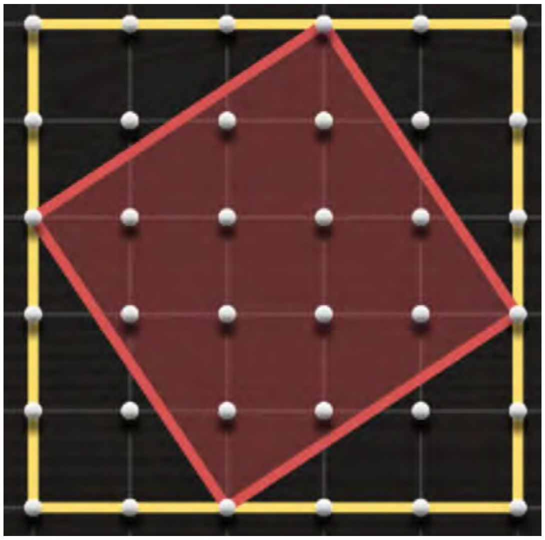
Let's Talk:

How might we find the area of this square?



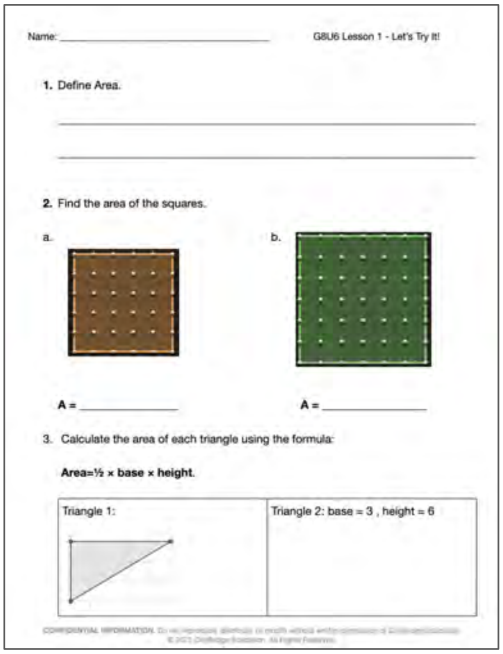
Let's Think:

Let's find the area of the red square.



Let's Try It:

Let's explore finding the area of tilted squares together.



Name:____________________ G8U6 Lesson 1 - Let's Try It!

1. Define Area.

____

____

2. Find the area of the squares.

a.

A = __________

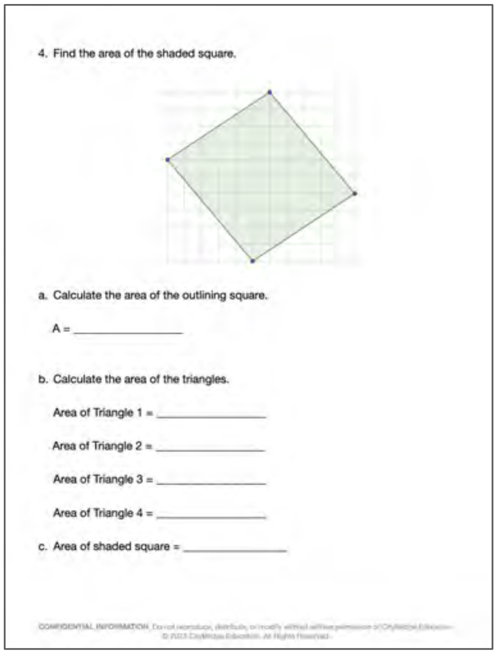
b.

A = __________

3. Calculate the area of each triangle using the formula:

Area=½ × base × height.

Triangle 1:	Triangle 2: base = 3 , height = 6



4. Find the area of the shaded square.

a. Calculate the area of the outlining square.

A = __________

b. Calculate the area of the triangles.

Area of Triangle 1 = __________

Area of Triangle 2 = __________

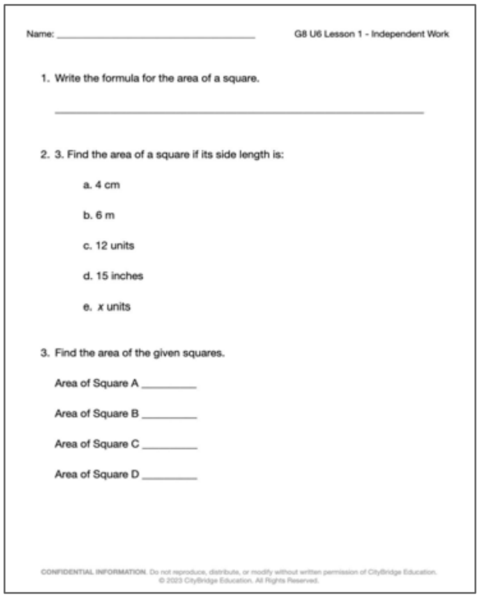
Area of Triangle 3 = __________

Area of Triangle 4 = __________

c. Area of shaded square = __________

On your Own:

Now it’s time to try finding the area of tilted squares on your own.



Name: ______________________________ G8 U6 Lesson 1 - Independent Work

1. Write the formula for the area of a square.

____

2. 3. Find the area of a square if its side length is:

   a. 4 cm

   b. 6 m

   c. 12 units

   d. 15 inches

   e. x units

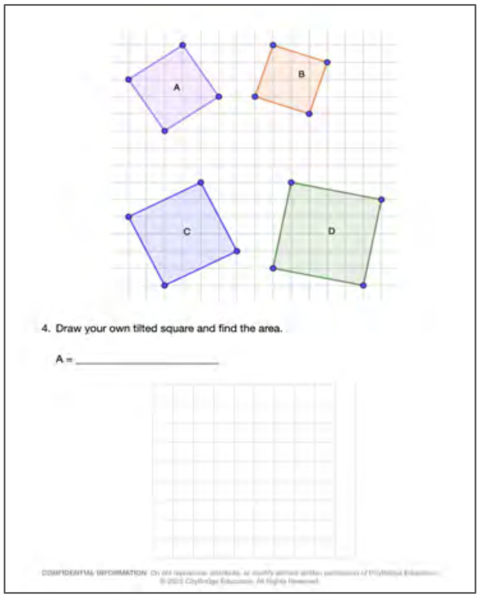
3. Find the area of the given squares.

Area of Square A _________

Area of Square B _________

Area of Square C _________

Area of Square D _________



4. Draw your own tilted square and find the area.

A = ____________________

Name: ____ G8U6 Lesson 1 - Let’s Try It!

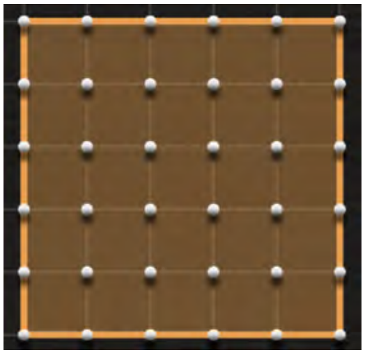
1. Define Area.

____

____

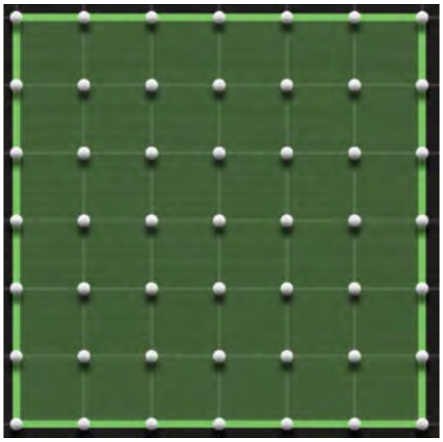
2. Find the area of the squares.

a.



A = ________________

b.



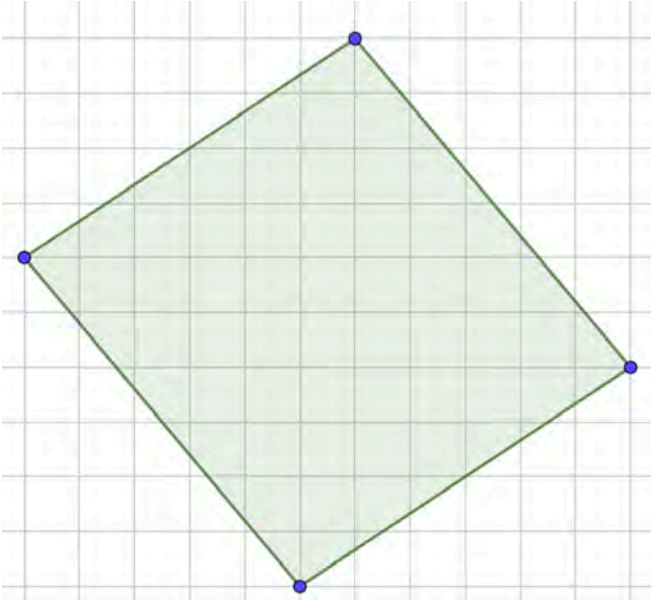
A = ________________

3. Calculate the area of each triangle using the formula:

Area=½ × base × height.

Triangle 1: 	Triangle 2: base = 3 , height = 6

4. Find the area of the shaded square.



a. Draw your enclosing square. Calculate the area of the enclosing square.

A = ___________________

b. Calculate the area of the triangles.

Area of Triangle 1 = ___________________

Area of Triangle 2 = ___________________

Area of Triangle 3 = ___________________

Area of Triangle 4 = ___________________

c. Area of shaded square = __________________

Name: ____ G8 U6 Lesson 1 - Independent Work

1. Write the formula for the area of a square.

____

2. 3. Find the area of a square if its side length is:

a. 4 cm ; A = _________________

b. 6 m ; A = _________________

c. 12 units ; A = _________________

d. 15 inches ; A = _________________

e. x units ; A = _________________

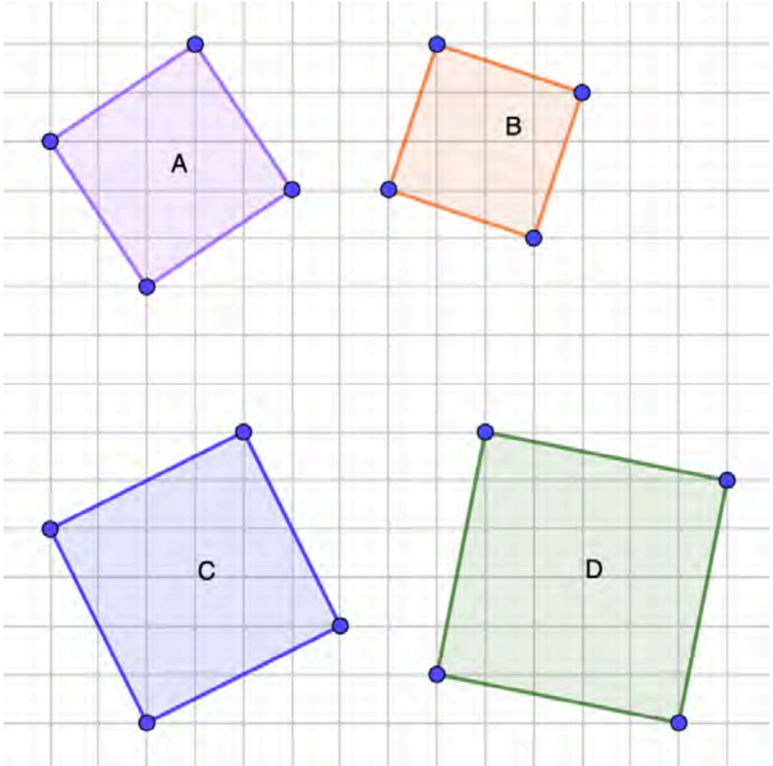
3. Find the area of the given squares.

Area of Square A = _______________

Area of Square B = _______________

Area of Square C = _______________

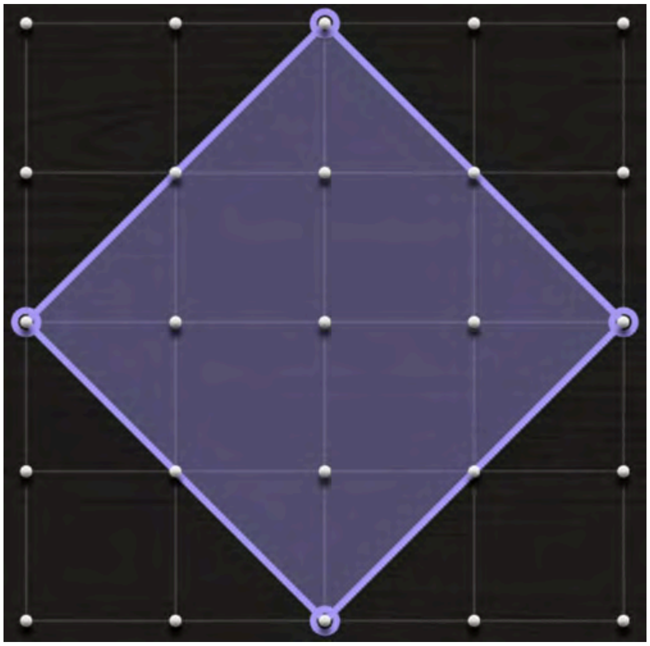
Area of Square D = _______________



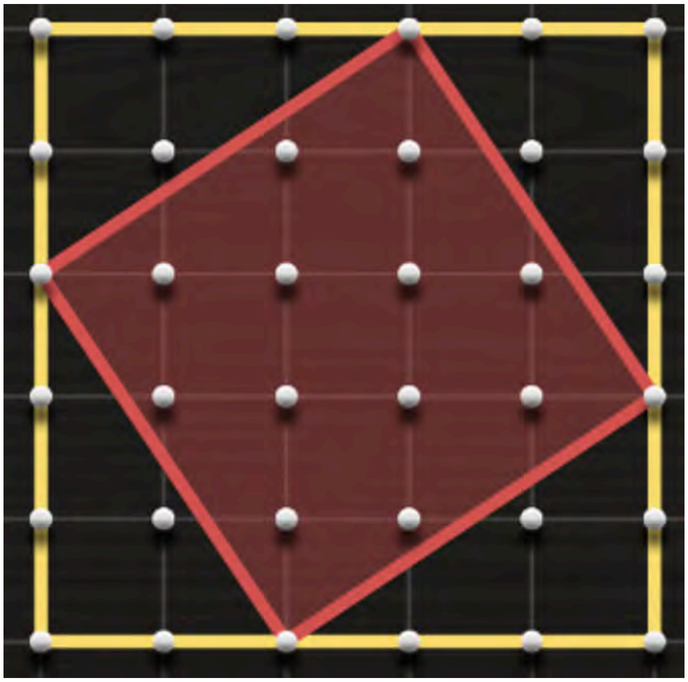
4. Draw your own tilted square and find the area.

A = ________________________

1.



2.



Name: Answer Key

G8U6 Lesson 1 - Let's Try It!

1. Define Area.

Area is the space enclosed by a shape.

2. Find the area of the squares.

a.

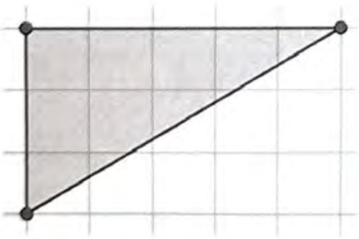
A = $25\ u^2$

b.

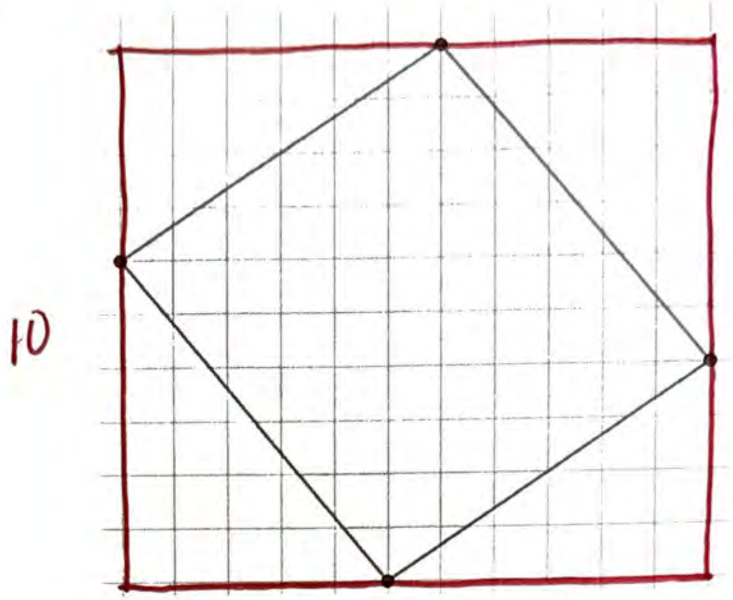
A = $36\ u^2$

3. Calculate the area of each triangle using the formula:

Area=½ × base × height.

Triangle 1:  $A=\frac{1}{2}\cdot b\cdot h$ $A=\frac{1}{2}\cdot 3\cdot 5$ $A=\frac{15}{2}$ or $7.5\ u^2$	Triangle 2: base = 3 , height = 6 $A=\frac{1}{2}\cdot b\cdot h$ $A=\frac{1}{2}\cdot 3\cdot 6$ $A=9\ u^2$

4. Find the area of the shaded square.



a. Draw your enclosing square. Calculate the area of the enclosing square.

A = $100u^2$

b. Calculate the area of the triangles.

Area of Triangle 1 = $12u^2$

Area of Triangle 2 = $12u^2$

Area of Triangle 3 = $12u^2$

Area of Triangle 4 = $12u^2$

c. Area of shaded square = $100-48=52\ u^2$

Name: ______________________________ G8 U6 Lesson 1 - Independent Work

1. Write the formula for the area of a square.

$A = s^2$

2. 3. Find the area of a square if its side length is:

a. 4 cm ; A = $16\ cm^2$

b. 6 m ; A = $36\ m^2$

c. 12 units ; A = $144\ u^2$

d. 15 inches ; A = $225\ in^2$

e. x units ; A = $x^2\ u^2$

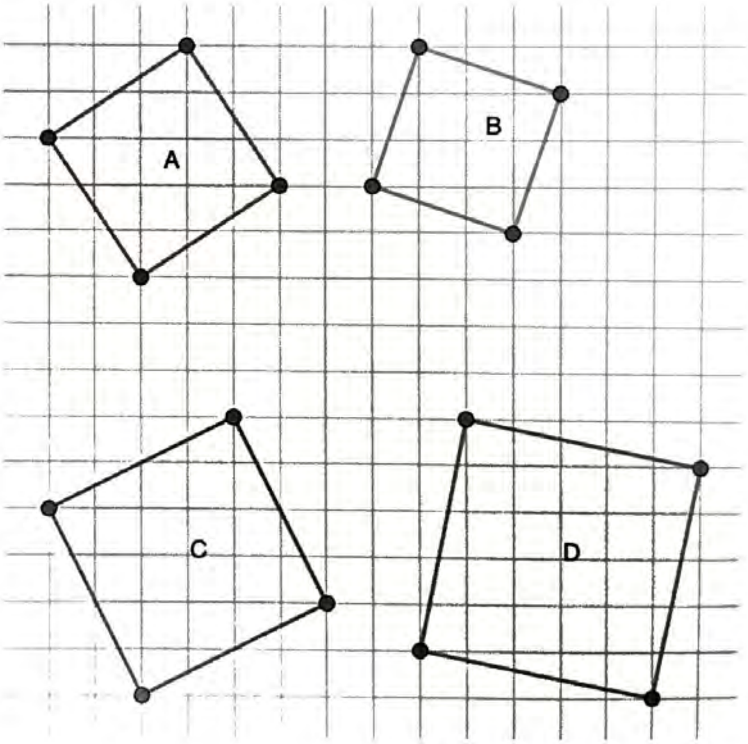
3. Find the area of the given squares.

Area of Square A = $13\ u^2$

Area of Square B = $10\ u^2$

Area of Square C = $20\ u^2$

Area of Square D = $26\ u^2$



Name: Answer Key

G8 U6 Lesson 1 - Independent Work

1. Write the formula for the area of a square.

$A = s^2$

2. 3. Find the area of a square if its side length is:

a. 4 cm ; A = $16\ cm^2$

b. 6 m ; A = $36\ m^2$

c. 12 units ; A = $144\ u^2$

d. 15 inches ; A = $225\ in^2$

e. x units ; A = $x^2\ u^2$

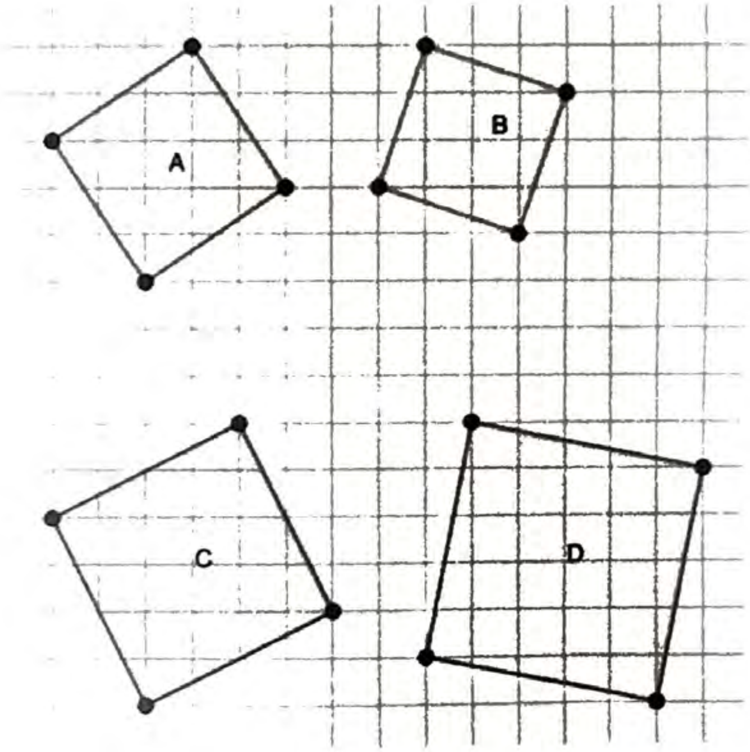
3. Find the area of the given squares.

Area of Square A = $13\ u^2$

Area of Square B = $10\ u^2$

Area of Square C = $20\ u^2$

Area of Square D = $26\ u^2$



4. Draw your own tilted square and find the area.

A = ____________________

Answers may vary.

G8 U6 Lesson 2

Comprehend “square root” and use square root notation to express the side length of a square, given its area.

G8 U6 Lesson 2 - Students will use the Square Root Notation to express the side length of a square, given its area.

Warm Welcome (Slide 1): Tutor choice

Frame the Learning/Connect to Prior Learning (Slide 2): Today, we will learn about square roots. By the end of this lesson, you'll understand what a square root is and how to use square root notation to find the side length of a square when you're given its area.

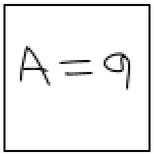
Let's Review (Slide 3): Let's brainstorm! **What does it mean to square a number?** Possible Student Answers, Key Points:

- To multiply the number by itself

When we square a number, we multiply that number by itself. For example, the square of 3 is 3 times 3, which equals 9. Who can give me another example? (*Allow 1- 2 students to share.)*

Let's Talk (Slide 4): We reviewed how to square a number. Can **someone tell me the relationship between the side length of a square and its area?** Possible Student Answers, Key Points:

- The area is the side length squared.
- $A = s^2$



$s=3$

$A=s^2$

$A=3^2$

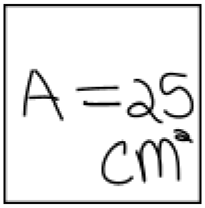
$9=3^2$

(Draw square on the Whiteboard.) The area of a square is the side length times itself, or $A = s^2$. If you know the side length, you can find the area. In this case, we see that the side length is 3 units. If we use the formula $A = s^2$, then $3^2 = 9$.

So, the relationship between the side length and the area of a square is that the side length squared equals the area of the square.

Let's Think (Slide 5): Sometimes, we may not be given the side length but will be given the Area, to find the side length. **How might we find the side length of a square if we only know the area?** Possible Student Answers, Key Points:

- Take the square root
- Do the opposite of squaring a number



(Draw a square on the board with an area of 25 cm^2.)

To find the side length, we must take the square root of the area.

$\sqrt{25} = 5$

$5 \cdot 5 = 25$

Let's start with the term 'square root.' The square root of a number is a value that, when multiplied by itself, gives the original number. For example, the square root of 25 is 5 because 5 times 5 equals 25." *(Teacher writes √25 = 5 on the board.)*

The symbol we use for square root is called a radical, and it looks like this *(point to radical symbol)*: So *√25 = 5* means that 5 is the square root of 25.

Now, let's relate this to squares. If you have a square with an area of 25 square units, the length of each side of the square is the square root of 25.

(Teacher writes on the board:)

Area = side length x side length

25 cm = side length x side length

side length = √25 = 5

So, the side length of a square with an area of 25 cm^2 is 5 cm.

Let's Try it (Slides 6): Now it's your turn. Remember that the square root of a number is the value that, when multiplied by itself, gives the original number. We use the radical symbol √ for square roots. We can also use square roots to find the side lengths of squares when we know their areas.

WARM WELCOME

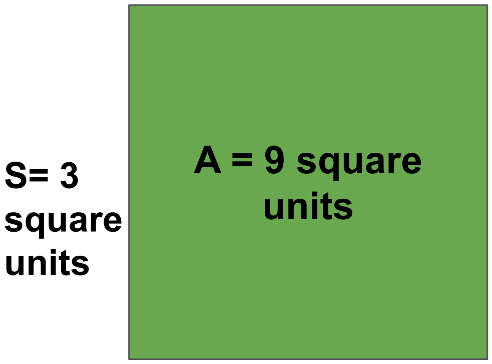
Today we will comprehend “square root” and use square root notation to express the side length of a square, given its area.

Let’s Review:

What does it to mean to square a number? Give an example.

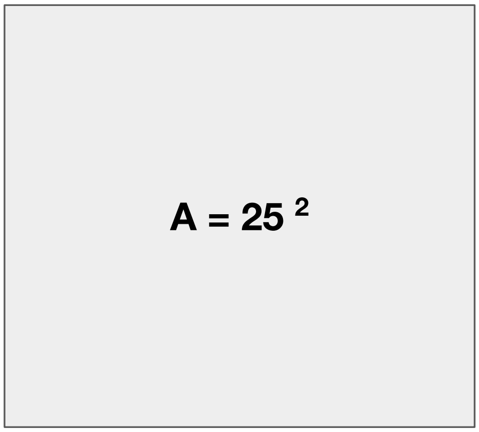
Let’s Talk:

What is the relationship between the side length and the area of a square?



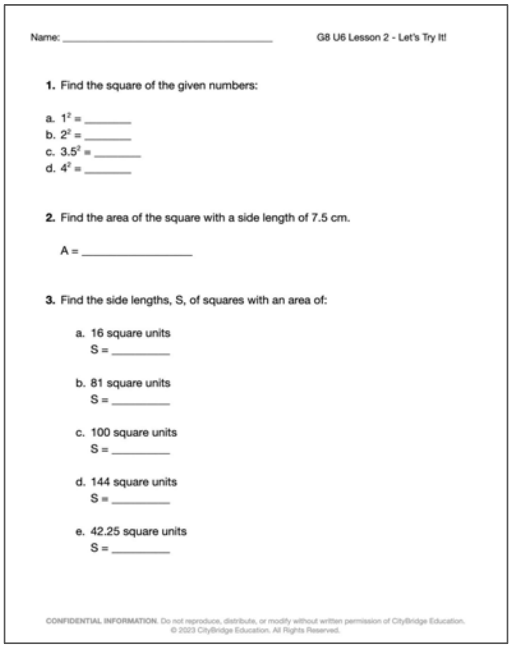
Let's Think:

How might we find the side length of a square if we only know the area?



Let's Try It:

Let's explore using the Square Root Notation to express the side length of a square, given its area together.



Name: ______________________ G8 U6 Lesson 2 - Let's Try It!

1. Find the square of the given numbers:

a. 1^2 = _______
b. 2^2 = _______
c. 3.5^2 = _______
d. 4^2 = _______

2. Find the area of the square with a side length of 7.5 cm.

A = ______________

3. Find the side lengths, S, of squares with an area of:

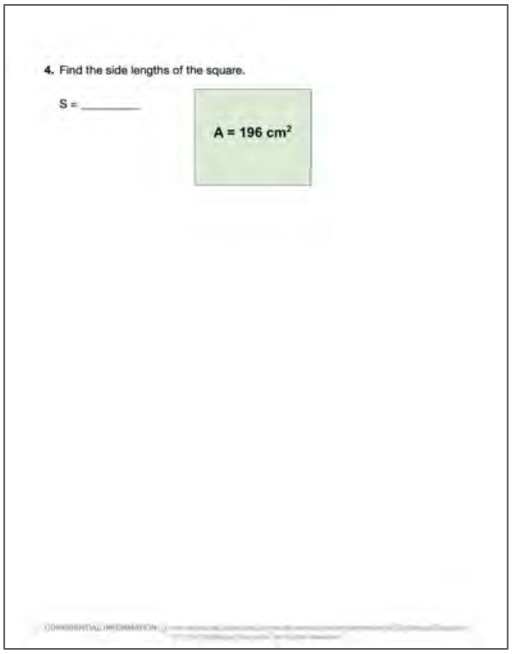
a. 16 square units
S = ________

b. 81 square units
S = ________

c. 100 square units
S = ________

d. 144 square units
S = ________

e. 42.25 square units
S = ________

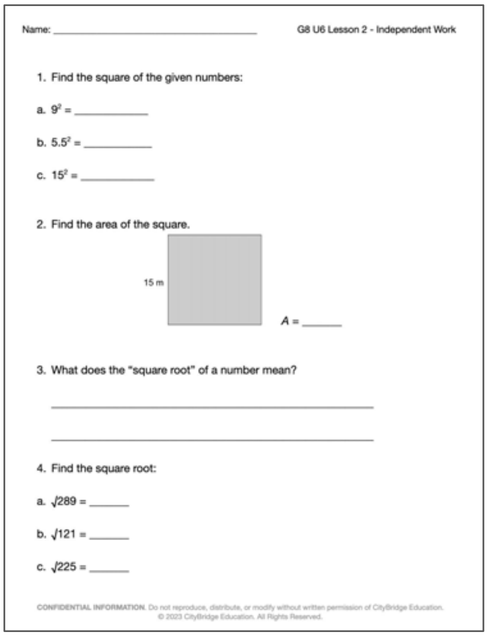


4. Find the side lengths of the square.

S = ________

On your Own:

Now it's time to use the Square Root Notation to express the side length of a square, given its area on your own.



Name: ______________________________ G8 U6 Lesson 2 - Independent Work

1. Find the square of the given numbers:

a. 9^2 = __________

b. 5.5^2 = __________

c. 15^2 = __________

2. Find the area of the square.

15 m

A = ______

3. What does the "square root" of a number mean?

____

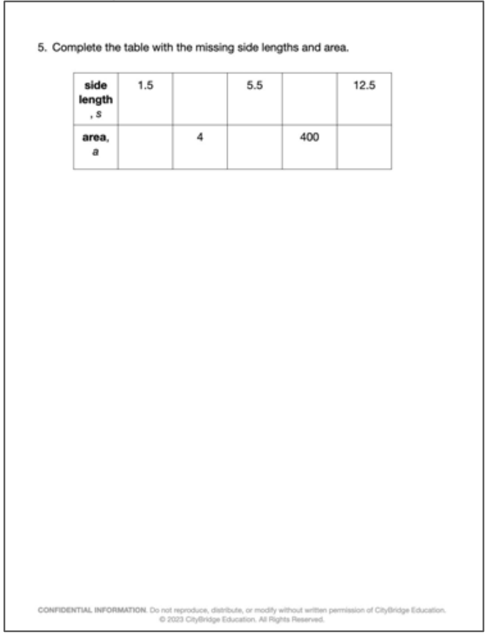
____

4. Find the square root:

a. $\sqrt{289}$ = ______

b. $\sqrt{121}$ = ______

c. $\sqrt{225}$ = ______



5. Complete the table with the missing side lengths and area.

side length, s	1.5		5.5		12.5
area, a		4		400	

Name: ______________________________________ G8 U6 Lesson 2 - Let's Try It

1. Find the square of the given numbers:

a. 1^2 = ________
b. 2^2 = ________
c. 3.5^2 = ________
d. 4^2 = ________

2. Find the area of the square with a side length of 7.5 cm.

A = ___________________

3. Find the side lengths, *S*, of squares with area, *A*.

a. *A = 16 square units*
S = __________

b. *A = 81 square units*
S = __________

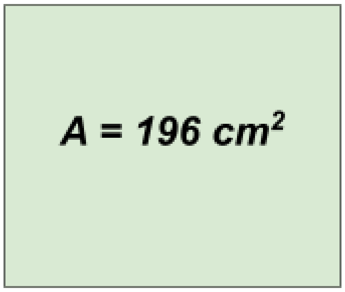
c. *A = 100 square units*
S = __________

d. *A = 144 square units*
S = __________

e. *A = 42.25 square units*
S = __________

4. Find the side length of the square.

S = __________



Name: ______________________________________ G8 U6 Lesson 2 - Independent Work

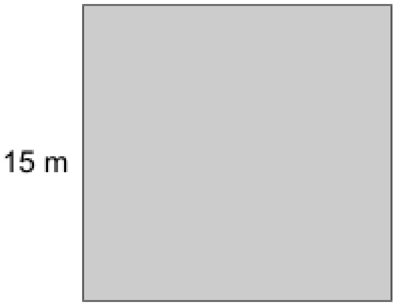
1. Find the square of the given numbers:

a. 9^2 = ____________

b. 5.5^2 = ___________

c. 15^2 = ____________

2. Find the area of the square.



A = _______

3. What does the "square root" of a number mean?

____

____

4. Find the square root:

a. $\sqrt{289}$ = _______

b. $\sqrt{121}$ = _______

c. $\sqrt{225}$ = _______

5. Complete the table with the missing side lengths and area.

side length, *s*	1.5		5.5		12.5
area, *a*		4		400	

Name: Answer Key

1. Find the square of the given numbers:

a. $1^2 =$ 1
b. $2^2 =$ 4
c. $3.5^2 =$ 12.25
d. $4^2 =$ 16

2. Find the area of the square with a side length of 7.5 cm.

$A =$ 56.25 cm^2

3. Find the side lengths, S, of squares with area, A.

a. $A = 16$ *square units*
$S =$ 4 units

b. $A = 81$ *square units*
$S =$ 9 units

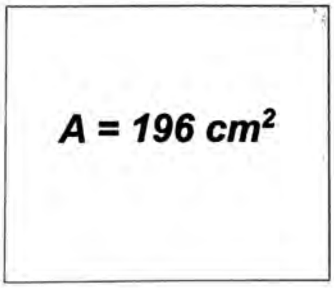
c. $A = 100$ *square units*
$S =$ 10 units

d. $A = 144$ *square units*
$S =$ 12 units

e. $A = 42.25$ *square units*
$S =$ 6.5 units

4. Find the side length of the square.

$S =$ 14 cm



Name: Answer Key

1. Find the square of the given numbers:

a. $9^2 =$ 81

b. $5.5^2 =$ 30.25

c. $15^2 =$ 225

2. Find the area of the square.

$A =$ 225 m^2

3. What does the "square root" of a number mean?

The square root of a number is a number multiplied by itself gives the original number.

4. Find the square root:

a. $\sqrt{289} =$ 17

b. $\sqrt{121} =$ 11

c. $\sqrt{225} =$ 15

5. Complete the table with the missing side lengths and area.

side length, *s*	1.5	2	5.5	20	12.5
area, *a*	2.25	4	30.25	400	156.25

G8 U6 Lesson 3
Classify rational and irrational numbers

G8 U6 Lesson 3 - Students will classify rational and irrational numbers.

Warm Welcome (Slide 1): Tutor choice

Frame the Learning/Connect to Prior Learning (Slide 2): Today, we will learn about rational and irrational numbers. By the end of this lesson, you will be able to explain what each term means and identify examples of each.

Can anyone tell me what a fraction is? What about a decimal? Great! Today, we will see how these concepts fit into our new terms: rational and irrational numbers.

Let's Talk (Slide 3): Let's start by looking at a number line. **What do you notice and wonder about this number line?** Possible Student Answers, Key Points:

- There are fractions, decimals, and percents.
- Some numbers are positive and negative. (positive & negative integers)
- There are whole numbers.

These are great observations and wonderings. This number line shows that numbers can be represented by fractions, decimals, and whole numbers. Numbers on a number line can be classified as rational and irrational numbers.

Let's Think (Slide 4): So, let's look at examples of rational numbers. **What do you notice and wonder about the examples of rational numbers?** Possible Student Answers, Key Points:

- There are fractions and decimals
- Repeating decimals
- Whole Numbers
- It can be negative or positive.
- Square Roots (perfect square)

Thank you for your noticings and wonderings. Yes, a rational number is any number that can be expressed as a fraction, where both the numerator and the denominator are integers, and the denominator is not zero.

(Write on the board: ***Rational Number = a/b and a and b are both integers, b ≠ 0.****)*
(Reference each example in the table as a rational number.)

Let's Think (Slide 5): Now let's look at irrational numbers; what **do you notice and wonder about these numbers?** Possible Student Answers, Key Points:

- There are fractions and decimals.
- Math Symbols
- Square roots (non-perfect square)
- Decimals that do not repeat.

Good noticings and wonderings. An irrational number is a number that cannot be expressed as a fraction. These numbers have non-repeating, non-terminating decimal parts.

(Write on the board: ***Irrational Number = a number cannot be written as a/b and a and b are both integers, b ≠ 0.****)*

(Reference each example in the table as an irrational number.)

Now, let's practice identifying rational and irrational numbers together. I'll show you a number, and you tell me if it's rational or irrational.

*(Give examples: ⅘, 1.25, .333…, **π**, and √7 .)*

- ⅘ - rational
- 1.25 - rational
- .333…- irrational
- **π** - irrational
- √7 - irrational

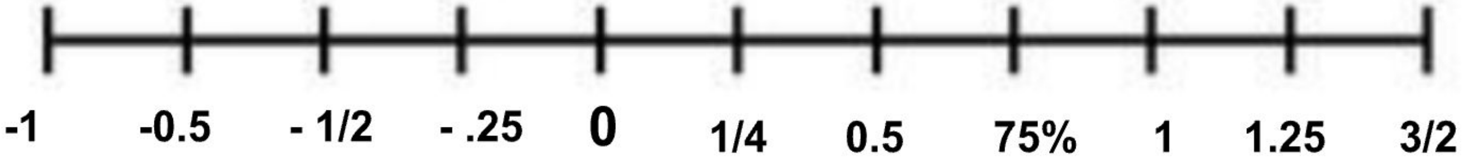
Let's Try it (Slides 6): Let's continue practicing classifying numbers as either rational or irrational.

WARM WELCOME

Today we will classify rational and irrational numbers.

Let's Talk:

What do you notice and wonder about the number line?



Let's Think:

What do you notice and wonder about rational numbers?

Examples:

1	**9.45454545…**	**-¾**
0.75 (since 0.75 = ¾)	**-2** (since -2 = - $^{2}/_{1}$)	**$\sqrt{49}$**

Let’s Think:

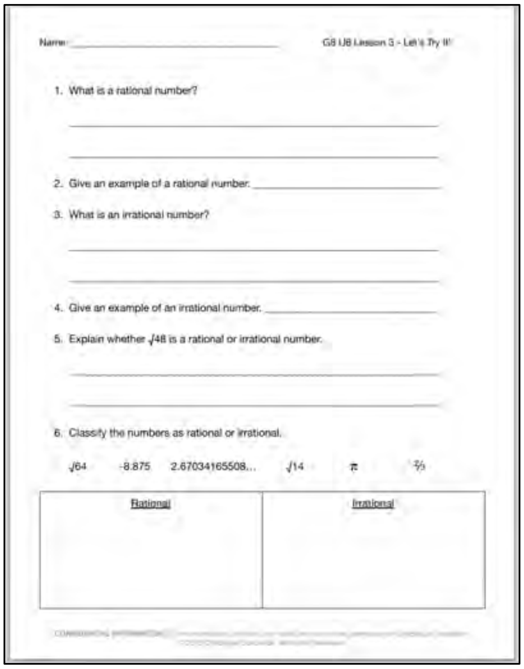
What do you notice and wonder about irrational numbers?

Examples:

π (pi)	**√3**	**√4**
1.243487…	**e** (Euler’s Number)	**√5**

Let’s Try It:

Let’s explore classifying rational and irrational numbers together.



Name: ______________________ G8 U8 Lesson 3 - Let's Try It!

1. What is a rational number?

____

____

2. Give an example of a rational number. ______________________

3. What is an irrational number?

____

____

4. Give an example of an irrational number. ______________________

5. Explain whether √48 is a rational or irrational number.

____

____

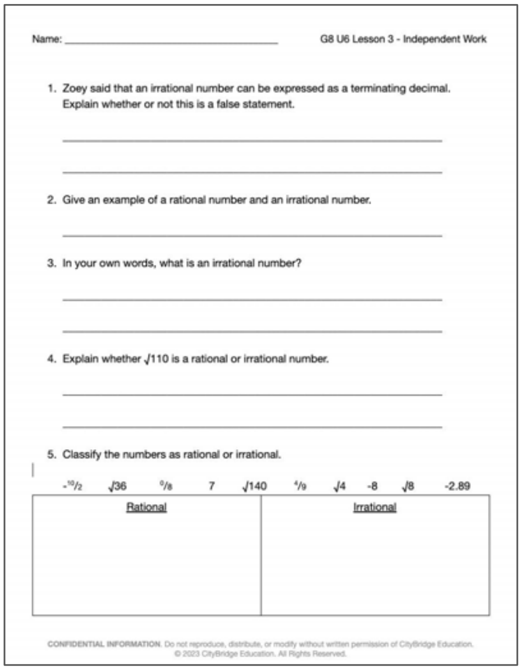
6. Classify the numbers as rational or irrational.

√64 -8.875 2.67034165508… √14 π ⅔

Rational	Irrational

On your Own:

Now it’s time to classify rational and irrational numbers on your own.



Name: ______________________________ G8 U6 Lesson 3 - Independent Work

1. Zoey said that an irrational number can be expressed as a terminating decimal. Explain whether or not this is a false statement.

____

____

2. Give an example of a rational number and an irrational number.

____

3. In your own words, what is an irrational number?

____

____

4. Explain whether √110 is a rational or irrational number.

____

____

5. Classify the numbers as rational or irrational.

$-^{10}/_{2}$ √36 $^{0}/_{8}$ 7 √140 $^{4}/_{9}$ √4 -8 √8 -2.89

Rational	Irrational

Name: ____ G8 U6 Lesson 3 - Let's Try It

1. What is a rational number?

   ____

   ____

2. Give an example of a rational number. ________________________________

3. What is an irrational number?

   ____

   ____

4. Give an example of an irrational number. ______________________________

5. Explain whether $\sqrt{48}$ is a rational or irrational number.

   ____

   ____

6. Classify the numbers as rational or irrational.

$\sqrt{64}$ -8.875 2.67034165508… $\sqrt{14}$ π $\frac{2}{3}$

Rational	Irrational

Name: ____ G8 U6 Lesson 3 - Independent Work

1. Zoey said that an irrational number can be expressed as a terminating decimal. Explain whether or not this is a false statement.

   ____

   ____

2. Give an example of a rational number and an irrational number.

   ____

3. In your own words, what is an irrational number?

   ____

   ____

4. Explain whether $\sqrt{110}$ is a rational or irrational number. **(Use a calculator if needed)**

   ____

   ____

5. Classify the numbers as rational or irrational.

$-{}^{10}/_{2}$ $\sqrt{36}$ ${}^{0}/_{8}$ 7 $\sqrt{140}$ ${}^{4}/_{9}$ $\sqrt{4}$ -8 $\sqrt{8}$ -2.89

Rational	Irrational

Name: Answer Key

G8 U6 Lesson 3 - Let's Try It!

1. What is a rational number?

Any number that can be written as a fraction, the numerator & denominator are integers, denominator $\neq 0$

2. Give an example of a rational number. answers may vary

3. What is an irrational number?

a real number that cannot be expressed as a ratio of integers.

4. Give an example of an irrational number. answers may vary

5. Explain whether $\sqrt{48}$ is a rational or irrational number.

$\sqrt{48}$ is an irrational number, it cannot express it as a fraction.

6. Classify the numbers as rational or irrational.

$\sqrt{64}$ -8.875 2.67034165508… $\sqrt{14}$ π ⅔

Rational	Irrational
$\sqrt{64}$ $2/3$ -8.875	π $\sqrt{14}$ 2.67034165508…

Name: Answer Key

1. Zoey said that an irrational number can be expressed as a terminating decimal. Explain whether or not this is a false statement.

Zoey is incorrect. Irrational numbers are non-terminating decimals

2. Give an example of a rational number and an irrational number.

Answers may vary

3. In your own words, what is an irrational number?

A real number that cannot be expressed as a ratio of integers

4. Explain whether $\sqrt{110}$ is a rational or irrational number. **(Use a calculator if needed)**

$\sqrt{110}$ is an irrational number because it cannot be written as a fraction or ratio.

5. Classify the numbers as rational or irrational.

$-{}^{10}/_{2}$ $\sqrt{36}$ ${}^{0}/_{8}$ 7 $\sqrt{140}$ ${}^{4}/_{9}$ $\sqrt{4}$ -8 $\sqrt{8}$ -2.89

Rational	Irrational
$\sqrt{36}$ $-10/2$ 7 $\sqrt{4}$ -8 $0/8$ $4/9$ -2.89	$\sqrt{8}$ $\sqrt{140}$

G8 U6 Lesson 4
Find decimal approximation for square roots

G8 U6 Lesson 4 - Students will find a decimal approximation for square roots and locate its approximation on the number line.

Warm Welcome (Slide 1): Tutor choice

Frame the Learning/Connect to Prior Learning (Slide 2): Today, we're going to learn how to find a decimal approximation for square roots and how to locate these approximations on the number line. First, let's review what a square root is.

Let's Review (Slide 3): We have worked with square roots over the last two lessons. **What does it mean to find the square root?** Possible Student Answers, Key Points:

- Find the number multiplied by itself that gives the original number

Nice! So, let's share some examples of perfect square roots. *(**Think-Pair-Share:** Give students 30 seconds to think about an example. Give students 30 seconds to share with an elbow partner, then share out loud with the group)*

Great! But not all numbers are perfect squares. Numbers like 2, 3, and 5 are not perfect squares and have square roots that are not whole numbers. Today, we'll learn how to approximate these square roots.

Let's Talk (Slide 4): Since we know that all square roots are not perfect**, how might we find the approximation of $\sqrt{2}$?** Possible Student Answers, Key Points:

- Use a calculator
- Use perfect squares that we know to help us approximate.

$\sqrt{2}$

$\sqrt{1}=1 \quad \sqrt{4}=2$

(Write $\sqrt{2}$ on the board) First, we need to identify the two closest perfect squares. What are they? 1 and 4

$$\begin{array}{r} 1.2 \\ \times 1.2 \\ \hline 24 \\ 120 \\ \hline 1.44 \end{array}$$

Correct! Since, $\sqrt{1} = 1$ and $\sqrt{4} = 2$, we know $\sqrt{2}$ is between 1 and 2. To get a better estimate and more accurate, we can use a method of guess and check. Since 2 is closer to 1 than 4, we can guess a decimal closer to 1, let's choose 1.2. If we multiply 1.2 by itself *(write on the board and calculate)*, we get 1.44.

$$\begin{array}{r} 1.4 \\ \times 1.4 \\ \hline 56 \\ + 140 \\ \hline 1.96 \end{array}$$

Let's try one more decimal, 1.4, and multiply it by itself. *(write on the board and calculate)* We get 1.96, which is pretty close to 2. That is a more accurate approximation of $\sqrt{2}$. (*Write $\sqrt{2}$ is approximately $\approx$ 1.4.*) So $\sqrt{2} \approx 1.4$

We will only use calculators to check our approximations.

$\sqrt{2} \approx 1.4$

Let's Think (Slide 5):

$\sqrt{10}$

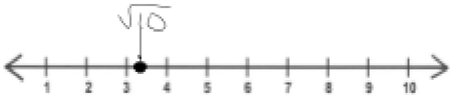
$\sqrt{9}=3$ $\sqrt{16}=4$

Now let's try one more: what is the approximation of $\sqrt{10}$; This time we are going to plot it on a number line *(Write $\sqrt{10}$ on the board)* What are the two perfect squares that are closest to $\sqrt{10}$? 9 and 16 Since $\sqrt{9} = 3$ and $\sqrt{16} = 4$, $\sqrt{10}$ it is located between 3 and 4. Would it be closer to 3 or 4? 3. That's right $\sqrt{10}$ is closer to 3 because 10 is closer to 9 and not 16.

$$\begin{array}{r} 3.2 \\ \times 3.2 \\ \hline 1\ 64 \\ +9\ 60 \\ \hline 10.24 \end{array}$$

So, let's guess a decimal to begin with. Let's try 3.2. We can multiply 3.2 by itself *(write on the board and calculate);* when we do, we get 10.24. This is very close to 10, but a little over. So we could try another decimal that is a little smaller, but we'll stop here and say that $\sqrt{10} \approx 3.2$. *(Write on the board)*

$\sqrt{10} \approx 3.2$



Now let's look at the number line, we have found an approximation and we can use that to plot $\sqrt{10}$ on the number line. We know that it is closer to 3, but a little over. *(Draw a number line on the board 1 - 10; make a dot closer to 3)*

Let's Try it (Slides 6): Now it's turn to practice. Remember we can find decimal approximations for square roots by identifying the two closest perfect squares and refining our estimates. We can also plot these approximations on a number line.

WARM WELCOME

Today we will learn how to find a decimal approximation for square roots and locate these approximations on the number line.

↺ Let's Review:

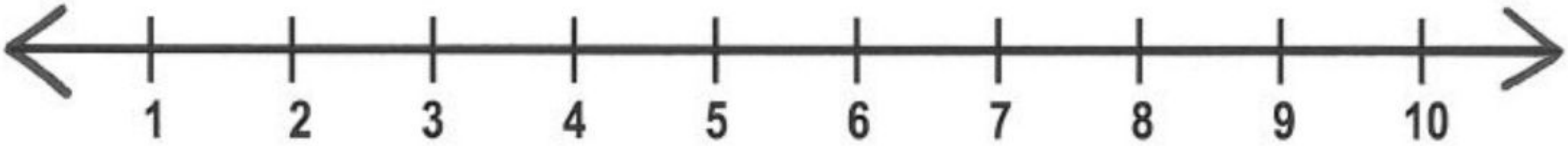
What does it mean to find the square root? Give an example of perfect squares.

Let's Talk:

How might we approximate the value of $\sqrt{2}$?

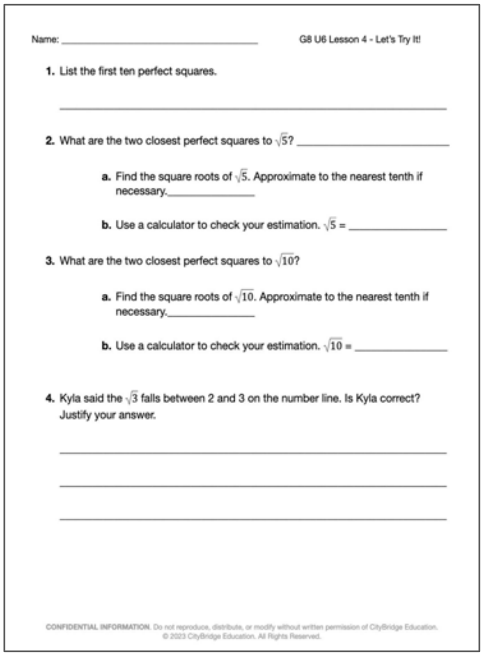
Let's Think:

Where might $\sqrt{10}$ be placed on the number line?



Let's Try It:

Let's find a decimal approximation for square roots and locate its approximation on the number line together.



Name: ____________________ G8 U6 Lesson 4 - Let's Try It!

1. List the first ten perfect squares.

____

2. What are the two closest perfect squares to $\sqrt{5}$? ____________

   a. Find the square roots of $\sqrt{5}$. Approximate to the nearest tenth if necessary.________

   b. Use a calculator to check your estimation. $\sqrt{5}$ = ________

3. What are the two closest perfect squares to $\sqrt{10}$?

   a. Find the square roots of $\sqrt{10}$. Approximate to the nearest tenth if necessary.________

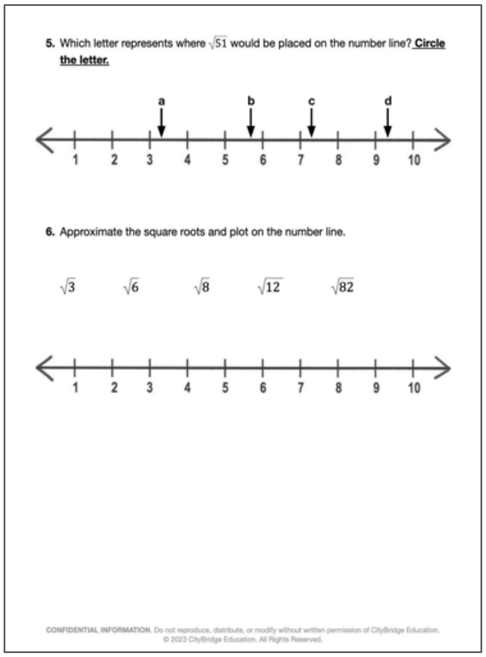
   b. Use a calculator to check your estimation. $\sqrt{10}$ = ________

4. Kyla said the $\sqrt{3}$ falls between 2 and 3 on the number line. Is Kyla correct? Justify your answer.

____

____

____



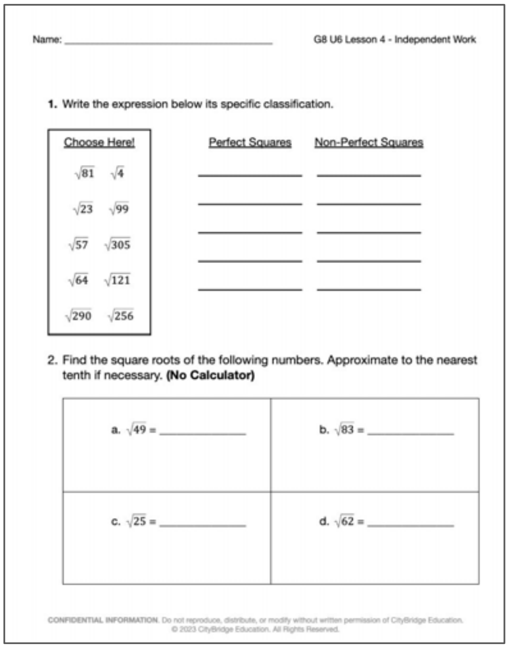
5. Which letter represents where $\sqrt{51}$ would be placed on the number line? **Circle the letter.**

6. Approximate the square roots and plot on the number line.

$\sqrt{3}$ $\sqrt{6}$ $\sqrt{8}$ $\sqrt{12}$ $\sqrt{82}$

On your Own:

Now it's your time to find a decimal approximation for square roots and locate it on the number line on your own.



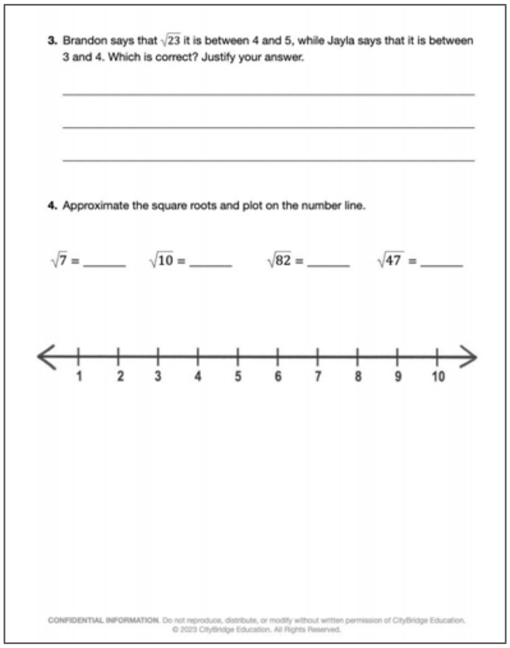
Name: ______________________________ G8 U6 Lesson 4 - Independent Work

1. Write the expression below its specific classification.

Choose Here!	Perfect Squares	Non-Perfect Squares
$\sqrt{81}$ $\sqrt{4}$	____________	____________
$\sqrt{23}$ $\sqrt{99}$	____________	____________
$\sqrt{57}$ $\sqrt{305}$	____________	____________
$\sqrt{64}$ $\sqrt{121}$	____________	____________
$\sqrt{290}$ $\sqrt{256}$	____________	____________

2. Find the square roots of the following numbers. Approximate to the nearest tenth if necessary. **(No Calculator)**

a. $\sqrt{49}$ = ____________	b. $\sqrt{83}$ = ____________
c. $\sqrt{25}$ = ____________	d. $\sqrt{62}$ = ____________



3. Brandon says that $\sqrt{23}$ it is between 4 and 5, while Jayla says that it is between 3 and 4. Which is correct? Justify your answer.

____

____

____

4. Approximate the square roots and plot on the number line.

$\sqrt{7}$ = ______ $\sqrt{10}$ = ______ $\sqrt{82}$ = ______ $\sqrt{47}$ = ______

Name: ____ G8 U6 Lesson 4 - Let's Try It

1. List the first ten perfect squares.

____

2. What are the two closest perfect squares to $\sqrt{5}$? _________________________________

    a. Find the square roots of $\sqrt{5}$. Approximate to the nearest tenth if necessary.______________

    b. Use a calculator to check your estimation. $\sqrt{5}$ = ______________________

3. What are the two closest perfect squares to $\sqrt{10}$? ________________________________

    a. Find the square roots of $\sqrt{10}$. Approximate to the nearest tenth if necessary.______________

    b. Use a calculator to check your estimation. $\sqrt{10}$ = ______________________

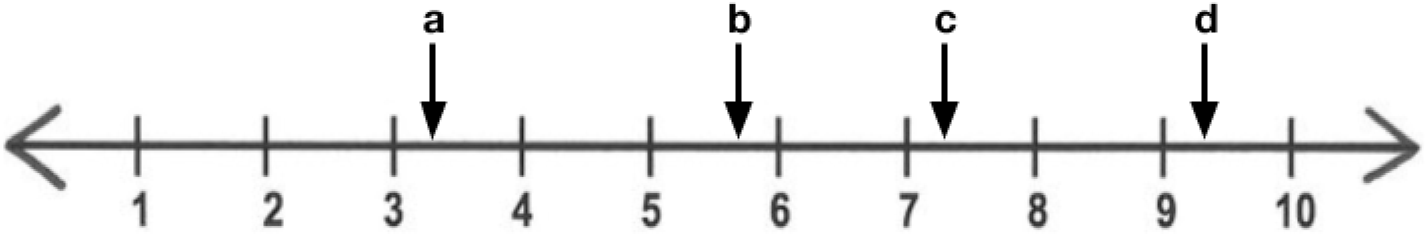
4. Kyla said the $\sqrt{3}$ falls between 2 and 3 on the number line. Is Kyla correct? Justify your answer.

____

____

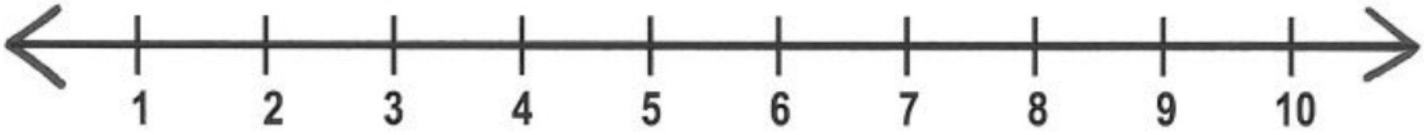
____

5. Which letter represents where $\sqrt{51}$ would be placed on the number line? **<u>Circle the letter.</u>**



6. Approximate the square roots and plot on the number line.

$\sqrt{3}$ $\sqrt{6}$ $\sqrt{8}$ $\sqrt{12}$ $\sqrt{82}$



1. Write the expression below its specific classification.

Choose Here!

$\sqrt{81}$ $\sqrt{4}$

$\sqrt{23}$ $\sqrt{99}$

$\sqrt{57}$ $\sqrt{305}$

$\sqrt{64}$ $\sqrt{121}$

$\sqrt{290}$ $\sqrt{256}$

Perfect Squares	Non-Perfect Squares
____________________	____________________
____________________	____________________
____________________	____________________
____________________	____________________
____________________	____________________

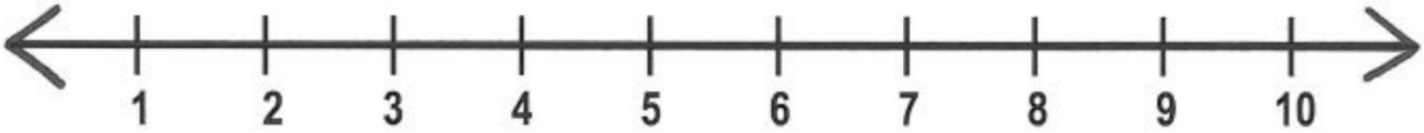
2. Find the square roots of the following numbers. Approximate to the nearest tenth if necessary. **(No Calculator)**

a. $\sqrt{49} =$ ________________	b. $\sqrt{83} =$ ________________
c. $\sqrt{25} =$ ________________	d. $\sqrt{62} =$ ________________

3. Brandon says that $\sqrt{23}$ it is between 4 and 5, while Jayla says that it is between 3 and 4. Which is correct? Justify your answer.

4. Approximate the square roots and plot on the number line.

$\sqrt{7}$ = ________ $\sqrt{10}$ = ________ $\sqrt{82}$ = ________ $\sqrt{47}$ = ________



Name: Answer Key

1. List the first ten perfect squares.

1, 4, 9, 16, 25, 36, 49, 64, 81, 100

2. What are the two closest perfect squares to $\sqrt{5}$? 4 and 9

   a. Find the square roots of $\sqrt{5}$. Approximate to the nearest tenth if necessary. 2.2

   b. Use a calculator to check your estimation. $\sqrt{5}$ = 2.23

3. What are the two closest perfect squares to $\sqrt{10}$? 9 and 16

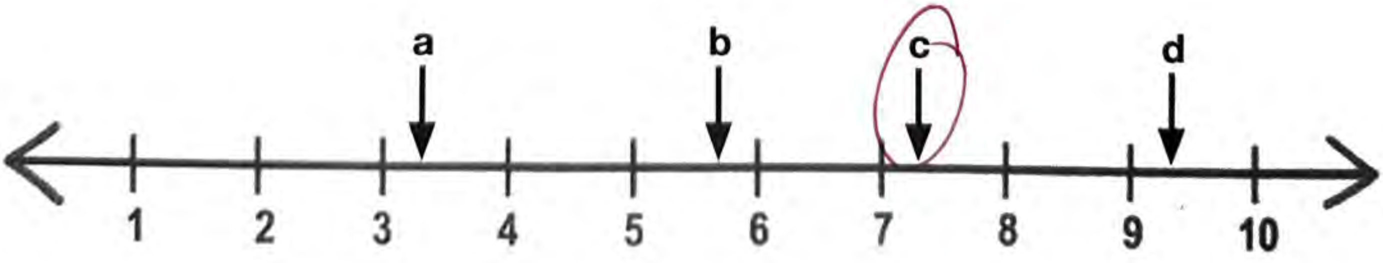
   a. Find the square roots of $\sqrt{10}$. Approximate to the nearest tenth if necessary. 3.1

   b. Use a calculator to check your estimation. $\sqrt{10}$ = 3.16

4. Kyla said the $\sqrt{3}$ falls between 2 and 3 on the number line. Is Kyla correct? Justify your answer.

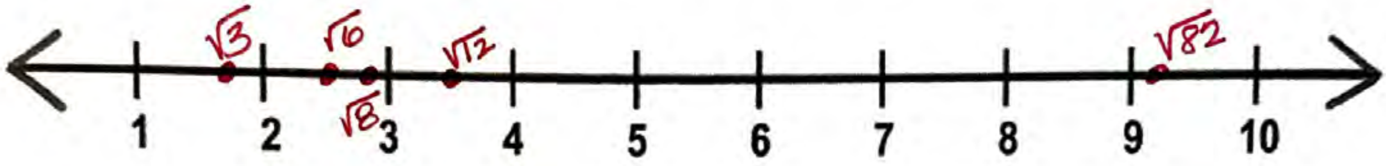
Kyla is incorrect. $\sqrt{3}$ falls between 1 and 4
$\sqrt{1} = 1$ and $\sqrt{4} = 2$, which means it would be
between 1 and 2.

5. Which letter represents where $\sqrt{51}$ would be placed on the number line? **Circle the letter.**



6. Approximate the square roots and plot on the number line.

$\sqrt{3}$ $\sqrt{6}$ $\sqrt{8}$ $\sqrt{12}$ $\sqrt{82}$



Name: Answer Key

1. Write the expression below its specific classification.

Choose Here!

$\sqrt{81}$

$\sqrt{23}$

$\sqrt{57}$

$\sqrt{64}$

$\sqrt{290}$

$\sqrt{4}$

$\sqrt{99}$

$\sqrt{305}$

$\sqrt{121}$

$\sqrt{256}$

Perfect Squares	Non-Perfect Squares
$\sqrt{81}$	$\sqrt{23}$
$\sqrt{64}$	$\sqrt{57}$
$\sqrt{4}$	$\sqrt{99}$
$\sqrt{64}$	$\sqrt{290}$
$\sqrt{256}$	$\sqrt{305}$

2. Find the square roots of the following numbers. Approximate to the nearest tenth if necessary. **(No Calculator)**

a. $\sqrt{49}$ = 7	b. $\sqrt{83}$ = 9.1
c. $\sqrt{25}$ = 5	d. $\sqrt{62}$ = 7.9

3. Brandon says that $\sqrt{23}$ it is between 4 and 5, while Jayla says that it is between 3 and 4. Which is correct? Justify your answer.

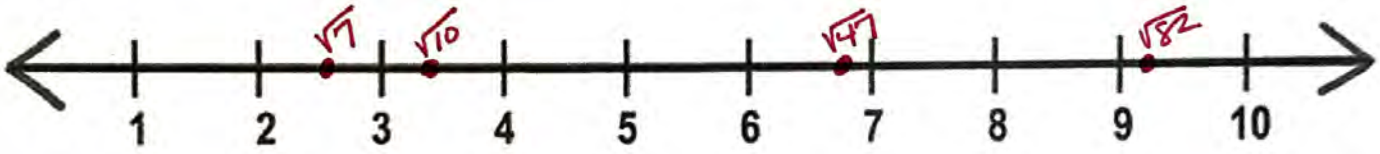
Brandon is correct $\sqrt{23}$ falls betwen 4 and 5.

$\sqrt{23}$ is betwen $\sqrt{16}$ and $\sqrt{25}$. $\sqrt{16}=4$ and

$\sqrt{25}=5$

4. Approximate the square roots and plot on the number line.

$\sqrt{7}$ = 2.6 $\sqrt{10}$ = 3.2 $\sqrt{82}$ = 9.1 $\sqrt{47}$ = 6.9



G8 U6 Lesson 5

Find a decimal approximation for square roots and locate its approximation on the number line

CITYTUTOR DC

G8 U6 Lesson 5 - Students will identify the two whole number values that a square root is between.

Materials: **Index Cards**

Warm Welcome (Slide 1): Tutor choice

Frame the Learning/Connect to Prior Learning (Slide 2): Today, we will learn how to identify the two whole numbers that a square root is between. Remember from our previous lesson that the square roots of perfect squares are whole numbers, but the square roots of other numbers fall between two whole numbers.

Let's Review (Slide 3): *(Pass out index cards)* Let's take 2 minutes to list the first 10 square numbers. Use your index card to jot them down. Possible Student Answers, Key Points:

- 1, 4, 9, 16, 25, 36, 49, 64, 81, 100 *(Have students call out and write them on the board)*

These numbers are important because they help us find the square roots of numbers that aren't perfect squares.

Let's Talk (Slide 4): **Can anyone explain how we know that the $\sqrt{31}$ is between 5 and 6 on a number line?** Possible Student Answers, Key Points:

- Find the approximation of the square root.
- Find the two perfect squares that $\sqrt{31}$ is between.

$\sqrt{31}$

(Write $\sqrt{31}$ on the board) Good explanations. Let's look at the number 31. Is 31 a perfect square? No, it's not. But we can find the two square numbers it's between. What are the square numbers closest to 31? *(Refer to the list on the board)* 25 and 36

$\sqrt{31}$

$\sqrt{25}$ $\sqrt{36}$

$5 < \sqrt{31} < 6$

Exactly! The square root of 31 is somewhere between the square roots of 25 and 36. So, we know that $\sqrt{25} = 5$ and $\sqrt{36} = 6$. Therefore, $5 < \sqrt{31} < 6$.

Remember that square roots of perfect squares can help us find two whole numbers that non-perfect square roots fall between.

Let's Think (Slide 5): Now, think about this another way. We can tell which number the non-perfect square root is closest to. **Explain how you know that $\sqrt{35}$ is a little less than 6.** Possible Student Answers, Key Points:

- Find which squared numbers $\sqrt{35}$ is closest to, 25 and 36.
- $\sqrt{36} = 6$.
- $\sqrt{35}$ is closest to $\sqrt{36}$, but less.

$\sqrt{35}$

$\sqrt{25}$ $\sqrt{36}$

$\sqrt{25}=5$ $\sqrt{36}=6$

(Write $\sqrt{35}$ on the board) Those are all good ideas! Just as before we can find the two closest square roots to $\sqrt{35}$. Those two would be 25 and 36. Remember that $\sqrt{25} = 5$ and $\sqrt{36} = 6$. Therefore, $\sqrt{35}$ would be a little less than 6 since, 35 is closest to 36.

Remember as you work today, you can use a calculator as tool to check your work.

Let’s Try it (Slides 6): Now, I want you to try a few on your own. I’ll be here to help if you need it. Remember, find the closest square numbers first and then identify the two whole numbers the square root is between.

WARM WELCOME

Today we will learn how to find the two whole numbers that a square root is between.

Let’s Review:

List the first ten square numbers.

Let’s Talk:

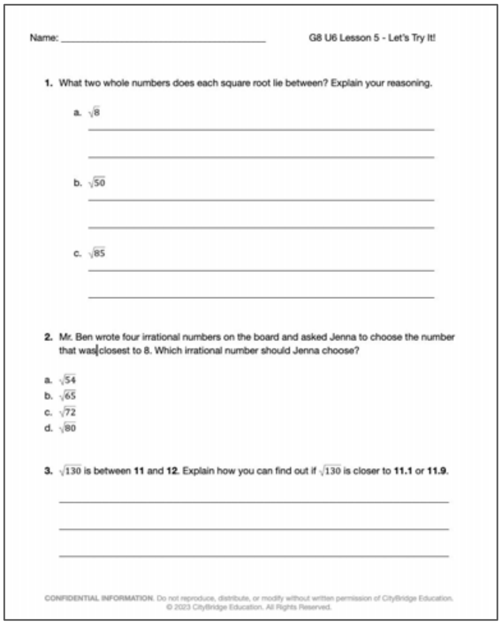
Explain how you know that $\sqrt{31}$ lies between 5 and 6 on a number line.

Let’s Think:

Explain how you know that √35 is a little less than 6.

Let’s Try It:

Let’s explore how identify the two whole number values that a square root is between together.



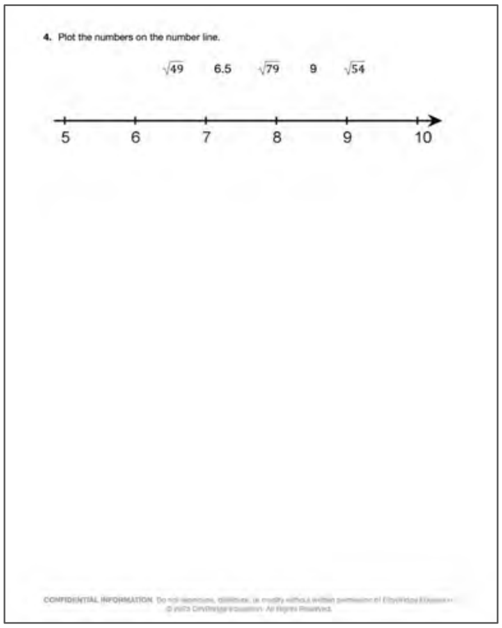
Name: ______________________ G8 U6 Lesson 5 - Let's Try It!

1. What two whole numbers does each square root lie between? Explain your reasoning.
   a. $\sqrt{8}$
   b. $\sqrt{50}$
   c. $\sqrt{85}$

2. Mr. Ben wrote four irrational numbers on the board and asked Jenna to choose the number that was closest to 8. Which irrational number should Jenna choose?

a. $\sqrt{54}$
b. $\sqrt{65}$
c. $\sqrt{72}$
d. $\sqrt{80}$

3. $\sqrt{130}$ is between **11** and **12**. Explain how you can find out if $\sqrt{130}$ is closer to **11.1** or **11.9**.

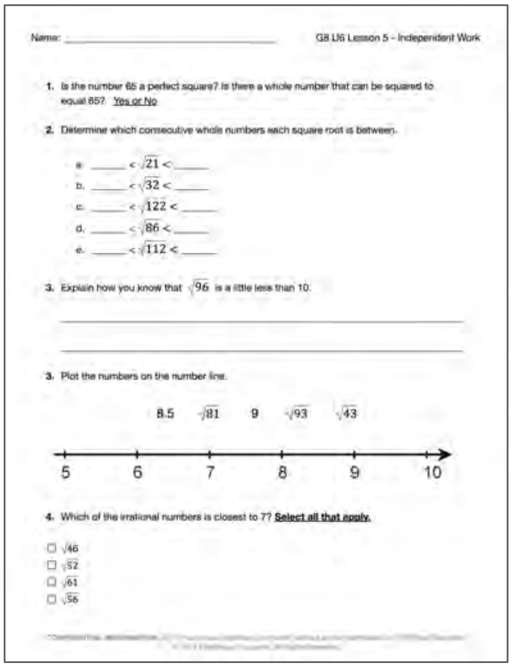


4. Plot the numbers on the number line.

$\sqrt{49}$ 6.5 $\sqrt{79}$ 9 $\sqrt{54}$

On your Own:

Now it’s your time identify the two whole number values that a square root is between on your own.



Name: ______________________________ G8 U6 Lesson 5 - Independent Work

1. Is the number 65 a perfect square? Is there a whole number that can be squared to equal 65? Yes or No

2. Determine which consecutive whole numbers each square root is between.

a. ______ $< \sqrt{21} <$ ______
b. ______ $< \sqrt{32} <$ ______
c. ______ $< \sqrt{122} <$ ______
d. ______ $< \sqrt{86} <$ ______
e. ______ $< \sqrt{112} <$ ______

3. Explain how you know that $\sqrt{96}$ is a little less than 10.

____

____

3. Plot the numbers on the number line.

8.5 $\sqrt{81}$ 9 $\sqrt{93}$ $\sqrt{43}$

4. Which of the irrational numbers is closest to 7? **Select all that apply.**

☐ $\sqrt{46}$
☐ $\sqrt{52}$
☐ $\sqrt{61}$
☐ $\sqrt{56}$

Name: ________________________________ G8 U6 Lesson 5 - Let's Try It

1. What two whole numbers does each square root lie between? Explain your reasoning.

a. $\sqrt{8}$

b. $\sqrt{50}$

c. $\sqrt{85}$

2. Mr. Ben wrote four irrational numbers on the board and asked Jenna to choose the number closest to 8. Which irrational number should Jenna choose?

a. $\sqrt{54}$
b. $\sqrt{65}$
c. $\sqrt{72}$
d. $\sqrt{80}$

3. $\sqrt{130}$ is between **11** and **12**. Explain how you can find out if $\sqrt{130}$ is closer to **11.1** or **11.9**.

4. Plot the numbers on the number line.

$\sqrt{49}$ 6.5 $\sqrt{79}$ 9 $\sqrt{54}$

Name: ____

1. Is the number 65 a perfect square? Is there a whole number that can be squared to equal 65? Yes or No

2. Determine which consecutive whole numbers each square root is between.

a. ______ $< \sqrt{21} <$ ______

b. ______ $< \sqrt{32} <$ ______

c. ______ $< \sqrt{122} <$ ______

d. ______ $< \sqrt{86} <$ ______

e. ______ $< \sqrt{112} <$ ______

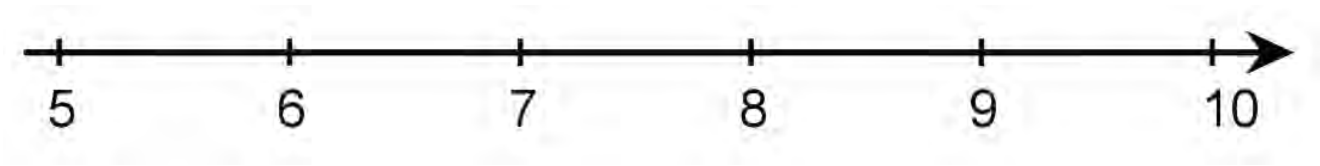
3. Explain how you know that $\sqrt{96}$ is a little less than 10.

____

____

3. Plot the numbers on the number line.

8.5 $\quad \sqrt{81} \quad$ 9 $\quad \sqrt{93} \quad \sqrt{43}$



4. Which of the irrational numbers is closest to 7? **Select all that apply.**

☐ $\sqrt{46}$
☐ $\sqrt{52}$
☐ $\sqrt{61}$
☐ $\sqrt{56}$

Name: Answer Key

1. What two whole numbers does each square root lie between? Explain your reasoning.

   a. $\sqrt{8}$

   $\sqrt{4} < \sqrt{8} < \sqrt{9}$, $2 < \sqrt{8} < 3$

   b. $\sqrt{50}$

   $\sqrt{49} < \sqrt{50} < \sqrt{64}$

   $7 < \sqrt{50} < 8$

   c. $\sqrt{85}$

   $\sqrt{81} < \sqrt{85} < \sqrt{100}$

   $9 < \sqrt{85} < 10$

2. Mr. Ben wrote four irrational numbers on the board and asked Jenna to choose the number closest to 8. Which irrational number should Jenna choose?

a. $\sqrt{54}$
[✓ b. $\sqrt{65}$]
c. $\sqrt{72}$
d. $\sqrt{80}$

3. $\sqrt{130}$ is between **11** and **12**. Explain how you can find out if $\sqrt{130}$ is closer to **11.1** or **11.9**.

You can multiply 11.1 by itself and 11.9 by itself to see which is closer to 130.

4. Plot the numbers on the number line.

$\sqrt{49}$ 6.5 $\sqrt{79}$ 9 $\sqrt{54}$

Name: Answer Key

G8 U6 Lesson 5 - Independent Work

1. Is the number 65 a perfect square? Is there a whole number that can be squared to equal 65? Yes or [✓ No]

2. Determine which consecutive whole numbers each square root is between.

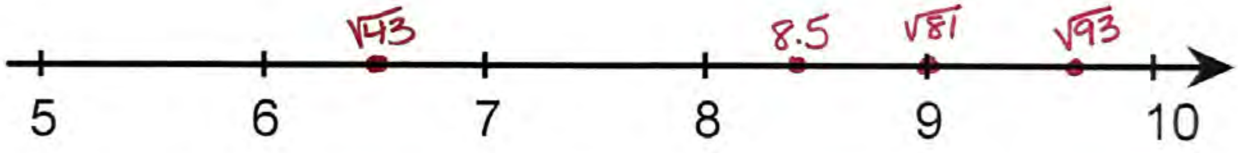
   a. 4 $< \sqrt{21} <$ 5
   b. 5 $< \sqrt{32} <$ 6
   c. 11 $< \sqrt{122} <$ 12
   d. 9 $< \sqrt{86} <$ 10
   e. 10 $< \sqrt{112} <$ 11

3. Explain how you know that $\sqrt{96}$ is a little less than 10.

$\sqrt{100} = 10$, since 96 is less than 100, then $\sqrt{96}$ would be less than $\sqrt{100}$

3. Plot the numbers on the number line.

8.5 $\quad \sqrt{81} \quad$ 9 $\quad \sqrt{93} \quad \sqrt{43}$



4. Which of the irrational numbers is closest to 7? **Select all that apply.**

☑ $\sqrt{46}$
☑ $\sqrt{52}$
☐ $\sqrt{61}$
☐ $\sqrt{56}$

G8 U6 Lesson 6
Comprehend the term "Pythagorean Theorem" as the equation a2 + b2 = c2.

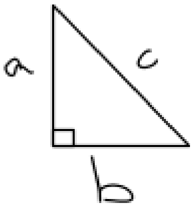
G8 U6 Lesson 6 - Students will comprehend the term “Pythagorean Theorem” as the equation $a^2 + b^2 = c^2$.

Warm Welcome (Slide 1): Tutor choice

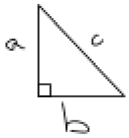
Frame the Learning/Connect to Prior Learning (Slide 2): Today, we're going to learn about a very important theorem in geometry, the Pythagorean Theorem. A theorem is a statement that has been proven or can be proven. We’ve learned about squaring numbers and finding the square root, which will be helpful today.

Let’s Talk (Slide 3): Before we dive in, can anyone tell me what a right triangle is? Possible Student Answers, Key Points:

- Has a right angle or 90-degree angle
- Has three sides
- has two legs and a hypotenuse



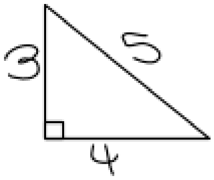
Exactly! A right triangle has one angle that is 90 degrees. Now, let's look at this right triangle." *(Draw a right triangle on the board and label the sides a (leg), b (leg), and c, with c being the hypotenuse.)* “a” and “b” are legs of the triangle and “c” is the longest side of the right triangle, which is also always across from the right angle, we call it the hypotenuse. Now let’s say it together: HYPOTENUSE!



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

The Pythagorean Theorem states that in a right triangle, the square of the length of the hypotenuse (the side opposite the right angle) is equal to the sum of the squares of the lengths of the other two sides. We can write this as $a^2 + b^2 = c^2$.

Let’s Think (Slide 4): Remember I said that the Pythagorean Theorem can be proved, and it can help us prove things about right triangles. Using the Pythagorean Theorem, $a^2 + b^2 = c^2$, determine if this triangle is indeed a right triangle. The Pythagorean Theorem can only be true for right triangles.



(Draw the triangle on the board.) So which sides could be labeled “a” and “b”? 3 or 4. Great. Which of the sides is the hypotenuse? The side that is 5.

So if we square of the length of the hypotenuse is equal to the sum of the squares of the lengths of the other two sides, then we know that this is a right triangle.

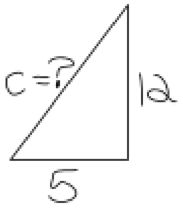
$3^2 + 4^2 = 5^2$

$9 + 16 = 25$

$25 = 25$ ✓

We first set 3 squared plus 4 squared equal to the hypotenuse squared, which is 5 squared. 3 squared is 9, and 4 squared is 16. 5 squared is 25. 9 + 16 equals 25, so that means that 25 = 25. This is a true statement. Therefore, these side lengths make a right triangle because the hypotenuse squared equals the sum of the squares of the other two sides.

Let's Think (Slide 5): Now let's look at how we can find the length of the hypotenuse if we know the side lengths of the other two sides. Remember that $a^2 + b^2 = c^2$.



(Draw triangle on whiteboard.) Suppose we have a right triangle where one leg is 5 units long and the other leg is 12 units long. We want to find the length of the hypotenuse. According to the Pythagorean Theorem, we have a = 5, b = 12, and we need to find c

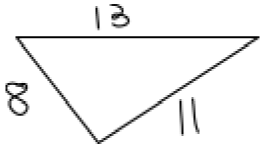
$$a^2 + b^2 = c^2$$
$$5^2 + 12^2 = c^2$$
$$25 + 144 = c^2$$
$$169 = c^2$$

We can substitute the values we know using the formula $a^2 + b^2 = c^2$. 5 squared plus 12 squared equals "c" squared." We know that 5 squared equals 25 and 12 squared equals 144. The sum of the squares equals 169.

$$\sqrt{c^2} = \sqrt{169}$$
$$c = 13$$

Now, we take the square root of both sides to find c. Remember, when we square root a squared number or variable, they cancel each other out. The square root of 169 equals 13. The hypotenuse is 13 units long.

Let's Think (Slide 6): Now let's look at one more example: **Is this a right triangle? Explain why or why not.**



(Draw non-right triangle on the whiteboard.) What can we use to help us determine whether this is a right triangle or not? The Pythagorean Theorem. Yes, we can test out this triangle using the Pythagorean Theorem. Since we know that the longest side is the hypotenuse, and we label that as "c," we will substitute 13 for c, and 8 and 11 will be our "a" and "b."

$$a^2 + b^2 = c^2$$
$$8^2 + 11^2 = 13^2$$
$$64 + 121 = 169$$
$$185 = 169$$
$$185 \neq 169$$

8 squared is 64, and 11 squared is 121. Remember, we set the sum of the squares equal to our longest side, in this case, 13 squared. 64 plus 121 is equal to 185, and 13 squared is equal to 169. Since 185 does not equal 185, we can say that this triangle is not a right triangle. The sides' lengths do not make for a right triangle, and the Pythagorean Theorem allowed us to test it.

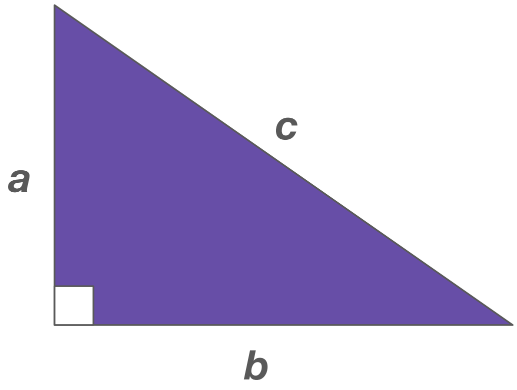
Let's Try it (Slides 7): Great job today! Remember, the Pythagorean Theorem is a powerful tool for working with right triangles. We can use $a^2 + b^2 = c^2$ to us determine if a triangle is a right triangle or not and we can find missing side lengths by using the theorem.

WARM WELCOME

Today we will comprehend the term "Pythagorean Theorem" as the equation $a^2 + b^2 = c^2$..

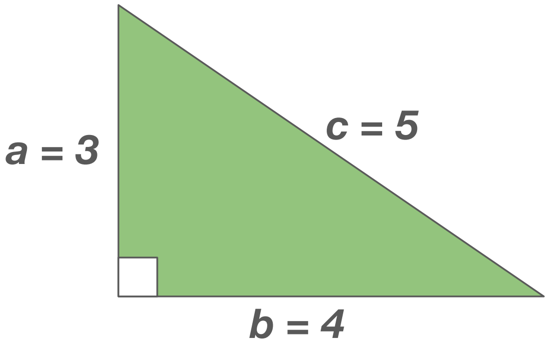
Let’s Talk:

What is a right triangle?



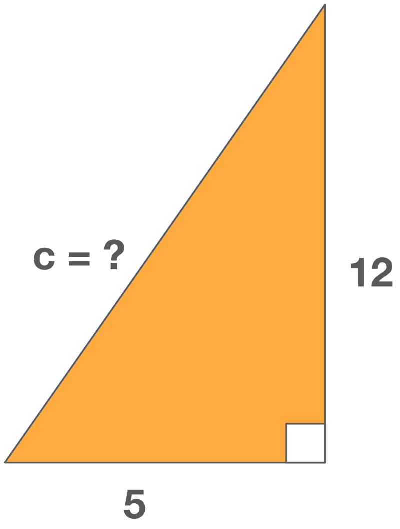
Let’s Think:

Using the Pythagorean Theorem, $a^2 + b^2 = c^2$, determine if this a right triangle?



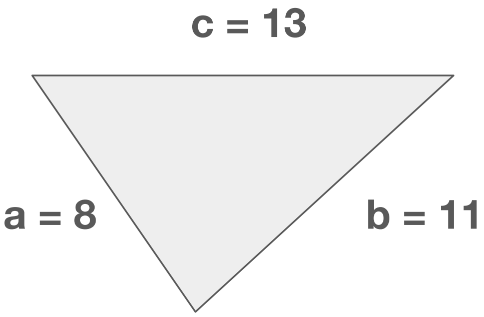
Let's Think:

How can we use the Pythagorean Theorem to solve for a the hypotenuse?



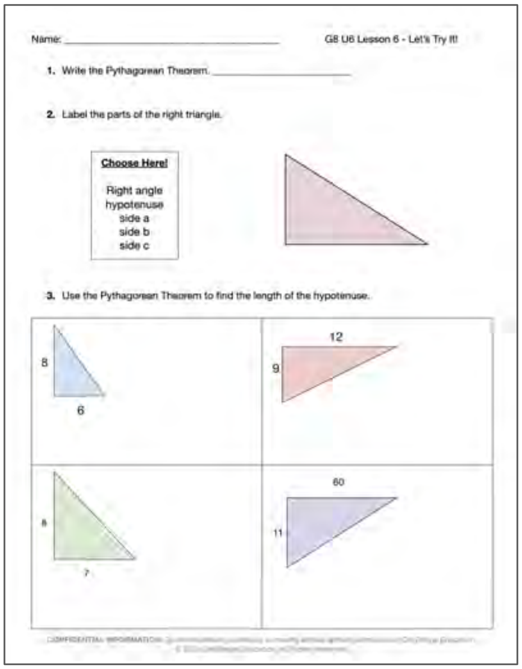
Let's Think:

Is this a right triangle? Explain why or why not.



Let's Try It:

Let's explore using the Pythagorean Theorem together.



Name: ______________________ G8 U6 Lesson 6 - Let's Try It!

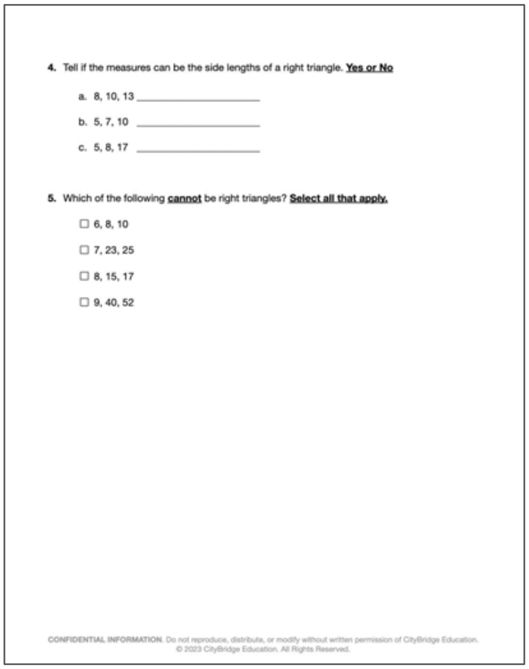
1. Write the Pythagorean Theorem. ______________________

2. Label the parts of the right triangle.

Choose Here!

Right angle
hypotenuse
side a
side b
side c

3. Use the Pythagorean Theorem to find the length of the hypotenuse.



4. Tell if the measures can be the side lengths of a right triangle. **Yes or No**

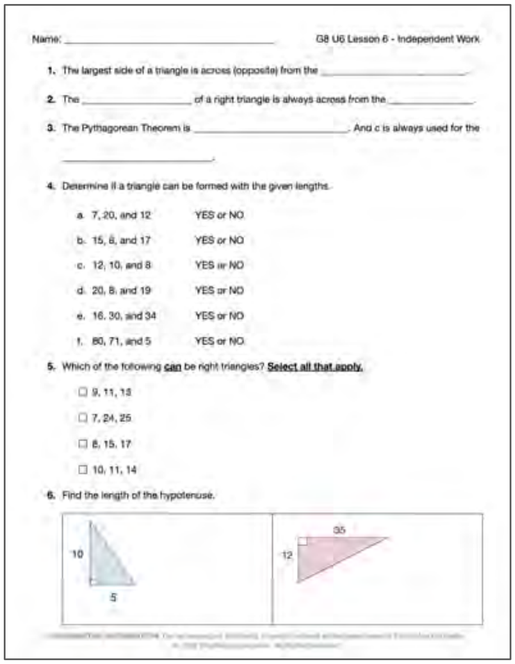
a. 8, 10, 13 ______________
b. 5, 7, 10 ______________
c. 5, 8, 17 ______________

5. Which of the following **cannot** be right triangles? **Select all that apply.**

- ☐ 6, 8, 10
- ☐ 7, 23, 25
- ☐ 8, 15, 17
- ☐ 9, 40, 52

On your Own:

Now it's time use the Pythagorean Theorem on your own.



Name: ______________________ G8 U6 Lesson 6 - Independent Work

1. The largest side of a triangle is across (opposite) from the ______________________.

2. The ______________ of a right triangle is always across from the ______________.

3. The Pythagorean Theorem is ______________________. And c is always used for the ______________________.

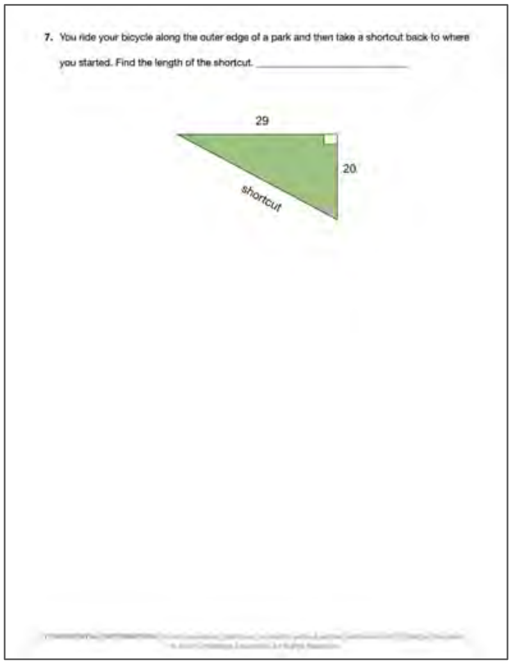
4. Determine if a triangle can be formed with the given lengths.

a. 7, 20, and 12 YES or NO
b. 15, 8, and 17 YES or NO
c. 12, 10, and 8 YES or NO
d. 20, 8, and 19 YES or NO
e. 16, 30, and 34 YES or NO
f. 80, 71, and 5 YES or NO

5. Which of the following **can** be right triangles? **Select all that apply.**

- ☐ 9, 11, 13
- ☐ 7, 24, 25
- ☐ 8, 15, 17
- ☐ 10, 11, 14

6. Find the length of the hypotenuse.



7. You ride your bicycle along the outer edge of a park and then take a shortcut back to where you started. Find the length of the shortcut. ______________________

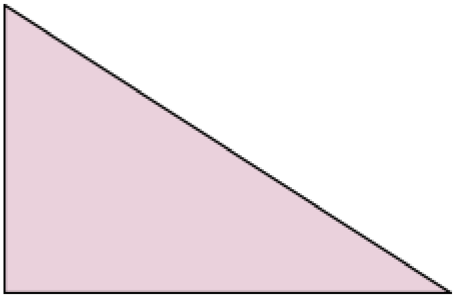
Name: ____ G8 U6 Lesson 6 - Let's Try It

1. Write the Pythagorean Theorem. __________________________

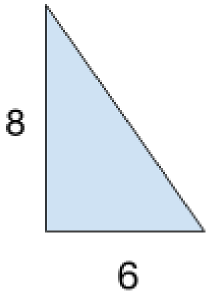
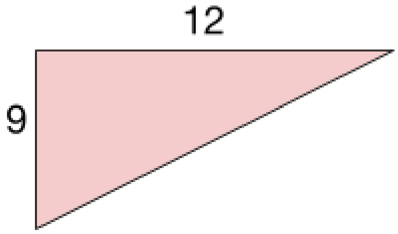
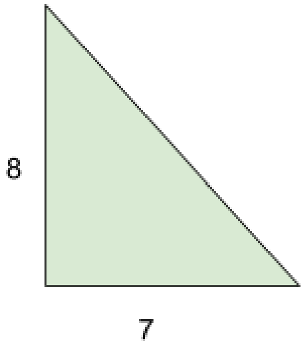
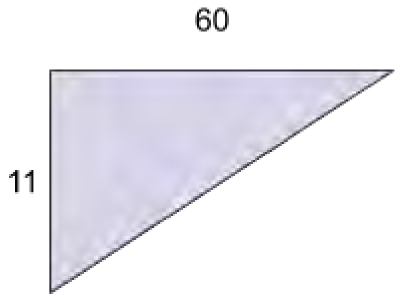
2. Label the parts of the right triangle.

<u>Choose Here!</u>

Right angle
hypotenuse
side a
side b
side c



3. Use the Pythagorean Theorem to find the length of the hypotenuse.

4. Tell if the measures can be the side lengths of a right triangle. **Yes or No**

a. 8, 10, 13 ________________________

b. 5, 7, 10 ________________________

c. 5, 8, 17 ________________________

5. Which of the following **cannot** be right triangles? **Select all that apply.**

☐ 6, 8, 10

☐ 7, 23, 25

☐ 8, 15, 17

☐ 9, 40, 52

Name: ____________________________________ G8 U6 Lesson 6 - Independent Work

1. The largest side of a triangle is across (opposite) from the ________________________.

2. The __________________ of a right triangle is always across from the ______________.

3. The Pythagorean Theorem is __________________________. And c is always used for the

________________________.

4. Determine if a triangle can be formed with the given lengths.

a. 7, 20, and 12 YES or NO

b. 15, 8, and 17 YES or NO

c. 12, 10, and 8 YES or NO

d. 20, 8, and 19 YES or NO

e. 16, 30, and 34 YES or NO

f. 80, 71, and 5 YES or NO

5. Which of the following **can** be right triangles? **Select all that apply.**

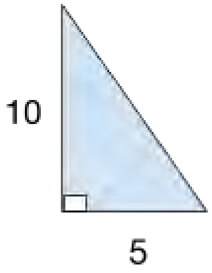
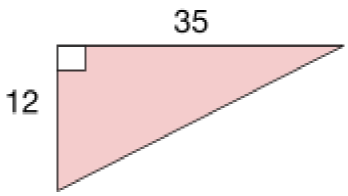
☐ 9, 11, 13

☐ 7, 24, 25

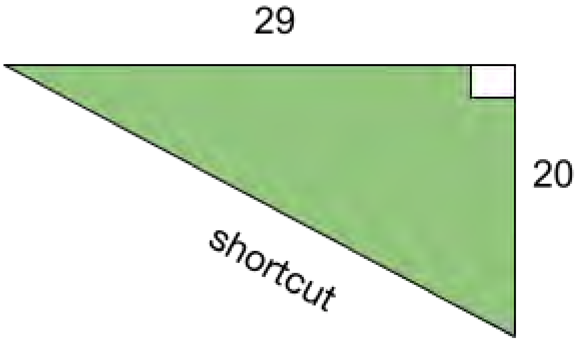
☐ 8, 15, 17

☐ 10, 11, 14

6. Find the length of the hypotenuse.

7. You ride your bicycle along the outer edge of a park and then take a shortcut back to where you started. Find the length of the shortcut. ___________________________



Name: Amswer Key

G8 U6 Lesson 6 - Independent Work

1. The largest side of a triangle is across (opposite) from the right angle.

2. The hypotenuse of a right triangle is always across from the right angle.

3. The Pythagorean Theorem is $a^2+b^2=c^2$. And c is always used for the hypotenuse.

4. Determine if a triangle can be formed with the given lengths.

a. 7, 20, and 12 YES or [✓ NO]

b. 15, 8, and 17 [✓ YES] or NO

c. 12, 10, and 8 YES or [✓ NO]

d. 20, 8, and 19 YES or [✓ NO]

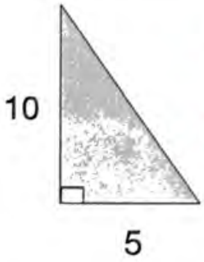
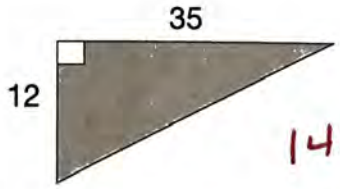
e. 16, 30, and 34 [✓ YES] or NO

f. 80, 71, and 5 YES or [✓ NO]

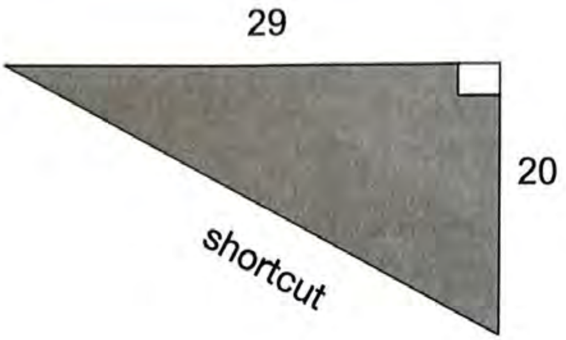
5. Which of the following **can** be right triangles? **Select all that apply.**

- ☐ 9, 11, 13
- ☑ 7, 24, 25
- ☑ 8, 15, 17
- ☐ 10, 11, 14

6. Find the length of the hypotenuse.

 $5^2+10^2=c^2$ $25+100=c^2$ $125=c^2$ $c=\sqrt{125}$	 $12^2+35^2=c^2$ $144+1225=c^2$ $1369=c^2$ $\sqrt{1369}=c$ $c=37$

7. You ride your bicycle along the outer edge of a park and then take a shortcut back to where you started. Find the length of the shortcut. 35.2 units



$20^2 + 29^2 = c^2$

$400 + 841 = c^2$

$1241 = c^2$

$c = \sqrt{1241} \approx 35.2$

Name: Answer Key

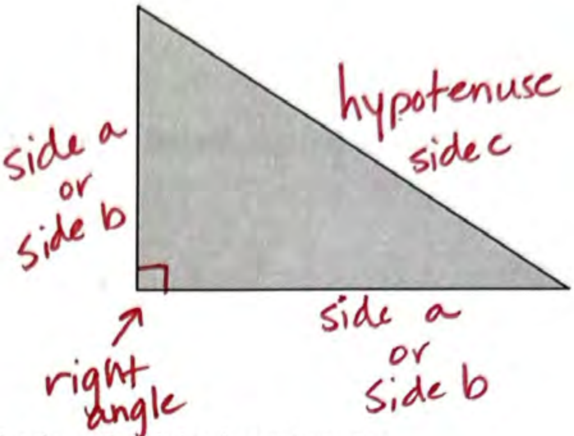
G8 U6 Lesson 6 - Let's Try It!

1. Write the Pythagorean Theorem. $a^2+b^2=c^2$

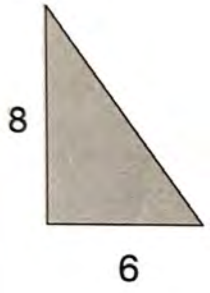
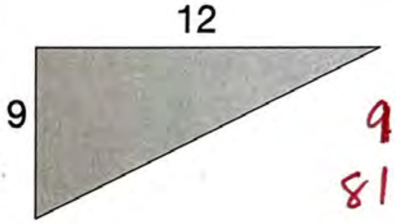
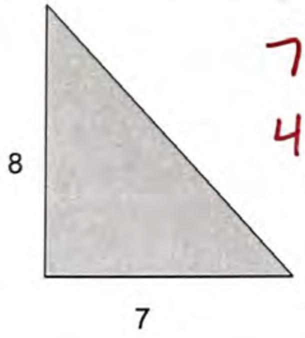
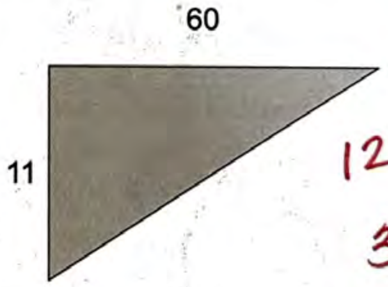
2. Label the parts of the right triangle.

Choose Here!

Right angle
hypotenuse
side a
side b
side c



3. Use the Pythagorean Theorem to find the length of the hypotenuse.

 $6^2+8^2=c^2$ $36+64=c^2$ $100=c^2$ $\sqrt{100}=c$ $c=10$	 $9^2+12^2=c^2$ $81+144=c^2$ $225=c^2$ $\sqrt{225}=c$ $c=15$
 $7^2+8^2=c^2$ $49+64=c^2$ $113=c^2$ $\sqrt{113}=c$ $c\approx 10.6$	 $11^2+60^2=c^2$ $121+3600=c^2$ $3721=c^2$ $\sqrt{3721}=c$ $c=61$

4. Tell if the measures can be the side lengths of a right triangle. **Yes or No**

a. 8, 10, 13 No

b. 5, 7, 10 No

c. 5, 8, 17 No

5. Which of the following **cannot** be right triangles? **Select all that apply.**

☐ 6, 8, 10

☑ 7, 23, 25

☐ 8, 15, 17

☑ 9, 40, 52

G8 U6 Lesson 7
Explain the Pythagorean Theorem proof and calculate unknown sides

CITYTUTOR DC

G8 U6 Lesson 7 - Students will explain the Pythagorean proof and calculate unknown sides.

Warm Welcome (Slide 1): Tutor choice

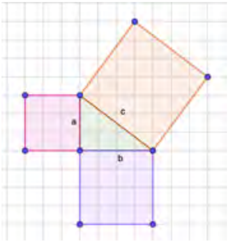
Frame the Learning/Connect to Prior Learning (Slide 2): Today, we're going to continue to explore one of the most famous theorems in mathematics: the Pythagorean Theorem. By the end of this lesson, you will understand a proof of the theorem and be able to calculate an unknown side length of a right triangle using the Pythagorean Theorem.

Let's Talk (Slide 3): In our last lesson, we learned about the Pythagorean Theorem. **When thinking about that, how could we determine if this is a right triangle or not?** Possible Student Answers, Key Points:

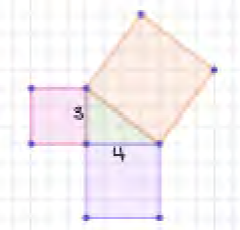
- Pythagorean Theorem
- Add the sum of the squares of sides "a" and "b", and they should equal the square of side "c."

That's right, we could use the Pythagorean Theorem. The Pythagorean Theorem states that in a right triangle, the square of the length of the hypotenuse is equal to the sum of the squares of the lengths of the other two sides. This can be written as $a^2 + b^2 = c^2$.

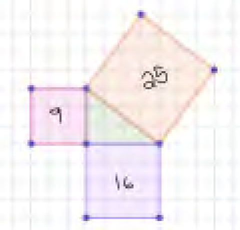
But why is the Pythagorean Theorem true? Let's see why this is true with a visual proof.



(Draw a large right triangle on the whiteboard, then draw squares on each triangle's sides. Show that the area of the square on the hypotenuse equals the sum of the areas of the squares on the other two sides.)



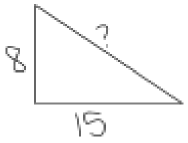
Here, we have a right triangle with legs of 3 and 4 units. Let's calculate the area of their squares. $A = 3^2 = 9$ and $A = 4^2 = 16$



According to the Pythagorean Theorem, the hypotenuse should be 5 units. The area of the square on the hypotenuse is 25, which is the same as the sum of the areas of the squares on the other two sides, 9 and 16.

So we see in this proof that the sum of the squares of the legs equals the square of the hypotenuse. This should always work for the Pythagorean Theorem.

Let's Think (Slide 4): We can use the Pythagorean Theorem to find the hypotenuse. If we know two side lengths, then we can find the hypotenuse. Can someone help me get started? *(Allow Students to walk you through the steps)* What are sides "a" and "b?" 8 and 15. What is the Pythagorean Theorem? $a^2 + b^2 = c^2$ *(Write on the whiteboard and Draw a right triangle)*



$a^2 + b^2 = c^2$
$8^2 + 15^2 = c^2$
$64 + 225 = c^2$
$289 = c^2$

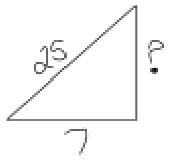
Let's substitute our values for "a" and "b." We get $8^2 + 15^2 = c^2$. $8^2 = 64$ and $15^2 = 225$. When we find the sum of the squares, we get 289. We have to find the value of "c," but now we have "c^2." We have to take the "Square root" of both sides of the equal sign to find "c." The square root of "c^2" cancels out the squared part, leaving you with "c." The square root of 289 is 17. That means the side "c", the hypotenuse, equals 17.

$289 = c^2$
$\sqrt{289} = \sqrt{c^2}$
$c = 17$

Let's Think (Slide 5): Now let's imagine that we know one leg (or side) and the hypotenuse of the right triangle; how could we use the Pythagorean Theorem to find the other side? Possible Student Answers, Key Points:

- Substitute into the Pythagorean
- Subtract the square of the hypotenuse and the square of the given side.

Those are great ideas! We can still use the Pythagorean Theorem, instead of adding the sum of squares when we know two sides, this time we are going to subtract the square of the hypotenuse and the square of the side that we know.



We can substitute what we know. We know that "a" is equal to "7" and that "c" is equal to "25." First, let's write the Pythagorean Theorem, $a^2 + b^2 = c^2$.

- $7^2 + b^2 = 25^2$
  - $b^2 = 25^2 - 7^2$
  - $b^2 = 625 - 49$
  - $b^2 = 576$
  - $\sqrt{b^2} = \sqrt{576}$
  - $b = 24$

$a^2 + b^2 = c^2$
$7^2 + b^2 = 25^2$
$b^2 = 25^2 - 7^2$
$b^2 = 625 - 49$
$b^2 = 576$
$\sqrt{b^2} = \sqrt{576}$
$b = 24$

So, the other leg is 24 units.

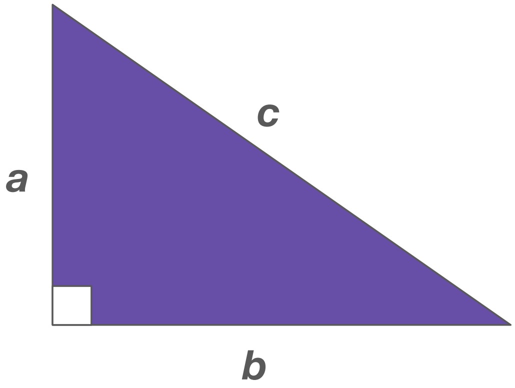
Let's Try it (Slides 6): Now it's your turn to try. Remember that the Pythagorean Theorem can help us find the length of the hypotenuse if we know two given side lengths, and we can find a side length if we know the hypotenuse and the other side. This is always true for right triangles.

WARM WELCOME

Today you will Explain the Pythagorean Theorem proof and calculate unknown sides.

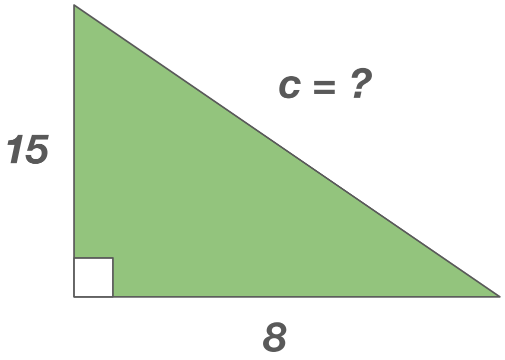
Let's Talk:

How could we determine if this is a right triangle or not?



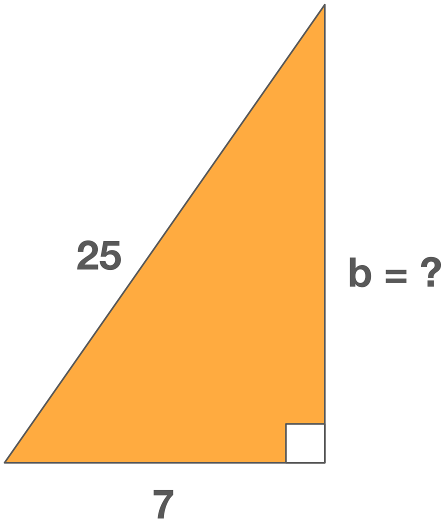
Let's Think:

How can we use the Pythagorean Theorem to solve for the hypotenuse?



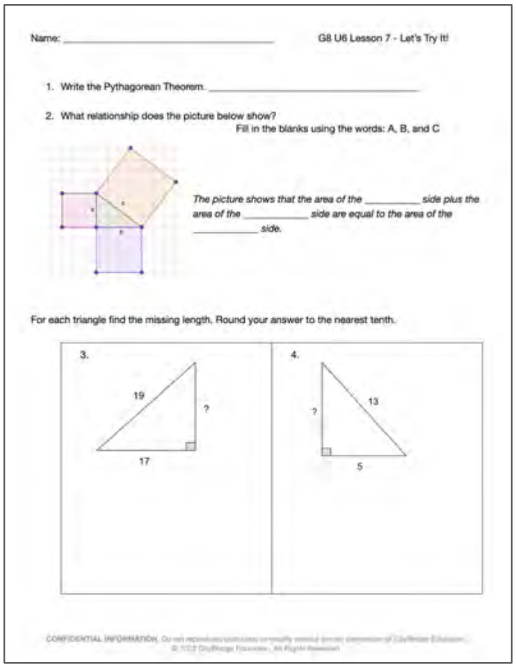
Let's Think:

How can we use the Pythagorean Theorem to solve for a missing leg?



Let's Try It:

Let's explore how to explain the Pythagorean proof and calculate unknown sides together.


Name: ______________________ G8 U6 Lesson 7 - Let's Try It!

1. Write the Pythagorean Theorem. ______________________

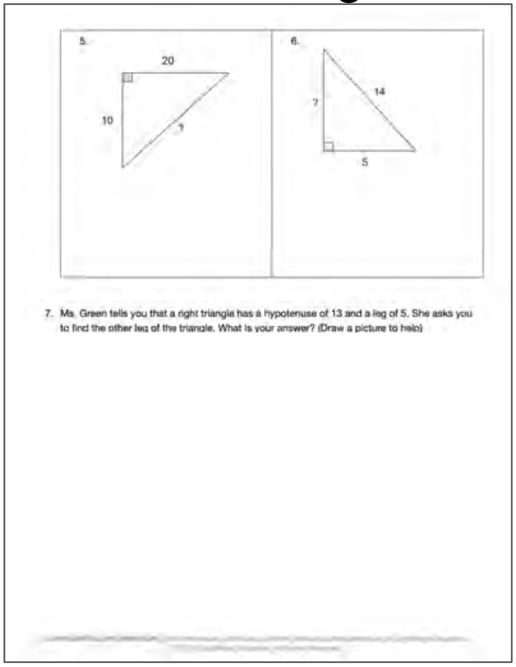
2. What relationship does the picture below show?
Fill in the blanks using the words: A, B, and C

The picture shows that the area of the __________ *side plus the area of the* __________ *side are equal to the area of the* __________ *side.*

For each triangle find the missing length. Round your answer to the nearest tenth.

3.

4.

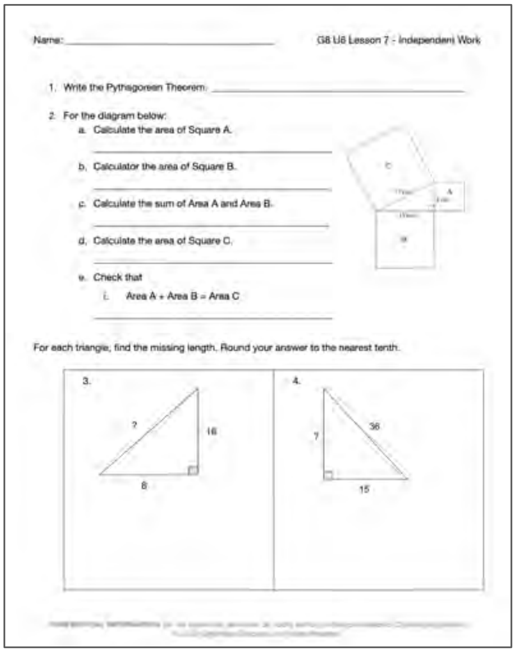

5.

6.

7. Ms. Green tells you that a right triangle has a hypotenuse of 13 and a leg of 5. She asks you to find the other leg of the triangle. What is your answer? (Draw a picture to help)

On your Own:

Now it’s time to try explain the Pythagorean proof and calculate unknown sides on your own.



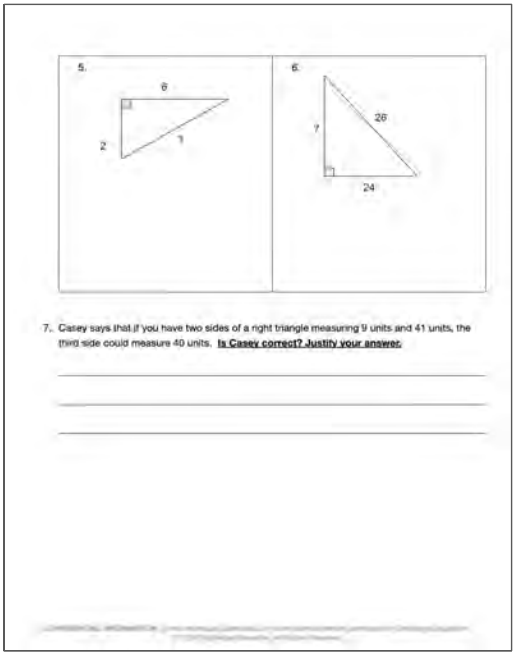
Name:____________________ G8 U8 Lesson 7 - Independent Work

1. Write the Pythagorean Theorem: ____________________
2. For the diagram below:
    a. Calculate the area of Square A.
    ____
    b. Calculator the area of Square B.
    ____
    c. Calculate the sum of Area A and Area B.
    ____
    d. Calculate the area of Square C.
    ____
    e. Check that
        i. Area A + Area B = Area C
    ____

For each triangle, find the missing length. Round your answer to the nearest tenth.

3.

4.



5.

6.

7. Casey says that if you have two sides of a right triangle measuring 9 units and 41 units, the third side could measure 40 units. **Is Casey correct? Justify your answer.**

____

____

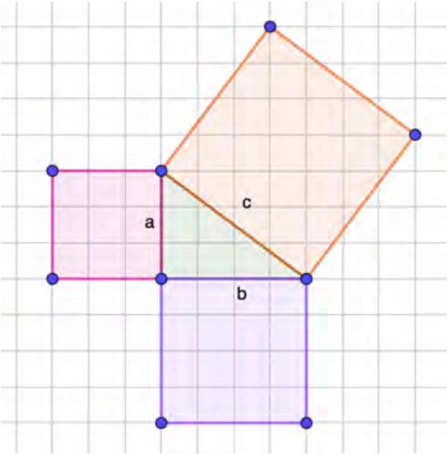
____

Name: ____

1. Write the Pythagorean Theorem. ____

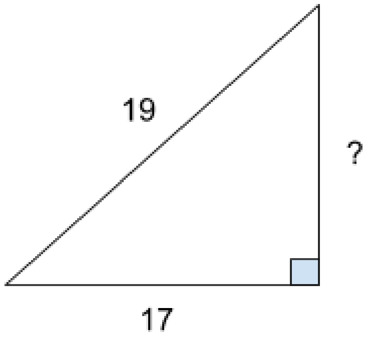
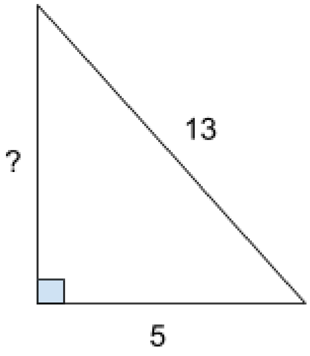
2. What relationship does the picture below show?

Fill in the blanks using the words: A, B, and C



The picture shows that the area of the __________ side plus the area of the ____________ side are equal to the area of the ____________ side.

For each triangle find the missing length. Round your answer to the nearest tenth.

3. 	4. 

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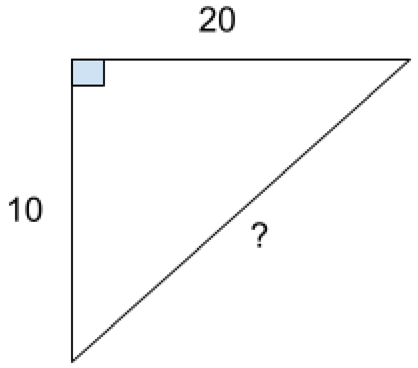

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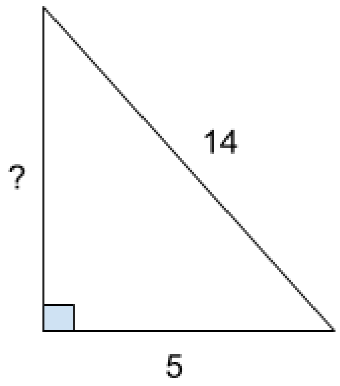


7. Ms. Green tells you that a right triangle has a hypotenuse of 101 and a leg of 20. She asks you to find the other leg of the triangle. What is your answer? (Draw a picture to help)

1. Write the Pythagorean Theorem. ____

2. For the diagram below:
    a. Calculate the area of Square A.

    ____

    b. Calculator the area of Square B.

    ____

    c. Calculate the sum of Area A and Area B.

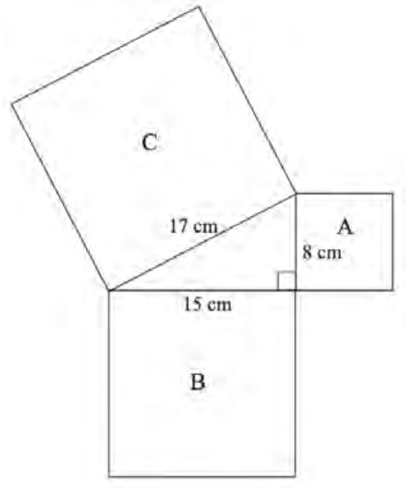
    ____

    d. Calculate the area of Square C.

    ____

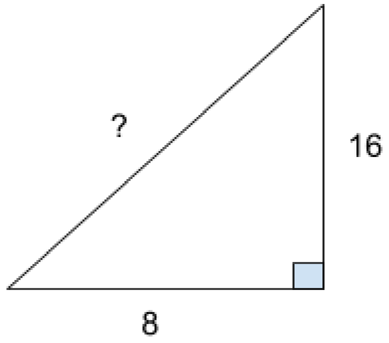
    e. Check that
        i. Area A + Area B = Area C

    ____



For each triangle, find the missing length. Round your answer to the nearest tenth.

3.



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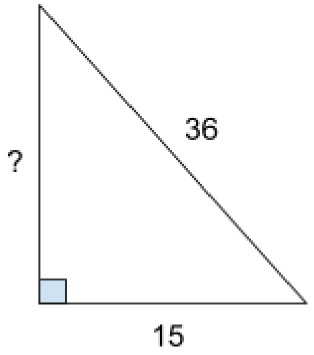

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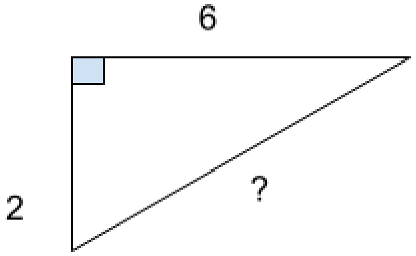

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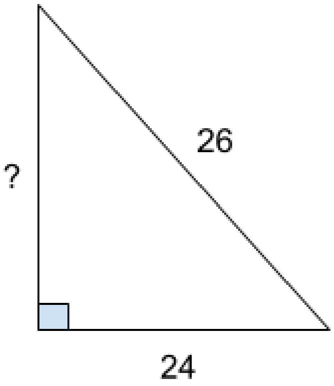


7. Casey says that if you have two sides of a right triangle measuring 9 units and 41 units, the third side could measure 40 units. **<u>Is Casey correct? Justify your answer.</u>**

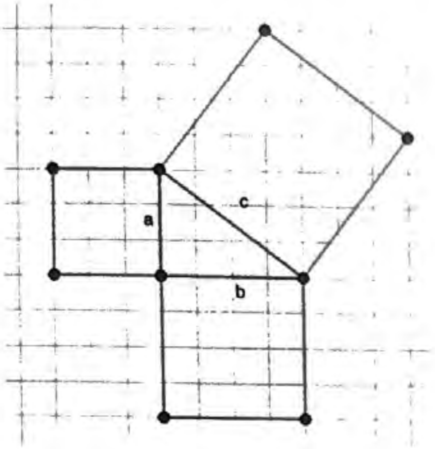
Name: Answer Key

G8 U6 Lesson 7 - Let's Try It!

1. Write the Pythagorean Theorem. $a^2+b^2=c^2$

2. What relationship does the picture below show?

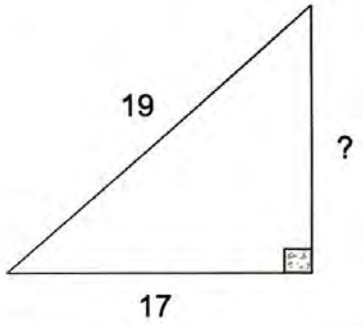
Fill in the blanks using the words: A, B, and C



The picture shows that the area of the A *side plus the area of the* B *side are equal to the area of the* C *side.*

For each triangle find the missing length. Round your answer to the nearest tenth.

3.



$17^2+b^2=19^2$

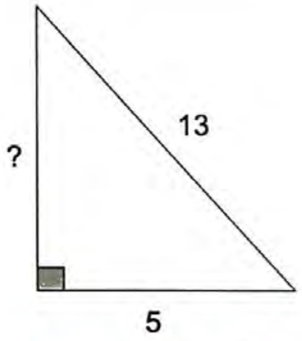
$b^2=19^2-17^2$

$b^2=361-289$

$b^2=72$

$b=8.5$

4.



$a^2+5^2=13^2$

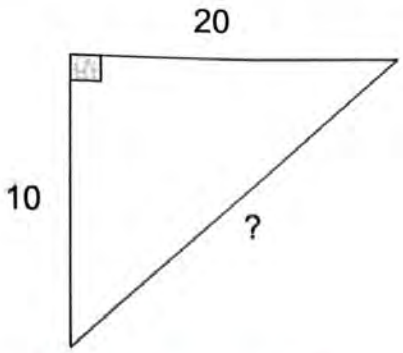
$a^2=13^2-5^2$

$a^2=169-25$

$a^2=144$

$a=12$

5.



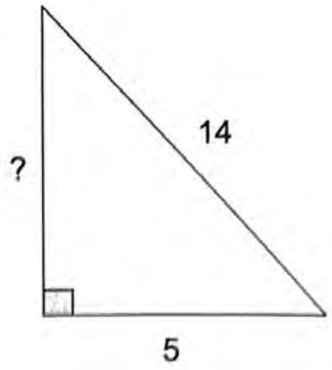
$10^2 + 20^2 = c^2$

$100 + 400 = c^2$

$500 = c^2$

$c = 22.4$

6.



$5^2 + b^2 = 14^2$

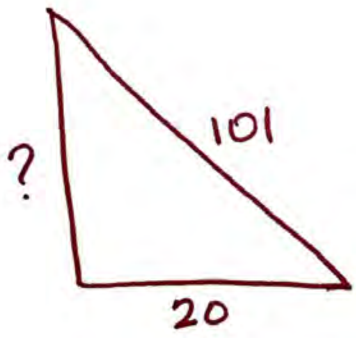
$b^2 = 14^2 - 5^2$

$b = 196 - 25$

$b^2 = 171$

$b = 13.1$

7. **Ms. Green tells you that a right triangle has a hypotenuse of 101 and a leg of 20. She asks you to find the other leg of the triangle. What is your answer? (Draw a picture to help)**



$20^2 + b^2 = 101^2$

$b^2 = 101^2 - 20^2$

$b^2 = 10201 - 400$

$b^2 = 9801$

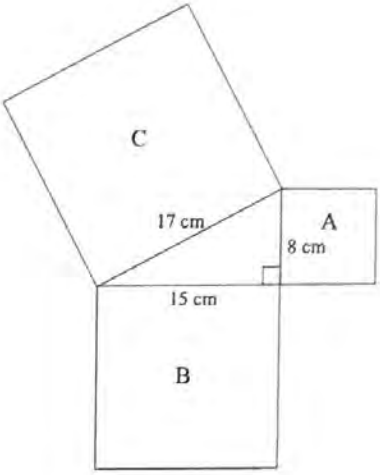
$b = 99$

Name: Answer Key

G8 U6 Lesson 7 - Independent Work

1. Write the Pythagorean Theorem. $a^2+b^2=c^2$

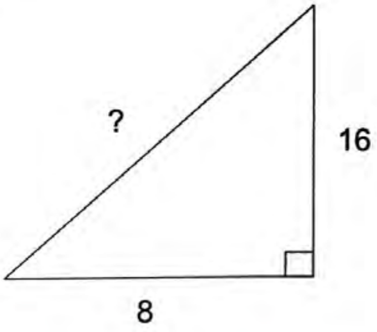
2. For the diagram below:



   a. Calculate the area of Square A.
   $A=8^2=64$
   b. Calculator the area of Square B.
   $A=15^2=225$
   c. Calculate the sum of Area A and Area B.
   $225+64=289$
   d. Calculate the area of Square C.
   $A=17^2=289$
   e. Check that
      i. Area A + Area B = Area C
      $64+225=289$ ✓

For each triangle, find the missing length. Round your answer to the nearest tenth.

3.



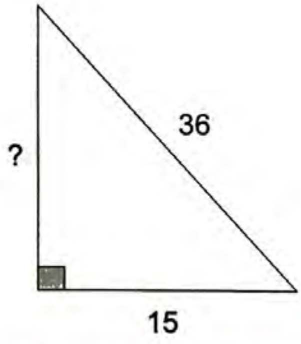
$8^2+16^2=c^2$

$64+256=c^2$

$320=c^2$

$c=17.9$

4.



$a^2+15^2=36^2$

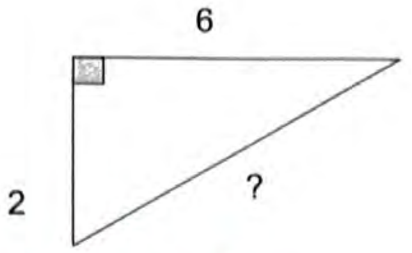
$a^2=36^2-15^2$

$a^2=1296-225$

$a^2=1071$

$a=32.7$

5.



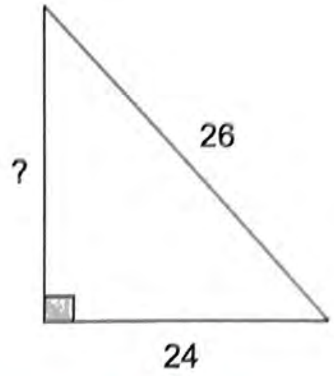
$2^2 + 6^2 = c^2$

$4 + 36 = c^2$

$40 = c^2$

$c = 6.3$

6.



$a^2 + 24^2 = 26^2$

$a^2 = 26^2 - 24^2$

$a^2 = 676 - 576$

$a^2 = 100$

$a = 10$

7. Casey says that if you have two sides of a right triangle measuring 9 units and 41 units, the third side could measure 40 units. **Is Casey correct? Justify your answer.**

Casey is correct. 9 and 40 could be side lengths and 41 is the hypotenuse. $9^2 + 40^2 = 41^2$

G8 U6 Lesson 8
Calculate unknown side lengths using the Pythagorean Theorem

CITYTUTOR DC

G8 U6 Lesson 8 - Students will calculate unknown side lengths of a right triangle by using the Pythagorean Theorem.

Warm Welcome (Slide 1): Tutor choice

Frame the Learning/Connect to Prior Learning (Slide 2): Today, we are still practicing using the Pythagorean Theorem to find the unknown side lengths of a right triangle. Remember, we can find the hypotenuse side or the leg side of a right triangle using the Pythagorean Theorem.

Let's Talk (Slide 3): If we look at these statements, **which do you feel doesn't belong? Justify your answer.** Possible Student Answers, Key Points:

- B.
- 10 is the hypotenuse length, and 6 is the leg length; you must subtract their squares to find the other leg length.

That's a valid observation. When we look at all the answer choices, we can tell that sides "a" and "b" are "8" and "6" and that the hypotenuse is "10" because it's the largest number. Let's look at each choice.

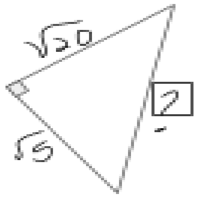
Choice A: What are we missing? Side "b." Yes, this is how we would initially set up the Pythagorean Theorem.
Choice B: We have the hypotenuse and a leg length. We would need to subtract the squares to find the other leg length.
Choice C: We are missing the other side but have the Pythagorean Theorem and one leg length. In this case, we would subtract their squares to find the missing leg.
Choice D: This is how the Pythagorean Theorem would look with all the side lengths substituted in. We could test to make sure that this triangle is a right triangle.

It's important to remember that when we have leg lengths, we add their squares to find the hypotenuse length. But if we have the hypotenuse and a leg length, we subtract their squares to find the other leg length.

Let's Think (Slide 4): Let's look at this example. **Can we use the Pythagorean Theorem to find the missing side? Justify your answer.** Possible Student Answers, Key Points:

- Yes, we can use the Pythagorean Theorem
- We know the lengths of both legs, but we are missing the hypotenuse.

We know the length of the two legs, but we are missing the hypotenuse. What can the Pythagorean Theorem help us find? Either the hypotenuse or a leg length. Exactly, we are going to use it in this case to find the hypotenuse.



(Draw a triangle on the board.) Let's solve for the hypotenuse by substituting what we know into the Pythagorean Theorem.

$$a^2 + b^2 = c^2$$
$$(\sqrt{5})^2 + (\sqrt{20})^2 = c^2$$
$$5 + 20 = c^2$$
$$25 = c^2$$
$$\sqrt{25} = \sqrt{c^2}$$
$$c = 5$$

What is the Pythagorean Theorem? $a^2 + b^2 = c^2$
What are the values of "a" and "b"? $\sqrt{5}$ and $\sqrt{20}$
Let's substitute into "a" and "b". Remember that when we square square roots, they cancel out each other. We are left with 5 and 20, and the sum of the squares is "25." Now we take the square root of both sides of the equal sign, and we find that the hypotenuse is 25 units long.

Let’s Try it (Slides 5): Today, we will work on finding any unknown side of a right triangle. Always pay attention to what you are given, when we have leg lengths, we add their squares to find the hypotenuse length. But if we have the hypotenuse and a leg length, we subtract their squares to find the other leg length.

WARM WELCOME

Today we will calculate unknown side lengths using the Pythagorean Theorem.

Let's Talk:

Which one does not belong? Justify your answer.

A. $8^2 + b^2 = 10^2$

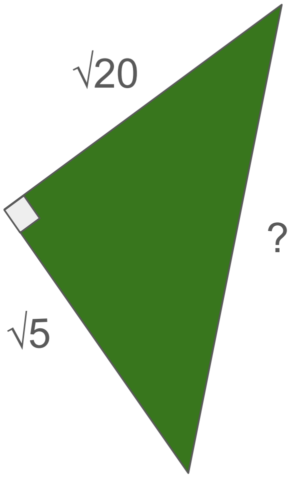
B. $10^2 + 6^2 = b^2$

C. $a^2 = 10^2 - 6^2$

D. $8^2 + 6^2 = 10^2$

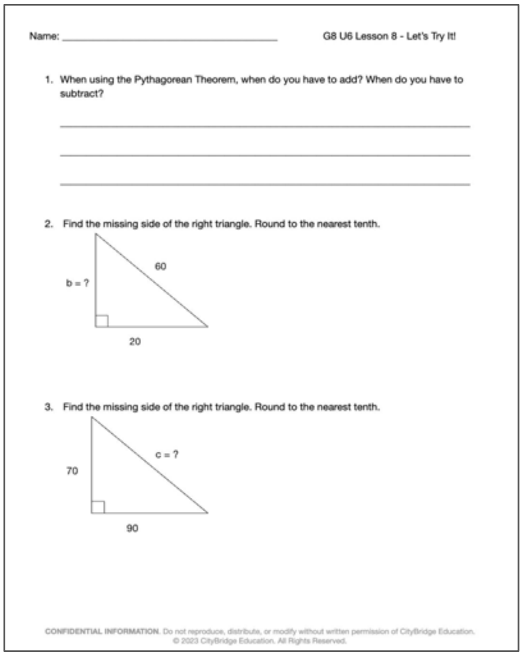
Let's Think:

Can we use the Pythagorean Theorem to find the missing side? Justify your answer.



Let's Try It:

Let's try calculating unknown side lengths of a right triangle by using the Pythagorean Theorem together.



Name: ______________________________

G8 U6 Lesson 8 - Let's Try It!

1. When using the Pythagorean Theorem, when do you have to add? When do you have to subtract?

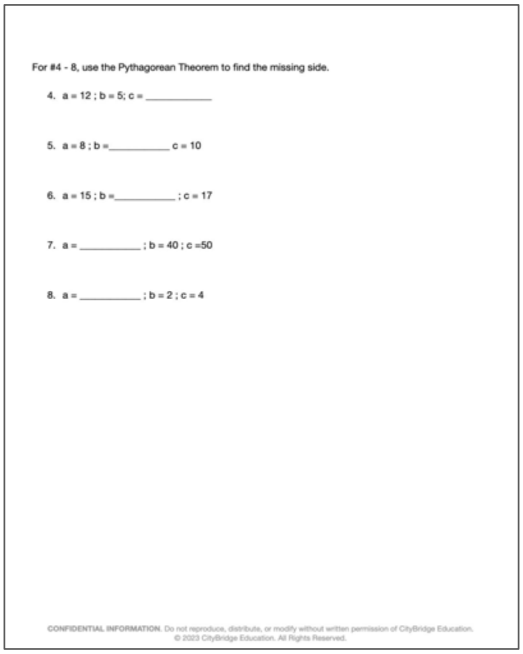
____

____

____

2. Find the missing side of the right triangle. Round to the nearest tenth.

3. Find the missing side of the right triangle. Round to the nearest tenth.



For #4 - 8, use the Pythagorean Theorem to find the missing side.

4. a = 12 ; b = 5; c = __________

5. a = 8 ; b = __________ c = 10

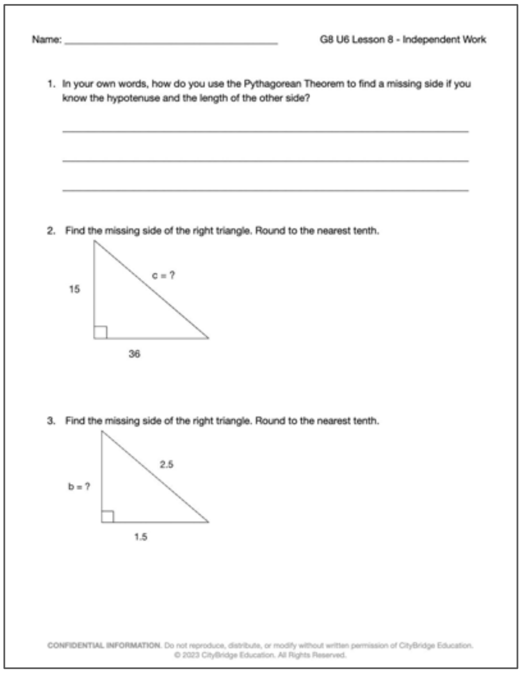
6. a = 15 ; b = __________ ; c = 17

7. a = __________ ; b = 40 ; c =50

8. a = __________ ; b = 2 ; c = 4

On your Own:

Now it's time to calculate unknown side lengths of a right triangle by using the Pythagorean Theorem on your own.



Name: ______________________________

G8 U6 Lesson 8 - Independent Work

1. In your own words, how do you use the Pythagorean Theorem to find a missing side if you know the hypotenuse and the length of the other side?

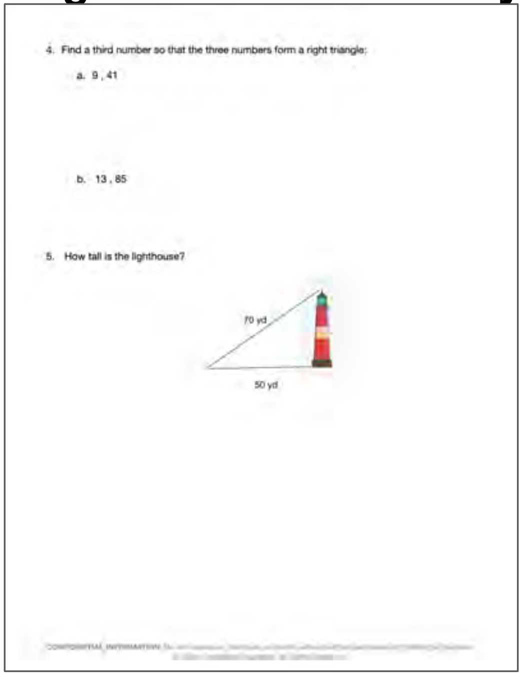
____

____

____

2. Find the missing side of the right triangle. Round to the nearest tenth.

3. Find the missing side of the right triangle. Round to the nearest tenth.



4. Find a third number so that the three numbers form a right triangle:
   a. 9 , 41
   b. 13 , 85

5. How tall is the lighthouse?

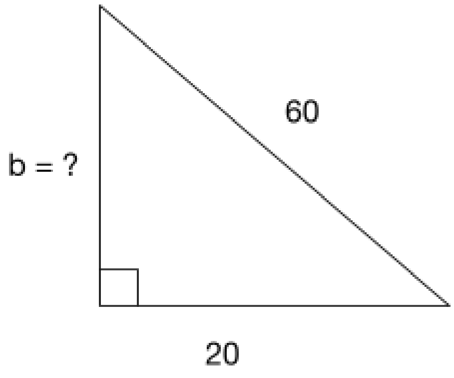
1. When using the Pythagorean Theorem, when do you have to add? When do you have to subtract?

   ____

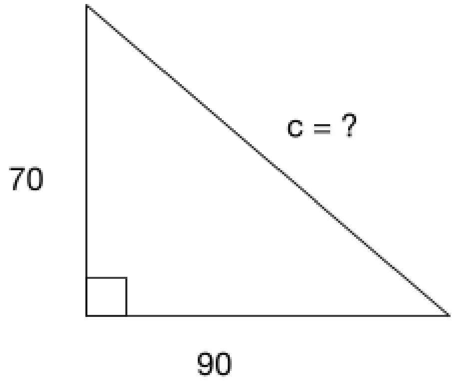
   ____

   ____

2. Find the missing side of the right triangle. Round to the nearest tenth.



3. Find the missing side of the right triangle. Round to the nearest tenth.



For #4 - 8, use the Pythagorean Theorem to find the missing side.

4. a = 12 ; b = 5; c = ____________

5. a = 8 ; b =___________ c = 10

6. a = 15 ; b =___________ ; c = 17

7. a = ___________ ; b = 40 ; c =50

8. a = ___________ ; b = 2 ; c = 4

Name: ____ G8 U6 Lesson 8 - Independent Work

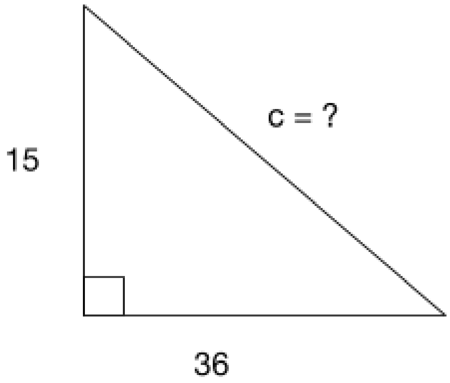
1. In your own words, how do you use the Pythagorean Theorem to find a missing side if you know the hypotenuse and the length of the other side?

____

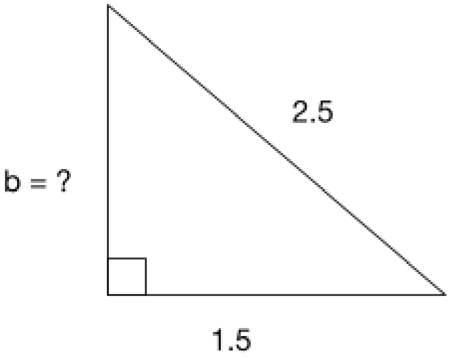
____

____

2. Find the missing side of the right triangle. Round to the nearest tenth.



3. Find the missing side of the right triangle. Round to the nearest tenth.

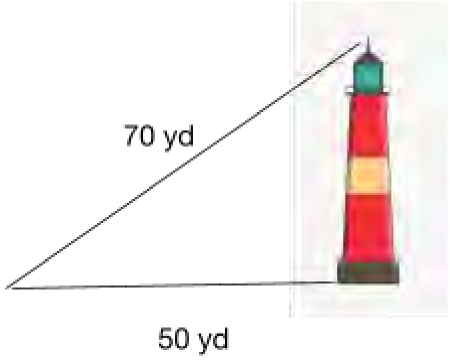


4. Find a third number so that the three numbers form a right triangle:

   a. 9 , 41

   b. 13 , 85

5. How tall is the lighthouse?



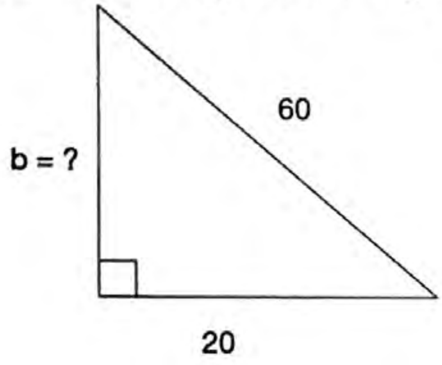
Name: Answer Key

G8 U6 Lesson 8 - Let's Try It!

1. When using the Pythagorean Theorem, when do you have to add? When do you have to subtract?

When you Know both leg lengths, you add their squares. When you Know the hypotenuse and a leg, you subtract their squares.

2. Find the missing side of the right triangle. Round to the nearest tenth.



$20^2 + b^2 = 60^2$

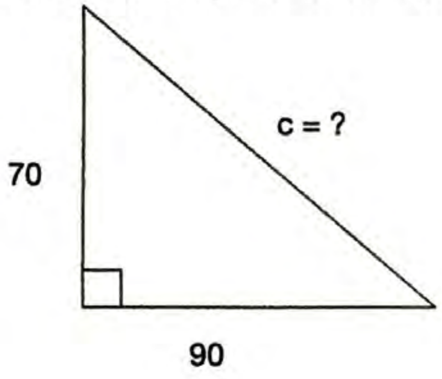
$b^2 = 60^2 - 40^2$

$b^2 = 3600 - 1600$

$b^2 = 2000$

$b = 44.7$

3. Find the missing side of the right triangle. Round to the nearest tenth.



$70^2 + 90^2 = c^2$

$4900 + 8100 = c^2$

$13000 = c^2$

$c = 114$

For #4 - 8, use the Pythagorean Theorem to find the missing side.

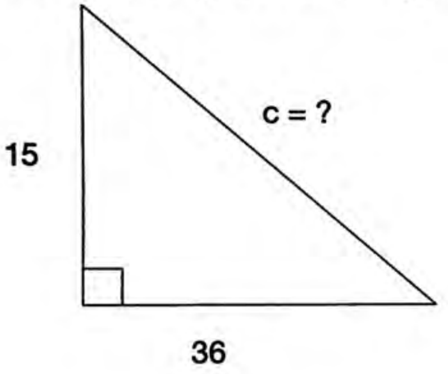
4. a = 12 ; b = 5; c = 13
5. a = 8 ; b = 6 c = 10
6. a = 15 ; b = 8 ; c = 17
7. a = 30 ; b = 40 ; c =50
8. a = 3.5 ; b = 2 ; c = 4

Name: Answer Key

1. In your own words, how do you use the Pythagorean Theorem to find a missing side if you know the hypotenuse and the length of the other side?

To find the length of the otherside, you can subtract the hypotenuse squared and the square of the leg you know.

2. **Find the missing side of the right triangle.** Round to the nearest tenth.



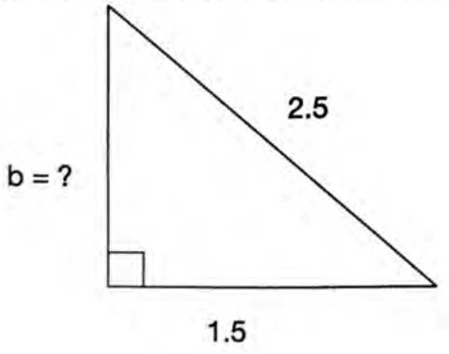
$15^2 + 36^2 = c^2$

$225 + 1296 = c^2$

$1521 = c^2$

$c = 39$

3. **Find the missing side of the right triangle.** Round to the nearest tenth.



$1.5^2 + b^2 = 2.5^2$

$b^2 = 2.5^2 - 1.5^2$

$b^2 = 6.25 - 2.25$

$b^2 = 4$

$b = 2$

4. Find a third number so that the three numbers form a right triangle:

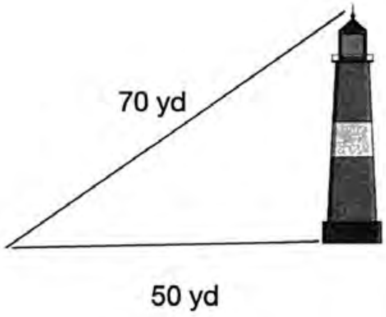
a. 9 , 41

40 or 42

b. 13 , 85

84 or 86

5. How tall is the lighthouse?



$$50^2 + b^2 = 70^2$$

$$b^2 = 70^2 - 50^2$$

$$b^2 = 4900 - 2500$$

$$b^2 = 2400$$

$$b = 49 \text{ yd}$$

G8 U6 Lesson 9
Use the converse of the Pythagorean Theorem to determine right triangles

G8 U6 Lesson 9 - Students will use the converse of the Pythagorean Theorem to determine right triangles

Warm Welcome (Slide 1): Tutor choice

Frame the Learning/Connect to Prior Learning (Slide 2): Today, we will use the converse of the Pythagorean Theorem to determine if a triangle is a right triangle. The converse of a statement is when we reverse the order of a statement. For example, if I say, " If the sky is blue, then it is sunny," the converse of that statement would be, "If it is sunny, then the sky is blue." The converse of the Pythagorean theorem will help us determine which lengths make a right triangle.

Let's Talk (Slide 3): **Who can remind me what the Pythagorean Theorem states?** Possible Student Answers, Key Points:

- The area of the square whose side is the hypotenuse is equal to the sum of the areas of the squares on the other two sides.
- $a^2 + b^2 = c^2$
- The sum of the areas of the two squares on the legs (a and b) equals the area of the square on the hypotenuse.

The Pythagorean Theorem states that, for right triangles, the sum of the squares of the two shorter sides must equal the square of the longest side, the hypotenuse. We could also say that if $a^2 + b^2 = c^2$, then the triangle is a right triangle.

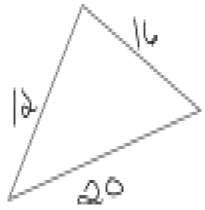
What do you think the converse of that statement might be? *(Allow students to answer.)* Possible Student Answers, Key Points:

- If the square of the length of the longest side of a triangle is equal to the sum of the squares of the lengths of the other two sides, then the triangle is a right triangle.
- If $c^2 = a^2 + c^2$, then the triangle is a right triangle.

Together, the Pythagorean Theorem and its converse provide a one-step test for checking to see if a triangle is a right triangle just using its side lengths. If $a^2 + b^2 = c^2$, it is a right triangle. If $a^2 + b^2 \neq c^2$, it is not a right triangle.

Let's Think (Slide 4): Now that we have discussed the Pythagorean Theorem and the converse of the Pythagorean Theorem. **Terry says that this is a right triangle. Do you agree or disagree? Justify your answer.** Possible Student Answers, Key Points:

- Yes, the square of the length of the longest side, "20", is equal to the sum of the squares of the lengths of the other two sides, "12" and "16", then the triangle is a right triangle.
- If $20^2 = 12^2 + 16^2$, then the triangle is a right triangle.



(Draw a Triangle on the Board)

The Pythagorean Theorem states that in a right triangle, the square of the hypotenuse (the longest side) equals the sum of the squares of the other two sides. But what if we have a triangle and don't know if it's a right triangle? We can use the converse of the Pythagorean Theorem to find out.

$20^2 = 12^2 + 16^2$

$400 = 144 + 256$

$400 = 400$ ✓

We can test it out. If "20 squared" equals the sum of "12 squared and 16 squared, then we have a right triangle. "20 squared" is 400, and the sum of the other two legs equals 400. Therefore, Terry was correct; this is a right triangle.

Let's Try it (Slides 5): Today, you will be testing lengths to verify whether they make a right triangle. Remember, the converse of the Pythagorean Theorem helps us determine whether a triangle is a right triangle. If $c^2 = a^2 + c^2$, then the triangle is a right triangle.

WARM WELCOME

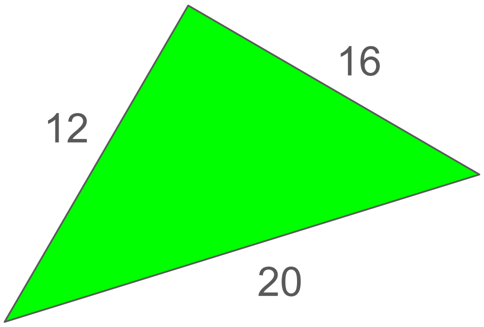
Today we will Use the converse of the Pythagorean Theorem to determine right triangles.

Let's Talk:

What does the Pythagorean Theorem state?

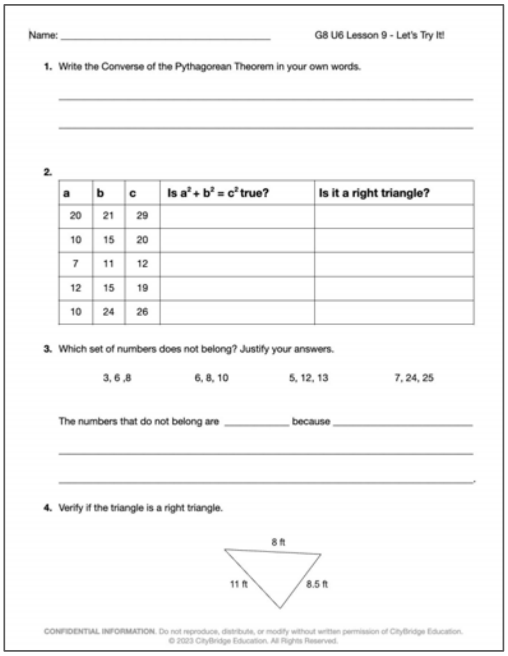
Let's Think:

Terry says that this is a right triangle. Do you agree or disagree? Justify your answer.



Let's Try It:

Let's use the converse of the Pythagorean Theorem to determine right triangles together.



Name: ______________________ G8 U6 Lesson 9 - Let's Try It!

1. Write the Converse of the Pythagorean Theorem in your own words.

2.

a	b	c	Is $a^2 + b^2 = c^2$ true?	Is it a right triangle?
20	21	29		
10	15	20		
7	11	12		
12	15	19		
10	24	26		

3. Which set of numbers does not belong? Justify your answers.

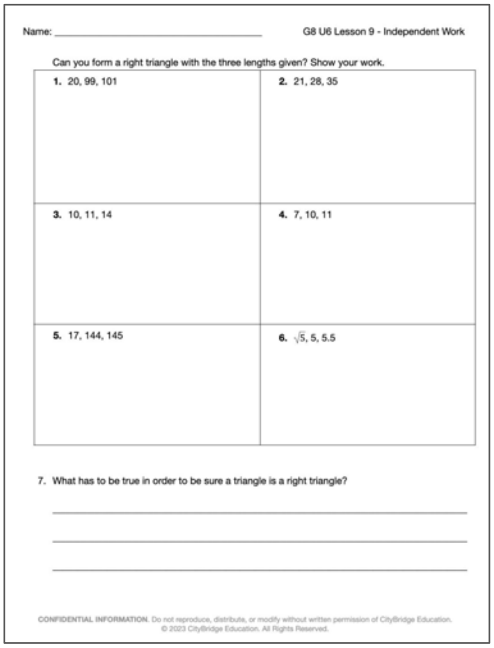
3, 6 ,8 6, 8, 10 5, 12, 13 7, 24, 25

The numbers that do not belong are __________ because ______________

4. Verify if the triangle is a right triangle.

On your Own:

Now it's time to determine right triangle using the converse of the Pythagorean Theorem on your own.



Name: ______________________ G8 U6 Lesson 9 - Independent Work

Can you form a right triangle with the three lengths given? Show your work.

1. 20, 99, 101	2. 21, 28, 35
3. 10, 11, 14	4. 7, 10, 11
5. 17, 144, 145	6. $\sqrt{5}$, 5, 5.5

7. What has to be true in order to be sure a triangle is a right triangle?

Name: ____ G8 U6 Lesson 9 - Let's Try It

1. Write the Converse of the Pythagorean Theorem in your own words.

____

____

2.

a	**b**	**c**	**Is $a^2 + b^2 = c^2$ true?**	**Is it a right triangle?**
20	21	29		
10	15	20		
7	11	12		
12	15	19		
10	24	26		

3. Which set of numbers does not belong? Justify your answers.

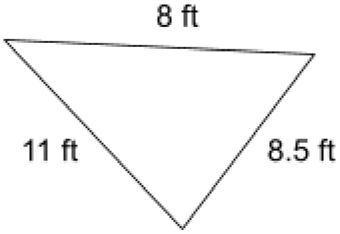
3, 6 ,8 6, 8, 10 5, 12, 13 7, 24, 25

The numbers that do not belong are ____________ because __________________________

____

____.

4. Verify if the triangle is a right triangle.



Name: ____

G8 U6 Lesson 9 - Independent Work

Can you form a right triangle with the three lengths given? Show your work.

1. 20, 99, 101

2. 21, 28, 35

3. 10, 11, 14

4. 7, 10, 11

5. 17, 144, 145

6. $\sqrt{5}$, 5, 5.5

7. What has to be true in order to be sure a triangle is a right triangle?

____

____

____

Name: Answer Key

1. Write the Converse of the Pythagorean Theorem in your own words.

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

2.

a	b	c	Is $a^2 + b^2 = c^2$ true?	Is it a right triangle?
20	21	29	Yes	Yes
10	15	20	No	No
7	11	12	No	No
12	15	19	No	No
10	24	26	Yes	Yes

3. Which set of numbers does not belong? Justify your answers.

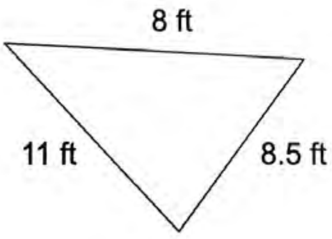
3, 6 ,8   6, 8, 10   5, 12, 13   7, 24, 25

The numbers that do not belong are 3,6,8 because $3^2 + 6^2 \neq 8^2$

The sum of the two shorter sides does not equal the square of the longer side.

4. Verify if the triangle is a right triangle.

It is not a right triangle.



Name: Answer Key

G8 U6 Lesson 9 - Independent Work

Can you form a right triangle with the three lengths given? Show your work.

1. 20, 99, 101

$101^2 = 20^2 + 99^2$

$10201 = 10201$ ✓

yes

2. 21, 28, 35

$35^2 = 21^2 + 28^2$

$1225 = 1225$ ✓

yes

3. 10, 11, 14

$14^2 = 10^2 + 11^2$

$196 \neq 221$

No

4. 7, 10, 11

$11^2 = 7^2 + 10^2$

$121 \neq 149$

No

5. 17, 144, 145

$145^2 = 17^2 + 144^2$

$21025 = 21025$ ✓

Yes

6. $\sqrt{5}$, 5, 5.5

$5.5^2 = (\sqrt{5})^2 + 5^2$

$30.25 \neq 30$

No

7. What has to be true in order to be sure a triangle is a right triangle?

The sum of the squares of the two shorter legs must be equal to the square of the longest side.

G8 U6 Lesson 10
Use the Pythagorean Theorem to solve problems within a context

CITYTUTOR DC

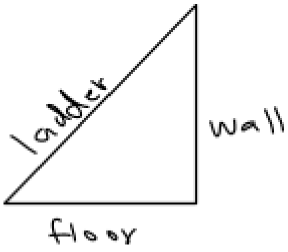
G8 U6 Lesson 10 - Students will use the Pythagorean Theorem to solve problems within a context.

Warm Welcome (Slide 1): Tutor choice

Frame the Learning/Connect to Prior Learning (Slide 2): Over the last several lessons, we've used the Pythagorean Theorem to find the lengths of different sides of right triangles. Today, we will learn how to use the Pythagorean Theorem to solve problems that have a more real-world application. This is a chance to see how we may use the Pythagorean Theorem daily.

Let's Talk (Slide 3): How can we determine the length of the ladder if we know the height of the wall and the distance from the wall to the base of the ladder? Possible Student Answers, Key Points:

- The floor and the ladder make a right angle.
- We can use the Pythagorean Theorem.
- $a^2 + b^2 = c^2$

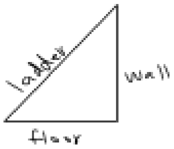


Those are all good answers! We can use the Pythagorean Theorem to determine the length of the ladder. When the ladder is placed against the wall, a right triangle is created. *(Draw a wall, floor, and ladder to demonstrate how the right triangle is made).*

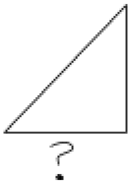
The Pythagorean Theorem helps us find the length of any side of a right triangle if we know the lengths of the other two sides. It's especially useful in solving real-world problems where right triangles are involved.

Let's Think (Slide 4): Let's look at an actual example. This is a word problem, and when we read word problems, we need to understand what the problem asks us to do. We will use a strategy used in math called a 3-Read Strategy. This strategy includes reading a math scenario three times with a different goal each time. The first read is to understand what the situation is and to draw a picture. The second read is to understand the mathematics, or what the question asks us to find. The third read is to understand the important information, like the numbers given.

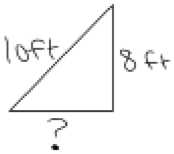
A 10-foot ladder leans against a wall, reaching a height of 8 feet. How far is the base of the ladder from the wall? Let's read this statement three times and pick out all the information.



(Have a student read through once) **What is the situation?** We have a ladder against a wall. Since our last scenario was about a ladder against the wall, let's use the picture that we just drew on the board.



(Have another student read through for the second time.) **What is the question asking us to find?** How far is the base of the ladder from the wall? Let's label our picture with a "?", which is the distance from the ladder's base to the wall.



Now, let's read for the third time. **What is the important information, what was given?** The ladder is 10 feet, reaching 8 feet on the wall. We can add this info to our drawing.

Now, we have a picture that helps us determine how to use the Pythagorean Theorem.

$$a^2+b^2=c^2$$
$$8^2+b^2=10^2$$
$$b^2=10^2-8^2$$
$$b^2=100-64$$
$$b^2=36$$
$$\sqrt{b^2}=\sqrt{36}$$
$$b=6$$

What are the “a”, “b”, and “c”? 8, we don’t know yet, and 10 Let’s write the Pythagorean Theorem, $a^2 + b^2 = c^2$. Then substitute in $8^2 + b^2 = 10^2$. Since we have a shorter leg and they hypotenuse, then we have to subtract the squares that are given and don’t forget to take the square root of both sides of the equal sign. The distance from the ladder's base to the wall is 6 feet.

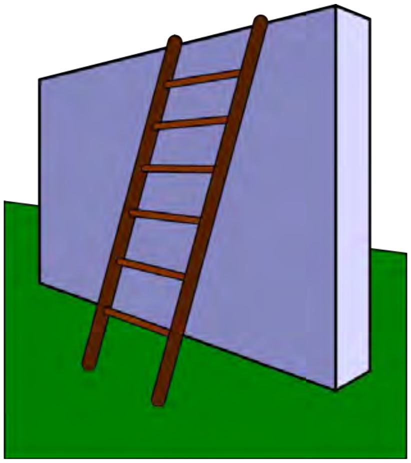
Let’s Try it (Slides 5): Now, I want you to work in groups to solve these real-world problems. Remember to read the problem 3 times to help you make a picture, identify what you need to find, and what are the most important numbers. Afterward, you will be able to identify the legs and the hypotenuse, set up the Pythagorean Theorem, and solve for the unknown side.

WARM WELCOME

Today we will learn how to use the Pythagorean Theorem to solve problems within a context.

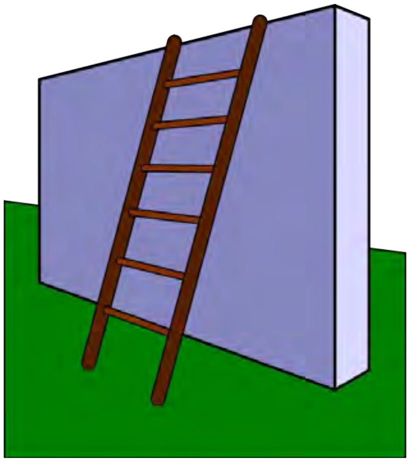
Let’s Talk:

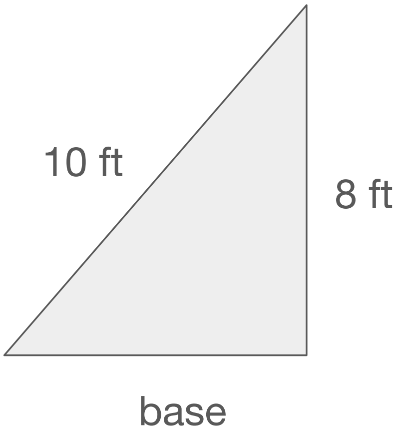
How can we determine the length of the ladder if we know the height of the wall and the distance from the wall to the base of the ladder?



Let’s Think:

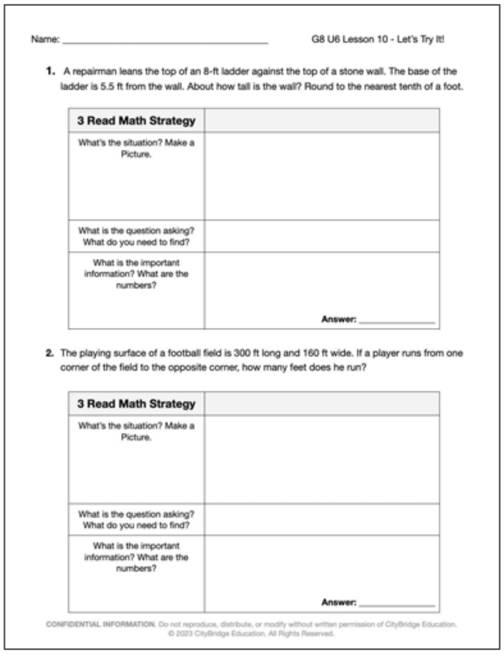
A 10-foot ladder leans against a wall, reaching a height of 8 feet. How far is the base of the ladder from the wall?





Let's Try It:

Let's use the Pythagorean Theorem to solve problems within a context together.



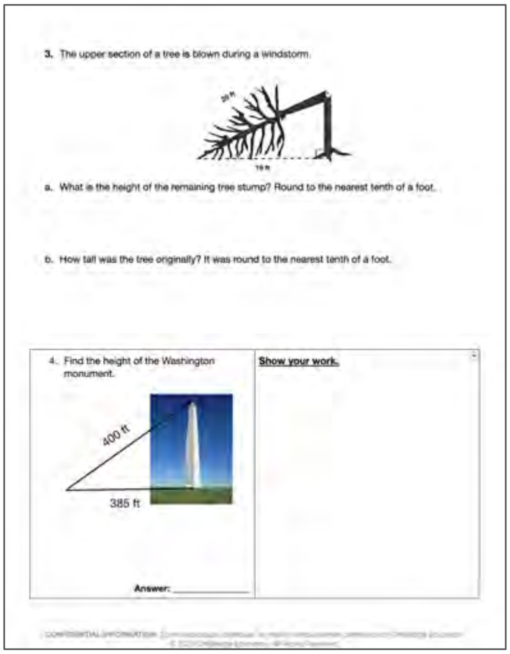
Name: ______________________ G8 U6 Lesson 10 - Let's Try It!

1. A repairman leans the top of an 8-ft ladder against the top of a stone wall. The base of the ladder is 5.5 ft from the wall. About how tall is the wall? Round to the nearest tenth of a foot.

3 Read Math Strategy	
What's the situation? Make a Picture.	
What is the question asking? What do you need to find?	
What is the important information? What are the numbers?	**Answer:** ________

2. The playing surface of a football field is 300 ft long and 160 ft wide. If a player runs from one corner of the field to the opposite corner, how many feet does he run?

3 Read Math Strategy	
What's the situation? Make a Picture.	
What is the question asking? What do you need to find?	
What is the important information? What are the numbers?	**Answer:** ________



3. The upper section of a tree is blown during a windstorm.

a. What is the height of the remaining tree stump? Round to the nearest tenth of a foot.

b. How tall was the tree originally? It was round to the nearest tenth of a foot.

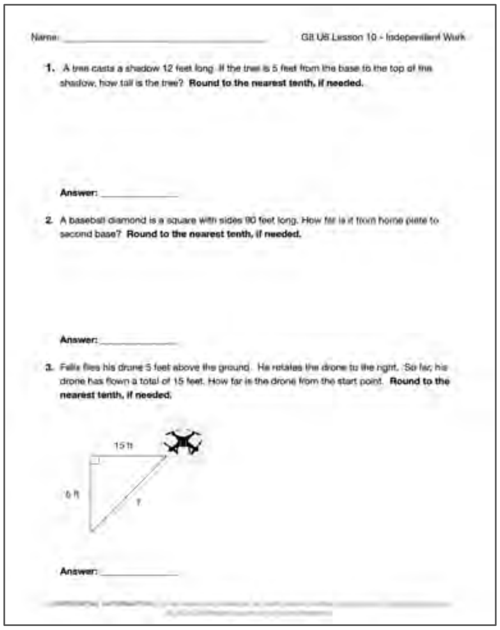
4. Find the height of the Washington monument.

Answer: ________

Show your work.

On your Own:

Now it's time to use the Pythagorean Theorem to solve problems within a context on your own.



Name: ______________________ G8 U6 Lesson 10 - Independent Work

1. A tree casts a shadow 12 feet long. If the tree is 5 feet from the base to the top of the shadow, how tall is the tree? **Round to the nearest tenth, if needed.**

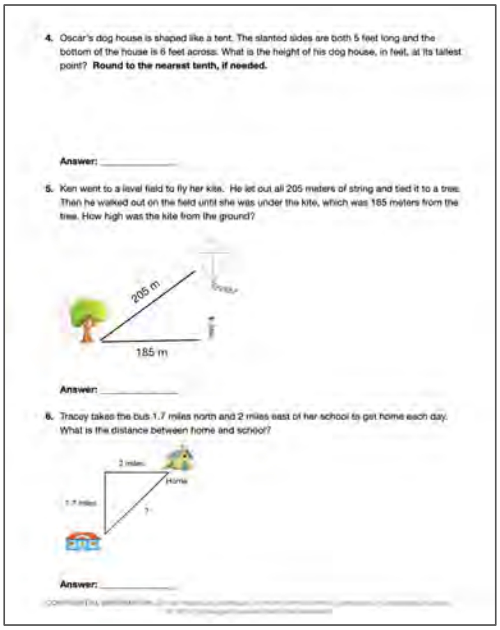
Answer: ________

2. A baseball diamond is a square with sides 90 feet long. How far is it from home plate to second base? **Round to the nearest tenth, if needed.**

Answer: ________

3. Felix flies his drone 5 feet above the ground. He rotates the drone to the right. So far, his drone has flown a total of 15 feet. How far is the drone from the start point. **Round to the nearest tenth, if needed.**

Answer: ________



4. Oscar's dog house is shaped like a tent. The slanted sides are both 5 feet long and the bottom of the house is 6 feet across. What is the height of his dog house, in feet, at its tallest point? **Round to the nearest tenth, if needed.**

Answer: ________

5. Ken went to a level field to fly her kite. He let out all 205 meters of string and tied it to a tree. Then he walked out on the field until she was under the kite, which was 185 meters from the tree. How high was the kite from the ground?

Answer: ________

6. Tracey takes the bus 1.7 miles north and 2 miles east of her school to get home each day. What is the distance between home and school?

Answer: ________

Name: ____ G8 U6 Lesson 10 - Let's Try It

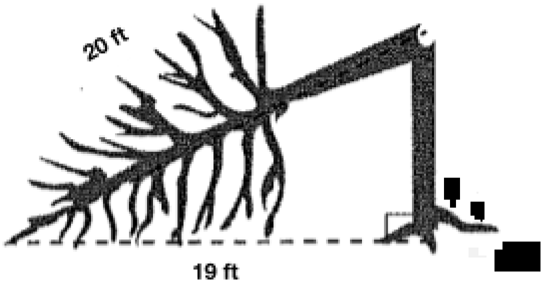
1. A repairman leans the top of an 8-ft ladder against the top of a stone wall. The base of the ladder is 5.5 ft from the wall. About how tall is the wall? Round to the nearest tenth of a foot.

3 Read Math Strategy	
What's the situation? Make a Picture.	
What is the question asking? What do you need to find?	
What is the important information? What are the numbers?	**Answer:** _______________

2. The playing surface of a football field is 300 ft long and 160 ft wide. If a player runs from one corner of the field to the opposite corner, how many feet does he run?

3 Read Math Strategy	
What's the situation? Make a Picture.	
What is the question asking? What do you need to find?	
What is the important information? What are the numbers?	**Answer:** _______________

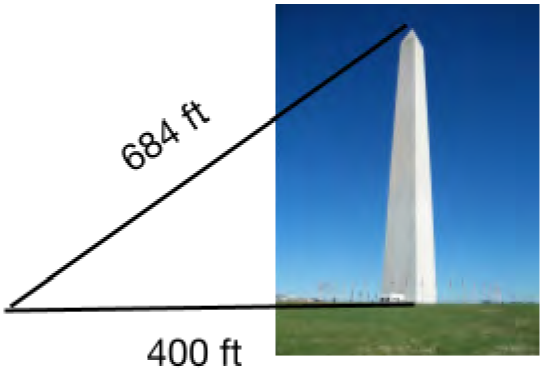
3. The upper section of a tree is blown during a windstorm.



[redacted]

a. What is the height of the remaining tree stump? Round to the nearest tenth of a foot.

b. How tall was the tree originally? It was round to the nearest tenth of a foot.

4. Find the height of the Washington monument.  **Answer:** ________________	**<u>Show your work.</u>**

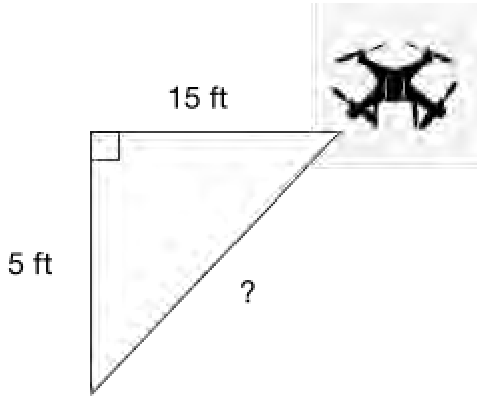
1. A tree casts a shadow 12 feet long. If the tree is 5 feet from the base to the top of the shadow, how tall is the tree? **Round to the nearest tenth, if needed.**

Answer: _______________

2. A baseball diamond is a square with sides 90 feet long. How far is it from home plate to second base? **Round to the nearest tenth, if needed.**

Answer: _______________

3. Felix flies his drone 5 feet above the ground. He rotates the drone to the right. So far, his drone has flown a total of 15 feet. How far is the drone from the start point. **Round to the nearest tenth, if needed.**

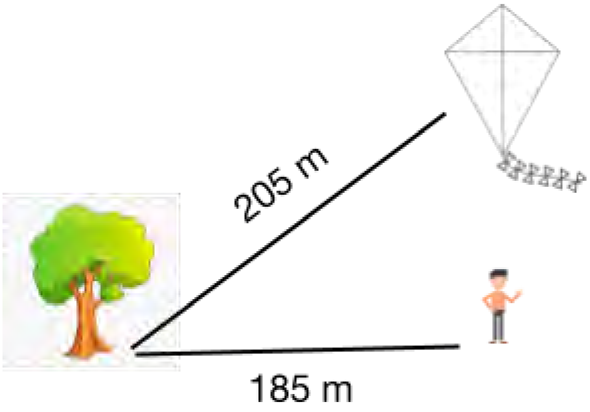


Answer: _______________

4. Oscar's dog house is shaped like a tent. The slanted sides are both 5 feet long and the bottom of the house is 6 feet across. What is the height of his dog house, in feet, at its tallest point? **Round to the nearest tenth, if needed.**

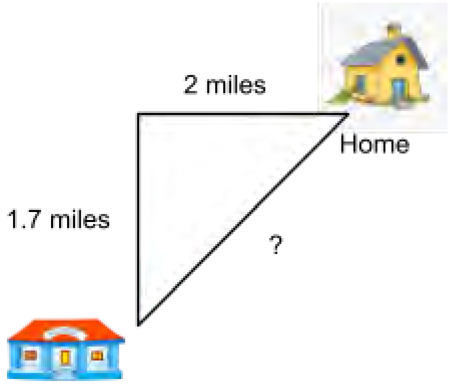
Answer: _______________

5. Ken went to a level field to fly her kite. He let out all 205 meters of string and tied it to a tree. Then he walked out on the field until she was under the kite, which was 185 meters from the tree. How high was the kite from the ground?



Answer: _______________

6. Tracey takes the bus 1.7 miles north and 2 miles east of her school to get home each day. What is the distance between home and school?



Answer: _______________

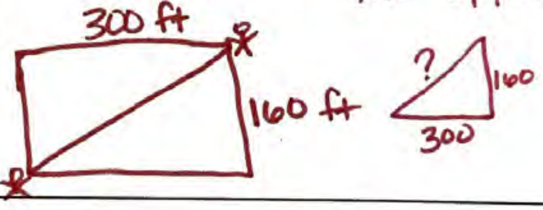
Name: Answer Key

G8 U6 Lesson 10 - Let's Try It!

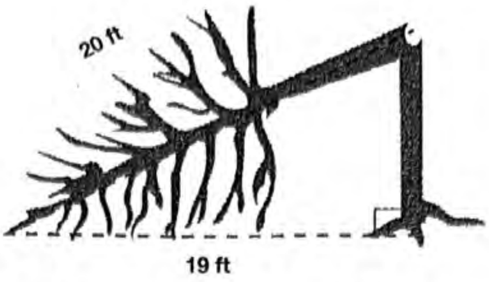
1. A repairman leans the top of an 8-ft ladder against the top of a stone wall. The base of the ladder is 5.5 ft from the wall. About how tall is the wall? Round to the nearest tenth of a foot.

3 Read Math Strategy	
What's the situation? Make a Picture.	Ladder Against a wall $a^2+5.5^2=8^2$ 
What is the question asking? What do you need to find?	How tall is the wall?
What is the important information? What are the numbers?	The ladder is 8ft Base to wall is 5.5ft **Answer:** 5.8ft

2. The playing surface of a football field is 300 ft long and 160 ft wide. If a player runs from one corner of the field to the opposite corner, how many feet does he run?

3 Read Math Strategy	
What's the situation? Make a Picture.	Football Player runs from one corner to the opposite  $160^2+300^2=c^2$
What is the question asking? What do you need to find?	How many feet does the player run?
What is the important information? What are the numbers?	Foot ball field is 300ft long & 160 ft wide **Answer:** 340 ft

3. The upper section of a tree is blown during a windstorm.



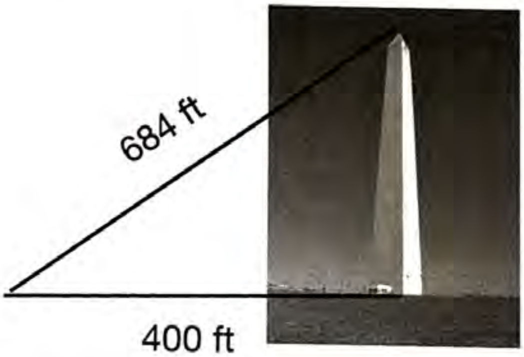
a. What is the height of the remaining tree stump? Round to the nearest tenth of a foot.

6.2 ft

b. How tall was the tree originally? It was round to the nearest tenth of a foot.

26.2 ft

4. Find the height of the Washington monument.



Answer: 555 ft

Show your work.

Name: Answer Key

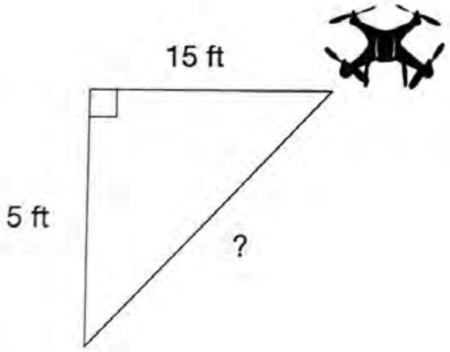
1. A tree casts a shadow 12 feet long. If the tree is 5 feet from the base to the top of the shadow, how tall is the tree? **Round to the nearest tenth, if needed.**

Answer: 13 ft

2. A baseball diamond is a square with sides 90 feet long. How far is it from home plate to second base? **Round to the nearest tenth, if needed.**

Answer: 127.3 ft

3. Felix flies his drone 5 feet above the ground. He rotates the drone to the right. So far, his drone has flown a total of 15 feet. How far is the drone from the start point. **Round to the nearest tenth, if needed.**

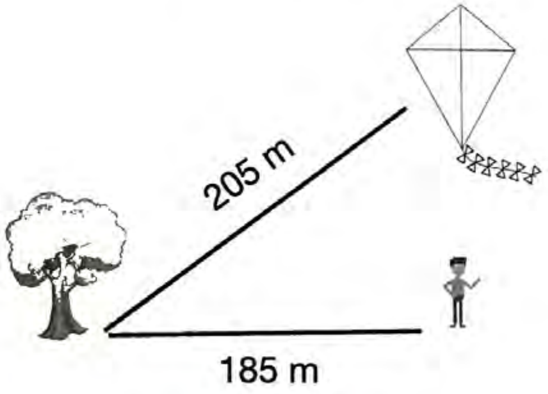


Answer: 15.8 ft

4. Oscar's dog house is shaped like a tent. The slanted sides are both 5 feet long and the bottom of the house is 6 feet across. What is the height of his dog house, in feet, at its tallest point? **Round to the nearest tenth, if needed.**

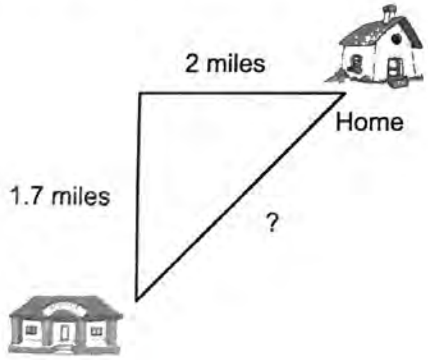
Answer: 4 ft

5. Ken went to a level field to fly her kite. He let out all 205 meters of string and tied it to a tree. Then he walked out on the field until she was under the kite, which was 185 meters from the tree. How high was the kite from the ground?



Answer: 88.3 m

6. Tracey takes the bus 1.7 miles north and 2 miles east of her school to get home each day. What is the distance between home and school?



Answer: 2.6 miles

G8 U6 Lesson 11
Calculate distance in the coordinate plane by using the Pythagorean Theorem

G8 U6 Lesson 11 - Students will calculate distance in the coordinate plane by using the Pythagorean Theorem.

Warm Welcome (Slide 1): Tutor choice

Frame the Learning/Connect to Prior Learning (Slide 2): Have you ever needed to find the shortest distance between two places on a map, like finding the shortest path from your house to your friend's house or figuring out the quickest way to get to a new restaurant? (Student Responses) Great! When we're looking at maps, we're often looking at a flat surface, just like the coordinate plane we use in math.

Today, we're going to learn a method to find the exact distance between two points on this plane. This method is actually very similar to finding the shortest path on a map.

Let's Review (Slide 3): Our goal today is to learn how to calculate the distance between two points on the coordinate plane using the Pythagorean Theorem. First, we'll review how to plot points. **What are the coordinates of these points? A(-3, 4) B(1, 2) C(4, -3) D(-5, -2)**

Remember for every point, there is an "x" and "y" value that makes that one point. "X" values move left and right. "Y" values move up and down.

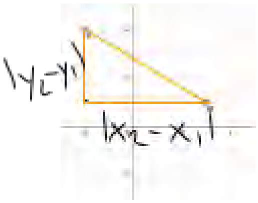
Let's Talk (Slide 4): How can you find the distance between points in the coordinate plane? Possible Student Answers, Key Points:

- Count the units across
- Use the Coordinates and find the horizontal distance

Those are good strategies. These two points make a horizontal line, so it's easier to count the units across. You can also use the coordinates to find the horizontal distance.

Let's Think (Slide 5): *(Hand Out Graph Paper)* Now, on our graph paper, we are going to plot points A and B. Point A is (-2, 4) and Point B (3, 1). **(***Write the coordinates on the board and plot points on the coordinate plane).*

A(-2,4) B(3,1)



Our objective is to find the distance between these two points. First we are going to draw a right triangle by connecting the points with horizontal and vertical lines to form the legs of the triangle, and the hypotenuse will be the line segment from point A to B.

Label the horizontal distance as $|x_2 - x_1|$ and the vertical distance as $|y_2 - y_1|$.

Horizontal Distance $|3-(-2)|=5$

Vertical Distance $|1-4|=3$

To find the horizontal distance, we will use the x-values of our points. The horizontal distance is $|3 - (-2)|$. Distance is always positive, which is why we find the absolute value. The distance would be 5.

The vertical distance uses the y-values of our points. Let's find the vertical distance $|1 - 4|$. The vertical distance is 3.

$$a^2 + b^2 = c^2$$
$$3^2 + 5^2 = c^2$$
$$9 + 25 = c^2$$
$$34 = c^2$$
$$\sqrt{34} = \sqrt{c^2}$$
$$c = 5.8$$

Now that we have our vertical and horizontal distance, we are able to use the Pythagorean Theorem to find the distance between Point A and B. We know the legs have lengths of 3 and 5 units.

The distance between Point A and B is 5.8 units.

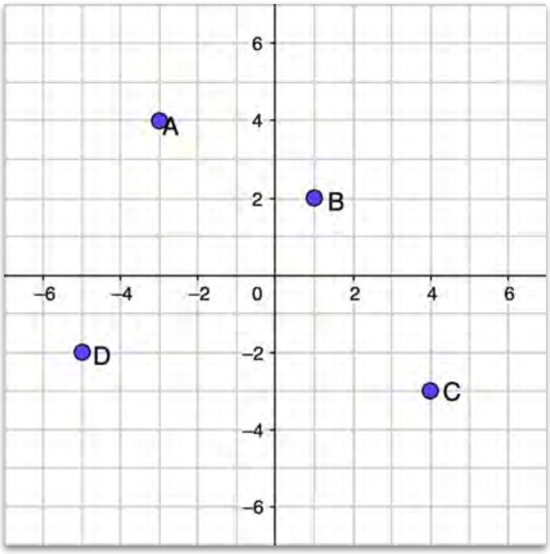
Let's Try it (Slides 6): Now it's your turn to find the distance between two points. If they are on the same horizontal or vertical line, we just subtract the coordinates that are different. If they aren't, we can construct a right triangle and use the Pythagorean Theorem.

WARM WELCOME

Today we will Calculate distance in the coordinate plane by using the Pythagorean Theorem.

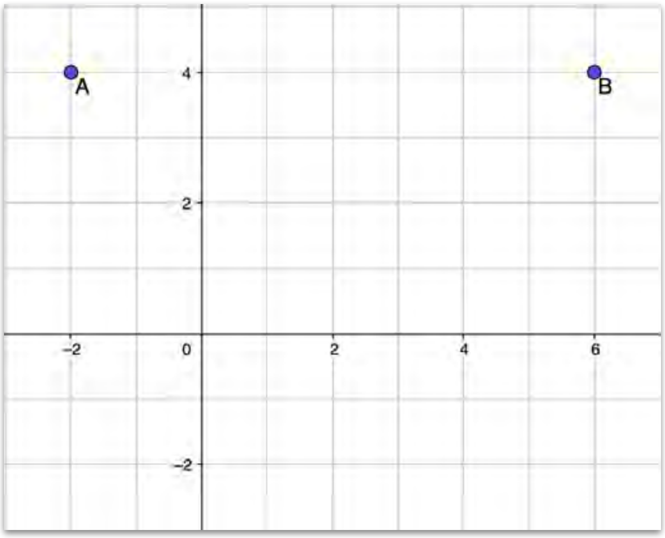
Let's Review:

Find the coordinates of the points.



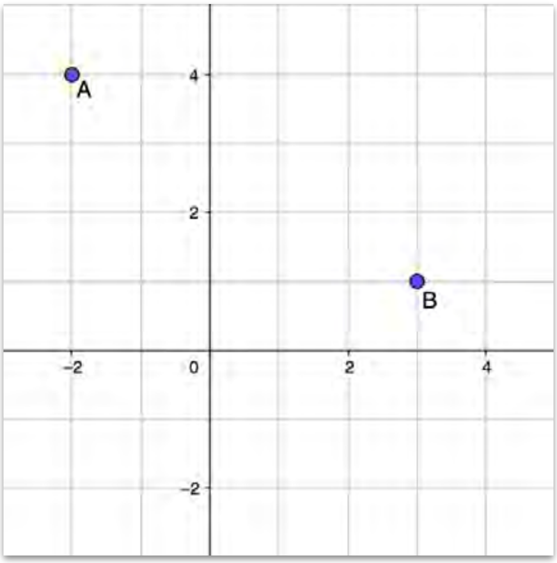
Let's Talk:

How can you find the distance between points in the coordinate plane?



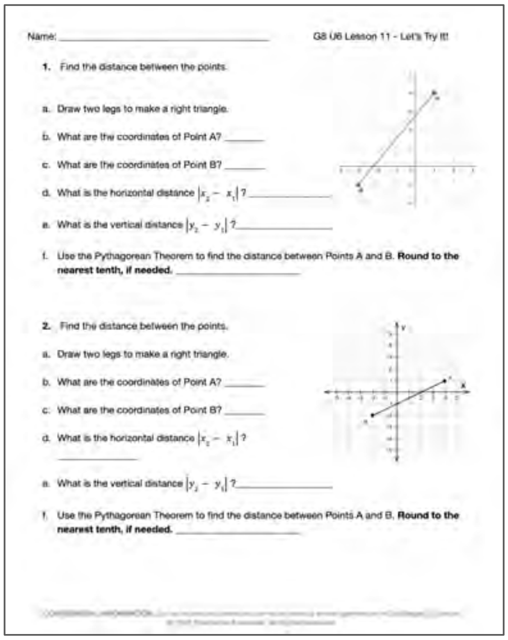
Let's Think:

How can you find the distance between points in the coordinate plane?



Let's Try It:

Let's calculate distance in the coordinate plane using the Pythagorean Theorem together.



Name: ____________________ G8 U6 Lesson 11 - Let's Try It!

1. Find the distance between the points.

a. Draw two legs to make a right triangle.

b. What are the coordinates of Point A? ______

c. What are the coordinates of Point B? ______

d. What is the horizontal distance $|x_2 - x_1|$? __________

e. What is the vertical distance $|y_2 - y_1|$? __________

f. Use the Pythagorean Theorem to find the distance between Points A and B. **Round to the nearest tenth, if needed.** ____________

2. Find the distance between the points.

a. Draw two legs to make a right triangle.

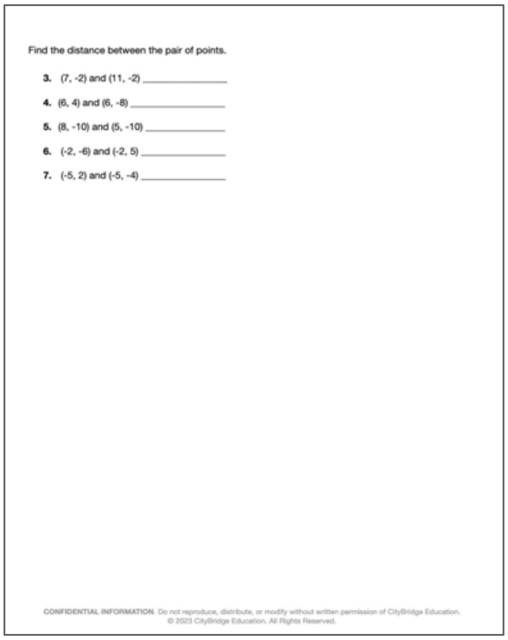
b. What are the coordinates of Point A? ______

c. What are the coordinates of Point B? ______

d. What is the horizontal distance $|x_2 - x_1|$? ______

e. What is the vertical distance $|y_2 - y_1|$? __________

f. Use the Pythagorean Theorem to find the distance between Points A and B. **Round to the nearest tenth, if needed.** ____________



Find the distance between the pair of points.

3. (7, -2) and (11, -2) ____________

4. (6, 4) and (6, -8) ____________

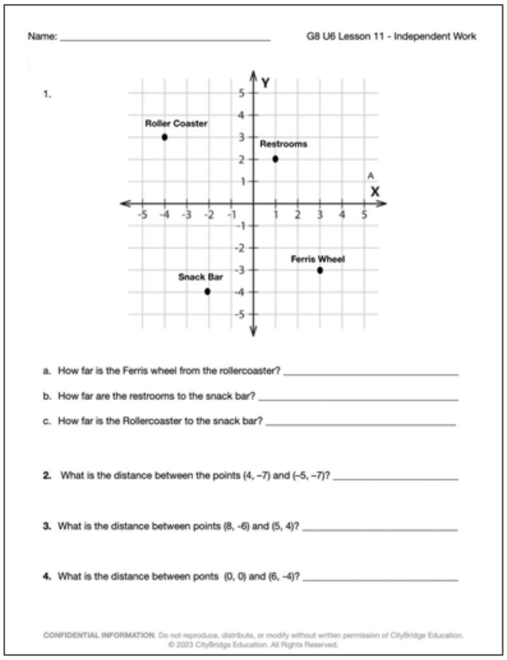
5. (8, -10) and (5, -10) ____________

6. (-2, -6) and (-2, 5) ____________

7. (-5, 2) and (-5, -4) ____________

On your Own:

Now it's time to calculate distance in the coordinate plane using the Pythagorean Theorem on your own.



Name: ______________________________ G8 U6 Lesson 11 - Independent Work

1.

a. How far is the Ferris wheel from the rollercoaster? ______________________

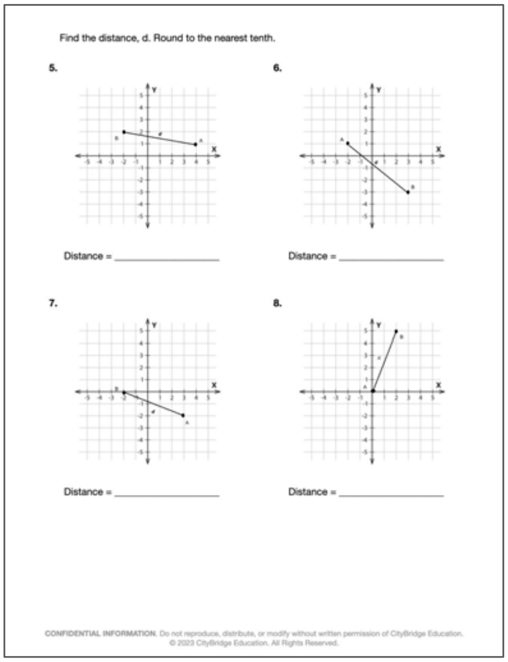
b. How far are the restrooms to the snack bar? ______________________

c. How far is the Rollercoaster to the snack bar? ______________________

2. What is the distance between the points (4, −7) and (−5, −7)? ______________________

3. What is the distance between points (8, -6) and (5, 4)? ______________________

4. What is the distance between ponts (0, 0) and (6, -4)? ______________________



Find the distance, d. Round to the nearest tenth.

5.

Distance = ______________________

6.

Distance = ______________________

7.

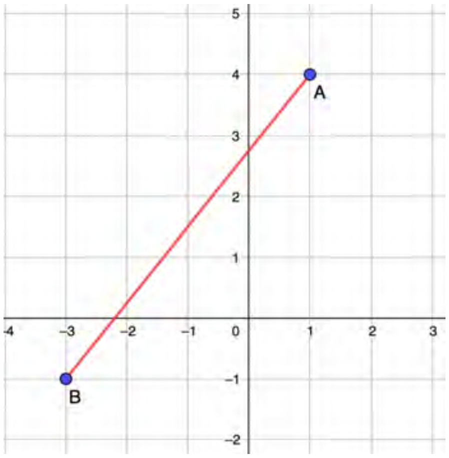
Distance = ______________________

8.

Distance = ______________________

Name: ____ G8 U6 Lesson 11 - Let's Try It

1. Find the distance between the points.



a. Draw two legs to make a right triangle.

b. What are the coordinates of Point A? ________

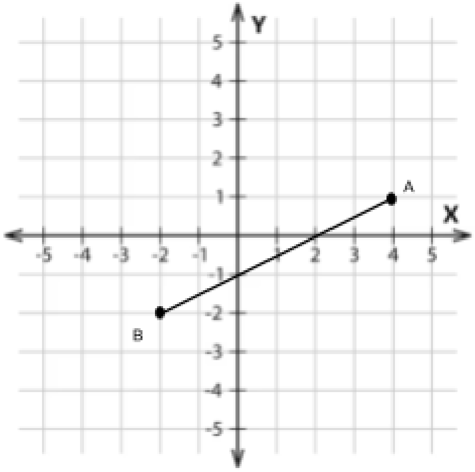
c. What are the coordinates of Point B? ________

d. What is the horizontal distance $|x_2 - x_1|$? ________________

e. What is the vertical distance $|y_2 - y_1|$?___________________

f. Use the Pythagorean Theorem to find the distance between Points A and B. **Round to the nearest tenth, if needed.** _________________________

2. Find the distance between the points.



a. Draw two legs to make a right triangle.

b. What are the coordinates of Point A? ________

c. What are the coordinates of Point B? ________

d. What is the horizontal distance $|x_2 - x_1|$?

____

e. What is the vertical distance $|y_2 - y_1|$?___________________

f. Use the Pythagorean Theorem to find the distance between Points A and B. **Round to the nearest tenth, if needed.** _________________________

Find the distance between the pair of points.

3. (7, -2) and (11, -2) ________________

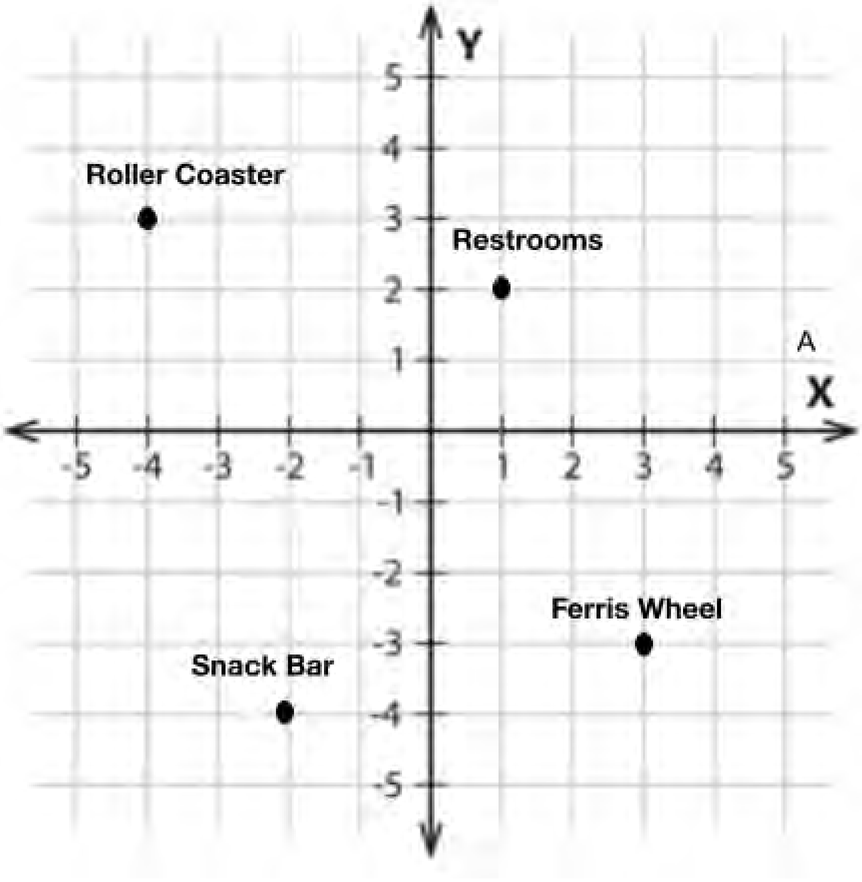
4. (6, 4) and (6, -8) __________________

5. (8, -10) and (5, -10) _______________

6. (-2, -6) and (-2, 5) ________________

7. (-5, 2) and (-5, -4) ________________

1.



a. How far is the Ferris wheel from the rollercoaster? ________________________________

b. How far are the restrooms to the snack bar? ____________________________________

c. How far is the Rollercoaster to the snack bar? __________________________________

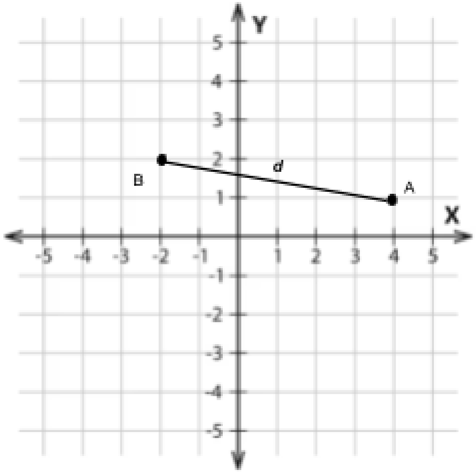
2. What is the distance between the points (4, –7) and (–5, –7)? ______________________

3. What is the distance between points (8, -6) and (5, 4)? _____________________________

4. What is the distance between ponts (0, 0) and (6, -4)? _____________________________

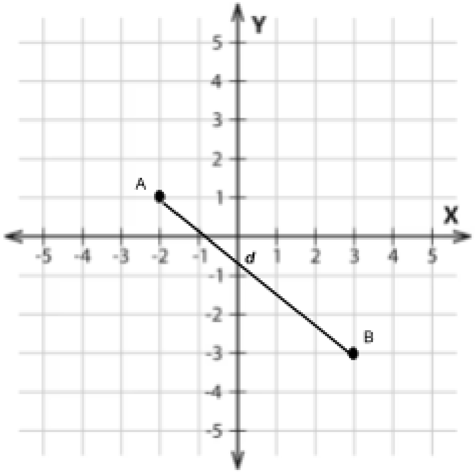
Find the distance, d. Round to the nearest tenth.

5.



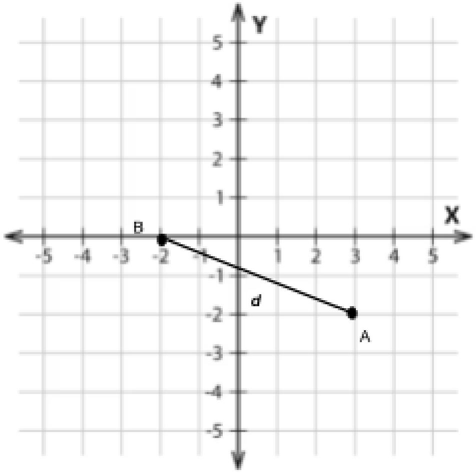
Distance = ____________________

6.



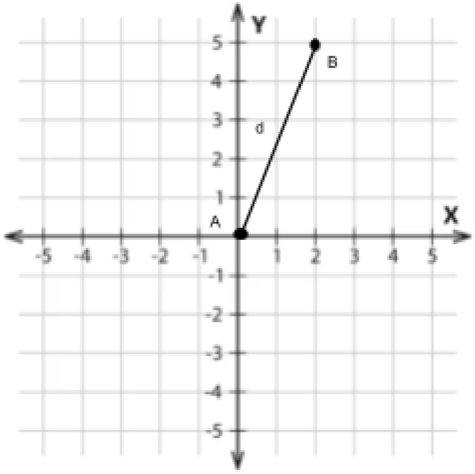
Distance = ____________________

7.



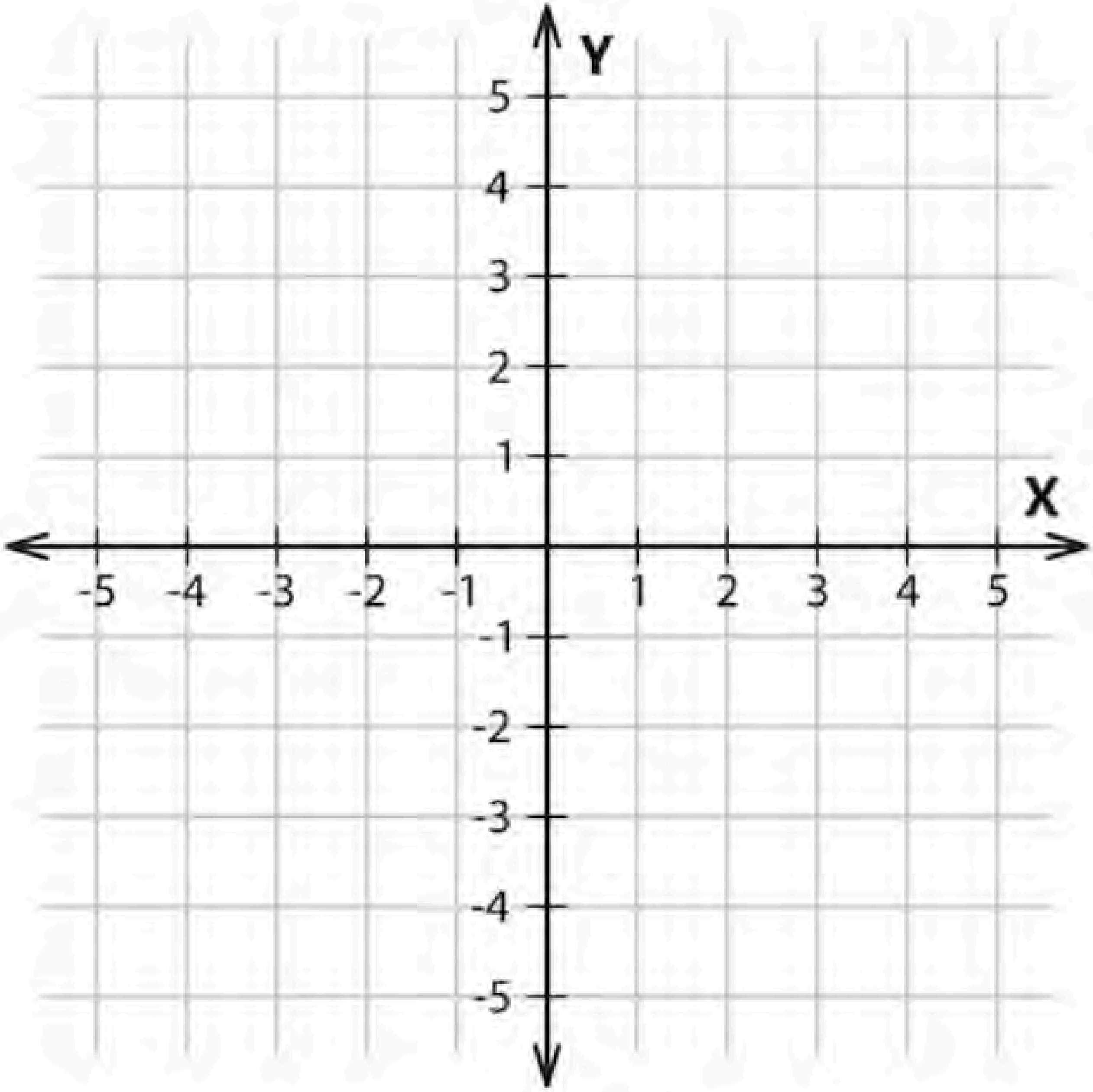
Distance = ____________________

8.



Distance = ____________________

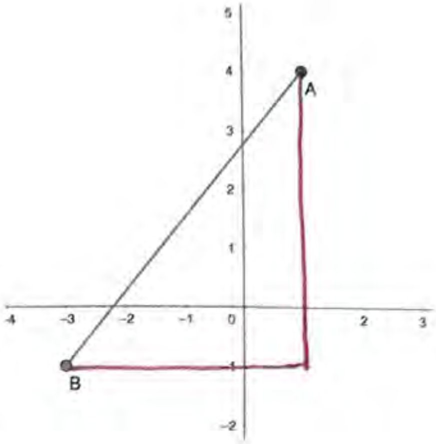
Name: ____ G8 U6 Lesson 11 - Graph Paper



Name: Answer Key

G8 U6 Lesson 11 - Let's Try It!

1. Find the distance between the points.



a. Draw two legs to make a right triangle.

b. What are the coordinates of Point A? (1,4)

c. What are the coordinates of Point B? (-3,-1)

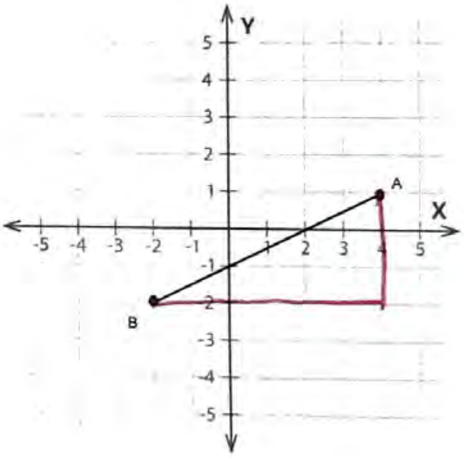
d. What is the horizontal distance $|x_2 - x_1|$? $|-3-1| = 4$

e. What is the vertical distance $|y_2 - y_1|$? $|-1-4| = 5$

f. Use the Pythagorean Theorem to find the distance between Points A and B. **Round to the nearest tenth, if needed.** 6.4 units

$4^2 + 5^2 = c^2$

2. Find the distance between the points.



a. Draw two legs to make a right triangle.

b. What are the coordinates of Point A? (4,1)

c. What are the coordinates of Point B? (-2,-2)

d. What is the horizontal distance $|x_2 - x_1|$?

$|4-(-2)| = 6$

e. What is the vertical distance $|y_2 - y_1|$? $|-2-1| = 3$

f. Use the Pythagorean Theorem to find the distance between Points A and B. **Round to the nearest tenth, if needed.** 6.7 units

$3^2 + 6^2 = c^2$

Find the distance between the pair of points.

3. (7, -2) and (11, -2) 4 units

4. (6, 4) and (6, -8) 12 units

5. (8, -10) and (5, -10) 3 units

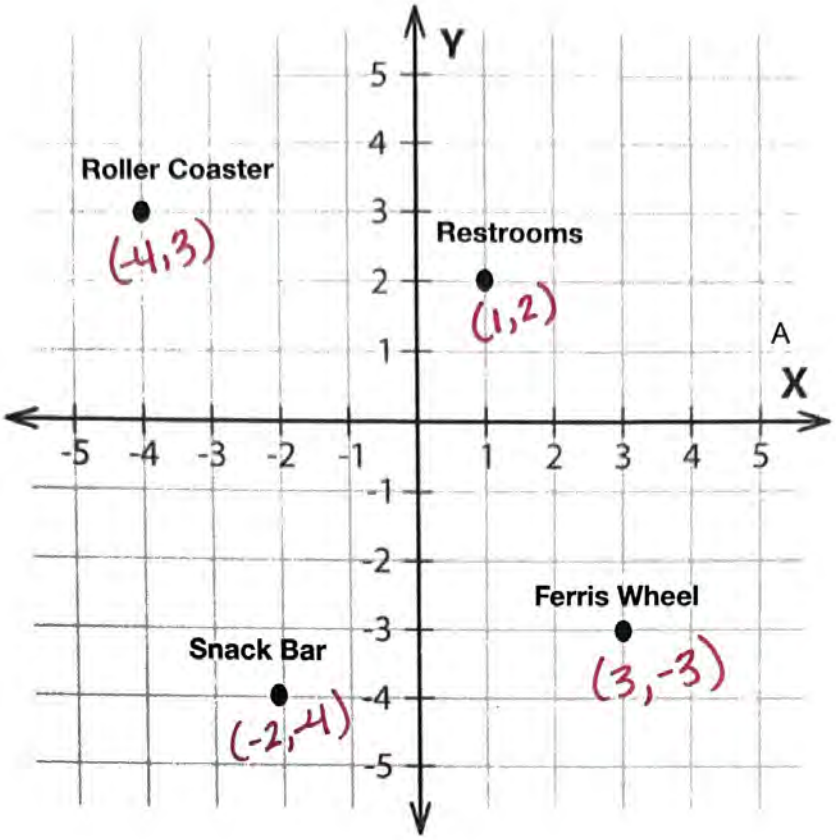
6. (-2, -6) and (-2, 5) 11 units

7. (-5, 2) and (-5, -4) 6 units

Name: Answer Key

G8 U6 Lesson 11 - Independent Work

1.



a. How far is the Ferris wheel from the rollercoaster? $7^2+6^2=c^2$ $c=9.2$ units

b. How far are the restrooms to the snack bar? $3^2+6^2=c^2$ $c=6.7$ units

c. How far is the Rollercoaster to the snack bar? $2^2+7^2=c^2$ $c=7.3$units

2. What is the distance between the points (4, –7) and (–5, –7)? $9^2+0^2=c^2$ $c=9$units

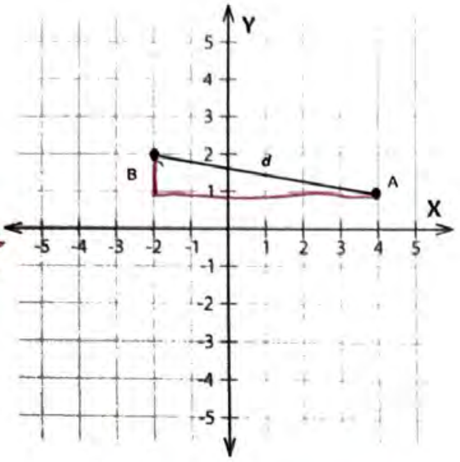
3. What is the distance between points (8, -6) and (5, 4)? $3^2+10^2=c^2$ $c=10.4$units

4. What is the distance between ponts (0, 0) and (6, -4)? $6^2+4^2=c^2$ $c=7.2$ units

Find the distance, d. Round to the nearest tenth.

5.

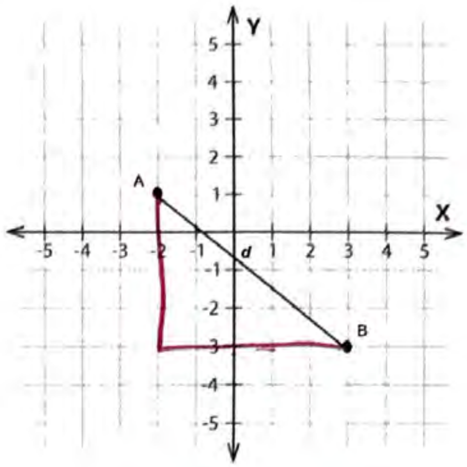
$1^2+6^2=c^2$



Distance = ~6.1 units

6.

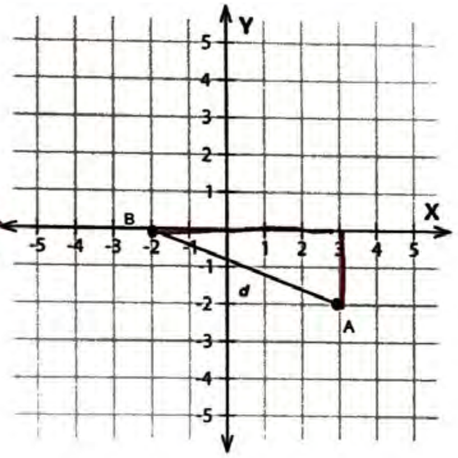
$4^2+5^2=c^2$



Distance = 6.4 units

7.

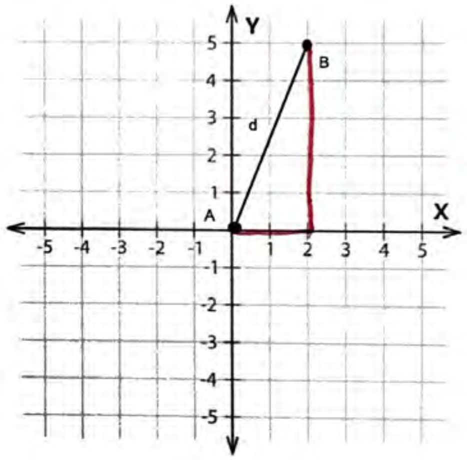
$2^2+5^2=c^2$



Distance = 5.4 units

8.

$2^2+5^2=$
c^2



Distance = 5.4 units

G8 U6 Lesson 12
Comprehend the term “cube root of a” and the notation $\sqrt[3]{a}$

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G8 U6 Lesson 12 - Students will comprehend the term “cube root of a” and the notation $\sqrt[3]{a}$.

Warm Welcome (Slide 1): Tutor choice

Frame the Learning/Connect to Prior Learning (Slide 2): Today, we are going to learn about cube roots and the notation used to represent them. By the end of the lesson, you'll understand what the cube root of a number is and how to find it.

Why is understanding cube roots important? Think about packing, construction, and even computing. Cube roots help us solve real-life problems involving volume.

Let’s Talk (Slide 3): Let’s review everything we know about Volume. This box is visual to help you think about what you may remember or have learned about volume. **What do you remember?** Possible Student Answers, Key Points:

- Volume is the total cubic units occupied by it, in a three-dimensional space.
- Volume is measured in units cubed.

Volume is the space occupied within a 3-dimensional space, like cubes, cylinders, and pyramids. What do you know about cubes? Possible Student Answers, Key Points:

- A cube has 6 square faces or sides.
- The length, width, and height of the cube are of equal length.
- The Volume of a cube is s^3.

Cubes have 6 faces that are equal in length, and when we find their volume, we take one side and multiply it by itself 3 times, so the volume is s^3.

Let’s Think (Slide 4): Look at this cube. We know the volume of the cube is 8 cm^3. **How might we figure out the side length of a cube if we know its volume?**

(Write on the board: Cube Root of a Number)

The cube root of a number denoted as $\sqrt[3]{a}$, is the number that, when multiplied by itself three times (cubed), gives the original number, a.

(Write on the board: If $b = \sqrt[3]{a}$ *then* $a = b^3$*)*

8

$2 \cdot 2 \cdot 2 = 8$

$\sqrt[3]{8} = 2$

For example, to find the side length of this cube, we can find the cube root of 8. We need to find a number that, when multiplied by itself three times, equals 8.

Let's try 2. 2 × 2 × 2 = 8, so $2 = \sqrt[3]{8}$ **.**

The notation $\sqrt[3]{a}$ helps us quickly identify the cube root operation. For instance, $\sqrt[3]{8}$ means the number which, when cubed, equals 8. That's 2 because 2 x 2 x 2 = 8.

$\sqrt[3]{1000}$

$10 \cdot 10 \cdot 10 = 1000$

$\sqrt[3]{1000} = 10$

Let’s solve one more problem together. What is the $\sqrt[3]{1000}$? *(Write $\sqrt[3]{1000}$ on the board)*

We need to find a number that can be multiplied 3 times and has a product of 1000.

Let's try 10. 10 × 10 × 10 = 1000, so $10 = \sqrt[3]{1000}$.

Let’s Try it (Slides 5): Now it’s your turn to try. Remember that the area of a cube is multiplying a side length three times by itself, and the cube root is finding the number that you multiply three times to get the original number.

WARM WELCOME

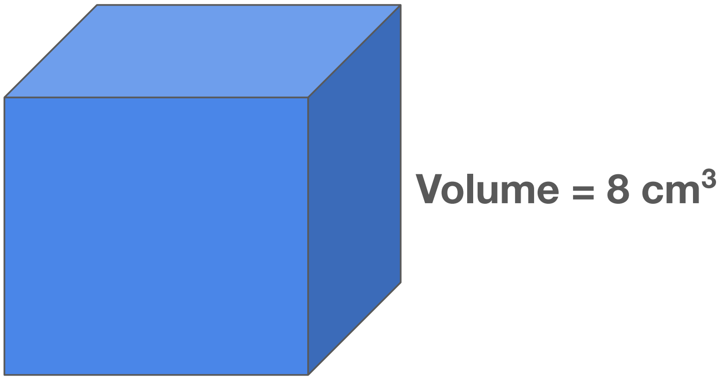
Today, you will comprehend the term "cube root of a" and the notation $\sqrt[3]{a}$.

Let's Talk:

What do you remember about volume?

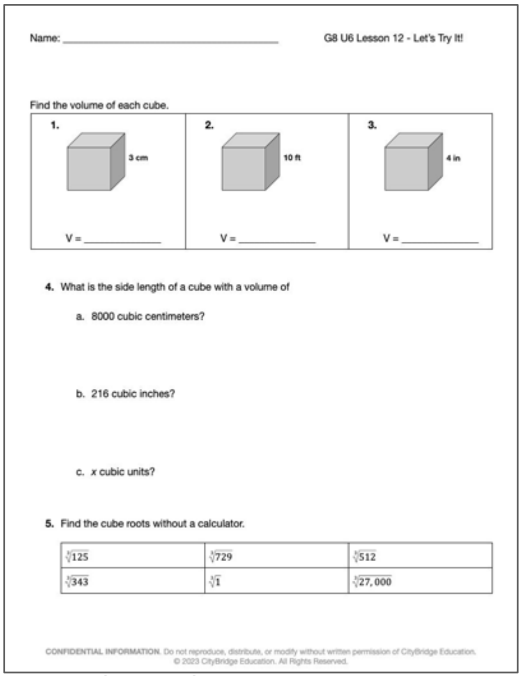
Let's Think:

How might we figure out the side length of a cube if we know its volume?



Let's Try It:

Let's explore finding the "cube root of a" and ∛a together.



Name: ____________________ G8 U6 Lesson 12 - Let's Try It!

Find the volume of each cube.

1. 3 cm V = __________

2. 10 ft V = __________

3. 4 in V = __________

4. What is the side length of a cube with a volume of

a. 8000 cubic centimeters?

b. 216 cubic inches?

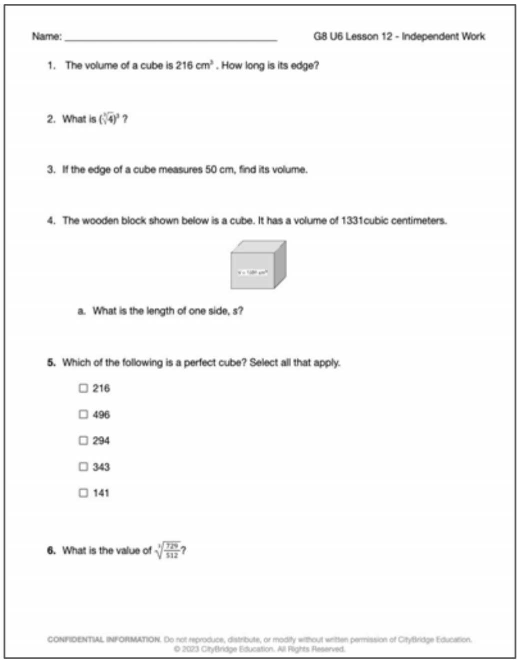
c. *x* cubic units?

5. Find the cube roots without a calculator.

$\sqrt[3]{125}$	$\sqrt[3]{729}$	$\sqrt[3]{512}$
$\sqrt[3]{343}$	$\sqrt[3]{1}$	$\sqrt[3]{27,000}$

On your Own:

Now it's time to find the "cube root of a" ∛a on your own.



Name: ____________________ G8 U6 Lesson 12 - Independent Work

1. The volume of a cube is 216 cm^3 . How long is its edge?

2. What is $(\sqrt[3]{4})^3$?

3. If the edge of a cube measures 50 cm, find its volume.

4. The wooden block shown below is a cube. It has a volume of 1331cubic centimeters.

   a. What is the length of one side, *s*?

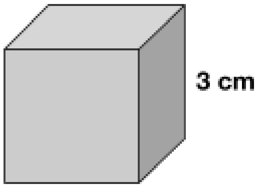
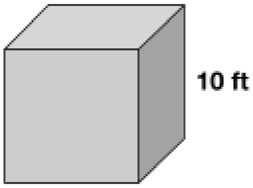
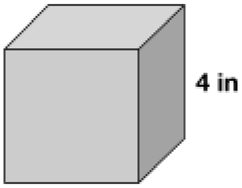
5. Which of the following is a perfect cube? Select all that apply.

- ☐ 216
- ☐ 496
- ☐ 294
- ☐ 343
- ☐ 141

6. What is the value of $\sqrt[3]{\frac{729}{512}}$?

Name: ______________________________________ G8 U6 Lesson 12 - Let's Try It

Find the volume of each cube.

1.  V = ______________	**2.**  V = ______________	**3.**  V = ______________

4. What is the side length of a cube with a volume of

a. 8000 cubic centimeters?

b. 216 cubic inches?

c. *x* cubic units?

5. Find the cube roots without a calculator.

$\sqrt[3]{125}$	$\sqrt[3]{729}$	$\sqrt[3]{512}$
$\sqrt[3]{343}$	$\sqrt[3]{1}$	$\sqrt[3]{27,000}$

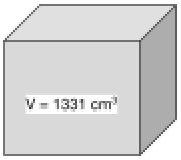
Name: ______________________________________ G8 U6 Lesson 12 - Independent Work

1. The volume of a cube is 216 cm^3 . How long is its edge?

2. What is $(\sqrt[3]{4})^3$?

3. If the edge of a cube measures 50 cm, find its volume.

4. The wooden block shown below is a cube. It has a volume of 1331cubic centimeters.



   a. What is the length of one side, *s*?

5. Which of the following is a perfect cube? Select all that apply.

- ☐ 216
- ☐ 496
- ☐ 294
- ☐ 343
- ☐ 141

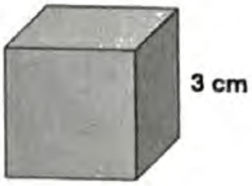
6. What is the value of $\sqrt[3]{\frac{729}{512}}$?

Name: Answer Key

G8 U6 Lesson 12 - Let's Try It!

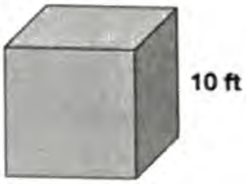
Find the volume of each cube.

1.



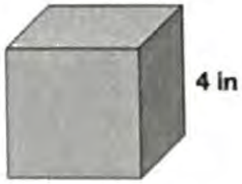
V = 27 cm^3

2.



V = 1000 ft^3

3.



V = 64 in^3

4. What is the side length of a cube with a volume of

a. 8000 cubic centimeters?

$S = 20$ cm

b. 216 cubic inches?

$S = 6$ in

c. x cubic units?

$S = \sqrt[3]{x}$ units

5. Find the cube roots without a calculator.

$\sqrt[3]{125} = 5$	$\sqrt[3]{729} = 9$	$\sqrt[3]{512} = 8$
$\sqrt[3]{343} = 7$	$\sqrt[3]{1} = 1$	$\sqrt[3]{27,000} = 30$

Name: Answer Key

G8 U6 Lesson 12 - Independent Work

1. The volume of a cube is 216 cm^3 . How long is its edge?

   $s = 6$ cm

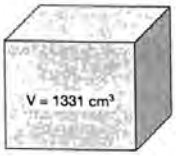
2. What is $(\sqrt[3]{4})^3$?

   4

3. If the edge of a cube measures 50 cm, find its volume.

   $V = 50^3 =$ 125,000 cm^3

4. The wooden block shown below is a cube. It has a volume of 1331cubic centimeters.



   a. What is the length of one side, *s*?

   $s = 11$ cm

5. Which of the following is a perfect cube? Select all that apply.

☑ 216

☐ 496

☐ 294

☑ 343

☐ 141

6. What is the value of $\sqrt[3]{\frac{729}{512}}$? $= \frac{9}{8}$

G8 U6 Lesson 13

Determine the whole numbers that a cube root lies between

CITYTUTOR DC

G8 U6 Lesson 13 - Students will determine the whole numbers that a cube root lies between.

Warm Welcome (Slide 1): Tutor choice

Frame the Learning/Connect to Prior Learning (Slide 2): Today, we're going to learn how to determine the whole numbers between which a cube root lies. This is very similar to when we learned about square roots. Sometimes, the cube roots of numbers are not whole numbers.

Let's Review (Slide 3): List the first ten cubes. This list will help you throughout today's lesson when determining what whole numbers' cube roots lie between.

1, 8, 27, 64, 125, 216, 343, 512, 729, 1000

To cube a number is to multiply it by itself three times, so at any time you are unsure about a cube number, you can figure it out.

Let's Talk (Slide 4): **Is the $\sqrt[3]{10}$ a perfect cube?** If it is, tell me why. If it isn't, tell me why. Possible Student Answers, Key Points:

- No, it is not a perfect cube.
- There is not one number we can multiply by itself three times to equal 10.

As I said before, sometimes, the cube roots of numbers are not whole numbers, and we can find what two whole numbers the cube root is between.

Let's Think (Slide 5): **How can we determine what two whole numbers $\sqrt[3]{10}$ lies between?** Possible Student Answers, Key Points:

- Use a Calculator.
- Find what two cubed numbers the 10 is between.
- List out the first ten cube roots.

To determine the whole numbers between which the cube root lies, we can use the list we generated earlier with the first ten cubed numbers.

$\sqrt[3]{10}$

$2^3 = 8$ $3^3 = 27$

$2 < \sqrt[3]{10} < 3$

(Write $\sqrt[3]{10}$ and so justification on the board) If we want to find the whole numbers that $\sqrt[3]{10}$ lies between. We know that $2^3 = 8$ and $3^3 = 27$. Since 10 is between 8 and 27, so $\sqrt[3]{10}$ is between 2 and 3.

We can also use a calculator as a tool to check our work.

$\sqrt[3]{50}$

$3^3 = 27$ $4^3 = 64$

$3 < \sqrt[3]{50} < 4$

Let's try another one. *(Write $\sqrt[3]{50}$ and so justification on the board)* Find the whole numbers that $\sqrt[3]{50}$ lies between. We know that $3^3 = 27$ and $4^3 = 64$. Since 50 is between 27 and 64, $\sqrt[3]{50}$ is between 3 and 4.

Let's Try it (Slides 6): Now it's your turn to try! Remember to determine the whole numbers between which a cube root lies, we need to find two perfect cubes that the number lies between.

WARM WELCOME

Today you will determine the whole numbers that a cube root lies between.

Let’s Review:

List the first ten cube roots.

Let’s Talk:

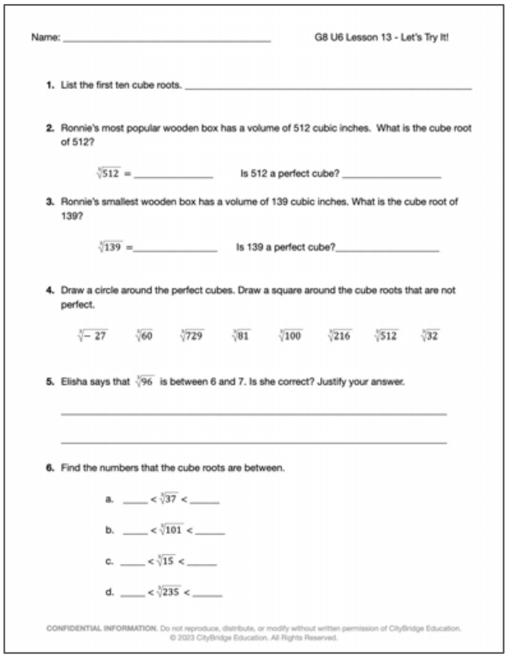
Is the $\sqrt[3]{10}$ a perfect cube? Justify your answer.

Let's Think:

What two whole numbers does the $\sqrt[3]{10}$ fall between?

Let's Try It:

Let's explore finding what whole numbers cube roots are between.



Name: ____________________ G8 U6 Lesson 13 - Let's Try It!

1. List the first ten cube roots. ____________________

2. Ronnie's most popular wooden box has a volume of 512 cubic inches. What is the cube root of 512?

   $\sqrt[3]{512}$ = __________ Is 512 a perfect cube? __________

3. Ronnie's smallest wooden box has a volume of 139 cubic inches. What is the cube root of 139?

   $\sqrt[3]{139}$ =__________ Is 139 a perfect cube?__________

4. Draw a circle around the perfect cubes. Draw a square around the cube roots that are not perfect.

   $\sqrt[3]{-27}$ $\sqrt[3]{60}$ $\sqrt[3]{729}$ $\sqrt[3]{81}$ $\sqrt[3]{100}$ $\sqrt[3]{216}$ $\sqrt[3]{512}$ $\sqrt[3]{32}$

5. Elisha says that $\sqrt[3]{96}$ is between 6 and 7. Is she correct? Justify your answer.

   ____

   ____

6. Find the numbers that the cube roots are between.

   a. ____ $< \sqrt[3]{37} <$ ____

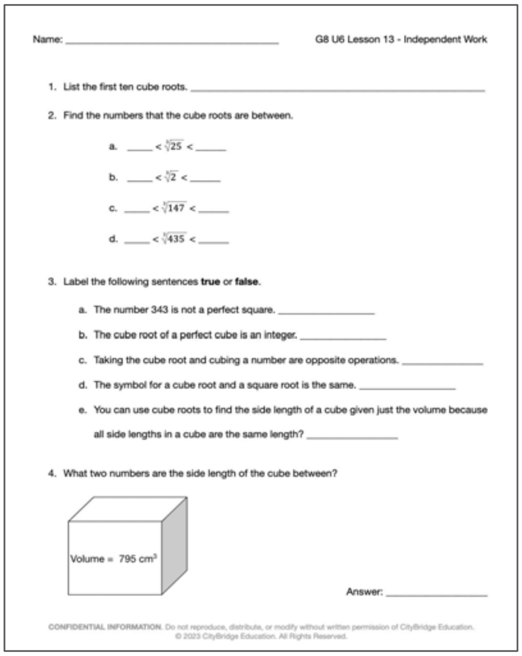
   b. ____ $< \sqrt[3]{101} <$ ____

   c. ____ $< \sqrt[3]{15} <$ ____

   d. ____ $< \sqrt[3]{235} <$ ____

On your Own:

Now it’s time to try finding what whole numbers cube roots are between on your own.



Name: ______________________________ G8 U6 Lesson 13 - Independent Work

1. List the first ten cube roots. ______________________________

2. Find the numbers that the cube roots are between.

   a. _____ < $\sqrt[3]{25}$ < _____

   b. _____ < $\sqrt[3]{2}$ < _____

   c. _____ < $\sqrt[3]{147}$ < _____

   d. _____ < $\sqrt[3]{435}$ < _____

3. Label the following sentences **true** or **false**.

   a. The number 343 is not a perfect square. ______________

   b. The cube root of a perfect cube is an integer. ______________

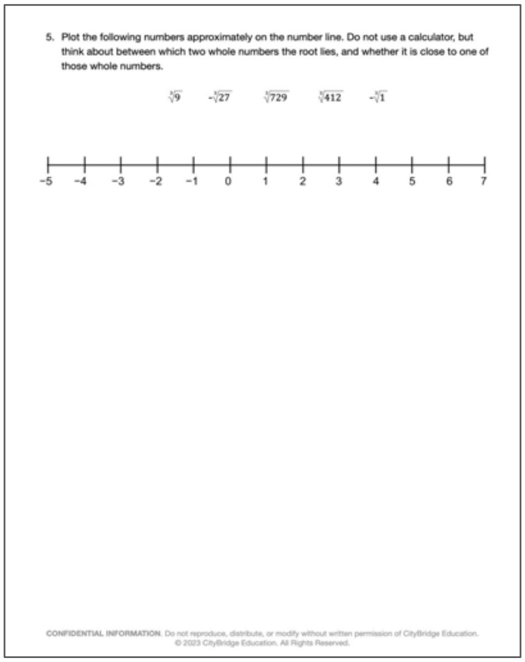
   c. Taking the cube root and cubing a number are opposite operations. ______________

   d. The symbol for a cube root and a square root is the same. ______________

   e. You can use cube roots to find the side length of a cube given just the volume because all side lengths in a cube are the same length? ______________

4. What two numbers are the side length of the cube between?

Answer: ______________



5. Plot the following numbers approximately on the number line. Do not use a calculator, but think about between which two whole numbers the root lies, and whether it is close to one of those whole numbers.

$\sqrt[3]{9}$ $-\sqrt[3]{27}$ $\sqrt[3]{729}$ $\sqrt[3]{412}$ $-\sqrt[3]{1}$

Name: ______________________________________ G8 U6 Lesson 13 - Let's Try It

1. List the first ten cubes. ____

2. Ronnie's most popular wooden box has a volume of 512 cubic inches. What is the cube root of 512?

$\sqrt[3]{512} =$ _______________ Is 512 a perfect cube? ___________________

3. Ronnie's smallest wooden box has a volume of 139 cubic inches. What is the cube root of 139?

$\sqrt[3]{139} =$ ________________ Is 139 a perfect cube? ____________________

4. Draw a circle around the perfect cubes. Draw a square around the cube roots that are not perfect.

$\sqrt[3]{-27}$ $\sqrt[3]{60}$ $\sqrt[3]{729}$ $\sqrt[3]{81}$ $\sqrt[3]{100}$ $\sqrt[3]{216}$ $\sqrt[3]{512}$ $\sqrt[3]{32}$

5. Elisha says that $\sqrt[3]{96}$ is between 6 and 7. Is she correct? Justify your answer.

____

____

6. Find the numbers that the cube roots are between.

a. _____ $< \sqrt[3]{37} <$ ______

b. _____ $< \sqrt[3]{101} <$ ______

c. _____ $< \sqrt[3]{15} <$ ______

d. _____ $< \sqrt[3]{235} <$ ______

Name: ______________________________________ G8 U6 Lesson 13 - Independent Work

1. List the first ten cubes. ____

2. Find the numbers that the cube roots are between.

   a. _____ $< \sqrt[3]{25} <$ ______

   b. _____ $< \sqrt[3]{2} <$ ______

   c. _____ $< \sqrt[3]{147} <$ ______

   d. _____ $< \sqrt[3]{435} <$ ______

3. Label the following sentences **true** or **false**.

   a. The number 343 is not a perfect square. __________________

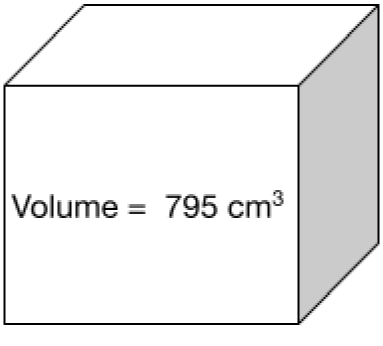
   b. The cube root of a perfect cube is an integer. ________________

   c. Taking the cube root and cubing a number are opposite operations. _______________

   d. The symbol for a cube root and a square root is the same. __________________

   e. You can use cube roots to find the side length of a cube given just the volume because all side lengths in a cube are the same length? _________________

4. What two numbers are the side length of the cube between?



Answer: ___________________

5. Plot the following numbers approximately on the number line. Do not use a calculator, but think about between which two whole numbers the root lies, and whether it is close to one of those whole numbers.

$\sqrt[3]{9}$ $-\sqrt[3]{27}$ $\sqrt[3]{200}$ $\sqrt[3]{343}$ $-\sqrt[3]{1}$

Name: Answer Key

G8 U6 Lesson 13 - Let's Try It!

1. List the first ten cubes. 1, 8, 27, 64, 125, 216, 343, 512, 729, 1000

2. Ronnie's most popular wooden box has a volume of 512 cubic inches. What is the cube root of 512?

   $\sqrt[3]{512} =$ 8

   Is 512 a perfect cube? yes

3. Ronnie's smallest wooden box has a volume of 139 cubic inches. What is the cube root of 139?

   $\sqrt[3]{139} =$ 5.18 or 5.2

   Is 139 a perfect cube? no

4. Draw a circle around the perfect cubes. Draw a square around the cube roots that are not perfect.

   [✓ $\sqrt[3]{-27}$] $\boxed{\sqrt[3]{60}}$ [✓ $\sqrt[3]{729}$] $\boxed{\sqrt[3]{81}}$ $\boxed{\sqrt[3]{100}}$ [✓ $\sqrt[3]{216}$] [✓ $\sqrt[3]{512}$] $\boxed{\sqrt[3]{32}}$

5. Elisha says that $\sqrt[3]{96}$ is between 6 and 7. Is she correct? Justify your answer.

   Elisha is incorrect. Since $4^3 = 64$ and $5^3 = 125$. 96 is between 64 and 125, then $4 < \sqrt[3]{96} < 5$.

6. Find the numbers that the cube roots are between.

   a. $3 < \sqrt[3]{37} < 4$

   b. $4 < \sqrt[3]{101} < 5$

   c. $2 < \sqrt[3]{15} < 3$

   d. $6 < \sqrt[3]{235} < 7$

Name: Answer Key G8 U6 Lesson 13 - Independent Work

1. List the first ten cubes. 1, 8, 27, 64, 125, 216, 343, 512, 729, 1000

2. Find the numbers that the cube roots are between.

   a. $2 < \sqrt[3]{25} < 3$

   b. $1 < \sqrt[3]{2} < 2$

   c. $4 < \sqrt[3]{147} < 5$

   d. $7 < \sqrt[3]{435} < 8$

3. Label the following sentences **true** or **false**.

   a. The number 343 is not a perfect square. false

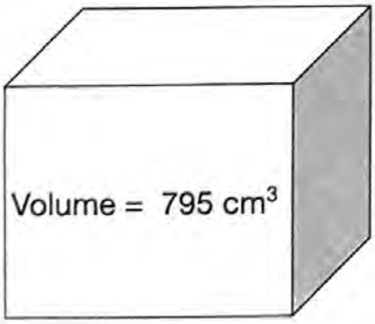
   b. The cube root of a perfect cube is an integer. true

   c. Taking the cube root and cubing a number are opposite operations. true

   d. The symbol for a cube root and a square root is the same. false

   e. You can use cube roots to find the side length of a cube given just the volume because all side lengths in a cube are the same length? true

4. What two numbers are the side length of the cube between?



$9^3 = 729$ $10^2 = 1000$

Answer: $9 < \sqrt[3]{795} < 10$

5. Plot the following numbers approximately on the number line. Do not use a calculator, but think about between which two whole numbers the root lies, and whether it is close to one of those whole numbers.

$\sqrt[3]{9}$ $\quad -\sqrt[3]{27}$ $\quad \sqrt[3]{200}$ $\quad \sqrt[3]{343}$ $\quad -\sqrt[3]{1}$