Pythagorean Theorem

I can...

- Use the Pythagorean Theorem
- ~~Use the converse of the Pythagorean Theorem~~
- ~~Classify triangles~~

Who is Pythagoras?

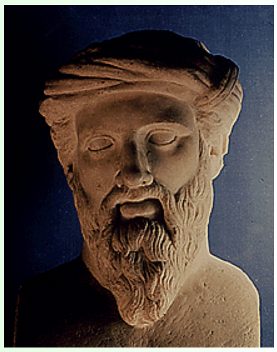
Pythagoras

Pythagoras of Samos was an Ionian Greek philosopher, mathematician, and founder of the religious movement called Pythagoreanism.

Born: 570 BC, Samos Island

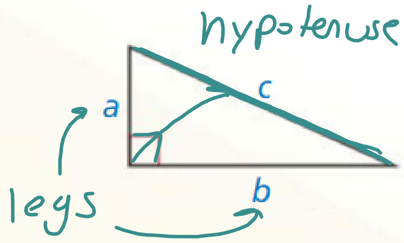
Died: 495 BC, Metapontum

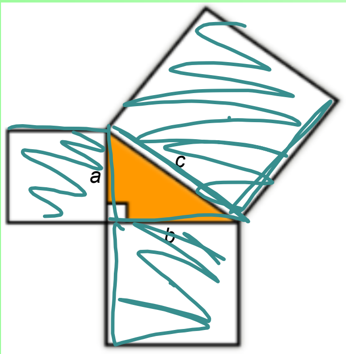
Full name: Pythagoras of Samos



Theorem 9.1 Pythagorean Theorem

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 legs.





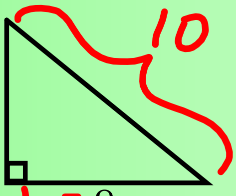
If right triangle, then $a^2 + b^2 = c^2$.

Copy/paste the link below for a visual demonstration of the Pythagorean Theorem.

https://youtu.be/CAkMUdeB06o

Do It Together - Example #1

Using the **Pythagorean Theorem**, determine the lengths of the missing sides of the right triangles below. Express your answer as a either a **whole number** or in **radical form**.



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

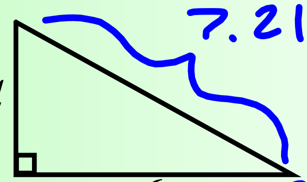
$6^2 + 8^2 = c^2$

$36 + 64 = c^2$

$100 = c^2$

$\boxed{10 = c}$

take $\sqrt{\ }$ to undo c^2



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

$4^2 + 6^2 = c^2$

$16 + 36 = c^2$

$52 = c^2$

$c = \sqrt{52}$

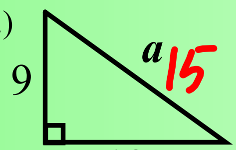
$c = 7.211$

Do It In Your Groups - Example #2

Find the missing side lengths in the right triangles below.

0:07:00

a.)



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

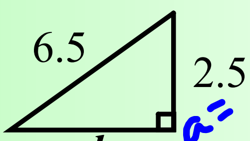
$9^2 + 12^2 = a^2$

$81 + 144 = a^2$

$225 = a^2$

$\boxed{a = 15}$

b.)



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

$2.5^2 + b^2 = 6.5^2$

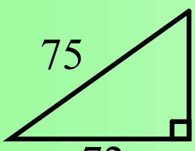
$6.25 + b^2 = 42.25$

$-6.25 \quad -6.25$

$b^2 = 36$

$\boxed{b = 6}$

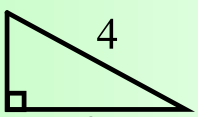
c.)



$72^2 + c^2 = 75^2$

$\boxed{c = 21}$

d.)



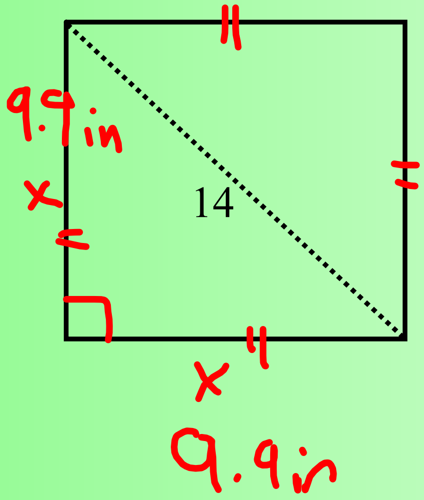
$d^2 + 3^2 = 4^2$

$\boxed{d = \sqrt{7} = 2.646}$

Example #3

Find the area of the square with a ***diagonal*** measuring 14 in.

- The area A of a square is defined as $A = s^2$, where s is the length of one side of the square.



$$x^2 + x^2 = 14^2$$

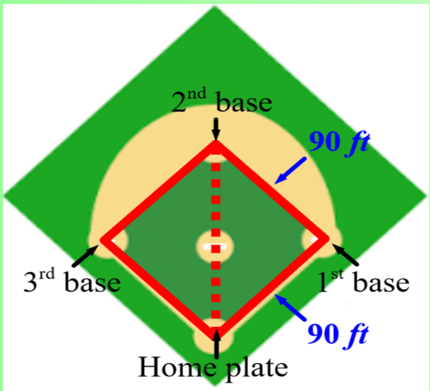
$$2x^2 = 196$$

$$x^2 = 98$$

$$x = \sqrt{98} = 9.900$$

Example #4

The bases on a professional baseball field are located at the vertices of a square. A runner starts at home plate and travels to 1st, 2nd, 3rd, then home again in order. The distance between consecutive bases (1st to 2nd, for example) is 90 feet. If a player in the field wanted to throw a ball directly from home plate to 2nd base, how far would that throw need to go



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

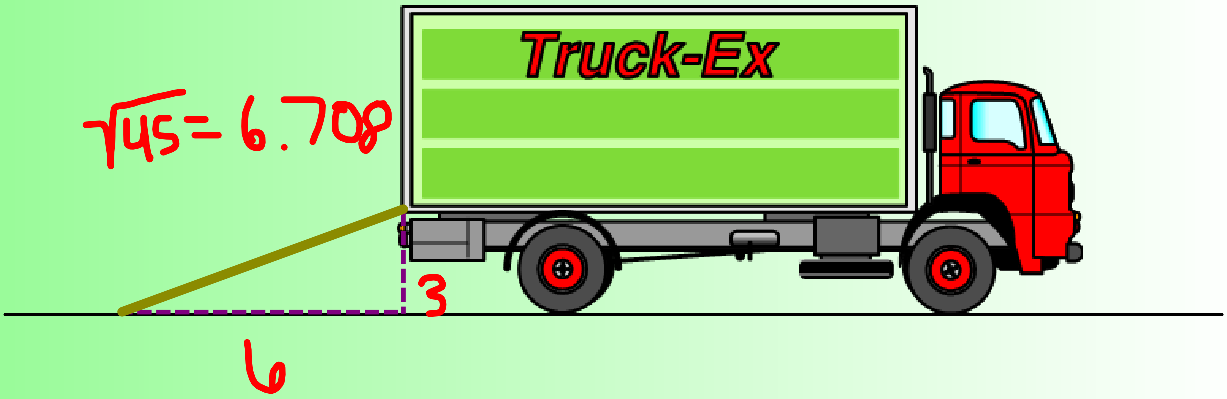
$$8100 + 8100 = c^2$$

$$16200 = c^2$$

$$c = 127.279$$

Example #5

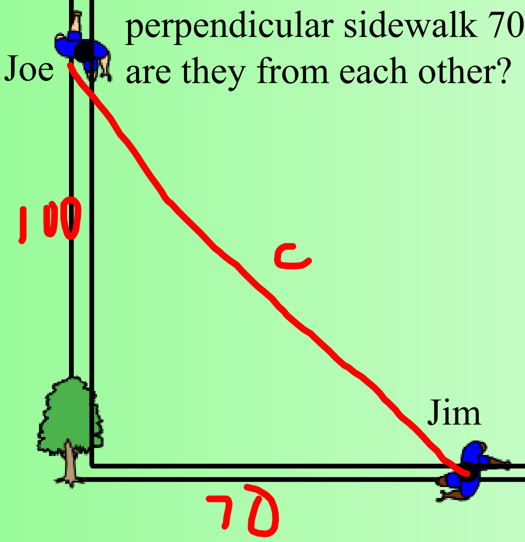
The height of a delivery truck bed is three feet. The edge of a ramp on the ground is six feet away from the truck. To the nearest tenth of a foot, how long is the ramp?



$\sqrt{45} = 6.708$

Example #6

Joe is on a sidewalk 100 ft. away from the tree, and Jim is on a perpendicular sidewalk 70 ft. away from the tree. How far away are they from each other?



$100^2 + 70^2 = c^2$

$10000 + 4900 = c^2$

$1490 = c^2$

$c = 122.066\text{ft}$

Geometry Name: ___________________________________
Pythagorean Theorem and Distance Formula Intro Date:_______________ Period: ____

Section 1 – Perfect Squares

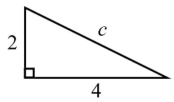
Each empty box in the grid below is the sum of the two perfect squares from 1 to 100 that line up in each row and column. For example, 4 + 16 = 20, so 20 has been placed for you in the table. Three other numbers (listed below) have also been placed as examples for you. Fill in all remaining missing values using the given numbers as a guide.

1 + 1 = 2, 25 + 100 = 125 81 + 36 = 117

	1	4	9	16	25	36	49	64	81	100
1	2									
4				20						
9										
16										
25										125
36										
49										
64										
81						117				
100										

Section 2 – Why Perfect Squares? Pythagoras would have wanted it that way!

In case you had not made the connection yet, these perfect squares are whole number values that arise when using the Pythagorean Theorem: $a^2 + b^2 = c^2$. For example, notice what happens when we find the length of the hypotenuse in each right triangle below using the Pythagorean Theorem.

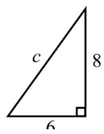


$$c^2 = 2^2 + 4^2$$
$$c^2 = 4 + 16$$
$$c^2 = 20$$
$$c = \sqrt{20}$$

When solving, we get 4 + 16, which is the sum of two perfect squares. These are the same perfect squares we have in the table above (4 + 16 = 20). This is no coincidence!

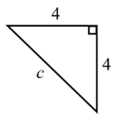
Using this same idea, find the length of the hypotenuse in each right triangle below using your table from section 1.

a.)



$6^2 + 8^2 = c^2$
$36 + 64 = c^2$
$100 = c^2$
$c = 10$

b.)



$4^2 + 4^2 = c^2$
$16 + 16 = c^2$
$32 = c^2$
$c = \sqrt{32}$
$c = 5.657$

Section 3 – Bringing it all together, in a distance sort of way.

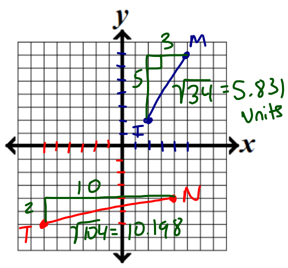
a.) Plot the following four points on the coordinate plane, assuming each box represents one unit.
$M(5,7)$ $I(2,2)$ $N(4,-4)$ $T(-6,-6)$

b.) Use Slope rise/run to draw a **right triangle** where segment *MI* is the hypotenuse.

c.) Find the length of segment *MI* using the Pythagorean Theorem and your table from **Section 1**.

$3^2 + 5^2 = c^2$
$9 + 25 = c^2$
$34 = c^2$

$c = \sqrt{34}$
$c = 5.831$



d.) Repeat steps (b) and (c) for segment *NT*. Express your answer a radical (you do not need to simplify).

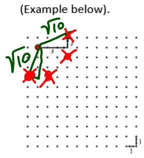
$2^2 + 10^2$
$4 + 100$
104

$c = \sqrt{104}$
$c = 10.198$

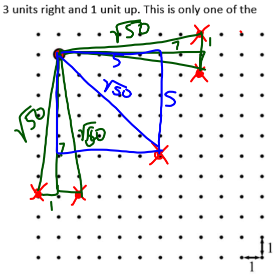
Section 4 –Reversing the Process: The treasure hunt begins.

The process done is Section 3 is called the ***Distance Formula***, and is just another way to use the Pythagorean Theorem but with coordinates. So, let's use it in a different way!

A treasure hunter is standing at the large dot in the upper left corner of the dot grid to the right. A metal detector he is using tells him that the item he is looking for is $\sqrt{50}$ units away from his location. Using everything you have learned from Sections 1-3 in this activity, determine all possible locations of the treasure and clearly mark them on the diagram (Example below).



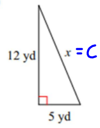
For example, on the grid to the left the square is $\sqrt{10}$ units away from the treasure hunter. Using our table from Section 1 we find 10 in our table of numbers listed as 1 + 9. Since $1 = 1^2$ and $9 = 3^2$, a possible location could be 3 units right and 1 unit up. This is only one of the possible locations for $\sqrt{10}$.



Section 5 Practicing Pythagorean Theorem and Distance Formula

Find the missing side of each triangle. Round your answers to the nearest tenth if necessary.

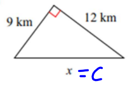
1)



$12^2+5^2=x^2$

$x=13$

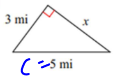
2)



$9^2+12^2=x^2$

$x=15$

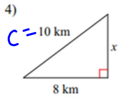
3)



$3^2+x^2=5^2$

$x=4$

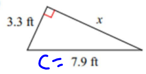
4)



$x^2+8^2=10^2$

$x=6$

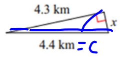
5)



$x^2+3.3^2=7.9^2$

$x=7.178$

6)

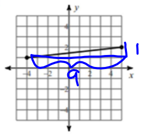


$4.3^2+x^2=4.4^2$

$x=0.933$

Find the distance between each pair of points. Round your answer to the nearest tenth, if necessary.

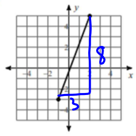
7)



$\sqrt{82}$

9.055

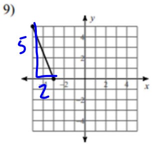
8)



$\sqrt{73}$

8.544

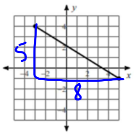
9)



$\sqrt{29}$

5.385

10)



$\sqrt{89}$

9.434