



The Distance Formula

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1



First let's take a look at...



2

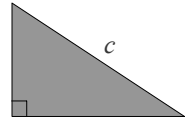
The Pythagorean Theorem



3

The Pythagorean Theorem

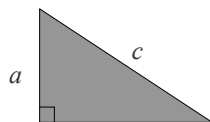
Remember for a right triangle with **hypotenuse** of length c



4

The Pythagorean Theorem

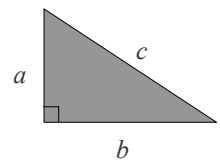
Remember for a right triangle with **hypotenuse** of length c and **sides** of lengths a



5

The Pythagorean Theorem

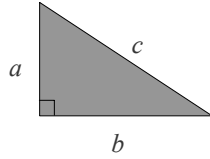
Remember for a right triangle with **hypotenuse** of length c and **sides** of lengths a and b



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The Pythagorean Theorem

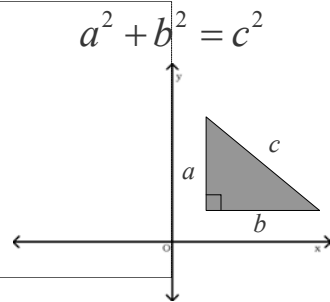
$$a^2 + b^2 = c^2$$



7

The Pythagorean Theorem

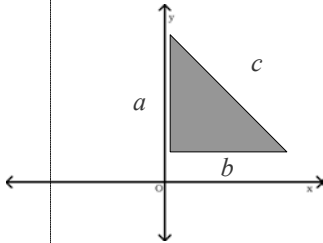
$$a^2 + b^2 = c^2$$



8

The Pythagorean Theorem

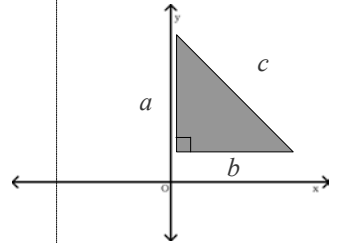
And if
 $a^2 + b^2 = c^2$



9

The Pythagorean Theorem

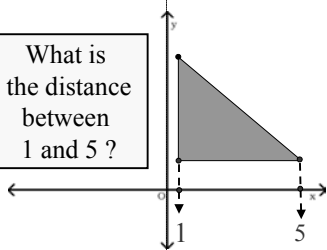
And if
 $a^2 + b^2 = c^2$
then the triangle
is a
right triangle



10

The Distance Formula

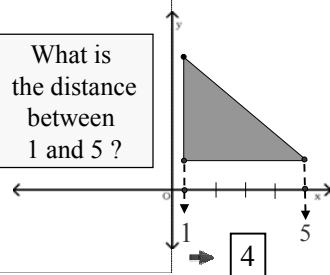
What is
the distance
between
1 and 5?



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The Distance Formula

What is
the distance
between
1 and 5?

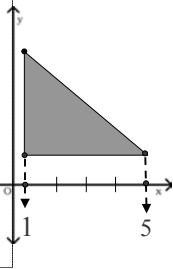


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The Distance Formula



How would you find the distance **without** counting?

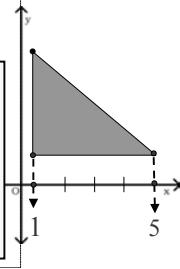


13

The Distance Formula



Math Alert:
Distance or Length is found by **subtracting!**

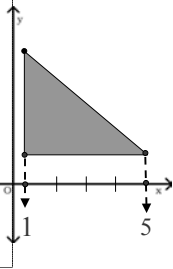


14

The Distance Formula



So, the distance between 1 and 5 can be found by **subtracting**
 $5 - 1$

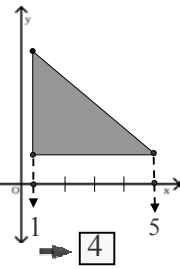


15

The Distance Formula



So, the distance between 1 and 5 can be found by **subtracting**
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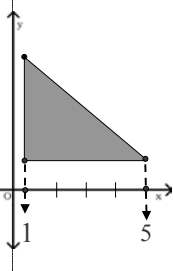


16

The Distance Formula



What if you subtracted $1 - 5$?

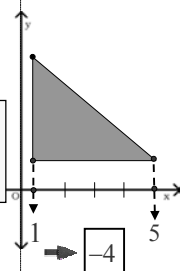


17

The Distance Formula



What if you subtracted $1 - 5$?

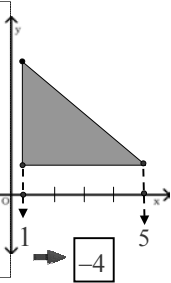


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The Distance Formula



Math Alert:
Distance is never negative!

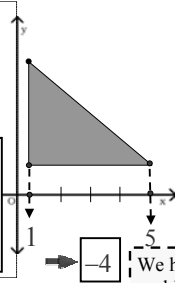


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The Distance Formula



Math Alert:
or, distance is always positive!



We have a problem here...

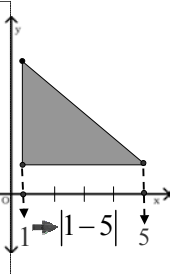


20

The Distance Formula



So, to make sure we always have **positive distance** absolute value is used

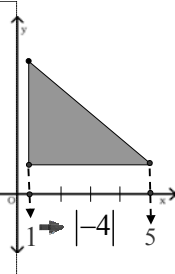


21

The Distance Formula



So, to make sure we always have **positive distance** absolute value is used

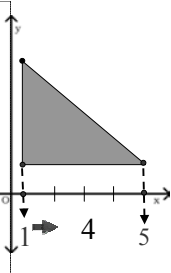


22

The Distance Formula



So, to make sure we always have **positive distance** absolute value is used

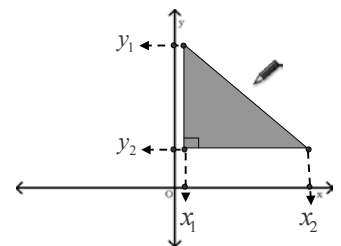


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The Distance Formula



Consider the right triangle



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Now, how do you find length?



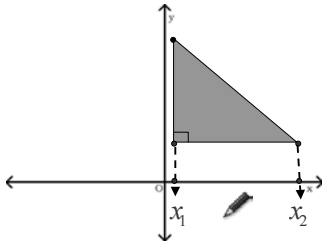
Now, how do you find length?

Subtract the endpoints and use **Absolute Value**



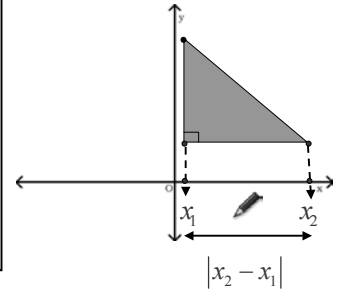
The Distance Formula

The horizontal distance between x_1 and x_2 is $|x_1 - x_2|$ or $|x_2 - x_1|$



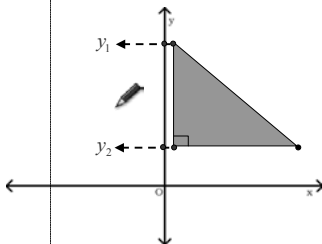
The Distance Formula

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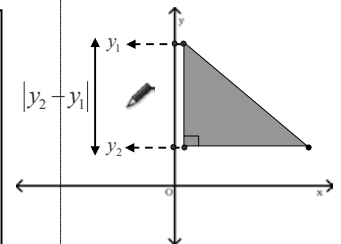
The Distance Formula

The vertical distance between y_1 and y_2 is $|y_1 - y_2|$ or $|y_2 - y_1|$



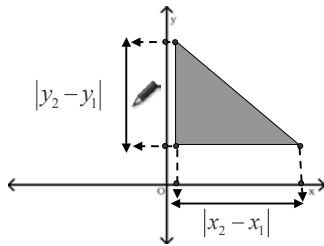
The Distance Formula

The vertical distance between y_1 and y_2 is $|y_1 - y_2|$ or $|y_2 - y_1|$



The Distance Formula

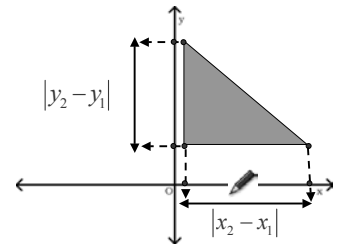
Note the lengths of both sides



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The Distance Formula

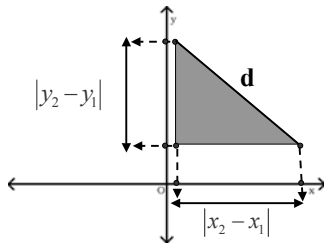
Note the lengths of both sides



32

The Distance Formula

 Assign **d** to the length of the hypotenuse



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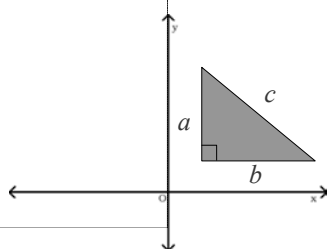
And remember ... 



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The Pythagorean Theorem

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



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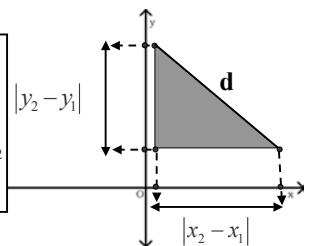
The Distance Formula

 so...

$$|y_2 - y_1|^2 + |x_2 - x_1|^2 = d^2$$

or

$$d^2 = |x_2 - x_1|^2 + |y_2 - y_1|^2$$



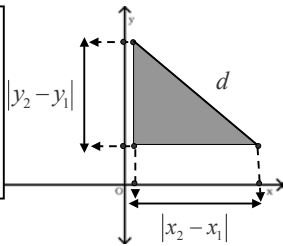
36

The Distance Formula

$$d^2 = |x_2 - x_1|^2 + |y_2 - y_1|^2$$

and solving for d

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

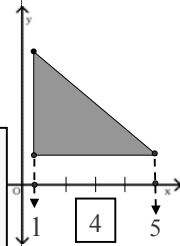


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The Distance Formula



Math Alert:
remember
distance is
always
positive!

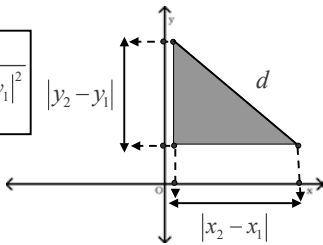


38

The Distance Formula

so...

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



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



Note: something **squared**
is always **positive!**



40

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



So, we can replace the **absolute value**
signs with **parentheses...**

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




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



So, we can replace the **absolute value**
signs with **parentheses...**

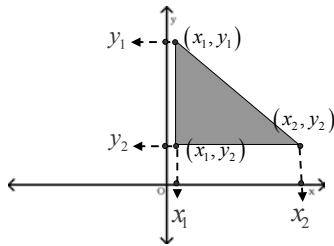
$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} $$



42

The Distance Formula

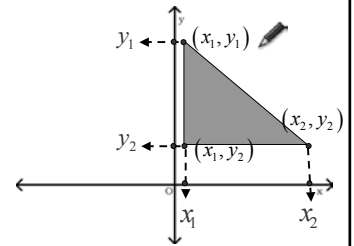
Note the ordered pairs of the **same** triangle



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The Distance Formula

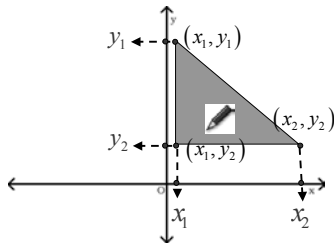
Note the ordered pairs of the **same** triangle



44

The Distance Formula

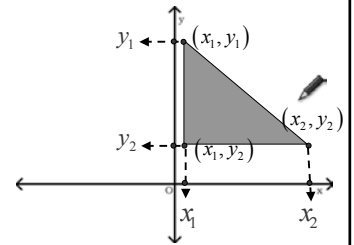
Note the ordered pairs of the **same** triangle



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The Distance Formula

Note the ordered pairs of the **same** triangle

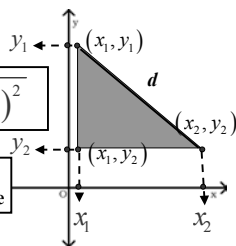


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The Distance Formula

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

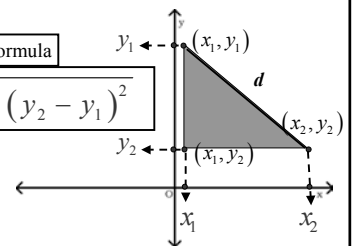
So... d is the distance between the ordered pairs of the hypotenuse



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The Distance Formula

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



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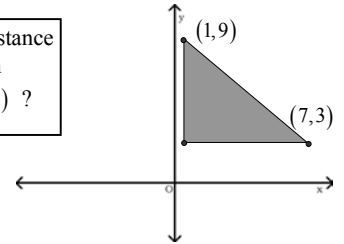
Now, let's do a little practice



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The Distance Formula

What is the distance between (1,9) and (7,3) ?



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You can do this!



51

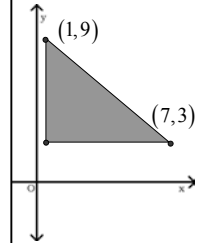
The Distance Formula

Applying the Distance Formula:

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

$$d = \sqrt{(1 - 7)^2 + (9 - 3)^2}$$

$$d = \sqrt{(-6)^2 + (6)^2}$$



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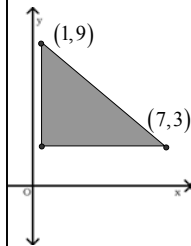
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53

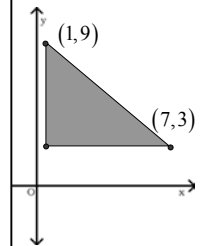
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54

The Distance Formula

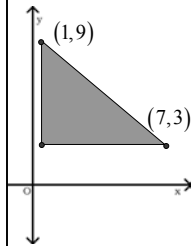
Applying the Distance Formula:

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

$$d = \sqrt{36 + 36} = \sqrt{72}$$

or simplifying the radical

$$d = 6\sqrt{2} \quad \text{or } d \approx 8.485$$



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The Distance Formula

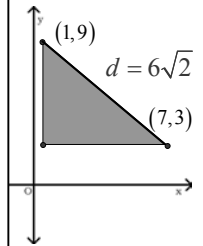
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$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

$$d = \sqrt{72}$$

or simplifying the radical

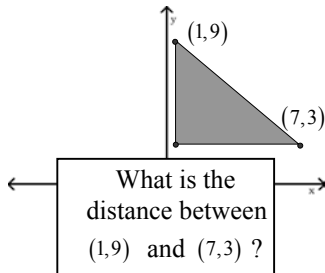
$$d = 6\sqrt{2} \quad \text{or } d \approx 8.485$$



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The Distance Formula

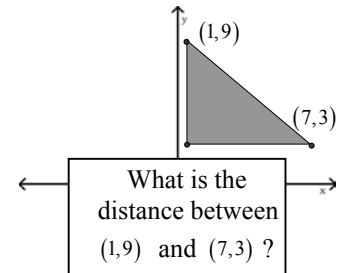
Math Alert:
It **doesn't**
matter
which 'X'
you
subtract
first in
finding
distance



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The Distance Formula

Math Alert:
But the
first 'X'
determines
the **first 'Y'**



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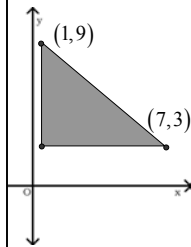
The Distance Formula

Applying the Distance Formula:

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

$$d = \sqrt{(7 - 1)^2 + (3 - 9)^2}$$

$$d = \sqrt{(6)^2 + (-6)^2}$$



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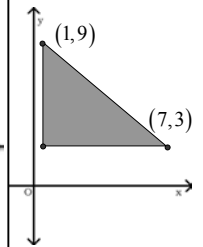
The Distance Formula

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60

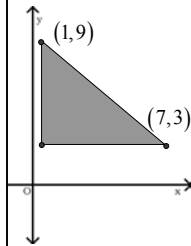
The Distance Formula

Applying the
Distance Formula:

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

$$d = \sqrt{(7 - 1)^2 + (3 - 9)^2}$$

$$d = \sqrt{(6)^2 + (-6)^2} \quad \text{✎}$$



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The Distance Formula

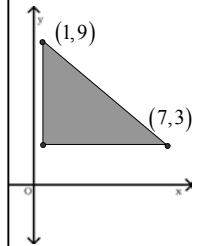
Applying the
Distance Formula:

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

$$\text{✎ } d = \sqrt{36 + 36} = \sqrt{72}$$

or **simplifying** the radical

$$d = 6\sqrt{2} \quad \text{or } d \approx 8.485$$



62

The Distance Formula

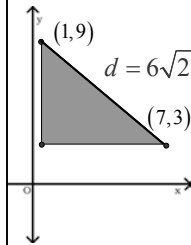
Applying the
Distance Formula:

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

$$d = \sqrt{36 + 36} = \sqrt{72}$$

or **simplifying** the radical

$$\text{✎ } d = 6\sqrt{2} \quad \text{or } d \approx 8.485$$



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The Distance Formula

Applying the
Distance Formula:

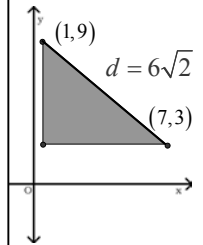
$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

$$d = \sqrt{36 + 36} = \sqrt{72}$$

or **simplifying** the radical

$$\text{✎ } d = 6\sqrt{2} \quad d \approx 8.5$$

or the **same value** as last time!



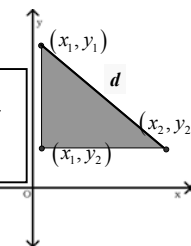
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The Distance Formula

Remember !!!

THE DISTANCE FORMULA

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



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You can do this!



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The Distance Formula

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