

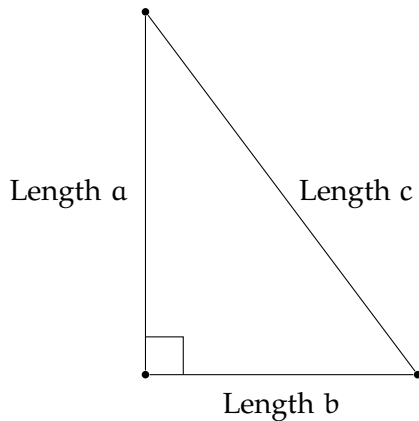
## CHAPTER 1

---

# Pythagorean Theorem

Watch's Khan Academy's Intro to the Pythagorean Theorem video at <https://youtu.be/AA6RfgP-AHU>.

If you have a right triangle, the edges that touch the right angle are called *the legs*. The third edge, which is always the longest, is known as *the hypotenuse*. The Pythagorean Theorem gives us the relationship between the length of the legs and the length of the hypotenuse.



The Pythagorean Theorem tells us that  $a^2 + b^2 = c^2$ .

For example, if one leg has a length of 3 and the other has a length of 4, then  $a^2 + b^2 = 3^2 + 4^2 = 25$ . Thus  $c^2$  must equal 25. So you know the hypotenuse must be of length 5.

(In reality, it rarely works out to be such a tidy number. For example, what is the length of the hypotenuse if the two legs are 3 and 6?  $a^2 + b^2 = 3^2 + 6^2 = 45$ . The length of the hypotenuse is the square root of that:  $\sqrt{45} = \sqrt{9 \times 5} = 3\sqrt{5}$ , which is approximately 6.708203932499369.)

**Exercise 1 Find the Missing Length**

What is the missing measure?

*Working Space*

Leg 1 = 6, Leg 2 = 17

8, Hypotenuse = ? (It should be a whole number.)

Leg 1 = 5, Leg 2 = 13, Hypotenuse = ? (It is an irrational number. Give the

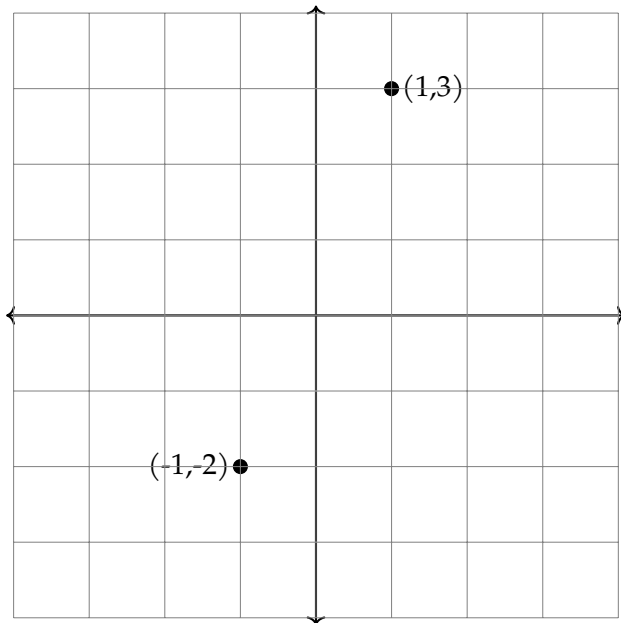
exact answer and then use a calculator to get an approximation.)

Leg 1 = ?, Leg 2 = 15, Hypotenuse =

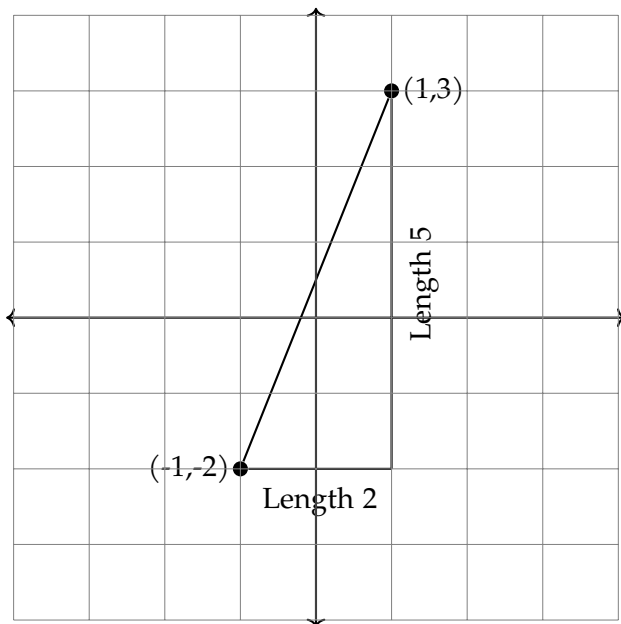
*Answer on Page 5*

**1.1 Distance between Points**

What is the distance between these two points?



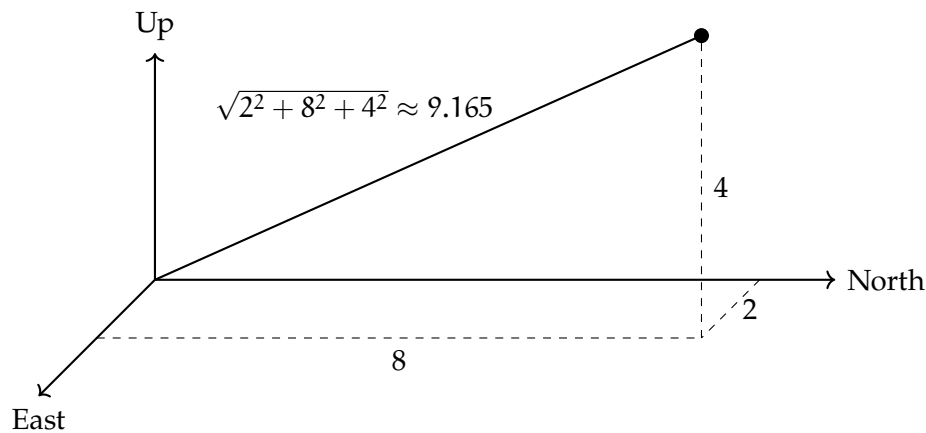
We can draw a right triangle and use the Pythagorean Theorem:



The distance between the two points is  $\sqrt{2^2 + 5^2} = \sqrt{29} \approx 5.385165$ . That is, you square the change in  $x$  and add it to the square of the change in  $y$ . The distance is the square root of that sum.

## 1.2 Distance in 3 Dimensions

What if the point is in three-dimensional space? That is, you move 2 meters East, 8 meters North, and 4 meters up in the air. How far are you from where you started? You just square each, sum them, and take the square root:  $\sqrt{2^2 + 8^2 + 4^2} = \sqrt{84} = 2\sqrt{21} \approx 9.165$  meters.



---

*This is a draft chapter from the Kontinua Project. Please see our website (<https://kontinua.org/>) for more details.*

# Answers to Exercises

## Answer to Exercise 1 (on page 2)

10 because  $6^2 + 8^2 = 10^2$

12 because  $5^2 + 12^2 = 13^2$

8 because  $8^2 + 15^2 = 17^2$

$3\sqrt{2} \approx 4.24$  because  $3^2 + 3^2 = (3\sqrt{2})^2$





---

# INDEX

distance

in 3 dimensions, [4](#)

distance using Pythagorean theorme, [2](#)

Pythagorean theorem, [1](#)