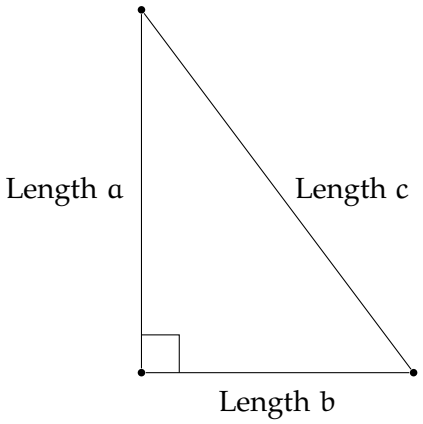
CHAPTER 1

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. This means 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?

Leg 1 = 6, Leg 2 = 8, Hypotenuse = ? (It should be a whole number.)

Leg 1 = 5, Leg 2 = ?, Hypotenuse = 13 (It should be a whole number.)

Leg 1 = ?, Leg 2 = 15, Hypotenuse = 17 (It should be a whole number.)

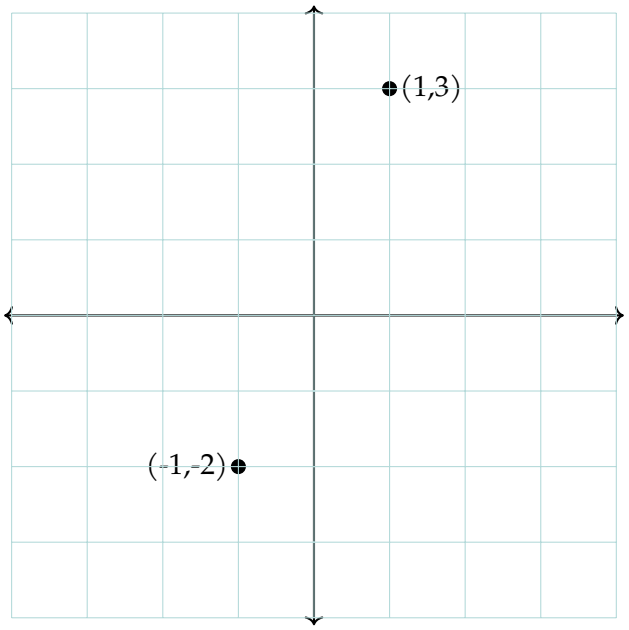
Leg 1 = 3, Leg 2 = 3, Hypotenuse = ? (It is an irrational number. Give the exact answer and then use a calculator to get an approximation.)

Working Space

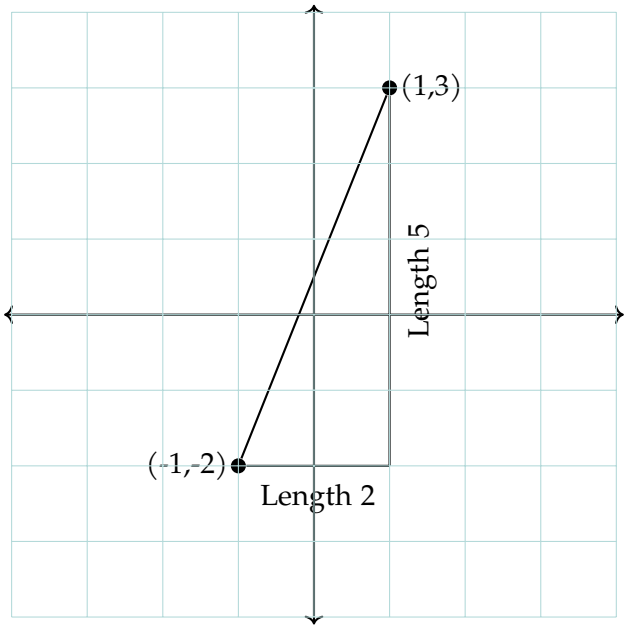
Answer on Page 5

1.1 Distance between Points

What is the distance between these two points?



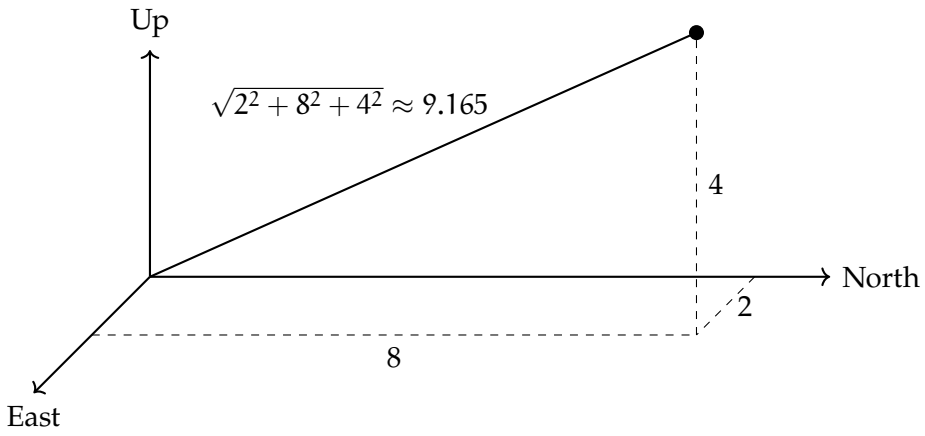
We can draw a right triangle and use the Pythagorean Theorem:



The distance between the two points is $\sqrt{2^2 + 5^2} = \sqrt{29} \approx 5.385165$. In other words, 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? For example, 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.



Appendix A

Answers to Exercises

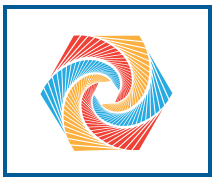
Answer to Exercise 1 (on page 2)

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 $3^2 + 3^2 = \left(3\sqrt{2}\right)^2$



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