Unit 8, Lesson 7

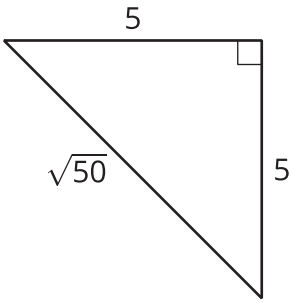
Finding Side Lengths of Triangles

Let's find triangle side lengths.

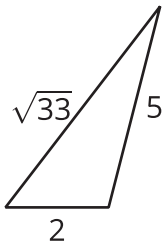
7.1 Which Three Go Together: Triangles

Which three go together? Why do they go together?

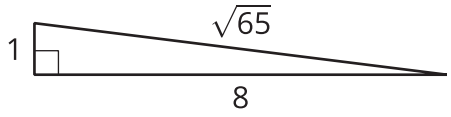
A



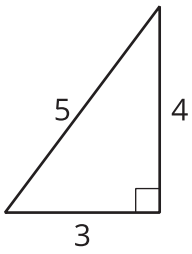
B



C



D

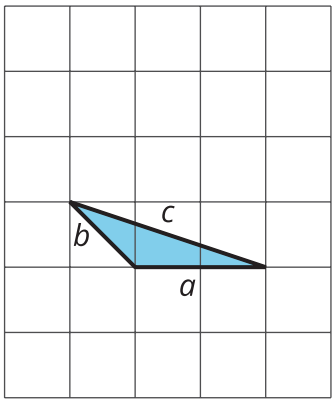


CC BY NC Illustrative Mathematics, based on IM 6–8 Math, CC BY Open Up Resources.

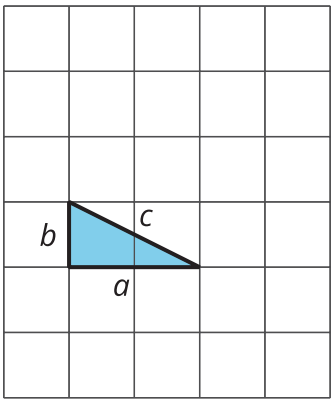
7.2 A Table of Triangles

1. Complete the tables for these three triangles:

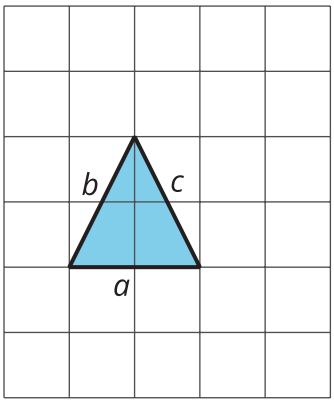
D



E



F



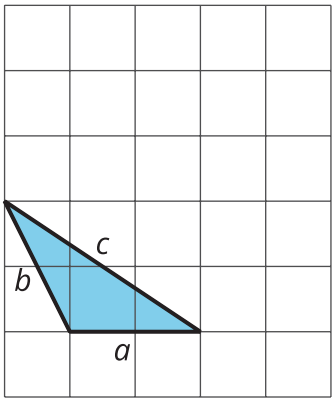
	a	b	c
Triangle D			
Triangle E			
Triangle F			

	a^2	b^2	c^2
Triangle D			
Triangle E			
Triangle F			

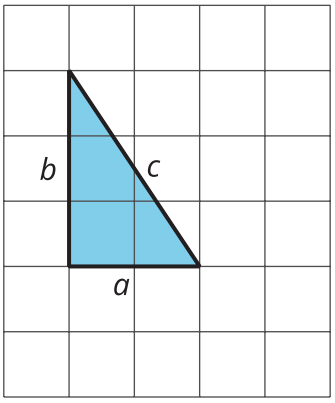
2. What do you notice about the values in the table for Triangle E but not for Triangles D and F?

3. Complete the tables for three more triangles:

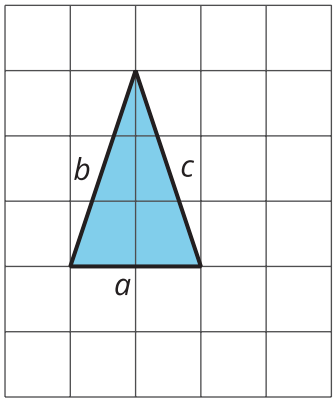
P



Q



R



	a	b	c
Triangle P			
Triangle Q			
Triangle R			

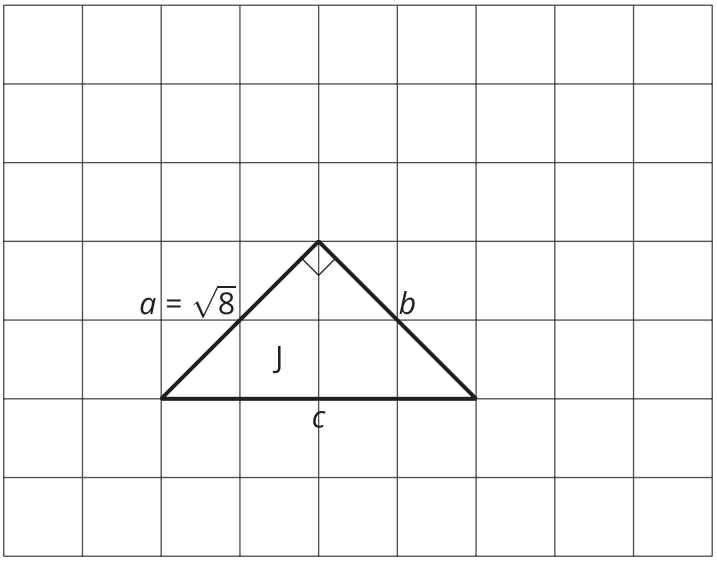
	a^2	b^2	c^2
Triangle P			
Triangle Q			
Triangle R			

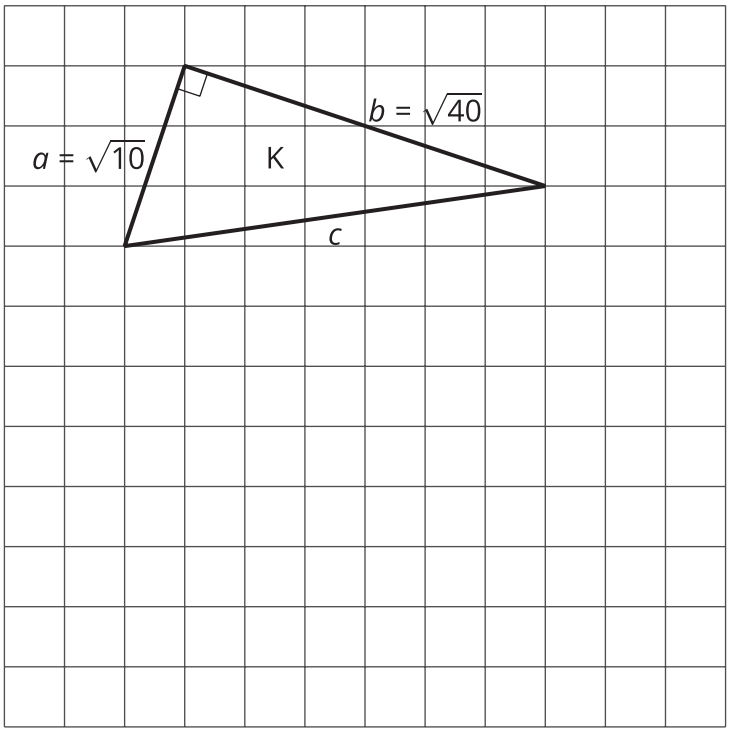
4. What do you notice about the values in the table for Triangle Q but not for Triangles P and R?

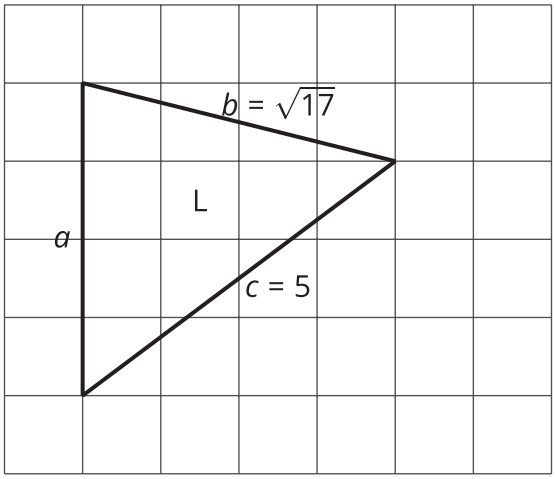
5. What do Triangle E and Triangle Q have in common?

7.3 Meet the Pythagorean Theorem

1. Find the missing side lengths. Be prepared to explain your reasoning.



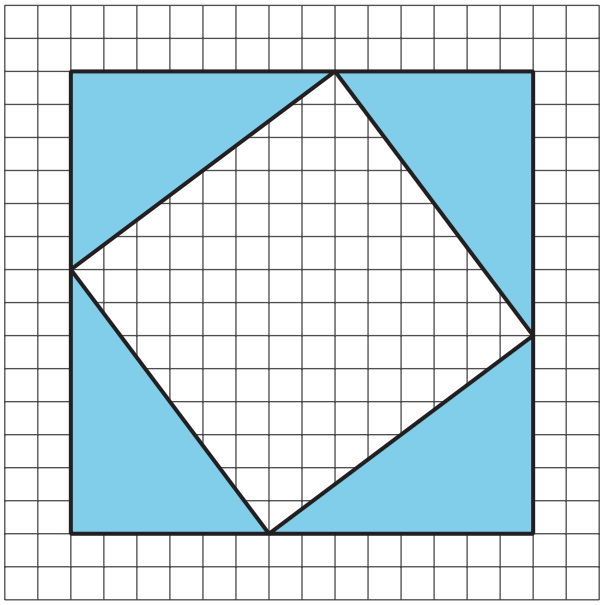




2. For which triangles does $a^2 + b^2 = c^2$?

Are you ready for more?

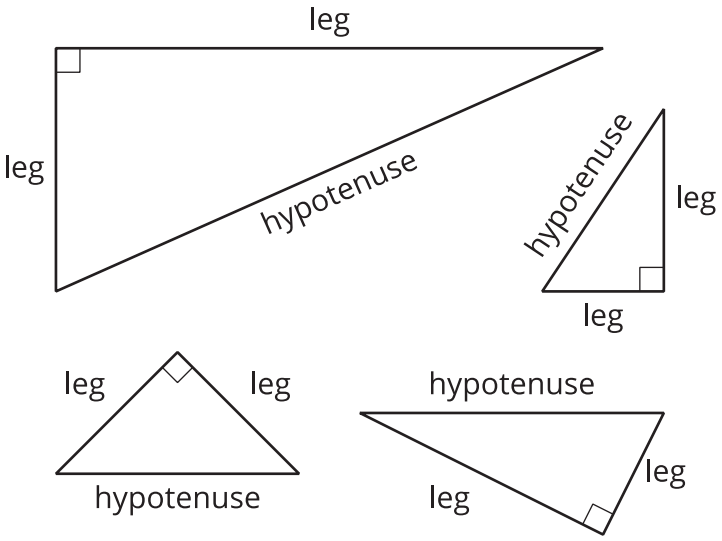
If the four shaded triangles in the figure are congruent right triangles, does the inner quadrilateral have to be a square? Explain how you know.

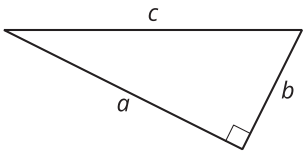


Lesson 7 Summary

A *right triangle* is a triangle with a right angle. In a right triangle, the side opposite the right angle is called the **hypotenuse**, and the two other sides that make the right angle are called its **legs**.

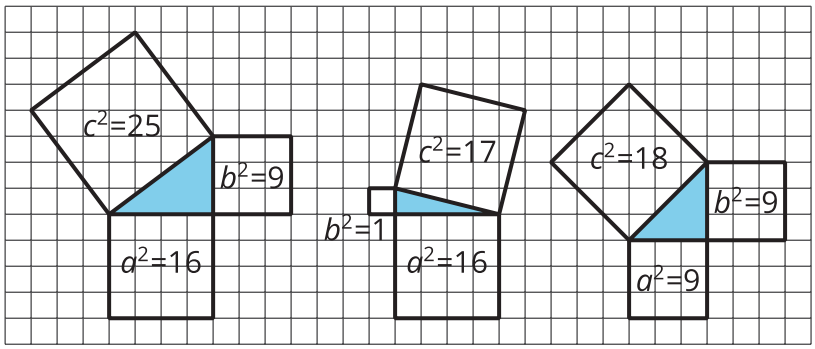
Here are some right triangles with the hypotenuse and legs labeled:





If the triangle is a right triangle, then a and b are used to represent the lengths of the legs, and c is used to represent the length of the hypotenuse. The hypotenuse is always the longest side of a right triangle.

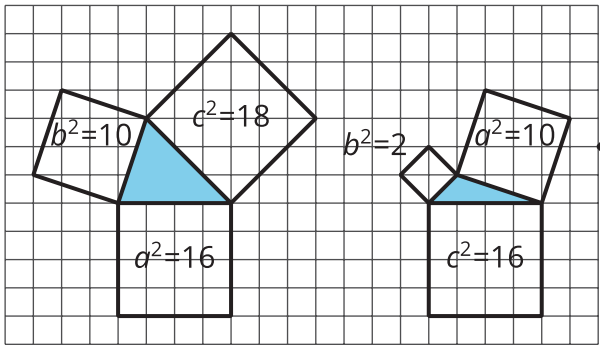
Here are some other right triangles:



Notice that for these examples of right triangles, the square of the hypotenuse is equal to the sum of the squares of the legs. In the first right triangle in the diagram, $16 + 9 = 25$, in the second, $16 + 1 = 17$, and in the third, $9 + 9 = 18$. Expressed another way, we have:

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

This is a property of all right triangles, not just these examples, and is often known as the **Pythagorean Theorem**. The name comes from a mathematician named Pythagoras who lived in ancient Greece around 2,500 BCE, but this property of right triangles was also discovered independently by mathematicians in other ancient cultures including Babylon, India, and China. In China, a name for the same relationship is the Shang Gao Theorem.

CC BY NC Illustrative Mathematics, based on IM 6–8 Math, CC BY Open Up Resources.

It is important to note that this relationship does not hold for *all* triangles. Here are some triangles that are not right triangles. Notice that the lengths of their sides do not have the special relationship $a^2 + b^2 = c^2$. That is, $16 + 10$ does not equal 18, and $10 + 2$ does not equal 16.