Find the length of AB.
From the opening exercise we saw two ways of find the length of a line on the grid page.

One way to find the length of a line.

1. Find the length of the segment AB.
2. Make a square with side AB:
3. Find the area of the square:

\[
\text{Area} = \underline{} 
\]

4. Then find the length of the side by taking the square root.

\[
\text{AB} = \underline{} 
\]

Another way (a shortcut to finding the area)

5. Make a square with side AB.
6. Find the areas of P and Q.

\[
\text{Area P: } \underline{}, \text{ Area Q: } \underline{} 
\]

7. Then find the length of the side by taking the square root.

\[
\text{AB} = \underline{} 
\]

So the length of AB is the same as

\[
\text{AB} = \sqrt{\text{Area P} + \text{Area Q}} 
\]

How do the areas relate to the area of R?

So the area of square R is the sum of the areas of P and Q.
The Pythagorean Theorem

In the previous exercises you saw how we use area to find the length of a line segment. The shortcut in step 6 is the key to what is called the Pythagorean Theorem, one of the oldest and most useful relationships in numbers. In order to describe it completely we need some definitions.

In a right triangle (a triangle with a 90° angle) the two sides that form the 90° angle are called the Legs. The side opposite the 90° angle is called the Hypotenuse.

From the previous exercises we saw that the three sides of the right triangle are related by $(L_1)^2 + (L_2)^2 = H^2$

The Pythagorean Theorem says that: The area of the square made from the hypotenuse is equal to the sum of the areas of squares made from the two legs.

Equivalently, we take the three areas:
The area of the square made from the hypotenuse: ________
The area of the square made from one leg $(a)$: ________
The area of the square made from the other leg $(b)$: ________ and according to Pythagoras,

$_______ + ________ = ________$

Which means that the length of hypotenuse is $c = \sqrt{______ + _____}$

Example: Find the length of the hypotenuse of the triangle below.

$H^2 = 5^2 + 12^2$
$H^2 = 25 + 144$
$H^2 = 169$
$H = \sqrt{169}$
$H = 13$

So the hypotenuse is 13.
Exercises

1. Find the length of the hypotenuse.

\[ c = \quad \]

2. Find the length of the hypotenuse.

\[ H = \quad \]

3. Find the length of the hypotenuse.

\[ x = \quad \]

4. Find the length of the hypotenuse.

\[ d = \quad \]

5. Find the perimeter of a right triangle if the legs are 8cm and 15cm long.

6. Find the perimeter of this triangle.