

## 8.1 - The Pythagorean Theorem

### MATH ON THE JOB

Jani Mroshaj is a stone mason in Halifax, NS. Jani learned his trade from his father while growing up in Albania, and then refined his skills while working as a stone mason in Greece and Italy. He immigrated to Canada in 2002, and is now the proud owner of Mr. Masonry, a business in Halifax that builds stone staircases, walls, patios, pathways, and fireplaces.

Jani uses math on the job every day. He calculates, estimates, and designs projects for clients, and does bookkeeping. When designing custom work, Jani needs to calculate how much material to order, knowing that this depends both on the dimensions of the stone that is available, and the size of the project he is building.

Jani is working on designing an outdoor patio. His client would like the patio design to feature squares of one kind of stone framing squares of a different kind of stone, with these rotated, as shown in the illustration.

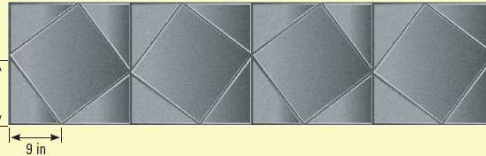
Jani wants the inner squares to be rotated according to the measurements shown in the illustration.

What will be the side lengths of the inner squares?



Jani Mroshaj uses a level to make sure the stone he just placed in this wall is straight.

$$\begin{aligned}
 c^2 &= a^2 + b^2 \\
 &= 12^2 + 9^2 \\
 &= 144 + 81 \\
 &= 225 \\
 c &= \sqrt{225} \\
 &= 15 \text{ in}
 \end{aligned}$$

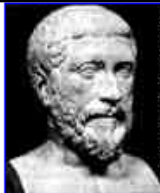


### SOLUTION

Use the Pythagorean theorem to solve the problem.

$$\begin{aligned}
 a^2 + b^2 &= c^2 \\
 12^2 + 9^2 &= s^2 \\
 144 + 81 &= s^2 \\
 225 &= s^2 \\
 \sqrt{225} &= s \\
 15 \text{ in} &= s
 \end{aligned}$$

Nov 13-5:43 PM



## 's Theorem...

Euclid (born circa 300 BCE) is called the Father of Modern Geometry. In his famous book *The Elements*, he generalized the Pythagorean theorem by stating that if one erects similar figures on the sides of a right triangle, then the sum of the areas of the two smaller figures will equal the area of the larger figure.

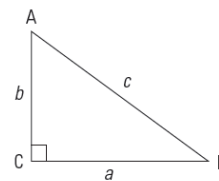
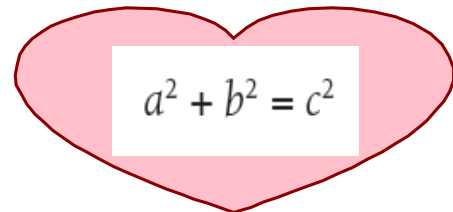
**right triangle:** a triangle with one right angle

**hypotenuse:** the longest side of a right triangle, opposite the  $90^\circ$  angle

**leg:** in a right triangle, the two sides that intersect to form a right angle

### Pythagorean theorem:

in a right triangle, the sum of the squares of the lengths of the legs is equal to the square of the length of the hypotenuse



Leg AC, or  $b$ , is adjacent to angle A and opposite angle B

Leg BC, or  $a$ , is adjacent to angle B and opposite angle A

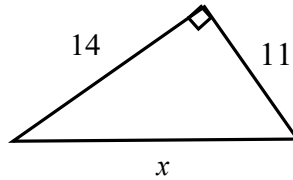
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## OPTIONS...

#1. Finding the unknown hypotenuse:

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

ex:

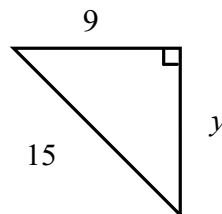


$$\begin{aligned} c^2 &= a^2 + b^2 \\ x^2 &= 11^2 + 14^2 \\ &= 121 + 196 \\ &= 317 \\ x &= \sqrt{317} \\ &= 17.8 \end{aligned}$$

#2. Finding an unknown side

$$a^2 = c^2 - b^2$$

ex:



$$\begin{aligned} a^2 &= c^2 - b^2 \\ y^2 &= 15^2 - 9^2 \\ &= 225 - 81 \\ &= 144 \\ y &= \sqrt{144} \\ &= 12 \end{aligned}$$

Nov 13-7:31 PM

**ACTIVITY 8.1**  
**INDIRECT MEASUREMENT**

Cam is a surveyor working in Prince Edward Island. He needs to estimate the length of a small pond beside the Summerside Airport. He decides to use a right triangle, as shown in the diagram, as an indirect method of measurement.

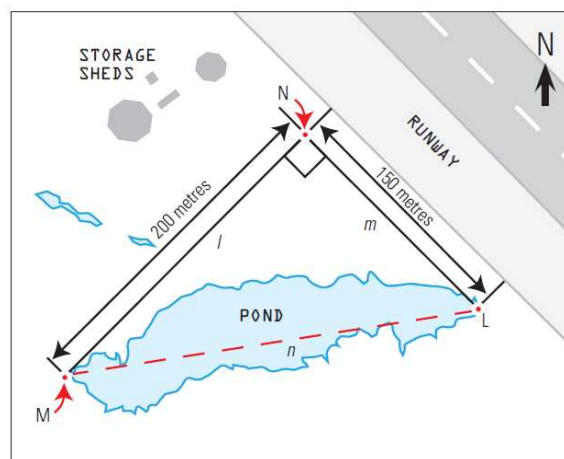
- Why might a surveyor use an indirect method of measurement in the example above?
- What is the length of the pond?

**SOLUTION**

- The surveyor can measure directly on dry land, but he cannot necessarily walk across the pond to measure it.
- Students will recognize the right triangle and should write the Pythagorean theorem as follows.

$$\begin{aligned} n^2 &= l^2 + m^2 \\ n^2 &= 200^2 + 150^2 \\ n^2 &= 40\,000 + 22\,500 \\ n^2 &= 62\,500 \\ n &= \sqrt{62\,500} \\ n &= 250 \end{aligned}$$

The pond is 250 m long.



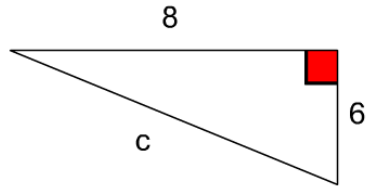
- measuring tape too short/terrain issues
- $$\begin{aligned} c^2 &= a^2 + b^2 \\ n^2 &= 200^2 + 150^2 \\ &= 40\,000 + 22\,500 \\ &= 62\,500 \\ n &= \sqrt{62\,500} \\ &= 250\text{m} \end{aligned}$$

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## Interactive Example #1

Let's try to solve a few problems

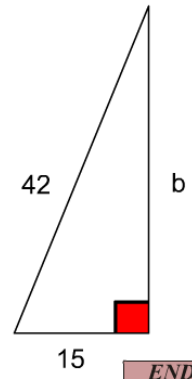
**Problem 1**  $6^2 + 8^2 = c^2$



Do the workings and click on the correct answer below

- 1) 12      2) 10      3) 5.3

**Problem 2**  $15^2 + b^2 = 42^2$



Do the workings and click on the correct answer below

- 1) 26.95      2) 10.2      3) 39.2



END

Jan 9-10:36 AM

## Interactive Example #2

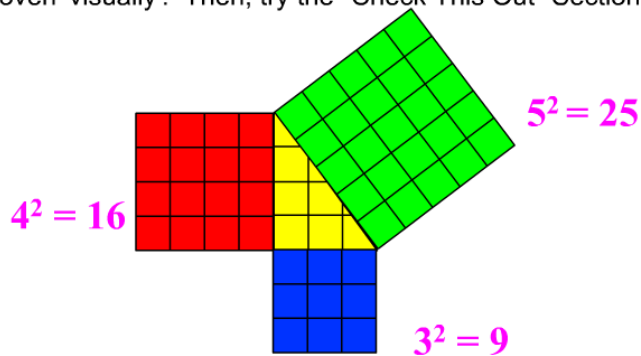
### Investigation 2: Pythagorean Theorem

Use the Steps on the right to see the Pythagorean Theorem proven 'visually'. Then, try the "Check This Out" Section.

Step 1

Step 2

Step 3



**Check This Out**  
(After Steps 1 - 3)

$$16 + 9 = 25$$

Read the Information at the top and use the buttons provided.

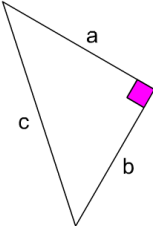
cdii INTERACTIVE

Jan 9-10:37 AM

### Pythagorean Triples

Figure out which of the following are Pythagorean Triples by putting them into  $a^2 + b^2 = c^2$   
Click on the corresponding button to see if it is a Pythagorean Triple

12	16	20	<input type="radio"/>
5	12	13	<input type="radio"/>
9	12	20	<input type="radio"/>
7	24	25	<input type="radio"/>
6	6	12	<input type="radio"/>



Verifying a Pythagorean Triple...

<table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left; border-bottom: 1px solid black;">LS</th> <th style="text-align: left; border-bottom: 1px solid black;">RS</th> </tr> </thead> <tbody> <tr> <td><math>c^2</math></td> <td><math>a^2 + b^2</math></td> </tr> <tr> <td><math>25^2</math></td> <td><math>7^2 + 24^2</math></td> </tr> <tr> <td>625</td> <td><math>49 + 576</math></td> </tr> <tr> <td></td> <td>625</td> </tr> <tr> <td></td> <td style="text-align: center;">✓</td> </tr> </tbody> </table>	LS	RS	$c^2$	$a^2 + b^2$	$25^2$	$7^2 + 24^2$	625	$49 + 576$		625		✓	<table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left; border-bottom: 1px solid black;">LS</th> <th style="text-align: left; border-bottom: 1px solid black;">RS</th> </tr> </thead> <tbody> <tr> <td><math>c^2</math></td> <td><math>a^2 + b^2</math></td> </tr> <tr> <td><math>12^2</math></td> <td><math>6^2 + 6^2</math></td> </tr> <tr> <td>144</td> <td><math>36 + 36</math></td> </tr> <tr> <td></td> <td>72</td> </tr> <tr> <td></td> <td style="text-align: center;">✗</td> </tr> </tbody> </table>	LS	RS	$c^2$	$a^2 + b^2$	$12^2$	$6^2 + 6^2$	144	$36 + 36$		72		✗
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## Remember... Common Pythagorean Triples

- 1) 3 - 4 - 5
- 2) 5 - 12 - 13
- 3) 8 - 15 - 17
- 4) 7 - 24 - 25

}

"Multiple any of these by a constant and you will have another triple..."

Is 10.5 14 17.5 a pythagorean triple?

LS	RS
$c^2$	$a^2 + b^2$
$17.5^2$	$10.5^2 + 14^2$
306.25	$110.25 + 196$
	306.25
	yes

Apr 25-7:52 AM

## HOMEWORK...

p. 332 - Build Your Skills #1 - 9, 12

**8.1 Build Your Skills Detailed Solutions.pdf**



Nov 13-7:41 PM

8.1 Build Your Skills Detailed Solutions.pdf