# Lesson 7-2: Pythagorean Theorem and Its Converse

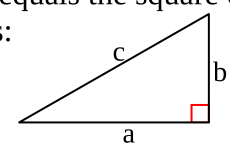
## Who cares anyways???

Last summer I was walking up the street. My Dad lives just two houses away and he was working in his yard. He had a long rope out that looked like it was marked in one foot increments. He had it in the shape of a right triangle, one leg against the curb. "What ya doing Dad?" "I'm putting in a rockery." "So, what's the rope for?" "I want the rockery edge to be perpendicular to the curb." As I took another look at what he was doing, it dawned on me…he was putting the Pythagorean Theorem to work to create a right angle!

## The Pythagorean Theorem (Theorem 7-4)

I'm sure most of you have run across the Pythagorean Theorem before. If you haven't, don't worry, it is really pretty easy to understand. Given a right triangle, the sum of the squares of the lengths of the legs equals the square of the length of the hypotenuse. A picture is worth a thousand words:

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




If you'd like to see a geometric proof of this using shapes check out this link.

## Pythagorean Triples

A Pythagorean triple is a set of numbers *a*, *b*, and *c* that satisfy the equation $a^2 + b^2 = c^2$. There are many Pythagorean triples. Perhaps the most common and well-known is 3, 4 and 5. Here are a few more:

- 6, 8, 10 and 5, 12, 13 and 8, 15, 17

## Putting it to work

My dad was using the 3, 4, 5 triple. He had a 12' rope marked at 1 foot increments. He'd placed one end at the curb, ran it out 3' away and drove a stake at that mark. He curved the rope around the stack and back toward the curb so that the 8 mark (5 more) just touched the curb. He drove a stake in there, curved the rope around and back to the first stake which was 4' away. Presto, he had a right triangle and a guaranteed right angle from the curb!

You can use the Pythagorean Theorem to do many things:

1. Form a right angle (and triangle).
2. Find the length of legs or the hypotenuse of a right triangle.
3. Find the area of a triangle.
4. Classify triangles as right, obtuse or acute.

## Examples

1. Is 4, 6, 7 a Pythagorean triple?

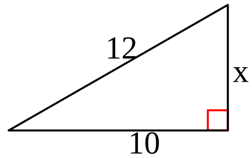
   $4^2 + 6^2 = 52,\ 7^2 = 49 \ldots$ no

2. Is 16, 30, 34 a Pythagorean triple?

   $16^2 + 30^2 = 1156,\ 34^2 = 1156 \ldots$ yes

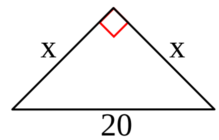
# Lesson 7-2: Pythagorean Theorem and Its Converse

3. Find the value of $x$:




$$x^2 + 10^2 = 12^2$$
$$x^2 + 100 = 144$$
$$x^2 = 44$$
$$x = \sqrt{44} = \sqrt{4 \cdot 11} = 2\sqrt{11}$$

4. The hypotenuse of an isosceles right triangle has length 20cm. Find the area.




$$x^2 + x^2 = 20^2$$
$$2x^2 = 400$$
$$x^2 = 200$$
$$x = \sqrt{200}$$

$$A = \frac{1}{2} b \cdot h = \frac{1}{2} x \cdot x = \frac{1}{2} x^2$$
$$= \frac{1}{2} \sqrt{200}^2 = \frac{1}{2} \cdot 200$$
$$= 100$$

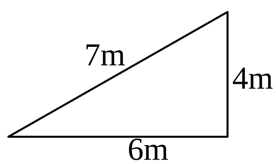
## Converse of the Pythagorean Theorem (Theorem 7-5)

Try to form the converse of the Pythagorean Theorem…

If the sum of the squares of the lengths of two sides of a triangle equals the square of the length of the third side, the triangle is a right triangle.

## Example

5. Is this triangle a right triangle?




$$6^2 + 4^2 = 52$$
$$7^2 = 49$$

…nope, it isn't.

## Using the Converse of the Pythagorean Theorem to Classify Triangles

If $c^2 \neq a^2 + b^2$ it is obvious the triangle is not a right triangle. Can we use this information to classify the triangle further?

What if $c^2 > a^2 + b^2$? That would mean the angle opposite side $c$ must be > 90.
What if $c^2 < a^2 + b^2$? That would mean the angle opposite side $c$ must be < 90.

## Theorem 7-6

If $c^2 > a^2 + b^2$, then the triangle is obtuse.

## Theorem 7-7

If $c^2 < a^2 + b^2$, then the triangle is acute.

## Homework Assignment

p. 355 #1-23 odd
p. 360 #1-43 odd, 49, 51, 71-75