

2.2.12: Triangles

You may use a calculator throughout this module as needed.



Classifying Triangles

We can classify triangles into three categories based on the lengths of their sides.

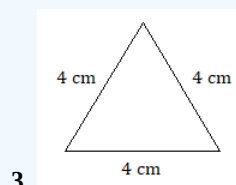
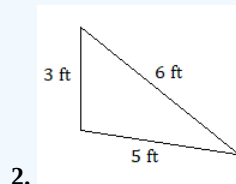
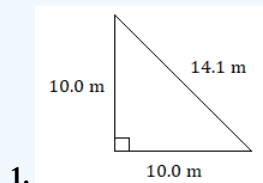
- Equilateral triangle: all three sides have the same length
- Isosceles triangle: exactly two sides have the same length
- Scalene triangle: all three sides have different lengths

We can also classify triangles into three categories based on the measures of their angles.

- Obtuse triangle: one of the angles is an obtuse angle
- Right triangle: one of the angles is a right angle
- Acute triangle: all three of the angles are acute

? Exercises 2.2.12.1

Classify each triangle by angle and side. For example, “acute scalene”.)



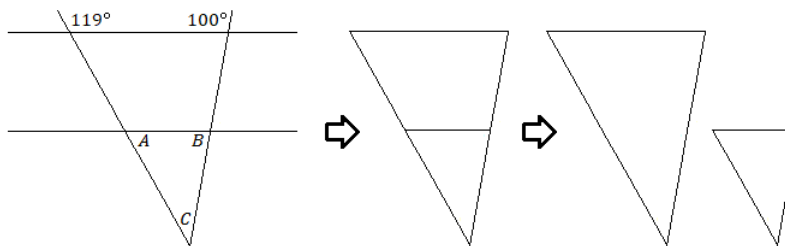
Answer

1. right isosceles triangle
2. obtuse scalene triangle

3. acute equilateral triangle (yes, an equilateral triangle will always be acute)

Similar Triangles

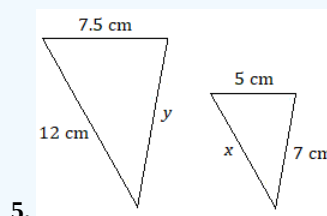
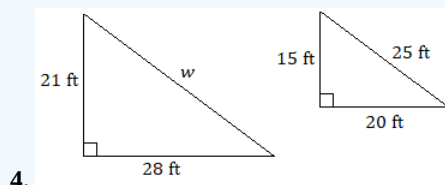
In one of the diagrams in the previous module, the parallel lines included two similar triangles, although they may be hard to see.



Two triangles are similar if the three angles of one triangle have the same measure as the three angles of the second triangle. The lengths of the sides of similar triangles will be in the same proportion. The triangles will have the same shape but the lengths will be scaled up or down.

? Exercises 2.2.12.1

Assume that each pair of triangles are similar. Use a proportion to find each unknown length.



Answer

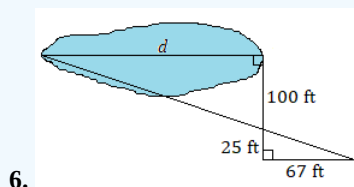
4. $w = 35$ ft

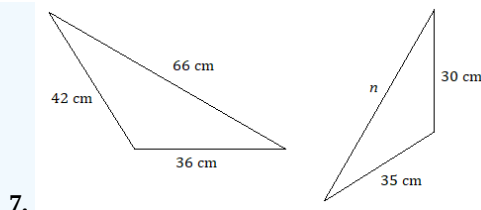
5. $x = 8$ cm; $y = 10.5$ cm

Recognizing corresponding sides can be more difficult when the figures are oriented differently.

? Exercises 2.2.12.1

Assume that each pair of triangles are similar. Use a proportion to find each unknown length.





Answer

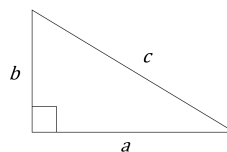
6. $d = 268$ ft

7. $n = 55$ cm

Right Triangles

In a right triangle, the two sides that form the right angle are called the **legs**. The side opposite the right angle, which will always be the longest side, is called the **hypotenuse**.

The Pythagorean theorem says that the sum of the squares of the lengths of the legs is equal to the square of the length of the hypotenuse.



Theorem 2.2.12.1: The Pythagorean Theorem

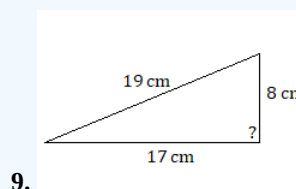
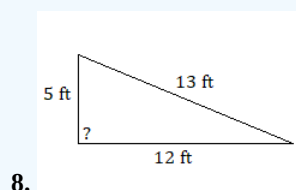
In a right triangle with legs a and b and hypotenuse c ,

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

If you know the lengths of all three sides of a triangle, you can use the Pythagorean theorem to verify whether the triangle is a right triangle or not. The ancient Egyptians used this method for surveying when they needed to redraw boundaries after the yearly flooding of the Nile washed away their previous markings.^[1]

? Exercises 2.2.12.1

Use the Pythagorean theorem to determine whether either of the following triangles is a right triangle.



Answer

8. right triangle, because $5^2 + 12^2 = 13^2$

9. not a right triangle, because $8^2 + 17^2 \neq 19^2$

Before we continue, we need to briefly discuss square roots. Calculating a square root is the opposite of squaring a number. For example, $\sqrt{49} = 7$ because $7^2 = 49$. If the number under the square root symbol is not a perfect square like 49, then the square root will be an irrational decimal that we will round off as necessary.

? Exercises 2.2.12.1

Use a calculator to find the value of each square root. Round to the hundredths place.

10. $\sqrt{50}$

11. $\sqrt{296}$

12. $\sqrt{943}$

Answer

10. 7.07

11. 17.20

12. 30.71

We most often use the Pythagorean theorem to calculate the length of a missing side of a right triangle. Here are three different versions of the Pythagorean theorem arranged to find a missing side, so you don't have to use algebra with $a^2 + b^2 = c^2$.

The Pythagorean Theorem, three other versions

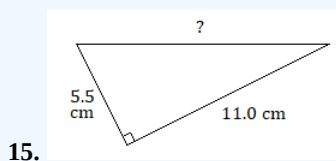
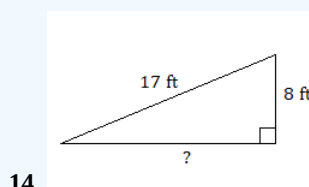
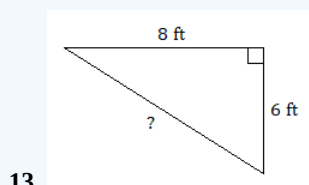
$$c = \sqrt{a^2 + b^2}$$

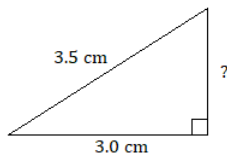
$$b = \sqrt{c^2 - a^2}$$

$$a = \sqrt{c^2 - b^2}$$

? Exercises 2.2.12.1

Find the length of the missing side for each of these right triangles. Round to the nearest tenth, if necessary.





16.

Answer

- 13. 10 ft
- 14. 15 ft
- 15. 12.3 cm
- 16. 1.8 cm

1. The surveyors were called "rope-stretchers" because they used a loop of rope 12 units long with 12 equally-spaced knots. Three rope-stretchers each held a knot, forming a triangle with lengths 3, 4, and 5 units. When the rope was stretched tight, they knew that the angle between the 3-unit and 4-unit sides was a right angle because $3^2 + 4^2 = 5^2$. From *Discovering Geometry: an Inductive Approach* by Michael Serra, Key Curriculum Press, 1997. ↩

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