

Grade 7 · Drawing Geometric Figures and Constructing Triangles · Lesson

Common Core 7.G.A.2 · mathovore.fr

A triangle can be drawn from given measurements only when the conditions allow it. Three side lengths work when the two shorter sides add up to more than the longest side. Two sides with the angle between them, or two angles with a side, give exactly one triangle. Three angles alone give many triangles.

Grade 7 Common Core: 7.G.A.2

Key facts:

- Triangle inequality: the sum of any two side lengths must be greater than the third side length.
- The three angles of a triangle always add up to 180° .
- Three sides, two sides with the angle between them, or two angles with a side give exactly one triangle when a triangle is possible.
- Three angles alone give infinitely many triangles that have the same shape but different sizes.
- Two sides and an angle that is not between them can give no triangle, one triangle, or two triangles.

How do you draw a triangle from given measurements?

To draw a figure with given conditions, use a ruler to measure lengths and a protractor to measure angles. Start with one side, add each angle or side in order, and close the figure.

Worked method: two sides and the angle between them

Draw triangle ABC with $AB = 6 \text{ cm}$, $AC = 4 \text{ cm}$ and $\angle A = 50^\circ$.

1. Use the ruler to draw segment AB, 6 cm long.
2. Place the center of the protractor on A and line up its 0 line with AB. Mark a dot at 50° .
3. Draw a ray from A through the dot. Measure 4 cm along it and label the point C.
4. Join B to C. The side BC measures about 4.6 cm.

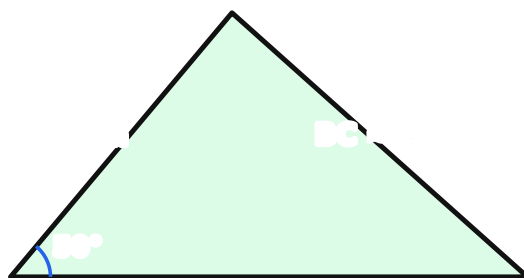


Figure 1. The triangle built in the steps above: 6 cm, 50° , 4 cm.

When can three lengths make a triangle?

Triangle inequality

Three lengths can be the sides of a triangle only if the sum of any two of them is greater than the third. It is enough to check the two shorter sides against the longest side.

Sticks of 3, 4, and 8 cannot form a triangle because $3+4=7$ is less than 8. Sticks of 3, 4, and 6 can, because $3+4=7$ is greater than 6. If the sum equals the longest side, the sticks lie flat on a line and make no triangle.

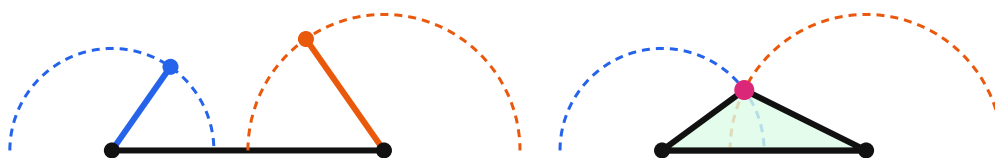


Figure 2. Sides 3, 4, 8 fail the triangle inequality. Sides 3, 4, 6 pass it.

Which conditions give exactly one triangle?

The angle measures of every triangle add up to 180° , so two angles are enough to find the third. Different sets of measurements lead to different counts of triangles.

Given	Triangles possible
Three sides that pass the triangle inequality	Exactly one
Two sides and the angle between them	Exactly one

Given	Triangles possible
Two angles and a side (angle sum less than 180°)	Exactly one
Three angles that add up to 180°	Infinitely many
Two sides and an angle not between them	None, one, or two
Sides that fail the inequality, or angles that do not add up to 180°	None

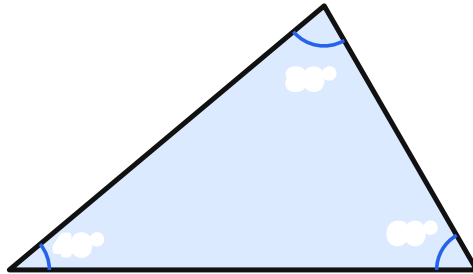


Figure 3. Two angles and the side between them fix one triangle.

With three angles only, the shape is fixed but not the size. The triangles in Figure 4 both have angles of 50° , 60° , and 70° , yet one is larger.

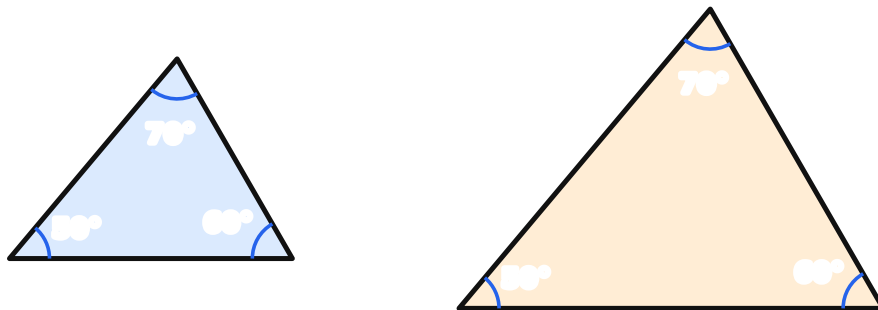


Figure 4. Same three angles, different sizes: the angles alone do not decide the triangle.

With two sides and a non-included angle, the compass arc can cross the other ray twice. In Figure 5, $\angle A = 30^\circ$, $AC = 8 \text{ cm}$, and $BC = 5 \text{ cm}$ fit two different triangles.

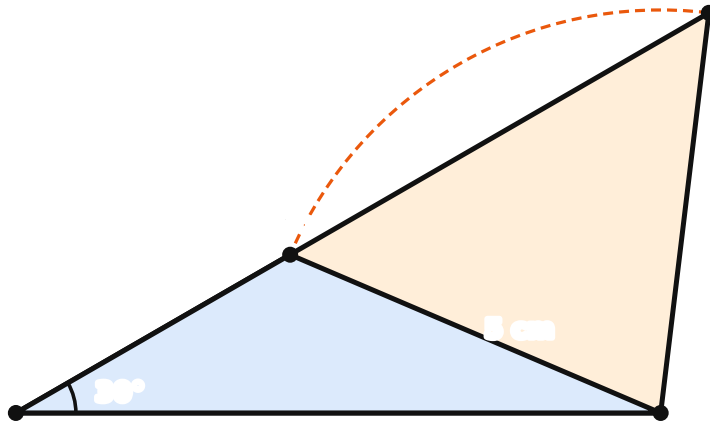


Figure 5. Angle A, side AC, and side BC can fit two triangles: ABC with B at B_1 or at B_2 .

Drawing Geometric Figures and Constructing Triangles: frequently asked questions

What is the triangle inequality?

The triangle inequality says that the sum of the lengths of any two sides of a triangle must be greater than the length of the third side. For lengths 5, 6, and 12, the sum $5+6=11$ is less than 12, so no triangle exists.

Can three angles form a unique triangle?

No. Three angles that add up to 180° fix the shape but not the size, so infinitely many triangles fit. A side length is needed to choose one size.

How many triangles can be made with two sides and a non-included angle?

There can be none, one, or two triangles. The compass arc drawn from the end of the known side may miss the ray, touch it once, or cross it twice. This is why side-side-angle does not guarantee one triangle.

How do you use a protractor to draw an angle?

Put the center mark on the vertex and line up one side of the angle with the 0 line. Read the scale that starts at 0 on that side, mark the angle, and draw a ray from the vertex through the mark.

How do you find the third angle of a triangle?

Add the two known angles and subtract the sum from 180° . For 40° and 60° , the third angle is

$180 - 100 = 80$, so it measures 80° .