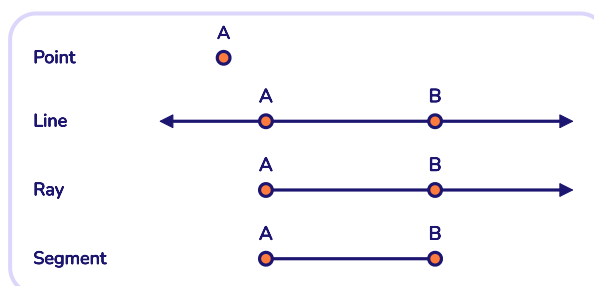


Geometry and Angles: math lesson, Grade 4 – download the PDF

Look around you. The corner of this page, the hands of a clock, a slice of pizza, a fence and the railroad tracks are all full of geometry. In this chapter you will learn the words that describe lines and angles, measure angles with a protractor, and sort triangles and quadrilaterals like a real mathematician.

1. Points, lines, rays and segments

Everything in geometry starts with a **point**: an exact position, drawn as a small dot and named with a capital letter. From points we build three important figures.



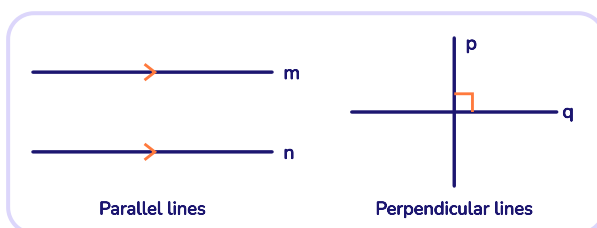
D Definition

A **line** goes on forever in both directions. A **ray** has one endpoint and goes on forever in one direction. A **segment** is the part of a line between two endpoints, so you can measure its length.

We write them with symbols: line $\overleftrightarrow{AB}$, ray $\overrightarrow{AB}$ (the endpoint is always named first) and segment $\overline{AB}$. Notice that $\overrightarrow{AB}$ and $\overrightarrow{BA}$ are different rays, but $\overline{AB}$ and $\overline{BA}$ are the same segment.

2. Parallel and perpendicular lines

Two lines in a flat surface can behave in different ways.



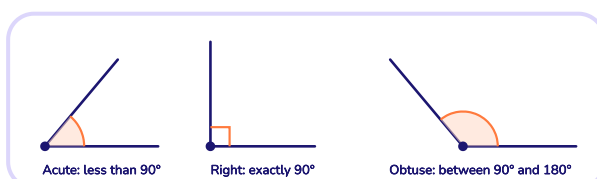
D Definition

Parallel lines never meet, no matter how far you extend them. They stay the same distance apart. **Perpendicular lines** cross and form four right angles (square corners). Lines that cross without making square corners are called **intersecting lines**.

We write $m \parallel n$ for parallel lines and $p \perp q$ for perpendicular lines. Two opposite edges of a ruler are parallel; the edge of a table meeting the edge of its leg is perpendicular.

3. Right, acute and obtuse angles

An **angle** is formed by two rays that share the same endpoint, called the **vertex**. The size of the opening between the rays is measured in **degrees** ($^\circ$). A full turn around a point is 360° , a half turn is 180° and a quarter turn is 90° .



Type of angle	Measure	Everyday example
Acute	less than 90°	a slice of pizza
Right	exactly 90°	corner of a notebook
Obtuse	more than 90° and less than 180°	a laptop screen leaned back
Straight	exactly 180°	a flat, open book

E Example 1

Classify the angles 72° , 90° , 143° and 180° .

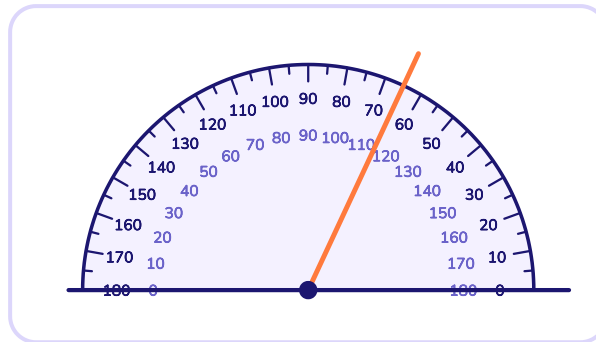
72° is less than 90° , so it is *acute*. 90° is *right*. 143° is between 90° and 180° , so it is *obtuse*. 180° is a *straight* angle.

I 4. Measuring angles with a protractor

M Method: measure an angle

1. Place the center mark of the protractor exactly on the vertex.
2. Line up the base line of the protractor with one ray, so that this ray points to 0.
3. Read the number where the other ray crosses the scale that starts at 0 on that first ray.
4. Check your answer: an acute angle must be less than 90° , an obtuse angle more than 90° .

The protractor below has two scales. The outer scale starts at 0 on the right and the inner scale starts at 0 on the left. Use the scale that begins at 0 on your first ray.



E

Example 2

In the picture, the base ray points to 0 on the outer scale and the orange ray crosses 65. So the angle measures 65° . It is less than 90° , so it is acute, which matches our check.

!

Zyro's tip

On my home planet we do a quick sanity check before reading the number: does the angle look smaller or larger than a square corner? That tells me which of the two numbers on the protractor to choose.

5. Adding angle measures

When an angle is split into smaller angles that do not overlap, the measure of the whole angle is the **sum** of the measures of the parts.

P Property

If angle $\angle ABC$ is split by a ray into two parts, then **whole** = **part 1** + **part 2**.
Therefore a missing part is found by subtraction: **part 2** = **whole** – **part 1**.

E Example 3

A right angle (90°) is split into a 35° angle and an unknown angle. Find the unknown angle.

$$90 - 35 = 55$$

The unknown angle measures 55° . Check: $35 + 55 = 90$.

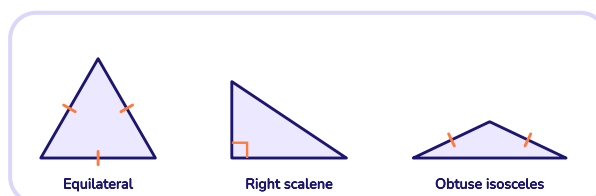
The same idea works for a straight angle: two angles that together make a straight line add up to 180° . For instance, $180 - 128 = 52$.

⚠ Watch out!

Do not mix up the sum for a right angle (90°) with the sum for a straight line (180°).
Check the picture first.

6. Classifying triangles

A **triangle** has three sides and three angles. We can sort triangles in two ways.

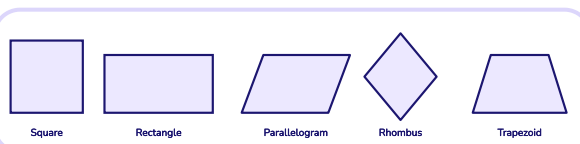


By its sides**Description****Equilateral****all 3 sides have the same length****Isosceles****at least 2 sides have the same length****Scalene****no sides have the same length****By its angles****Description****Acute****all 3 angles are acute****Right****one angle is a right angle****Obtuse****one angle is obtuse****E****Example 4**

A triangle has sides of 6 in, 6 in and 9 in. Two sides are equal and the third is different, so it is *isosceles*. If its biggest angle is 110° , it is also *obtuse*.

7. Classifying quadrilaterals

A **quadrilateral** is a shape with four straight sides. Look at what makes each one special.



Parallelogram

both pairs of opposite sides are parallel

Rectangle

a parallelogram with four right angles

Rhombus

a parallelogram with four equal sides

Square

four equal sides and four right angles

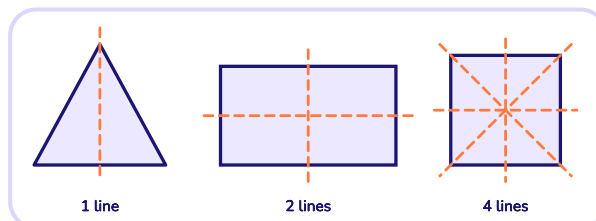
Trapezoid

at least one pair of parallel sides

A square is also a rectangle and also a rhombus, because it has all of their properties. But a rectangle that is not a square is not a rhombus.

8. Lines of symmetry

A **line of symmetry** is a line that splits a shape into two parts that match exactly when you fold along the line. Each part is the mirror image of the other.



E Example 5

How many lines of symmetry does a rectangle that is not a square have?

Folding down the middle from top to bottom works, and folding from left to right works. Folding along a diagonal does not match the corners. So there are exactly 2 lines of symmetry.

Key takeaways

- A line has no endpoints, a ray has one endpoint and a segment has two endpoints.
- Parallel lines never meet; perpendicular lines make right angles.
- Acute is less than 90° , right is 90° , obtuse is between 90° and 180° , straight is 180° .
- Put the protractor's center on the vertex and read the scale that starts at 0 on your first ray.
- The measure of a whole angle is the sum of its parts: **whole** = **part 1** + **part 2**.
- Triangles are sorted by sides (equilateral, isosceles, scalene) and by angles (acute, right, obtuse).
- A square is a rectangle and a rhombus; a trapezoid has at least one pair of parallel sides.
- A line of symmetry folds a shape into two matching halves.



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