

Geometry and the Coordinate Plane: math lesson, Grade 5 – download the PDF

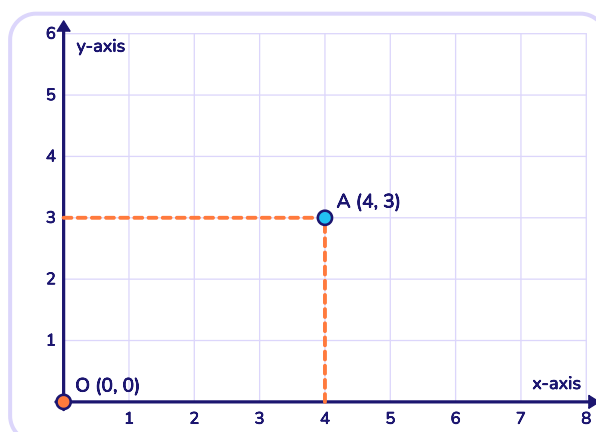
Maps, video games and city streets all use the same idea: a grid that gives every place an address. In this chapter you will learn to find and graph points on the coordinate plane, and you will also sort two-dimensional figures like a real geometer, by looking at their sides, angles and parallel lines.

1. The coordinate plane

The **coordinate plane** is made of two number lines that cross at a right angle. The horizontal number line is the **x-axis**. The vertical number line is the **y-axis**. They meet at the point called the **origin**.

D Definition: origin and ordered pair

The origin is the point $(0, 0)$ where the two axes cross. Every point is named by an **ordered pair** (x, y) . The first number, x , tells how far to move right. The second number, y , tells how far to move up.



Look at the figure. To reach point A you start at the origin, move 4 units right and then 3 units up. So A is at $(4, 3)$. In this chapter we work in the **first quadrant**, the part of the plane where both numbers are 0 or greater.

2. Plotting ordered pairs

M

Method: plot a point

1. Start at the origin $(0, 0)$.
2. Move right along the x-axis by the first number.
3. From there, move up by the second number.
4. Draw a dot and label it with its letter.

E

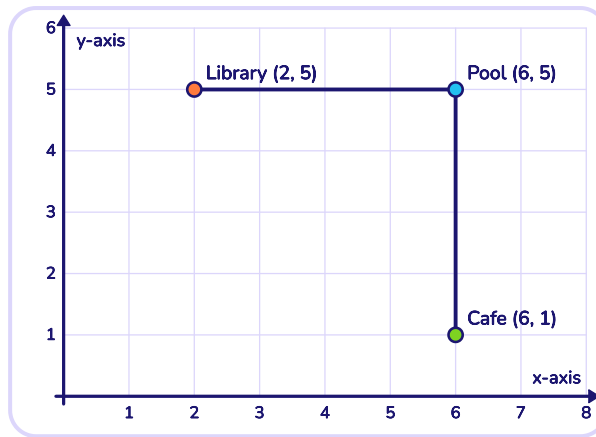
Example 1 Plot $(6, 2)$ and $(2, 6)$. For $(6, 2)$ you go 6 units right and 2 units up. For $(2, 6)$ you go 2 units right and 6 units up. These are two different points, because the order of the numbers matters.

⚠

Watch out Do not swap the numbers. The pair (x, y) always lists the horizontal move first. A point on the x-axis has $y = 0$, like $(5, 0)$. A point on the y-axis has $x = 0$, like $(0, 5)$.

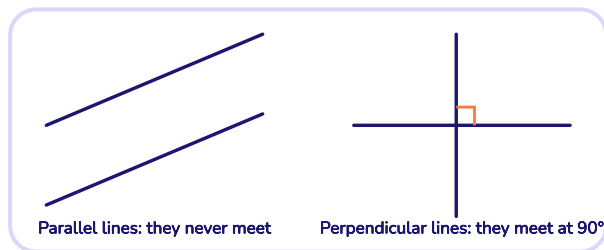
3. Problems on the coordinate plane

A coordinate plane can be a map. Each grid unit stands for a real distance, such as 1 block, 100 meters or half a mile. When two points share the same first number, they sit on a vertical line. When they share the same second number, they sit on a horizontal line. Then the distance is easy: subtract the numbers that are different.



E Example 2: a park map On the map, the library is at $(2, 5)$, the pool at $(6, 5)$ and the cafe at $(6, 1)$. Each unit is 50 yards. From the library to the pool, only the first number changes: $6 - 2 = 4$ units, so the walk is $4 \times 50 = 200$ yards. From the pool to the cafe, only the second number changes: $5 - 1 = 4$ units, which is also 200 yards. The whole trip is $200 + 200 = 400$ yards (about 366 meters).

4. Parallel and perpendicular lines



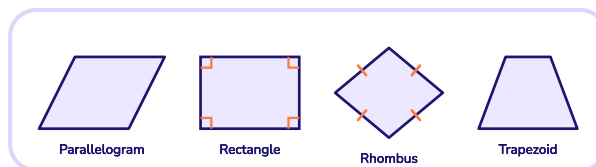
D Definition: parallel and perpendicular

Two lines are **parallel** if they stay the same distance apart and never meet. Two lines are **perpendicular** if they meet and form a **right angle** (a square corner of 90°).

On the coordinate plane, the x-axis and the y-axis are perpendicular. Any two horizontal lines are parallel to each other, and any horizontal line is perpendicular to any vertical line. The sides of a door frame, the rails of a train track and the edges of a notebook page show both ideas.

5. Attributes of quadrilaterals

A **quadrilateral** is a closed figure with 4 straight sides. We sort quadrilaterals by their **attributes**: parallel sides, equal sides and right angles.

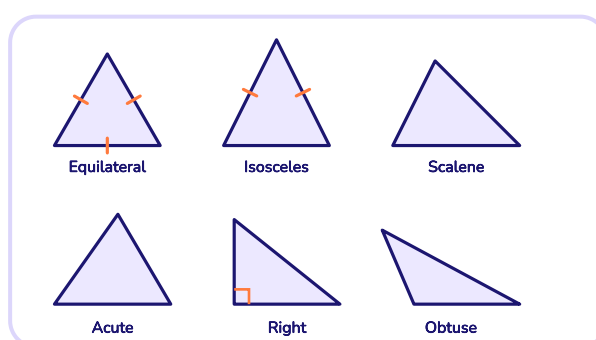


Shape	Parallel sides	Equal sides	Right angles
Trapezoid	at least 1 pair	not required	not required
Parallelogram	2 pairs	opposite sides equal	not required
Rectangle	2 pairs	opposite sides equal	4
Rhombus	2 pairs	all 4 sides equal	not required
Square	2 pairs	all 4 sides equal	4

E **Example 3** A quadrilateral has 4 sides of length 5 in, and its opposite sides are parallel, but its corners are not square. It has 4 equal sides, so it is a rhombus. Its perimeter is $4 \times 5 = 20$ in, which is 50.8 cm.

6. Classifying triangles

A triangle can be named in two ways. By its **sides**: **equilateral** (3 equal sides), **isosceles** (at least 2 equal sides) or **scalene** (no equal sides). By its **angles**: **acute** (3 angles smaller than 90°), **right** (one angle of exactly 90°) or **obtuse** (one angle larger than 90°).

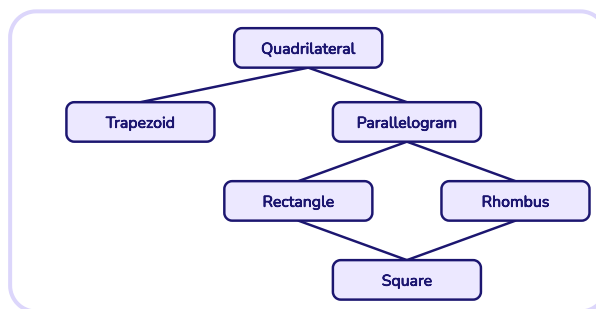


E **Example 4** A triangle has sides of 6 cm, 6 cm and 9 cm and one angle of 104° . Two sides are equal, so it is isosceles. One angle is larger than 90° , so it is also obtuse. We call it an obtuse isosceles triangle.

! **Zyro's tip** On my home planet we say “iso” means “same”. If you see the little tick marks on two sides, the triangle is isosceles. Check the angles separately: the sides and the angles give two different names!

7. The hierarchy of two-dimensional figures

Some shapes belong to a bigger family. A shape in a lower box has **all** the attributes of the boxes above it, plus something extra.



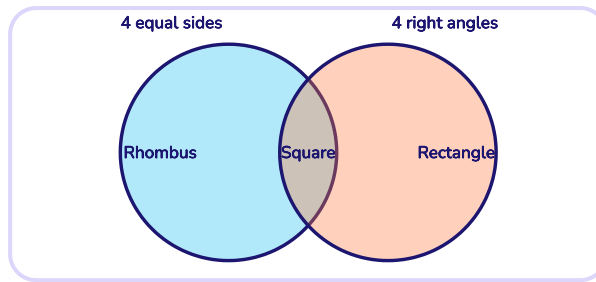
P Property: the family tree

Every square is a rectangle and a rhombus. Every rectangle and every rhombus is a parallelogram. Every parallelogram is a trapezoid and a quadrilateral. The reverse is not true: a rectangle with unequal sides is not a rhombus.

This is why a square can have many names. The most specific name, **square**, tells you the most about it.

8. Venn diagrams for shapes

A **Venn diagram** uses overlapping circles to sort objects. Each circle holds the shapes with one attribute. The overlap holds the shapes that have both attributes.



E Example 5 In the diagram, the left circle is “4 equal sides” and the right circle is “4 right angles”. A rhombus with slanted corners has 4 equal sides only, so it goes in the left part. A rectangle with a long side and a short side goes in the right part. A square has both attributes, so it goes in the overlap.

Key takeaways

- The origin is $(0, 0)$. In an ordered pair (x, y) , move right x units first, then up y units.
- Points that share the same first number are on a vertical line. Points that share the same second number are on a horizontal line.
- Parallel lines never meet. Perpendicular lines meet at 90° .
- A parallelogram has 2 pairs of parallel sides. A rectangle has 4 right angles. A rhombus has 4 equal sides. A square has both.
- Triangles are named by their sides (equilateral, isosceles, scalene) and by their angles (acute, right, obtuse).
- Every square is a rectangle, a rhombus, a parallelogram and a quadrilateral.
- In a Venn diagram, the overlap holds the shapes with both attributes.



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