Lesson - Coordinates and translation

Year: Year 4

Hello, I am Otto! A map, a seating plan and a computer game all need a way to say exactly where something is. Coordinates give every point on a grid its own address. In this chapter you learn to read and write coordinates, to plot points and shapes, and to describe how a shape moves when it is translated.

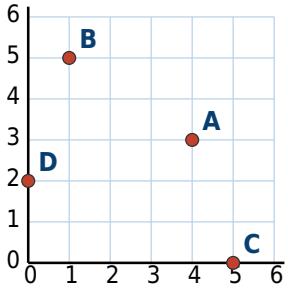
Starter activity

Imagine a treasure map with a grid. The treasure is 4 squares across and 3 squares up from the start. If you tell a friend "go 4 across and 3 up" they can find it without looking at the map. Now write it as a pair of numbers (4, 3). That pair is a coordinate. You have just invented the idea of coordinates!

Coordinates

Definition: coordinates

Coordinates are a pair of numbers that give the position of a point on a grid. They are written in brackets with a comma between them, for example (4, 3). The first number is the **x-coordinate**: how far across (along the horizontal axis). The second number is the **y-coordinate**: how far up (along the vertical axis). The point where the two axes meet is called the **origin**, which has coordinates (0, 0).



On this grid point A is at (4, 3): go 4 across and 3 up. Point B is at (1, 5). Point C is on the horizontal axis at (5, 0) and point D is on the vertical axis at (0, 2).

Watch out: along the corridor, then up the stairs

Always give the x-coordinate first, then the y-coordinate. To remember the order, think "along the corridor and up the stairs". The point (2, 5) is not the same as (5, 2)! Also, read the numbers on the lines of the grid, not the spaces between them.

Method: plotting and reading coordinates

1. Start at the origin (0, 0).

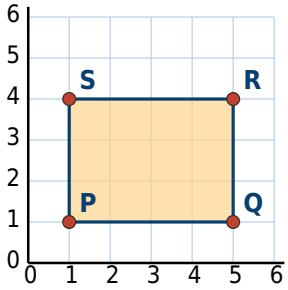
2. Move along the horizontal axis to the x-coordinate (the first number).
3. Then move up parallel to the vertical axis for the y-coordinate (the second number).
4. Mark the point with a cross or a dot and label it. To read a point, do the same in reverse: look down to the horizontal axis for x and across to the vertical axis for y.

Example 1

Write the coordinates of the point that is 5 squares across and 2 squares up from the origin, and of the point that is 3 squares up on the vertical axis.

The first point is **(5, 2)**. The second point is on the vertical axis, so it has not moved across at all: x = 0, and y = 3. Its coordinates are **(0, 3)**.

Shapes on a grid



The four points P (1, 1), Q (5, 1), R (5, 4) and S (1, 4) are the corners of a rectangle. Points that have the same y-coordinate lie on a horizontal line. Points with the same x-coordinate lie on a vertical line.

Key fact: using coordinates to find a missing corner

- In a rectangle, opposite corners share their x-values and y-values: P (1, 1) and R (5, 4) give the other corners (5, 1) and (1, 4).
- The length of a horizontal side is the difference between the x-coordinates: from x = 1 to x = 5 is 4 units.
- The length of a vertical side is the difference between the y-coordinates: from y = 1 to y = 4 is 3 units.

Example 2

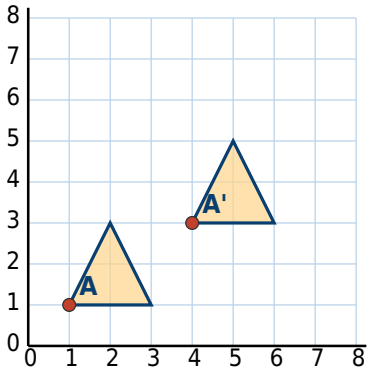
Three corners of a rectangle are (2, 1), (6, 1) and (6, 5). Find the fourth corner and the area.

The fourth corner has the x-coordinate of (2, 1) and the y-coordinate of (6, 5), so it is **(2, 5)**. The width is $6 - 2 = 4$ and the height is $5 - 1 = 4$, so this is a square with area $4 \times 4 =$ **16 square units**.

Translation

Definition: translation

A **translation** is a movement of a shape (or a point) in a straight line without turning it or flipping it. Every point of the shape moves the same distance in the same direction. The size and shape do not change. We describe a translation by saying how many units left or right, and how many units up or down.



The triangle with corners (1, 1), (3, 1) and (2, 3) is translated 3 right and 2 up. Every corner moves 3 right and 2 up: (1, 1) → (4, 3), (3, 1) → (6, 3) and (2, 3) → (5, 5).

Rule: translating a point

To translate a point, add to its x-coordinate for a move to the right (subtract for a move left) and add to its y-coordinate for a move up (subtract for a move down). For example, translate (3, 4) by 2 right and 1 down: $x = 3 + 2 = 5$, $y = 4 - 1 = 3$, so the new point is (5, 3).

Example 3

Translate the point (6, 2) by 4 left and 5 up.

4 left: $x = 6 - 4 = 2$. 5 up: $y = 2 + 5 = 7$. The new point is **(2, 7)**.

Example 4

A shape moves from corner A (2, 3) to A′ (7, 1). Describe the translation.

Compare the x-coordinates: 2 to 7 is 5 to the right. Compare the y-coordinates: 3 to 1 is 2 down. The translation is **5 right and 2 down**. Check: (2 + 5, 3 − 2) = (7, 1).

Method: describing a translation

1. Choose one corner of the shape and the matching corner of the moved shape.
2. Find the change in x: right is positive and left is negative.
3. Find the change in y: up is positive and down is negative.
4. Say the movement in words, first the sideways move and then the up or down

move. Check with a second corner.

Example 5

The square with corners (1, 1), (3, 1), (3, 3) and (1, 3) is translated 2 right and 4 up. Write the new corners.

Add 2 to each x-coordinate and 4 to each y-coordinate: (1, 1) → (3, 5); (3, 1) → (5, 5); (3, 3) → (5, 7); (1, 3) → (3, 7). The new corners are **(3, 5), (5, 5), (5, 7) and (3, 7)**. The square has the same size: its side is still 2.

Did you know?

The idea of coordinates was made famous by a French mathematician and philosopher called René Descartes, about 400 years ago. The story says he thought of it while watching a fly walking on the ceiling of his room and wondering how to describe its position exactly. That is why the x-y grid is also called the Cartesian grid. Computer games use coordinates all the time to place characters on the screen.

Otto's tip

For every question, write the order "x then y" at the top of your page. When you translate a shape, move one corner at a time and write down each new pair of coordinates. Then check the sides: they should have the same lengths as before!