# Lesson - Four-quadrant coordinates and transformations

Year: Year 6

A coordinate grid helps us describe position. In Year 6 the grid has four quadrants, so coordinates can be negative.

**Starter activity**

Zara is playing a treasure hunt game. The treasure is at a secret point, and she is given the instructions "start at the origin, move 4 to the left and 3 up". Where does she end up? How can she describe the position of the treasure so that her friend can find it too? In this chapter you will use coordinates in all four quadrants, and use translations and reflections to move shapes around the grid.

## The coordinate grid

**Definition: axes and quadrants**

The **x-axis** runs left to right and the **y-axis** runs up and down. They cross at the **origin**, (0, 0), and split the grid into four **quadrants**.

**Key fact: signs of coordinates**

Right and up are positive. Left and down are negative. So (−3, 2) is 3 left and 2 up.

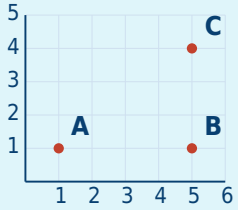
## Reading and writing coordinates

**Rule: coordinates**

Write coordinates as (x, y). Always give the x-coordinate (along) first and the y-coordinate (up or down) second.

**Example 1**

**Points A(1, 1), B(5, 1) and C(5, 4) are three corners of a rectangle. Find the fourth corner.**



The fourth corner is directly above (1, 1) and level with (5, 4). It has x-coordinate 1 and y-coordinate 4. The point is (1, 4).

## Distances on the grid

**Example 2**

**How far is (−3, 2) from (4, 2)?**

Both points are at y = 2, so count along: from −3 to 4 is 3 + 4 = 7 units.

## Translations

**Definition: translation**

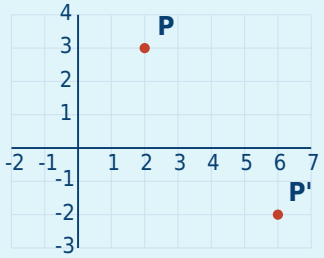
A **translation** moves every point of a shape the same distance in the same direction, without turning or flipping.

**Method: translating a point**

1. Add or subtract from the x-coordinate for a move right or left.
2. Add or subtract from the y-coordinate for a move up or down.
3. Plot the new point.

**Example 3**

**Translate the point (2, 3) by 4 to the right and 5 down.**




x: 2 + 4 = 6. y: 3 − 5 = −2. The image is (6, −2).

**Example 4**

**A triangle has a corner at (−1, −2). Translate it 3 left and 4 up.**

x: −1 − 3 = −4. y: −2 + 4 = 2. The image is (−4, 2).

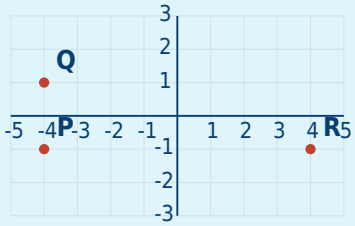
## Reflections in the axes

**Rule: reflecting in the axes**

Reflecting in the x-axis changes the sign of the y-coordinate: (a, b) becomes (a, −b).
Reflecting in the y-axis changes the sign of the x-coordinate: (a, b) becomes (−a, b).

**Example 5**

**Reflect (−4, −1) in the x-axis and then in the y-axis.**




In the x-axis the y-coordinate changes sign, so the image is (−4, 1). In the y-axis instead, the image is (4, −1).

**Watch out**

Do not swap x and y. Count carefully across zero: from −2 to 3 is 5 steps, not 1.

## More about the coordinate grid

**Method: translating a shape**

1. Write down the coordinates of each corner.
2. Add the horizontal move to every x-coordinate (add if right, subtract if left).
3. Add the vertical move to every y-coordinate (add if up, subtract if down).
4. Plot the new points and join them in the same order.

**Example 7**

**Triangle ABC has corners A(−2, 1), B(0, 1) and C(−2, 4). It is translated 3 to the right and 5 down. Write the new corners.**

Add 3 to each x-coordinate and subtract 5 from each y-coordinate. A′ is (−2 + 3, 1 − 5) = (1, −4). B′ is (0 + 3, 1 − 5) = (3, −4). C′ is (−2 + 3, 4 − 5) = (1, −1). So the new corners are **A′(1, −4), B′(3, −4) and C′(1, −1)**.

**Example 8**

**Reflect the point (−5, 3) in the x-axis and in the y-axis.**

For a reflection in the x-axis the y-coordinate changes sign and the x-coordinate stays the same: **(−5, −3)**. For a reflection in the y-axis the x-coordinate changes sign: **(5, 3)**. A point and its image are always the same distance from the mirror line.

## Example 9

**Find the distance from (−3, −2) to (4, −2).**

The y-coordinates are the same, so the points lie on a horizontal line. The distance is the difference between the x-coordinates. From −3 up to 0 is 3 and from 0 to 4 is 4, so the distance is 3 + 4 = **7 units**. You can also subtract: 4 − (−3) = 7.

## Example 10

**Describe the transformation that maps (3, 4) onto (−1, 1).**

The x-coordinate goes from 3 to −1, which is 4 to the left. The y-coordinate goes from 4 to 1, which is 3 down. This is a **translation of 4 left and 3 down**. It is not a reflection, because reflections change signs but do not shift by a fixed amount.

## Watch out: common mistakes

Coordinates are always (x, y), never (y, x). When you count across zero, count both parts: from −2 to 3 is 2 + 3 = 5 steps, not 1. When you translate left or down, you must subtract. Also, a translation and a reflection are different: a reflection flips the shape, but a translation only slides it without turning it.

## The four quadrants

The quadrants are numbered 1, 2, 3 and 4 going anticlockwise from the top right. In quadrant 1 both coordinates are positive. In quadrant 2, x is negative and y is positive. In quadrant 3 both are negative. In quadrant 4, x is positive and y is negative.

## Did you know?

The coordinate grid is named after the French mathematician René Descartes. About 400 years ago he realised that any position on a flat surface can be described by two numbers. The story says that he had the idea while watching a fly walk across the ceiling of his bedroom. His system is now used in maps, computer games and satellite navigation.

## Otto's tip

Along the corridor, then up the stairs! x comes first, y comes second.