Lesson - Reflection and translation

Year: Year 5

Hello, I am Otto! Maps, games and computer screens all use coordinates to say exactly where something is. In this chapter you describe positions with coordinates, slide shapes with a translation and flip them in a mirror line with a reflection. Both keep the size and shape the same, only the position changes.

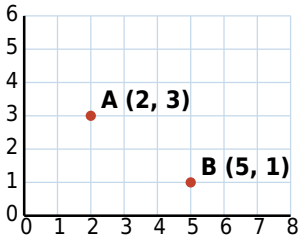
Starter activity

Play a game of battleships on squared paper. To fire a shot you say a pair of numbers, such as (3, 5). Why does the order matter? Is (3, 5) the same square as (5, 3)? Think about walking along a corridor and then going up the stairs: you must go across first and then up. Keep this in mind as you read about coordinates.

Coordinates

Definition: coordinates

Coordinates are a pair of numbers that give a position on a grid. They are written in brackets as (x, y). The first number x tells you how far **across** (along the horizontal axis) and the second number y tells you how far **up** (along the vertical axis). The point (0, 0) is called the **origin**.



Method: plotting and reading coordinates

1. Start at the origin (0, 0).
2. Go along the horizontal axis to the x value.
3. Go up to the y value and mark the point.
4. To read a point, go down to the horizontal axis for x and across to the vertical axis for y.

Watch out

Remember: along the corridor, then up the stairs. The coordinates (2, 3) and (3, 2) are different points. A common mistake is to read the y value first. Also write the numbers on the lines, not in the spaces between the lines.

Example 1

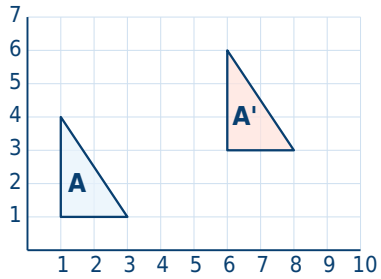
Point A is shown on the grid at (2, 3). Where is the point 3 squares to the right of A?

Moving right changes the x value: 2 + 3 = 5. The y value stays 3. The new point is **(5, 3)**.

Translation

Definition: translation

A **translation** slides every point of a shape the same distance in the same direction. The shape does not turn or flip, and it stays exactly the same size. The original shape is the **object** and the new shape is the **image**.



Rule: describing a translation

Describe a translation by saying how far left or right and how far up or down every point moves, for example "5 squares right and 2 squares up". Moving right adds to x, moving left subtracts from x, moving up adds to y and moving down subtracts from y.

Example 2

Translate B(7, 5) by 3 squares left and 4 squares down.

Left 3: x = 7 − 3 = 4. Down 4: y = 5 − 4 = 1. The image is **(4, 1)**.

Method: translating a shape

1. Write down the coordinates of every corner (vertex) of the shape.
2. Apply the same move to each corner.
3. Plot the new corners and join them in the same order.
4. Check that every side of the image is the same length as the matching side of the object.

Example 3

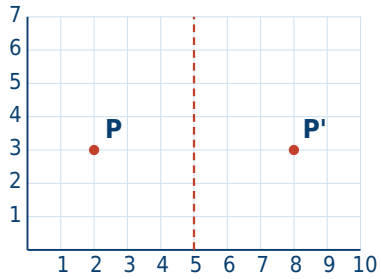
A triangle has corners (1, 1), (3, 1) and (1, 4). Translate it 5 squares right and 2 squares up.

Add 5 to every x and 2 to every y: (1, 1) becomes (6, 3), (3, 1) becomes (8, 3) and (1, 4) becomes (6, 6). The image has corners **(6, 3), (8, 3) and (6, 6)**.

Reflection

Definition: reflection

A **reflection** flips a shape over a **mirror line**. Each point of the image is the same distance from the mirror line as the matching point of the object, but on the other side. A point that lies on the mirror line does not move.



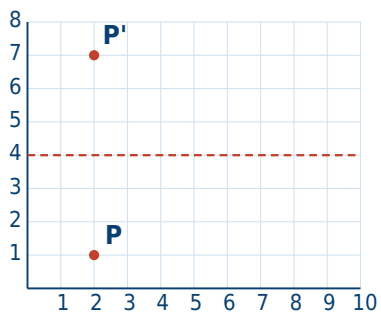
Rule: reflecting in a vertical or horizontal line

To reflect in a **vertical** mirror line x = k, keep y the same and count the distance across to the line: the new x is 2k − x. To reflect in a **horizontal** mirror line y = k, keep x the same and the new y is 2k − y. Counting squares on a grid is the easiest way.

Example 4

Point P is at (2, 3). Reflect it in the line x = 5.

P is 3 squares to the left of the line (5 − 2 = 3). The image is 3 squares to the right of the line: 5 + 3 = 8. So the image is **(8, 3)**, and y stays 3.



Example 5

Point P is at (2, 1). Reflect it in the line y = 4.

P is 3 squares below the line (4 − 1 = 3). The image is 3 squares above the line: 4 + 3 = 7. So the image is **(2, 7)**, and x stays 2.

Key fact: what stays the same

In a translation and in a reflection the shape stays the same size: every length and every angle is unchanged. A translation keeps the shape facing the same way. A reflection turns the shape into its mirror image, so left and right swap.

Did you know?

Computer game designers use translations and reflections all the time. A game character that moves across the screen is being translated, and a reflection in a lake gives the shiny mirror effect. The idea of coordinates was invented by the French mathematician René Descartes about 400 years ago, who is said to have thought of it while watching a fly crawl across the ceiling.

Otto's tip

Always do the same thing to every corner of the shape. After you have plotted the image, check one corner by counting squares from the mirror line or along the translation. If one corner is wrong, the whole shape will look odd!