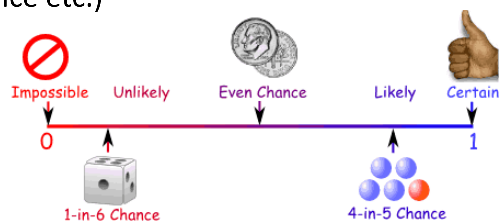
UNIT 8 : Probability | Year 7 Higher | Mathematics Department

## Probability

Probability is the likelihood / chance of something happening.
It is expressed as a number **between 0** (impossible) **and 1** (certain).
Can be **expressed as a fraction, decimal, percentage or in words** (likely, unlikely, even chance etc.)




**P(Red Queen)** refers to the **probability of picking a Red Queen** from a pack of cards.

**Outcomes** – a list of all the possibilities.
**Events** – a combination of one or more outcomes i.e P(even number on a dice) or P(Q,K or A card).
**Trial** – the result of an experiment (which is often repeated a number of times to calculate an experimental probability.
**Sample** – A sample is a small selection of items from a population.
**Biased** – where the sample or outcome is distorted or unfair and the outcomes are not equally likely.
**Fair** – unbiased and all the outcomes are equally likely.

## Theoretical Probability

Theoretical probability is a probability that is calculated on the properties of the problem (i.e 52 cards in a pack or 6 faces on a fair dice).

$$\frac{\textit{Number of Favourable Outcomes}}{\textit{Total Number of Possible Outcomes}}$$

Example:
Probability of rolling a 4 on a fair 6-sided die = $\frac{1}{6}$

## Experimental Probability

Experimental probability is a probability calculated from an experiment which has been repeated a number of times and the outcomes recorded.
You calculate it by working out the **relative frequency =**

$$\frac{\textit{Number of Successful Trials}}{\textit{Total Number of Trials}}$$

Example:
A coin is flipped 50 times and lands on Tails 29 times.
The relative frequency of getting Tails = $\frac{29}{50}$

## Expected Outcomes

An expected outcome is the number of times you expect to achieve a particular event when an experiment is repeated a number of times.

To find the number of expected outcomes, **multiply** the **probability** by the **number of trials**.

Example:
The probability that a football team wins is 0.2
How many games would you expect them to win out of 40? $0.2 \times 40 = 8\ games$

## Sample Space

Is a diagram or table listing all of the possible outcomes.
It gives you a set of all possible outcomes of an experiment.

Example:
Draw a sample space for all the possible outcomes of when the score of two dice are added together.

| + | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| 6 | 7 | 8 | 9 | 10 | 11 | 12 |

## Key Words

Probability; Theoretical; Experimental; Expected; Outcomes; Numerator; Denominator; Events; Biased; Fair; Trial; Event

## Linked Topics

Statistics; Averages; Data; Tree diagrams; Venn diagrams; Equivalent fractions; Multiplication; Addition and Subtraction; Calculate fractions of quantities.

## Types of Data

- Qualitative: Data which is descriptive, uses words not numbers.
  **Example**: Green, blue, orange.
- Quantitative: Measures quantities using numbers.
  **Example**: Shoe sizes, Heights.

This can also be distinguished by 2 further types:

- Continuous: Data that can take any numerical value in a range.
  **Example**: Time, Weight, Distance, Money
- Discrete: Data which can only take specific values.
  **Example**: Rolling a dice, flipping a coin.

- **Secondary Data**: Data collected by someone else.
- **Primary Data**: Data collected by yourself

**Population**:
The whole group you are collecting data from.
**Census**:
Data that is collected for the whole population.

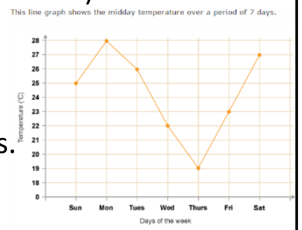
**Bias:**
When collecting data we need to ensure our sample is not biased. A biased sample is a sample that does not properly reflect the whole population. To spot bias you need to think about: where, when and how the sample is taken.

## Averages

**Median**: The middle value when values are in numerical order: 1, 2, 2, 3, **3**, 3, 5, 7, 9
If there are an even number of pieces of data, then the median will be the **MIDPOINT** of the two middle pieces of data:
2, 3, **5, 7**, 9, 10 → Midpoint of 5 and 7 = **6**
**Mode**: Most common (frequent) piece* of data:
*You can have more than 1 mode – bimodal
1, 2, 2, **3, 3, 3**, 5, 7, 9
**Mean**: Is mean to calculate:
Sum of data ÷ Total pieces of data = Mean
(5+3+9+1+3+2+7+2+3) ÷ 9 = **3.9** (to 1dp)
**Range**: Difference between the biggest and smallest: 9 – 1 = **8**

## Line Graphs (Discrete)

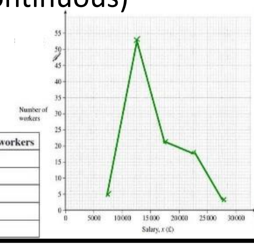
A line graph is often used to show a trend. It is plotted as a series of points, which are then joined with straight lines. The ends of the line graph do not have to join to the axes.




## Frequency Polygons (Continuous)

Frequency polygons are similar to line graphs however are used when the data is grouped. We plot the MIDPOINT of each group.

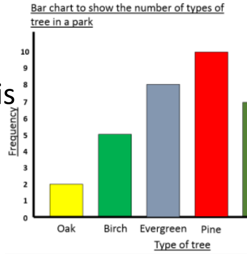
| Salary, $x$ (£) | Number of workers |
|---|---|
| $5000 < x \leqslant 10000$ | 5 |
| $10000 < x \leqslant 15000$ | 53 |
| $15000 < x \leqslant 20000$ | 21 |
| $20000 < x \leqslant 25000$ | 18 |
| $25000 < x \leqslant 30000$ | 3 |




## Bar Charts (Qualitative)

All bar charts must have:

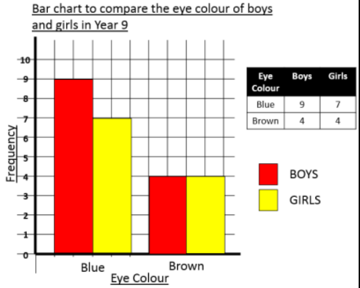
- Title
- Frequency on the y-axis
- Equal bar widths
- Equal gaps between categories
- Labelled axis




| Tree | Frequency |
|---|---|
| Oak | 2 |
| Birch | 5 |
| Evergreen | 8 |
| Pine | 10 |
| Cedar | 7 |

## Comparative Bar Chart

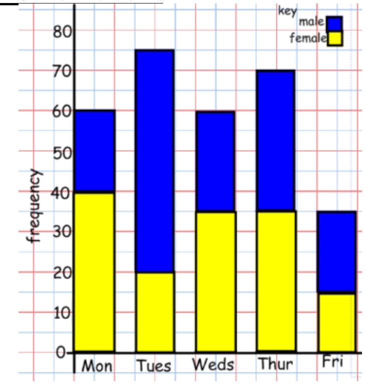
A comparative bar chart shows two sets of data alongside each other. It allows us to easily compare two data sets




| Eye Colour | Boys | Girls |
|---|---|---|
| Blue | 9 | 7 |
| Brown | 4 | 4 |

## Composite Bar Chart

Composite bar charts split each bar into a subcategory, in this case gender. It is still easy to read the full total but also compare each gender.




## Key Words

Averages; Data; Quantitative; Discrete; Continuous; Qualitative; Mode; Mean; Median; Range; Bias; Census; Population; Axis; Chart

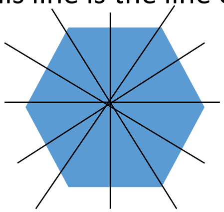
## Linked Topics

Frequency tables; Pie charts; Scatter graphs; Presenting data; Analysing Data; Interpreting data; Cumulative frequency; Frequency polygons; Box plots; Histograms

**UNIT 10 : Transformations** | **Year 7 Higher** | **Mathematics Department**

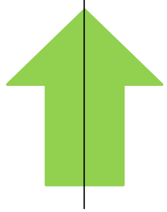
## Line Symmetry

A shape has line symmetry if a line can be drawn through the shape and the image each side of this line is exactly the same.
This line is the line of symmetry or mirror line.



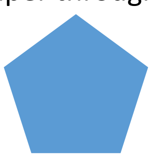
**Lines of symmetry = 6**

**Lines of symmetry = 1**



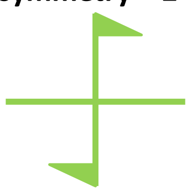
## Rotational Symmetry

A shape has rotational symmetry if it can be rotated (or turned) around a point to look exactly the same in a new position.
The order of rotational symmetry is the number of new positions in which the shape will look exactly the same.
One way to find the order of rotational symmetry of a shape is to draw the shape on tracing paper and count the number of positions in which the shape is exactly the same as you turn the tracing paper through one complete turn (360°).



**Order of rotational symmetry = 5**

**Order of rotational symmetry = 2**

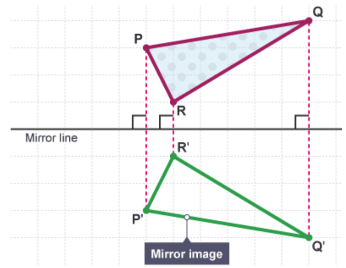


## Similarity and Congruence

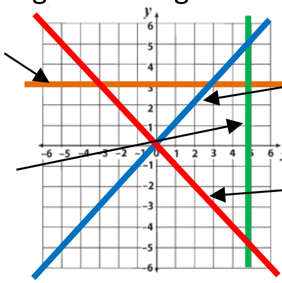
**Similarity** – two shapes are similar if they have the same angles but different size side lengths.
**Congruence** – two shapes are congruent if they have exactly the same size angles and side lengths
**Object** – is that starting shape before the transformation.
**Image** – is the shape created by the transformation.

## Reflection

Every point in the image is the same distance from the mirror line as the original shape.
The line joining a point on the original shape to the same point on the image is perpendicular to the mirror line.




A reflection creates a congruent image.



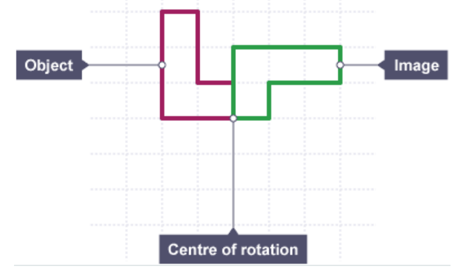

The line **y = 3** crosses the y-axis at 3 and every y coordinate along the line is 3 i.e.(0,3) (1,3)
The line **y = x** has the same x and y coordinates at every point along the line i.e. (0,0) (1,1)

## Rotation

Rotation turns a shape around a fixed point called the centre of rotation.
3 parts of a rotation:

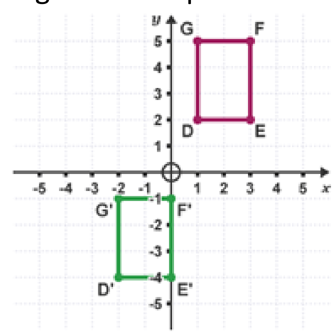
- the centre of rotation
- the angle of rotation
- the direction of rotation

A Rotation creates a congruent image:




## Translation

A translation moves a shape up, down or from side to side and creates a congruent image.
Column vectors are used to describe translations:
$\begin{pmatrix} 4 \\ -3 \end{pmatrix}$ means translate the shape 4 squares to the right and 3 squares down.




$\begin{pmatrix} -2 \\ 1 \end{pmatrix}$ means translate the shape 2 squares to the left and 1 square up.

$\begin{pmatrix} -3 \\ -6 \end{pmatrix}$

## Key Words

Symmetry; Line; Rotational; Order; Object; Image; Congruent; Similar; Perpendicular; Reflection; Mirror; Rotation

## Linked Topics

Transformations; Graph transformations; Shapes; Transformation of functions; Similar shapes; Scales; Angles; Straight line graphs