Probability

We often make judgements as to whether an event will take place, and use words to describe how probable that event is. For example, we might say that it is likely to rain tomorrow, or that it is impossible to find somebody who is more than 3 m tall.

Commonly used words to describe the chance of an event happening include:

certain

very likely

likely

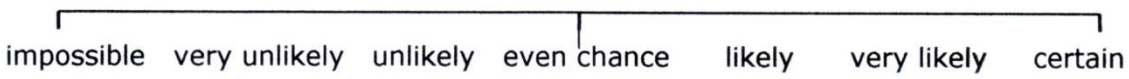
evens (even chance)

unlikely

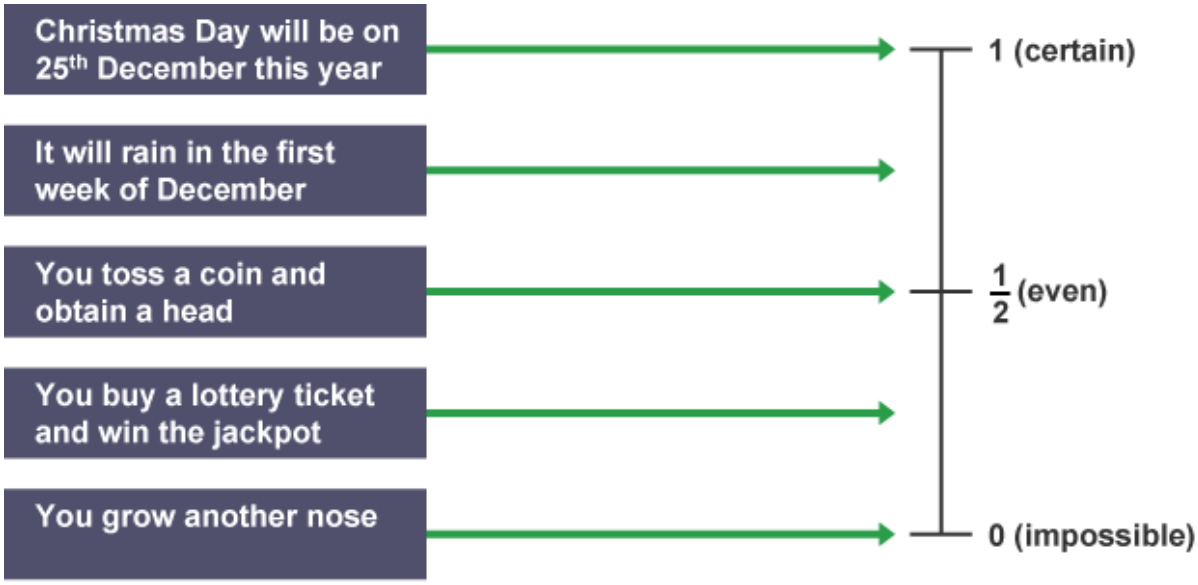
very unlikely

impossible

The Probability Scale



Maths uses numbers to describe probabilities. Probabilities can be written as fractions, decimals or percentages. You can also use a probability scale, starting at 0 (impossible) and ending at 1 (certain).



Finding probabilities

When you throw a die (plural: dice), there are six possible different outcomes. It can show either 1, 2, 3, 4, 5 or 6.

But how many possible ways are there of obtaining an even number? There are three possibilities: 2, 4 and 6.

The probability of obtaining an even number is $^{3}/_{6}$ = ½

If every possible outcome has the same chance of occuring, the probability of an outcome equals the number of ways the outcome can happen divided by the total number of possible outcomes.

Example How many outcomes are there for the following experiments? List all the possible outcomes.

a) Tossing a coin
   There are two possible outcomes (head and tail).

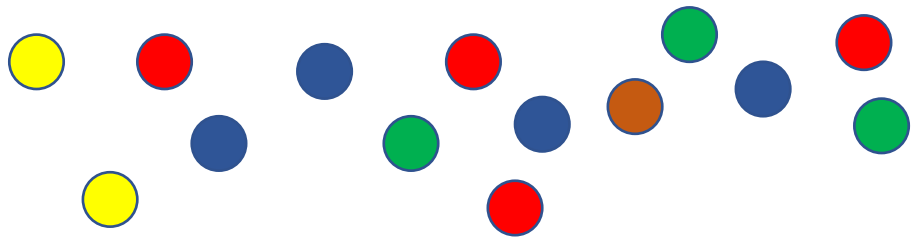
b) Choosing a sweet from a bag containing 1 red, 1 blue, 1 white and 1 black sweet.
   There are four possible outcomes (red, blue, white and black).

c) Choosing a day of the week at random.
There are seven possible outcomes (Sunday, Monday, Tuesday, Wednesday, Thursday, Friday and Saturday).

It is important to note that when working out probability, you cannot have an answer larger than 1.

If something is impossible, the probability is 0; if something is certain, the probability is 1. For any other thing, the probability is somewhere in between (a fraction less than 1).

Example Mark has a bag with coloured balls.



He has 2 yellow balls, 4 red balls, 4 blue balls, 3 green balls and one brown ball.

So, in all he has 14 balls.

What is the probability that he picks:

a) A blue ball
There are 4 blue balls. So the probability of picking a blue ball is $^{4}/_{14}$ which can be simplified to $^{2}/_{7}$

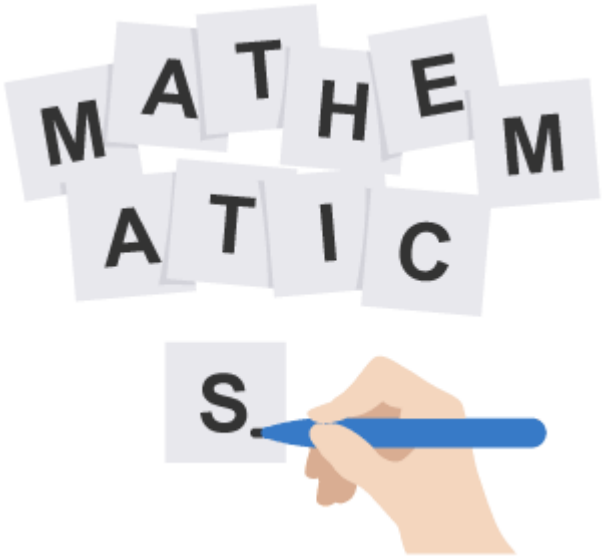
b) A yellow ball
There are 2 yellow balls. So the probability of picking a yellow ball is $^{2}/_{14}$ which can be simplified to $^{1}/_{7}$

c) A green ball
There are 3 green balls. So the probability of picking a green ball is $^{3}/_{14}$

d) A brown ball
There is 1 brown balls. So the probability of picking a brown ball is $^{1}/_{14}$

e) A pink ball
There are no pink balls. So the probability of picking a pink ball is 0

Example Sandra writes the letters of the word 'MATHEMATICS' on separate cards and places them in a bag. She then draws a card at random.



What is the probability that Sandra chooses the letter 'A'?

There are 11 letters in MATHEMATICS, 2 of which are A. So, the probability that Sindhu chooses the letter A is $^{2}/_{11}$.

Finding probability by experiment

What is wrong with the following statement? The probability of obtaining a 6 when I throw a die is $^{1}/_{6}$, so if I throw the die 6 times, I should expect to get exactly one 6.

In theory this statement is true, but in practice it might not be the case. Try throwing a die 6 times - you will not always get exactly one 6.

Example Kate and Josh each throw a die 30 times.

a) How many times would you expect Kate to obtain a 6?

In theory, Kate should obtain a 6 on $^1/_6$ of her throws. Therefore, in theory, you should expect Kate to throw a 6 on 5 of her 30 throws.

b) How many times would you expect Josh to obtain a 6?

Josh should also obtain a 6 on 5 of his 30 throws.

c) What is the total number of sixes you would expect Kate and Josh to obtain between them?

In total, Kate and Josh have thrown the die 60 times. You would expect them to obtain a 6 on 10 of those throws. It is very unlikely that either Kate or Josh would have obtained exactly five 6s, or that together they would have thrown ten 6s. However, it is more likely that their combined results were closer to the expected outcome (ten 6s) than their individual results.

If an experiment is repeated, the results are not necessarily the same each time. However, as it is more likely that the combined results will be closer to the expected outcome, we can see that if you do a large number of trials you will get a more accurate result.