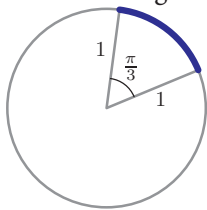
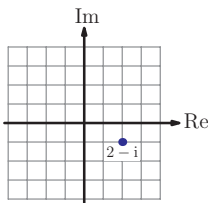
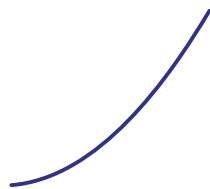


Glossary

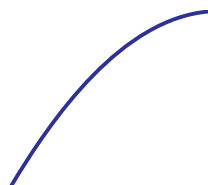
	Definition	Example
acceleration	The rate of change of velocity with respect to time.	An object falling under the influence of gravity has a constant acceleration.
addition principle	A rule for counting the number of ways in which event A or event B can occur if A and B are mutually exclusive events.	By the addition principle, the number of ways of getting an even number on the first die or a multiple of three on the second die is $3 + 2$.
amplitude	The distance from the centre of an oscillation to an extreme point; often found by calculating half of the distance between the maximum and minimum values.	$y = 4 \sin 3x$ has amplitude 4.
angle of depression	The angle below the horizontal.	A ship is observed at an angle of depression of 48° from a cliff top.
angle of elevation	The angle above the horizontal.	The top of a tower forms an angle of elevation of 16° from a point 30 m away.
anomaly	An observation which is invalid due to a systematic error.	The life expectancy in Jamaica is an anomaly as it comes from data collected ten years after other countries.
arc	Part of the circumference of a circle between two points. For each pair of points on the circle there are two arcs: the larger is called the major arc; the smaller is called the minor arc.	The minor arc in the diagram has length $\frac{\pi}{3}$. 
arcsin, arccos, arctan	The inverse functions of sine, cosine and tangent.	$\arcsin\left(\frac{1}{2}\right) = \frac{\pi}{6}$
Argand diagram or Argand plane.	A way of representing complex numbers where the real part is plotted horizontally and the imaginary part plotted vertically.	The complex number $2 - i$ is represented as follows on an Argand diagram: 
argument	<ol style="list-style-type: none"> 1. An expression which is transformed by a function. 2. The angle that a complex number makes with the positive real axis, measured anticlockwise. 	<ol style="list-style-type: none"> 1. The argument of $\sin(3x + 1)$ is $3x + 1$. 2. The argument of $1 + i$ is $\frac{\pi}{4}$.
arithmetic sequence or arithmetic progression	A sequence in which the difference between consecutive terms is constant.	$3, 7, 11, 15, \dots$ is an arithmetic sequence.

	Definition	Example
asymptote	A line which a curve approaches.	The graph $y = \frac{1}{x-2}$ has an asymptote $x = 2$.
background level	The value that a function will approach after a sufficiently long time that the effect of any intervention has become negligible.	A model predicts that the temperature will drop to a background level of 25 °C.
base	The number which is being multiplied with itself a certain number of times.	The base in $(xy)^5$ is xy .
base vectors	A set of vectors which can be used to describe other vectors.	In three dimensions we conventionally use the base vectors i, j and k .
Bayes' theorem	A rule for changing the order of conditional probabilities.	Bayes' theorem shows that, in general, $P(A B)$ is not the same as $P(B A)$.
bimodal	A probability distribution or data set which has two modes.	The data set 1, 1, 1, 3, 4, 4, 4 is bimodal.
binomial	Containing two terms.	$a + x$ is a binomial expression.
binomial coefficient	A coefficient in the expansion of $(1+x)^n$, usually denoted by $\binom{n}{r}$.	10 is a binomial coefficient in the expansion of $(1+x)^5$.
binomial distribution	A common distribution modelling the number of 'successes' occurring in a situation with a fixed number of independent trials and a constant probability of success.	The number of heads obtained when ten fair coins are tossed follows the binomial distribution $B(10, 0.5)$.
binomial theorem or binomial expansion	A formula for expanding $(a+b)^n$ into $n+1$ terms.	The first three terms in the binomial expansion of $(2x-3y)^5$ are $32x^5 - 240x^4y + 720x^3y^2$.
Cartesian equation	An equation directly linking x and y and possibly z .	$x + 2y + z = 8$ is the Cartesian equation of a plane.
Cartesian form	Expressing a complex number as a real number plus an imaginary number: $a + ib$.	$\frac{i\pi}{e^4}$ can be written in Cartesian form as $\frac{1}{\sqrt{2}} + \frac{1}{\sqrt{2}}i$.
chain rule	A rule for differentiating composite functions: $\frac{dy}{dx} = \frac{dy}{du} \times \frac{du}{dx}$	The derivative of $\sin x^2$ with respect to x can be found using the chain rule with a substitution $u = x^2$ to get $2x \cos x^2$.
change-of-base rule	A rule for converting logarithms to different bases.	$\log x$ can be converted into $\frac{\ln x}{\ln 10}$ using the change-of-base rule.
chord	A line connecting two points on a curve.	A chord connecting two points is always shorter than the minor arc between those two points.
coefficient	A number multiplying an algebraic expression.	The coefficient of x^2 in $5x^2 + 3$ is 5.
column vector	A vector described by its components written vertically.	$2i + 3j$ can be written as the column vector $\begin{pmatrix} 2 \\ 3 \end{pmatrix}$.

	Definition	Example
combination	A way of choosing a set of objects where the order does not matter.	There are 56 ways of choosing three people from a group of eight.
complement	All relevant events other than the event in question.	The complement of rolling a 6 on a die is rolling a 1, 2, 3, 4 or 5.
completed square form	A quadratic expression written in the form $a(x-r)^2 + s$.	The completed square form is convenient for finding the vertex, which has coordinates (r, s) .
complex conjugate	An operation which changes the sign of the imaginary part of a complex number; the complex conjugate of z is usually denoted by z^* .	The complex conjugate of $z = 2 - 4i$ is $z^* = 2 + 4i$.
complex number	A number which can be expressed as the sum of a real number and an imaginary number (Cartesian form).	$1 + 3i$ is a complex number.
complex roots	Solutions to an equation which can include complex numbers.	The equation $x^3 + 1 = 0$ has two complex roots.
component	The amount of displacement of a vector in the direction of a base vector.	The component of $\begin{pmatrix} 3 \\ 4 \\ -1 \end{pmatrix}$ in the k direction is -1 .
composite function	A function applied to another function.	$f(x) = \sin(x^2)$ is a composite function.
compound interest	Increasing an amount by a given ratio over a specific period of time, usually in a financial context.	If \$1000 was invested in a bank account at a rate of 5% interest compounded annually, the account balance will be \$1152.5 after two years.
compound-angle formula	An identity which expresses a trigonometric function involving a sum or difference of two angles in terms of trigonometric functions of those angles.	$\cos(A - B) = \cos A \cos B + \sin A \sin B$ is a compound-angle formula.
concave down/concave up (concavity)	A description of whether a graph is bending upwards or downwards, i.e. whether the gradient is increasing or decreasing. For example, a concave-up graph might look like	The graph $y = x^3$ is concave down when $x < 0$ and concave up when $x > 0$.



and a concave-down graph might look like





	Definition	Example
conditional probability	The probability of an event occurring given that another event has occurred.	The conditional probability $P(\text{getting an ace on the second card} \mid \text{first card was an ace})$ is $\frac{3}{51}$.
conjugate pair	Two complex numbers which are conjugates of each other.	$i + 2$ and $-i + 2$ form a conjugate pair.
constant of integration	A constant which reflects the fact that many different functions differentiate to give a particular function.	If you say that the integral of $\cos x$ is $\sin x$, then you are forgetting the constant of integration.
continuous	May take any value in a given interval.	Weight is a continuous variable.
continuous random variable (crv)	A random variable which can take any value in a given interval.	The weight of a hamster is a continuous random variable.
convergent sequence	A sequence which gets closer and closer to a particular number.	The sequence $\frac{1}{2}, -\frac{1}{3}, \frac{1}{4}, -\frac{1}{5}$ is convergent; it converges to zero.
cosecant	The reciprocal of the sine function.	$\csc \frac{\pi}{3} = \frac{2}{\sqrt{3}}$.
cosine	A fundamental trigonometric function, often abbreviated to 'cos'; can be defined as the x -coordinate of a point on the unit circle.	$\cos \frac{\pi}{6} = \frac{\sqrt{3}}{2}$.
cosine rule	A rule linking side lengths and angles in any triangle: $c^2 = a^2 + b^2 - 2ab \cos C.$	The cosine rule can be used to find the angles in a triangle when all of the side lengths are known.
cotangent	The reciprocal of the tangent function.	$\cot \frac{\pi}{6} = \sqrt{3}$.
cumulative probability	The probability of a random variable being less than or equal to a particular value.	If X is a binomially or Poisson-distributed random variable, the cumulative probability $P(X \leq 2)$ equals $P(X = 0) + P(X = 1) + P(X = 2)$.
De Moivre's theorem	A rule stating that when a complex number is raised to a power, the modulus gets raised to that power while the argument is multiplied by the power.	By De Moivre's theorem, $\left(3 \operatorname{cis} \frac{\pi}{10} \right)^2 = 9 \operatorname{cis} \frac{\pi}{5}.$
deductive rule	A rule for generating terms of a sequence based on each term's position in the sequence.	$u_n = n^3 - 1$ is a deductive rule.
definite integration	Integration with limits; the result is a definite value.	$\int_0^1 e^x dx = e - 1.$
degree	1. A unit for measuring angles: 1 degree or 1° is $\frac{1}{360}$ of a full rotation. 2. Another name for the order of a polynomial.	1. A right angle is 90° . 2. The polynomial $x^5 - 3x$ has degree 5.

	Definition	Example								
derivative	A function which gives the gradient of (the graph of) another function at every point of its domain.	The derivative of $3x^2 + 2$ is $6x$.								
difference	The result of subtracting two numbers.	21 and 7 have a difference of 14.								
differentiation	The process of finding the derivative of a function.	If we differentiate $\sin 2x$, we get $2 \cos 2x$.								
differentiation from first principles	Finding the derivative of a function by considering the limit of gradients of smaller and smaller chords.	The general formula for differentiation from first principles is $\lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$.								
discrete	Restricted to fixed values in a given domain.	Shoe size is a discrete variable.								
discriminant	An expression ($b^2 - 4ac$) which determines the number of solutions to a quadratic equation.	Since the discriminant of $x^2 + x + 12 = 0$ is negative, the equation has no solutions.								
displacement	A vector quantity representing the distance and direction from one point to another.	A ship has a displacement of $\begin{pmatrix} 3 \\ 6 \end{pmatrix}$ km relative to the lighthouse.								
divergent sequence	A sequence which does not get closer and closer to a particular number.	The sequence 1, 4, 9, 16, 25, . . . is divergent.								
domain	The set of all allowed input values of a function.	The domain of $f(x) = \sqrt{x+2}$ is $x \geq -2$.								
double angle formula	An identity which expresses a trigonometric function involving 2θ in terms of trigonometric functions involving θ .	$\sin 2x = 2 \sin x \cos x$ is a double-angle formula.								
equation	Two expressions which are equal for some values of the variable. Not to be confused with an identity.	$x^2 = 9$ is an equation.								
Euler Form	Writing a complex number in the form $re^{c\theta}$	$1 + i$ is $\sqrt{2}e^{i\frac{\pi}{4}}$ in Euler form.								
exclusion principle	Counting the number of outcomes that satisfy a given condition by first counting everything which does not satisfy the condition and then subtracting this from the total number of outcomes.	If out of 712 possible committees 16 involve both John and Sandra, by the exclusion principle 696 do not involve both John and Sandra.								
expectation	The expected mean of a probability distribution.	The following probability distribution has expectation $E(X) = 1.25$. <table border="1"><tr><td>X</td><td>0</td><td>1</td><td>2</td></tr><tr><td>P</td><td>0.25</td><td>0.25</td><td>0.5</td></tr></table>	X	0	1	2	P	0.25	0.25	0.5
X	0	1	2							
P	0.25	0.25	0.5							
exponent form	A number or expression written in the form of a base raised to an exponent.	The exponent form of 32 is 2^5 .								
exponent or power	The number of times the base is multiplied together.	The exponent of x in x^7 is 7.								

	Definition	Example
exponential decay	Something that can be modelled by a negative exponential function.	The mass of a radioactive isotope exhibits exponential decay.
exponential growth	Something that can be modelled by a positive exponential function.	A population of bacteria grows exponentially.
expression	An allowed combination of numbers, variables and mathematical operations, containing no equals or inequality signs.	$\sin(\sqrt{x+3})$ is an expression.
factor theorem	If $f(a) = 0$, then $(x - a)$ is a factor of the polynomial $f(x)$.	If $g(3) = 0$, by the factor theorem $(x - 3)$ is a factor of $g(x)$.
factorised form	An expression written as a product of (usually) linear factors.	The factorised form allows us to easily find the zeros of an expression.
foot of the perpendicular	The point where a perpendicular line meets a line or a plane.	The foot of the perpendicular from the origin to the plane $x + y + z = 3$ is the point $(1, 1, 1)$.
function	A relation in which each allowable input has only one output; a rule that associates with each input exactly one output value.	$f: x \mapsto \sqrt{x+2}$ is a function.
geometric sequence or geometric progression	A sequence in which the ratio between consecutive terms is constant.	$3, 6, 12, 24, \dots$ is a geometric progression.
gradient	The steepness of a line, measured as how far up it goes for a shift of each unit to the right.	The gradient of the line $y = 3x + 2$ is 3.
growth factor	The factor that a function increases by (above the background level) when the independent variable increases by 1 unit.	The function $R = 12 \times 1.05^{2t}$ has a growth factor of 1.1025.
horizontal asymptote	A horizontal line of the form $y = a$ which a curve approaches.	$y = \frac{10x}{2x-3}$ has a horizontal asymptote $y = 5$.
horizontal line test	A way of deciding from the graph whether a function is one-to-one.	The graph $y = x^2$ does not pass the horizontal line test, so the function $f(x) = x^2$ is not one-to-one.
identity	Two expressions which are equal for every possible value of the variable, often confused with an equation.	$x^2 = x \times x$ is an identity.
imaginary number	The result of square-rooting a negative number; usually written in terms of the square root of -1 , which is denoted by i .	$3i$ is an imaginary number.
imaginary part	The coefficient of i when a complex number is written in Cartesian form.	The imaginary part of $2 - 3i$ is -3 .
implicit differentiation	A method for differentiating an implicit function.	If $x^2 + y^2 = 1$, then the derivative $\frac{dy}{dx}$ can be found using implicit differentiation, which gives $2x + 2y \frac{dy}{dx} = 0$.

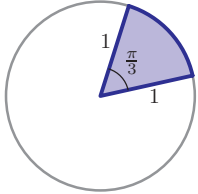
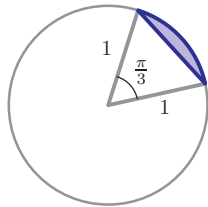
	Definition	Example
implicit function	A relation between variables x and y which is not written in the form $y = f(x)$.	$x^2 + y^2 = 1$ is an implicit function.
improper algebraic fraction	An algebraic fraction where the order of the numerator is greater than or equal to the order of the denominator.	$\frac{x}{3+x}$ is an improper algebraic fraction.
indefinite integration	Integration without limits; the result is a function plus a constant of integration.	$\int e^x dx = e^x + c$
independent events	Two events whose probabilities are not affected by the outcome of each other.	A person's telephone number and the number of their house are independent events.
inductive step	A part of proof by induction where the assumption is linked to the next proposition.	Adding on the next term in a sequence is often a useful inductive step.
inequality	Two expressions where one is greater than the other for some values of the variable.	The solution to the inequality $x^2 > 9$ is $x > 3$ or $x < -3$.
initial value	The value of a function at time zero.	The speed of a car takes an initial value of 3 ms^{-1} .
inner function	The function $g(x)$ in a composite function $f(x) = h(g(x))$, i.e. the function that is applied first.	The composite function $f(x) = \sin(x^2)$ has inner function $x \mapsto x^2$.
integers	Whole numbers.	$-7, 0$ and 8 are all integers.
integration	The reverse process to differentiation.	The integral of x^{-1} with respect to x is $\ln x + c$.
integration by parts	A rule for integrating a product of two functions: $\int u \frac{dv}{dx} dx = uv - \int v \frac{du}{dx} dx.$	The integral of xe^x with respect to x can be found using integration by parts.
integration by substitution	A method for turning one integral into another, hopefully easier, integral.	The integral of xe^{x^2} with respect to x can be found using the substitution $u = x^2$.
interquartile range	A measure of how spread out the data is: the length of the interval covering the central 50% of values in the data set.	The interquartile range of 1, 1, 4, 6, 8, 10, 12 is 9.
intersection	The combined event corresponding to two events both occurring.	The intersection of odd numbers less than 6 and prime numbers less than 6 is $\{3, 5\}$.
inverse function	A function which undoes the action of another function.	Cube-rooting is the inverse function of cubing.
inverse normal distribution	A function which turns a cumulative probability into a Z-score; often denoted by $\Phi^{-1}(x)$.	In a normal distribution, the values in the top 20% are at least $\Phi^{-1}(0.8) = 0.842$ standard deviations above the mean.
kinematics	The study of the movement of objects.	One important rule of kinematics is that the area under a graph of velocity against time gives the displacement.

	Definition	Example
lead coefficient	The coefficient of the leading order term.	The lead coefficient of $3x^6 - 12x$ is 3.
leading order term	The term containing the largest exponent in a polynomial.	$6x^2$ is the leading order term in $1 + 3x + 6x^2$.
limits	<ol style="list-style-type: none"> The points between which a function is integrated in an definite integral. Values which convergent sequences approach. 	<ol style="list-style-type: none"> The limits of the integral $\int_0^1 e^x dx$ are 0 and 1. The limit of the sequence $1, \frac{1}{2}, \frac{1}{3}, \frac{1}{4}, \dots$ is 0.
local maximum	A point around which the graph looks like 	The graph $y = x^3 - 12x + 7$ has a local maximum at $(-2, 23)$.
local minimum	A point around which the graph looks like 	The graph $y = x^3 - 12x + 7$ has a local minimum at $(2, 9)$.
logarithm to base a ($x = \log_a b$)	The answer to the question 'what power of the base a is this number?'	The logarithm to base 2 of 32 is 5.
magnitude	The size of a vector; the magnitude of a vector \mathbf{v} is usually denoted by $ \mathbf{v} $.	The magnitude of a velocity vector is the speed.
many-to-one function	A function where some outputs come from more than one input.	A many-to-one function does not have an inverse function.
mean	An average found by dividing the sum of a set of data values by the number of data values in the set.	The mean of 6, 3 and 3 is 4.
median	An average found by identifying the central value of the data set when the data items are arranged in order.	The median of 6, 3 and 3 is 3.
mode	An average found by identifying the most frequently occurring data item.	The mode of 6, 3 and 3 is 3.
modelling	Describing a real-world situation in terms of mathematical functions.	Tides can be modelled by a sine function.
modulus	<ol style="list-style-type: none"> The function which makes a negative input positive but leaves positive inputs unchanged. The distance of a complex number from the origin on an Argand diagram. 	<ol style="list-style-type: none"> The modulus of -3 is 3. The modulus of $3 + 4i$ is 5.
negative exponential	A curve of the form $ka^x + c$ where $0 < a < 1$	$y = \left(\frac{1}{2}\right)^x$ is a negative exponential curve.
negative polynomial	A polynomial with a negative lead coefficient.	$5 - 7x^3$ is a negative cubic.
normal	A line intersecting a graph such that it is perpendicular to the tangent at the point of intersection.	The normal to $y = x^2$ at $x = 1$ is $y = \frac{1}{2}(3 - x)$.

	Definition	Example
normal distribution	A common distribution modelling many naturally occurring continuous random variables.	The arm span of adults follows a normal distribution.
normal vector	A vector perpendicular to a plane.	A normal vector to $x + 2y + z = 8$ is $\begin{pmatrix} 1 \\ 2 \\ 1 \end{pmatrix}$.
oblique asymptote	An asymptote which is neither horizontal nor vertical.	$y = x + 2$ is an oblique asymptote of the curve $y = x + 2 + \frac{3}{x-1}$.
one-to-one function	A function where every output comes from only one input.	$y = 3x$ is a one-to-one function but $y = 3x^2$ is not.
order	The largest exponent in a polynomial.	$5x^3 - 6x^4$ is a fourth-order polynomial.
origin	A fixed reference point in space.	The origin is at the intersection of the x and y axes.
outer function	The function $h(x)$ in a composite function $f(x) = h(g(x))$.	The composite function $f(x) = \sin(x^2)$ has outer function $x \mapsto \sin x$.
outlier	An observation which is unusually large or small.	Usain Bolt's 100 m time record is an outlier.
parabola	The shape of the graph of a quadratic function.	The curve $y = x^2 + 4$ is a parabola.
parallel	Lines or vectors which point in the same or opposite direction.	The vectors $\mathbf{i} - 3\mathbf{j}$ and $6\mathbf{j} - 2\mathbf{i}$ are parallel.
parametric equations	Equations linking each of x , y and z to another variable.	$x = 1 + t$, $y = 7 - 2t$ are the parametric equations of a line.
period	The interval between the repeating units of a periodic function.	The period of $\cos 2x$ is π .
periodic function	A function whose graph repeats itself regularly.	$\sin(3x) + 2$ is a periodic function.
permutation	A way of arranging a set of objects in a particular order.	There are 24 possible permutations of the letters in the word CARS.
point of inflexion	A place on a graph where the concavity changes.	The graph $y = x^3 + 3x^2 - 2x + 1$ has a point of inflexion at $(-1, 5)$.
Poisson distribution	A common distribution modelling the number of 'successes' occurring in a situation where there is a constant average rate of success and such that successes occur independently.	If the average number of leaks in pipes produced by a certain factory is 0.2 per metre, the number of leaks in pipes of length 3 m follows the Poisson distribution $\text{Po}(0.6)$.
polar form or modulus-argument form	Expressing a complex number in a way that makes the modulus and argument explicit, such as $r \text{ cis } \theta$.	The complex number $1 + i$ can be written in polar form as $\sqrt{2} \text{ cis } \frac{\pi}{4}$.
polynomial	A sum of terms which are all of the form ax^n where n is a non-negative integer.	$3x^4 + 5x - 13$ is a polynomial but $2 + \sqrt{x}$ is not.
population	The entire group of interest.	The population of all children in Malawi includes those not attending school as well as those who are.

	Definition	Example								
position vector	A vector relative to the origin.	The point A (1, 2) has position vector $\begin{pmatrix} 1 \\ 2 \end{pmatrix}$.								
positive exponential	A curve of the form $ka^x + c$ where $a > 1$.	$y = 3^x$ is a positive exponential curve.								
positive polynomial	A polynomial with a positive lead coefficient.	$x^2 + 5$ is a positive quadratic.								
probability density function (pdf)	A function whose definite integral gives the probability of a continuous random variable falling between the limits.	The probability density function of the waiting time for a bus is $3e^{-3x}$.								
probability distribution	A list of all possible outcomes of a random variable along with their probabilities.	The probability distribution for the number of heads obtained when two coins are tossed (H) is: <table><tr><td>H</td><td>0</td><td>1</td><td>2</td></tr><tr><td>P</td><td>0.25</td><td>0.5</td><td>0.25</td></tr></table>	H	0	1	2	P	0.25	0.5	0.25
H	0	1	2							
P	0.25	0.5	0.25							
probability mass function.	A function which outputs the probability of the input.	The probability mass function of the Poisson distribution is $\frac{(e^{-m})m^r}{r!}$.								
product principle	A rule for counting the number of ways in which event A and event B both occur.	By the product principle, the number of ways of getting an even number on the first die and a multiple of three on the second die is 3×2 .								
product rule	A rule for differentiating a product $y = uv$ of two functions: $\frac{dy}{dx} = u \frac{dv}{dx} + v \frac{du}{dx}$.	The derivative of xe^x is $xe^x + e^x$ by using the product rule.								
proper algebraic fraction	An algebraic fraction where the order of the numerator is less than the order of the denominator.	$\frac{x}{3 + x^2}$ is a proper algebraic fraction.								
quadrant	One of the four regions obtained when the plane is subdivided by a pair of coordinate axes. The first quadrant is the region with positive x and y coordinates; the quadrants are then numbered in an anticlockwise fashion.	The point (3, -5) lies in the fourth quadrant.								
quadratic function or quadratic expression	A polynomial whose highest power is x^2 .	The path of flight of a javelin can be modelled by a quadratic function.								
quadratic inequality	An inequality involving a quadratic expression.	$x^2 > 3x + 2$ is a quadratic inequality.								
quotient	The result of division. When two algebraic expressions are divided, the quotient refers to the polynomial part of the result.	When x^2 is divided by $x + 1$, the quotient is $x - 1$.								

	Definition	Example
quotient rule	A rule for differentiating a quotient (fraction) $y = \frac{u}{v}$ of two functions: $\frac{dy}{dx} = \frac{v \frac{du}{dx} - u \frac{dv}{dx}}{v^2}.$	The derivative of $\tan x$ can be found by expressing $\tan x$ as $\frac{\sin x}{\cos x}$ and using the quotient rule.
radian	A unit for measuring angles: 1 radian is $\frac{1}{2\pi}$ of a full rotation.	A right angle is $\frac{\pi}{2}$ radians.
random sample	A variable or sample which can be different each time it is observed.	Picking the first person on each page in a telephone directory does not produce a random sample.
range	1. The set of all outputs from a function defined on a specified domain. 2. A measure of spread of a data set, found by subtracting the smallest value from the largest value.	1. The range of $f(x) = x^2 + 3$ is $f(x) \geq 3$. 2. The range of 7, 3, 5, 10, 12 is 9.
rate of change	How quickly a quantity changes as another quantity changes.	The rate of change of velocity with respect to time is acceleration.
rational function	A ratio of two polynomials.	$f(x) = \frac{2x-1}{x^2+3x-5}$ is a rational function.
real part	When a complex number is written in the form $a + ib$.	The real part of $2 - 3i$ is 2.
real polynomial	A polynomial whose coefficients are all real numbers.	$3x^2 - 2ix + 4$ is not a real polynomial. $u_{n+1} = 5u_n$ is a recursive definition
recursive function/recursive definition (also known as inductive)	A rule for generating terms of a sequence which depends upon previous results.	
relation	Any set of ordered pairs.	People's names and their ages form a relation.
remainder	When two algebraic expressions are divided, the remainder refers to the numerator of the proper algebraic fraction that results.	When x^2 is divided by $x + 1$, the remainder is 1.
remainder theorem	When the polynomial $f(x)$ is divided by $(x - a)$, the remainder is $f(a)$.	Since $f(-1) = 7$, the remainder when $f(x)$ is divided by $(x + 1)$ is 7.
repeated factor	A factor that occurs more than once.	$(x - 2)$ is a repeated factor of $(x + 3)(x - 2)^2$.
reverse chain rule	A method for integrating a product by recognising it as the result of a chain rule differentiation.	The integral of $x \cos x^2$ with respect to x can be seen to be $\frac{1}{2} \sin x^2 + c$ by using the reverse chain rule.
root or solution	The values of a variable that make an equation true.	3 is a root of $x^2 + 15 = 8x$.
sample	A collection from the group of interest.	The twelve chosen boys are a sample taken from all boys in the school.

	Definition	Example
sample space	A list of all possible equally likely outcomes.	The sample space when two coins are tossed can be represented by HH, HT, TH, TT.
scalar	A quantity which has size but no direction.	Energy is a scalar quantity.
scalar product equation	An equation for a plane in the form $\mathbf{r} \cdot \mathbf{n} = d$.	$\mathbf{r} \cdot \begin{pmatrix} 1 \\ 3 \\ -2 \end{pmatrix} = 3$ is the scalar product equation of a plane.
scalar product or dot product or inner product	An operation which combines two vectors \mathbf{a} and \mathbf{b} to produce the scalar $ \mathbf{a} \mathbf{b} \cos\theta$.	$\begin{pmatrix} 3 \\ -2 \end{pmatrix} \cdot \begin{pmatrix} 3 \\ 4 \end{pmatrix} = 1$
secant	The reciprocal of the cosine function.	$\sec \frac{\pi}{4} = \sqrt{2}$
second derivative	The derivative of the derivative of a function.	The second derivative of x^3 is $6x$.
sector	A region in a circle enclosed by two radii and an arc. Each pair of radii defines two such regions: the larger is called the major sector; the smaller is called the minor sector.	The sector in the diagram has area $\frac{\pi}{6}$. 
segment	A region in a circle enclosed by a chord and an arc. Each chord defines two such regions: the larger is called the major segment; the smaller is called the minor segment.	The segment below has area $\frac{\pi}{6} - \frac{\sqrt{3}}{4}$. 
sequence	A list of numbers in a specified order.	1, 4, 9, 16, ... is a sequence.
series	A sequence formed by summing terms from another sequence.	The harmonic series $1 + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \dots$ is formed by summing the terms of the sequence $1, \frac{1}{2}, \frac{1}{3}, \frac{1}{4}, \dots$
sigma notation	A shorthand way of describing the sum of values with a common pattern.	The n th square number can be expressed as $\sum_{k=1}^n 2k - 1$.
simultaneous equations	A set of at least two equations involving more than one variable.	The intersection of two graphs can be found by solving a pair of simultaneous equations.
sine	A fundamental trigonometric function, often abbreviated to 'sin'; can be defined as the y -coordinate of a point on the unit circle.	$\sin \frac{\pi}{6} = \frac{1}{2}$.

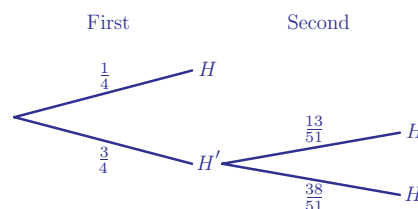
	Definition	Example
sine rule	A rule linking side lengths and angles in any triangle: $\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}.$	When using the sine rule to find an angle, there may be two possible answers.
skew	Two lines which are neither parallel nor intersecting.	The lines $x - 2 = \frac{y + 4}{3} = \frac{z - 1}{4}$ and $r = \lambda \begin{pmatrix} 1 \\ 0 \\ 1 \end{pmatrix}$ are skew.
speed	A scalar quantity describing how fast an object is moving.	The magnitude of the velocity vector is the speed.
standard derivatives	Derivatives, given in the Formula booklet, which can be quoted without proof.	$\frac{d}{dx}(\arctan x) = \frac{1}{1 + x^2}$ is a standard derivative.
standard deviation	A measure of how spread out the data is, given by an average distance from the mean.	The standard deviation of 1, 1, 4, 6, 8, 10, 12 is $\sqrt{\frac{110}{7}}$.
standard integrals	Integrals, given in the Formula booklet, which can be quoted without proof.	$\int \tan x \, dx = \ln \sec x + c$ is a standard integral.
standard normal distribution or Z-distribution	A normal distribution with mean zero and standard deviation one.	If $X \sim N(\mu, \sigma^2)$, then $\frac{X - \mu}{\sigma}$ follows a standard normal distribution.
stationary point	A point on a graph at which the gradient is zero.	The graph $y = x^3 - 12x + 7$ has stationary points at (2, -9) and (-2, 23).
strict inequality	An equality in which the boundary case (equality) is excluded.	$x > 3$ is a strict inequality while $x \geq 3$ is not.
subtends	When each end of a curve (or line) is joined by a straight line to a specified point, the angle enclosed by the two lines is said to be subtended by the curve at that point.	The diameter of a circle subtends an angle of 90° at any point on the circumference.
sum to infinity	The value which the sum of a never-ending sequence approaches as more terms are added.	The sum to infinity of $1 + \frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \dots$ is 2.
tangent	<ol style="list-style-type: none"> 1. A trigonometric function, often abbreviated to 'tan'. 2. A line which touches a curve without crossing it (except at points of inflexion). 	<ol style="list-style-type: none"> 1. $\tan \frac{\pi}{3} = \sqrt{3}$ 2. A tangent to a circle meets any radius in a right angle.
term	<ol style="list-style-type: none"> 1. A component of a sum. 2. A number in a sequence. 	<ol style="list-style-type: none"> 1. The expression $3x^2y + 2x$ consists of two terms. 2. The third term of the sequence 2, 5, 10, 17, ... is 10.

tree diagram**Definition**

A representation of events that shows the probability of each event occurring depending on previous outcomes.

Example

When two cards are drawn without replacement from a standard deck of cards, the probabilities of drawing at least one heart can be represented in the following tree diagram:

**trigonometric function**

One of the functions relating to ratios of lengths in a right-angled triangle or in the unit circle: sine, cosine, tangent, secant, cosecant or cotangent.

$\sin 4x$ is a trigonometric function.

turning point or vertex

A place where a graph changes from increasing to decreasing or vice versa. Also known as a stationary point.

The line of symmetry of a quadratic graph passes through its vertex.

union

The combined event corresponding to either or both of two events occurring.

The union of odd numbers less than 6 and prime numbers less than 6 is $\{1, 2, 3, 5\}$.

unit circle

A circle with radius one unit centred at the origin.

$\cos \theta$ is the x -coordinate of the point on the unit circle where the radius makes an angle θ with the positive x -axis.

unit vector

A vector with magnitude one.

$\frac{1}{\sqrt{3}} \begin{pmatrix} 1 \\ -1 \\ -1 \end{pmatrix}$ is a unit vector in the direction of $\begin{pmatrix} 1 \\ -1 \\ -1 \end{pmatrix}$.

variable

An unknown quantity.

In the expression $3x^2$, the only variable is x .

variance

An indirect measure of how spread out the data is, given by the square of the standard deviation.

The variance of 1, 1, 4, 6, 8, 10, 12 is $\frac{110}{7}$.

vector

A quantity which has both size (magnitude) and direction.

Force is a vector quantity.

vector equation


An equation whose variables are vectors.

The vector equation of a plane containing the points A , B and C is $\mathbf{r} = \mathbf{a} + \lambda(\mathbf{b} - \mathbf{a}) + \mu(\mathbf{c} - \mathbf{a})$.

vector product or cross product

An operation which combines two three-dimensional vectors \mathbf{a} and \mathbf{b} to produce another vector with magnitude $|\mathbf{a}||\mathbf{b}|\sin \theta$ and direction perpendicular to both \mathbf{a} and \mathbf{b} .

$$\begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix} \times \begin{pmatrix} 1 \\ 0 \\ -1 \end{pmatrix} = \begin{pmatrix} -1 \\ 2 \\ -1 \end{pmatrix}$$

	Definition	Example
velocity	A vector quantity describing how fast an object is moving and in what direction.	Velocity is the rate of change of displacement with respect to time.
Venn diagram	A representation of events as regions in a rectangular area (which represents the whole sample space).	If events A and B are mutually exclusive, their Venn diagram will look like 
vertical asymptote	A vertical line of the form $x = a$ where a function is undefined.	$y = \ln(x - 1)$ has a vertical asymptote $x = 1$.
vertical line test	A way of deciding from a graph whether a relation is a function.	By the vertical line test, the relation $y = \pm x$ is not a function.
volume of revolution	A solid shape formed by rotating a curve around an axis.	The volume of revolution of a straight line through the origin is a cone.
with respect to	A phrase for describing the controlled variable that is being changed in the process of differentiation or integration.	The derivative of ax^2 with respect to x is $2ax$.
zeros of a polynomial	The values of a variable that make an expression equal to zero.	-2 is a zero of $x^2 + 5x + 6$.
Z-score	In a normal distribution the number of standard deviations that a particular value lies above the mean.	In a normal distribution with mean 150 and standard deviation 10, the value 135 has a Z-score of -1.5 .