**Introduction to calculus**:

Calculus is about continuous change and analysis of infinitely small values.

Calculus is widely used in physics, chemistry, biology, economics, quantum computing, etc.

**Number theory in calculus**:

Calculus mostly deals with real numbers.

Also, whole, natural, integer, prime, rational, irrational and complex numbers are important in calculus.

Real and irrational numbers are uncountable, there much more of them than in countable whole, natural, integer and rational numbers.

Surd and absurd irrational numbers differ by surd being a root of an integer whereas absurd irrational number cannot be represented as a root of an integer.

Calculate the largest prime number and win a million dollars.

Calculate the irrational numbers π and e.

**Complex numbers** deal with imaginary one, which is the square root of -1.

A complex number z = x + iy, where x and y are real numbers. x is a real part of the complex number z and y is an imaginary part of the complex number z.

Complex numbers are similar to vectors when it comes to addition, subtraction of complex numbers and multiplying them by the real constants, but complex numbers are different from vectors when it comes to multiplying, dividing, razing to the power, etc.

A complex number is similar to a vector if a real component of a complex number is considered as the first components of the vector and the imaginary component of the complex number is considered as the second component of the vector.

Complex number z\* is called complex conjugate to z = x + iy if z\* = x + iy.

z z\*= x2 + y2, which is a real number.

z + z\* = 2x, which is a real number.

z - z\* = 2iy, which is an imaginary number.

**Function** is a relation for which there is no more than one element of the range corresponds to any element of the domain.

A **linear function** has an equation in the form y = gx + i, hear g is the gradient of the straight line and i is the intercept. g is a non-zero constant and i is any constant.

**Parallel** lines have the same gradient.

The gradients of the **perpendicular** lines are related by this equation: g1g2 = -1.

The proof uses the dot-product of the vectors and trigonometric identities.

A **quadratic function** has an expression in the form y = ax2 + bx + c, here a is a non-zero constant, b and c are any constants.

The **vertex** of a parabola can be found as xv=-b/(2a) and yv=y(xv).

The roots of the quadratic equation are found using the quadratic formula: $x=\frac{-b\pm \sqrt{b^{2}-4ac}}{2a}$

Quadratic relations include **parabola**, **circumference**, **ellipse** and **hyperbola**.

**Domains** of functions are limited by inability of dividing by zero, calculating the root of even order of negative numbers, calculating logarithms of positive bases from non-positive numbers, etc.

**Composite function** is a combination of two or more functions: f(g(x)).

**Inverse function** undoes what the function does.

f(f-1(x)) = f-1(f(x)) = x

Geometrically, graphs of inverse functions are symmetrical with respect to y = x as a mirror line.

Only **one-to-one function** can be inverted because otherwise the resulting relation will not be a function.

Invert linear functions.

Find inverse functions to linear functions.

Show that it is impossible to find inverse function of a parabola.

**Limit** is the essence of calculus.

We use the “epsilon-delta” language to define the limit and infinitely small values.

We solve the problems of the limits by substitution, elimination, etc.

Exploring the two **great limits**: Lim(sinx/x) = 1, Lim(1+1/x)^x = e.

**Derivative** is also essence of calculus.

We define derivative as a limit.

The most general definition of derivative and differential are given by Taylor series.

**Multiple derivatives** and their applications must be explored.

The first derivative of distance is velocity.

The first derivative finds **minimum** and **maximum** of a function.

Second derivative finds **inflection** points of functions.