Transcendental Numbers Encyclopedia Article

Transcendental Numbers

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Contents

Transcendental Numbers Encyclopedia Article.....1

Contents.....2

Transcendental Numbers.....3

Transcendental Numbers

Transcendental numbers, named after the Latin expression meaning *to climb beyond,* are numbers which exist beyond the realm of **algebraic numbers**. Mathematicians have defined algebraic numbers as those which can function as a solution to polynomial **equations** consisting of x and **powers** of x. In 1744, the Swiss mathematician **Leonhard Euler** (1707-1783) established that a large variety of numbers (for example, **whole numbers**, **fractions**, **imaginary numbers**, **irrational numbers**, **negative numbers**, etc.) can function as a solution to a polynomial equation, thereby earning the attribute *algebraic*. However, Euler pointed to the existence of certain irrational numbers which cannot be defined as algebraic. Thus,2, , and *e* are all irrationals, but they are nevertheless divided into two fundamentally different classes. The first number is algebraic, which means that it can be a solution to a polynomial equation. For example, 2 is the solution of $x^2 - 2 = 0$. But and *e* cannot solve a polynomial equation, and are therefore defined as transcendental. While , which represents the ratio of the **circumference** of a **circle** to its **diameter**, had been known since antiquity, its transcendence took many centuries to prove: in 1882, Ferdinand Lindemann (1852-1939) finally solved the problem of "squaring the circle" by establishing that there was no solution. There are infinitely many transcendental numbers, as there are infinitely many algebraic numbers. However, in 1874, Georg Cantor (1845-1919) showed that the former are more numerous than the latter, suggesting that there is more than one kind of **infinity**.