# Real Numbers Encyclopedia Article

## Real Numbers

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# Real Numbers

Plainly stated, the real number system consists of zero, the positive and negative integers, fractions and the irrational numbers. Any number that can be represented as a point on a number line can be thought of as a real number, while the imaginary numbers and complex numbers are not part of the real number system. The ancient civilizations of Greece, Egypt and Babylonia had all developed and freely used integer and fractional numbers as early as 1500 b.c., although the other types of numbers were much longer in gaining acceptance. Around the year a.d. 628, Hindu mathematician and astronomer Brahmagupta (598-ca. 665) began to employ negative and irrational numbers in arithmetic.

By 1700 all of the real numbers—whole numbers, negatives, fractions and irrationals--were known, yet irrationals and negatives, were still labelled as "absurd," "fictitious," or "impossible solutions" by many mathematicians. Surprisingly, it would take almost two hundred more years before the structure and properties of the real number system would be developed. Mathematicians saw that the lack of clarity in the number system had to be remedied and were motivated by a desire to secure a logical foundation of mathematics. In 1872 German mathematician Richard Dedekind (1831-1916) took the first step towards this goal. In his book *Stetigkeit und irrationale Zahlen*, Dedekind presented a theory of irrational numbers and their properties. Through similar efforts by other mathematicians, a logical foundation of the irrational number system was clearly laid out.

Although considered unnecessary to some, the next step was the definition and deduction of the properties of the real numbers, particularly the negative numbers and fractions, based upon an axiomatic foundation for the natural numbers. The first such effort had been made in 1822 by Martin Ohm, a Berlin professor. Equally important work in this area was completed by the mathematicians Karl Weierstrass (1815-1897), Giuseppe Peano (1858-1932), Leopold Kronecker (1823-1891), and Richard Dedekind. By methodically and logically addressing each element of the real number system, mathematicians were able to resolve many of the problems they had previously faced. In unlocking the properties of the real number system they gained valuable knowledge of the logical structure of algebra as well.