ALU SCHOOL OF MATHEMATICS

Volume 1, Issue 11 **News Letter** *Since: 09/03/2017*

We are delighted to bring to you this issue of ALU Mathematics News, a monthly newsletter dedicated to the emerging field of Mathematics. This is the first visible ―output from the Department of Mathematics, Alagappa University. We are committed to make ALU Mathematics News a continuing and effective vehicle to promote communication, education and networking, as well as stimulate sharing of research, innovations and technological developments in the field. However, we would appreciate your feedback regarding how we could improve this publication and enhance its value to the community. We are keen that this publication eventually grows beyond being a mere ―news letter to become an invaluable information resource for the entire Mathematics community, and look forward to your inputs to assist us in this endeavor.

Dr. N. Anbazhagan

What is e?

Euler's constant '*e*' is also known as "Euler's number" after the Swiss mathematician Leonhard Euler. The constant '*e*' was discovered by several mathematicians who didn't know of its significance until Euler started to use the letter 'e' for the constant around 1727. It is an irrational number that represents the idea that all continually growing systems are a scaled version of a common rate. The constant '*e*' is mostly used in logarithms, exponential growth, and complex numbers. Many celebrate *e*-Day as Euler's constant day on February 7.

Ramanujan's Number

1,729 is the smallest number which can be represented in two different ways as the sum of two cubes:

$$1729 = 1^3+12^3$$
$$= 9^3+10^3$$

It is also incidentally the product of three prime numbers:

$$1729 = 7×13×19$$

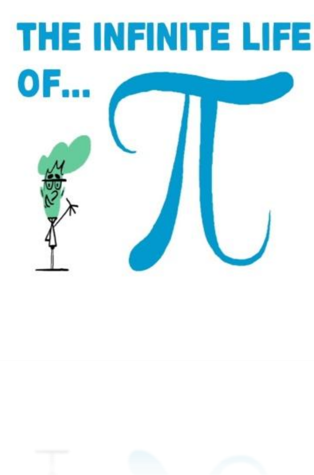
The largest known similar number is:

$$885623890831 = 7511^3+7730^3$$
$$= 8759^3+5978^3$$
$$= 3943×14737×15241$$

It's taken, can you find us another one?

Visualizing Pi

The decimal representation of Pi has been computed to more than a trillion digits (10^{12}). Pi can be estimated by dividing the circumference of any circle by its diameter. Pi has about 6.4 billion known digits which would take a person roughly 133 years to recite without stopping. The world record holder for the most memorized digits of Pi took nine hours to recite over 44,000 digits of Pi.

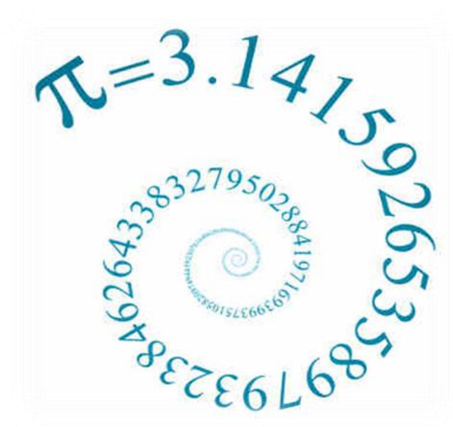


The Greek genius Archimedes was the first to compute digits in the decimal expansion of Pi. He showed 3.140845<π<3.142857. He found it by taking a polygon with 96 sides and inscribing a circle inside the polygon that was Archimedes concept of Pi.

All the digits of Pi can be never fully known. It took Yasumasa Canada, a Professor at the University of Tokyo approximately 116 hours to compute 6,442,450,000 decimal places of Pi on a computer.

There is no zero in the first 31 digits of Pi. At Position 763 there are six nines in a row. This is known as the Feynman Point.

This designation was not introduced until 1706, when used by William Jones in his "Synopsis palmariorum matheseos", probably after the initial letter of the Greek "periphery". Until then, instead of π, one had to content oneself with the quaint Latin phrase: "quantitas, in quam cum multiplicetur diameter, provenient circumferential", meaning "the quantity which, when the diameter is multiplied by it, gives the circumference".



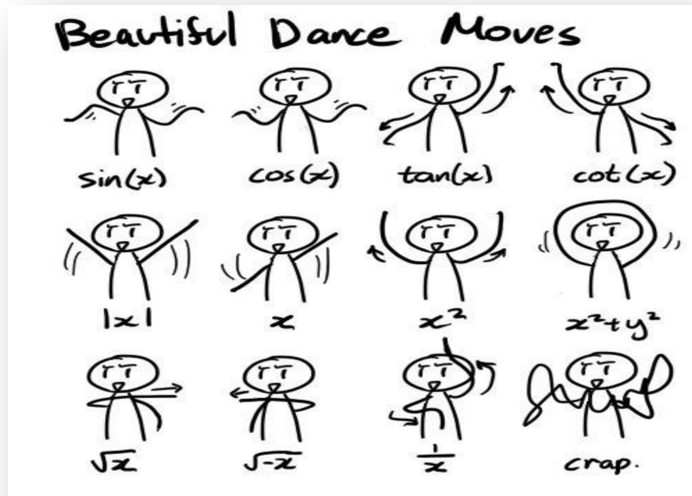
It is due to the great prestige of the Swiss mathematician Leonhard Euler that we use π with today's meaning. In his early writings, Euler had frequently used p to denote circumference-to-diameter ratio, but changed to π in his textbook "Mechanica", published in 1736.

Where did the concept of zero originated?

The concept of zero is attributed to the Hindus. The Hindus were also the first to use zero in the way it is used today. Some symbol was required in positional number system to mark the place of a power of the base not actually occurring. This was indicated by the Hindus by a small circle, which were called 'Sunya', the Sanskrit word for vacant. This was translated into the Arabic 'sifr' which also gave us the English word 'Cipher' which means 'a secret way of writing' about 800A.D subsequent changes have given us the word zero.

Origin of sin-cos-tan

The first use of the idea of 'sine' in the way we use it today was in the work Aryabhatiyam by Aryabhatta, in A. D. 500. Aryabhatta used the word ardha-jya for the half-chord, which was shortened to jya or jiva in due course. When the Arybhatiyam was translated into Arabic, the word jiva was retained as it is. The word jiva was translated into sinus, which means curve, when the Arabic version was translated into Latin. Soon the word Sinus, also used as sine, become common in mathematical texts throughout Europe. An English Professor of astronomy Edmund Gunter (1581-1626), first used the abbreviated notation 'sin'.



The origin of the term 'cosine' and 'tangent' was much later. The cosine function arose from the need to compute the sine of the complementary angle. Aryabhatta called it Kotijya. The name cosines originated with Edmund Gunter. In 1674, the English Mathematician Sir Jonas Moore first used the abbreviated notation 'cos'.

A Theodolite

Surveyors have used trigonometry for centuries. One such large surveying project of the nineteenth century was the '**Great Trigonometric survey'** of British India for the two largest-ever theodolites were built. During the survey in1852, the highest mountain in the world was discovered. From a distance of over 160km, the peak was Observed from six named after Sir George Everest, Who had commissioned and first used the giant theodolities. The thedolites are now on display in the Museum of the survey of the India in Dehradun.

Ramanujan's Partition Formula

A *partition* of an integer *n* is a set of positive integers whose sum equals *n*. The partition function *p(n)* is defined to be the number of such partitions of integer *n*.

For *n* = 4, there are 4 partitions: 3 + 1, 2 + 2, 2 + 1 + 1, and 1 + 1 +1 + 1.
So $p(4) = 4$.

Obviously, the value of the function gets larger as *n* increases. One can list the possibilities, and laboriously verify that $p(10) = 42$, and $p(20) = 627$. However, for 150 years, mathematicians were unable to find an explicit formula for the function.

In 1918, Ramanujan produced the formula,

$$\frac{1}{2\pi\sqrt{2}}\sum_{k=1}^{v} A_k(n)\sqrt{k}\,\frac{d}{dn}\left(\frac{1}{\sqrt{n-\frac{1}{24}}}\exp\left[\frac{\pi}{k}\sqrt{\frac{2}{3}(n-\frac{1}{24})}\right]\right)$$

Where

$$A_k(n) = \sum_{0\le m<k,(m,k)=1} e^{\pi i\,(s(m,n)-2nm/k)}$$

Except for a few mathematicians, the formula is more amazing than enlightening.
Had Ramanujan not died at age 32, there would probably be many more such results.

The highest highly composite number listed by Ramanujan is 6748328388800 having 10080 factors.

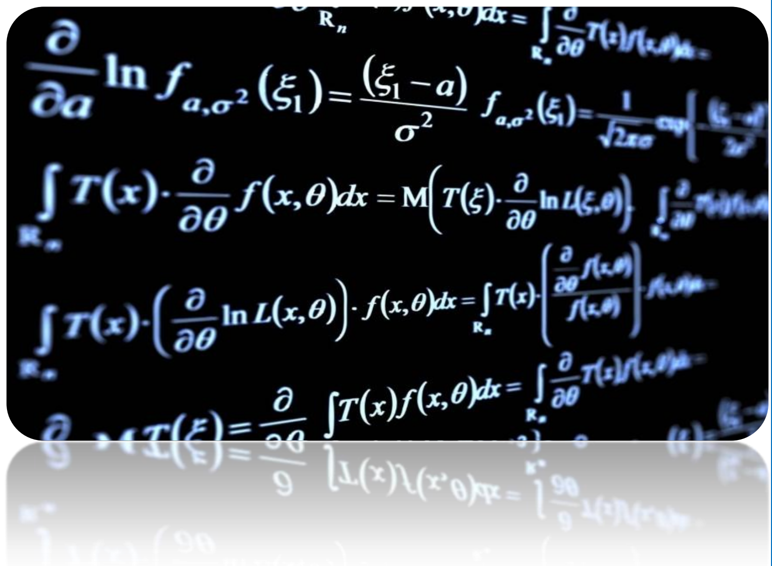
Mathematical Illusion

$$\begin{aligned}
-1 &= -1\\
-1/1 &= -1/1\\
-1/1 &= 1/-1\\
\sqrt{-1/1} &= \sqrt{1/-1}\\
i/1 &= 1/i\\
i &= 1/i\\
i^2 &= 1\\
-1 &= 1
\end{aligned}$$

Theory of Integration

In the middle of the 19th century Riemann introduced his theory of integration. The last third of the century saw the arithmetization of analysis by Weierstrass, who thought that geometric reasoning was inherently misleading, and introduced the "epsilon-delta" definition of limit. Then, mathematicians started worrying that they were assuming the existence of a continuum of real numbers without proof.

Dedekind then constructed the real numbers by Dedekind cuts, in which irrational numbers are formally defined, which serve to fill the "gaps" between rational numbers, thereby creating a complete set: the continuum of real numbers, which had already been developed by Simon Stevin in terms of decimal expansions. Around that time, the attempts to refine the theorems of Riemann integration led to the study of the "size" of the set of discontinuities of real functions.



Also, "monsters" (nowhere continuous functions, continuous but nowhere differentiable functions, space-filling curves) began to be investigated. In this context, Jordan developed his theory of measure, Cantor developed what is now called naive set theory, and Baire proved the Baire category theorem. In the early 20th century, calculus was formalized using an axiomatic set theory. Lebesgue solved the problem of measure, and Hilbert introduced Hilbert spaces to solve integral equations. The idea of normed vector space was in the air, and in the 1920s Banach created functional analysis.

Mathematics Interesting and Amazing Facts

- Americans called mathematics as ‘Math’ arguing that “Mathematics” functions as a singular noun so ‘Math’ should be singular too.

- "FOUR" is the only number in English that is spelt with the same number of letters as the number itself.

- At his teens, Evariste Galois invented on entirely new branch of math, called group theory, to prove that "the quintic" an equation with a term of x^5 was not solvabe by any formula.

- The equal sign "=" was invented in 1557 by Welsh Mathematician "Robert Recorde" who was fed up with writing "is equal to" in his equation. He choose the two lines because "no two things can be more equal".

  In his book Robert Recorde explains: '… to avoid the tedious repetition of these words: "is equal to", I will set (as I do often in work use) a pair of parallels, or Gemowe lines, of one length (thus =), because no two things can be more equal'.

- There are shapes of constant width other than the circle one can even drill square holes.

- Different name for the number 0 include zero, nought, nil, zilch and zip.

- Zero is the only number which cannot be represented by Roman Numerals.

- 2,520 is the smallest number that can be exactly divided by all the numbers 1 to 10.

- A German Mathematician "Ludolph Van Ceulen" spent his entire life to calculate the first 35 decimal places of Pi.

- "The man who Knew infinity: A Life of Genius Ramanujan" is a biography of Srinivasa Ramanujan written in 1991 By Robert Kanigel.

- Letters 'a', 'b', 'c' &'d' do not appear anywhere in the spelling of 1 to 99.

  (Letter 'd' comes for the first time in Hundred)

- Letters ‘a’, ‘b’ &‘c’ do not appear anywhere in the spelling of 1 to 999.
  (Letter ‘a’ comes for the first time in Thousand)

- Letters ‘b’ &‘c’ do not appear anywhere in the spelling of 1 to 999,999,999.
  (Letter ‘b’ comes for the first time in Billion)

- Letters ‘c’ does not appear anywhere in the spelling of 1 entire English counting.

The Women’s Who Changed Our World

19TH CENTURY

(1815–1852)

Ada Lovelace

Considered the first computer programmer, she was a gifted mathematician at an early age. This English woman calculated the Bernoulli Numbers Sequence in the mid-1800s, and wrote the first algorithm designed for a machine—all before she died at the age of 36. She is honored in England every October 14th with Ada Lovelace Day.

(1882–1935)

Emmy Noether

This German woman provided the foundation for Albert Einstein’s world-changing General Theory of Relativity. Of Jewish heritage, she immigrated to the United Sates in the 1930s, where she worked at Bryn Mawr and lectured at the Institute for Advanced Study in Princeton.

21TH CENTURY

(1977–Present)

Maryam Mirzkhani

This Iranian woman is the first woman to win the world’s highest math honor—the Fields Medal—which she did in 2014. Born in Iran, she resettled in the United States to pursue her passion: math. Her work is the next step in understanding of the universe.