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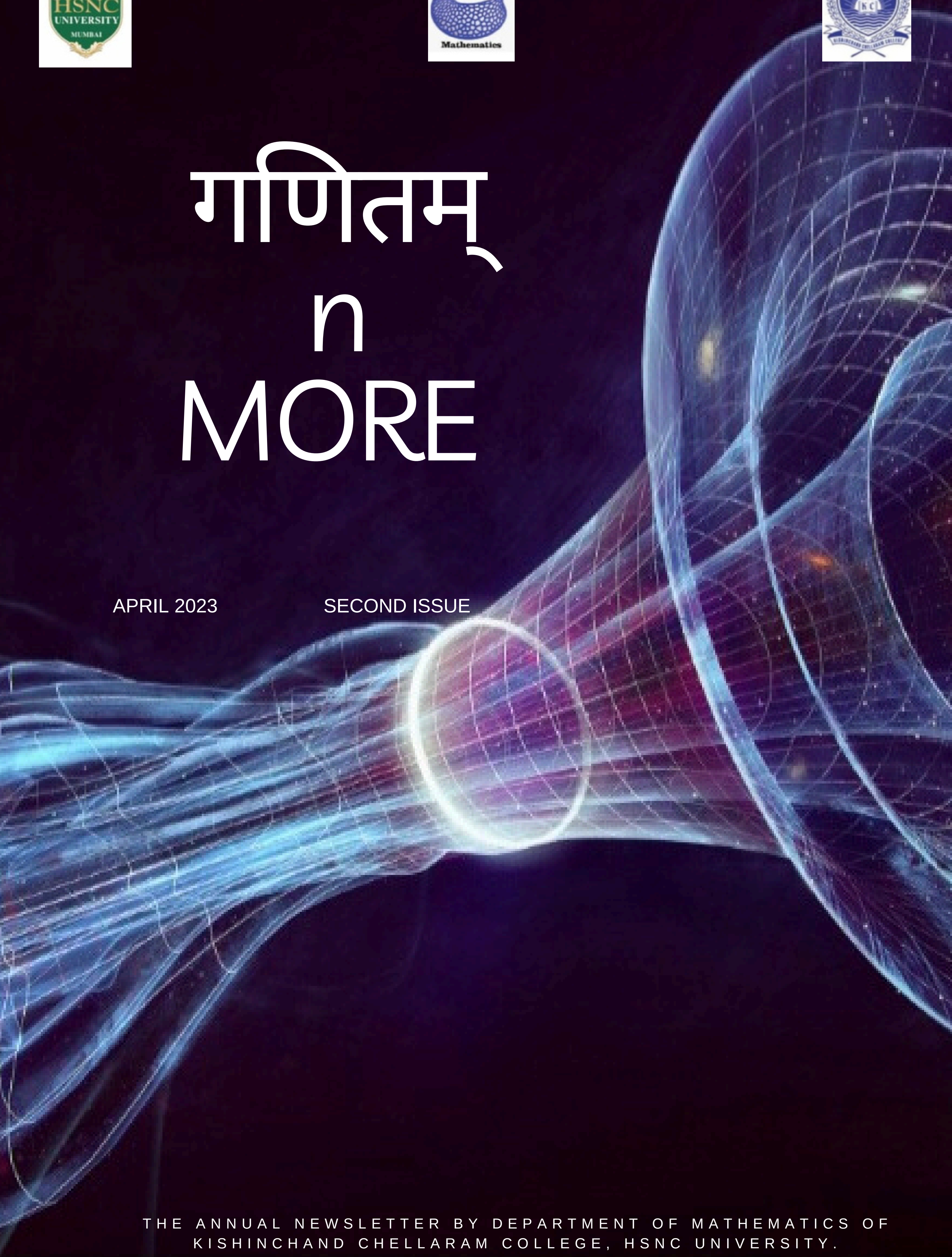
MORE

APRIL 2023 SECOND ISSUE



THE ANNUAL NEWSLETTER BY DEPARTMENT OF MATHEMATICS OF KISHINCHAND CHELLARAM COLLEGE, HSNC UNIVERSITY.

VICE CHANCELLOR'S FOREWORD

PROF. DR. HEMLATA BAGLA

Vice Chancellor, HSNC University

The field of mathematics is an embodiment of human ingenuity, deeply rooted in the everyday needs of our lives, and evolving alongside our ever-changing world. It fills me with immense joy to witness the remarkable progress made by the Department of Mathematics during the academic years 2021-22 and 2022-23.

Throughout this period, the department has meticulously orchestrated a wide array of activities, all thoughtfully designed to enrich the educational journey of our students and enhance their experiences through active participation in various programs.

It is with great pleasure that I extend my heartfelt congratulations to the department on the launch of their new newsletter, गणितम् n MORE. This initiative promises to be an invaluable window into the department's numerous accomplishments, providing periodic insights into their impressive work.

This newsletter serves a dual purpose. Firstly, it offers a platform to celebrate the remarkable achievements of our mathematics department. Secondly, it is poised to kindle the curiosity and enthusiasm of students and faculty members from diverse disciplines, drawing them closer to the captivating world of mathematics.

The interdisciplinary nature of mathematics allows it to transcend traditional boundaries, and this newsletter will undoubtedly help foster a deeper appreciation for the subject across our academic community. I want to assure you of my unwavering support for such commendable initiatives in the future.

It is with great pride that I once again extend my heartfelt congratulations to the Department of Mathematics and wish them continued success in their endeavors.

PRINCIPAL'S FOREWORD

It gives me great pleasure to see that the Mathematics Department of K.C. college has launched its departmental newsletter, "Ganitam n More". This newsletter provides our students the opportunity to express their mathematical talents and abilities through the form of articles, puzzles, anecdotes, posing challenging and thought provoking problems and much more. This, in turn, encourages students to think beyond their text books and dive deeper into the subject. I am delighted to see that the efforts and enthusiasm of our students have culminated into this issue of the newsletter whose theme is "Numbers".

This academic year 2022/23, the Mathematics Department of K.C. college also started its first batch of TYBSc Mathematics. It offers a wide range of courses at this level, including python programming and financial mathematics. The department also conducts various programs for students, such as seminar presentations, quiz competitions, guest lectures and field trips etc to nurture the interests and mathematical aptitude of students. I am proud to see the department grow and expand into its current form. I congratulate all the faculty members and students of the department, once again, for the release of this newsletter and look forward to hear more laurels from them in the future.

My best wishes to the Mathematics Department.

DR.
TEJASHREE
SHANBHAG

Principal I/C, K.C.College
Dean of Faculty of Science & Technology

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Editorial Board

Editors Note

It would be an understatement to say that we are thrilled to be writing for you. We are proud to present Ganitam N More!

A biennial mathematics newsletter with hand-picked and insightful topics and riddles to challenge your mind. Our riddles will keep you awake at night as you try to figure out the answers, and our memes will make you laugh until you cry. This newsletter will provide you with a 360-degree view of the world of mathematics as seen by our students.

Our experience as editors for this edition of गणितम् N More has been extremely rewarding. The entire process of compiling articles, editing them, and receiving feedback has been a great lesson in responsibility, authority, and accountability that comes with getting the work done effectively and efficiently. We sincerely hope that गणितम् N More's legacy is carried on and each edition is better than the last one. Thank you especially to our teachers in charge, who chose us and thought we were capable enough to pull this off. Their assistance and encouragement made us strive harder to complete this masterpiece of wisdom. This year the theme for the newsletter was 'It's all about Numbers' and thereby students have been encouraged to relate their articles to the same.

Faariya Syed & Nandini Roy
STUDENT EDITORS

Nilesh Bhandarkar
TEACHER EDITOR

ARTICLES

SRINIVASA RAMANUJAN

NANDINI ROY AND ARCHITA PATEL (SYBSC)

Ramanujan was an Indian prodigy who shook the entire globe with his theory and intuitive research in mathematics. Every year his birth anniversary is commemorated as National Mathematics Day. The greatest part about him is that he developed and discovered numerous mathematical theories without having any formal training in advanced mathematics or calculus. He was truly a self taught genius. Ramanujan was extremely observant and had a keen interest in dream interpretation and astrology. Growing up, he learned to worship Namagiri, the Hindu Goddess of creativity. He often understood mathematics and spirituality as one. For him-'An equation has no meaning unless it expresses a thought of God'. He started working on his mathematics in geometry and arithmetic series. He worked on real analysis, number theory, infinite series, and continued fractions. Some of his other works such as Ramanujan number, Ramanujan prime, Ramanujan theta function, partition formulae, mock theta function, and many more opened new areas for research in the field of mathematics

. • Ramanujan made substantial contributions to the analytical theory of numbers and worked on elliptic functions and continued fractions.

• Ramanujan compiled around 3,900 results consisting of equations and identities. One of his most treasured findings was his infinite series for pi. This series forms the basis of many algorithms we use today. He gave several fascinating formulas to calculate the digits of pi in many unconventional ways.

• He discovered a long list of new ideas to solve many challenging mathematical problems, which gave a significant impetus to the development of game theory. His contribution to game theory is purely based on intuition and natural talent and remains unrivalled to this day.

• He elaborately described the mock theta function, which is a concept in the realm of modular form in mathematics. Considered an enigma till sometime back, it is now recognized as holomorphic parts of mass forms.

• One of Ramanujan's notebooks was discovered by George Andrews in 1976 in the library at Trinity College. Later the contents of this notebook were published as a book.

• In his school days, he used to enjoy solving magic squares. Magic squares are the cells in 3 rows and 3 columns, filled with numbers starting from 1 to 9. The numbers in the cells are arranged in such a way that the sum of numbers in each row is equal to the sum of numbers in each column is equal to the sum of numbers in each diagonal. Ramanujan gave a general formula for solving the magic square of dimension 3×3,

C+Q	A+P	B+R
A+R	B+Q	C+P
B+P	C+R	A+Q

Where A,B,C and P,Q,R are in arithmetic progression.The following formula was also Given by him

2Q+R	2P+2R	P+Q
2P	P+Q+R	2Q+2R
P+Q+2R	2Q	2P+R

• 1729 is known as the Ramanujan number. It is the sum of the cubes of two numbers 10 and 9. For instance, 1729 results from adding 1000 (the cube of 10) and 729 (the cube of 9). This is the smallest number that can be expressed in two different ways as it is the sum of these two cubes.That is , 1729=1^3+(12)^3 = 9^3 + 10^3. This smallest number expressible as a sum of two cubes in two different ways have been dubbed taxicab numbers. 1729 is called the Hardy- Ramanujan number. The next number in the sequence, the smallest number that can be expressed as the sum of two cubes in three different ways, is 87,539,319.
• Ramanujan's contributions stretch across mathematics fields, including complex analysis, number theory, infinite series, and continued fractions.
• Rogers-Ramanujan Identity

$$\sum_{n=0}^{\infty} \frac{q^{n^2}}{(q;q)_n} = \prod_{n=1}^{\infty} (1-q^{5n-1})^{-1}(1-q^{5n-4})^{-1}$$
$$\sum_{n=0}^{\infty} \frac{q^{n^2+n}}{(q;q)_n} = \prod_{n=1}^{\infty} (1-q^{5n-2})^{-1}(1-q^{5n-3})^{-1}$$

Even though during his lifetime, Ramanujan got very few opportunities to showcase his talent and calibre, his passion for mathematics ultimately left a legacy for the world to marvel at. Today, the legendary story of Ramanujan is being told through the big screen in the film: The Man Who Knew Infinity. Srinivasa Ramanujan left this world at the ripe age of 32 battling tuberculosis but his work, the amount of knowledge and intellect that he endowed continues to inspire and baffle mathematicians all over the world.

APPLICATION OF MATHS IN CYBER SECURITY

FAARIYA SYED (SYBSC)

Math is everywhere - managing money, playing music, preparing food, weather, medicine, etc. from finance to communication systems, knowledge-based professions need to excel in mathematics and logical/quantitative reasoning. The skills sharpens through the study of math. Math is much more than formulae, equations, statistics, logic, rational and algebra.
A day is incomplete without mathematics.
Math plays an extremely important role in many careers. Every field of work requires mathematics in some way or the other and Cyber security is also not independent of it. In fact, mathematics is the foundation of cyber security.

Following Mathematical concepts will be required to excel in cyber security:
1. Binary & Hexadecimal math
2. Complex Numbers
3. Boolean algebra
4. Cryptography

1. Binary math: All digital computers rely on a binary system. In simple words Binary math is a conversion of data or information into a group of several 1's and 0's. As computer only understands binary language hence this conversion is made. In case of Decimal Number System, the base is 10 whereas in Binary number system the base is 2.
Let us consider a very basic example of binary number derived from real number 45:
45 = 1x32 + 0x16 + 1x8 + 1x4 + 0x2 + 1x1
45 = 1x2^5 + 0x2^4+ 1x2^3 + 1x2^2 + 0x2^1 + 1x2^0
Here the coefficients of 2 to the power in reverse order is the required binary number
Hence, 45= 101101
Hexadecimal math: Another mathematical concept that is very important in cyber security is hexadecimal math. Hexadecimal math is based on the idea that you can count up to any one of 16 different choices, contrary to binary math where only two options are available '0' and '1'.

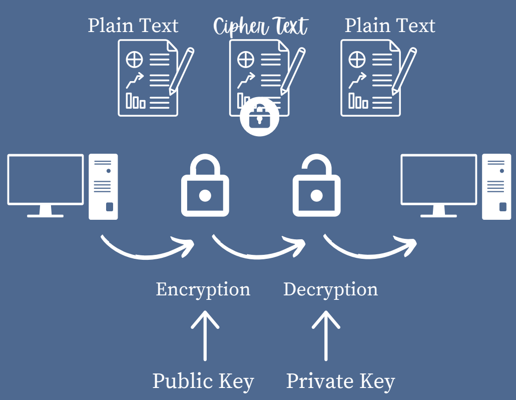
Counting in hexadecimal math has options from 0to 15, providing total sixteen choices. Since one-digit numbers only range from 0 to 9, we have to represent everything from 10 to 15 using the alphabets from A to F.
Symbols 0,1,2,3,4,5,6,7,8,9,A,B,C,D,E,F

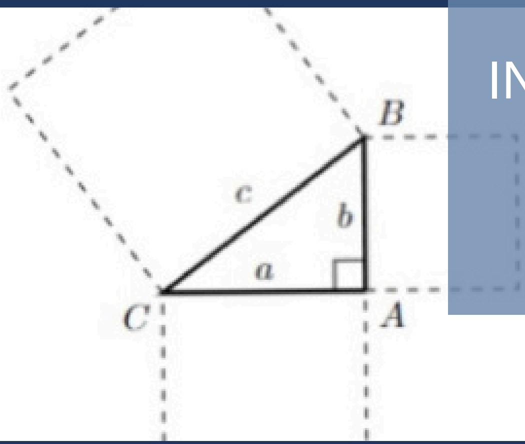
2. Complex Numbers: Complex numbers is a branch of algebra that deals with imaginary numbers. Complex number is expressed in the form of a+bi wherein a and b are real numbers and 'i' is an imaginary number called iota and is equal to square root of -1 . Complex numbers are seen in various cyber security processes, so knowing them proves to be very essential and can give you a serious edge.

3. Boolean algebra has been fundamental in the development of various fields such as electronics. Although first introduced by George Boole in his book The Mathematical Analysis of Logic in 1847, Boolean algebra is applied in modern computer programming languages and has proven to be tremendously advantageous. Characteristically, Boolean Logic is the idea that all values are either true or false. It deals with operations on logical values and incorporates binary variables of 0 and 1.
Python programming is a favourite language among cyber security communities. Therefore, knowledge and comfort with Boolean algebra concepts can provide a good foundation.

4. Cryptography is the science of using mathematics to hide data behind encryption. The math used in cryptography ranges from basic to highly advanced. It involves storing secret information with a key that one must have in order to access the raw data. Without cracking the cipher, it's impossible to know what the original data or information was.

Cryptography probably accounts for the most massive use of mathematics in cyber security. In mathematics and computer science, an algorithm is a pattern of directions that must be very clear and more importantly implementable by the computer. These algorithms are used to solve problems and even in completing the requiredcomputations. As we all know algorithms are crucial to computer science and cyber security.





INTEGRAL SOLUTIONS TO THE PYTHAGOREAN EQUATION

AAYUSHI GALA (TYBSC)

The Pythagorean theorem states that in a right-angled triangle, the square of the hypotenuse is equal to the sum of the squares of the adjacent sides.

$(BC)^2 = (AC)^2 + (AB)^2$

$\Rightarrow c^2 = a^2 + b^2$

Suppose (a, b, c) is a triple of integer solutions to the Pythagorean Equation. Then by using definition $c^2 = a^2 + b^2$

some Pythagorean triples are mentioned in the table below:

a	b	c	Type
3	4	5	
5	12	13	
9	12	15	3-4-5
10	24	26	5-12-13

Suppose (a,b,c) is a primitive Pythagorean triple (gcd(a,b,c)=1).

We know that $mn = k^2$ a perfect square with gcd(m,n)=1.

It follows $m=p^2$, $n=q^2$ such that gcd(p,q)=1.

$m = p^2$, $n = q^2$, $\gcd(p,q)=1 \Rightarrow p^2 = (c-a)/2$, $q^2 = (c+a)/2 \Rightarrow 2p^2 = c-a$, $2q^2 = c+a$

$b^2 = (c+a)(c-a) = 4p^2q^2 \Rightarrow b = 2pq$, $a = q-p$, $c = q+p \Rightarrow$ a is odd, b is even and c is odd.

p	**q**	**a**	**b**	**c**
1	2	3	4	5
2	3	5	12	13
3	8	55	48	73
24	37	793	1776	1945

Theorem:

Let u,v,w be the three sides of a primitive integral right triangle. There are co-prime integers x,y of different parity (i.e. one number is odd while the other number is even) such that $(u,v,w) = x^2 - y^2, 2xy, x^2+y^2$

For example,

1) If x=2, y=1 we obtain 3,4,5.
2) If x=3 , y=2 we obtain 5,12,13.
3) If x=4 , y=3 we obtain 7,24,25.

NUMBER BASES

DHRUV PATIL (FYBSC)

Numbers come in many forms and can be expressedusing different numeral systems depending on the usage. The decimal system we use today is base 10, along with most other historical and cultural numeral systems e.g. the roman system (although it did not use place values like the modern system).
Let us first understand how number bases work:
Base 10 means that every digit can have 10 face values {0,1,2,3,4,5,6,7,8,9}. For a number of digits, the amount of numbers which can be denoted with it is 10n (for example with 3 digits, amount of numbers which can be denoted with it is 10^3 = 1000 [nine hundred and ninety-nine numbers and a zero])

1		2		3		5
= 1 x 10^3	+	2 x 10^2	+	3 x 10^1	+	5 x 10^0

The advent of electronic communications technology brought with it the thought of interpreting electronic signals as a binary. It was used for morse code communication (dots or dashes) and was carried over to computers (0s or 1s for bits). In this manner, Base 2, the binary system was set in place as the way machines read numbers.

However, Base 2 is very long (example: 16,456 in decimal is 100000001001000 in binary). In order to shorten these numbers, bases which are of powers of 2 are used. Base 2^3=8 which is Octal and Base 2^4=16 which is Hexadecimal, using which 3/4 binary bits can be compressed into one Octal or Hexadecimal digit. Octal uses the digits 0–7, while Hexadecimal uses 10 digits and the characters A–F to get 16 characters.

The early days of computing saw the release 6-bit and 12-bit machines, which led to the initial use of Octal as a method of compressing 3 bits into 1 digit, however the establishment of the 8-bit machine as the industry standard has seen it being eclipsed by Hexadecimal, which cleanly compresses a byte of binary data into 2 digits of Hexadecimal. Hexadecimal notation is used to store IP Addresses, MAC Addresses, Error Codes (HTML and others), HTML Colour Codes among a multitude of other uses.

Another power of 2 which is used is 2^6=64. Base 64 is created by 10 digits + All uppercase characters + All lowercase characters + 2 special characters (10+26+26+2). These can store very high numbers using a small amount of characters, and is used for IDs in website URLs (e.g. Video IDs in youtube and customer/product IDs). There even exists the highly impractical Base 65536, created using Unicode Characters.

Other than computers, there exist other bases which have been used on a cultural basis. Base 60 was the counting system of the Babylonians, and their influence is seen even today in our measure of angles(degrees, minutes, seconds), time (hours, minutes, seconds), and geographic coordinates (degrees, minutes, seconds) among others.

INFINITY

PUNAM CHAHAR (SYBSC)

In mathematics, the useful concept of a process with no end. It is the concept of something that is unlimited, endless, without bound. As represented by the symbol ∞. Infinity is not a real number, it is an
idea. It is the idea of a limit, as in the expression $x \to \infty$, which suggests that the variable x increases without bound. For example, the function $f(x) = 1/x$, or the reciprocal of x, tends toward 0 as x approaches infinity as a limit.
The common symbol for infinity, ∞, was invented by the English mathematician John Wallis in 1655. We can sometimes use infinity like it is a number, Example: $\infty + 1 = \infty$. It says that when something is endless, we can add 1 and it is still endless. Let us try to subtract ∞ from both sides: $\infty - \infty + 1 = \infty - \infty \Rightarrow 1 = 0$; Oh no! Something is wrong here. In fact $\infty - \infty$ is undefined.
Good example of infinity can be found in the decimal expansion of the number π or pi.
Mathematicians use a symbol for pi because it's impossible to write the number down. Pi consists of an infinite number of digits. It's often rounded to 3.14 or even 3.14159, yet no matter how many digits you write, it's impossible to get to the end.
Another example is; Fractals and Infinity.A fractal is an abstract mathematical object, used in art and to simulate
natural phenomena. Written as a mathematical equation, most fractals are nowhere differentiable. When viewing an image of a fractal, this means you could zoom in and see new detail. In other words, a fractal is infinitely magnifiable. The Koch snowflake is an
interesting example of a fractal. The snowflake starts as an equilateral triangle.
For each iteration of the fractal:

1. Each line segment is divided into three equal segments.
2. An equilateral triangle is drawn using the middle segment as its base, pointing outward.

3. The line segment serving as the base of the triangle is removed.
The process may be repeated an infinite number of times. The resulting snowflake has a finite area, yet it is bounded by an infinitely long line.

 Three main types of infinity may be distinguished: the mathematical, the physical, and the metaphysical. Mathematical infinities occur, for instance, as the number of points on a continuous line or as the size of the endless sequence of counting numbers: 1, 2, 3... Spatial and temporal concepts of infinity occur in physics when one asks if there are infinitely many stars or if the universe will last forever. In a metaphysical discussion of God or the Absolute, there are questions of whether an ultimate entity must be infinite and whether lesser things could be infinite as well.

 Mathematical infinities
The ancient Greeks expressed infinity by the word ape iron, which had connotations of being unbounded, indefinite, undefined, and formless. One of the earliest appearances of infinity in mathematics regards the ratio between the diagonal and the side of a square. Pythagoras and his followers initially believed that any aspect of the world could be expressed by an arrangement involving just the whole numbers (0, 1, 2, 3,...), but they were surprised to discover that the diagonal and the side of a square are incommensurable—that is, their lengths cannot both be expressed as whole-number multiples of any shared unit (or measuring scale). In modern mathematics this discovery is expressed by saying that the ratio is irrational and that it is the limit of an endless, nonrepeating decimal series. In the case of a square with sides of length 1, the diagonal is Square root of√2, written as 1.414213562..., where the ellipsis (...) indicates an endless sequence of digits with no pattern.
The issue of infinitely small numbers led to the discovery of calculus in the late 1600s by the English mathematician Isaac Newton and the German mathematician Gottfried Wilhelm Leibniz. Newton introduced his own theory of infinitely small numbers, or infinitesimals, to justify the calculation of derivatives, or slopes. In order to find the slope (that is, the change in y over the change in x) for a line touching a curve at a given point (x, y), he found it useful to look at the ratio between dy and dx, where dy is an infinitesimal change in y produced by moving an infinitesimal amount dx from x. Infinitesimals were heavily criticized, and much of the early history of analysis revolved around efforts to find an alternate, rigorous foundation for the subject.
A more direct use of infinity in mathematics arises with efforts to compare the sizes of infinite sets, such as the set of points on a line (real numbers) or the set of counting numbers.

Galileo demonstrated that the set of counting numbers could be put in a one- to-one correspondence with the apparently much smaller set of their squares.
He similarly showed that the set of counting numbers and their doubles (i.e., the set of even numbers) could be paired up. Galileo concluded that “we cannot speak of infinite quantities as being the one greater or less than or equal to another.” Such examples led the German mathematician Richard Dedekind in 1872 to suggest a definition of an infinite set as one that could be put in a one-to-one relationship with some proper subset.
□The confusion about infinite numbers was resolved by the German mathematician Georg Cantor beginning in 1873. Cantor proved the surprising result that not all infinities are equal. Using a so-called “diagonal argument,” Cantor showed that the size of the counting numbers is strictly less than the size of the real numbers. This result is known as Cantor’s theorem.
Thus, infinity remains an enigmatic and captivating concept, transcending the boundaries of our finite understanding. It beckons us to delve deeper, reminding us that in the vast expanse of mathematical exploration, there are always new horizons awaiting our discovery.

RELATION BETWEEN MATHEMATICS AND ART

KINJAL KALPESHBHAI PATEL (SYBSC)

Albert Einstein once said, “After a certain high level of technical skill is achieved, science and art tends to coalesce in aesthetics, plasticity and form. The greatest scientists are artists as well.”

Mathematics and art are kind of fields which goes mostly hand-in-hand. Most people think that there is no relation between mathematics and art but in reality they both have been intertwined since ancient days. There are many aspects where we can relate them. So, let us see few of the aspects of mathematics and art, and how they are relative to each other in this assignment.

HISTORY:

Mathematics and art have a very long historical relationship then we know. It all started in 4th Century B.C. when a Greek Sculpture Polycleitus (C. 450-420 B.C.) from School of Argos wrote ‘Canon’. He gave the term of ‘Golden Ratio’ which many artists have used in their painting. He is also ranked as one of the most important sculptors of classical work for his work on the ‘Doryphorus’ and ‘The Statue of Hera’. Polycleitus is the one who gave the world a mathematical approach towards sculpturing human body.

The ‘Canon’ applies the basic mathematical concepts of Greek geometry, such as the ratio, proportion and symmetria which turns it into a system capable of describing human form through a continuous series of geometric progression.

An Italian painter, Piero Della Francesca, develops Euclid’s idea on perspective in his paintings. In the 19th Century, the works of Gauss, Labatehevsky and Riemann popularized ideas of spatial dimensions and exotic geometry or geometric. The conception of space given to young artists while developing the Theory of Relativity, which we can see in the work of 20th Century art history of “The Young Ladies of Avignon”.

The Renaissance (1400 A.D.) brought rebirth to classical Greek and Roman culture and ideas, by putting study of mathematics to understand nature and the art among them. There are/were two important things that drove artists from late middle age and Renaissance towards Mathematics:

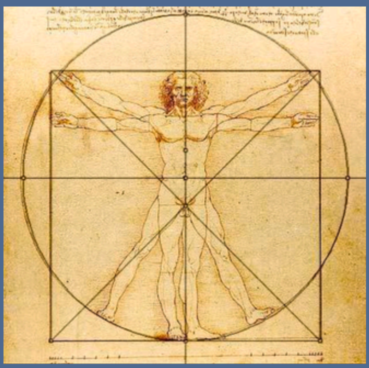
1) Painters needed to how to apply the 3-D figures in three dimensional sense on a two dimensional canvas.

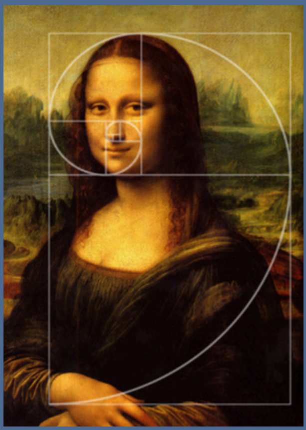
Philosophers and artist alike were convinced that mathematics was the true essence of the physical world and that the entire universe, including the art, could be explained in geometric terms.

THE GOLDEN RATIO:

Polycleitus used the first-half of the little finger as the basic module for determining the proportion of human body. He multiplied the length of distal phalanx (First half of Little Finger) by to get the last half of finger. He then took the finger length and multiplied that by to get length of the palm. This way he continued to multiple till he got the whole measure of a human body. The golden ratio is return as approximately equal to 1.618.

The famous Fibonacci, author of Fibonacci Sequence, have also proven the existence of the Golden Ratio in nature.





EXAMPLES:

1) The most famous example of Golden Ratio is “The Birth of Venus”, painted by Sandro Botticelli in 1482.

2) Cathedral of Charters (12th century) and Notre Dame de Pair (1160).

3) The worldwide known painting, the painting of ‘Mona Lisa’ painted by Leonardo Da Vinci has also used Golden Ratio for drawing Mona Lisa’s face, elbows, etc.

GEOMETRY:

In 1415, the Italian architect Filippo Brunelleschi demonstrated geometrical method using similar triangles formulated by Euclid, to find height of distant object. The historian Vasari calls Pireo Della Francesca as “greatest geometer of his time, or perhaps of anytime” in his book named ‘Lives of the Painters’. Piero is a great mathematician as well as geometer who has written books like ‘Abacus Treaties’, ‘On Prespective for Painting’, etc

His work on geometry later influenced Mathematicians and artists like Luca Pacioli and Leonardo Da Vinci. He also studied ‘Clasicaal Mathematics’ and ‘Work of Archimedes’. Peiro defines the POINT as “the tiniest thing that is possible for the eye to comprehend” while studying Euclid.
There are many branches of geometry which are linked to paintings and art.
For example:
1) Euclidean Geometry which studies the Plane and Solid figures.
2) Affine Geometry.
3) Other forms of Hyperbolic Geometry, Algebraic Geometry, Spherical Geometry, etc….
In this modern times, the graphic artist M.C. Escher made great use of Hyperbolic Geometry with the help of Mathematician H. S. M. Coxeter. Also modern day painters who are obsessed with Geometry are Salvador Dali, Bridget Riley, etc

PYTHAGORAS THEOREM:
Leonardo Da Vinci used the tight ratio of 12:6:4:3 in his painting, ‘The Last Supper’ which includes Pythagoras Theorem with a table of ideal ratios. It can also be seen in the artwork of William Blake ‘The Ancient of Days’. Even pyramidologist also argued on mathematical grounds that Golden Ratio or Pythagoras Theorem was used to build the pyramid. As we are talking about pyramids Alberti explained in 1435 De Pictuera: “light rays travel in straight lines from points in the observed scene to the eye, forming a kind of pyramid with the eye as a vertex”. So when a pyramid is constructed which linear perspective we get the cross-section of the pyramid.

The Chinese acquired the art or technique of 3-D art from India, while India developed it from Ancient Rome. We can see oblique projection in Japanese art, such as ‘Ukiyo-e’ painting of Torii Kiyonaga (1725-1815). Planar symmetries can be seen in Carpets, Lattices, Textiles, etc…. Elaborate lattice are found in Indian Jaali work, carved from marbles, to decorate tombs and palaces. Chinese Lattices, have same symmetry in every painting, existing in 14 out of 17 wallpaper groups they symmetry like mirror, double mirror or rotational symmetry. In Islamic art, we see symmetry evidently in forms as varied as Persian Girih and Moroccan Zellige Tile work, Mughal Jaali, etc….

WHAT IS GIRIH TILINGS?
The most evident or influenced art by mathematics in Islamic art is Girih tilings. They are formed using a set of five tile shapes, namely, a Regular Decagon, an Elongated Hexagon, a Bow Tie, a Rhombus and a Regular Pentagon. All the sides of these tiles have the same length; and all their angles are multiplex of 36 (), offering fivefold and tenfold symmetries.

PATTERNS, TRANSFORMATION AND SYMMETRY:

Patterns, Transformation and Symmetry are fundamental concepts in both mathematics and art. It is seen that mathematical patterns can generate artistic patterns. While the application of a group of simple designs or spatial objects of transformations automatically generates beautifully symmetric patterns and forms. A liberal arts inquiry project examines connections between mathematics and art through Mbius strip, Flexagon, Origami and Panorama photography. Mathematical objects including the Lorentz manifold and the hyperbolic plane can be crafted using fiber arts including crochet. The mathematician J. C. P. Miller used the Rule 90 cellular automation to design tapestries depicting both trees and abstract patterns of triangles.

REASONS ON WHY WE SHOULD COMBINE MATHEMATICS AND ARTS:

1) Improved Comparison:

Taking number off of paper and onto something that people can touch and feel the significance of mathematics can make it more reliable and understandable.

2) The Fun Factor:

If we see Math is often associated with fear, boredom and irrelevance. Adding art to mathematics makes mathematics fun leading to increased interest and fun.

3) Increased Inspiration: According to Jim Crowley, Executive Director of the Society for Industrial and Applied Mathematics (SIAM),'mathematicians gets insight into the mathematical structures they create by visualizing objects'. Thus combining both Arts and Mathematics increases creativity factor of the person.

4) Brain-Building: Mathematics and Art skills draw the same part of the brain, so strengthening one's arts ability or abilities positively affects skills related to Math. They both go hand-in-hand and together cause the mind to think in new and unexpected ways.

There are many more reasons like Mind-Stimulating, Technological Appreciation, Concept Visualization, etc... that boost Math and Art to go together hand-in-hand.

MATHEMATICS CONSTRAINS ARTS:

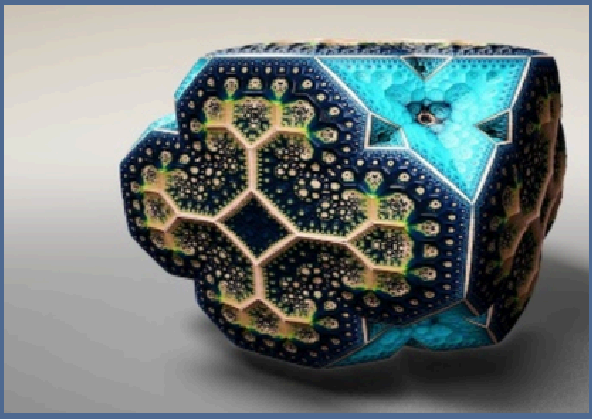
We often hear about 'artistic freedom' which means the rejection of rules in order to have freedom of expression. Yet we cannot, reject many mathematics constriction or contraints. Rather than confining art or requiring art to confirm to a narrow set of rules. But with the understanding of mathematical constrictions artists gets freedom to use their intuition and creativity within the constraints. It is not necessary that constraints have to be negative, they can show the often limitless Realm of Possibility. Voluntary Mathematical constraints can serve to guide artistic creation. If proportion has always been fundamental in aesthetic of art, design, etc... then mathematically it means the observance of ratio. Other ratio and geometric constructions also guide composition and design.

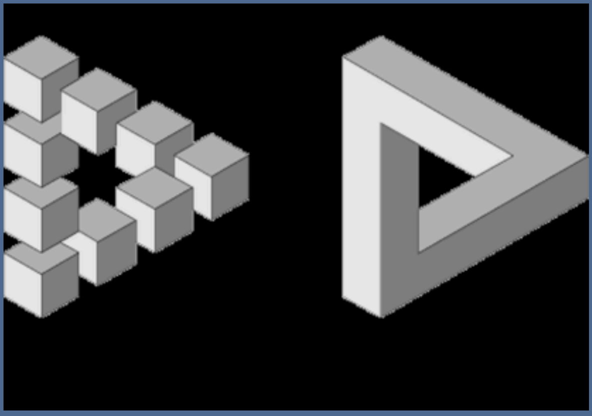
Let us also know about now-a-days mathematics and artists artwork and their thinking:

TOM BEDDARD: Fractals are patterns that repeat at every scale creating never-ending swirls, lines and curves. Tom Beddard UK Physicist shows his appreciation on fractals by creating – digital renderings of 3-D Faberge Eggs covered in detailed fractal patterns.

KERRY MITCHELL: Kerry Mitchelli's celebration of the 'Curiosity' landing on Mars. It was done by mathematical formulae and fractals.

PENROSE TRIANGLES AND PENROSE STAIRS: The fact that the world said that 'Relativity' cannot exists in real life was displays faultlessly in an image, which was of particular mathematical interest to mathematician and Cosmologist Professor Sir Roger Penrose. He published a special mathematical research paper "Impossible Objects: A Special Type of Visual Illusion". The paper was in-depth investigation of physically impossible geometries same as Relativity and contained sketches and details of two worldwide known 'Impossible Objects', the Penrose Triangle and Penrose Stairs.

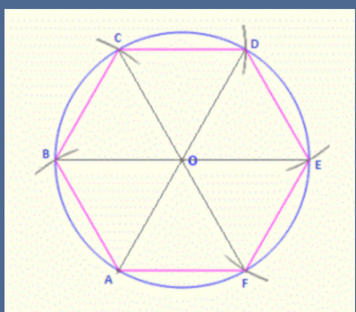




PI

AMISH PATIL (FYBSC)

The symbol pi has multiple uses, it is being used in many fields for a long period of time. Here's a little history on pi. Pi is a number that relates a circle's circumference to its diameter. Pi is an irrational number, which means that it is a real number that cannot be expressed by a simple fraction. Pi has been used in many historical civilizations like Indian, Egyptian, Chinese etc. That's because pi is what mathematicians call an "infinite decimal" — after the decimal point, the digits go on forever and ever without a recognizable pattern.
Students are usually introduced to the number pi as having an approximate value of 3.14 or 3.14159. Though it is an irrational number, some people use rational expressions, such as 22/7 or 333/106, to estimate pi. (These rational expressions are accurate upto two to three decimal places.)
The symbol π was devised by British mathematician William Jones in 1706 to represent the ratio and was later popularized by Swiss mathematician Leonhard Euler. Because pi is irrational (not equal to the ratio of any two whole numbers), its digits do not repeat, and an approximation such as 3.14 or 22/7 is often used for everyday calculations.
To thirty-nine decimal places, pi is 3.141592653589793238462643383279502884197.
The Babylonians (c. 2000 BCE) used 3.125 to approximate pi, a value they obtained by calculating the perimeter of a hexagon inscribed within a circle and assuming that the ratio of the hexagon’s perimeter to the circle’s circumference was 24/25.



The Rhind papyrus (c. 1650 BCE) indicates that ancient Egyptians used a value of 256/81 or about 3.16045. Archimedes (c. 250 BCE) took a major step forward by devising a method to obtain pi to any desired accuracy, given enough patience.

By inscribing and circumscribing regular polygons about a circle to obtain upper and lower bounds, he obtained $223/71 < \pi < 22/7$, or an average value of about 3.1418. Archimedes also proved that the ratio of the area of a circle to the square of its radius is the same constant.

Over the ensuing centuries, Chinese, Indian, and Arab mathematicians extended the number of decimal places known through tedious calculations, rather than improvements on Archimedes' method. By the end of the 17th century, however, new methods of mathematical analysis in Europe provided improved ways of calculating pi involving infinite series. For example, Isaac Newton used his binomial theorem to calculate 16 decimal places quickly.

Infinite series for π
$\pi = \frac{4}{1} - \frac{4}{3} + \frac{4}{5} - \frac{4}{7} + \frac{4}{9} - \frac{4}{11} + \frac{4}{13} + \cdots$
$\pi = 3 + \frac{4}{2 \times 3 \times 4} - \frac{4}{4 \times 5 \times 6} + \frac{4}{6 \times 7 \times 8} - \cdots$

Early in the 20th century the Indian mathematician Srinivasa Ramanujan developed exceptionally efficient ways of calculating pi that were later incorporated into computer algorithms. In the early 21st century computers calculated pi to 62,831,853,071,796 decimal places, as well as its two-quadrillionth digit when expressed in binary (0).

$$\pi = \cfrac{4}{1 + \cfrac{1^2}{2 + \cfrac{3^2}{2 + \cfrac{5^2}{2 + \cfrac{7^2}{2 + \ddots}}}}}$$

Pi has even trickled into the literary world. Pilish is a form of writing English in which the numbers of letters in successive words follow the digits of pi, according to author Mike Keith. Keith used Pilish in his book "Not A Wake." Here is an example from the book: "Now I fall, a tired suburbian in liquid under the trees, drifting alongside forests simmering red in the twilight over Europe."
"Now" has 3 letters, "I" has 1 letter, "fall" has 4 letters, "a" has 1 letter, and so on.
Infinite series for π

In basic mathematics, π is used in many everyday applications, such as:
• Measuring the circumference and area of circles, such as in the design of wheels, gears, and circular objects.
• Measuring the volume of circular objects such as cylinders, spheres, and cones.
• In trigonometry, which is used in navigation, physics, engineering, and many other fields.

• In computer graphics, such as rendering 3D images and animation.
• In surveying and cartography, to calculate distances and angles on the Earth's surface.
• In signal processing, to model and analyse cyclical signals.
In physics and engineering, pi is used in the calculation of wave patterns, fluid dynamics, and electromagnetism.
• In architecture and construction, pi is used to calculate the dimensions of circular structures such as domes and arches.
• In music, pi is used to calculate the frequencies of different musical notes.
• In computer science, pi is used in various algorithms and coding such as image processing and computer graphics, random number generation and cryptography.
• In chemistry, pi is used in the calculation of the properties of molecules and chemical reactions.
• In machine learning, pi is used in the calculation of various trigonometric functions, which are used in many algorithms such as gradient descent and backpropagation.
• In computer vision, pi is used to calculate the angles and distances of objects in images and videos, which is important for tasks such as object detection and tracking.
• In robotics, pi is used to control the movement of robotic arms and legs, as well as to calculate the position and orientation of robots in space.
• In neural networks, pi is used in the activation function such as Sigmoid, Hyperbolic tangent, which are used to introduce non-linearity in the model.
If pi (π) was never discovered, it would have significant impacts on many areas of mathematics, science, engineering, and technology

In simple words without Pi life would be very difficult. It is widely used due to its simplicity and universality, and without it, scientists and mathematicians would likely have to develop other methods to calculate these properties, slowing down progress in many fields. Without pi, many of the historical, cultural and societal significance of pi would have never occurred.

Just like Newton and Ramanujan, can you find a solution to figure out the value of pi?

NUMBERS IN THE ANCIENT WORLD

SHREY CHOUDHARY (SYBCOM)

Numbers have been an integral part of human life since ancient times. From counting and measuring to conducting trade and commerce, numerical systems have played a crucial role in shaping the world as we know it today. In this article, we'll delve into the history of numbers in the ancient world, exploring the different numerical systems and their significance.

One of the earliest numerical systems was the tally system, also known as the tally stick. This system was used in ancient civilizations such as the Babylonians and the Sumerians to record numerical information on sticks or bones. The sticks were marked with notches or incisions, which represented units, tens, hundreds, and so on. This simple but effective system was used for centuries and was widely adopted throughout the ancient world.

Another important numerical system was developed by the ancient Egyptians. The Egyptian numerical system was based on the use of hieroglyphs, which represented numbers and served as a means of recording numerical information. The Egyptians used this system for counting, record keeping, and even for calculating astronomical events. The system was based on the concept of a unit fraction, which allowed them to represent fractional numbers and perform complex calculations.

The ancient Greeks also developed their own numerical system, known as the Attic system. The Attic system was used for trade and commerce, and it was based on the use of letters as symbols for numbers. The letters were written from right to left and represented units, tens, hundreds, and so on. This system was widely used in the ancient Greek world and played a significant role in the development of mathematics.

The Romans developed a numerical system that was based on the use of numerals and a symbol for zero. The Roman numeral system was widely used for trade and commerce and became the dominant numerical system throughout the Roman Empire. The system was later adopted by the Europeans and remained in use for centuries, until the advent of the Arabic numeral system.

The Arabic numeral system, also known as the Hindu-Arabic numeral system, was developed in India and later adopted by the Arabs. The system was based on the use of ten symbols, including the symbols for zero, one, two, three, and so on. The system was designed to be easily written and read and quickly became popular throughout the Islamic world. In the 10th century, the system was introduced to the West, where it eventually replaced the Roman numeral system and became the dominant numerical system in Europe.

The importance of numerical systems in the ancient world cannot be overstated. They played a crucial role in shaping the way we think about numbers and paved the way for the development of modern mathematics. From trade and commerce to scientific and mathematical calculations, numerical systems were an essential tool in the daily lives of ancient peoples.

In conclusion, the history of numbers in the ancient world is rich and fascinating. From the tally system of the Babylonians and Sumerians to the Arabic numeral system, numerical systems have evolved over thousands of years to become the sophisticated tools that we use today. They have played a critical role in shaping the world as we know it and will continue to play a crucial role in shaping our future.

EVENTS

Maths Day

On 22 December 2022, the students of the Mathematics Department of K.C.College organised National Mathematics Day to commemorate the birthday of Shri Srinivasa Ramanujan, the great mathematical genius who made exemplary contributions to mathematics.The purpose of Mathematics Day was to raise awareness about the importance of mathematics in everyday life and to pique students' interest in studying mathematics.
'I Love Mathematics' was the theme of this event.
As part of the festivities, first and second year BSc students organised a quiz and games.
The event began with an introduction to Shri Srinivasa Ramanujan and his contributions to mathematics. It was followed by several quizzes on Algebra, Geometry, and Speed Mathematics.
Students and teachers alike had a great time at the event. The event came to a close with a vote of thanks to the Principal and the Vice Principals and the faculty of Department of Mathematics for making this event a grand success. It was indeed an enjoyable event that not only made the subject of Mathematics more interesting but also ignited the fire of mathematics within the students.

Sci-Code

The Department of Mathematics, at K.C. College organized two events in SCI CODE #23 on 28th February 2023. The theme of our events was: “It’s All About Numbers”. Dr. Rakesh Barai, Associate Professor from G.N. Khalsa College was the external judge for the events.

Our first event “SANKHYA”; the poster competition saw 12 entries from F.Y. and S.Y. BSc students. Students explored and expressed their ideas on canvas on various types and aspects of numbers such as π, ∞, i, 0, magic squares and history of numbers. Amish Patil and Shruti Shende (FYBSc)secured first, Punam Chahar (SYBSc) secured second and Mahak Bafna and Diya Poojary (FYBSc) secured the third rank.

Our Second event “STORIES OF NUMBERS”; the seminar presentation competition had 10 entries from F.Y, S.Y and T.Y. BSc students. Students dived deep into specific types and patterns of numbers such as the Pythogorean Triplets, Pascal’s Triangle, Origin and History of the number Zero, Types of Infinities, etc. They gave presentations in the form of PPT. Aayushi Gala and Tarakeshwar Chadaram (TYBSc) won the first, Rahul Yadav (FYBSc) won the second and Faariya Syed(SYBSc) won the third prize.

Field Visit

The Mathematics Department of K.C College organised a field trip to the Indian Institute of Technology (IIT Bombay) for its first batch of TYBSc Mathematics students on 10th November 2022.
This trip aimed to foster in our students, the desire to pursue further studies in Mathematics from institutes such as the IIT. To give our students the opportunity to interact with students and faculty members of the Mathematics Department of IITB and also to enjoy the subject and understand it's intricacies.
7 students from TYBSc Mathematics joined this trip with Prof. Nilesh Bhandarkar.
This field trip to IIT Bombay has been a wonderful success for our TYBSc mathematics students. They got an opportunity to learn mathematics and imbibe ideas from Professor Ananthnarayan Hariharan through his highly interactive guest lecture. The students from mathematics department at IIT were also warm, supportive and encouraging.
Our students connected and bonded easily with them. They discussed many things from curriculum to life in IIT campus. The visit to central library was also highly enriching as students explored books from different areas in mathematics. Our students also walked miles in the campus, appreciating the various departments, hostels, lake and the temple area.
We, at mathematics department in KC College, look forward to conduct many such interactive programs with professors and students from mathematics department, IIT Bombay in the future.

Events of 2021-22

DATE	EVENTS	LEARNING OUTCOME
20th September 2021 to 10th October 2021	The department along with MTTS trust hosted **a Series of 12 Lectures under** the national level Online Foundation Course in Mathematics. **Resource person**: Dr.Vikram Aithal, Associate Professor, Institute of Chemical Technology, Mumbai	The participating students also got better conceptual understanding of the subject by attending these sessions. The online platform was effectively used so that the students from rural region get an opportunity to interact with teachers from reputed institutes.
23rd July 2021	**Informative Webinar: "Financial Planning Lessons from Covid affected families"** was organized for the benefit of nonteaching staff from various colleges in Mumbai. Resource Person: Ms. Uma Chandar, Certified Financial Planner.	Resource person explained in detail the need of financial planning as far as family wellbeing is concerned. Importance of life insurance, medical insurance were also discussed.
8th and 9th of July 2021.	**Two days state level online workshop: "Mathematical and Computational Applications in Biological, Chemical and Related Sciences".** Jointly organized with Life Science, Statistics and Chemistry Departments of K C College.	Workshop added value to the prior knowledge and gave the participants ideas they can work on in the future. The aim of the workshop was accomplished in teaching and igniting importance of Data Science as a new edge in the field of Sciences.

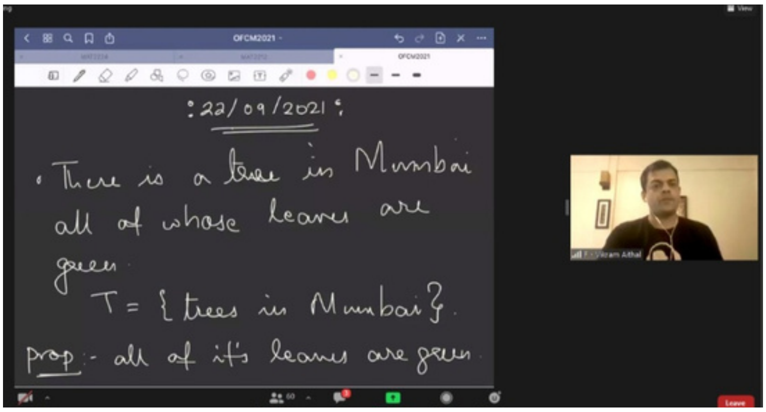
Events of 2021-22

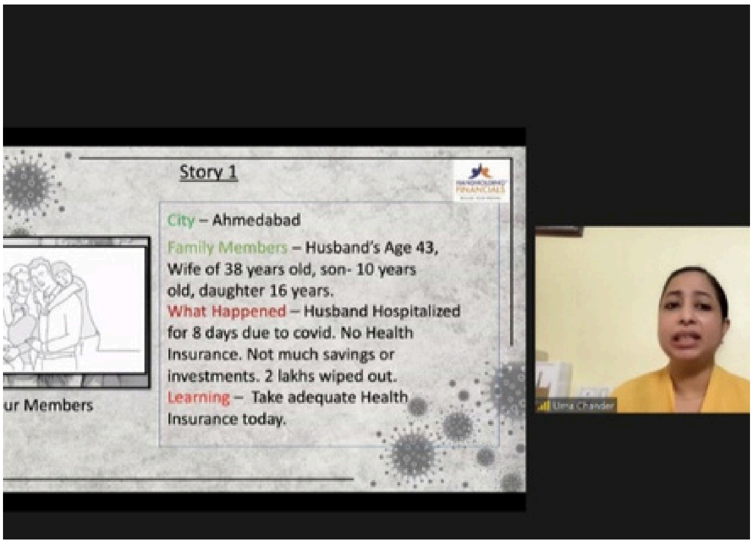
DATE	EVENTS	LEARNING OUTCOME
18th January 2022	National Webinar on **'Interdisciplinarity and Natural Sciences: Disrupting the Silos'** **Resource persons**:Dr. K Sridhar, Azim Premji University,Dr. Ram Ramaswamy, Visiting Professor, IIT-Delhi. And Dr. PrajvalShastri,ICRAR, Australia	Man divided knowledge into different branches for the simplicity in understanding The need of the time is now to work together for the further development
9th February 2022	**International Online Lecture series on "Ecological Data Science: Concepts, Mathematical Modelling, and Inference"** Star Scheme-Status activity, Jointly organized with Department of Statistics, Department of Life Sciences and Environmental Committee, KC College.	Students were introduced to the concepts and mathematical modelling of the problems in Ecology.
22nd December 2022	Online Talk Under DBT Star Scheme/ SHP – Jigyaasa **Title: Making your Money Count.** **Resource Person:** Mr. Akshat Shrivastava,INSEAD management Consultant	42 students from SYBSc, SYBA, SYBCom were the beneficiaries of this event full of information by Mr. Akshat Shrivastava.

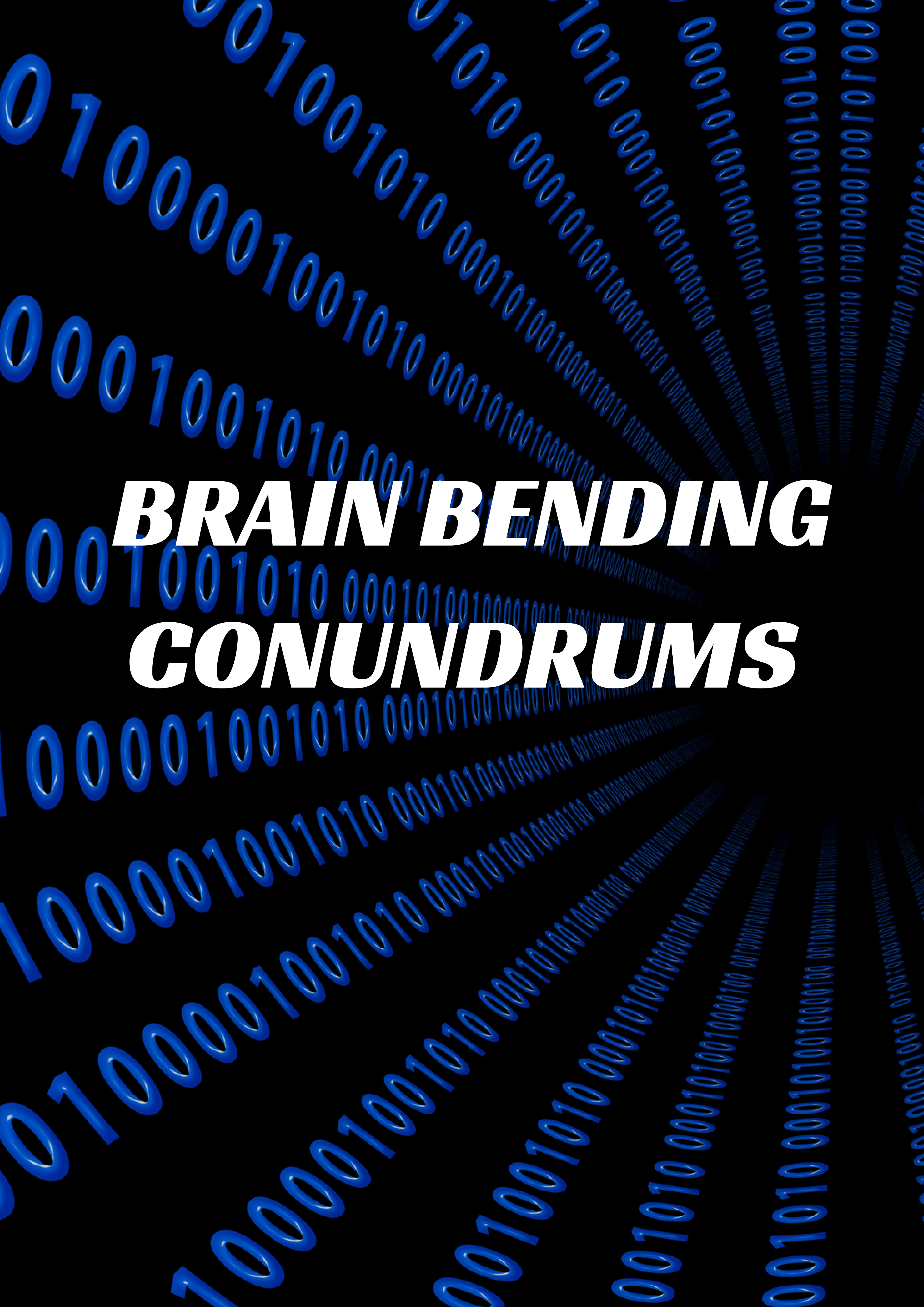
Events of 2021-22

DATE	EVENTS	LEARNING OUTCOME
29th, 30th January and 1st February 2022	Online IIT- JAM Workshop jointly with the Department of Mathematics And Statistics, NES Ratnam College of Arts,Science & Commerce. Resource Persons: Mr. Kunalkumar Shelar,Mr.Shriprasad Tambe,Mr. Pranil Waikar	Students got good problem-solving practice and were also introduced to the techniques of studying for such competitive examinations.
17th December 2021	**RCRCG '21: REROUTING FROM CODE RED TO GREEN.** Online talk by Mr. Bhushan Bhoir, Assistant Professor,Department of Zoology, Sonopant Dandekar College, Palghar on "Climate Change: Challenges and Solutions" jointly with the department of History and the Environmental Committee of K C College.	The students faculty got insight of the environmental issues and also got to know various ways one can contribute for the bringing about change and evolution while safeguarding the environment
10th February 2022	Intercollegiate Science festival of K C College,Mathematics Department organised Online presentation Competition, Online Rangoli Competition, Origami Workshop.	Students learnt about origami and it's history along with the mathematical angle to this skill. While exploring various folds and cuts, students got familiar with many geometric shapes and figures.
12th February 2022	The Webinar "Data Analytics using MS Excel" was organised Jointly with Departments of Information Technology and Computer Science for undergraduate students. Resource Person :Kaushal Shah	Students were introduced to different statistical functions and data analytics tools available in MS- Excel to solve financial problems.

Images from the events of 2021-22



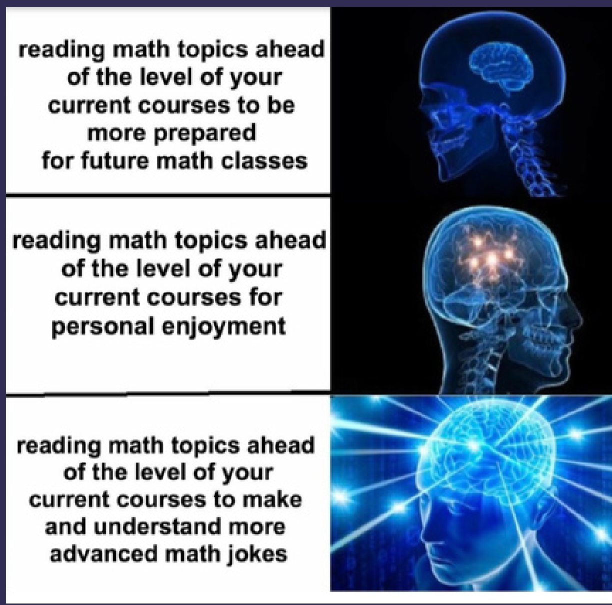


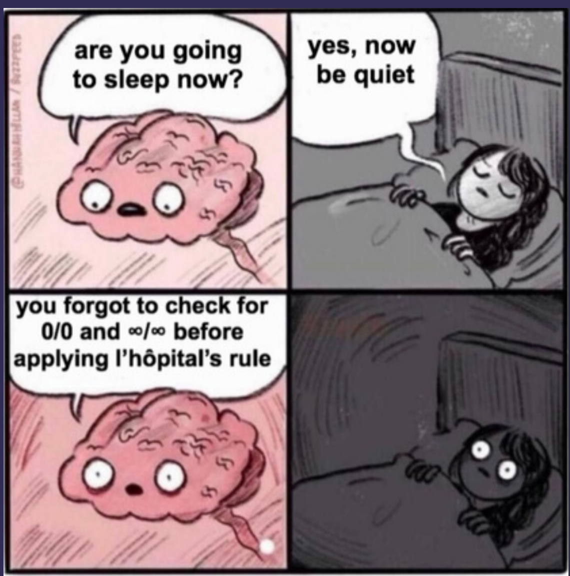


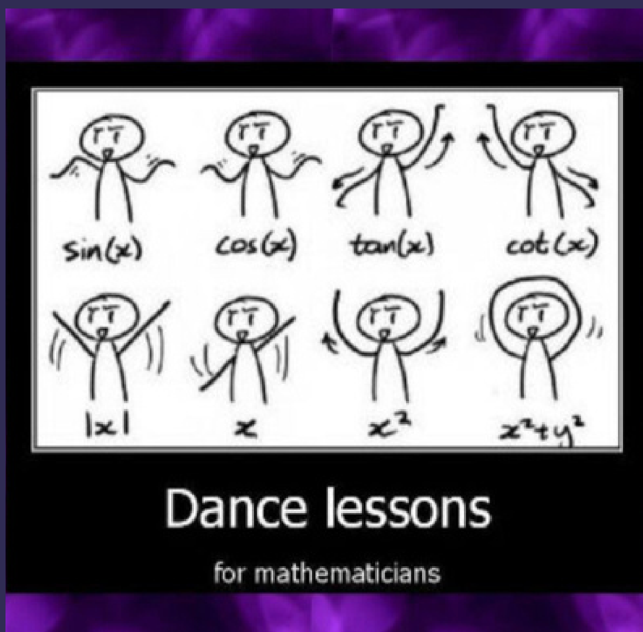
BRAIN BENDING CONUNDRUMS

MEME TIME


HE'S IRRATIONAL AND HE GOES ON AND ON.
Counselor
WIFE OF Pi
©2013 Scott Hilburn/Distributed by Universal Uclick
2/8


reading math topics ahead of the level of your current courses to be more prepared for future math classes
reading math topics ahead of the level of your current courses for personal enjoyment
reading math topics ahead of the level of your current courses to make and understand more advanced math jokes

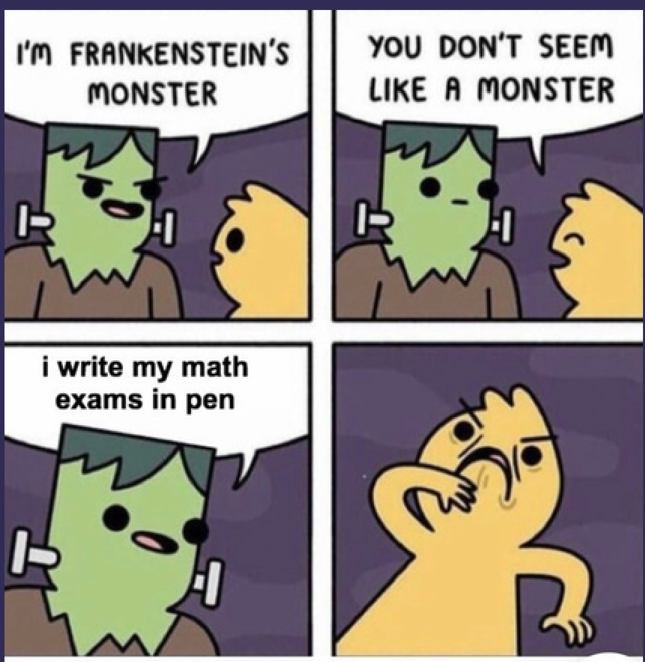

are you going to sleep now?
yes, now be quiet
you forgot to check for 0/0 and ∞/∞ before applying l'hôpital's rule

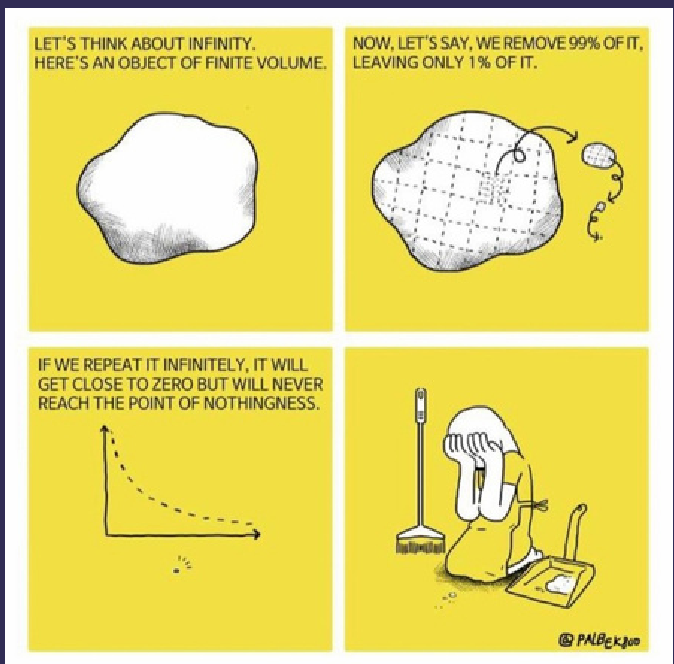

sin(x)
cos(x)
tan(x)
cot(x)
|x|
x
x²
x²+y²
Dance lessons
for mathematicians

MEME TIME


Tell me your best merits and I will choose the next king
I'm Brave
I'm strong
I remember to add +c after integrating


for every epsilon
there exists a delta


I'M FRANKENSTEIN'S MONSTER
YOU DON'T SEEM LIKE A MONSTER
i write my math exams in pen


LET'S THINK ABOUT INFINITY. HERE'S AN OBJECT OF FINITE VOLUME.
NOW, LET'S SAY, WE REMOVE 99% OF IT, LEAVING ONLY 1% OF IT.
IF WE REPEAT IT INFINITELY, IT WILL GET CLOSE TO ZERO BUT WILL NEVER REACH THE POINT OF NOTHINGNESS.
@ PALBEK800

RIDDLE TIME

1 . PROBLEM OF SHOPPING

Meena went out shopping. She had in her handbag approximately Rs. 15/- in one rupee notes and 20 p. coins. When she returned she had as many one rupee notes as she originally had and as many 20p. coins as she originally had one rupee notes. She actually came back with about one-third of what she
had started out with. How much did she spend and exactly how much did she have with her when she started out?

2 . A QUESTION OF DISTANCE

It was a beautiful sunny morning. The air was fresh and a mild wind was blowing against my windscreen. I was driving from Bangalore to Brindavan Gardens. It took me 1 hour and 30 minutes to complete the journey. After lunch I returned to Bangalore. I drove for 90 minutes. How do you explain it?

3. SMALLEST INTEGER

Can you name the smallest integer that can be written with two digits?

4. A Problem of Regions

There are thirty-four lines that are tangent to a circle, and these lines create regions in the plane. Can you tell how many of these regions are not enclosed?

RIDDLE TIME

5 . A PECULIAR NUMBER

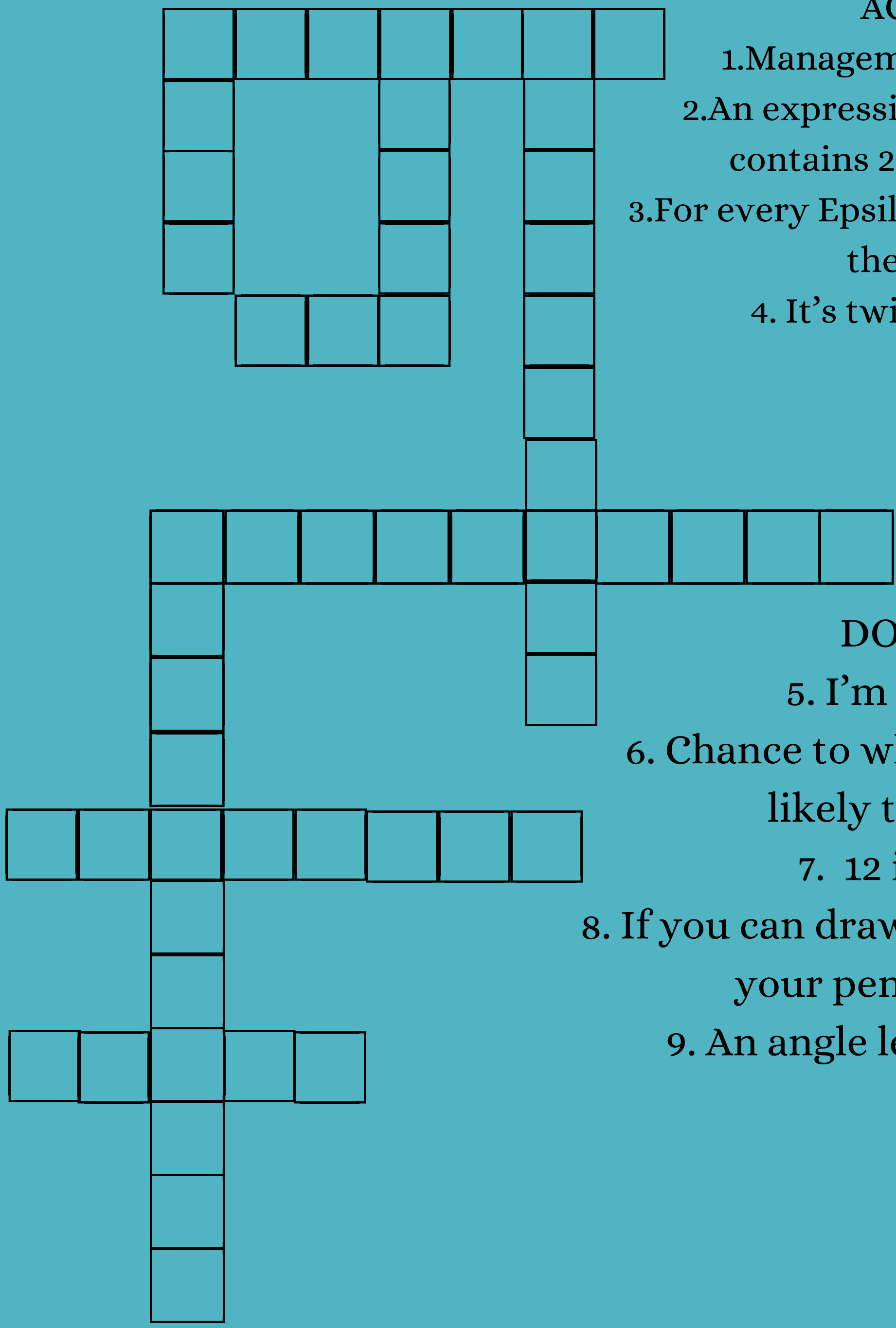
Here is a multiplication: 159 x 487632 Can you see something peculiar in this multiplication? Yes, all the nine digits are different. How many other similar numbers can you think of?

6 . A PROBLEM OF BIGGEST NUMBER

Can you name the biggest number that can be written with four 1s?

7. PROBLEM OF WALKING

Next door to me lives a man with his son. They both work in the same factory. I watch them going to work through my window. The father leaves for work ten minutes earlier than his son. One day I asked him about it and he told me he takes 30 minutes to walk to his factory, whereas his son is able to cover the distance in only 20 minutes. I wondered, if the father were to leave the house 5 minutes earlier than his son, how soon the son would catch up with the father. How can you find the answer?



ACROSS

1.Management's of Money

2.An expression in algebra that contains 2 or more terms

3.For every Epsilon greater than zero, there exist

4. It's twice the radius

DOWN

5. I'm 3.14159

6. Chance to which an event is likely to occur

7. 12 inches

8. If you can draw it without lifting your pen then it is

9. An angle less than right

ANSWERS

1) Let us assume that originally Meena had X 1 Let us rupees and Y 20 paise coins. Going shopping she had (100X + 20 Y) paise She returned with only (100 Y + 20 X) paise. This last sum, as we know, is one-third of the original and therefore
3(100Y + 20X) = 100X + 20 Simplifying we have X = 7 Y. If Y is 1 then X is 7. Assuming this, Meena had 7.20 rupees when she set out for shopping.This is wrong because Meena actually had about 15 rupees. Let us see now what we get if Y = 2. Then X = 14 . The original sum was 14.40 rupees which accords with the condition of the problem. If we assume that Y = 3 then the sum will be too big- 21.60 rupees. Therefore the only suitable answer is 14.40 rupees. After shopping Meena had 2 one rupee notes and 14 twenty Paise coins. This is actually 1/3rd of the original sum 1.440: 3= 480. Meena's purchases, therefore, cost 14.40 - 4.80 = 9.60

2) There is nothing to explain here. The driving time there and back is absolutely the same because 90 minutes and 1 hour and 30 minutes are one and the same thing. This problem is meant for inattentive readers who may think that there is some difference between 90 minutes and 1 hour 30 minutes.

3) The smallest integer that can be written with two digits is not 10 as one may assume. But it is expressed as follows:
1/1 2/2 3/3 etc upto 9/9

4) 68 regions. Each new tangent increases the non-enclosed areas by two.

5) 0ne can think of at least 9 examples:
39 x 186 = 7254
18 x 297 = 5346
28 x 157 = 4396
42 x 138 = 5796
12 x 483 = 5796
48 x 159 = 7632
4 x 1738 = 6952
27 x 198 = 5346
4 x 1963 = 7852
If you try patiently, perhaps you may come up with some more.

6) People often think of the number 1111 as the biggest number that can be written with four l's. But there is a number many, many times greater than this number, namely: 11^11 = 285311670611 As you can see 11^11 is almost 250 million times greater than 1111.

7) There are many ways of solving this problem without equations. There is one way- In five minutes the son covers ¼ of the way and the father ⅙ i.e. ¼ - ⅙ = 1/12 less than the son.Since the father was ⅙ of the way ahead of the son, the son would catch up with him after ⅙ : 4/12 = 2 five minute intervals, or 10 minutes. There is one other way of doing this calculation which is even simpler:
To get to work the father needs 10 minutes more than the son. If he were to leave home 10 minutes earlier, they would both arrive at work at the same time. If the father were to leave only five minutes earlier, the son would overhaul him halfway to work i.e. 10 minutes later, since it takes him 20 minutes to cover the whole distance.

Mathematics reveals its
secret only to those who
approach it with pure
love, for its own beauty.