Contribution of Mathematicians

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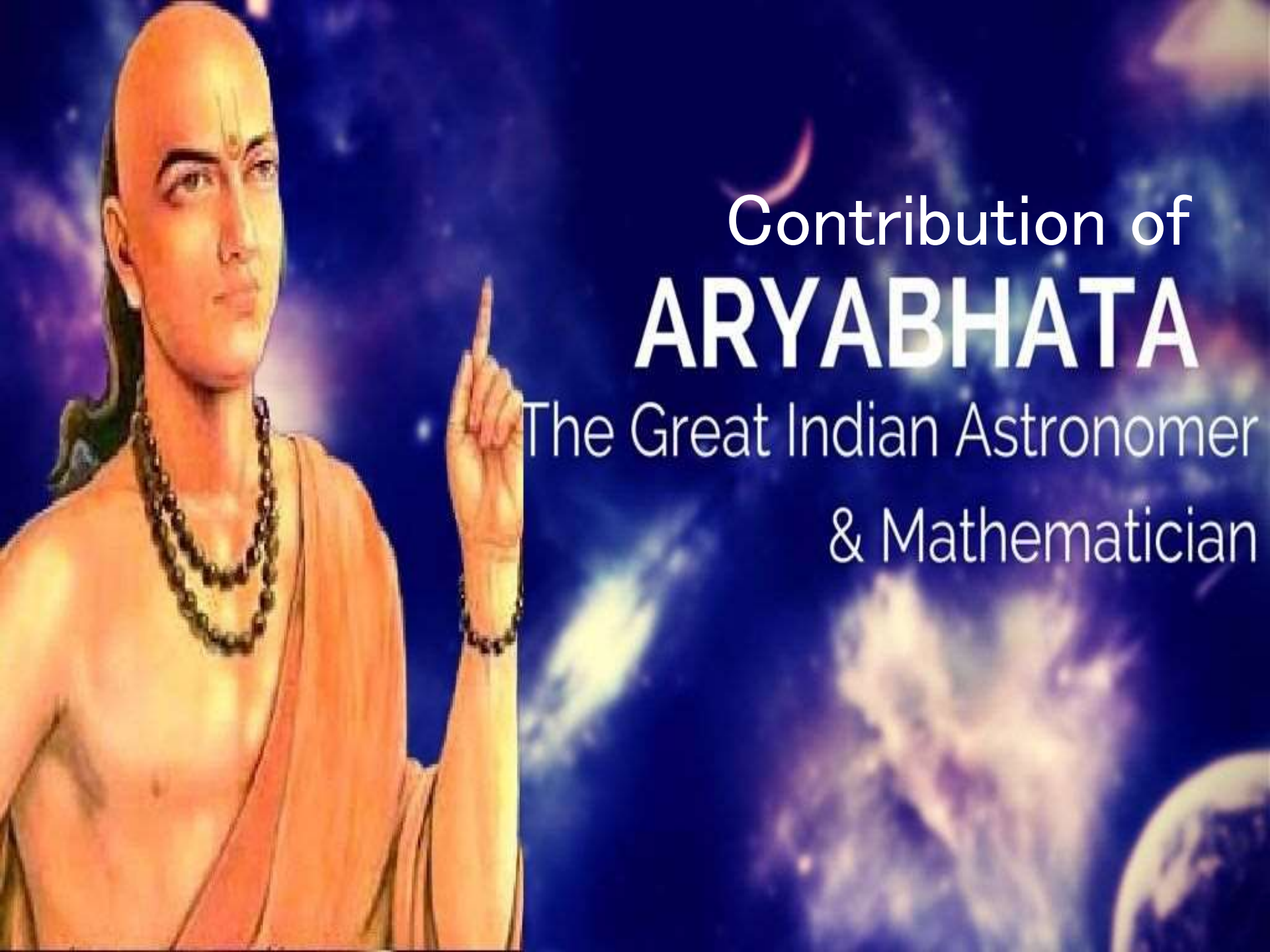

Contribution of
ARYABHATA
The Great Indian Astronomer
& Mathematician

HIS LIFE

Born	476 AD (1707-04-15)
Died	550 AD
Residence	Kusumapura or Pataliputra (Patna)
Nationality	Indian
Fields	Mathematics, Astronomy
Institutions	Nalanda University

One of the most notable works of Aryabhata is the **Aryabhatiya**

- The text is written in Sanskrit and divided into four sections, covering a total of 121 verses that describe different results using a mnemonic style typical for such works in India.
- The *Aryabhatiya* begins with an introduction called the "Dasagitika" or "Ten Giti Stanzas." This begins by paying tribute to Brahman, the "Cosmic spirit" in Hinduism. Next, Aryabhata lays out the numeration system used in the work. It includes a listing of astronomical constants and the sine table. The book then goes on to give an overview of Aryabhata's astronomical findings.
- Most of the mathematics is contained in the next part, the "Ganitapada" or "Mathematics."
- The next section is the "Kalakriya" or "The Reckoning of Time." In it, he divides up days, months, and years according to the movement of celestial bodies. He divides up history astrologically - it is from this exposition that historians deduced that the *Aryabhatiya* was written in c. 499 C.E. It also contains rules for computing the longitudes of planets using eccentrics and epicycles.
- In the final section, the "Gola" or "The Sphere," Aryabhata goes into great detail describing the celestial relationship between the Earth and the cosmos. This section is noted for describing the rotation of the earth on its axis. It further uses the armillary sphere and details rules relating to problems of trigonometry and the computation of eclipses.

Aryabhata is the author of several treatises on mathematics and astronomy, some of which are lost.

His major work, *Aryabhatiya*, a compendium of mathematics and astronomy, was extensively referred to in the Indian mathematical literature and has survived to modern times. The mathematical part of the *Aryabhatiya* covers arithmetic, algebra, plane trigonometry, and spherical trigonometry. It also contains continued fractions, quadratic equations, sums-of-power series, and a table of sines.

The *Arya-siddhanta*, a lot work on astronomical computations, is known through the writings of Aryabhata's contemporary, Varahamihira, and later mathematicians and commentators, including Brahmagupta and Bhaskara I. This work appears to be based on the older Surya Siddhanta and uses the midnight-day reckoning, as opposed to sunrise in *Aryabhatiya*. It also contained a description of several astronomical instruments: the gnomon (*shanku-yantra*), a shadow instrument (*chhAyA-yantra*), possibly angle-measuring devices, semicircular and circular (*dhanur-yantra / chakra-yantra*), a cylindrical stick *yasti-yantra*, an umbrella-shaped device called the *chhatra-yantra*, and water clocks of at least two types, bow-shaped and cylindrical.

A third text, which may have survived in the Arabic translation, is *Al ntf* or *Al-nanf*. It claims that it is a translation by Aryabhata, but the Sanskrit name of this work is not known. Probably dating from the 9th century, it is mentioned by the Persian scholar and chronicler of India, Abū Rayhān al-Bīrūnī.

His remarkable contributions in Maths were in-

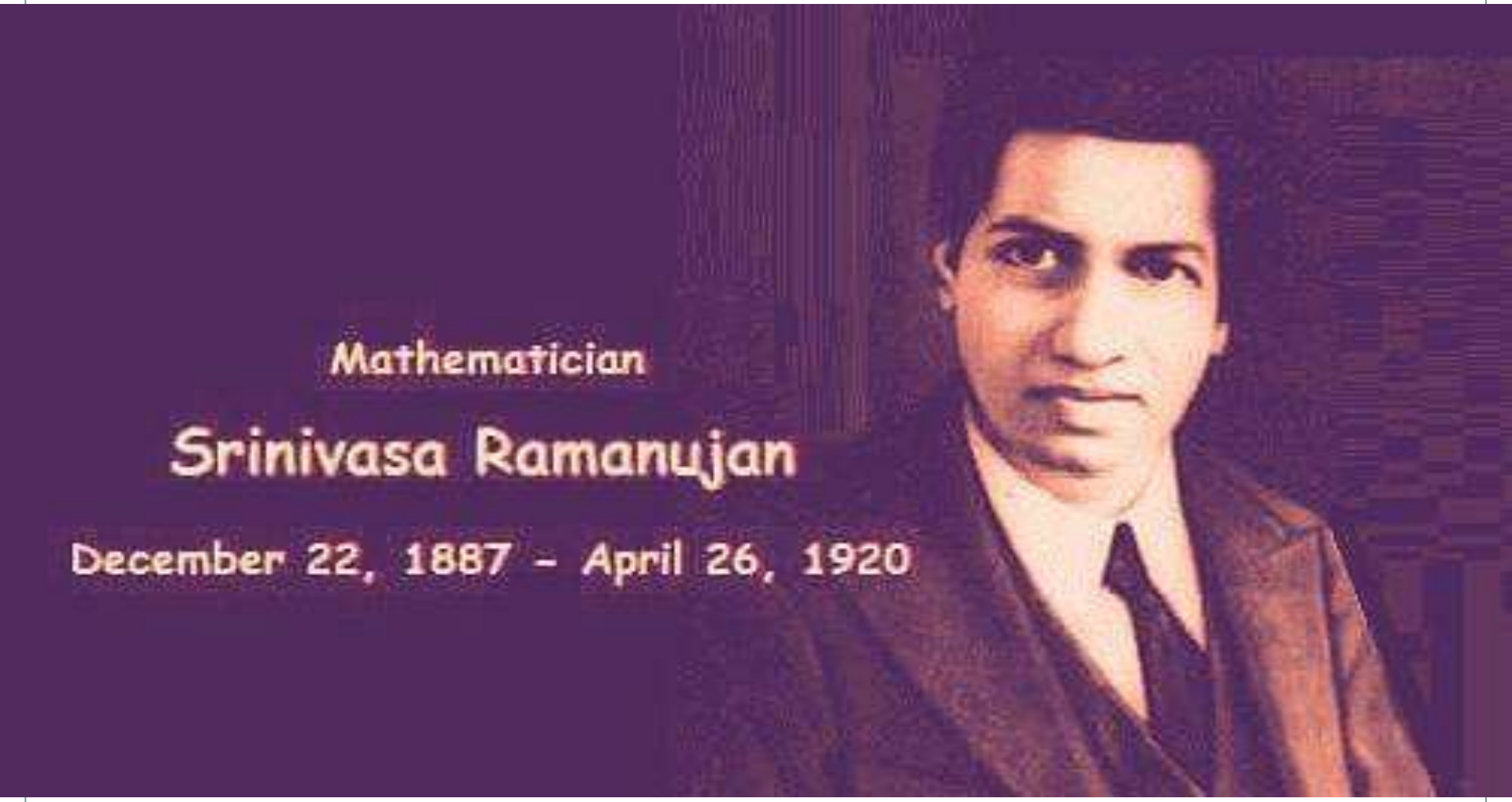
- **Place value system and zero**
- The place-value system, first seen in the 3rd-century Bakhshali Manuscript, was clearly in place in his work. While he did not use a symbol for zero, the French mathematician Georges Ifrah explains that knowledge of zero was implicit in Aryabhata's place-value system as a place holder for the powers of ten with null coefficients.
- **Approximation of π**
- Aryabhata worked on the approximation for pi ( ), and may have come to the conclusion that is irrational. In the second part of the *Aryabhatiyam* (gaṇitapāda 10), he writes:
- ."Add four to 100, multiply by eight, and then add 62,000. By this rule the circumference of a circle with a diameter of 20,000 can be approached."
- This implies that the ratio of the circumference to the diameter is $((4 + 100) \times 8 + 62000)/20000 = 62832/20000 = 3.1416$, which is accurate to five significant figures.

Sidereal periods

Considered in modern English units of time, Aryabhata calculated the sidereal rotation (the rotation of the earth referencing the fixed stars) as 23 hours, 56 minutes, and 4.1 seconds; the modern value is 23:56:4.091. Similarly, his value for the length of the sidereal year at 365 days, 6 hours, 12 minutes, and 30 seconds (365.25858 days) is an error of 3 minutes and 20 seconds over the length of a year (365.25636 days).

Heliocentrism

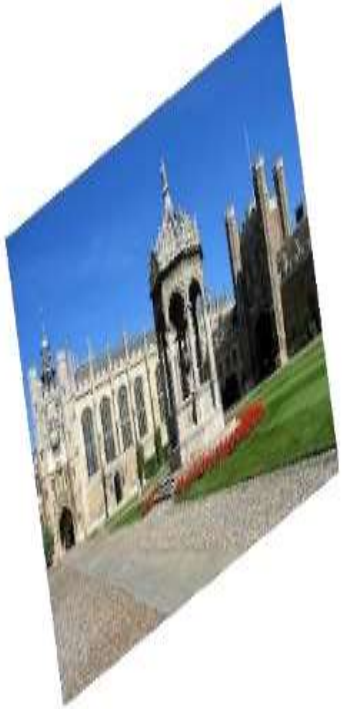
As mentioned, Aryabhata advocated an astronomical model in which the Earth turns on its own axis. His model also gave corrections (the *śīgra* anomaly) for the speeds of the planets in the sky in terms of the mean speed of the sun. Thus, it has been suggested that Aryabhata's calculations were based on an underlying heliocentric model, in which the planets orbit the Sun, though this has been rebutted. It has also been suggested that aspects of Aryabhata's system may have been derived from an earlier, likely pre-Ptolemaic Greek, heliocentric model of which Indian astronomers were unaware, though the evidence is scant.


Mathematician
Srinivasa Ramanujan
December 22, 1887 - April 26, 1920

History Of S.RAMANUJAN-

- Born on December 22 , 1887.
- In a village in Madras State, at Erode, in Tanjore District.
- In a poor HINDU BRAHMIN family.
- Full name is "SRINIVAS RAMANUJAN AYYANGER".
- Son of Srinivas Iyenger.
- Accountant to a cloth merchant at KUMBHAKONAM. Daughter of petty official (Amin) in District Munsif's court at Erode.
- Daughter of petty official (Amin) in District Munsif's court at Erode.
- First went to school at the age of 7.

- So intelligent that as students of class 3rd or primary school.
- Solved all problems of Looney's Trigonometry meant for degree classes.
- At the age of seven , he was transferred to Town High School at Kumbhakonam.
- He held scholarship.
- Stood first in class.
- Popular in mathematics.



- At the age of 12, he was declared "CHILD MATHEMATICIAN" by his teachers.
- Entertain his friends with theorem and formulas.
- Recitation of complete list of Sanskrit roots and repeating value of ∏ and square root of 2, to any number of decimal places.
- In 1903 , at the age of 15, in VI form he got a book , "Carr's Synopsis".
- "Pure and Applied Mathematics"

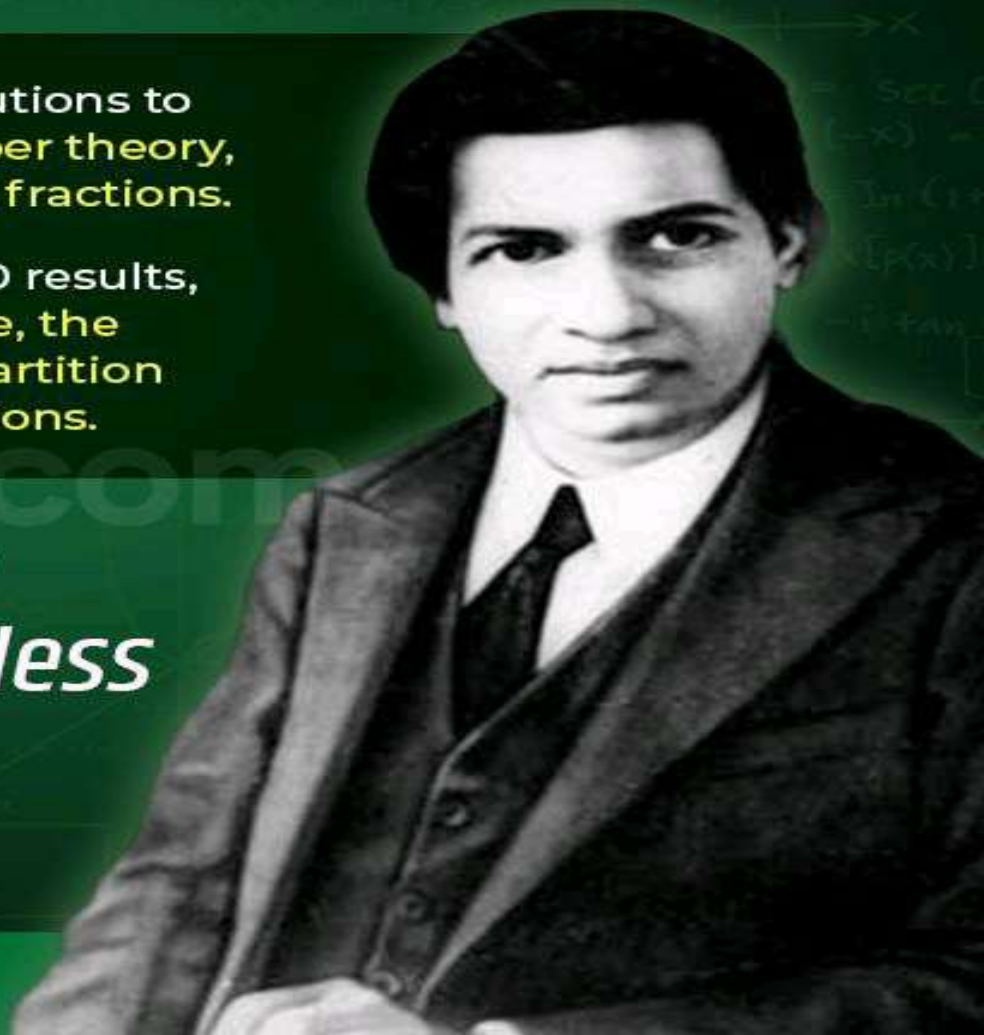
NATIONAL MATHEMATICS DAY

22nd Dec

National Mathematics Day is celebrated on Srinivasa Ramanujan's birthday in recognition of his contribution to Mathematics.

He made substantial contributions to mathematical analysis, number theory, infinite series, and continued fractions.

He also compiled nearly 3,900 results, such as the Ramanujan prime, the Ramanujan theta function, partition formulae & mock theta functions.



"An equation has no meaning for me unless it expresses a thought of God."

❖Published his work in the **Journal of Indian Mathematician Society**

❖In 1911, at the age of 23 years wrote a long article on the Some Properties of **Bernoulli's Number**

❖In 1912, he contributed two more notes to the same journal and also several questions for solution.

❖Correspondence with **Prof. G.H. Hardy** (leading Mathematicians of that time)

❖120 theorems attached to his first letter

❖In 1914, invited in Cambridge University and in 1916 he got honorary B.A. degree from Cambridge University.

His Achievements-

1) **Divergent Series**:- When Dr. Hardy examined his investigation – "I had never seen anything the least like them before. A single look at them is enough to show that this could only be written by Mathematician of highest class".

2) **Hyper Geometric series and continued Fraction**: He was compared with Euler and Jacobi.

3) **Definite Integrals**

9. Diwan Bahadur Ramachandra Rao, Collector of Nellore

10. Professor P.V. Seshu Iyer, Maths Professor at Kumbakonam

11. Sir Francis Spring Chairman, Madras Port Trust

LEFT: Kumbhakonam Town High School, which Ramanujan attended.
RIGHT: A facsimile of a school certificate that was given to Ramanujan when he was in the seventh grade.

4)Elliptic Functions

5)Partition functions

6)Fractional Differentiation: He gave a meaning to Eulerian second integral for all values of n .He proved x $^{n-1}$ e $-$ ⊟ Gamma is true for all Gamma.

7)Theory of Numbers: The modern theory of numbers is most difficult branch of mathematician .It has many unsolved problems. Good Example is of Gold Bach's Theorem which states that every even number is sum of two prime numbers. Ramanujan discovered Reimann's series , concerning prime numbers . For him every integer was one of his personal friend.

He detected congruence, symmetries and relationships and different wonderful properties.Taxi cab Nowas an interesting number to him.

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

8. **Partition of whole numbers**: Take case of 3. It can be written as…

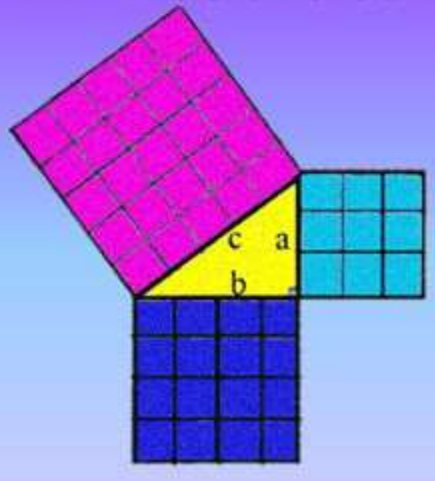
3+0,1+2,1+1+1

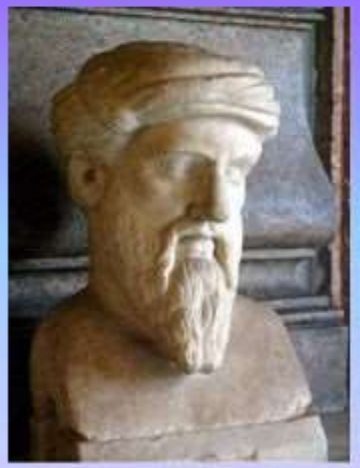
He developed a formula , for partition of any number which can be made to yield the required result by a series of successive approximation.

Pythagoras

Who was Pythagoras?

- Pythagoras was born around 570 BC and passed away around 495 BC.
- He was a philosopher and mathematician.
- He was famous for his Pythagorean Theorem.
- He had a teacher named Themistoclea. He taught him principles of ethics.
- He traveled to different places to learn, such as Egypt.



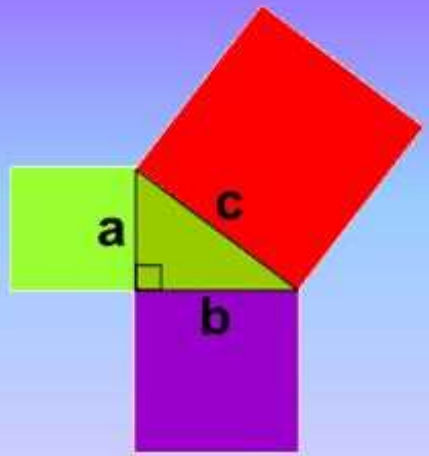


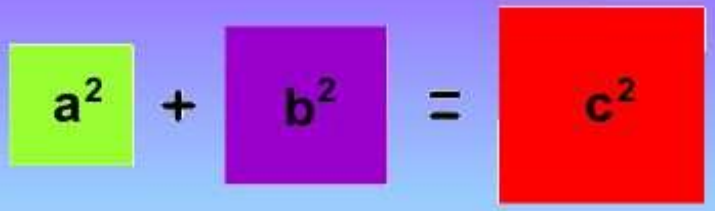
Pythagoras and Math

- Pythagoras made many contributions to the world of math including:
  - Studies with even/odd numbers
  - Studies involving Perfect and Prime Numbers
  - Irrational Numbers
  - Various theorems/ideas about triangles, parallel lines, circles, etc.
  - Of course THE PYTHAGOREAN THEOREM

The Pythagorean Theorem

- This theorem, came up by Pythagoras, states that in a right angled triangle, the area of the square on the hypotenuse [side opposite to right angle] is equal to the sum of the areas of the squares of the other 2 side. That is—$a^2+b^2=c^2$
- In other words, if you had a right angle triangle, and you made a square on each of the sides of the triangle, the biggest square will be the other 2 added up together.





Contribution of Euclid in Mathematics

Euclid
c. 325 BC - c. 265 BC

Nationality: Greek

Fields of Expertise:
Mathematics

Notable Contributions (Mathematics):
Euclidean geometry,
Euclid's elements,
Divisions of figures

Euclid's construction of a regular dodecahedron.

EUCLID'S DEFINITONS

Some of the definitions made by Euclid in volume I of 'The Elements' that we take for granted today are as follows :-

- ✓ *A point is that which has no part.*
- ✓ *A line is breadth less length.*
- ✓ *The ends of a line are points.*
- ✓ *A straight line is that which has length only.*

Summer Vacation Holiday Homework

Continued.....

- ✓ A surface is that which has length and breadth only.
- ✓ *The edges of a surface are lines*
- ✓ *A plane surface is a surface which lies evenly with the straight lines on itself*
- ○ *Axioms or postulates are the assumptions which are obvious universal truths. They are not proved.*
- ○ *Theorems are statements which are proved, using definitions, axioms, previously proved statements and deductive reasoning .*

EUCLID's Axioms and Postulates

Euclid assumed certain properties, which were not be proved. These are actually 'obvious universal truths'. He divided them into two types: axioms and postulates

Postulates	Axioms
• Postulates are universal truths with out any proofs.	• Axioms are universal thruths without any proofs.
• Postulates are assumptions used specifically used for geometry.	• Axioms are assumptions used throughout mathematics and not specifically geometry.

Euclid's Postulates

- Postulates are assumptions specific to geometry.
- Let the following be postulated:
- To draw a straight line from any point to any point.
- To produce [extend] a finite straight line continuously in a straight line.
- To describe a circle with any centre and distance [radius].
- That all right angles are equal to one another.
- *The parallel postulate*: That, if a straight line falling on two straight lines make the interior angles on the same side less than two right angles, the two straight lines, if produced indefinitely, meet on that side on which are the angles less than the two right angles.

Euclid's Postulates

1. Two points determine one and only one straight line
2. A straight line extends indefinitely far in either direction
3. A circle may be drawn with any given center and any given radius
4. All right angles are equal
5. Given a line k and a point P not on the line, there exists one and only one line m through P that is parallel to k

Euclid's Axioms

- Axioms are assumptions used throughout mathematics and not specifically linked to geometry.
- Here are some of euclid's axioms:
- Axiom 1: Things that are equal to the same thing are also equal to one another (Transitive property of equality).
- Axiom 2: If equals are added to equals, then the wholes are equal.
- Axiom 3: If equals are subtracted from equals, then the remainders are equal.
- Axiom 4: Things that coincide with one another equal one another (Reflexive Property).
- Axiom 5: The whole is greater than the part.
- Axiom 6: Things which are halves of the same things are equal to one another
- Axiom 7: Things which are double of the same things are equal to one another

EUCLID'S DIVISION ALGORITHM

- To obtain the HCF of two positive integer ,say 'c' and 'd' , with c > d,

Follow the steps

1. Apply the division lemma to find 'q' and 'r' where a=bq + r, o< r< b
2. If r=o ;, the HCF is b, if r is not equal to 'o'appiy Euclid lemma to 'd' and 'r'
3. Continue the process till the remainder is 'zero' . The divison at this stage will be the required HCF