

ASTRONOMY & MATHEMATICS IN ANCIENT INDIA

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Introduction

Aryabhata (476 AD - 550 AD) - the first of the major mathematician-astronomers from the classical age of Indian mathematics and Indian astronomy. For his explicit mention of the relativity of motion, he also qualifies as a major early physicist. He was the Kulapa (Head) of University of Nalanda.



Works

- **Aryabhatiya**: most famous work - a compendium of mathematical and astronomical knowledge.
- **Arya-Siddhanta**: deals with astronomy; includes discussion on motion of planets & stars.
- **Ganita**: work on mathematics; includes arithmetic, algebra & geometry.
- **Kuttaka**: book on algebra; deals with indeterminate equations and their solutions.
- **Aryabhata's system of numeration**: based on the decimal system - a significant improvement over the earlier systems used in India.
- **Computation of π** : first to give an accurate approximation of the value of $\pi = 3.1428$.

Achievements

Place Value System

- Introduced zero and the place value system
- Simplified calculations
- Representation of large numbers using fewer symbols

Algebra and Trigonometry

- Introduced
 - Quadratic and polynomial equations
 - Letters to represent unknown values
 - Sine and cosine functions
 - Tables of sines

Value of Pi

- Estimated the value of pi to four decimal places
- Accurate and used till now

Aryabhata....

- Proposed that Earth rotates on its axis and planets revolve around the Sun
- Calculated the length of the solar year and the duration of daylight
- Designed the gnomon, a precursor to the sundial

Results

- Developed a method for calculating the positions of celestial objects
- Proposed that Earth rotates on its axis.
- Developed the Hindu-Arabic numeral system, using the concept of zero as a placeholder.
- His work continues to influence modern science and technology, and his legacy is a source of inspiration.

Gitika Pada

The astronomical treatise

- Outlines 13 stanzas.
- Defines astronomical parameters & units of time.
- Notes the rotations of the Earth, the revolutions of the Sun, Moon & planets over 43,20,000 years.
- Details the positions of apogees & ascending nodes of planets, orbits of the Sun, Moon, epicycles & sine-difference table.

Ganita Pada

The mathematical treatise

- Outlines 33 stanzas.
- Covers geometrical figures, mensuration, gnomon shadows, power series, interest & equations: simple, simultaneous, quadratic, & linear.
- Describes methods for extracting square roots, cube roots & constructing the sine table.



Future Works

- Our future work focuses on researching the remaining two padas of Aryabhatiya i.e. Gola Pada & Kalakriya Pada.
- A study of his observations could shed light on the evolution of astronomy in ancient India.
- Explore how his work was received and interpreted by his contemporaries, as well as how his ideas have been incorporated into Indian culture and society over time.
- Comparing his ideas with those of other ancient mathematicians and astronomers, as well as their influence on modern mathematics and astronomy.

