e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:03/Issue:10/October-2021 Impact Factor- 6.752 www.irjmets.com

BRAHMAGUPTA: A NAME THAT BROUGHT INDIA'S NAME TO TOP IN MATHEMATICS

Dr. Chetan Kumar Sahu[*1]

[*1]Assistant Professor, Department Of Mathematics, Govt. Dr. Baba Saheb Bhimrao Ambedkar P. G. College Dongargaon, Rajnandgaon, C.G., India.

ABSTRACT

India's contribution to mathematics is incomparable. Great mathematicians like Aryabhata, Ramanujan were born in India. The name of Brahmagupta also comes in these great mathematicians. With his knowledge, he has increased the value of India in the world. Known as "Ganak Chakra Chudamani", Brahmagupta was a great knower of mathematics and astrology. He was the head of the space laboratory of the famous city of Ujjain (present-day Madhya Pradesh) under the then Gurjara Pradesh (Bhinmal) and during this time he wrote two special texts: Brahmasphutasiddhanta (in 628 AD) and Khandakhadyak or Khandakhadyapadti (in AD 665).

Keywords: Patiganit, Ganitpad, Kuttakadhyaya, Turiya Yantra, Cyclic Quadrilateral.

I. INTRODUCTION

Brahmagupta also enjoys an important place among the ancient astronomers and mathematicians of India. He added a new chapter in the field of astronomy and mathematics. In that era, it seems impossible to develop astronomy without the help of any equipment, but our ancient scientists proved it to be true.

Scientific thought was given shelter during the time of Brahmagupta. Everyone was given complete freedom to present his theory in any subject. He composed three texts during his lifetime. Brahmasphuta Siddhanta, Khand Food, Meditation Graphopadesha. The Brahmasphuta theory got the most recognition. Before this, a book called Brahmasiddhanta was in vogue. The 'Brahmasphut Siddhanta' prepared this new book in opposition to the old and obsolete principles of that book.

LIFE STORY OF BRAHMAGUPTA

The great Indian mathematician Brahmagupta was born in 598 AD in a city called Bhinmal in Rajasthan. His father's name was Jishnu. Brahmagupta is also known as Bhillamal Acharya. Brahmagupta has given very little information about himself. Brahmagupta gives his brief introduction in the two verses of the last 'Sgnadhyaya' of 'Brahmasphut-siddhant' as follows-

श्रीचापवंषतिलके श्रीव्याघ्रमुखे नृपे शकनृपाणाम्।

पंचाशत्संयुक्तैर्वर्षषतैः पंचभिरतीतैः।।

ब्राह्मः स्फुटसिद्धांत सज्जनगणितज्ञगोलवित्प्रीत्यै।

त्रिंषद्वर्षेण कृतों जिष्णुसुतब्रह्मगुप्तेन।। -संज्ञाध्याय

This shows that Brahmagupta wrote his book during the reign of King Vyaghramukh of the Chap dynasty in Shaka-Samvat 550 and at that time his age was 30 years. That is, Brahmagupta was born in 598 AD and at the age of 30 (AD 628) he composed his 'Brahmasphut-siddhanta'. Varunacharya, a commentator on Brahmagupta, has called him 'Bhillamalacharya'. The city of Bhillamal was the capital of North Gujarat, situated on the banks of the Luni River. It was also called Shrimal. It was a splendid city during the time of Brahmagupta. The city of 'Pi-lo-mo-to' mentioned by the Chinese Buddhist traveler Yuvan-chwang is this Bhillamal. Presently it is located in Jalore district and is known as Bhinmal.

Brahmagupta was not only a great mathematician but also a great researcher. It is believed that Brahmagupta was the head of the space laboratory of Ujjain, a famous city of Gurjar region under Harshavardhana Empire. He composed the 'Brahmasphut Siddhanta' only after doing direct observation of the planets. They believe that whenever there is a difference between calculation and perforation, then the calculation should be purified through perforation. In the 'Yantradhyay' of Brahmasphuta-siddhanta, he has given information about many astrology-yantras, and has clearly written:-

गणितज्ञो गोलज्ञो गोलज्ञो ग्रहगतिं विजानाति।

e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:03/Issue:10/October-2021 Impact Factor- 6.752 www.irjmets.com

यो गणितगोलबाह्यो जानाति ग्रहगतिं स कथम्।।

That is, one who knows mathematics knows the sphere (spherical astronomy), and one who knows the round knows the motion of the planets. How can one who is ignorant of mathematics and rounds know the motion of the planets?

Brahmagupta wrote his second book - Khand in 665 AD at the age of 67. In this, he has provided the knowledge of making Panchang, the English scholar Kolbark published a translation of Brahmagupta's book Kuttakadhyay (Algebra) in English language in 1817. Then the scholars of Europe know that modern algebra is actually based on Indian algebra. Brahmagupta also composed a treatise called Dhyan Guhopadesha. He died in the year 680 AD.

In fact, Brahmagupta was a great master of mathematical astrology. After Aryabhata, the first mathematician of India was 'Bhaskaracharya I'. Then there was Brahmagupta. Brahmagupta was also an astronomer and you discovered the rules for the use of 'zero'. After this there were many mathematicians who wrote on the subject of arithmetic and algebra. Brahmagupta died in 668 AD. Even after so many centuries, Brahmagupta is remembered for his contributions to mathematics and astrology.

WORK OF BRAHMAGUPTA

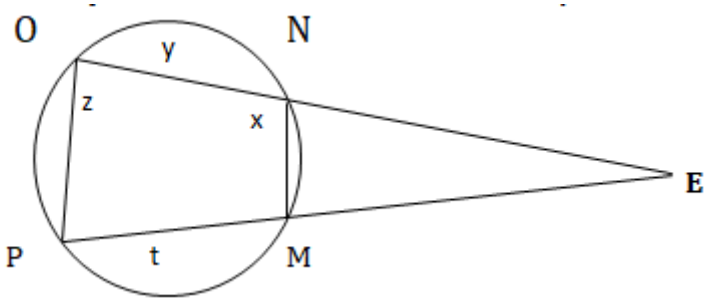
1. Brahmagupta's Formula and Theorem:- Brahmagupta's most important contribution is on the cyclic quadrilateral. He said that the diagonals of a cyclic quadrilateral are perpendicular to each other. Brahmagupta has also given the approximate formula and the exact formula for finding the area of a cyclic quadrilateral.

Let A be the area of cycle quadrilateral, length of its sides are x, y, z and t then

A = $\sqrt{(s-x)(s-y)(s-z)(s-t)}$ where s denotes the semi perimeter of cycle quadrilateral given by

s = $\frac{x+y+z+t}{2}$

proof:- Let the quadrilateral be MNOP with MN = x, NO = y, OP = z, PM = t



Extend OM and PM to meet at a point E outside the circle. Denote OE = a and PE = b. Then known that

4 x area of △ POE = $\sqrt{(a+b+z)(a-b+z)(-a+b+z)(a+b-z)}$ (1)

But △MNE and △POE are similar there we have

$\frac{Area\ of\ \triangle \mathrm{MNE}}{Area\ of\ \triangle \mathrm{POE}} = \frac{x^2}{z^2}$

$\Rightarrow \frac{Area\ of\ \triangle \mathrm{POE-S}}{Area\ of\ \triangle \mathrm{POE}} = \frac{x^2}{z^2}$

$\Rightarrow \frac{-A}{Area\ of\ \triangle \mathrm{POE}} = \frac{x^2-z^2}{z^2}$

$\Rightarrow \frac{A}{Area\ of\ \triangle \mathrm{POE}} = \frac{z^2-x^2}{z^2}$

$\Rightarrow Area\ of\ \triangle \mathrm{POE} = A\frac{z^2}{z^2-x^2}$ (2)

Since sides are similar therefore their corresponding sides are proportional therefore

$\frac{OE}{OP} = \frac{NE}{MN}$

$\Rightarrow \frac{a}{z} = \frac{a-y}{x}$ and

e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:03/Issue:10/October-2021 Impact Factor- 6.752 www.irjmets.com

$\frac{PE}{OP} = \frac{ME}{MN}$

$\Rightarrow \frac{b}{z} = \frac{b-t}{x}$ adding and subtracting these two we get

$\frac{a+b}{z} = \frac{a-y}{x} + \frac{b-t}{x}$ and $\frac{a-b}{z} = \frac{a-y}{x} - \frac{b-t}{x}$

$\Rightarrow \frac{a+b}{z} - \frac{a+b}{x} = -\frac{y+t}{x}$ and $\frac{a-b}{z} - \frac{a-b}{z} = \frac{t-y}{x}$

$\Rightarrow$ a+b+z =z $\frac{y+t}{z-x}$ +z = z$\frac{y+z+t-x}{z-x}$ = 2z$\frac{s-x}{z-x}$

Similarly we can find that a – b + z = 2z$\frac{s-t}{z+x}$, -a +b + z = 2z$\frac{s-y}{z+x}$, a + b – z = 2z$\frac{s-z}{z-x}$

Putting these values in (1) we get the area of triangle POE as

4 x area of $\triangle$ POE = $4z^2 \frac{\sqrt{(s-x)(s-y)(s-z)(s-t)}}{z^2-x^2}$

$\Rightarrow$ area of $\triangle$ POE = $z^2 \frac{\sqrt{(s-x)(s-y)(s-z)(s-t)}}{z^2-x^2}$

$\Rightarrow$ A $\frac{z^2}{z^2-x^2} = z^2 \frac{\sqrt{(s-x)(s-y)(s-z)(s-t)}}{z^2-x^2}$ from (2)

$\Rightarrow$ A = $\sqrt{(s-x)(s-y)(s-z)(s-t)}$

2.Brahmagupta wrote two phenomenal texts in astrology and mathematics. Both the texts named "Brahmasphut Siddhanta and Khandakhadyak" are great texts of astrology and mathematics.

3. In the Brahmasphuta Granth (628 AD), he had told algebra. He called algebra as a kutak. A detailed description of algebra is given in Kutakadhyay. Apart from this, he also explained Geometry in detail. He expressed addition and rest well in arithmetic. Brahmagupta had taken the value of Om to be 10, which is wrong. Based on this he made calculations.

4. He was the first to mention "inverse method" and "classification method".

5. Brahmagupta Brahmagupta described zero as an independent number. He was the first to explain how zero is used. But he told 0 to be divided by 0 which is wrong. Because dividing 0 by 0 can give anything.

6. He also used negative numbers in mathematics. He also told about lunar eclipse and solar eclipse. Brahmagupta also told that there are 365 days, 5 minutes and 19 seconds in a year.

7. Brahmagupta also gave the formula of "cyclic quadrilateral". He told in this context that the diagonals of a cyclic quadrilateral are perpendicular to each other.

8. The second major text composed by Brahmagupta was Khand Khadak (668 AD). In this he has explained the astrology calendar.

9. The works of Brahmagupta were later translated into Arabic by Arabic scholars. The Arabs named the Brahmasphut text "Sindhind" and Khand Khadak as "Al Akarand". Later these works were taken by the Arabs to Europe.

10. Bhaskaracharya had made the radiances of Brahmagupta as the basis of his book Siddhant Shiromani.

11. He was also the head of the observatory located in Ujjain. Brahmagupta had also known the circumference of the earth, which is very near according to today's value.

12. Geometry was first used in astrology, but Brahmagupta was the first mathematician of India, who used algebra in the calculations of astrology. He used to say about astrology who knew algebra, that just as the light of the sun dims the light of stars, in the same way astrology who knows algebra makes everyone fade before their knowledge.

13. Brahmagupta suggested new solutions to the equations. Brahmagupta established the Vedashala by inventing some new instruments, through which the motion, positions of planets and stars were studied. Brahmagupta refuted the theories of Aryabhata and Varahamihira related to the rotation speed of the earth and the lunar eclipse and solar eclipse.

14. His denial was of his prejudiced mentality or narrow intelligence. This is beyond comprehension. In his second book, Khandkhadya, he has written about the methods of making Panchang. In this, he made it clear that

e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Volume:03/Issue:10/October-2021 Impact Factor- 6.752 www.irjmets.com

I am writing a useful yadyath like Aryabhatta, that is, either he did not have to accept Aryabhata's talent or else he was upset with the unpopularity of his first yadyath, due to which he must have written so.

15. Brahmagupta's Brahmasphuta Siddhanta and Khandakhadya gained a lot of fame in Baghdad, which were also translated into Arabic. Through this book, the Arab people got information about Indian astrology and mathematics. When Alberuni arrived in the 11th century, he greatly admired Brahmagupta's others, along with other Indian mathematics and astrologers. He was well versed in Sanskrit.

16. After the establishment of English rule, in 1817, an Englishman named Colebrook translated Kuttakadhyay into the English language. Only then he came to know that the modern algebra taught in Europe is actually based on Indian algebra. In this way, in the field of mathematics, Brahmagupta is also known abroad.

17. In the history of Western mathematics, the credit for the solution of equation" x^2- dy^2= 1 where d is positive non square integer" is given to Jol Pell (1688 AD) and is known as 'Pell' equation. But the fact is that Brahmagupta had presented the solution of this equation 1000 years before Pell. For this the Praemikas which were discovered by Brahmagupta have been called 'Bhavana' in Indian mathematics.

18. The method of classification was first described by Brahmagupta and the inverse method was also described very well. Maths chapter is in pure mathematics only. In this there are addition, subtraction etc. Treaashik Bhand, Pratiband etc. Arithmetic convention is there in mathematics – triangle behavior, area behavior, method of knowing the area of triangle, quadrilateral etc., picture behavior, triangle behavior, zodiac behavior, shadow behavior, etc. There are 24 types of chapters under it.

19. Brahmagupta considered the value of pi (π) to be equal to the square root of 10 = 3.16227766. Which is very close to the current count 3.14159265.

II. CONCLUSION

Brahmagupta's place in the field of mathematics and astronomy will remain immortal for ages. Brahmagupta's important contribution was to take science out of superstitions and give new thinking, new vision. He is the first mathematician in the world to find the solution of equation x^2- dy^2= 1 where d is positive non square integer , but the credit is given to Jol Pell, which is wrong. Such a great scientist died at the age of 70. With time people's thinking has changed and here along with the interest of the people of the world has also started to know and understand Indian culture. Perhaps it is the result of this that the attention of the people towards the great works of ancient sages and mathematicians and Bhaskaracharya is also known as Indian Newton and Bodhayan as father of geometry. The biggest example of this is the theorem of Pythagoras, which is now known as the Bodhayana-Pythagoras theorem. The aim of the Indians from the very beginning has been "Vasudhaiva-Kutumbakam". Everything discovered by them was dedicated to the welfare of the people. We forgot our great tradition and got lost in the depths of ignorance. Today there is a need to re-research on the beliefs established by our sages so that their discovery can be planned in the direction of public welfare.

III. REFERENCES

[1] S Balachandra Rao, Indian Mathematics and Astonomy, 3rd Edition, 2004, Lakshmimudranalaya, Bangalore.
[2] G.R Kay, Indian mathematics: Thacker Spink & Co, Calcutta, 1915
[3] J.F Scott, A History of mathematics: London , 1958.
[4] R. A. Johnson, Advanced Euclidean Geomtry, Dover, 2007
[5] E. J. Barbeau, M. S. Klamkin, W. O. J. Moser, Five Hundred Mathematical Challenges, MAA,1995.
[6] S S Prakash Sarasvati, A critical study of Brahmagupta and his works : The most distinguished Indian astronomer and mathematician of the sixth century A.D. (Delhi, 1986).
[7] S P Arya, On the Brahmagupta- Bhaskara equation, Math. Ed. 8 (1) (1991), 23-27.
[8] G S Bhalla, Brahmagupta's quadrilateral, Math. Comput. Ed. 20 (3) (1986), 191-196.
[9] R C Gupta, Munisvara's modification of Brahmagupta's rule for second order interpolation, Indian J. Hist. Sci. 14 (1) (1979), 66-72.
[10] S P Arya, On the Brahmagupta- Bhaskara equation, Math. Ed. 8 (1) (1991), 23-27.
[11] S C Kak, The Brahmagupta algorithm for square rooting, Ganita Bharati 11 (1-4) (1989), 27-29.