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Algebra and its applications in technical and engineering problems

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Abstract

This work deals with the emergence of Algebra and its applications in technical and engineering problems. History of algebra goes back to antiquity. Obviously, her appearance was caused directly connected with the first astronomical and other calculations, anyway using natural numbers and arithmetic operations. The history of algebra confirmed such original recordings, found among samples of writing of the earliest civilizations. Algebra is one of the most important disciplines in mathematics, which at first glance may seem complex and distant from everyday life. However, in fact, algebra is an integral part of our reality and has wide practical applications in a variety of situations. Algebra allows you to solve various problems: from simple arithmetic operations to solving complex equations and systems of equations. It helps us deal with unknown quantities and establish relationships between different variables. Without algebra, we would not be able to effectively solve problems related to finance, science, engineering, and even everyday problems such as budgeting or calculating travel times.

Introduction

Algebra is a part of mathematics, which, along with arithmetic and geometry, is one of the oldest branches of this science. Problems, as well as methods of algebra, which distinguish it from other branches of mathematics, were created gradually, starting from antiquity. Problems of solving and studying equations had a great influence on the development of the original arithmetic concept of number. With the introduction of negative, irrational, complex numbers into science, the general study of the properties of these various number systems also moved to algebra. At the same time, it formed its characteristic letter notations, which made it possible to write down the properties of operations on numbers in a compressed form convenient for constructing calculus over letter expressions. The literal calculus of identity transformations constitutes the apparatus of classical algebra. Thus, algebra was distinguished from arithmetic: algebra studies, using letter notations, the general properties of numerical systems and general methods for solving problems using equations; arithmetic deals with methods of calculations with specifically given numbers, and in its higher areas - with the subtle individual properties of numbers. The development of algebra, its methods and symbolism had a very great influence on the development of newer areas of mathematics, preparing, in particular, the emergence of mathematical analysis. Writing down the simplest basic concepts of analysis, such as a variable, a function, is impossible without the letter symbols of classical algebra. In its development, algebra, like any other science, has gone through a long historical path, which can be divided into several periods.

In the history of mathematics, many scientists around the world worked on the development of mathematics. It cannot be said that before Al-Khorezmi there was no algebra, in ancient times people solved the simplest algebraic problems, there were techniques for solving individual specific problems, but Al-Khorezmi was the first to introduce algebra as the science of general methods for solving numerical linear and quadratic equations, and gave a classification of these equations, which was essential for “Preliteral” algebra. Historians of science highly appreciate both the scientific and popularization activities of Al-Khorezmi.

The famous historian of science J. Sarton called him "The greatest mathematician of his time and, all things considered, one of the greatest of all time." Al-Khorezmi (full name Abu Abdullah Muhammad ibn Musa Al-

Khorezmi) father of Abdullah, Muhammad, son of Musa, native of Khorezm, mathematician, astronomer, historian and geographer of the 9th century. Even the exact dates of his birth and death have not reached us. It is only known that he was born at the end of the eighth century, and died in the second half of the ninth, more precisely after 847. Now it is conventionally accepted to consider the year of his birth to be 783, and the year of death to be 850. The scientist's homeland was Khorezm, a vast region of Central Asia, which corresponds to the modern Khorezm region of Uzbekistan. Al Khorezmi's diverse scientific interests concerned mathematics, theoretical and practical astronomy, geography and history.

Not all of the works he wrote have survived. In 975-997 he wrote Mafatih al-'Ulum ("Key to the Sciences"), the first Arabic encyclopedia of knowledge that was organized on scientific principles. As a scientist, Al-Khwarizmi becomes famous for his achievements in mathematics. His work on arithmetic was translated into Latin in the 12th century, and although the original is lost, the Latin translation Algoritmi de numero Indorum ("Al-Khwarizmi on Indian numbers") still exists. Its name gave rise to the mathematical term "Arithmetic" [1]-[3].

Works of Al-Khwarizmi

It is considered established that Al-Khwarizmi was the author of 9 works:

1. Book about Indian arithmetic (or Book about Indian counting);
2. A short book on the calculus of algebra and almukabala;
3. Astronomical tables (zij);
4. Book of pictures of the Earth;
5. Book about building an astrolabe;
6. A book about actions using an astrolabe;
7. Book about sundial;
8. Treatise on the definition of the era of the Jews and their holidays;
9. History book.

Of these books, only seven have reached us in the form of texts either by Al-Khwarizmi himself or his Arab commentators, or in translations into Latin. Al-Khwarizmi's work on arithmetic played a vital role in the history of mathematics, and although its original Arabic text is lost, its contents are known from a 12th-century Latin translation, the only manuscript of which is kept in Cambridge. This work provides the first systematic presentation of arithmetic based on the decimal positional number system. The translation begins with the words "Dixit Algorizmi" (said Algorizmi).

In Latin transcription, the name Al-Khorezmi sounded like Algorizmi or Algorizmus, and since the essay on arithmetic was very popular in Europe, the author's name became a household name - medieval European mathematicians called arithmetic based on the decimal positional number system. Later, this was the name given to any system of calculations according to a certain rule; now this term means a prescription that specifies a calculation process, starting with arbitrary initial data and aimed at obtaining a result completely determined by these initial data [4].

The algebraic book of Al-Khorezmi (Kitab mukhtasab al-jabr and wa-l-mukabala) consists of two parts - theoretical (theory of solving linear and quadratic equations, some questions of geometry) and practical (application of algebraic methods in solving household, trade and legal tasks - division of inheritance, drawing up wills, division of property, various transactions, measuring land, building canals). The word al-jabr (replenishment) meant transferring the negative term from one side of the equation to another, and it was from this term that the modern word "algebra" arose. Al-muqabala (contrast) - reduction of equal terms in both sides of the equation. The doctrine of linear and quadratic equations, inherited from Eastern mathematicians, became the basis for the development of algebra in Europe. The geometric part of the treatise is devoted mainly to measuring the areas and volumes of geometric figures: triangle, square, rhombus, parallelogram called rhomboid, circle, segment of a circle, quadrangle with different sides and angles, parallelepiped, circular cylinder, prism and cone [5-7].

Algebra in technical and engineering problems

One important area where algebra is applied is in electrical and electronic engineering. Algebra allows you to analyze and synthesize electrical circuits, solve equations related to current and voltage, and also model and simulate the operation of various electronic devices. In mechanics, algebra is used to solve problems involving the motion of bodies. Using algebra, you can derive equations that describe the movement of a body, determine its speed, acceleration, and predict its movement in the future. Algebra is also applicable in the fields of construction and architecture. With its help, you can solve problems related to the calculation of building structures, determination of volumes and areas, analysis of forces and loads. Due to the development of computer technology and the use of software, algebra is becoming an integral part of the work of engineers and

technicians. With its help, you can create mathematical models and solve complex problems, conduct data analysis and present research results. The basic principle of algebra is working with symbols and expressions. Knowledge of algebra allows us to analyze and solve complex problems, especially in fields related to science, economics and finance. In the business world, algebra is used to calculate the cost of goods, production planning, and analytical forecasting. Knowledge of algebra will help entrepreneurs optimize their activities and make informed decisions. In engineering, algebra is also an integral part. It is used for complex system modeling, power and electrical circuit calculations, data analysis, and hypothesis testing. Without algebra, it would not be possible to create innovative technologies and develop new products.

Conclusion

Astronomy occupied a leading place among the exact sciences in the medieval East as one of the most necessary sciences in practice; it was impossible to do without it either in irrigated agriculture or in sea and land trade. By the 9th century include the first independent works on astronomy in Arabic, a special place among them was occupied by ziji collections of astronomical and trigonometric tables (at that time trigonometry was part of astronomy), with the help of these tables the positions of the luminaries on the celestial sphere, solar and lunar eclipses were calculated, they served and for measuring time. Among the first zijs is the zij of Al-Khorezmi, which began with a section on chronology and calendar - this was very important for practical astronomy, since different peoples used different calendars at different times, and dating is important when making observations. There were lunar, solar and lunisolar calendars, and the beginning of chronology in various systems referred to an arbitrarily chosen event. This led to many different eras; different peoples dated the same event differently, in accordance with the era they adopted. Al-Khwarizmi described the Arabic lunar calendar, the Julian calendar - the calendar of the “rums” (Romans and Byzantines). Humanity owes all the greatest discoveries that have given the world geniuses to mathematics. Today everyone needs mathematics. This is the call of the times, an urgent necessity of life. Accelerating scientific and technological progress is impossible without managing the volume of mathematical knowledge at all levels, starting primarily from high school, academic lyceums, colleges and higher educational institutions.

We are faced with financial decisions every day, whether it's budgeting, calculating mortgage payments, investing, or managing debt. Algebra allows us to solve complex problems efficiently and accurately. Interestingly, the history of the emergence of algebra is not limited to Europe and having contact with her Arab civilization. Thus, the significant results achieved in the Indian science of mathematics. In particular, they introduced the concept of "zero", which later came across the Arab world to Europe and has been used by scientists. The Chinese are quite independently, since the dawn of our era, have learned to solve the equations of the first degree. They were known to the irrational and negative numbers.

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