数学专业英语

堵秀凤 高晓巍 马占春 编著

清华大学出版社

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内容简介

本书是为数学与应用数学专业开设"数学专业外语"课程编写的教材，也可作为自学数学专业英语的阅读和学习参考教材。

本书共分8个单元，每单元包含3篇精读的相关文章，从专业词汇、构词、语法分析、数学英语表达等多方面对精读文章进行拓展，对学生加深理解，学习巩固专业词汇，掌握专业表达的方式与技巧，提高阅读能力等方面大有益处。本书在出版以前，作为讲义使用多年，并经不断调整与改进，形成了继大学基础英语之后学习数学专业英语的适用教材。

本书内容体系完整，逻辑安排合理，概念表述严谨，语言精练，既便于教学，又便于自学。

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前　言

随着经济全球化进程的加速，国际交流与合作的日益频繁，拥有一大批具备国际意识、国际知识和国际交流能力的高素质人才，是参与国际竞争的重要战略资源，也是科教兴国的发展之本。

数学与人们生活和科学技术密切联系，同时，数学与其他学科也存在广泛联系。马克思说过“一门科学，只有当它成功地运用数学时，才能达到真正完善的地步”，数学的广泛应用为社会的快速发展提供了广阔空间。从数学这一特点看数学教育，更加突出这一学科在整个教育中的重要地位。伴随着社会经济全球发展对人才培养的需要与要求，培养既具备数学专业知识，又精通专业英语的高素质综合人才尤为重要。数学专业英语作为大学英语教学的第二阶段，在已掌握英语阅读、理解能力的基础上，结合数学专业领域内基础知识，围绕专业词汇、特有的表达形式，进一步提高了专业英语的阅读、理解及运用能力，为读者阅读数学文献、书刊及从事双语教学奠定了基础。

国内已有的数学专业英语教材较少，无法满足不同读者的不同需求。本书阅读材料选自近代英美原著，内容由浅入深，利于读者循序渐进地阅读与学习。本书共分 8 个单元，每单元包含 3 篇主要的相关文章，其内容涉及数、函数、方程、集合、几何、微积分、矩阵、逻辑、概率统计等，拓宽了读者对专业词汇的掌握。在每篇阅读文章后提炼汇总了所出现的专业词汇，对其读音、所涉及的相关词组、同义词、反义词、一词多译、特殊复数变形等方面做重点强调；对文章中出现的特殊句式、词组搭配、文法结构加以分析；针对数学学科特有的表达特点，课后补充了相关的英语表达形式；通过不同题型的设计，巩固基础知识的同时锻炼和提高学生实际应用数学专业英语的综合能力。

数学专业英语在表达上除了具备基础英语表达的基本特征之外，同时还具有数学语言所特有的特点，即高度的抽象性、严密的逻辑性、应用的广泛性，需要我们在不断的学习与实践中深刻地认识，全面地掌握。

本书 1～4 单元由高晓巍完成，第 5 和第 7 单元由堵秀凤完成，第 6 和第 8 单元由马占春完成。由于作者水平有限，书中难免有不当或错误之处，恳请各位专家、读者提出批评意见，以便我们不断地完善。

CONTENTS

Unit one MATHEMATICS

SECTION A MATHEMATICS COMES FROM PRACTICE

Mathematics comes from man's social practice, for example, industrial and agricultural production, commercial activities, military operations and scientific and technological researches. And in turn, mathematics serves the practice and plays a great role in all fields. No modern scientific and technological branches could be regularly developed without the application of mathematics.

From the early need of man came the concepts of numbers and forms. Then, geometry developed out of measuring land, and trigonometry came from problems of surveying. To deal with some more complex practical problems, man established and then solved equation with unknown numbers, thus algebra occurred. Before 17th century, man confined himself to the elementary mathematics, i. e. geometry, trigonometry and algebra, in which only the constants were considered.

The rapid development of industry in 17th century promoted the progress of economics and technology and required dealing with variable quantities. The leap from constants to variable quantities brought about two new branches of mathematics analytic geometry and calculus, which belong to the higher mathematics.

Mathematicians study conceptions and propositions. Notations are a special and powerful tool of mathematics and are used to express conceptions and propositions very often. Formulas, figures and charts are full of different symbols. Some of the best known symbols of mathematics are the Arabic numbers 1, 2, 3, 4, 5, 6, 7, 8, 9, 0, and the signs of addition $+$, subtraction $-$, multiplication $\times$, division $\div$, and equality $=$.

In a word, mathematics comes from man's social practice. In studying mathematics, we must combine theory with practice. We must make mathematics serve socialist revolution and socialist construction of our country.

Professional vocabulary

1. mathematics [mæθi'mætiks] *n.* 数学
   elementary mathematics
   higher mathematics
2. symbol ['simbəl] *n.* 记号、符号
   symbol computation
   symbol error rate

3. sign [sain]　　*n.* 记号,符号
   sign of operation
   sign rules
4. number [ˈnʌmbə]　　*n.* 数,数字
   unknown numbers
   even number
   odd number
5. numeral [ˈnju:mərəl]　　*n.* 数字
   numeral system
   numeral row
6. numerical [nju:ˈmerikəl]　　*adj.* 数值的,数字的
   numerical calculation
   numerical analysis
7. addition [əˈdiʃən]　　*n.* 加,加法
   addition principle
   addition formulas
8. subtraction [səbˈtrækʃən]　　*n.* 减,减法
   subtraction of vectors
   subtraction sign
9. multiplication [ˌmʌltipliˈkeiʃən]　　*n.* 乘,乘法
   multiplication by constants
   multiplication of matrices
10. division [diˈviʒən]　　*n.* 除,除法
    division with remainder
    division transformation
11. equality [iˈkwɔliti]　　*n.* 等号,相等,等式
    equality of sets
    equality of vector
12. equation [iˈkweiʃən]　　*n.* 方程
    equation of motion
    equation of condition
13. geometry [dʒiˈɔmitri]　　*n.* 几何,几何学
    geometry of space
    geometry of plane
14. algebra [ˈældʒibrə]　　*n.* 代数,代数学
    higher algebra
    algebra of logic
15. trigonometry [ˌtrigəˈnɔmitri]　　*n.* 三角学

Some mathematical symbols and notations

1. Four fundamental operations

(1) **Addition**

The expression "$a+b$" is read "a plus b" or "the sum of a and b". Here "a" is called the summand and "b" the addend.

(2) **Subtraction**

The expression "$a-b$" is read "a minus b"or "the difference of a and b". Here "a" is called the minuend and "b" the subtrahend.

(3) **Multiplication**

The expression "$a\times b$" is read "a times b"or "a multiplied by b"or "the product of a and b". Here "a" is called the multiplicand and "b" the multiplier.

(4) **Division**

The expression "$a\div b$" is read "a divided by b" or "the quotient of a and b". Here "a" is called the dividend and "b" the divisor.

The results of addition, subtraction, multiplication and division are called the sum, the difference, the product and the quotient respectively.

Example:

$x+5=3$	The sum of x and 5 equals 3.
	x plus 5 is equal to 3.
$2x=14$	The product of 2 and x equals 14.
	2 multiplied by x is 14.
	2 times x is equal to 14.
$2(b-7)=9$	Twice the difference of b and 7 equals 9.
$\frac{y}{6}=3$	The quotient of y and 6 is 4.

2. How to express Integers in English:

Like in China, when reading integers in English, starting from the left to the right, read each group of figures separately, applying the proper name to the comma as it is reached. The first comma from the right is read "thousand", the second comma "million", the third comma "billion", and the fourth comma "trillion".

Example 1: 35 896 732 546 285

thirty-five trillion eight hundred and ninety-six billion seven hundred and thirty-two million five hundred and forty-six thousand two hundred and eighty-five.

Example 2: 326 784 520 398 216

three hundred and twenty-six trillion seven hundred and eighty-four billion five hundred and twenty million three hundred and ninety-eight thousand two hundred and sixteen.

Exercises:

Ⅰ. Express the following values and mathematical relations in English:

(1) 461　　　(2) 578 321

(3) $a+x=b$　　　(4) $3x=5$

(5) $5(x-4)=13$　　　(6) $\frac{x}{a}=2(x+b)$

Ⅱ. Translate the following phrases into Chinese:

(1) symbols system

(2) higher mathematics

(3) numerical approximation

(4) algebra class group

(5) equation of higher degree

(6) equality of matrices

(7) subtraction formulas

(8) additive identity property

(9) commutative property of multiplication

(10) associative property of addition

Ⅲ. Fill in the following blanks:

operations	expression	read	a	b	c
addition	$a+b=c$	a plus b equals c		addend	sum
subtraction	$a-b=c$	a minus b equals c	minuend		difference
multiplication	$a\times b=c$	a times b equals c		multiplier	product
division	$a\div b=c$	a divided by b equals c	dividend	divisor	

Ⅳ. Match each of the following terms to the phrase or definition:

A. sum　　B. product　　C. value　　D. addend

E. multiplier　　F. substitute　　G. additive inverse　　H. zero exponent theorem

(1) any number that is being multiplied

(2) to replace one value or quantity with another

(3) the total obtained by adding numbers together

(4) the numerical quantity of a variable or function

(5) Any real non-zero number raised to the power of zero equals one.

(6) any number that is added, or is intended to be added, to any other number or set of numbers

(7) a number that is the opposite, or inverse, or negative, of another number

(8) The total obtained by multiplying numbers or quantities.

Ⅴ. Translation:

(1) 在初等数学中,我们只探讨常数。

(2) 数学来自人类的社会实践。

(3) 数学的语言就是由记号和符号组成的语言。

(4) Axioms, postulates, definitions and theorems are all propositions.

(5) Now there are many branches in higher mathematics, among which are mathematical analysis, higher algebra, differential equations, function theory and so on.

SECTION B MEASUREMENT

In the development of the physical sciences, we observed a rapid increase in scientific achievements after man began basing his conclusions upon experimental facts instead of upon inference. Experimentation, however, shows a quantitative study of some aspect of nature, and the important part of such a study is the measurement of the things with which it deals. Measuring any quantity means comparing it with an accepted unit as a standard, and finding out how many times larger or smaller it is than the standard unit. The length of an object is measured by finding how many times longer it is than some standard unit of length. For example, if this book were taken as a standard, and laid end to end five times along a desk surface, we know that the desk is 5 book-lengths long. If this book is laid down end to end five times and it does not quite reach the other end of the desk, we say that its length is a little over 5 books. In scientific work this "little over" part is not accurate enough. To be more accurate, we must measure what fractional part of the book the desk exceeds 5 book-lengths. If we measure the desk to be $\frac{1}{5}$ of a book longer than the 5 book-lengths, we say its length as $5\frac{1}{5}$ or 5.2 book-lengths. A more accurate measurement could be made by subdividing the book into ten equal parts. We would measure the desk to be a little more than 5.2 books long. Again we would have to measure the fractional part of the subdivision by which the desk is longer than 5.2 book-lengths. If we found the fractional part as $\frac{1}{2}$ a subdivision, we would write down a length of 5.25 book. The last measurement is obviously far more accurate than those for the larger units. The greater the accuracy needed, the smaller the subdivision must be.

The weight of an object is similarly determined by finding how much heavier it is than some accepted standard weight unit. For example, if a piece of copper is four times as heavy as a standard pound, its weight is 4 pounds. Also, the smaller the subdivisions we have for the standard weight, the more accurate the weighing can be made.

Professional vocabulary

1. measurement [ˈmeʒəmənt] *n.* 度量
   measurement of area
   measurement system
2. inference [ˈinfərəns] *n.* 推论,推理
   inference formula
   inference rules

3. quantity ['kwɔntəti] n. 量，数量，分量
   quantity relation
   quantity index number
4. quantitative ['kwɔntiteitiv] adj. 量的，定量的
   quantitative analysis
   quantitative character
5. unit ['ju:nit] n. 单位
   unit area
   unit circle
6. length [leŋθ] n. 长度
   length of arc
   length of segment
7. surface ['sə:fis] n. 表面，面，曲面
   surface area
   surface of the second order
8. fraction ['frækʃən] n. 分数
   fraction representation
   fraction stroke
9. fractional ['frækʃənl] adj. 分数的，小数的
   fractional equation
   fractional linear transformation
10. equal ['i:kwəl] adj. 相等的 vt. 等于
    equal coefficients
    equal distance
11. subdivision ['sʌbdi,viʒən] n. 细分，重分
    subdivision graph
    subdivision of variance
12. numerator
13. denominator
    denominator of rational matrix rationalize the denominator

Some mathematical symbols and notations

1. How to express fractions in English:

A fraction consists of a numerator, a denominator and a fraction stroke. In English, we usually use a cardinal to express the numerator and ordinal to express the denominator. Except that the numerator is 1, all the ordinals must be plural.

(1) **Proper fractions**:

1/2 one half; a half; one over two

1/3 one third; a third; one over three

1/4 one fourth; one quarter; one over four

2/3 two-thirds; two over three

4/5 four-fifths; four over five

(2) **Improper fractions**:

10/7 ten-sevenths; ten over seven

(3) **Mixed fractions**:

$4\frac{2}{3}$ four and two-thirds

$2\frac{1}{2}$ two and one half

2. How to express decimals in English:

A decimal consist of three parts-whole number, point and decimal fraction. The left side of a point is the area of a whole number and the right side the decimal area. The first place to the right of the units' place expresses tenth (1/10), the second place hundredth (1/100), the third place thousandth (1/1000), the fourth place ten-thousandth, etc.

To express a decimal, we need to read each number and just read point for the decimal point, such as 3.576, which is read "three point five seven six". If the integral part is zero such as 0.45, then the figure is read "zero point four five" or "point four five". If the decimal part is 0.1, 0.01, 0.001, etc. then the figure is read "one tenth, one hundredth, one thousandth" or "point one, point zero one, point zero zero one, etc."

(1) **Mixed Decimals**:

The decimal whose integral part is not zero is called a mixed decimal. When reading a mixed decimal, just read the whole number for the integral place and decimal for the decimal place.

Example 1: 329 671 239.953 579

three hundred and twenty-nine million six hundred and seventy-one thousand two hundred and thirty-nine point nine five three five seven nine

Example 2: 2 050.035 7

two thousand and fifty point zero three five seven

(2) **Recurring and Terminating Decimals**:

Decimals can be divided into terminating decimals and recurring or repeating decimals. For example, $\frac{2}{5}=0.4$ is a terminating decimal and 0.66666… is a recurring or repeating decimal, which can be written as $0.\overline{6}$, where the overbar indicates the digit(s) to be repeated; hence $\frac{2}{3}=0.\overline{6}$ can also be written as $0.\dot{6}$, where the " . " indicates the digit(s) to be repeated as well.

Example:

$0.\dot{3}\dot{7}$ zero point three seven recurring

	point three seven repetend three seven
$0.3\dot{7}$	point three, seven recurring
	point three seven repetend seven
$0.24\dot{7}\dot{3}$	zero point two four, seven three recurring
	zero point two four seven three repetend seven three

Exercises:

Ⅰ. Express the following values in English:

(1) 2.134　　(2) 0.0001　　(3) 1 081 915

(4) 301 001 121　　(5) 213 030 209 101　　(6) $0.\dot{5}$

(7) $0.2\dot{4}$　　(8) $0.\dot{3}\dot{5}$　　(9) $0.24\dot{1}\dot{7}$

(10) $\frac{1}{12}$　　(11) $\frac{3}{5}$　　(12) $3\frac{2}{7}$

(13) $\frac{123}{567}$　　(14) 11 : 13

Ⅱ. Translate the following phrases into Chinese:

(1) function theory ________　　(2) mathematical analysis ________

(3) differential equation ________　　(4) logical deduction ________

(5) reasoning method ________　　(6) linear equation ________

(7) surface coordinates ________　　(8) fractional linear transformation ________

Ⅲ. Read the passages carefully and choose the best word or phrases to each of the blank:

Mathematical induction

When we studied the ________ progression in high school, we encountered the formula

$$1+2+3+\cdots+n=\frac{n(n+1)}{2}$$

To prove such a ________, we can, of course, verify the statement for very many ________ of n, but this process will not prove the formula for even one ________ of n. What is needed is some kind of "chain reaction" which will have the effect that once the formula is proved for a ________ integer the formula will automatically, follow for the next integer and the next and the next indefinitely. Such a ________ is produced by the method of mathematical ________.

If a theorem is formulated in terms of n and involves the statement that a formula or ________ holds when n is any positive integer, a proof by mathematical induction consists of the following two steps:

(1) Verify the theorem for $n=1$ (or, in special case, some other value of n).

(2) Assume that the theorem holds for $n=k$, where k is an arbitrary, but fixed, positive integer, and then prove that it holds for $n=k+1$.

These two steps constitute the method of proof of a theorem by mathematical induction, Once they have been carried out, the" chain reaction" mentioned above is set in motion.

(1) positive integral values (2) reaction (3) induction
(4) particular (5) property (6) additional value
(7) arithmetic (8) formula

Ⅳ. Match each of the following words with the given expression.

A. ratio B. sum C. zero D. radicand
E. quotient F. repetend G. reciprocal

(1) The mathematical symbol used to show no measurable value.
(2) The total obtained by adding numbers together.
(3) The number or set of numbers in a repeating decimal that repeats.
(4) The total obtained from dividing one number by another number.
(5) the number located under the radical sign.
(6) The relationship of one number to another, expressed as a quotient.
(7) The mirror image of a fraction, in which the numerator and denominator are inverted.

Ⅴ. Reading comprehension—Ratio

The ratio of one quantity to another like quantity is the quotient of the first divided by the second.

A ratio is a fraction and all the rules governing a fraction apply to ratio. We write a ratio either with a fraction bar, a solidus, division sign, or with the symbol ":"(which is read "is to"). Thus the ratio of 3 to 4 is $\frac{3}{4}$, 3/4, $3 \div 4$, or 3 : 4. The 3 and 4 are called terms of the ratio.

It is important for the student to understand that a ratio is a quotient of like quantities. The ratio of a line segment to an angle has no meaning; they are not quantities of the same kinds. We find the ratio of one line segment to a second line segment or the ratio of one angle to a second angle. This we do by measuring them and then finding the quotient of their measurement. The measurements must be expressed in the same units.

A ratio is always an abstract number; i. e. , it has no units. It is a number considered apart from the measured units from which it came. Unless there is an important reason to the contrary, a ratio should be expressed in its simplest form. In the previous example where the dimensions of a living room are 18 by 24 feet, the final ratio of width to length is 3 : 4, but not 18 : 24.

SECTION C THE CIRCLE-MEASUREMENTS BY THE ANCIENT CHINESE MATHEMATICIANS

We already know that the ancient Chinese employed for π the value 3, or that they counted the circumference of a circle compared with diameter as 3 to 1. The value of π was used in China as early at least as in the 12th century B. C. But the Chinese did not in any way remain satisfied with this rough value of π. Ever since then great efforts have been made to improve its accuracy and brilliant achievements obtained.

Among the earliest Chinese circle-squarers mention must be made of Chang Hung in the first place. Chang was a famous scholar of the Han Dynasty. Chang's calculation of the circle, however, has been lost, although his value of π is given in a commentary on the "Arithmetic in Nine Sections" in the form that the ratio of the square of the circular circumference to that of the perimeter of the circumscribed square is 5 to 8. This is equivalent to taking π at $\sqrt{10}$.

In the period of the Three Kingdoms there lived another mathematician Liu Hui, in whose commentaries on the "Arithmetic in Nine Sections" we find the particulars of his quadrature of the circle.

Liu Hui starts, in his measurement of the circle, with a hexagon inscribed in a circle the diameter of which is taken as two feet. Each side of the hexagon is equal to half the circular diameter. On this hexagon Liu Hui describes a dodecagon by doubling the number of its sides, and then doubles again the sides and describes a 24-gon, and so on. In this way the areas of the polygons thus formed gradually approach to the area of the circle, the difference diminishing step by step.

Two centuries after Liu Hui, there appeared another and more distinguished circle-squarer, Tsu Chung-chih. Tsu contrived a more effective method of proceeding than his predecessors had followed, and obtained the accurate value for π. It was $\frac{355}{113}$. From this it is seen that China had possessed the accurate value for over 1 300 years before Europe, where the same value was obtained in 1855.

Tsu Chung-chih died in 500 at the advanced age of 71. His son Tsu Hong-chi was another distinguished mathematician following his father. It was he who first derived the world formula about the volume of a spherical ball, which is equal to $\frac{1}{6}\pi D^3$, where D denotes the diameter.

Professional vocabulary

1. circle [ˈsəːkl] *n.* 圆
   circle of symmetry
   circle transformation
2. circular [ˈsəːkjulə] *adj.* 圆的
   circular arc
   circular cylinder
3. value [ˈvæljuː] *n.* 值
   value field

value of expectation

4. diameter [dai'æmitə] n. 直径

diameter of a circle

diameter of a connected graph

5. ratio ['reiʃiəu] n. 比,比例,比率

ratio minimization

ratio chart

6. square [skwεə] n. 正方形,正方 vt. 自乘

square matrix

square factor

7. circumscribe ['sə:kəmskraib] vt. 在四周画线,使外切

circumscribed adj. 外切的

circumscribed circle

circumscribed polygon

8. equivalent [i'kwivələnt] adj. 等价的,等势的

equivalent class

equivalent relation

9. quadrature ['kwɔdrətʃə] n. 求(面)积,求积分,积圆法

quadrature formula

quadrature rule

10. polygon ['pɔligən] n. 多边形

hexagon ['heksəgən] n. 六边形

dodecagon [dəu'dekəgən] n. 十二边形

24-gon=polygon of 24 sides n. 二十四边形

11. formula ['fɔ:mjulə] n. 公式

formula of integration

formula language

12. spherical ['sferikəl] adj. 球形的,球面的

spherical cap

spherical coordinates

13. mathematician [ˌmæθimə'tiʃən] n. 数学家

14. circumference [sə'kʌmfərəns] n. 圆周

15. perimeter [pə'rimitə] n. 周长

Some mathematical symbols and notations

1. How to express involution and evolution in English:

If b is any real number and n is a positive integer, then the expression b^n is defined as the number $b^n = b \cdot b \cdot b \cdots b$ (n factors). The number b is called the base, and the superscript n is called the power of the exponential expression b^n.

If $b \neq 0$, we define $b^0 = 1$, but the expression 0^0 is undefined.

If n is a positive integer, then the expression $b^{\frac{1}{n}}$ is defined to be the number that, when raised to the nth power, is equal to b. Thus $(b^{\frac{1}{n}})^n = b$.

Such a number, if it exists, is called the nth root of b, also written $\sqrt[n]{b}$.

Observe that the nth root of a negative number is not defined when n is even. For example, the square root of -2 is not defined because there is no real number b such that $b^2 = -2$. Also, given a number b, more than one number might satisfy our definition of the nth root. For example, both 3 and -3 squared equal 9, and each is a square root of 9. So, to avoid ambiguity, we define $b^{\frac{1}{n}}$ to be the positive nth root of b whenever it exists. Thus $\sqrt{9} = 9^{\frac{1}{2}} = 3$.

If $\frac{p}{q}$ (p and q are integers with $q \neq 0$) is a rational number in lowest terms, then the expression $b^{\frac{p}{q}}$ is defined as the number $(b^{\frac{1}{q}})^p$ or, equivalently, $\sqrt[q]{b^p}$, whenever it exists. Expressions involving negative rational exponents are taken care of by the definition $b^{-\frac{p}{q}} = \frac{1}{b^{\frac{p}{q}}}$.

2. How to express exponents and radicals in English:

(1) **exponents**:

a^2 read "a to the second power", "a to the power of two" or "a square or a squared"

a^3 read "a to the third power", "a to the power of three" or "a cube or a cubed"

a^n read "a to the nth power" or "a to the power of n"

Here "a" is called the base and "n" the index, power or exponent.

(2) **radicals**:

$\sqrt{a}$ the square root of a

$\sqrt[3]{a}$ the cube root of a

$\sqrt[n]{a}$ the nth root of a

The symbol $\sqrt{\ }$ is called the radical sign, and the expression under the radical sign is called the radicand.

Exercise:

Ⅰ. Express the following values in English:

(1) a^2 (2) x^3 (3) $\sqrt{x-y}$

(4) $\sqrt[3]{3ab}$ (5) $5^{\frac{2}{3}}$ (6) $x^{\sqrt{a}}$

Ⅱ. Translate the following phrases into Chinese:

(1) circular truncated cone ______ (2) square residue ______

(3) spherical mapping ______ (4) spherical region ______

(5) equivalent propositions ______ (6) circumscribed quadrilateral ______