海外优秀数学类教材系列丛书

PEARSON Education

影印版

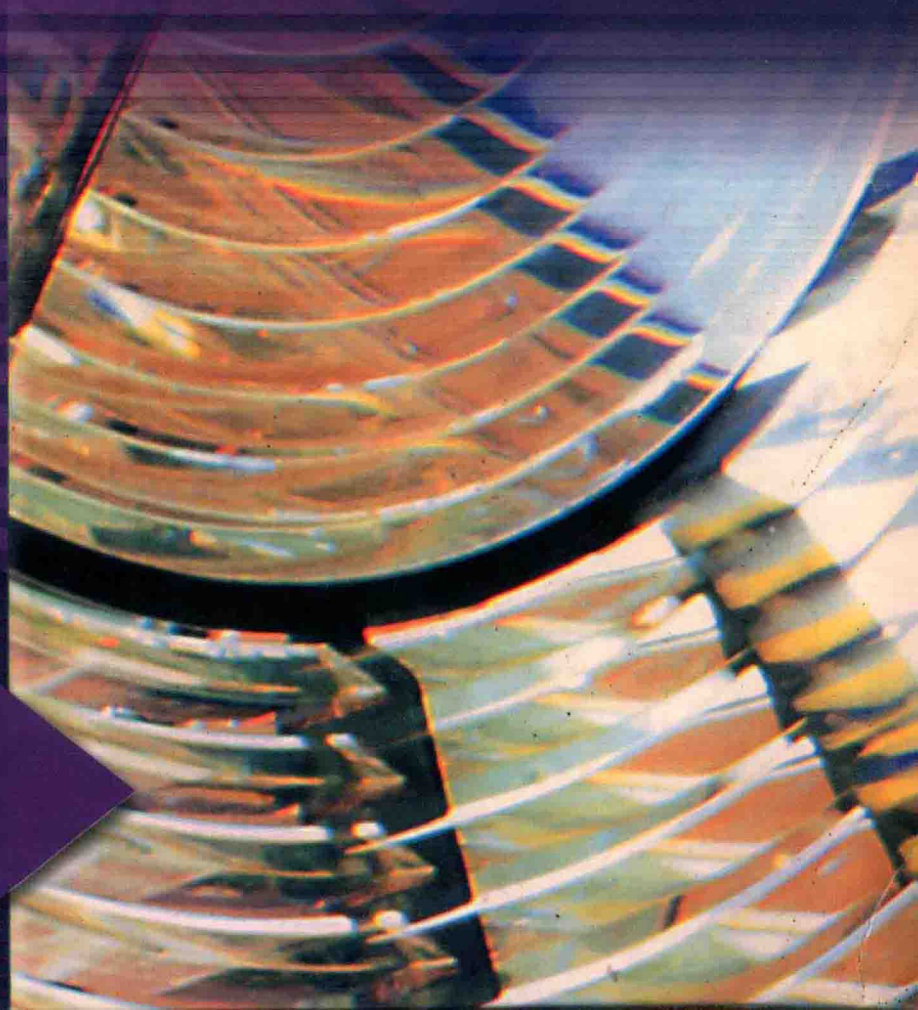
Thomas' CALCULUS

(Tenth Edition)

托马斯微积分（第10版）

（上册）

- FINNEY
- WEIR
- GIORDANO



高等教育出版社

Higher Education Press

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Thomas' CALCULUS

(TENTH EDITION)

托马斯微积分(第10版)(上册)

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Algebra

1. Laws of Exponents

$$a^m a^n = a^{m+n}, \qquad (ab)^m = a^m b^m, \qquad (a^m)^n = a^{mn}, \qquad a^{m/n} = \sqrt[n]{a^m}$$

If $a \neq 0$,

$$\frac{a^m}{a^n} = a^{m-n}, \quad a^0 = 1, \quad a^{-m} = \frac{1}{a^m}.$$

2. Zero

Division by zero is not defined.

If $a \neq 0$: $\quad \dfrac{0}{a} = 0, \quad a^0 = 1, \quad 0^a = 0$

For any number a: $\quad a \cdot 0 = 0 \cdot a = 0$

3. Fractions

$$\frac{a}{b} + \frac{c}{d} = \frac{ad + bc}{bd}, \qquad \frac{a}{b} \cdot \frac{c}{d} = \frac{ac}{bd}, \qquad \frac{a/b}{c/d} = \frac{a}{b} \cdot \frac{d}{c}, \qquad \frac{-a}{b} = -\frac{a}{b} = \frac{a}{-b}.$$

4. The Binomial Theorem

For any positive integer n,

$$(a + b)^n = a^n + na^{n-1}b + \frac{n(n-1)}{1 \cdot 2} a^{n-2}b^2 + \frac{n(n-1)(n-2)}{1 \cdot 2 \cdot 3} a^{n-3}b^3 + \cdots + nab^{n-1} + b^n.$$

5. Difference of Like Integer Powers, n > 1

$$a^n - b^n = (a - b)(a^{n-1} + a^{n-2}b + a^{n-3}b^2 + \cdots + ab^{n-2} + b^{n-1})$$

For instance,

$$a^2 - b^2 = (a - b)(a + b),$$

$$a^3 - b^3 = (a - b)(a^2 + ab + b^2),$$

$$a^4 - b^4 = (a - b)(a^3 + a^2b + ab^2 + b^3).$$

6. Completing the Square

If $a \neq 0$,

$$\begin{aligned} ax^2 + bx + c &= a\left(x^2 + \frac{b}{a}x\right) + c \\ &= a\left(x^2 + \frac{b}{a}x + \frac{b^2}{4a^2} - \frac{b^2}{4a^2}\right) + c \\ &= a\left(x^2 + \frac{b}{a}x + \frac{b^2}{4a^2}\right) + a\left(-\frac{b^2}{4a^2}\right) + c \\ &= \underbrace{a\left(x^2 + \frac{b}{a}x + \frac{b^2}{4a^2}\right)}_{\text{This is } \left(x + \frac{b}{2a}\right)^2.} + \underbrace{c - \frac{b^2}{4a}}_{\text{Call this part } C.} \\ &= au^2 + C \qquad (u = x + (b/2a)) \end{aligned}$$

7. The Quadratic Formula

If $a \neq 0$,

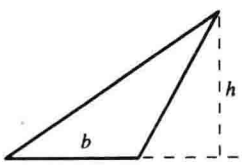
$$ax^2 + bx + c = 0$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}.$$

Geometry

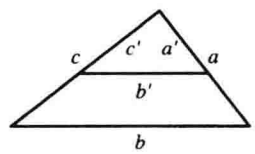
(A = area, B = area of base, C = circumference, S = lateral area or surface area, V = volume)

1. Triangle



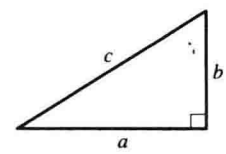
$$A = \frac{1}{2}bh$$

2. Similar Triangles



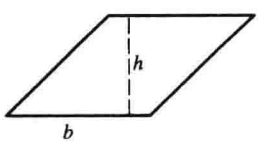
$$\frac{a'}{a} = \frac{b'}{b} = \frac{c'}{c}$$

3. Pythagorean Theorem



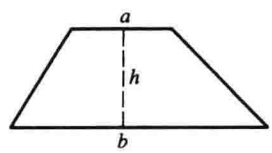
$$a^2 + b^2 = c^2$$

4. Parallelogram



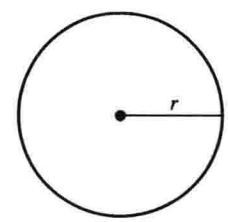
$$A = bh$$

5. Trapezoid



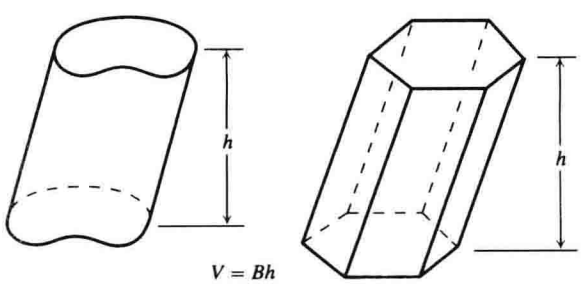
$$A = \frac{1}{2}(a + b)h$$

6. Circle



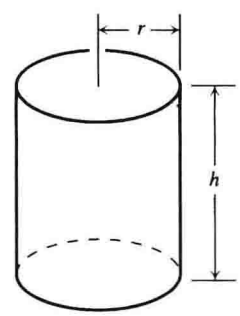
$$A = \pi r^2,$$
$$C = 2\pi r$$

7. Any Cylinder or Prism with Parallel Bases



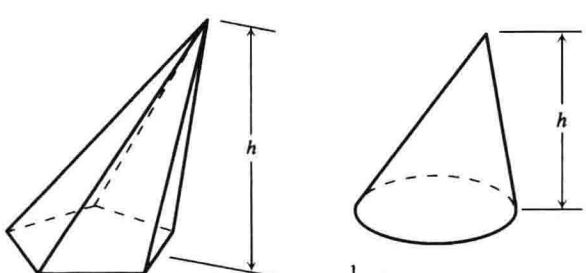
$$V = Bh$$

8. Right Circular Cylinder



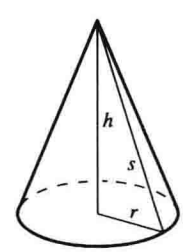
$$V = \pi r^2 h,\ S = 2\pi rh$$

9. Any Cone or Pyramid



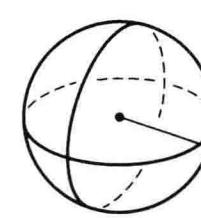
$$V = \frac{1}{3}Bh$$

10. Right Circular Cone



$$V = \frac{1}{3}\pi r^2 h,\ S = \pi rs$$

11. Sphere



$$V = \frac{4}{3}\pi r^3,\ S = 4\pi r^2$$

出版者的话

在我国已经加入 WTO、经济全球化的今天，为适应当前我国高校各类创新人才培养的需要，大力推进教育部倡导的双语教学，配合教育部实施的“高等学校教学质量与教学改革工程”和“精品课程”建设的需要，高等教育出版社有计划、大规模地开展了海外优秀数学类系列教材的引进工作。

高等教育出版社和 Pearson Education，John Wiley & Sons，McGraw-Hill，Thomson Learning 等国外出版公司进行了广泛接触，经国外出版公司的推荐并在国内专家的协助下，提交引进版权总数 100 余种。收到样书后，我们聘请了国内高校一线教师、专家、学者参与这些原版教材的评介工作，并参考国内相关专业的课程设置和教学实际情况，从中遴选出了这套优秀教材组织出版。

这批教材普遍具有以下特点：（1）基本上是近 3 年出版的，在国际上被广泛使用，在同类教材中具有相当的权威性；（2）高版次，历经多年教学实践检验，内容翔实准确、反映时代要求；（3）各种教学资源配套整齐，为师生提供了极大的便利；（4）插图精美、丰富，图文并茂，与正文相辅相成；（5）语言简练、流畅、可读性强，比较适合非英语国家的学生阅读。

本系列丛书中，有 Finney、Weir 等编的《托马斯微积分》（第 10 版，Pearson），其特色可用“呈传统特色、富革新精神”概括，本书自 20 世纪 50 年代第 1 版以来，平均每四五年就有一个新版面世，长在 50 余年始终盛行于西方教坛，作者既有相当高的学术水平，又热爱教学，长期工作在教学第一线，其中，年近 90 的 G.B.Thomas 教授长年在 MIT 工作，具有丰富的教学经验；Finney 教授也在 MIT 工作达 10 年；Weir 是美国数学建模竞赛委员会主任。Stewart 编的立体化教材《微积分》（第 5 版，Thomson Learning）配备了丰富的教学资源，是国际上最畅销的微积分原版教材，2003 年全球销量约 40 余万册，在美国，占据了约 50%~60%的微积分教材市场，其用户包括耶鲁等名牌院校及众多一般院校 600 余所。本系列丛书还包括 Anton 编的经典教材《线性代数及其应用》（第 8 版，Wiley）；Jay L. Devore 编的优秀教材《概率论与数理统计》（第 5 版，Thomson Learning）等。在努力降低引进教材售价方面，高等教育出版社做了大量和细致的工作，这套引进的教材体现了一定的权威性、系统性、先进性和经济性等特点。

通过影印、翻译、编译这批优秀教材，我们一方面要不断地分析、学习、消化吸收国外优秀教材的长处，吸取国外出版公司的制作经验，提升我们自编教材的立体化配套标准，使我国高校教材建设水平上一个新的台阶；与此同时，我们还将尝试组织海外作者和国内作者合编外文版基础课数学教材，并约请国内专家改编部分国外优秀教材，以适应我国实际教学环境。

这套教材出版后，我们将结合各高校的双语教学计划，开展大规模的宣传、培训工作，及时地将本套丛书推荐给高校使用。在使用过程中，我们衷心希望广大高校教师和同学提出宝贵的意见和建议，如有好的教材值得引进，请与高等教育出版社高等理科分社联系。

联系电话：010-58581384，E-mail: xuke@hep. com.cn。

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2004 年 4 月 20 日

Computer Algebra System (CAS) Exercises

P Preliminaries

P.7 Fitting curves to observed data, analyzing the error, making predictions, and improving the model if appropriate.

1 Limits and Continuity

1.1 Comparing graphical estimates of limits with CAS symbolic limit calculations.
Exploring the formal definition of limit by finding deltas for specific epsilons graphically.

1.3 Exploring asymptotes and graphical behavior as $x \to \pm\infty$.

1.5 Exploring graphically and numerically average rates of change and tangents.

2 Derivatives

2.1 Exploring graphically the convergence of the secant lines. Using the definition to find a function's derivative. Exploring the relationship between the graphs of f and f' and plotting selected tangent lines.

2.2 Exploring animated visualizations of the derivatives for velocity and acceleration.

2.4 Exploring the motions of harmonic and decaying oscillations.

2.5 Exploring trigonometric "polynomial" approximations to sawtooth and square wave functions. Plotting curves defined parametrically together with a specified tangent line.

2.6 Finding a derivative implicitly and plotting implicit curves together with a specified tangent line.

3 Applications of Derivatives

3.1 Finding absolute extrema by analyzing f and f' numerically and graphically.

3.2 Graphing solutions of differential equations.

3.3 Exploring families of cubic and quartic polynomials and logistic functions.

3.5 Investigating the strength and stiffness of a beam and their relationship to points of inflection. Exploring the volumes of cones constructed from a circular disk. Exploring a triangle circumscribing an ellipse.

3.6 Finding linearizations and exploring the absolute error in a linearization by comparing its graph with that of the function.

3.7 Finding zeros of functions using Newton's method. Approximating the numbers $\sqrt{2}$, π, and e.

4 Integration

4.1 Solving initial value problems.

4.3 Finding the average value of $f(x)$ and the point or points where it is assumed by f. Estimating volumes with finite sums.

4.4 Exploring Riemann sums and their limits.

4.5 Investigating the relationship of $F(x) = \int_a^x f(t)\,dt$ to $f(x)$ and $f'(x)$. Analyzing $F(x) = \int_a^{u(x)} f(t)\,dt$.

4.7 Evaluating definite integrals numerically.

5 Applications of Integrals

5.1 Finding the volumes of solids of revolution about the x-axis for circular and washer cross sections.

5.3 Estimating the lengths of curves defined explicitly or parametrically.

5.4 Exploring the relationship between work and kinetic energy.

6 Transcendental Functions and Differential Equations

6.1 Exploring the linearization of $\ln(1 + x)$ at $x = 0$.

6.2 Exploring the linearizations of e^x, 2^x, and $\log_3 x$.
Exploring inverse functions and their derivatives.

6.4 Investigating the differential equation modeling the change over time in glucose fed intravenously. Plotting slope fields and solution curves for separable differential equations.

6.6 Plotting the slope field and investigating solutions of a modified logistic equation. Finding numerical solutions using Euler's and improved Euler's methods. Exploring solutions to initial value problems graphically, analytically, and numerically, and comparing the results.

7 Integration Techniques, L'Hôpital's Rule, and Improper Integrals

7.5 Using a CAS to integrate. An example of a CAS-resistant integral. Monte Carlo integration.

7.7 Exploring the convergence of improper integrals involving $x^P \ln x$.

8 Infinite Series

8.1 Plotting sequences to explore their convergence or divergence. For convergent sequences, finding a tail that lies within a specified interval centered at the limit.

8.2 Exploring the convergence of sequences defined recursively. Compound interest with deposits and withdrawals. The logistic difference equation and chaotic behavior.

8.4 Exploring $\sum_{n=1}^{\infty} (1/(n^3 \sin^2 n))$, a series whose convergence or divergence has not yet been determined.

8.7 Comparing functions' linear, quadratic, and cubic approximations.

8.9 Finding Fourier series expansions. Using a Fourier series to show that $\sum_{n=1}^{\infty} 1/n^2 = \pi^2/6$.

8.10 Finding Fourier sine and cosine series for $f(x) = |2x - \pi|, 0 < x < \pi$.

9 Vectors in the Plane and Polar Functions

9.6 Exploring a figure skater tracing a polar plot.

10 Vectors and Motion in Space

10.3 Putting a three-dimensional scene on a two-dimensional canvas.

10.4 Plotting three-dimensional lines, planes, cylinders, and quadric surfaces.

10.5 Plotting tangents to space curves. Exploring a general helix curve.

10.6 Analyzing the motion of a particle moving along a space curve.

10.7 Finding κ, τ, **T, N,** and **B** for curves in space. Finding and plotting circles of curvature for curves in the plane.

11 Multivariable Functions and Their Derivatives

11.1 Plotting surfaces $z = f(x, y)$ and associated level curves. Plotting implicit and parametrized surfaces.

11.5 Exploring directional derivatives.

11.7 Finding and classifying critical points for functions of two independent variables using information gathered from surface plots, level curves, and discriminant values. Looking for patterns in data and applying the method of least squares.

11.8 Implementing the method of Lagrange multipliers for functions of three and four independent variables.

12 Multiple Integrals

12.1 Using a double-integral evaluator to find values of integrals. Finding volume under a nonnegative surface using Monte Carlo integration.

12.3 Changing Cartesian integrals into equivalent polar integrals for evaluation.

12.4 Evaluating triple integrals over solid regions. Using volumes to measure rainfall and ensure adequate drainage from a satellite dish.

12.5 Exploring moments and means to determine if a buoy will overturn. Exploring new plotting techniques.

13 Integration in Vector Fields

13.1 Evaluating line integrals along different paths.

13.2 Estimating the work done by a vector field along a given path in space.

13.3 Visualizing force fields. Verifying that a force field is conservative.

13.4 Applying Green's Theorem to find counterclockwise circulation. Finding the path through a force field that maximizes the work done. Comparing conservative and nonconservative force fields.

13.8 Visualizing and interpreting flux and divergence in three dimensions. Evaluating integrals on surfaces defined parametrically. Evaluating the divergence integral.

To the Instructor

Throughout its illustrious history, *Thomas' Calculus* has been used to support a variety of courses and teaching methods, from traditional to experimental. This tenth edition is a substantial revision, yet it retains the traditional strengths of the text: sound mathematics, relevant and important applications to the sciences and engineering, and excellent exercises. This flexible and modern text contains all the elements needed to teach the many different kinds of courses that exist today.

A book does not make a course; the instructor and the students do. This text is a resource to support your course. With this in mind, we have added a number of features to the tenth edition making it even more flexible and useful, both for teaching and learning calculus.

Features of the Tenth Edition

- For the first time, this classic text is available in *both* standard and Early Transcendentals versions.
- The new *Annotated Instructor's Edition* contains suggestions for the incorporation of technology, highlighting how the Web site and CD-ROM can be used to enhance the presentation of chapter topics.
- As always, this text continues to be easy to read, conversational, and mathematically rich. Each new topic is motivated by clear, easy-to-understand examples and is then reinforced by its application to real-world problems of immediate interest to students.
- Each section now begins with a list of subsection headings, making key concepts readily apparent.
- Within the tenth edition is an increased emphasis on modeling and applications using real data. As a result, there is an improved balance of graphical, numerical, and analytic methods and techniques, accomplished without compromising the mathematical integrity of the book.
- Vectors and projectile motion in the plane are now covered separately in one chapter, concluding the treatment of single-variable calculus. Three-dimensional vectors are then treated in conjunction with multivariable calculus.
- Exercise sets continue to be grouped within appropriate headings. Titles that indicate the content or application have been added for most word problems, and those requiring the use of a graphing utility are identified throughout the text by the icon T. Computer Algebra System (CAS) exercises also

appear in every chapter and are grouped in special subsections labeled "Computer Explorations."

- Together, the CD-ROM and Web site provide students and instructors with even more support:
  - A collection of Maple® and *Mathematica®* modules, videos, and Java applets are available to help students visualize key calculus concepts.
  - Interactive online tutorials help students review precalculus and textbook-specific material, take practice tests, and receive diagnostic feedback on their performance.
  - Chapter-by-chapter quizzes are also provided. These quizzes can be administered and graded online for skills-based mastery assessment.
  - Downloadable technology resources are provided for specific computer algebra systems and graphing calculators.
  - Expanded historical biographies are now on the Web site and CD-ROM, leaving more room in the margin of the text for notes, observations, and annotations and giving the book a more open look.

With all these changes, we have not compromised our belief that the fundamental goal of calculus is helping prepare students to enter the worlds of mathematics, science, and engineering.

Mastering Skills and Concepts

As always, this text continues to maintain a strong skill-building emphasis. Throughout this edition, we have included examples and discussions encouraging students to think visually, analytically, and numerically. Almost every exercise set contains problems requiring students to generate and interpret graphs as a tool for understanding mathematical or real-world relationships. Many sections also contain problems to extend the range of applications, mathematical ideas, and rigor.

Students are asked to explore and explain a variety of calculus concepts and applications in writing exercises placed throughout the text. In addition, each chapter ends with a list of questions to help students review and summarize what they have learned. Many of these review questions make great writing assignments.

Problem-Solving Strategies

We believe students learn best when procedural techniques are laid out as clearly and simply as possible. To this end, stepwise problem-solving summaries are included as appropriate, especially for the more difficult or complicated procedures. As always, we are especially careful that examples in the text illustrate the steps outlined by the summaries.

Exercises

Exercise sets have been carefully reviewed and revised in this new edition. They are grouped by topic, with special sections for computer explorations. These sections contain CAS explorations and projects.

Within exercise sets are practice and applied problems, critical thinking and challenging exercises (in subsections marked "Applications and Theory"), and exercises requiring students to write about important calculus concepts. Writing

exercises appear throughout exercise sets. Exercises generally follow the order of presentation in the text, and those requiring a graphing utility (such as a graphing calculator) are identified throughout the text by the icon T.

Chapter-End Support Material

At the end of each chapter are three features summarizing the chapter contents:

"Questions to Guide Your Review" ask students to think about key chapter concepts and then verbalize their understanding of them and include illustrative examples. These are questions suitable for writing exercises.

"Practice Exercises" provide a review of the techniques, computational and numerical skills, and key applications.

"Additional Exercises: Theory, Examples, and Applications" provide students with more theoretical or challenging applications and problems to further deepen their understanding of the mathematical ideas.

Applications and Examples

A hallmark of this book has been the application of calculus to science and engineering. These applied problems have been updated, improved, and extended continually over the last several editions. With this edition, we include more problems based on real data requiring graphical and numerical techniques for their solution. Throughout the text, we cite sources for the data or articles from which these applications are drawn, helping students understand that calculus is a current, dynamic field requiring a multiplicity of different techniques and approaches. Most of these applications are directed toward the physical sciences and engineering, but there are many from biology and the social sciences as well.

Technology: Graphing Utility and Computer Explorations

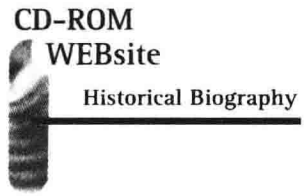
Virtually every section of the text contains exercises to explore numerical patterns or graphing utility exercises that ask students to generate and interpret graphs as a tool to understanding mathematical and real-world relationships. Many of the graphing utility exercises are suitable for classroom demonstration or for group work by students in or out of class. These exercises are identified throughout the text by the icon T or the heading "Computer Explorations."

Computer Explorations

Numbering more than 200, the computer explorations exercises have been solved using both *Mathematica* and Maple. In addition, *Mathematica* and Maple modules are available on the Web site and CD-ROM. These modules have been carefully designed to help students develop a geometric intuition and a deeper understanding and appreciation of calculus concepts, methodologies, and applications. CD/Web site icons mark the locations in the text where material related to these modules is covered.

CD-ROM
WEBsite

Notes also appear throughout the text that encourage students to explore with graphing utilities and help them assess when the use of technology is helpful and when it may be misleading.



Expanded History and Biographies

Any student is enriched by seeing the human side of mathematics through its historical development. In previous editions, we featured history boxes describing the origins of ideas, conflicts concerning ownership of these ideas, and interesting sidelights into modern topics such as fractals and chaos. For the tenth edition, we have expanded and written more biographies and historical essays. These essays are now available on the CD-ROM and Web site; they are referenced by icons throughout the text, leaving more room in the margins for student notes, observations, and annotations.

The Many Faces of This Book

Mathematics Is a Formal and Beautiful Language

Calculus is one of the most powerful of human intellectual achievements. One goal of this book is to give students an appreciation of the beauty of calculus. As in previous editions, we have been careful to say only what is true and mathematically sound. Every definition, theorem, corollary, and proof has been reviewed for clarity and mathematical correctness.

Whether calculus is taught in a traditional lecture format or entirely in labs with individual and group learning focusing on numerical and graphical experimentation, its ideas and techniques need to be articulated clearly and accurately.

Students Will Learn from This Book for Many Years to Come

We intentionally provide far more material than any one instructor would want to teach. Students can continue to learn calculus from this book long after the class has ended. It provides an accessible review of the calculus a student has already studied and is a resource for the working engineer or scientist.

Highlights of New Content Features, by Chapter

Preliminaries

- All the familiar precalculus functions are covered completely.
- Parametric equations are introduced.
- Inverses of familiar functions, including inverse trigonometric functions, are also covered.
- Mathematical modeling, with modeling exercises, is introduced.
- New examples and exercises employ real data and regression analysis using a calculator.

Chapter 1 Limits and Continuity

- Limits are introduced by way of rates of change, with a concluding section on tangent lines to connect and complete the initial discussion.
- All the fundamental ideas on limits are now together in a single chapter, including finite limits, infinite limits, asymptotes, limit rules, and $\lim_{\theta \to 0}((\sin \theta)/\theta)$.
- Both informal and precise definitions of the limit concept are given, but there is less emphasis on using the precise definition to prove theorems.

Chapter 2 Derivatives

- The derivative as a rate of change is presented earlier to stress its importance in studying motion along a line in modeling real-world phenomena.
- Differentiation rules are presented in two sections to enhance the clarity and flow of the presentation.
- First and second derivatives for parametric equations are included as an application of the Chain Rule.

Chapter 3 Applications of Derivatives

- The treatment of using the first and second derivatives to determine the shape of a graph is more focused and streamlined.
- A new section on using the first and second derivative to produce graphical solutions to autonomous first-order differential equations acts as a graphical prelude to Chapters 4 and 6.
- The new section includes an introduction to population modeling.

Chapter 4 Integration

- As before, indefinite integrals are presented first, stressing their importance for solving elementary differential equations. The rules for antiderivatives and the substitution method follow next.
- As in the previous edition, estimating with finite sums in a variety of application settings motivates the ideas of Riemann sums and definite integrals. Students see the definite integral early as more than just a tool for finding area.
- The section defining the definite integral as a limit of Riemann sums has been streamlined and now focuses on continuous functions. Piecewise-continuous functions are treated in the Additional Exercises at the end of the chapter.
- All the material on single integral area calculations (including areas between curves) is now treated in this chapter.

Chapter 5 Applications of Integrals

- The treatment of volumes has been combined from three into two sections.
- Arc length formulas are developed for both explicit function and parametric curves in the plane.
- Surface area has been moved to Chapter 13, where it is needed for surface integrals. There, it is treated in a unified fashion rather than as a special case of surfaces of revolution.
- The important applications to springs, pumping and lifting, fluid forces, and moments have all been retained from the previous edition.

Chapter 6 Transcendental Functions and Differential Equations

- This chapter has been reorganized to present the calculus of logarithmic, exponential, and inverse trigonometric functions immediately. (The differential calculus of these functions is presented in Chapters 2 and 3 in the Early Transcendentals version.) The treatment includes integrals leading to inverse trigonometric functions.
- Separable variable and linear first-order differential equations follow, modeling growth and decay, heat transfer, a falling body with resisting forces, and mixture problems.
- Euler's method and the improved Euler's method are combined with additional material on population models, illustrating graphical, numerical, and analytic solution methods.

Chapter 7 Integration Techniques, L'Hôpital's Rule, and Improper Integrals

- Monte Carlo integration is now included with the use of integral tables or computer algebra systems (CAS) to find integrals.
- L'Hôpital's Rule is covered in this chapter just prior to its use for calculating some improper integrals and limits of sequences (in Chapter 8).

Chapter 8 Infinite Series

- The basic ideas concerning sequences of numbers and their limits are covered in the first section. The next section, which is optional, treats the more theoretical ideas involving subsequences and bounded monotonic sequences.

- Most of the important series convergence tests are presented together in a single, streamlined section.
- Two new optional sections at the end of the chapter cover the basics of Fourier series. This inclusion allows for an earlier introduction to these important concepts for students requiring their use right away in their applied science and engineering courses. Completing the elementary introduction to series, these sections illustrate important representations of functions by series other than power series.

Chapter 9 Vectors in the Plane and Polar Functions

- This is a new chapter on vectors and projectile motion in the plane, with two sections at the end covering polar coordinates and graphs and the calculus of polar curves to prepare students for their use in multivariable calculus. It permits an earlier self-contained treatment of planar vectors, if desired. The chapter can be covered any time after the coverage of the integral and the calculus of exponential and logarithmic functions.
- Chapters P through 9 now form a complete package treating the ideas of single variable calculus. Three-dimensional vectors are presented independently along with multivariable calculus, beginning in Chapter 10.
- Vector ideas are motivated by their application to studying paths, velocities, accelerations, and forces associated with bodies moving along planar paths.
- The detailed analytic geometry of conic sections and quadratic equations has been eliminated. These ideas are thoroughly covered in high school and precalculus courses, but we nevertheless review many of the basics throughout the text as needed.
- Parametrizations of plane curves has been moved to earlier chapters.

Chapter 10 Vectors and Motion in Space

- Three-dimensional vectors, the geometry of space, and vector-valued functions defining space curves are now organized together in this single chapter with fresh introductions and examples. This chapter now constitutes, and clearly delineates, the entry point for the multivariable calculus.
- Letters representing vectors have been changed from uppercase letters to the now more standard lowercase letters.
- Vectors in the plane are reviewed along with the development of the algebra and geometry of three-dimensional vectors to help students bridge any possible gap between Calculus II and Calculus III courses.
- The logical treatment and organization of motion along space curves and the **TNB** frame has been retained from the previous edition.

Chapter 11 Multivariable Functions and Their Derivatives

- The chapter has been reorganized to improve efficiency and flow. The treatment of partial derivatives with constrained variables has been moved toward the end of the chapter to follow the introduction to Lagrange multipliers. The treatment of linearization and differentials now follows the treatment of directional derivatives, gradient vectors, and tangent planes.
- The treatment of gradients and tangent planes is shorter and more direct.
- A new introduction to extreme values and saddle points compares and contrasts the multivariable case with the single-variable case.
- The exercise sets have been streamlined and all applications exercises labeled for quick identification.

Chapter 12 Multiple Integrals

- The treatment of the calculation of masses, moments, and centers of mass with multiple integrals is now self-contained. It no longer assumes previous exposure to the single-integral calculations in Chapter 5, which may now be bypassed entirely.
- Again, the practice of titling exercises makes them noticeably easier to select than before.

Chapter 13 Integration in Vector Fields

- In the treatment of Green's Theorem in the plane, circulation density at a point is introduced as the k-component of a more general circulation vector called the curl, which is treated in detail in the later section on Stokes' Theorem. This arrangement resolves the apparent inconsistency of having circulation in the plane represented by a scalar while circulation in space is represented by a vector.

Supplements for the Instructor

TestGen-EQ with QuizMaster-EQ

Windows and Macintosh CD (dual platform)
ISBN 0-201-70287-8
TestGen-EQ's friendly graphical interface enables instructors to view, edit, and add questions, transfer questions to tests, and print tests in a variety of fonts and forms easily. Search and sort features let the instructor quickly locate questions and arrange them in a preferred order. Six question formats are available, including short answer, true–false, multiple choice, essay, matching, and bimodal formats. A built-in question editor gives the user power to create graphs, import graphics, insert mathematical symbols and templates, and insert variable numbers or text. Computerized test banks include algorithmically defined problems organized according to each version of the textbook (standard and Early Transcendentals). An "Export to HTML" feature allows instructors to create practice tests for the Web.

QuizMaster-EQ enables instructors to create and save tests using *TestGen-EQ* so that students can take them for either practice or a grade on a computer network. Instructors can set preferences for how and when tests are administered. *QuizMaster-EQ* automatically grades exams, stores results on disk, and allows the instructor to view or print a variety of reports for individual students, classes, or courses.

This software is free to adopters of the text. Consult your Addison-Wesley representative for details.

Instructor's Solutions Manual

Volume I (Chapters P–9), ISBN 0-201-50403-0
Volume II (Chapters 8–13), ISBN 0-201-50404-9
The *Instructor's Solutions Manual* by Maurice D. Weir and John L. Scharf contains complete worked-out solutions to all the exercises in the text.

Answer Book

ISBN 0-201-44144-6
The *Answer Book* by Maurice D. Weir and John L. Scharf contains short answers to most of the exercises in the text.

Technology Resource Manuals for Computer Algebra Systems and Graphing Calculators

TI-Graphing Calculator Manual ISBN 0-201-72198-8
Maple Manual ISBN 0-201-72197-X
Mathematica Manual ISBN 0-201-72196-1
Each manual provides detailed guidance for integrating a specific software package or graphing calculator throughout the course, including syntax and commands.

Transparency Masters

Instructors may download from the CD-ROM a full set of color PowerPoint art transparencies featuring a number of the more complex figures from the text for use in the classroom.

Supplements for the Student

Student's Study Guide

Volume I (Chapters P–9), ISBN 0-201-50405-7
Volume II (Chapters 8–13), ISBN 0-201-50406-5
Organized to correspond with the text, the *Student's Study Guide* reinforces important concepts and provides study tips and additional practice problems.

Student's Solutions Manual

Volume I (Chapters P–9), ISBN 0-201-50381-6
Volume II (Chapters 8–13), ISBN 0-201-50402-2
The *Student's Solutions Manual* by Maurice D. Weir and John L. Scharf is designed for the student and contains carefully worked-out solutions to all the odd-numbered exercises in the text.

Just-in-Time Algebra and Trigonometry for Students of Calculus, Second Edition

ISBN 0-201-66974-9
Sharp algebra and trigonometry skills are critical to mastering calculus, and *Just-in-Time Algebra and Trigonometry for Students of Calculus, Second Edition* by Guntram Mueller and Ronald I. Brent is designed to bolster these skills while students study calculus. As students make their way through calculus, this text is with them every step of the way, showing them the necessary algebra or trigonometry topics and pointing out potential problem spots. The easy-to-use contents has algebra and trigonometry topics arranged in the order in which students will need them as they study calculus.

AWL Math Tutor Center

The AWL Math Tutor Center (www.awl.com/tutorcenter) provides assistance to students who take calculus and purchase a mathematics textbook published by Addison Wesley Longman. Help is provided via phone, fax, and e-mail. Students

who use the service will be helped by tutors who are qualified mathematics instructors.

CD-ROM and Web Site

Maple and Mathematica Modules

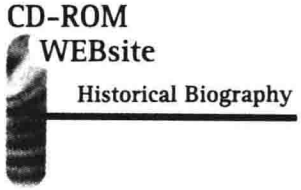
Over 35 modules have been written by John L. Scharf and Marie M. Vanisko of Carroll College in Montana and Colonel D. Chris Arney of the U.S. Military Academy. These modules have been carefully designed to help students develop their geometric intuition and deepen their understanding of calculus concepts and methods. Based on real-world applications, they encourage students to visualize calculus and to discover its importance in everyday life. Users will need *Mathematica* or Maple to access these modules. Icons reference these modules throughout the text.

Interactive Calculus (Java Applets)

These unique interactive calculus Java applets are easy to use, with no syntax or special languages to learn. Students can manipulate equations and graphs in "real time." Topics span limits, projectile motion, slopes, tangents, derivatives, integrals, **TNB** frames, and the concept of curl. By bringing these applets into classroom demonstration and discussion, laboratory and homework assignments, or independent study, teachers and students can explore the mathematics of time and motion. These applets are designed to build a clear understanding of concepts when they are first encountered and to help students over the hurdles of abstraction that have often confused them in the past.

Video Clips

Video clips of real-world situations provide motivation for learning and applying calculus. These videos have been developed specifically to accompany several of the calculus modules described above.



Expanded History and Biographies

Icons throughout the book refer to expanded historical biographies and notes on the Web site and CD-ROM. These materials have been written by Colonel D. Chris Arney of the U.S. Military Academy in collaboration with Joe B. Albree of Auburn University.

Just-in-Time Online Algebra and Trigonometry

Compiled by Ronald I. Brent and Guntram Mueller of the University of Massachusetts, Lowell, this interactive Web-based testing and tutorial system allows students to practice the algebra and trigonometry skills critical to mastering calculus. *Just-in-Time Online* tracks student progress and provides personalized study plans to help students succeed. The registration coupon at the back of this text provides access to this feature of the Web site.

Interactive Calculus Tutorial

Written by G. Donald Allen, Michael Stecher, and Philip B. Yasskin of Texas A&M University, this interactive online calculus tutorial lets students review