

table of contents

Introduction	xxi
Chapter 1. Coordinates, Graphs, Lines	1
1.1 Real Numbers, Sets, and Inequalities (A Review)	1
1.2 Absolute Value	17
1.3 Coordinate Planes; Distance; Circles	24
1.4 Slope of a Line	33
1.5 Equations of Straight Lines	42
Chapter 2. Functions and Limits	51
2.1 Functions	51
2.2 Operations on Functions; Classifying Functions	64
2.3 Introduction to Calculus: Tangents and Velocity	75
2.4 Limits (An Intuitive Introduction)	85
2.5 Limits (Computational Techniques)	95
2.6 Limits: A Rigorous Approach (Optional)	109
Chapter 3. Differentiation	122
3.1 The Derivative	122
3.2 Techniques of Differentiation	130
3.3 Derivatives of Trigonometric Functions	140
3.4 Δ -Notation; Differentials	150
3.5 The Chain Rule	159
3.6 Implicit Differentiation	167
3.7 Continuity	175

Chapter 4. Applications of Differentiation	191	
4.1	Related Rates	191
4.2	Maximum and Minimum Values of a Function	200
4.3	Applied Maximum and Minimum Problems	208
4.4	Intervals of Increase and Decrease; Concavity; Higher Derivatives	224
4.5	Sketching Graphs of Polynomials and Rational Functions	234
4.6	Other Graphing Problems	243
4.7	Relative Extrema	247
4.8	More Applied Maximum and Minimum Problems	254
4.9	Rolle's Theorem; Mean-Value Theorem	260
4.10	Proofs of Key Results Using the Mean-Value Theorem (Optional)	267
Chapter 5. Integration	274	
5.1	Introduction	274
5.2	Antiderivatives; the Indefinite Integral	279
5.3	Integration by u-substitution	287
5.4	Rectilinear Motion (An Application of the Indefinite Integral)	295
5.5	Sigma Notation	303
5.6	Areas as Limits	313
5.7	The Definite Integral	322
5.8	The Fundamental Theorem of Calculus	332
5.9	Properties of the Definite Integral; Distance Traveled in Rectilinear Motion	340
5.10	Mean-Value Theorem for Integrals; Average Value	348
Chapter 6. Applications of the Definite Integral	354	
6.1	Area Between Two Curves	354
6.2	Volumes by Slicing; Disks and Washers	358
6.3	Volumes by Cylindrical Shells	367
6.4	Length of a Plane Curve	374
6.5	Area of a Surface of Revolution	378
6.6	Work	383
6.7	Liquid Pressure and Force	388
Chapter 7. Logarithm and Exponential Functions	396	
7.1	Introduction	396
7.2	The Natural Logarithm; the Second Fundamental Theorem of Calculus	396

7.3	Properties of the Natural Logarithm	404
7.4	The Number e ; the Functions a^x and e^x	412
7.5	Additional Properties of e^x	421
7.6	The Hyperbolic Functions	425
7.7	First-Order Differential Equations and Applications	431
Chapter 8. Inverse Trigonometric and Hyperbolic Functions		450
8.1	Inverse Functions	450
8.2	Inverse Trigonometric Functions	458
8.3	Derivatives and Integrals Involving Inverse Trigonometric Functions	462
8.4	Inverse Hyperbolic Functions	470
Chapter 9. Techniques of Integration		477
9.1	A Brief Review	477
9.2	Integration by Parts	479
9.3	Integrating Powers of Sine and Cosine	488
9.4	Integrating Powers of Secant and Tangent	495
9.5	Trigonometric Substitutions	500
9.6	Integrals Involving $ax^2 + bx + c$	507
9.7	Integrating Rational Functions; Partial Fractions	510
9.8	Miscellaneous Substitutions (Optional)	521
9.9	Numerical Integration; Simpson's Rule	526
Chapter 10. Improper Integrals; L'Hôpital's Rule		537
10.1	Improper Integrals	537
10.2	L'Hôpital's Rule (Indeterminate Forms of Type 0/0)	544
10.3	Other Indeterminate Forms (∞/∞ , $0 \cdot \infty$, 0^0 , ∞^0 , 1^∞ , $\infty - \infty$)	552
Chapter 11. Infinite Series		562
11.1	Sequences	562
11.2	Monotone Sequences	571
11.3	Infinite Series	579
11.4	Convergence; the Integral Test	588
11.5	Additional Convergence Tests	597
11.6	Applying the Comparison Test	605

11.7	Alternating Series; Conditional Convergence	613
11.8	Power Series	625
11.9	Taylor and Maclaurin Series	632
11.10	Taylor Formula with Remainder; Convergence of Taylor Series	642
11.11	Computations Using Taylor Series	654
11.12	Differentiation and Integration of Power Series	663
Chapter 12. Topics in Analytic Geometry		674
12.1	Introduction to the Conic Sections	674
12.2	The Parabola; Translation of Coordinate Axes	675
12.3	The Ellipse	683
12.4	The Hyperbola	690
12.5	Rotation of Axes; Second Degree Equations	698
Chapter 13. Polar Coordinates and Parametric Equations		710
13.1	Polar Coordinates	710
13.2	Graphs in Polar Coordinates	716
13.3	Area in Polar Coordinates	726
13.4	Parametric Equations	732
13.5	Tangent Lines and Arc Length in Polar Coordinates (Optional)	745
Chapter 14. Vectors in the Plane		754
14.1	Vectors	754
14.2	Vector Calculus in Two Dimensions	762
14.3	Unit Tangent and Normal Vectors; Arc Length as a Parameter	769
14.4	Curvature	777
14.5	Motion in a Plane	785
Chapter 15. Three-Dimensional Space		799
15.1	Rectangular Coordinates in 3-Space; Spheres; Cylindrical Surfaces	799
15.2	Vectors and Lines in 3-Space	807
15.3	Dot Product; Projections	813
15.4	Cross Product	825
15.5	Curves in 3-Space	836
15.6	Planes in 3-Space	847

	15.7 Cramer's Rule (Optional)	856
	15.8 Quadric Surfaces	864
	15.9 Spherical and Cylindrical Coordinates	875

Chapter 16. Partial Derivatives 884

	16.1 Functions of Two Variables	884
	16.2 Partial Derivatives	895
	16.3 Limits, Continuity, and Differentiability	903
	16.4 The Chain Rule for Functions of Two Variables	915
	16.5 Directional Derivatives; Gradient	923
	16.6 Tangent Planes	933
	16.7 Functions of Three Variables	942
	16.8 Functions of n Variables; More on the Chain Rule	955
	16.9 Maxima and Minima of Functions of Two Variables	963
	16.10 Lagrange Multipliers	972

Chapter 17. Multiple Integrals 983

	17.1 Double Integrals	983
	17.2 Double Integrals Over Nonrectangular Regions	994
	17.3 Double Integrals in Polar Coordinates	1006
	17.4 Surface Area	1015
	17.5 Triple Integrals	1021
	17.6 Centroids, Centers of Gravity, Theorem of Pappus	1033
	17.7 Triple Integrals in Cylindrical and Spherical Coordinates	1049

Chapter 18. Topics in Vector Calculus 1065

	18.1 Line Integrals	1065
	18.2 Line Integrals Independent of Path	1077
	18.3 Green's Theorem	1088

Appendix 1 Trigonometry Review A1

Appendix 2 Supplementary Material A25

Appendix 3 Tables A44

Answers A49

Index I1