

PREFACE TO THE INSTRUCTOR

This Instructor's Solutions Manual contains the solutions to every exercise in the 12th Edition of THOMAS' CALCULUS by Maurice Weir and Joel Hass, including the Computer Algebra System (CAS) exercises. The corresponding Student's Solutions Manual omits the solutions to the even-numbered exercises as well as the solutions to the CAS exercises (because the CAS command templates would give them all away).

In addition to including the solutions to all of the new exercises in this edition of Thomas, we have carefully revised or rewritten every solution which appeared in previous solutions manuals to ensure that each solution

- conforms exactly to the methods, procedures and steps presented in the text
- is mathematically correct
- includes all of the steps necessary so a typical calculus student can follow the logical argument and algebra
- includes a graph or figure whenever called for by the exercise, or if needed to help with the explanation
- is formatted in an appropriate style to aid in its understanding

Every CAS exercise is solved in both the MAPLE and *MATHEMATICA* computer algebra systems. A template showing an example of the CAS commands needed to execute the solution is provided for each exercise type. Similar exercises within the text grouping require a change only in the input function or other numerical input parameters associated with the problem (such as the interval endpoints or the number of iterations).

For more information about other resources available with Thomas' Calculus, visit <http://pearsonhighered.com>.

TABLE OF CONTENTS

1 Functions 1

- 1.1 Functions and Their Graphs 1
- 1.2 Combining Functions; Shifting and Scaling Graphs 8
- 1.3 Trigonometric Functions 19
- 1.4 Graphing with Calculators and Computers 26
 - Practice Exercises 30
 - Additional and Advanced Exercises 38

2 Limits and Continuity 43

- 2.1 Rates of Change and Tangents to Curves 43
- 2.2 Limit of a Function and Limit Laws 46
- 2.3 The Precise Definition of a Limit 55
- 2.4 One-Sided Limits 63
- 2.5 Continuity 67
- 2.6 Limits Involving Infinity; Asymptotes of Graphs 73
 - Practice Exercises 82
 - Additional and Advanced Exercises 86

3 Differentiation 93

- 3.1 Tangents and the Derivative at a Point 93
- 3.2 The Derivative as a Function 99
- 3.3 Differentiation Rules 109
- 3.4 The Derivative as a Rate of Change 114
- 3.5 Derivatives of Trigonometric Functions 120
- 3.6 The Chain Rule 127
- 3.7 Implicit Differentiation 135
- 3.8 Related Rates 142
- 3.9 Linearizations and Differentials 146
 - Practice Exercises 151
 - Additional and Advanced Exercises 162

4 Applications of Derivatives 167

- 4.1 Extreme Values of Functions 167
- 4.2 The Mean Value Theorem 179
- 4.3 Monotonic Functions and the First Derivative Test 188
- 4.4 Concavity and Curve Sketching 196
- 4.5 Applied Optimization 216
- 4.6 Newton's Method 229
- 4.7 Antiderivatives 233
 - Practice Exercises 239
 - Additional and Advanced Exercises 251

5 Integration 257

- 5.1 Area and Estimating with Finite Sums 257
- 5.2 Sigma Notation and Limits of Finite Sums 262
- 5.3 The Definite Integral 268
- 5.4 The Fundamental Theorem of Calculus 282
- 5.5 Indefinite Integrals and the Substitution Rule 290
- 5.6 Substitution and Area Between Curves 296
 - Practice Exercises 310
 - Additional and Advanced Exercises 320

6 Applications of Definite Integrals 327

- 6.1 Volumes Using Cross-Sections 327
- 6.2 Volumes Using Cylindrical Shells 337
- 6.3 Arc Lengths 347
- 6.4 Areas of Surfaces of Revolution 353
- 6.5 Work and Fluid Forces 358
- 6.6 Moments and Centers of Mass 365
 - Practice Exercises 376
 - Additional and Advanced Exercises 384

7 Transcendental Functions 389

- 7.1 Inverse Functions and Their Derivatives 389
- 7.2 Natural Logarithms 396
- 7.3 Exponential Functions 403
- 7.4 Exponential Change and Separable Differential Equations 414
- 7.5 Indeterminate Forms and L'Hôpital's Rule 418
- 7.6 Inverse Trigonometric Functions 425
- 7.7 Hyperbolic Functions 436
- 7.8 Relative Rates of Growth 443
 - Practice Exercises 447
 - Additional and Advanced Exercises 458

8 Techniques of Integration 461

- 8.1 Integration by Parts 461
- 8.2 Trigonometric Integrals 471
- 8.3 Trigonometric Substitutions 478
- 8.4 Integration of Rational Functions by Partial Fractions 484
- 8.5 Integral Tables and Computer Algebra Systems 491
- 8.6 Numerical Integration 502
- 8.7 Improper Integrals 510
 - Practice Exercises 518
 - Additional and Advanced Exercises 528

9 First-Order Differential Equations 537

- 9.1 Solutions, Slope Fields and Euler's Method 537
- 9.2 First-Order Linear Equations 543
- 9.3 Applications 546
- 9.4 Graphical Solutions of Autonomous Equations 549
- 9.5 Systems of Equations and Phase Planes 557
 - Practice Exercises 562
 - Additional and Advanced Exercises 567

10 Infinite Sequences and Series 569

- 10.1 Sequences 569
- 10.2 Infinite Series 577
- 10.3 The Integral Test 583
- 10.4 Comparison Tests 590
- 10.5 The Ratio and Root Tests 597
- 10.6 Alternating Series, Absolute and Conditional Convergence 602
- 10.7 Power Series 608
- 10.8 Taylor and Maclaurin Series 617
- 10.9 Convergence of Taylor Series 621
- 10.10 The Binomial Series and Applications of Taylor Series 627
 - Practice Exercises 634
 - Additional and Advanced Exercises 642

11 Parametric Equations and Polar Coordinates 647

- 11.1 Parametrizations of Plane Curves 647
- 11.2 Calculus with Parametric Curves 654
- 11.3 Polar Coordinates 662
- 11.4 Graphing in Polar Coordinates 667
- 11.5 Areas and Lengths in Polar Coordinates 674
- 11.6 Conic Sections 679
- 11.7 Conics in Polar Coordinates 689
 - Practice Exercises 699
 - Additional and Advanced Exercises 709