

Contents

<i>Preface</i>	<i>page</i> xi
<i>How this book is organized, and how it can be used</i>	xiii
<i>Some study hints</i>	xv
0 Prerequisites	1
0.1 Fundamental operations; parentheses	1
0.2 Zero and negatives	3
0.3 Fractions and rational numbers	5
0.4 Integral exponents	8
0.5 Radicals, fractional exponents, and real numbers	9
0.6 Notation for implication	11
0.7 Equalities	11
0.8 Inequalities	13
0.9 Linear equations	16
0.10 Quadratic equations	18
0.11 Higher-degree equations	20
0.12 Progressions	24
0.13 Logarithms	27
0.14 Keeping track of units	29
0.15 Mensuration formulas	30
1 Functional relationships	33
1.1 Introduction	33
1.2 An example	33
1.3 Variation of one quantity with another; graphical interpolation	34

Contents		
1.4	More on graphing, interpolation, and extrapolation	37
1.5	Linear interpolation	41
1.6	Relations expressed by formulas	44
★ 1.7	Formulas (<i>continued</i>)	53
1.8	Relationships between science and mathematics	55
1.9	Functions	56
1.10	Further discussion of functions: notation and natural domains	59
1.11	Inverse functions	62
★ 1.12	Absolute values	65
1.13	Summary	65
2 Rate of change		72
2.1	Average speed and average velocity	72
2.2	Instantaneous velocity and limits	74
2.3	Theorems on limits	81
★ 2.4	Proofs of some results on limits	84
2.5	Average slope in an interval and slope at a point	87
2.6	Tangent to a curve	91
2.7	The derivative	93
★ 2.8	Guessing limits with a calculator	101
2.9	Review	103
3 Applications of the derivative		110
3.1	The Mean-Value Theorem	110
3.2	Increasing and decreasing functions	112
3.3	Approximate increments	114
3.4	Applications to economics: marginal cost and unit cost	119
3.5	Maxima and minima: the basic idea	123
3.6	How do we know whether we have a maximum or a minimum?	125
3.7	Further questions about maxima and minima	129
3.8	Applied maxima and minima	130
3.9	Maxima and minima in some problems in economics	136

	Contents
3.10 Approximate solution of equations: the Newton–Raphson method and the bisection method	139
3.11 Review	144
4 Further differentiation	148
4.1 Repeated differentiation and derived curves	148
4.2 Points of inflection and third test for maxima and minima	152
4.3 Extreme rates	156
4.4 Derivative of a function of a function: the Chain Rule	157
4.5 Continuity	161
* 4.6 Proof that differentiability implies continuity and proof of the Chain Rule	164
4.7 Notation	165
4.8 Related rates	168
4.9 Functions in implicit form and implicit differentiation	171
4.10 Derivatives of fractional powers	173
4.11 Implicit differentiation applied to related rates	174
4.12 Differentials	176
4.13 Formulas for derivatives of products and quotients	178
4.14 Marginal cost, marginal revenue, and optimal production levels	182
* 4.15 Maxima and minima using implicit differentiation	185
4.16 Summary	186
5 Antidifferentiation and integration	194
5.1 The reverse of differentiation	194
5.2 The antiderivatives of a given function differ by at most a constant	196
5.3 Formulas for antiderivatives	197
5.4 Repeated antidifferentiation: projectiles thrown vertically	202
5.5 The limit of a sum	205
5.6 Further limits of sums	209
5.7 The Fundamental Theorem	213
5.8 Applications of the Fundamental Theorem	217

Contents		
5.9	Use of the Chain Rule in integration (antidifferentiation)	222
5.10	The indefinite integral	224
5.11	Summary	225
6 Exponential functions		231
6.1	Introduction to exponential functions	231
6.2	The rate of change: preliminary remarks	235
6.3	Compound interest	237
6.4	Continuous compounding	240
6.5	The derivative of the exponential function	243
6.6	Relative errors and relative rates	246
6.7	Antiderivatives of the exponential	249
6.8	e^x : derivative and antiderivative	253
6.9	Summary	255
7 Logarithmic functions		257
7.1	Introduction	257
7.2	Inverse functions and the inverse of the exponential	257
7.3	Laws of logarithms	259
7.4	The derivative of the log function	264
7.5	Antiderivatives of $1/x$	266
7.6	Derivatives of b^x and $\log_b x$	268
7.7	Log–log and semilog graphs	269
7.8	Summary	274
8 Differential equations		282
8.1	Introduction	282
8.2	An approximate solution of a differential equation	284
8.3	Variables separable	286
8.4	Comparison of approximate and exact solutions	287
8.5	Population changes	289
8.6	The logistic equation	290
8.7	The method of partial fractions	291

	Contents
8.8 The logistic equation (<i>continued</i>)	292
8.9 Linear differential equations with constant coefficients	294
8.10 Linear differential equations with constant coefficients (<i>continued</i>)	299
★ 8.11 Approximating the solutions of a pair of simultaneous differential equations	302
9 Further integration	308
9.1 Introduction	308
9.2 Review of the use of the Chain Rule in integration (antidifferentiation)	308
9.3 Force of attraction	310
9.4 Loads	312
9.5 Moment of a force	314
9.6 Consumers' and producers' surpluses	315
9.7 Horizontal rectangular strips and circular strips	317
9.8 The idea of an average	320
9.9 Average velocity	321
9.10 The average of a function defined on an interval	322
★ 9.11 Further averages	325
9.12 Summary	329
9.13 Quadrature	334
9.14 More on quadrature: the trapezoidal rule and its adjustment	336
10 Trigonometric functions	343
10.1 Introduction	343
10.2 Angle measure	346
10.3 The sine and cosine functions	349
10.4 The tangent function, and application of the basic functions to triangles	354
10.5 Differentiation of the trigonometric functions	358
10.6 Antidifferentiation and integration of trigonometric functions	363
10.7 Inverse trigonometric functions	365
10.8 Further integration involving trigonometric functions	371

Cambridge University Press

978-0-521-09590-7 - Calculus: Basic Concepts and Applications

R. A. Rosenbaum and G. Philip Johnson

Table of Contents

[More information](#)

Contents		
★ 10.9 Other periodic functions		375
10.10 A return to differential equations		380
10.11 Summary		386
<i>Answers to selected problems</i>		391
<i>Appendix: Tables</i>		411
A Compound interest: $(1 + r)^n$		411
B ₁ Values of e^x and e^{-x}		412
B ₂ Natural logarithms ($\ln x$)		413
C Logarithms, base 10		415
D Trigonometric functions		417
<i>Index</i>		421