

Contents

Preface	vii
Introduction	1
1 Math fundamentals	3
1.1 Solving equations	4
1.2 Numbers	6
1.3 Number representations	11
1.4 Variables	24
1.5 Functions and their inverses	26
1.6 Basic rules of algebra	29
1.7 Solving quadratic equations	34
1.8 Exponents	39
1.9 Logarithms	44
1.10 The Cartesian plane	48
1.11 Functions	51
1.12 Functions reference	58
Line	58
Square	60
Square root	61
Absolute value	62
Polynomials	63
Solving polynomial equations	64
Sine	67
Cosine	69
Tangent	70
Exponential	71
Natural logarithm	72
1.13 Function transformations	73
1.14 Geometry	79
1.15 Trigonometry	83
1.16 Trigonometric identities	89
1.17 Circle	92

1.18	Ellipse	95
1.19	Hyperbola	99
1.20	Solving systems of linear equations	104
1.21	Compound interest	107
1.22	Set notation	110
1.23	Math problems	123
2	Introduction to physics	133
2.1	Introduction	133
2.2	Kinematics	136
2.3	Introduction to calculus	143
2.4	Kinematics with calculus	148
2.5	Kinematics problems	153
3	Vectors	159
3.1	Great outdoors	160
3.2	Vectors	162
3.3	Basis	172
3.4	Vector products	173
3.5	Complex numbers	176
3.6	Vectors problems	182
4	Mechanics	185
4.1	Introduction	185
4.2	Projectile motion	189
4.3	Forces	199
4.4	Force diagrams	202
4.5	Momentum	214
4.6	Energy	219
4.7	Uniform circular motion	229
4.8	Angular motion	238
4.9	Simple harmonic motion	248
4.10	Conclusion	263
4.11	Mechanics problems	264
5	Calculus	275
5.1	Introduction	275
5.2	Overview	277
5.3	Infinity	288
5.4	Limits	293
5.5	Limit formulas	300
5.6	Derivatives	305
5.7	Derivative formulas	308
5.8	Derivative rules	309
5.9	Higher derivatives	316

5.10 Optimization algorithm	321
5.11 Implicit differentiation	326
5.12 Integrals	332
5.13 Riemann sums	343
5.14 The fundamental theorem of calculus	349
5.15 Techniques of integration	355
5.16 Applications of integration	376
5.17 Improper integrals	386
5.18 Sequences	387
5.19 Series	390
5.20 Conclusion	402
5.21 Calculus problems	403
End matter	419
Conclusion	419
Acknowledgments	419
Further reading	420
A Answers and solutions	427
B Notation	447
Math notation	447
Set notation	448
Complex numbers notation	448
Vectors notation	449
Mechanics notation	449
Calculus notation	450
C Constants, units, and conversion ratios	451
Fundamental constants of Nature	451
Units	452
Other units and conversions	453
D SymPy tutorial	455
E Formulas	481
Calculus formulas	481
Mechanics formulas	484
Index	485