Contents

Introduction 9

Chapter 1 **General Calculator Design Features** 13
1.1 Decimals and exponents 13
1.2 Algebraic logic 17
1.3 Reverse Polish logic 19
1.4 Arithmetic facilities 21
1.5 Memory facilities 23
1.6 Overflow and underflow. Scientific notation 24
1.7 Miscellaneous features 27
Exercises 30

Chapter 2 **Everyday Calculations on the Simple Calculator** 39
2.1 Introduction 39
2.2 What about logarithms? 39
2.3 Multiplication convention 43
2.4 Error estimation (or the virtue of humility) 44
2.5 Simple and compound interest 47
2.6 Mortgages 49
2.7 Building society investments 52
2.8 Hire purchase 53
2.9 Areas and volumes 54
2.10 Average speed: a use for reciprocals 57
2.11 The 'there and back' problem 60
2.12 Metres and megahertz 62
2.13 Cube roots from square roots 65
Exercises 67

Chapter 3 Simple Mathematics and Science Using Calculators 70
3.1 Some useful results 70
3.2 Sums of products (for S.A.L. calculators) 71
3.3 Products of sums 73
3.4 Square and cube roots 75
3.5 Numbers near to one 80
3.6 Calculator 'stretching' 83
3.7 Change of base 85
3.8 Nested multiplication 86
3.9 More 'stretching'. Rational numbers 87
3.10 More repeating decimals 88
3.11 Lenses and lighthouses 92
3.12 Series and parallel resistors 93
3.13 Ramps and radios: Pythagoras 98
3.14 Kinds of average 102
3.15 Sums of products again. Complex numbers 107
3.16 Derivatives. The calculus 108
3.17 The slaves problem (a diversion) 111
3.18 Comments on the exercises 112
Exercises 113

Chapter 4 Scientific Calculators and Calculations 125
4.1 General introduction 125
4.2 Trigonometric functions 126
4.3 The derivative of $\cos x$ 130
4.4 Power series 131
4.5 Some uses for sines and cosines 134
4.6 Compound interest. Exponentials 137
4.7 Decibels 141
4.8 Power laws 144
4.9 A bit of information 146
4.10 Simple methods for $\exp x$ and $\ln x$ 150
4.11 Inverse functions 152
4.12 Calculation of arbitrary powers 152
4.13 i i, it's complex numbers again! 153
4.14 'Broken calculator' games 154
4.15 Matrices 157

4.16 Fahrenheit–Centigrade conversion 160
4.17 Children's arithmetic 161
Exercises 163

Chapter 5 How the Calculator Works 174
5.1 Chips and all that 176
5.2 Binary addition 175
5.3 Subtraction. Complements 177
5.4 Multiplication. Shifts 178
5.5 Binary coded decimals 179
5.6 General operating features 181
5.7 Algorithms 184
Exercises 185

Chapter 6 Programmable Calculators 188
6.1 Introduction 188
6.2 Jump instructions 188
6.3 The use of labelled memories 190
6.4 Calculating π: a case study 191
6.5 Numerical integration 195
6.6 Roots of equations. Newton's method 200
6.7 Matrix inverses. Linear equations 202
Exercises 204

Postscript 208
Appendix 1 Useful Numbers 210
Appendix 2 Formulae for Trigonometric Functions 211
Appendix 3 Formulae for $\cosh x$, e^x, $\ln x$ 212
Appendix 4 Formula for x^y 213
Appendix 5 Formula for $\cos^{-1} x$ 214
Some Further Reading 215
Index 219