

TABLE OF CONTENTS

	Page
Equipment Lists . . . . .	1
Chapter 1. AN EXPERIMENTAL APPROACH TO THE REAL NUMBERS . . . . .	7
1.1 Introduction . . . . .	7
1.2 The Loaded Beam . . . . .	7
1.3 The Real Number Line . . . . .	10
Exercise 1 . . . . .	12
1.4 Ordering the Real Numbers . . . . .	13
Exercise 2 . . . . .	14
1.5 Opposites . . . . .	16
Exercise 3 . . . . .	16
1.6 Absolute Value . . . . .	19
Exercise 4 . . . . .	20
1.7 Addition of Real Numbers . . . . .	20
Exercise 5 . . . . .	21
1.8 The Real Number Plane . . . . .	22
Exercise 6 . . . . .	23
Sample Test Items . . . . .	25
Answers to Sample Test Items . . . . .	26
Chapter 2. AN EXPERIMENTAL APPROACH TO LINEAR FUNCTIONS . . . . .	29
2.1 Real Number Generator . . . . .	29
Exercise 1 . . . . .	30
2.2 Functions and Relations . . . . .	31
2.3 The Face-Scale Relation . . . . .	31
Exercise 2 . . . . .	33
2.4 Seesaw Experiment and Multiplication of Numbers . . . . .	35
Exercise 3 . . . . .	36
2.5 Slope . . . . .	37
Exercise 4 . . . . .	37
2.6 Absolute Value and Relation . . . . .	37
Exercise 5 . . . . .	38
2.7 Slope-Intercept Form . . . . .	38
Exercise 6 . . . . .	39

Sample Test Items . . . . .	44
Answers to Sample Test Items. . . . .	46
Chapter 3. THE FALLING SPHERE . . . . .	47
3.1 The Falling Sphere. . . . .	47
3.2 The Falling Sphere. . . . .	48
3.3 Tabulating Data . . . . .	49
3.4 Analysis of Data. . . . .	50
3.5 Graphing the Experimental Data. . . . .	51
Exercise 1 . . . . .	53
3.6 The Point-Slope Form. . . . .	55
Exercise 2 . . . . .	56
3.7 Relations and Converses . . . . .	58
Exercise 3 . . . . .	58
3.8 Inverse Functions . . . . .	61
Exercise 4 . . . . .	61
3.9 Graphical Translation of Coordinate Axes. . . . .	63
Exercise 5 . . . . .	63
3.10 Algebraic Translation of Coordinate Axes. . . . .	65
Exercise 6 . . . . .	66
Sample Test Items . . . . .	66
Answers to Sample Test Items. . . . .	68
Chapter 4. AN EXPERIMENTAL APPROACH TO NONLINEAR FUNCTIONS. . . . .	71
4.1 Introduction. . . . .	71
4.2 The Wick. . . . .	71
4.3 The Physical Model. . . . .	73
4.4 Mathematical Model. . . . .	73
Exercise 1 . . . . .	73
4.5 The Horizontal Metronome Experiment . . . . .	76
Exercise 2 . . . . .	81
4.6 The Parabola. . . . .	86
Exercise 3 . . . . .	87
4.7 The Oscillating Spring Experiment . . . . .	91
4.8 The Physical Model. . . . .	93
4.9 The Oscillating Spring's Converse Relation. . . . .	96
Exercise 4 . . . . .	98
4.10 Relations and Converses . . . . .	100
Exercise 5 . . . . .	100

4.11	Translation of the Parabola . . . . .	102
	Exercise 6 . . . . .	103
	Sample Test Items . . . . .	107
	Answers to Sample Test Items. . . . .	111
Chapter 5. ANALYSIS OF NONLINEAR FUNCTIONS. . . . .		113
5.1	Introduction. . . . .	113
5.2	Inclined Planes . . . . .	113
5.3	Analysis of the Experiment. . . . .	115
	Exercise 1 . . . . .	118
5.4	Slope of a Curve at a Point . . . . .	119
	Exercise 2 . . . . .	119
5.5	Experimental Measurement of the Slope . . . . .	121
5.6	The Simple Lens . . . . .	122
	Exercise 3 . . . . .	127
5.7	The Lens Relation . . . . .	127
	Exercise 4 . . . . .	130
5.8	The Reciprocal Function . . . . .	133
	Exercise 5 . . . . .	133
5.9	Translation of Axes . . . . .	137
	Exercise 6 . . . . .	137
5.10	Curve Sketching . . . . .	138
	Exercise 7 . . . . .	139
5.11	The Floating Magnet . . . . .	140
5.12	Search for a Mathematical Model . . . . .	144
5.13	The Reciprocal Relation . . . . .	144
	Exercise 8 . . . . .	145
5.14	Curve Fitting . . . . .	146
	Exercise 9 . . . . .	146
	Sample Test Items . . . . .	149
	Answers for Sample Test Items . . . . .	151
Appendix A. THE BEST FITTING LINE. . . . .		155
A.1	Experimental Data . . . . .	155
A.2	The Method of Least Squares . . . . .	158
A.3	The Best Fitting Line . . . . .	158
A.4	The Best Fitting Line Through the Origin. . . . .	160
A.5	The Best Fitting Parabola . . . . .	160