A Letter to the Student xii Introduction: Mathematics—A Universal Language 1
1
MATHEMATICAL WAYS OF THINKING 5
<ol> <li>The Path of a Billiard Ball</li> <li>More Billiard-Ball Mathematics</li> <li>Inductive Reasoning: Finding and Extending Patterns</li> <li>The Limitations of Inductive Reasoning</li> <li>Deductive Reasoning: Mathematical Proof</li> <li>Number Tricks and Deductive Reasoning</li> <li>38</li> </ol>
Summary and Review 44 Problems for Further Exploration 49
2
NUMBER SEQUENCES 57
<ol> <li>Arithmetic Sequences: Growth at a Constant Rate 58</li> <li>Geometric Sequences: Growth at an Increasing Rate 63</li> <li>The Binary Sequence 75</li> <li>The Sequence of Squares 82</li> <li>The Sequence of Cubes 90</li> <li>The Fibonacci Sequence 97</li> <li>Summary and Review 104</li> </ol>
Problems for Further Exploration 110

ix

Foreword by Martin Gardner

_	`
-	Ł
_	,

FUNCTIO	ONS AND THEIR GRAPHS 119
2. 3. 4. 5.	The Idea of a Function 120 Descartes and the Coordinate Graph 128 Graphing Linear Functions 134 Functions with Parabolic Graphs 142 More Functions with Curved Graphs 149 Interpolation and Extrapolation: Guessing Between and Beyond 157
	Summary and Review 165 Problems for Further Exploration 171
4	
arge n	NUMBERS AND LOGARITHMS 181
2. 3 3. 4 4. 1 5. 0	Large Numbers 182 Scientific Notation 190 An Introduction to Logarithms 197 Logarithms and Scientific Notation 204 Computing with Logarithms 211 Logarithmic Scales 217
	Summary and Review 224 Problems for Further Exploration 230
5	
Symmet	RY AND REGULAR FIGURES 241
2.   3.   4.   5. !	Symmetry 242 Regular Polygons 250 Mathematical Mosaics 257 Regular Polyhedra: The Platonic Solids 265 Semiregular Polyhedra 275 Pyramids and Prisms 284
	Summary and Review 292 Problems for Further Exploration 300

1	
r	٦
ı	,

О
MATHEMATICAL CURVES 311
<ol> <li>The Circle and the Ellipse 312</li> <li>The Parabola 322</li> <li>The Hyperbola 329</li> <li>The Sine Curve 336</li> <li>Spirals 345</li> <li>The Cycloid 352</li> </ol>
Summary and Review 360 Problems for Further Exploration 368
7
METHODS OF COUNTING 377
<ol> <li>The Fundamental Counting Principle 378</li> <li>Permutations 388</li> <li>More on Permutations 395</li> <li>Combinations 402</li> </ol>
Summary and Review 410 Problems for Further Exploration 416
8 THE MATHEMATICS OF CHANCE 423
1. Probability: The Measure of Chance 424
<ol> <li>Frobability. The Measure of Chance 424</li> <li>Binomial Probability 431</li> <li>Pascal's Triangle 442</li> <li>Dice Games and Probability 452</li> <li>Independent and Dependent Events 461</li> <li>The Birthday Problem: Complementary Events 47</li> </ol>
Summary and Review 481  Problems for Further Exploration 487

J		
AN INTRODUCTION TO	STATISTICS	499
<ol> <li>Organizing Data: Frequer</li> <li>The Breaking of Ciphers         An Application of Statisti     </li> <li>Measures of Location</li> <li>Measures of Variability</li> <li>Displaying Data: Statistic</li> <li>Collecting Data: Samplin</li> </ol>	and Codes: ics 510 519 526 al Graphs 536	500
Summary and Review Problems for Further Expl	555 Ioration 564	

## 10

## TOPICS IN TOPOLOGY 575

1.	The Mathematics of Distortion	576
2.	The Seven Bridges of Königsberg:	

An Introduction to Networks

3. Euler Paths 590

4. Trees 596

5. The Moebius Strip and Other Surfaces 603

Summary and Review Problems for Further Exploration 615

## APPENDIX: BASIC IDEAS AND OPERATIONS 623

1	Angles	and	Thoir	Measurement	()4
١.	Angles	anu	rneir	Measurement	624

2. The Distributive Rule 626

3. Signed Numbers 628 631

4. Percent

Answers to Selected Exercises 633 Index 643