Contents

1 Geometrical Preliminaries page 1

1. History of the development of trigonometry. 2. Coordinate systems on a line. 3. Coordinate systems in a plane. 4. Angles. 5. Measurement of angles. 6. Relation between degree and radian. 7. Relation between degree and mil. 8. Relation between radian and mil. 9. Summary.

2 The Trigonometric Functions page 11

1. Angles in standard position. 2. Definitions of the trigonometric functions. 3. The signs of the trigonometric functions. 4. The trigonometric functions of important special angles. 5. Notation for powers of trigonometric functions. 6. Properties of the sine of an angle. 7. Properties of the cosine of an angle. 8. Applications of properties of sine and cosine. 9. Properties of the tangent of an angle. 10. Properties of the secant of an angle. 11. Applications of properties of tangent and secant. 12. Properties of the cotangent of an angle. 13. Properties of the cosecant of an angle.

3 Relations Between the Trigonometric Functions page 39

1. Quotient and reciprocal relations. 2. The Pythagorean relations. 3. Expression of all functions in terms of one. 4. Problems involving relations between functions of an angle. 5. Identities.

4 Inverse Trigonometric Functions page 47

1. Nature of inverse functions. 2. The inverse sine. 3. The inverse cosine. 4. The inverse tangent. 5. The inverse cotangent, secant, and cosecant.

5 Trigonometric Equations page 57

1. Angles for which the sine has a given value. 2. Angles for which the cosine has a given value. 3. Angles for which the tangent has a given value. 4. Angles for which the cotangent has a given value. 5. Angles for which the secant or the cose-cant has a given value. 6. Summary of solutions. 7. Polynomial equations in a single function.

6 Tables of Trigonometric Functions page 65

1. Introduction. 2. Functions of acute angles. 3. Interpolation. 4. Functions of angles between 90° and 180°. 5. Functions of angles between 180° and 270°. 6. Functions of angles between 270° and 360°. 7. Functions of angles greater than 360°.

viii · CONTENTS

7 Logarithms page 74

1. Introduction. 2. Properties of logarithms. 3. The system of common logarithms. 4. Tables of logarithms to the base 10. 5. Interpolation. 6. Computations by means of logarithms. 7. The system of natural logarithms. 8. Logarithms of trigonometric functions.

8 Solution of Triangles: the Right Triangle page 95

1. Introduction. 2. Solution of the right triangle. 3. Applied problems on heights and distances. 4. Applied problems on navigation. 5. Applied problems on vectors. 6. Applied problems on distance and dip of the horizon. 7. Applied problems on areas of sectors and segments of circles.

9 Complex Numbers page 111

1. The complex-number system. 2. The representation a+bi for complex numbers. 3. Further representations of complex numbers. 4. Algebraic addition and subtraction of complex numbers. 5. Graphical representation of addition. 6. Graphical representation of subtraction. 7. Algebraic multiplication and division of complex numbers. 8. Operations with complex numbers in binomial form. 9. Graphical representation of multiplication. 10. Graphical representation of division. 11. De Moivre's theorem. 12. Powers and roots of complex numbers. 13. Some interesting consequences of De Moivre's theorem.

10 The Addition Formulas page 135

1. Derivation of the addition formulas. 2. The tangent of the sum and difference of two angles. 3. The double-angle formulas. 4. The half-angle formulas. 5. Products, sums, and differences of sines and cosines. 6. Trigonometric equations.

11 Solution of Triangles: the General Triangle page 159

1. Introduction. 2. The law of sines. 3. The law of cosines. 4. The law of tangents. 5. Half-angle formulas. 6. Areas of triangles. 7. The radii of the circumscribed and inscribed circles. 8. The solution of a general triangle. 9. To solve a triangle for which the three sides are given. 10. Given: two sides and the included angle. 11. Given: one side and two angles. 12. Given: two sides and the angle opposite one of them. 13. Applied problems.

Appendices page 177

Appendix A: Summary of important results. Appendix B: Answers to exercises.

Index page 199

Tables