

Contents

<i>I. Preliminaries</i>	1
1. Quaternions	1
2. The hyperbolic functions	3
3. Trace relations	8
4. The fractional linear group and the cross ratio	10
Notes to Chapter I	16
<i>II. The Möbius Group</i>	17
1. Similarity transformations	17
2. The extended space. Orientation. Angular measure	18
3. Inversion	20
4. Circle- and sphere-preserving transformations	22
5. The Möbius group of the upper half-space	24
Notes to Chapter II	27
<i>III. The Basic Notions of Hyperbolic Geometry</i>	28
1. Lines and planes. Convexity	28
2. Orthogonality	31
3. The invariant Riemannian metric	34
4. The hyperbolic metric	36
5. Transformation to the unit ball	40
Notes to Chapter III	42
<i>IV. The Isometry Group of Hyperbolic Space</i>	44
1. Characterization of the isometry group	44
2. Classification of the motions	45
3. Reversals	48
4. The isometry group of a plane	54
5. The spherical and cylindric surfaces	56
Notes to Chapter IV	60

<i>V. Lines</i>	61
1. Line matrices	61
2. Oriented lines.....	63
3. Double crosses.....	67
4. Transversals	70
5. Pencils and bundles of lines	72
Notes to Chapter V	78
<i>VI. Right-Angled Hexagons</i>	79
1. Right-angled hexagons and pentagons	79
2. Trigonometric relations for right-angled hexagons.....	81
3. Trigonometric relations for polygons in a plane.....	85
4. Determination of a hexagon by three of its sides.....	93
5. The amplitudes of a right-angled hexagon.....	102
6. Transversals of a right-angled hexagon.....	107
7. The bisectors and radii of a right-angled hexagon.....	111
8. The medians of a right-angled hexagon	123
9. The altitudes of a right-angled hexagon	127
Notes to Chapter VI.....	138
<i>VII. Points and Planes</i>	140
1. Point and plane matrices	140
2. Incidence and orthogonality	144
3. Distances and angles	148
4. Pencils of points and planes.....	155
5. Bundles of points and planes.....	159
6. Tetrahedra.....	164
Notes to Chapter VII.....	174
<i>VIII. Spherical Surfaces</i>	175
1. Equations of spherical surfaces.....	175
2. An invariant of a pair of spherical surfaces.....	177
3. The power of a point with respect to a spherical surface.....	182
4. The radical plane of a pair of spherical surfaces	185
5. Linear families of spherical surfaces	191
Notes to Chapter VIII	201

IX. Area and Volume 202

1. Various coordinate systems 202

2. Area 206

3. Volume of some bodies of revolution 209

4. Volume of polyhedra 213

Notes to Chapter IX 220

References 221

Index 223

The reader should take notice of the following:

In Chapters I, II, III all terms denoting geometrical notions are to be understood in the Euclidean sense. In Chapter III those denoting notions of hyperbolic geometry are provided with the prefix *h*. In the following chapters terms denoting geometrical notions are to be understood in the sense of hyperbolic geometry. Those denoting Euclidean notions are provided with prefix *e*.

The values of square roots of positive numbers are always assumed to be positive.