

# 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

<i>IX. Area and Volume</i> . . . . .	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
<i>References</i> . . . . .	221
<i>Index</i> . . . . .	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.