

Contents

Visual perception and binocular vision *anatomy eye*

- 2.1 The stimulus and perception 45 *receptors* 45
2.2 Perceptual organization 46 *perception* 46
2.3 Selective attention to visual information 47 *attention* 47
2.4 Pupil organisation in perception 48 *pupil* 48
2.5 Binocular vision and depth perception 49 *binocular vision* 49
2.6 Visual illusions 50 *optical illusions* 50

Chapter 1

Background Optics

- 1.0 Introduction 1
1.1 The sign convention 3
1.2 Refraction – objects and images 4
1.3 Reduced distances and vergences 5
1.4 The Paraxial Equation 6
1.5 Linear magnification 8
1.6 Focal lengths of a surface 9
1.7 Surface power and focal lengths 10
1.8 Thick lenses 11
1.9 Vertex powers and focal lengths 12
1.10 Systems of three or more surfaces 13
1.11 Thin lenses and the equivalent lens 14
1.12 A note on lens forms 16
1.13 The principal points of a thick lens 17
1.14 The image in two or more surfaces 18
1.15 Image size of a finite object 20
1.16 Image size of a distant object 21
1.17 Nodal points 23
1.18 Significance of the cardinal points 27
1.19 The equivalent mirror 28
List of formulae 29
Exercises 32

Chapter 2

Optics of the Eye

- 2.1 The human eye 33
2.2 Model eyes 34
2.3 Emmetropia and ametropia 37
2.4 Axial, curvature and index ametropia in the reduced eye 40
2.5 Spectacle correction of ametropia 42
2.6 Correction of ametropia with a real lens 45
2.7 Some examples involving K 46
2.8 Clear and blurred images in the reduced eye 48
2.9 Blurred images in the simplified schematic eye 50
2.10 Pupil size and blur disc diameter 52

- 3.0 Introduction 98
3.1 The eye as a lens system 99
3.2 The eye as a thin lens 100
3.3 The eye as a thick lens 101
3.4 The eye as a contact lens 102
3.5 The eye as a system of lenses 103
3.6 The eye as a camera 104
3.7 The eye as a projector 105
3.8 The eye as a viewer 106
3.9 The eye as a viewer with a contact lens 107
3.10 The eye as a viewer with a contact lens 108
3.11 The eye as a viewer with a contact lens 109
3.12 The eye as a viewer with a contact lens 110
3.13 The eye as a viewer with a contact lens 111
3.14 The eye as a viewer with a contact lens 112
3.15 Clinical recording of the standard of vision – visual acuity 113
3.16 Clinical recording of the standard of vision – visual acuity 114
3.17 Clinical recording of the standard of vision – visual acuity 115
3.18 Clinical recording of the standard of vision – visual acuity 116
3.19 Clinical recording of the standard of vision – visual acuity 117
3.20 Clinical recording of the standard of vision – visual acuity 118
3.21 Clinical recording of the standard of vision – visual acuity 119
3.22 Clinical recording of the standard of vision – visual acuity 120
3.23 Clinical recording of the standard of vision – visual acuity 121
3.24 Clinical recording of the standard of vision – visual acuity 122
3.25 Clinical recording of the standard of vision – visual acuity 123

Chapter 3

Astigmatism

- 3.0 Introduction 98
3.1 The eye as a lens system 99
3.2 The eye as a thin lens 100
3.3 The eye as a thick lens 101
3.4 The eye as a contact lens 102
3.5 The eye as a system of lenses 103
3.6 The eye as a camera 104
3.7 The eye as a projector 105
3.8 The eye as a viewer 106
3.9 The eye as a viewer with a contact lens 107
3.10 The eye as a viewer with a contact lens 108
3.11 The eye as a viewer with a contact lens 109
3.12 The eye as a viewer with a contact lens 110
3.13 The eye as a viewer with a contact lens 111
3.14 The eye as a viewer with a contact lens 112
3.15 Clinical recording of the standard of vision – visual acuity 113
3.16 Clinical recording of the standard of vision – visual acuity 114
3.17 Clinical recording of the standard of vision – visual acuity 115
3.18 Clinical recording of the standard of vision – visual acuity 116
3.19 Clinical recording of the standard of vision – visual acuity 117
3.20 Clinical recording of the standard of vision – visual acuity 118
3.21 Clinical recording of the standard of vision – visual acuity 119
3.22 Clinical recording of the standard of vision – visual acuity 120
3.23 Clinical recording of the standard of vision – visual acuity 121
3.24 Clinical recording of the standard of vision – visual acuity 122
3.25 Clinical recording of the standard of vision – visual acuity 123

3.15	Defocus blur and letter acuity	134
3.16	Subjective determination of spherical refractive error	135
3.17	The duochrome and binocular balancing tests	137
3.18	The subjective determination of astigmatic ametropia	
		141
3.19	The effect of an off-axis correcting cylinder	154
3.20	Irregular refraction	155
3.21	Spectacle lens design	156
	List of formulae	177
	Exercises	178

Chapter 4**Accommodation**

4.1	Possible mechanisms of accommodation	181
4.2	Theories of accommodation	182
4.3	Changes in the lens during accommodation	185
4.4	The nervous mechanism	186
4.5	The stimulus to accommodation	186
4.6	Resting state of accommodation	189
4.7	The amplitude of accommodation	191
4.8	Amplitude of accommodation versus age	196
4.9	Presbyopia	199
4.10	Hypermetropia and accommodation	207
4.11	Juvenile stress myopia	209
4.12	Aphakia and pseudophakia	211
4.13	Bifocal and multifocal lenses	222
	Formulae	231
	Exercises	232

Chapter 5**Ophthalmic instruments**

5.1	Retinoscopy	234
5.2	Subjective optometers	247
5.3	Ophthalmoscopy	253
5.4	Keratometry	264
5.5	Objective optometers	272
5.6	Automatic objective refractors	274
5.7	Ultrasonography	280
5.8	The slit lamp	288
5.9	Tonometry	291
5.10	The placido disc and keratoscope	296
	Exercises	297

Association of British Opticians**Chapter 6****Eye movements**

6.1	The orbit	299
6.2	Anatomy of the extraocular muscles	300
6.3	Outline of the nervous control of extraocular muscles	
		303
6.4	Actions of the extraocular muscles	311
6.5	Binocular movements	318
6.6	Convergence through spectacles	325
6.7	Ocularotation and anisometropia	326
6.8	Vertical facial asymmetry	328
	Exercises	329

Chapter 7**Ocular aspects of vision**

7.1	Eye and brain	330
7.2	The stimulus	331
7.3	The measurement of light – photometry	336
7.4	The retina	340
7.5	Rod and cone pigments	347
7.6	The light sense	354
7.7	The colour sense	364
7.8	Induction	366
7.9	Entoptic phenomena	369
7.10	Aberrations	372
7.11	The visual acuities	379
7.12	Eye movements and vision	394
7.13	Flicker	395
	Exercises	396

Chapter 8**Coding in the visual system**

8.1	The primary visual pathway	398
8.2	Visual fields	402
8.3	Intensity coding in the visual system	412
8.4	The extra-striate regions	422
8.5	Brain development	423
8.6	Contrast sensitivity	429
8.7	Frequency coding – colour vision	447
	Exercises	457

Chapter 9

Visual perception and binocular vision

- | | | |
|------|------------------------------------|-----|
| 9.1 | The stimulus and perception | 458 |
| 9.2 | Peripheral and central factors | 459 |
| 9.3 | Perceptual constancies | 460 |
| 9.4 | Pattern organisation in perception | 462 |
| 9.5 | Binocular perception | 467 |
| 9.6 | Binocular single vision | 472 |
| 9.7 | Fixation disparity | 481 |
| 9.8 | Binocular depth perception | 488 |
| 9.9 | Vertical partition of the retina | 497 |
| 9.10 | Chromatic stereopsis | 498 |
| 9.11 | Distortion in stereoscopic vision | 499 |
| 9.12 | Fusion, rivalry and suppression | 505 |
| 9.13 | Aniseikonia and anisometropia | 507 |
| 9.14 | Monocular versus binocular vision | 515 |
| | Exercises | 516 |

Chapter 10

Binocular vision anomalies

- 10.1 Introduction 517
 - 10.2 The cover test 519
 - 10.3 The causes of squint 526
 - 10.4 Anomalies of accommodation and convergence 531
 - 10.5 Heterophoria 529
 - 10.6 Measurement of heterophoria 531
 - 10.7 Investigation of heterophoria 536
 - 10.8 The management of heterophoria 543
 - 10.9 Strabismus 549
 - 10.10 The Pulfrich phenomenon 567
 - Exercises 569

Appendices

- | | | |
|-------------------|--|-----|
| Appendix 1 | Back and front vertex powers of a lens:
derivation of the equations | 570 |
| Appendix 2 | Equivalent power of a lens | 570 |
| Appendix 3 | Radiometry and photometry | 571 |
| Appendix 4 | Pattern glare | 578 |
| Appendix 5 | ChromaGen lenses | 579 |
| References | | 581 |
| Index | | 584 |