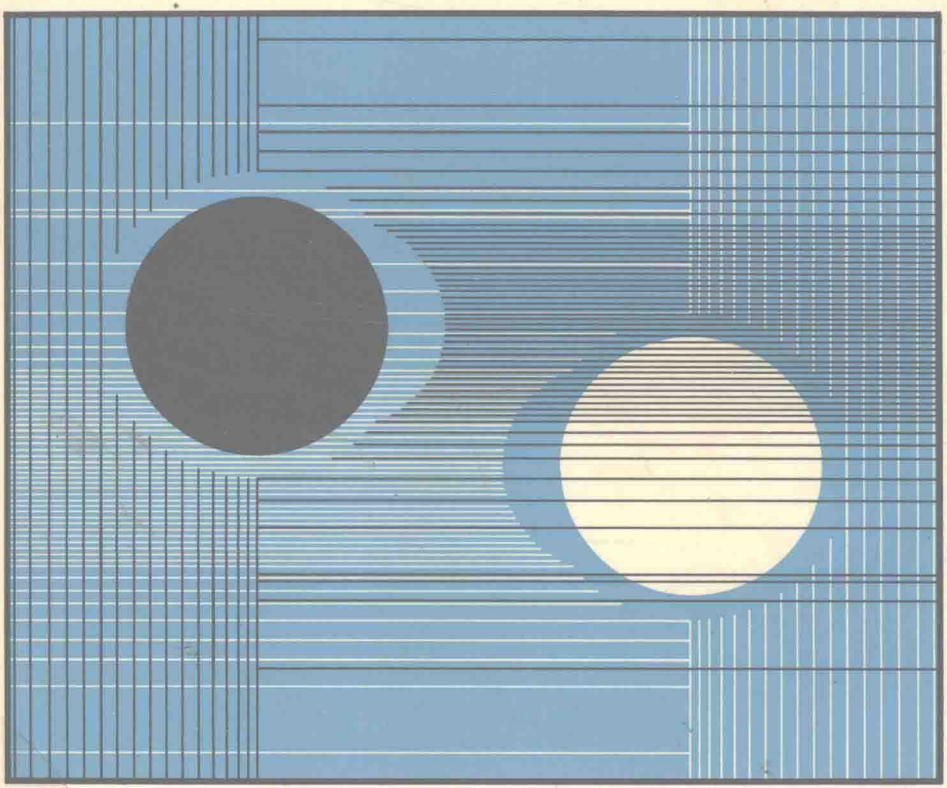
THIRD EDITION

REFRACTION

A PROGRAMMED TEXT



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A PROGRAMMED TEXT

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This book is dedicated to
Betsey Herm
and
Mary Reinecke

Preface

Our aspiration for this book remains unaltered in this third edition—namely to assist the neophyte refractionist over the early hurdles in the rather painful race to become a reasonably skilled refractionist. The results of the first two editions were gratifying. The third edition is further refined in the specifics of the frames, which, we hope, makes it clearer and less confusing than the original text. Some major changes in ophthalmology are reflected in some of the new subjects covered, such as pseudophakia, soft contact lenses of better quality, and automated refractometers. We recognize that the student of refraction is learning a great many other subjects at this time, but refraction is a daily problem of the first order in patient care. If this text makes the task easier through this relatively simple format, you and your patients may be grateful. We urge you to read fairly rapidly through the book, repeating the process from time to time. The subsequent readings proceed much faster and become more meaningful as you look back at real problems in refraction which you have failed to solve, or perhaps even have created. The subject may appear difficult to you at this point, but several years from now you will be convinced that "there is nothing to it." If this edition can make you say this sooner, your time and ours will have been well spent.

Robert D. Reinecke, M.D.
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To the Student

This programmed text is designed to teach you its subject in an effective manner. Unlike an ordinary textbook, this program is set up so that you will learn on a step-by-step basis by making an *active* response to a question and then immediately comparing your answer with a printed answer on the next page.

This method of teaching is called "programmed instruction," and depends on the careful analysis of the information given and its presentation in a sequence of *frames*. Each frame provides new information to which you respond by answering a question, completing a sentence, or otherwise using the information you have just received. Checking against the correct answer allows you to evaluate your progress immediately. For the program to be successful, it is important that you actually *write* all the required responses. Most answers will come easily, but if you go along merely "thinking" your answers, you will not remember what you learn, and you will not grasp later material. Remember, the program will teach effectively only if the proper order of items is followed and every answer is written *before* referring to the correct answer on the following page.

Proceed through the program in the following manner:

1. Start at frame 1 at the top of page 1, and after reading the frame turn to page 3.
2. Read the question in frame 2 at the top of page 3.
3. Write your answer in the blank space provided in the frame.
4. Turn to page 5 and compare your written answer with the printed answer in the small answer frame 2 in the left-hand corner of the page.
5. Continue on page 5, answering the question in frame 3 and checking your answer on page 7. Go on to the next frame in the same way. Be sure to go through the frames in numerical order.

6. After you have answered all the frames in the top layer on the right-hand pages, return to page 1 and continue on the second row of frames. Go through all the right-hand pages this way.
7. When you have completed all the frames on the right-hand pages, turn to page 2, and follow the same procedure for the left-hand pages.

From time to time, the program will refer to illustrative reference material, which is included in the Appendix at the end of the book. These references to the Appendix will appear in a form such as the following: (See Fig. 1, p. 347.). When you reach such a reference, turn to the appropriate figure in the Appendix as instructed in the program.

Contents

1.

PART I

NEUTRALIZATION OF LENSES AND THE MEASUREMENT OF VISUAL ACTIVITY

(Turn to page 3.)

173. The amplitude of accommodation is typically approximately equal in the two eyes. A patient with an amplitude of accommodation of 8.00 D in the right eye will probably have an amplitude of _____ D in the left eye.

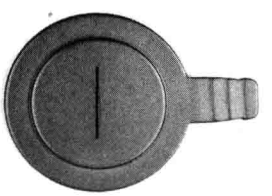
345. Occasionally you may wish to use only spheres to refract an astigmatic eye. A stenopaic slit as pictured may be used. If the slit were held at 180 degrees and the patient required a +2.00 D sphere, and if the slit were held at 90 degrees and the patient required a +1.00 D sphere the patient's refractive error would be _____.
(sphere, cylinder, and axis)

Remember the power of a cylinder is 90 degrees from its axis.

+2.00 = Refractive error

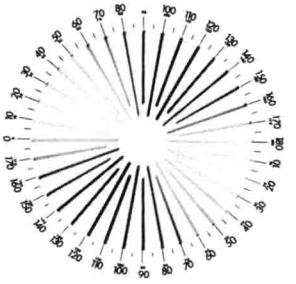
Position "A"

+1.00 = Refractive error



Position "B"

517. Patient A is directed to look at the Lancaster-Regan dial 20 feet away with a −0.75 sphere before the right eye and an occluder before the left. The photograph shows how the dial appears to patient A. By walking to the chart and holding a pointer parallel to various lines, you determine that the blackest and clearest lines indicate the axis of the correcting minus cylinder to be _____ degrees. *(Record on data sheet; see Fig. 7.)*



689. The adequacy of cycloplegia can only be determined by measuring _____.

861. As a clinical problem aniseikonia is rarely recognized and rarely clinically significant. Its measurement is time consuming and its correcting lenses expensive and cosmetically inferior. If aniseikonia due to anisometropia is anticipated, it is frequently minimized by undercorrecting one eye. The incidence of clinically significant aniseikonia is unknown, but a measurable amount should be found in 20 to 30 percent of spectacle wearers.

Aniseikonia due to anisometropia can be minimized by _____.

2. The eye is an optical system which forms discrete images on the retina. Any defect in this optical system may throw the image out of focus. Ophthalmic lenses may correct such defects. The measurement of these optical defects is called refraction.

This programmed course is designed to help you acquire the basic skills in _____.

173. 8.00 D

174. Accommodation changes inversely with age. The first reasonably accurate study of the relationship between accommodative amplitude and age was published in 1912 by Duane. Duane's graph relates the decrease in amplitude of accommodation to _____.

345. $+2.00 - 1.00 \times 180$ (or $+1.00 + 1.00 \times 90$)

346. If the radius of curvature is uniform in each separate meridian (although the radii of the meridians may differ), the astigmatism is termed regular. If there are many radii in one meridian, such as a scarred cornea might have, the astigmatism is termed irregular. To correct irregular astigmatism, the irregularities in the surface must be corrected or covered. Irregular astigmatism would probably be corrected by (1) _____, while regular astigmatism is usually corrected with (2) _____.

517. *(Be sure to record 25 degrees on Fig. 7.)*

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518. Continuing with the refraction of patient A, OD, dial No. 2 is turned so that one line is at (1) _____ degrees and the other line is at (2) _____ degrees.

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689. residual accommodation

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690. A patient over age 10 will generally have a satisfactorily low residual accommodation for cycloplegic refraction with the use of the short-acting drugs (1) _____ or (2) _____.

---

861. undercorrecting one eye

---

862. Some of the intolerance of patients to spectacles is a result of magnification of retinal images. Aberrations of lenses are another cause of spectacle intolerance, as are prismatic effects. Two causes of intolerance to spectacles in addition to magnification of retinal images are (1) _____ and (2) _____.

2. refraction

---

3. The properties of ophthalmic lenses will be considered first. These properties will be used as basic tools in measuring the refractive state of the eye, that is, in the procedure called _____.

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174. age (increasing age)

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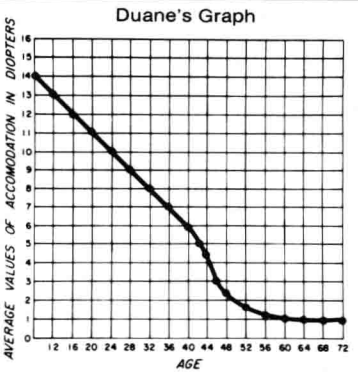
175. Duane's graph relates (1) _____ to (2) _____.



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346. (1) contact lenses
(2) cylindrical spectacle lenses

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347. Astigmatism caused by irregular refracting surfaces is called _____.

518. (1) 25 } either
(2) 115 } order

---

519. Patient A is directed to observe dial No. 2 with OD through a −0.75 sphere in the trial frame and sees that the line at _____ degrees on the dial is the blacker and clearer.

---

690. (1) cyclopentolate } either
(2) tropicamide } order

---

691. The darker the patient's iris in color, the more effective the cycloplegic which must be used for refraction. A deep brown iris pigmentation in a 12-year-old child may be an indication for cycloplegic refraction using _____.

---

862. (1) aberrations of lenses } either
(2) prismatic effects } order

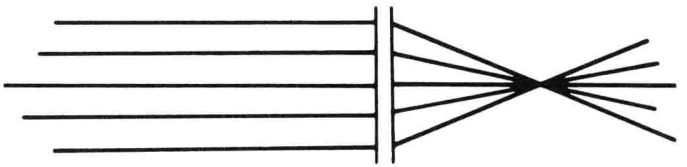
---

863. Inherent characteristics of lenses which result in optical defects of images are known as aberrations. Those usually described for ophthalmic lenses are spherical aberration, chromatic aberration, coma, astigmatism of oblique incidence, and distortion. Coma is a type of lens _____.

3. refraction

---

4. The term **spherical** refers to a lens that does either one of two things: either it converges parallel rays of light passing through it to a point focus, or it diverges them so that they appear to come from a point source. The lens in the diagram brings parallel rays of light to a point focus indicating that it is a _____ converging lens.



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175. (1) amplitude of accommodation
(2) age
} either order

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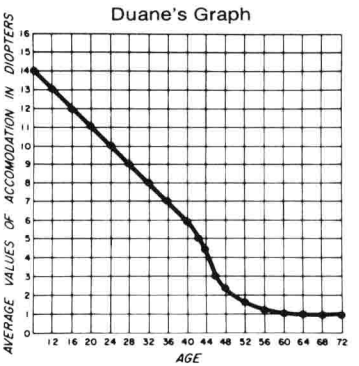
176. The average amplitude of accommodation of a child 8 years old is about 14.00 D. At age 35, it is about 7.00 D. Refer to Duane's graph. At what age is the average amplitude of accommodation 10.00 D?



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347. irregular astigmatism

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348. Irregular astigmatism can be corrected only by substituting a new surface. The only practical means of achieving this is to do a corneal graft of the deformed cornea or use a contact lens, which in effect creates a new surface.

Irregular astigmatism (can/cannot) be corrected with cylindrical spectacle lenses.

519. 115

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520. With the blacker and clearer line on dial No. 2 at 115 degrees, minus cylinders will be placed before the eye at axis _____ degrees.

---

691. atropine

---

692. The cycloplegic drug with the longest effect on accommodation is _____.

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863. aberration

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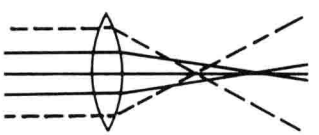
864. Spherical aberration results from the fact that rays of light parallel to the axis of the lens are focused closer to the lens the further from the axis they enter it. This causes a point object to be focused to an image symmetrically blurred around the axis of the lens. Symmetrical blurring of the image of a point source around the axis of a lens is known as _____.



4. spherical

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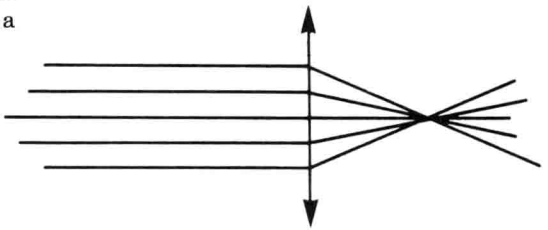
5. Spherical lenses may be convex or concave. Convex lenses converge rays of light, and concave lenses diverge rays of light. The lens diagrammed is a _____ spherical lens.



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176. 24

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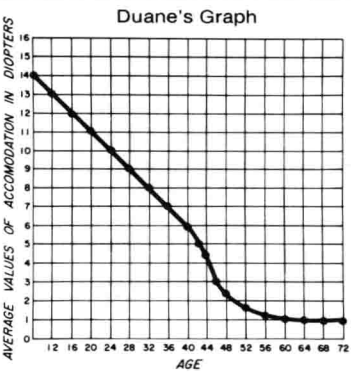
177. Refer to Duane's graph of accommodation versus age. A patient's amplitude of accommodation is 3.00 D. About what age is the average patient with this amplitude?



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348. cannot

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349. Irregular astigmatism is usually corneal in nature but may be refractive due to different indices of refraction in different portions of the crystalline lens. Will a contact lens correct irregular astigmatism of the crystalline lens?