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New York State Continuing Education Mail-In Course

The Optics of Light & Vision

From Marchon Continuing Education Program

Visual acuity (usually referred to as “V.A.”) is the term for clearness of vision. The degree of V.A. depends upon the sharpness of images and the sensitivity of the nerve elements in the retina.

Clinically, V.A. is measured on a *Snellen Chart* (named in honor of Dr. Herman Snellen who invented it in 1862). The chart—still the most widely used test for measuring vision—consists of alphabet letters designed to subtend 5-minute angles to the eye at a distance of 20 feet. Each letter is enclosed in a square of 5' of arc, with the width of its arms and interstices subtending a 1' angle (Fig. 1). The design conforms with the distribution of cone-shaped elements in the retina that are primarily responsible for acute vision.

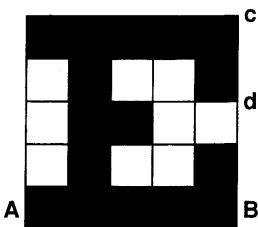


Fig. 1 -- Construction of the Snellen test letter in which A-to-B's width subtends a 5' angle; the arm-widths of c-to-d and the interstices subtend 1' angles.

The Snellen Chart's first line of type is constructed so that its angle is formed at a distance of 200 feet; the second at 120 feet; the third at 80 feet; the fourth at 60 feet; the fifth at 40 feet; the sixth at 30 feet; the seventh at 20 feet, plus additional lines subtending the same angle at 15 and 10 feet. Consequently, if a patient is placed at a distance of 20 feet, he should be able to recognize a test letter 20 feet away if he is able to recognize the very same letter if it is twice the size when viewed at 40 feet (Fig. 2). This is why the chart

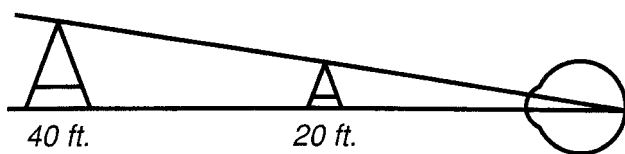


Fig. 2 -- Basic principle of the modern Snellen Chart. If a patient is placed at a distance of 20 feet, he or she should be able to recognize the very same letter if it's twice the size when viewed at 40 feet.

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doesn't have to be relocated from one test distance to another when recording visual acuity but, rather, is able to obtain reliable findings by utilizing letter of different sizes.

Visual acuity by Snellen's method is recorded in the form of a fraction. The numerator represents the distance at which the test was made, while the denominator represents the distance for which the test was made, while the denominator represents the distance for which the letter was designed. Thus, 20/20 vision represents normal sight because it indicates an eye can recognize a letter from 20 feet away that it *should* be able to recognize at 20 feet.

20/40 indicates defective vision; it means the eye can read a letter from no farther than 20 feet away that it *should* be able to recognize at 40 feet. Conversely, 20/15 denotes superior sight because it indicated the eye *can* recognize a test letter from 20 feet away that an average eye cannot recognize from farther than 15 feet.

The Landolt Broken-Ring Visual Acuity Test Chart

In 1888, Dr. Edmond Landolt designed a test chart that's still used today. His chart employs broken “O-Ring” test objects that prove to be useful when testing patients unfamiliar with Roman script as well as for illiterates. Each ring has an overall diameter of 5' of arc with its thickness and gap each subtending 1' of arc (Fig. 3).

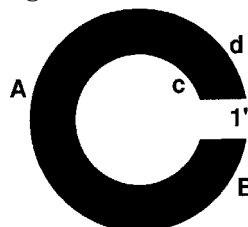


Fig. 3 -- The Landolt-ring test object. Width of the ring (A-to-B) subtends 5' of arc; c-to-d's width and gap subtend 1' of arc.

When administering the test, the gap in the ring is placed to the right, left and up down and, as each line of reduced-size rings are presented, the patient is required to identify the break's position.

Another version along the same lines is the "Tumbling-E Game" in which testing can be done with children and illiterate persons by having them merely indicate the direction of the charted "E" with their fingers. This test is sometimes combined with pictures to help avoid mistakes in symbol recognition.

Near-vision testing is performed at around 15 inches. The most popular test chart for this purpose is called the "Jaeger System," introduced by Dr. E. Von Jaeger in the latter part of the 19th century. He fashioned a reading card and assigned numbers to indicate the size of the print. J/1 was used to show that the patient could read the smallest print and larger numbers indicated larger print.

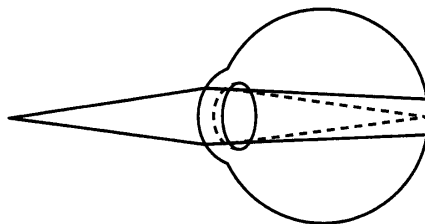
Why 20 feet is the ideal visual acuity test distance

Twenty feet is the ideal test distance for determining the patient's distance visual acuity for the following reasons:

Recall, first, that rays of light emanating from a distance of 20 feet or more from the eye are considered to be coming from *optical infinity*, in which the rays are parallel to each other. However, when light rays emanate from distances less than 20 feet, they *diverge* as they travel toward the eye.

In emmetropia, *parallel* rays coming from 20 feet or more focus clearly on the retina. On the other hand, *divergent rays* emanating from less than 20 feet enter the eye at a much sharper angle and, thus, tend to focus behind the retina. To help these rays focus accurately, *accommodation* must come into play (Fig. 4).

Fig. 4 -- The dotted lines represent increased crystalline-lens convexity which, in turn, enables light rays to focus clearly on the retina. See also Figs. 5a and 5b.



This is the process by which the refractive power of the anterior lens segment increases so that a near object may be distinctly focused upon the retina. The increased refractive power results from increased thickness of the lens and increased convexity of the central portion of its anterior surface which, in turn, is in response to contraction of the ciliary muscle. This muscle is attached to the lens capsule through zonular fibers.

When the ciliary muscle is relaxed, the lens diameter is minimal, the zonular fibers are taut, and the lens is not accommodated. Contraction reduced the diameter of circular muscle and relaxes the zonular fibers (Fig. 5, a and 5, b).

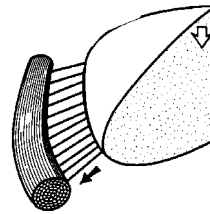


Fig. 5a -- Accommodation. When the ciliary muscle is at rest, the zonulas are contracted and the refractive power of the lens is minimal. (Diagrams courtesy Newell's Ophthalmology, C.V. Mosby Co., St. Louis, 1976.)

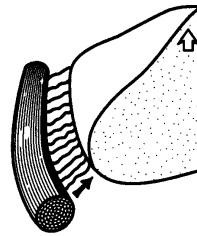


Fig. 5b -- Accommodation. When the ciliary muscle contracts, the zonulas are relaxed and the inherent elasticity of the lens causes it to increase in thickness and refractive power

With aging, the lens capsule becomes less elastic and, thus, causes a gradual loss of accommodation (see *presbyopia*).

Hyperopia

Hyperopia is one of the most common defects of vision found in the eye. Simply defined, hyperopia is that form of refractive error in which parallel rays of light tend to focus behind the retina when the eye is at rest. In this case, the images formed are made up of diffusion circles and are consequently blurred unless aided by accommodation.

In contrast to myopia, hyperopia is caused either by the eye being too short in length while the refractive power is normal (axial hyperopia) or by the length being normal and the refractive power being deficient (refractile hyperopia). In both cases, the focal length is greater than the distance from the front surface of the cornea to the retinal plane. It is virtually impossible, in practice, to determine whether one cause or the other predominates but, fortunately, differential diagnosis is immaterial.

Common belief is that hyperopia appears at birth. But as a condition requiring correction, the problem may manifest itself at any period of life. And, since true emmetropia is rare, with the exception of those that are myopic, practically all eyes are hyperopic.

The influence of accommodation in hyperopia is of considerable significance. So long as accommodation is active, a certain amount of the optical error is corrected and vision frequently is normal. In cases where accommodative effort is sufficient to "neutralize" the defect, these patients enjoy good vision at long distances but suffer eyestrain when engaged in excessive use of their eyes for near vision tasks, such as reading or book-keeping. They often complain of headaches, burning and twitching sensations of the eyes and eyelids and difficulty in concentrating when doing book work.

Hyperopia is classified as being "latent" when it is corrected by the physiological tone of the ciliary muscle; "facultative," when it represents the amount of residual after accommodation is exerted. Added together, the

latter two categories are classified as “total” (for example, a 4.00 D. hyperope might have 1.5 D. of *facultative* hyperopia plus 2.50 D. of *absolute* hyperopia which equals 4.00 D. of *total* hyperopia).

Uncorrected visual acuity in hyperopia varies with the degree of optical error and the proportion which cannot be overcome by the physiological tone of the ciliary muscle and/or by accommodation. Vision in high degrees of hyperopia is blurred but, as stated above, in low degrees when accommodation is active and able to overcome the defect, vision could be entirely normal.

Rx lenses for the correction of hyperopia *converge* rays of light as they pass through the lenses, thus shortening the focal length so that images are able to focus accurately on the retina.

Myopia

Myopia is defined as that form of refractive error in which parallel rays of light come to a focus in front of the retina with the eye at rest.

Myopia may be due to excessive axial length of the globe while the refracting power is normal or, alternately, the globe may be of normal length but the refracting power too great. The former type of myopia is called “axial” and the latter “refractive.” The result is the same in both since the focal length is less than the distance from the front surface of the cornea to the retinal plane.

Myopia is essentially acquired; very few infants are born with the defect. It is frequently hereditary, with the children of myopic parents being born with the tendency to develop the disorder. There also are some types of myopia that are acquired late in life due to changes in the crystalline lens or with diabetes mellitus. The latter types are late-developing myopias that are often referred to as “second sight” because these patients, long dependent upon glasses for near vision, are suddenly able to read without them. Another type of acquired myopia that sometimes occurs is called “pseudomyopia” - a false nearsightedness caused by ciliary spasm or overactive accommodation. This type of myopia is correctable by eyeglasses and/or vision training which relax the faulty accommodative effort.

Accommodation has no value in myopia and the only way myopes can temporarily improve their visual acuity without the use of lenses is to half-shut their eyelids which, in effect, creates an artificial “pin-hole pupil” which, in turn, temporarily improves vision by reducing excessive refractions.

Spectacle correction for myopia, of course, is made with concave lenses which *diverge* light rays as they pass through the lens and, in this way, increase the focal length so that images focus properly on the retina. Contrary to hyperopia, accommodation is of no help in myopia and would only contribute to the problem since its function is limited to shortening, rather than lengthening, focal lengths.

In addition to eyeglasses and contact lenses, myopia is sometimes correctable by means of certain surgical procedures, especially *radial keratotomy*—a controversial operation in which radial incisions are made in the cornea to flatten it and, thus, reduce the length of the globe. In this procedure, a diamond knife is used to create four to eight deep radial slices in the cornea which, in turn, weaken the cornea peripherally, pushing it forward and reducing the eye’s axial length. The defect can also be treated surgically by laser beams which “slice off” a layer of the cornea in an effort to reduce the globe’s axial length.

Astigmatism

Astigmatism is a refractive error in which the eye focuses rays of light in two planes, only one of which is able to focus on the retina.

Astigmatism may be caused by a number of conditions, but the main cause is a cornea that is out-of-round, or toroidal, like the toric surface on a cylindrical lens. Other cases could be unequal curvatures on one or both of the crystalline-lens surfaces or excessive traction on the globe by the eye’s extraocular muscles. Astigmatism is purely *refractive* in nature; it is never *axial* since the eye cannot be two different lengths.

The defect may be either congenital or acquired, but it is usually regarded as congenital. As mentioned above, the most frequent cause is corneal. But, even if it’s due to other causes, differential diagnosis is unimportant.

The meridians of an astigmatic eye with the highest and lowest powers are termed the *principal meridians*. Except in a condition called *irregular astigmatism* (which is mentioned later in this lesson), the principal meridians are always at right angles to each other, and, in both testing and correcting, only these need be considered.

The cylinder’s minus axis is considered to be *with-the-rule* when it is on or close to 180 degrees; *against-the-rule* when it is on or close to 90 degrees; and *oblique* when it is on or close to 45 to 135 degrees. The minus axis goes from zero to 180 degrees, with the 180-degree axis always on the left side as the dispenser faces the patient (Fig. 6).

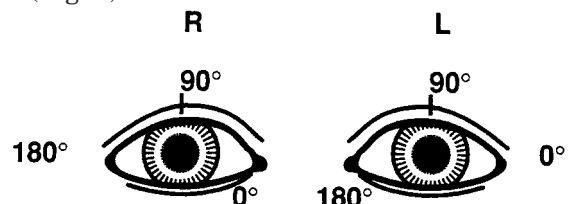


Fig. 6 -- With the dispenser facing an astigmatic patient, the axis of the correcting minus cylinder goes from zero to 180 degrees, with the 180-degree axis always on the left side.

The optical consideration in astigmatism is one of unequal refraction. Both meridians may be hyperopic or myopic to different degrees; or one meridian may be emmetropic and the other hyperopic or myopic; and, finally, one may be hyperopic and the other myopic.

In any of these cases, if the difference between the two meridians is, say 2.00 D., there is an astigmatic error of 2.00 D., which is quite independent of the optical condition of the individual principal meridians or of the eye as a whole. To carry the example further, if the astigmatic error of 2.00 D. is corrected by a 2.00 D. cylinder that may be either convex or concave, the axis of the plus cylinder is positioned to coincide with the meridian of greatest power or the axis of the minus cylinder is placed to coincide with the meridian of least power. Once the astigmatism is "neutralized," the eye is considered a sphere.

Astigmatism of moderate to high amounts impairs visual acuity; more so in myopic astigmatism than in hyperopic astigmatism and, of course, more marked in high levels of the defect. But small amounts of astigmatism can be troublesome, too, since these often give rise to a group of symptoms called *asthenopia* (frequently alluded to an *eyestrain*) in which ocular discomfort and headaches prevail.

Astigmatism is corrected by spectacle lenses and contacts that are opposite in design to the astigmatic eye. The cylindrically shaped lenses effectively "neutralize" the defect.

Presbyopia

The term *presbyopia* is taken from the Greek language meaning, "old eye." The condition is due to advancing age in which the amount of accommodation needed for comfortable viewing at the near point is insufficient. This is a normal condition in the sense that it is a natural concomitant of the age-related decrease in the amplitude of accommodation so that all persons will develop the defect in the course of time.

The culprit is a loss of resiliency in the eye's crystalline lens which, as one gets older, responds less and less to a given amount of accommodation. This hardening of the crystalline lens begins quite early in life, at 10 years of age or so, and perhaps earlier. However, glasses are not usually prescribed until the defect interferes with the ability to use the eyes for continued close work and, with their easy adjustability, for various near distances.

Presbyopia's appearance depends upon the amount of accommodation that can be exerted comfortably for continued close work. As a general rule, the defect becomes noticeable around the age of 45 years and is absolute at, say, 50 years. The reading distance plays a major role, too, for obviously one who reads at a shorter distance becomes presbyopic earlier than another who reads at a greater distance. Thus, women usually develop presbyopia sooner than men, and short-armed men sooner than those with longer arms.

When Presbyopia begins to appear, the first symptom is a desire to elevate the head or move reading matter to a greater distance than previously. Soon the presbyope's eyes become "tired" when reading, and he or she complains of being unable to recognize very small

print. The condition then becomes absolute and, after reading for a short span, even ordinary-sized print seems to run together.

The symptoms are more noticeable at night than in daylight. This is due to the fact that eyes are fresher during the day so the extra accommodative effort is more easily effected. Secondly, artificial light does not reveal as sharp a contrast between black and white, so print has to be held closer to be seen. Eventually, presbyopia becomes so totally absolute that fine print cannot be read without glasses at any distance, no matter how bright the illumination or how great an effort at accommodation is made.

Treatment of presbyopia consists of convex spherical lenses which represents the difference between the amount of accommodation produced and the amount needed for seeing at the reading distance. The spectacle correction is made binocularly - usually, but not always, with the same amount of plus power in each eye. Based on a general rule for a reading distance of 15 inches, presbyopic adds for various ages are expected to conform with the following adds: +0.75 for age 45 years; +1.25 for age 50 years; +1.75 for 55 years; +2.00 for 60 years; and +2.50 to +3.00 for ages 65 years and older. Any marked deviations from these normal averages should be referred back to the O.D. or M.D. for further investigation.

Dispensers should be alert to the fact that the incidence of eye disease are: open-angle glaucoma, diabetic retinopathy and age-related macular degeneration. Another common problem is the increasing incidence of dry-eye syndromes in which both tear volume and quality are altered.

Anisometropia

Anisometropia is a condition in which the refractive error of one eye differs from that of the other. The defect is the rule rather than the exception and, in fact, so seldom are the eyes found to be exactly equal that the term is used mainly to define the condition where the difference is considerable. It has been suggested that such difference should exceed 1.00 D. The term *antimetropia* is used when one eye is hyperopic and the other myopic, the term *anisometropia* being reserved for hyperopia or myopia in both eyes but to different extents.

The incidence of anisometropia and antimetropia has been increasing dramatically since the introduction of intraocular implants for the surgical correction of cataracts. This remarkable procedure, now considered to be one of the most successful ophthalmic invasive operations from the stand point of safety and good monocular visual acuity, nevertheless carries with it the problem of induced anisometropia since it is extremely difficult to duplicate the condition of the other eye's refractive status of previously implanted IOL. Thus, from a monocular point of view, the operations are usu-

ally successful; however, the upset in binocularity introduces unwanted prismatic imbalances that result in symptoms such as transitory diplopia when reading, blurred vision, headaches and rapid fatigue when engaged in close-vision tasks.

The best way to correct anisometropia when faced with the foregoing symptoms is to grind slab-off, or bicentric lenses that incorporate prism grinding at segment height on the surface of a lens. Their purpose is to compensate for unequal prismatic effects that area created when patients try to read through anisometric corrections.

Slab-off prism lenses are far from new. However, for reasons explained later in this section, they have fallen into relative disuse so that today, not all opticians, optometrists or ophthalmologists are familiar with them and, up to now, few labs knew how to grind them.

When viewed from the front, slab-off single vision lenses look like executive bifocals with very smooth, almost invisible seams—the upper half prism free while the lower half contains the prism. Molded slab-off bifocals look like smooth-seamed executive bifocals in which flat-top segments are incorporated, the tope of the slab coinciding with the apex of the prism.

Old-style slab-offs were ground by first cementing a single-vision plano lens (called a “dummy”) to the front surface of the prescription lens, the concave surface of the dummy matching the convex side of the correcting lens. The lens “sandwich” then was ground off-center so that the upper half of the dummy could be removed while leaving its lower half still cemented to the Rx lens. After the front surface was ground and polished, the back surface was processed and discarded, leaving the front surface with base-up prism in its lower portion.

The above method was tedious, time consuming and very expensive. However, thanks to modern technology, pre-molded slab-off blanks are now available in a wide range of base curves. These not only reduce the cost of fabricating slab-off prescriptions but, also, they dramatically cut down on delivery time.

Old-style slab-offs were ground *base-up on the weaker convex or stronger concave surface* of anisometric corrections since it was much easier to grind the lenses that way. The new molded slab-offs are made in reverse form; that is, with *base-down prism on the most plus or least minus lens*. According to some authorities, this renders the lenses not only more uniformly consistent and parallax-free but, in addition, it makes the demarcation line less conspicuous.

To calculate the amount of prism needed in a molded slab-off Rx, the near-point decentration below the distance optical center is considered to be, by rule of thumb, 8mm. for single vision and bifocal cases. In the latter case, calculations are based on 3 mm. below O.C. plus 5 mm. into the reading segment. By Prentice’s formula,

the discrepancy in anisometric prism power easily is computed, as follows:

Formula:

$$\text{Prism power} = \text{decentration in cm.} \times \text{dioptric power of lens}$$

Example:

$$\begin{aligned} \text{O.D.} &= +1.25 \text{ sph.}, \text{ O.S.} = +3.75 \text{ sph.} \\ \text{O.D. Prism power} &\times .8\text{cm} \times +1.25 = 1.0 \\ &\text{D. prism base up} \\ \text{O.S. Prism power} &\times 8\text{cm.} \times +3.75 = 3.0 \\ &\text{D. prism base up} \end{aligned}$$

Therefore:

$$\text{O.S. needs } 2.0 \text{ D. prism base down to compensate (molded blank)}$$

A shortcut to arriving at the above calculations can be found by merely subtracting the dioptric values of the two lenses and multiplying the result by .8 cm. In the above example: Prism power = +3.75 sph. minus +1.25 sph. = +2.50 sph. x .8 cm. = 2.0 D. prism slab-off needed in the O.S. to compensate (molded blank).

The needed prismatic power can also be calculated accurately without mathematical computation by placing the Rx in a trial frame and then placing the glazed trial frame, in turn, in a lensometer. All you have to do here is to raise the lensometer’s stage 8 mm. And measure the prism induced by the decentration in each lens, the difference between the two measurements represents the amount of compensatory prism. The lensometer method is especially useful when anisometric imbalances involve oblique cylinders.

Full correction of vertical imbalances is not always necessary. Many spectacle wearers are able to partially compensate for an imbalance. The lesser value can be ascertained by a method suggested by Borish and Brooks in their textbook, *System for Ophthalmic Dispensing*. In their procedure, the upper portion of an anisometric Rx above the seg line is taped. This forces the wearer to look through the lower lenses at near in the same manner as used in locating the reading level during the dispensing process. Thus, the prism amount is found in a subjective manner and becomes a part of the prescription. As with all prescriptions, when you receive the finished Rx from the lab, the amount and direction of the slab-off should be checked carefully. A simple method for doing this is suggested by the Guild of Prescription Opticians of American (Figs. 7a and 7b) as follows:



Fig. 7a

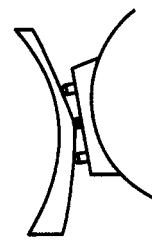


Fig. 7b

First, using a standard lens clock, check both sides of the dividing line to make sure the curves are equal (Fig. 7a). The clock is then placed on the front surface of the lens with its center pin on the dividing line (Fig. 7b). The difference in dioptric curves represents the amount of prism slab-off. From our example, let's say the gauge reads +8.00 in either section when checked as in Fig. 16a and reads +6.00 in Fig. 16b. Therefore, +8.00 D. minus +6.00 equals 2.0 prism diopers.

Aniseikonia

Aniseikonia is a condition in which the image of an object seen by one eye differs in size and/or shape from that seen by the other eye as contrasted with *anisometropia* in which there is a difference in refraction between the two eyes.

Aniseikonia is caused by magnification properties inherent in all ophthalmic corrective lenses; for example, plus lenses create larger-than-normal image sizes on the retina while, on the other hand, minus lenses create smaller-than-normal retinal images. When the magnification factor of each lens is so dissimilar as to trigger adverse symptoms, the condition needs treatment.

Magnification in a spectacle lens depends upon four parameters: dioptric power, front curve, center thickness, and vertex distance. The disparity in dioptric power, as we have already learned from our discussion on *anisometropia* (page 9), is correctable with slab-off lenses. But slab-offs cannot correct the magnification

imbalances present in aniseikonia. In the latter case, correction is made by iseikonic spectacles in which a smaller retinal image is increased to match the magnification of its mate. This is accomplished by altering the front curve, the center thickness, or the vertex distance.

The amount of aniseikonia is measured on an instrument called an *eikonometer*, which contains a three-dimensional target. If aniseikonia is present, the target appears to be slanted; the amount of aniseikonia is then calculated by a formula that enables the target to swing back into its upright plane.

Due to widespread use of contact lenses and intraocular lens implants that help to control magnification, many problems related to aniseikonia have been lessened. But some problems still remain. Since diagnosis of aniseikonia requires special equipment and expertise on the part of the refractionist, anisometropic cases that do not successfully respond to slab-offs and/or contact lenses should be referred to an optometrist or ophthalmologist for aniseikonic evaluation.

Dispensers interested in fitting aniseikonic prescriptions should familiarize themselves with a number of special techniques required for adjusting iseikonic spectacles. These procedures can be found in *Ophthalmic Dispensing*, 3rd Ed. By Russell L. Stimson, published by Charles C. Thomas, Inc., Springfield, IL, 1979, pp. 349-356, and in *Aniseikonia* by David D. Michaels, Md. and Thomas A. Chee, FNA, published by the National Academy of Opticianry, Bowie, MD, 1988, pp. 3-17

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The Optics of Light & Vision

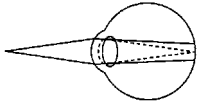
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- Which of the following answers are correct?
 - The Snellen Chart consists of alphabet letters designed to subtend 5-minute angles to the eye at a distance of 20 feet
 - Each letter is enclosed in a square of 5' of arc
 - Each letter's arms and interstices subtend 1' of arc
 - All of the above
- If a patient is able to recognize a 12" high letter placed 40 feet away, he should be able to recognize the same letter at 20 feet if its height were:
 - 4" b. 6" c. 8" d. 10"
- Which type of refractive error benefits most when accommodation comes into play?
 - Myopia
 - Hyperopia
 - Regular astigmatism
 - Irregular astigmatism
- Hyperopia is considered to be "latent" when it is:
 - Corrected by the physiological tone of the ciliary muscle
 - Correctable by accommodation
 - Uncorrectable by accommodation
 - Presbyopic
- Radial keratotomy is a delicate operation designed to:
 - Prepare the eye for an intraocular implant
 - Remove a cataract
 - Alter the cornea in an attempt to reduce myopia
 - Stretch the eyeball
- The principal meridians of an astigmatic eye are:
 - Always at right angles to each other
 - Always at 90 and 180 degrees
 - Never oblique
 - Never at 90 and 180 degrees
- If an astigmatic error of 2.00 D. is corrected by a 2.00 D. cylinder that is either convex or concave, the axis of the correcting plus cylinder is positioned:
 - To coincide with the meridian of greatest power
 - To coincide with the meridian of least power
 - To coincide with the meridian halfway between the greatest and least powers
 - None of the above.
- Facing the patient, a cylinder's axis goes from zero to 180 degrees:
 - Clockwise
 - Counter-clockwise
 - Depending upon the cylinder's power
 - Depending upon the principal meridian
- The condition in which the crystalline lens loses its elasticity due to advancing age is called:
 - Macular degeneration b. Cataract
 - Presbyopia d. Hyperopia
- Irregular astigmatism may be caused by:
 - Irregular corneal surface
 - Irregular front surface of the crystalline lens
 - Irregular back surface of the crystalline lens
 - Any or all of the above.
- In pre-presbyopic patients, modest amounts of hyperopia are helped by:
 - Low-plus lenses b. Accommodation
 - "Rest" glasses d. All of the above.
- According to definition, what does this diagram represent?
 - Hyperopia
 - Myopia
 - Astigmatism
 - Accommodation
- Optical infinity is considered to be a minimum distance of:
 - 5 feet b. 10 feet c. 20 feet d. 40 feet
- With-the-rule astigmatism is present when:
 - The minus axis is on or near 180 degrees
 - The plus axis is on or near 180 degrees
 - The minus axis is on or near 90 degrees
 - The axes are oblique
- The denominator of a Snellen Fraction represents:
 - Normal visual acuity
 - The metric equivalent of feet
 - The distance at which the chart should be mounted
 - The distance at which the eye should be able to recognize a designated test letter
- A type of nearsightedness called "pseudomyopia" is caused by:
 - Incorrect glasses
 - Advancing age
 - Ciliary Spasm
 - Excessive curvature of the cornea
- During the act of accommodation:
 - The ciliary muscle is at rest, the zonules contracted and the refractive power is maximal
 - The ciliary contracts, the zonulas are relaxed and the refractive power is maximal
 - The cornea assumes a more convex shape
 - The cornea assumes a flatter shape
- Some patients become presbyopia sooner than others because they:
 - Usually read at closer distances
 - Have shorter arms
 - Attempt to read in poor light
 - All of the above.
- Which of the following refractive errors are due to axial length of the globe:
 - Myopia b. Astigmatism
 - Hyperopia d. Presbyopia
- The incidence of eye disease increases with age. Included in this group of diseases are:
 - Glaucoma
 - Age-related macular degeneration
 - Dry-eye syndrome
 - All of the above.
- Based on a general rule for a reading distance of 15 inches, what power of presbyopic add would you expect a 55-year-old patient to require?
 - +0.75 D. b. +1.25 D. c. +1.75 D. d. +2.25D.
- Slab-off on a molded blank is always ground with the prism:
 - Base up on the weaker plus lens
 - Base down on the stronger plus
 - Base down on the stronger minus lens
 - On the thicker lens
- How much slab-off prism would have to be ground to completely correct vertical imbalance at a point 8 mm. below the optical center for the following Rx: O.D. +1.00 D. sphere.; O.S. +4.00 D. sphere.
 - 2.0 prism D. b. 2.4 prism D.
 - 2.8 prism D. d. 3.0 prism D.
- A dispenser is able to increase magnification through a plus lens by:
 - Reducing the thickness
 - Flattening the front curve
 - Fitting the lens farther from the eye
 - Increasing the lens size

Membership Application

INDIVIDUAL'S NAME _____ COMPANY _____
 HOME ADDRESS _____ FAX # _____
 BUSINESS ADDRESS _____ EMAIL ADDRESS _____
 PHONE (HOME) _____ PHONE (BUSINESS) _____

Preferred Address: Home Business Preferred Phone: Home Business

Membership Type: Active (\$150.00) Newly Licensed-Active (\$75.00) Associate (\$75.00)
 (see below for category descriptions) Corporate (\$150.00) Student (~~\$150.00~~) *Waived for current membership year*

Method of Payment: Check (payable to NYSSO) Credit Card (please complete section below)



Type of Credit Card: Visa Mastercard Dollar Amount: _____

Expiration Date: _____ Card #: _____ Signature: _____ 02/05

Voluntary Opticians PAC Contribution

(Contributions to the NYSSO Political Action Committee)

\$25.00 \$50.00 \$75.00 \$100.00 Other _____

Membership Year is September 1-August 31.

Mail Application to: NYSSO, 90 State Street, Suite 1009, Albany, NY 12207. NYSSO Membership Services Line (518) 426-0599
 E-mail: nyssocaphill.com • Web Page: www.nyssso.org

To be listed accurately in the NYSSO Membership Directory, please indicate which of the following services are offered by your business:

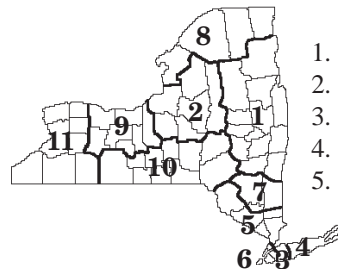
- Artificial Eyes Contact Lenses
 Eyeglasses Refractions Available
 Hearing Aids Low Vision

Please Complete the Following:

Chapter (see map) _____ Date of Birth: ____/____/____
 NYS License # _____ Sex: Male Female
 Contact Lens Fitter # _____ Signature _____
 Sponsor (if applicable): _____ Date _____

Please indicate to which organizations you belong:

- American Board of Opticianry Certified (ABO)
 Fellow, National Academy of Opticianry (FNAO)
 Opticians Association of America (OAA)
 National Contact Lens Examiners (NCLE)
 Contact Lens Society of America (CLSA)



NYSSO Chapters

1. Capital District
2. Central
3. Long Island-Nassau
4. Long Island-Suffolk Valley
5. Lower Hudson
6. Metropolitan
7. Mid Hudson Valley
8. North Country
9. Rochester
10. Southern Tier
11. Western Out of State

Membership Categories

ACTIVE MEMBERSHIP — Annual dues of \$150.00. Any person possessing a valid New York State Ophthalmic Dispensing License is eligible to become an Active Member.

NEWLY LICENSED MEMBERSHIP — Annual dues of \$75.00 (first year), \$100.00 (second year), and \$150.00 (third year). Any newly licensed optician (licensed within the past six months) is eligible for the special three-year pro-rated membership incentive. Newly licensed opticians who join under the special offer will be entitled to full Active Member benefits.

ASSOCIATE MEMBERSHIP — Annual dues of \$75.00. Any person who does not qualify for Active membership but is supportive of opticianry shall be eligible to become an Associate Member. Associate Members are entitled to all the rights of an Active Member, except voting and may participate in all activities of this Society, unless specifically excluded by the Board of Directors.

CORPORATE MEMBERSHIP — Annual dues of \$150.00. Any proprietorship or corporation maintaining 51% of its licensed opticians as members of this Society and upholding the by-Laws and constitution of the Society is eligible to become a Corporate Member. Corporate Members are entitled to all rights of an Active Member, except voting and may participate in all activities of the Society, unless specifically excluded by the Board of Directors.

STUDENT MEMBERSHIP — Annual dues of ~~\$150.00~~. Any person who is enrolled as a student in a New York State-accredited program for Ophthalmic Dispensing is eligible to become a Student Member. Student Members are entitled to all rights of an Active Member, except voting and may participate in all activities of this Society, unless specifically excluded by the Board of Directors. *Waived for current membership year*