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We have eliminated all paper session evaluation forms. Please be sure to complete your electronic session evaluations online when you login to request your CE Letter for each course you attended! Your feedback is important to us as our Education Planning Committee considers content and speakers for future meetings to provide you with the best education possible.

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# ABO Advance Review

Thomas Neff MA, LDO, ABO-AC, NCLE-AC
Thomasneffldo@gmail.com

Presented By:

UOA United Opticians ASSOCIATION

Representing Contact Lens and Spectacle Opticians since 1925

Visit the Opticon Hub for more information on joining and helping the UOA with there mission to improve Opticianry!

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## Conflict of interest

- The speaker, Thomas Neff MA LDO, ABO-AC, NCLE-AC, has no conflicts of interest to disclose.
- Part of the Speaker Bureau with Mitsui Chemicals

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## ABO Advance Test Specifications New for 2024

- **1. Optics**
  - **30%**
- **2. Ocular Anatomy, Physiology, Pathology, and Refraction**
  - **33%**
- **3. Ophthalmic Products**
  - **10%**
- **4. Instrumentation**
  - **9%**
- **5. Dispensary Protocols and Procedures**
  - **10%**
- **6. Laws, Regulations, and Standards**
  - **8%**

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## ABO Masters Program

- The ABO Master in Ophthalmic Optics designation demonstrates to the public and colleagues that an individual has attained a superior level in ophthalmic dispensing.
- Any Optician who is currently Advanced Certified by the American Board of Opticianry for at least one complete three-year renewal cycle and satisfies one of two additional qualifications is eligible to apply for this designation.
- Today 10:30am: Panel discussion: Masters Designation hosted by Cira Collins in the OptiCon Hub

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## ABO Masters Program

Have written two published ABO-approved Advanced Level III articles

OR

An ABO-approved speaker with two ABO-approved Advanced Level III Courses, or

OR

Have one published ABO-approved Advanced Level III article AND one ABO- approved Advanced Level III Course for which you are the ABO-approved Speaker.

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# ABO Advance Review Domain 1 Part 1

Thomas Neff MA, LDO, ABO-AC, NCLE-AC | 2024

Presented By:

UOA United Opticians Association

Representing Contact Lens and Spectacle Opticians since 1925.

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Scan the QR code to learn about complimentary UOA membership, made possible through an investment by ABO & NCLE to:
- state associations,
- state licensees &
- ABO-NCLE certificants.

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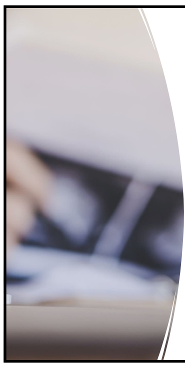

## Domain 1 Tasks
### Ophthalmic Optics Part 1

I. Optics - 30%
   a) Optical Terminology
   b) Prescriptions
   c) Lens measurements, changes and their effects, and characteristics
   d) Optical properties of lens materials
   e) Lens designs
   f) Measurement systems and conversions (e.g., Imperial, metric, box)

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## Terminology

Ametropia – refractive error. Any optical error( e.g., myopia); can be corrected by eyeglasses, contact lenses, or refractive surgery.

Antimetropia – Opposite refractive errors in the eyes: one nearsighted (myopic), one farsighted (hyperopic)

Anisopia – Unequal vision in the two eyes.

Anisometropia – Unequal refractive errors in the two eyes; usually at least 1 diopter different.

Aniseikonia – Unequal retinal image sizes in the two eyes, usually from different refractive errors

Diplopia – Perception of two images from one object.

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## Terminology

- Amblyopia – The loss of vision without any apparent defect to the eye.
- Aphakic – patients have had their crystalline lens removed.
- Ptosis - A drooping lid. Corrected by using a Ptosis Crutch.
- Psuedoaphakics - have an implant to replace the crystalline lens.
- Nystagmus - A fluctuation of movement of the eye. Rapid eye movement
- Cycloplegics - Inhibit accommodation.
- Scotoma - Blind spot, An area of retinal vision loss.
- Mydriatic Drops - Dilates pupil.

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- **Focal Length**

$$D = \frac{1}{f\ meters}$$

- **Horizontal Decentration**

$$\frac{FPD}{2} - Mono\ PPD = HD$$

- **Vertical Decentration**

$$OC - \frac{B}{2} = VD$$

- **Minimum Blank Size**

$$MBS = ED + (2 \text{ x Mono Dec})$$

- Nominal Lens Power

$$F_T = F_1 + F_2$$

- Index Formula

$$N = \frac{Speed\ of\ light\ in\ air\ (186{,}000mps)}{speed\ of\ light\ in\ medium}$$

- Vertex Compensation

$$Dc = \frac{dD^2}{1000}$$

- Prentice Rule

$$\Delta = \frac{dD}{10} \qquad d = \frac{\Delta x10}{D} \qquad D = \frac{\Delta x10}{d}$$

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- **Sagittal Formula For Thickness**

$$\text{Sag} = \frac{n-1}{D} - \sqrt{\left(\frac{n-1}{D}\right)^2 - \left(\frac{d}{2}\right)^2}$$

- **Sagittal Formula for Thickness Approximation**

$$\text{Sag} = \frac{(d/2)^2 xD}{2000\ (n-1)}$$

- **Resolving Prism**

$$V = (P)(\sin a)$$

$$H = (P)(\cos a)$$

- **Resultant Prism**

$$P = \sqrt{H^2 + V^2}$$

$$a = tan^{-1}\left(\frac{V}{H}\right)$$

- Martins Lens Tilt

2 Degrees for every 1 mm is lowered

$$S' = S\left[1 + \frac{(\sin\alpha)^2}{2n}\right] \qquad C' = S'(\tan\alpha)^2$$

- Oblique Powers at 90 & 180

$$Power\ @\ 90 = (sin(AXIS)^2 * CYL + SPH)$$

$$Power\ @\ 180 = (sin(AXIS)^2 * CYL + SPH)$$

- Specular Magnification

$$SM = \left[\frac{1}{1 - \frac{t}{n}D_1}\right]\left(\frac{1}{1 - hD}\right)$$

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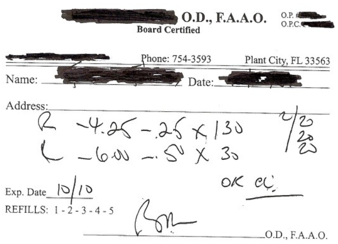
## Prescription Analysis


[redacted] O.D., F.A.A.O. O.P. [redacted] O.P.C. [redacted]
Board Certified
[redacted] Phone: 754-3593 Plant City, FL 33563
Name: [redacted] Date: [redacted]
Address:
R -4.25 -.25 x 130
L -6.00 -.50 X 30
OK OU
Exp. Date 10/10
REFILLS: 1 - 2 - 3 - 4 - 5
O.D., F.A.A.O.

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## Flat Transposition

| | |
|---|---|
| Add | Add SPH + CYL (algebraically) |
| Change | Change SIGN of CYL power |
| Change | Change AXIS 90 Degrees |

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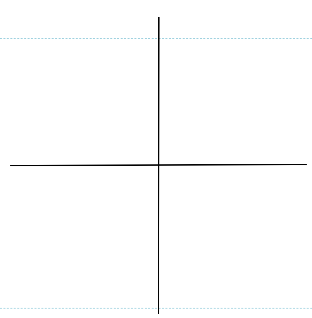

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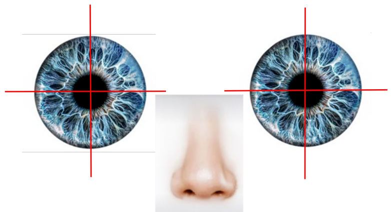

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## Martins Lens Tilt Formula

**6-1.** A +10.00D lens made of CR-39 ($n = 1.498$) is tilted 15°. What is the effective power of this lens on the combined eye/lens system?

$$S' = S[1 + (\sin \alpha)^2/2n]$$
$$= (+10.00)(1 + [\sin 15]^2/2[1.498])$$
$$= (+10.00)(1 + 0.06699/2.996)$$
$$= (+10.00)(1.02235)$$
$$= \mathbf{+10.22D}$$
$$C' = S' (\tan \alpha)^2$$
$$= (+10.22)(\tan 15)^2$$
$$= (+10.22)(0.0718)$$
$$= \mathbf{+0.73 \times 180}$$

**Effective Rx +10.22 +0.73 ×180**

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## Wrap Around Sunglasses

- Frame requires approximately
- +8.00 or higher Base Curve
  - Remember that BEST optics are on a SPECIFIC designed base curve (Tsherning's Ellipse)….Artificially increasing BC will affect optics

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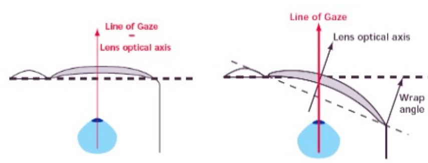


By increasing WRAP, will INCREASE Base OUT prism

To counter, will have to ADD BI to counteract

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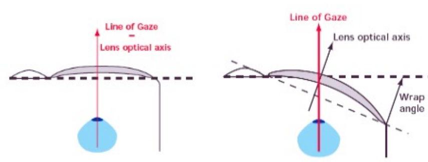


Will also change Sphere Power and change Cylinder Power

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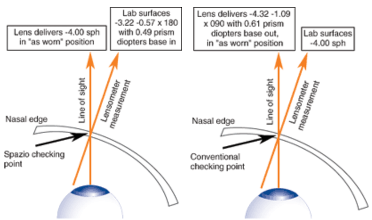
## Correction for Wrap Rx Lenses




- Must:
- Add BI
- Reduce Sph Power
- Add WTR Cyl to counteract ATR that is created

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## VERTEX COMPENSATION

**Effective Power**
It is what is felt if the lens when moved farther or closer to the eye

**Vertex Compensation**
Is what is needed to change the RX to compensate for the movement to and from the eye.

$$Dc = \frac{dD^2}{1000}$$

- **When the lens sit a different distance from where the doctor refracted the patient.**
  - \+ MOVED AWAY GETS MORE PLUS
  - \+ MOVED CLOSER GETS MORE MINUS
  - – MINUS MOVED AWAY GETS MORE PLUS
  - – MINUS MOVED CLOSER GETS MORE MINUS

Use the sign it is moving in
Away from eye = add plus / subtract minus
Towards the eye = subtract plus / add minus

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## Vertex Compensation

- Closer? Farther?
- Plus Lenses? Minus Lenses?

(CAP)
Closer Add Plus

(FAM)
Further Add Minus

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## Vertex Compensation

- A Distometer, millimeter rule, or digital device is used to measure vertex distance.
- If the power in any meridian is > 7.00D, an adjustment to power if the frame is fit at a distance different than the Rx vertex distance

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## VERTEX COMPENSATION

Effective Power

Vertex Compensation

Given the Rx of -14.00 OU is fitted in front of the eye at 9 mm what would be the compensation needed?

$$Dc = \frac{dD^2}{1000}$$

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## VERTEX COMPENSATION

Effective Power

Vertex Compensation

$$Dc = \frac{dD^2}{1000}$$

Given the Rx of ________________________OU is fitted in front of the eye at 9 mm what would be the compensation needed?

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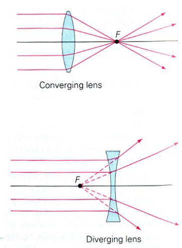
## Lens Designs

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## Base Curves

***Flatter Base Curves***
Less Magnification
Thinner lenses

***Steeper Base Curves***
More Magnification
Thicker lenses

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## Corrective Curve or "Best Form" Lens Theory

- Tscherning Ellipse
  - Best Base Curve to eliminate **Marginal** or **Oblique Astigmatism**

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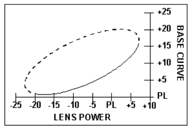
## Tscherning Ellipse

- A graphical representation of the front surface power as a function of the total lens power in best-form lenses.
- There are two possible solutions, those that are least curved and those that are most curved.

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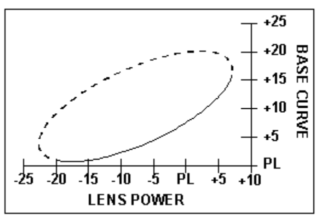
## Tscherning Ellipse: Oswalt Branch

The least curved portion is called the Oswalt Branch.

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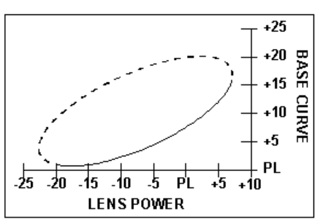
## Tscherning Ellipse: Wollaston Branch

The most curved portion of the ellipse is called the Wollaston Branch.

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## Corrected Curve Theory

- Different curves were needed to suit different families of Rx's.
- Proper matching would result in "Best Form" lenses with minimal aberrations.

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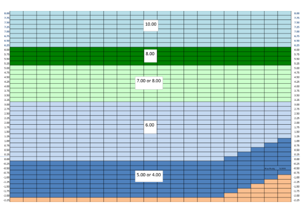
## Corrected Curve Theory



- Different curves were needed to suit different families of Rx's.
- Proper matching would result in "Best Form"
- lenses with minimal aberrations.

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## Choosing an Appropriate Base Curve

Higher Plus = STEEPER Base/Front Curves

Higher Minus = FLATTER Base/Front Curves

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## Vogel's Formula

Choosing an Appropriate Base Curve

For Plus Lenses :

BC = SE +6.00

For Minus Lenses :

BC = (SE +6.00) / 2

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## Vogel's Formula

Example: Rx +3.75 -1.50 x 90 = +3.00

BC = SE +6.00

SE = +3.00

Base Curve = +3.00 +6.00 = +9.00

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## Example

- Example 2 : Rx -3.00 - 1.00 x 90

BC = (SE +6.00) / 2

Spherical Equivalent = -3.50

BC = (-3.50/2)+6.00 =

+4.25

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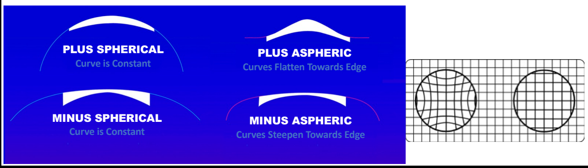
## Aspheric Curves

Instead of a single radius of curvature (same curve throughout surface of the lens), changes towards periphery of lens

**ASPHERIC VS. NON-ASPHERIC**

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## Aspheric Curves: Three main uses

1. Optical Aberration Control
   - Improved off center optics for Rx's > +7.00 or -23.00D than spherical base curve
2. Cosmetic:
   - Allows the use of flatter base curves while maintaining good optics.
3. Power Changes:
   - Used for progressive addition lenses.

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## Aspheric Lenses

- Non-spherical surface that gradually changes in curvature from the center of the lens toward the edge
- Delivers the peripheral clarity of a "Best-Form" lens with a flatter profile.
- With high index, up to 25% thinner and 30% lighter

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# Aspheric vs Best Form Lenses

+4.00 D Lens Design Comparison*

| | Best Form Lens | Flat Lens | Aspheric Lens |
|---|---|---|---|
| Front Curve | 9.75 D | 4.25 D | 4.25 D |
| Center Thickness | 6.6 mm | 5.9 mm | 5.1 mm |
| Weight | 20.6 grams | 17.7 grams | 14.8 grams |
| Plate Height | 13.7 mm | 6.0 mm | 5.1 mm |
| Rx off-axis | +3.78 DS | +5.18 DS -0.99 DC | +3.77 DS |

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# Aspheric Advantages:

Plus Lenses:

- Reduced lens thickness
- Less bulge for Plus Rx's
- Less magnification for plus Rx's

Minus lenses

- Less minification for minus
- Lenses look and stay better in frames.
- More frame choices.
- Improved peripheral vision

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# Aspheric Lens Limitations

- Aspheric lenses, like spherical lenses, can be optimized for only one lens power. Each lens requires one of two unique base curves to deliver optimum optical performance in the periphery.

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Minimum Blank Size

$$MBS = ED + (2 \text{ x Mono Dec})$$

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Minimum Blank Size:

MBS = ED + 2 x Decentration

Example: A=54 DBL=18 P.D.=64 ED=58

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Minimum Blank Size:

MBS = ED + 2 x Decentration

Example: A=54 DBL=18 P.D.=64 ED=58

A + DBL = GCD or Frame PD
54 + 18 = 72

GCD - P.D. divided by 2 = decentration per eye

72 - 64 = $\frac{8}{2}$ = 4mm in per eye

ED + 2 x Dec. = MBS

58 + 2 x 4 = 66mm

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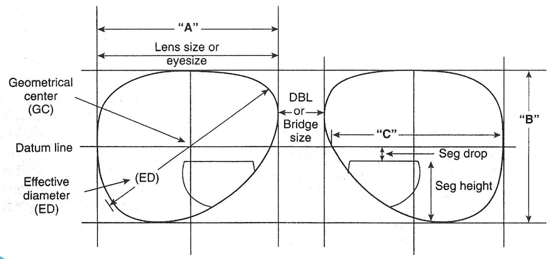
## Boxing System

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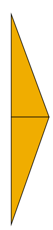
## Plus Lens Characteristics

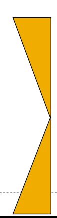
- Can visualize as "base to base" prisms increasing in power from the center to the edge.
- Thicker at the center.
- Magnify
- Exhibit "Against Motion"
- Designs:
  - Equiconvex, Biconvex
  - Flat Convex
  - Meniscus



50

## Minus Lens Characteristics

- Series of apex to apex prisms increasing in power from the center to the edge.
- Thinnest at the center.
- Minify
- Exhibits "With Motion"
- Designs:
  - Equiconcave, Biconcave
  - Flat Concave
  - Meniscus



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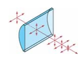
## Compound Lens Characteristics

- Combine a spherical surface with a toric or cylindrical surface.
- Strongest and weakest curves are 90 degrees apart.
  - Plus cylinder form has cylinder on the front
  - Minus cylinder form has cylinder on the back.



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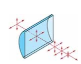
## Compound Lens Characteristics

- SPH is throughout ENTIRE lens
- Cyl based upon meridian:
  - Meridian that corresponds with rx Axis represents 0% cylinder power.
  - 90 degrees away = Full Cyl
  - Remember LENS CROSS!!!



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## Lens Power

- The power of a lens in diopters is equal to the reciprocal of it's focal length in meters

$$D = 1/f$$

$$f = 1/D$$

D = dioptric power of lens (in D)
F = focal length of lens (in M)

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## Lens Power: Examples

$1D = \frac{1}{1M}$

$2D = \frac{1}{.5M}$

$0.25D = \frac{1}{4M}$

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## Specular Magnificatio

**6-4.** What is the spectacle magnification for each of the lenses in the prescription below, and what is the difference in magnification percent for the two lenses?
The Rx is: +1.50
+4.50
The glasses fit at 12 mm. The lenses are made of CR-39, n = 1.498, BCs +6.25 and +9.25.
Use of calipers on the completed lenses shows thicknesses of 3 mm and 5 mm.

**OD:**

$$SM = \frac{1}{1-\left(\frac{t}{n}\right)D_1} \times \frac{1}{1-hD}$$

$$SM = \frac{1}{1-\left(\frac{0.003}{1.498}\right)(+6.25)} \times \frac{1}{1-(0.015)(+1.50)}$$

$$SM = \frac{1}{1-0.0125167} \times \frac{1}{1-0.0225}$$

**SM** = (1.01268)(1.02302) = **1.036**
**%SM** = (SM – 1)100 = (1.036 – 1)100 = **3.6%**

**OS:**

$$SM = \frac{1}{1-\left(\frac{t}{n}\right)D_1} \times \frac{1}{1-hD}$$

$$SM = \frac{1}{1-\left(\frac{0.005}{1.498}\right)(+9.25)} \times \frac{1}{1-(0.015)(+4.50)}$$

$$SM = \frac{1}{1-0.0308745} \times \frac{1}{1-0.0675}$$

**SM** = (1. 03186)(1. 07239) = **1.107**
**%SM** = (SM – 1)100 = (1.107 – 1)100 = **10.7%**

The right lens has 3.6% magnification, and the left lens has 10.7% magnification. The wearer has a magnification difference of 10.7 – 3.6 = **7.1%**.
If the wearer has good vision in each eye when corrected, this person might have a problem with fusion.
What can be done to decrease the 7.1% magnification difference?[1]

t = thickness of the lens in meters
n = index of refraction of the lens material
$D_1$ = base curve (BC) or front surface power of the lens
D = actual power of the lens
h = vertex distance + 3 mm, converted to meters

**RULES FOR SPECTACLE MAGNIFICATION**

| | PLUS LENS | MINUS LENS |
|---|---|---|
| Increase BC | More magnification | Less minification |
| Increase t | More magnification | Less minification |
| Increase VD | More magnification | More minification |

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