



Prism is Not a Four-Letter Word

Phernell Walker, MBA, ABOM, LDO
Renowned International Speaker



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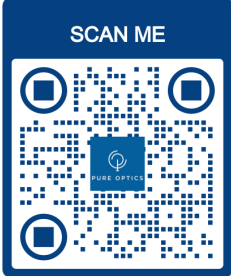
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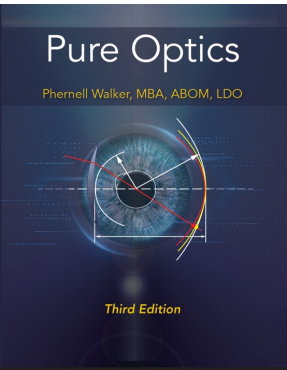
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Reference Resource

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Refract Light


Ophthalmic Technicians

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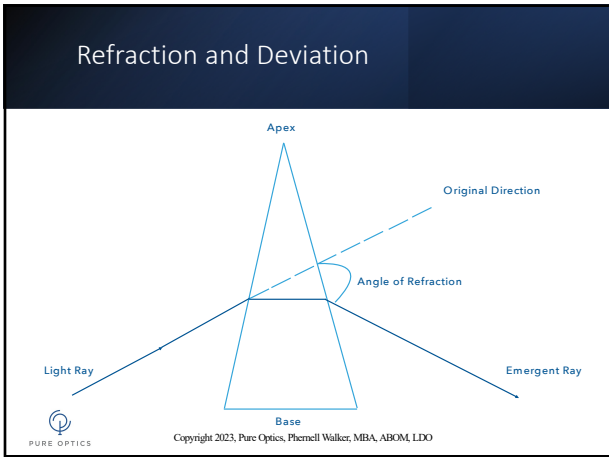
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Prism Magic

- **Ametropia** - ophthalmic lenses move image across a plane (1-dimension)
- Move images in 3D space

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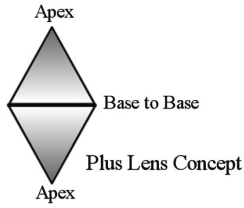


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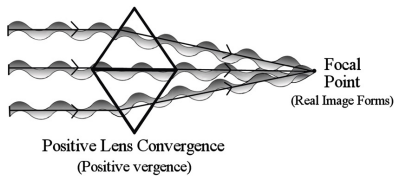
Fundamental Plus Lens Design



- **+ Plus Lenses** - used to correct hyperopia and/or presbyopia
- Two prisms connected **base to base**

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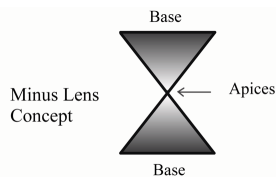
Forming Real Images



- **+ Plus Lenses** - converge light because the prism's base (thickest part) is located at the lens center
- Plus lenses can create a **real image** located behind the lens

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Fundamental Minus Lens Design



- **- Minus Lenses** - used to correct myopia
- Two prisms connected **apex to apex**

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Forming Virtual / Imaginary Images

Virtual image

Minus Lens Divergence

- **Minus Lenses** - diverge light because the prism's base (thickest part) is located at the lens periphery (edges)
- Minus lenses have a **virtual image** located in front of the lens

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Refractions Determines Focal Length

+2.00D 1/2 Meter 1 Meter

+1.00D 1 1 Meter

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Calculating Focal Length

$$F = 1 / D$$

where:

- D = dioptic power
- 1 = constant
- F = focal length in meters

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Ray Tracing

Paraxial Ray
Axial Ray
Paraxial Ray

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3D Space

- X = Length
- Y = Width
- Z = Height

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Ophthalmic Prism

- **Prism Base** - thickest part of the prism
- **Prism Apex** - thinnest part of the prism

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Prentice Rule

$$P = (h_{cm}) (D)$$

where:

- P = Prism Diopters
- h_{cm} = amount off in centimeters
- D = lens dioptic power (at axis 180 or 090)



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Example

$$P = (h_{cm}) (D)$$

When verifying a pair of new glasses in the lensometer, you discover that the lenses were edged at a PD of 60 mm.

Since the patient's PD is 66 mm, how much prism was induced assuming the patient's Rx is:

O.D. -3.75 D.S.
O.S. -3.00 - 1.00 x 045



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Horizontal Prism

Solution:

$P = (h_{cm}) (D @ 180th \text{ meridian})$

$P = (.6 \text{ cm}) (O.D. -3.75 \ \& \ O.S. -3.50)$


$P = (.6 / 2) (O.D. -3.75 \ \& \ O.S. -3.50)$

O.D. Prism = $(.3)(-3.75)$ & O.S. Prism = $(.3)(-3.50)$

O.D. Prism = 1.125 D & O.S. Prism = 1.05 D

Total Prism = 1.125 D + 1.05 D

Total Prism = 2.18 D (almost 2.25 prism diopters)



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Vertical Prism

The O.C. of a OD lens was edged at 30mm.
 And the OS lens was edged at 26mm.

How much vertical prism was induced with the Rx below?

O.D. +4.25 – 1.00 x 060
 O.S. +4.25 – 0.75 x 135
 OC: 26mm


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Vertical Prism

Only calculate prism for the right lens because the OS lens is correct:


$P = (h_{cm}) (D @ 090th\ meridian)$
 $P = (.4\ cm) (+4.00)$
P = 1.60 D (a little more than 1.50 prism diopters)

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Base Direction

Both Lenses Edged (same direction)		
Plus Lenses		
Edged		Result
Too Wide		Base Out
Too Narrow		Base In
Minus Lenses		
Edged		Result
Too Wide		Base In
Too Narrow		Base Out

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Compounding Prism

Amounting Prism
(O.D. & O.S. Lens)

- Base In & Base In
- Base Out & Base Out
- Base Up & Down

- **Amounting prism (compounding prism)** - when the total prism equals the sum of the right and left lens.
- It results when either the base direction in the 180th meridian is the same in each lens or if the base is in opposite directions in the 090th meridian



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Neutralizing Prism

Neutralizing Prism
(O.D. & O.S. Lens)

- Base Down & Down
- Base Out & Base In
- Base Up & Base Up

- **Neutralizing prism** - When either the base direction in the 180th meridian of each lens is in opposite directions or if the base is in same direction in the 090th meridian.
- Total prism equals the dioptric difference between each lens and the base orientation is the direction of the strongest prism



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Monocular Prism

The lab edged lenses at 31/35mm PD. How much prism was induced?

OD +3.00 – 0.50 x 090
OS +3.75 – 1.00 x 060

Patient PD: 33/33 mm



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Solution

- P = (h_{cm}) (D @ 180th meridian)
- P = (OD 31 -33 = 2 mm & OS 35 - 33 = 2 mm) (O.D. +2.50 & O.S. +3.00)
- P = (OD .2cm & OS .2cm) (OD +2.50 & O.S. +3.00)
- O.D. Prism = (.2 cm too narrow) (+2.50) & O.S. Prism = (.2 cm too wide) (+3.00)
- O.D. Prism = 0.50 D. B.I. & O.S. Prism = 0.60 D. B.O.
- Total Prism = Prism OD + Prism OS
- Total Prism = 0.50 D. B.I. + 0.60 D. B.O.
- Total Prism = 0.10 D. B.O. (base out because the stronger prism is Base Out)



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Monocular Prism

What is the total amount of prism if the OC on the right lens was edged 4 mm too high and the left OC was edged 2 mm too low with the following prescription?

OD: -2.00 -1.00 x 180
OS: -2.50 -1.00 x 180

Solution:

- P = (h_{cm}) (D @ 090th meridian)
- P = (.4 cm OD & .2 cm OS) (-3.00 OD & -3.50 OS)
- P = OD 1.20 D. B.D. & OS 0.70 D. B.U.
- P = 1.20 + 0.70
- P = 1.90 D**



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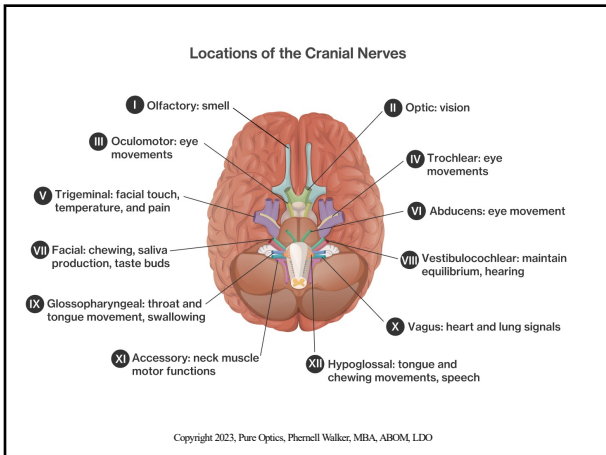
Cranial Nerves

- CN II - vision
- CN III - eye motility
- CN IV - superior oblique eye muscle
- CN VI - lateral rectus eye muscle
- CN VII - facial and lacrimal gland



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Traumatic Brain Injury (TBI)

Traumatic Brain Injury (TBI) can result from stroke, automobile accidents, concussions, whiplash, post neurosurgical (e.g., tumor excision, aneurism repair)

80% of TBI patients suffer vision issues

We can use prism to widen a patient's field of view

1.00^Δ diopter is equal to 0.573 degrees

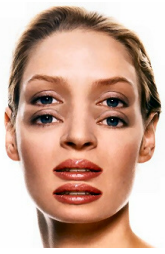
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Diplopia

Diplopia can result in difficulty:

- stereopsis
- walking
- balance
- reading
- visual field loss





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Prism Therapy

- **Bilateral prism** - splitting prism between both eyes
- **Convergence (ESO)** - bilateral Base Out (B.O.)
- **Divergence (EXO)** - bilateral Base In (B.I.)
- **Right (Hyper)**
 - OD lens = Base Down (B.D.)
 - OS lens = Base Up (B.U.)
- **Left (Hyper)**
 - OD lens = Base Up (B.U.)
 - OS lens = Base Down (B.D.)





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Prism Therapy


Divergence - bilateral Base In (B.I.)

- Advantage - promotes bifocal stimulation
- Disadvantage - reduces (P.F.R.) prism fusional vergence amplitude



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Amplitude of Convergence



Fusional Convergence amplitudes - focus on a accommodative target at near while holding a base out prism bar in front of one eye




Increasing the prism power gradually while maintaining a single image looking through Base Out Prism (B.O.)


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Creating Prism

- **Decentration (Mechanical)** - optical center edged in a different location than in conjugate with the patient's pupil (180th, 090th or combination)
- **Generated** - prism is created across the entire lens


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Calculating Prism

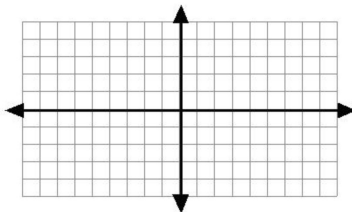
$$P = (h_{cm}) (D)$$


$P =$ prism	$h_{cm} =$ movement or difference	$D =$ dioptric power in a specific meridian
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Combined Horizontal & Vertical Prism



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Convert Degrees to Rectangular Notation

$V = D_e (\text{sine } a)$
 $H = D_e (\text{cosine } a)$

where:


- V = vertical prism
- H = horizontal prism
- D_e = prism dioptic power



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Convert Degrees to Rectangular Notation



Convert the following prescription neutralized in the lensometer from polar notation to rectangular notation:

O.D. +3.25 DS, 4.00^ΔB.I. @ 045



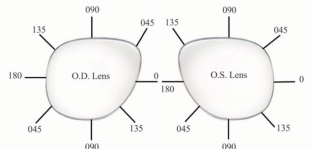

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Convert Degrees to Rectangular Notation

OD: -3.25 DS, 4^Δ BI @ 045
 $V = (4.00) (.707)$
 $H = (4.00) (.707)$
 $V = 2.82$
 $H = 2.82$

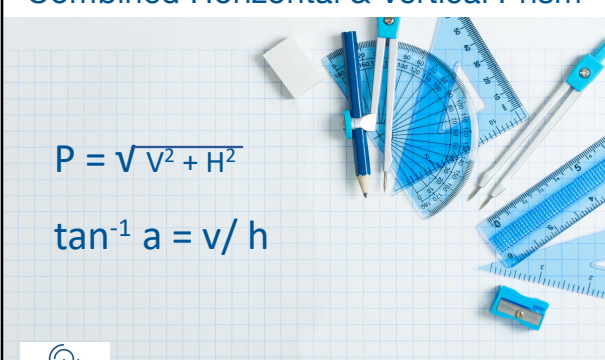
OD: +3.25, 2.82^Δ B.U., 2.82^Δ B.I. Notice the rectangular coordinates for the right eye directly corresponds with the polar coordinate of 045 degrees (fig. 11-5).

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Combined Horizontal & Vertical Prism



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

$$\tan^{-1} a = v/h$$

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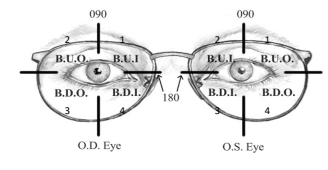
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What is the net result?

Rx

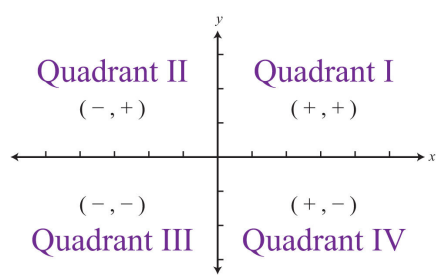
OD: -2.00 DS, 1.00[▲] B.U. & 3.00[▲] B.I.

OS: -2.50 DS, 1.00[▲] B.U. & 3.00[▲] B.I.



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OD:	OS:	<p><u>Determine Tangent Angle</u></p> <table border="0"> <tr> <td>a₁</td> <td>a</td> </tr> <tr> <td>Quadrant I</td> <td>a₁ = a</td> </tr> <tr> <td>Quadrant II</td> <td>180 - a₁ = a</td> </tr> <tr> <td>Quadrant III</td> <td>180 + a₁ = a</td> </tr> <tr> <td>Quadrant IV</td> <td>360 - a₁ = a</td> </tr> </table>	a₁	a	Quadrant I	a ₁ = a	Quadrant II	180 - a ₁ = a	Quadrant III	180 + a ₁ = a	Quadrant IV	360 - a ₁ = a
a₁	a											
Quadrant I	a ₁ = a											
Quadrant II	180 - a ₁ = a											
Quadrant III	180 + a ₁ = a											
Quadrant IV	360 - a ₁ = a											
$P = \sqrt{V^2 + H^2}$	$P = \sqrt{V^2 + H^2}$											
$P = \sqrt{1^2 + 3^2}$	$P = \sqrt{1^2 + 3^2}$											
$P = \sqrt{1 + 9}$	$P = \sqrt{1 + 9}$											
$P = \sqrt{10}$	$P = \sqrt{10}$											
$P = \sqrt{3.16}$	$P = \sqrt{3.16}$											
$\tan^{-1} a = v/h$	$\tan^{-1} a = v/h$											
$\tan^{-1} a = 1/3$	$\tan^{-1} a = 1/3$											
$\tan^{-1} a = 18.43$	$\tan^{-1} a = 18.43$											
$\tan^{-1} a = 18 \text{ degrees}$	$\tan^{-1} a = 162 \text{ degrees}$											

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Rectangular Prism Rx

OD: -2.00 DS, 1.00[▲] B.U. & 3.00[▲] B.I.

OS: -2.50 DS, 1.00[▲] B.U. & 3.00[▲] B.I.

Combined Prism Rx

OD: -2.00 DS, 3.16[▲]@ 018 degrees

OS: -2.50 DS, 3.16[▲]@ 162 degrees

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