ABO Advanced Exam Review

NFOS presentation
Review Course Topics
ABO-AC Blueprint (Domain and Task)

Analyze & Interpret Prescription
Design, Fit & Dispense Eyewear and Other Ophthalmic Devices
Use Ophthalmic Instrumentation

- Exam Makeup
- 125 Multiple Choice Questions
  - Analyze & Interpret Prescription (38%)
  - Design, Sell, Fit & Dispense (39%)
  - Use Ophthalmic Equipment (23%)
- Three Hours to Complete
- 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.
- 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.
- Analyze and Interpret Visual Assessment

ABO Advanced Exam Review Domain 1 Part 1

- Domain 1 Tasks
- Analyze customer's/patient's prescription
- Recognize limitations of the prescription
- Assess medical abnormalities of the customer's/patient's vision
- Prescription Analysis
- Types of Astigmatism
  - Refractive Errors
  - Spherical Rx:
    - Simple Hyperopia
    - Simple Myopia

- Spherocylindrical:
  - Simple Hyperopic Astig Plano / +
  - Simple Myopic Astig Plano / -
  - Compound Hyperopic Astig + / +
  - Compound Myopic Astig - / -
  - Mixed Astigmatism + / -

- Accommodation
  - Amplitude of Accommodation
  - Age
  - Push-Up Method
  - Accommodative Facility
  - Accommodative Insufficiency
  - Flipper
  - Accomadation
    - amplitude of accommodation = is the max amt of accommodation in an eye
    - The amplitude of accommodation declines with age
    - Approx 14 diopters at age 10
    - Approx 0.50 diopters at age 60.
    - Push Up Test move 20/20 near chart until blurs
    - Accommodation
    - Accommodation in diopters is equal to the viewing distance in centimeters divided into 100.
    - The uncorrected hyperope will need to accommodate more.
    - The uncorrected myope will need less accommodation.
    - Error + Accommodation required = Total Accommodation
  - Accomadation
    - Accommodative facility is the eyes ability to focus on stimuli at various distances and in different sequences in a given period of time.
    - The patient looks at a small target while a flipper with plus and minus lenses is alternated in front of the eyes.(for example, +2.00D lenses on one side and -2.00D lenses on the other side)
    - Insufficient accommodation below age level may be caused by fatigue, stress, mTBI, systemic medications, ocular inflammation, thyroid disease or juvenile diabetes mellitus.
    - Flipper
    - Convergence
    - Near Point of Convergence (NPC)
    - Light
    - Break Point
    - Greater then 7cm abnormal
- Formulas to know
- **Focal Length**

- **Horizontal Decentration**
- **Vertical Decentration**
- **Minimum Blank Size**
- **Sagittal Formula For Thickness**
- **Sagittal Formula for Thickness Approximation**
- **Resolving Prism**
- **Resultant Prism**
- Flat Transposition
- Oblique Cylinder Power
- Prism
- Prism: Patient Problems
- Prism Measurements
- One prism diopter = Deviate light by 1 cm over 1 M
- Think triangles
- So if NOT 1 Prism Diopter?
- Prism Measurements
    - How much does a 3 Δ deviate light at:
    - 1 M
    - 2 M
    - 3 M
    - 0.5M

- Prism Measurements
- Prism Charts
- Prentice's Rule
- The prismatic effect of a lens on rays of light that pass through it at points other than it's optical center is equal to the product of the dioptric power of the lens and the distance in centimeters from the optical center to the point of passage.
        - Δ = prismatic effect
        - D = Lens BVP (in D)
        - d = distance from OC (in mm)
- Bi-Centric Grinding
- Figuring out Slab Off or Reverse Slab Off
- Find Power at 90 for both eyes
- Find "drop" (how much do the eyes move down from Dist to Near VERTICALLY)
- Use prentices rule to determine Prism induced in each eye
- Find difference, and that is amount of slab off to order at near
- Bi-Centric Grinding
- OD -4.00 -2.00 x 180
- OS -2.50 -0.50 x 180 +2.50 Add OU
    - ST 28 bifocal
        - Looking 4 mm above seg at distance
        - Looking 5 mm below seg while reading
        - Total 9mm drop

- OD: Power at 90= -6.00 Drop = 9mm prism = 5.4
- OS: Power at 90 = -3.00 Drop = 9mm prism = 2.7
- Difference = 2.7 Prism diopters…will require that much Slab off in OD to eliminate vertical imbalance
- Bi-Centric Grinding
- Slab Off
- Note…can also take DIFFERENCE in distance power at 90 between OD and OS and multiply by amount eye drops vertically and will come up with same difference (as long as ADDs are similar)
- Examples
- Make sure you understand Oblique Axes
- Power at 90 and or 180
- ANSI standards (vertical and horizontal)
- Prims (induced/decentered)
- Slab off
    - find diff in vertical meridian/90 OD vs OS
    - Find diff vertical
    - Use prentices rule to find amount of prism

- End of Part 1

ABO Advanced Exam Review Domain I Part 2

- Areas of Review
    - The Eye Exam
    - Medical History
    - Preliminary Tests
    - Refraction
    - Eye Health
    - Special Tests
    - Patient History
    - Preliminary Tests
    - Chart Abbreviations
    - Visual Acuity
    - Acuity Charts
    - With Current Rx
    - 20/20
    - Pinhole
    - +/- Recordings
    - What is 20/20?
    - Ability can distinguish two points separated by an angle of one minute of arc
        - Each letter on an acuity chart subtends a five minute angle to the eye independent of distance.
    - Visual Fields: (peripheral vision)

- Normal Monocular Visual Field:
- Normal Binocular Visual Field:
- Scotoma: Blind spot
- Testing:
  - Perimeters
  - Amsler Grids
  - Confrontation Test

- Legal Categories:
  - Ocular Motility
  - Ocular Muscle Deviations
  - Alternating Cover Test
  - Cover / Uncover Test
  - Eye Movements: Ductions & Torsions
  - Rotations around vertical axis (Z-Axis)
    - Abduction: Rotate out
    - Adduction: Rotate in
  - Rotations around horizontal axis(X-Axis)
    - Supraduction (Elevation) Rotate up
    - Infraduction (Depression) Rotate down
  - Rotations around sagittal axis (Y-Axis)
    - Intorsion: Rotates nasally from position
    - Extorsion: Rotates temporally from position

- Extraocular Muscle Innervation
  - 12 Cranial Nerves
  - Number and Name
  - Oculomotor (CN III)
  - Trochlear (CN IV)
  - Abducens (CN VI)
  - Extrinsic / Extraocular Eye Muscles:
  - Superior Rectus
  - Inferior Rectus
  - Lateral Rectus
  - Medial Rectus
  - Superior Oblique
  - Inferior Oblique

- The Retina
  - Optic Disc: Exit site of retinal nerve fibers from the eye.(Blind Spot)
  - Macula Lutea (Yellow Spot): Small, specialized central area of the retina, surrounding the fovea.
  - Fovea: Central pit in the macula that produces sharpest vision; contains a high concentration of cones and no retinal blood vessels.

- Color Vision
- Three photosensitive pigments in the cones
  - Blue - 460nm
  - Green - 525nm
  - Red - 650nm
- Color depends on:
  - Hue – Wave-length
  - Saturation - Purity of hue
  - Brightness - Light intensity
- Color Vision
- Pseudoisochromatic Plates
  - Ishihara
  - Wool Test
- Color Vision
- Congenital color defects (BORN with it)
    - occur in:
      - 8%-10% of the male population
    - 0.4% of the female population.
- Acquired Color defect (disease, dystrophy, etc)
  - sickle cell anemia, diabetes, macular degeneration, Alzheimer's disease, multiple sclerosis, glaucoma, Parkinson's disease, chronic alcoholism and leukemia
- Color Defects

- The Visual Pathway
  - Optic Nerve: Comprised of the axons of the retinal ganglion cells surrounded by pia, arachnoid, and dura sheaths.
  - Optic Chiasma: Nasal retinal fibers cross, temporal fibers do not. This enables stimulation of corresponding points of the two retinas to send simultaneous messages to the visual centers on one side of the brain
  - Optic Tract: Carries nerve impulses from the Chiasma to the Lateral Geniculate Body.
  - Lateral Geniculate Body: A relay station for nerve impulses on their way to the visual cortex.
  - Optic Radiations: Nerve fiber bundles whose cell bodies lie in the LGB. Their axons fan out and terminate at the visual cortex.
- Refraction
- Methods of Corneal Analysis
  - Types of Astigmatism: Corneal
  - Regular With The Rule Astigmatism
  - Total / Refractive Astigmatism

- Objective Refraction: Retinoscopy
  - Purpose
  - objectively determine the refractive status of the patient’s eyes.

- Retinoscopy Lens
    - With Motion
    - Against Motion
- Retinoscopy Procedures
- Patient
- Acuity Chart
- Refractor/Phoropter
- Working Distance
- Intercept
- Sphere/Cylinder
- Verifying Neutrality
- Set Up
- Position patient behind phoropter
- Look at Chart (not at light, not at any object at near, including refractionist)
- Keep distance from pt
- Shine light in eye back and forth and observe reflex
- Intercept
- Streak opposite the meridian you are neutralizing
- With Motion: Eye has too much minus power, add plus
- Against motion: Eye has too much plus power, add minus
- Light extending beyond pupil
- Aligns with reflex if no astigmatism or on axis
- Sphere/Cylinder
- Neutralize each meridian separately
- Verifying Neutrality
- Pupil fills with light when neutralized.
- To verify, move toward patient and you should see with motion.
- Move away from the patient and you should see against motion.

- Subjective Refraction: Starting Point
    - Subjective Refraction: Sequence
    - Jackson Cross Cylinder (JCC) Test
    - Purpose
    - Procedure
    - Refine Axis
        - Cyls @ 45 Degrees
    - Refine Cyl. Power
        - Cyls. @ Axis
    - Results
    - Refining The Sphere Power
    - Fogging
    - Add Minus
    - Duochrome, Bichrome or Red-Green Test
    - Results

- Binocular Balance
- Purpose
- Prism Dissociation Test
- Duochrome Test
- Medications Used During an Exam
- Cycloplegic Refraction
- Conditions
- Cornea: Keratoconus
- Corneal Scar
- Due to injury or disease.
- Nebula : Faint lack of transparency
- Macula :Translucent but well defined
- Leukoma: Dense and opaque.
- Corneal Scars: RK
- Cataract
- Retinitis Pigmentosa
- Macular Degeneration
- Diabetes and Diabetic Retinopathy
- Glaucoma
- When to Refer
- Reduced Acuity (sudden or unexplained)
- Flashes/Floaters (possible Retinal Detach)
- Pathology
    - Cornea
    - Cataract
    - Retina
    - Visual Pathway
    - Muscles

ABO Advanced Exam Review Domain II

- **Design, Fit and Dispense Eyewear and Other Ophthalmic Devices**
    - Assess patient's/customer's expectations
    - Describe methods of taking accurate facial, ocular and frame measurements.
    - Evaluate patient's complaints regarding performance of correction.
    - Apply formulae in the design of lenses.
    - Describe the advantages and disadvantages of current lens materials.
    - Solve problems associated with differences in new and previous eyewear.
    - Evaluate the customer's/patients needs and wants
    - Evaluate the parameters of the new and old eyewear
    - Design and market ophthalmic instrumentation and eyewear
    - Evaluate the results of facial, ocular and frame measurements
    - Verify the ordered eyewear in accordance with the specifications on the order form

- Evaluate the eyewear in relation to the customer's/patient's head and face
- Educate customer's on products and performance
- Apply ophthalmic professional and legal guidelines
- Establishing Direction
- Request the prescription

- Analyze the prescription
  - Date
  - Strength
  - Purpose

- Examine patient's present eyewear
  - Determine lifestyle and needs
  - Prescription Analysis
  - Lensometry
  - Refractive Error
  - Prescription Imbalance
  - Vertex Distance & Compensation
  - Prescription Use: Occupational & Rec.
  - Lens Type: Tints and Coatings
  - Initial Frame Selection
  - Select five or six frames based on patient's prescription, objectives, facial features, and color.
  - Select a variety of plastic and metal frames
  - Do not prejudge!
  - Ask patient to judge the appearance, not the fit.
  - Features and Benefits
  - Features vs Benefits:
    - Patients don't want features, they want to know how they will benefit them.
    - **A feature** is something you can touch.
      - Example: Titanium, Spring Temple, Polo Design, Silicone Nose Pad.
    - **A benefit** is how it helps the patient.
      - Example: Lightweight, fewer adjustments, save time, more fashionable, safer, sharper vision.
  - Lens Options and Additional Pairs
  - Discuss during frame selection, not at the closing.
    - Better yet, in exam chair with Doc…
  - Explain features and benefits.
  - Relate to their needs.
  - Demonstrate!
  - Include when pricing eyewear early in the frame selection process, avoid sticker shock.
  - Lens Options
  - Anti-Reflection treatment/thin film:

        - Driving/less glare
        - Appearance
        - indoor reading.
    - Polarized lenses:
        - Glare protection,
        - Driving reflected glare
        - Water sports, fishing , boating.
    - Photochromic:
        - Ocular health
        - cataracts,
        - pinguecula
        - outdoor occupations/recreation
    - Scratch coating:
        - Better vision
        - longer lens life.
    - Lens Options
    - High Index lenses:
        - Improved appearance (thinner)
        - comfort (lighter)
    - Aspheric lenses:
        - Improved appearance (thinner, less magnification)
        - better vision (less peripheral aberrations)
        - comfort (lighter)
    - Digitally Surfaced: High definition optics
        - Better Vision
        - Customized optics/PALs
    - Optical Theory
    - Metric System

- Lens Material Characteristics
    - Lens Design
        - Plus Lenses
        - Minus Lenses
        - Compound Lenses
        - Lens Power
    - Electromagnetic Radiation
    - Ultraviolet
        - UVC: 200-275 nm Ozone Layer
        - UVB: 275-330 nm Sunburn
        - UVA: 330-400 nm Ocular Hazard
    - Visible Light
        - 400-750 nm ROY G BIV
    - Infrared - Heat
        - 750-1,000,000 nm

- The Metric System
- 1 **meter = 39.37 inches**
- 1 meter = 10 decimeters
- **1 meter = 100 centimeters**
- **1 meter = 1000 millimeters**
- **1 meter = 1,000,000 micrometers/microns**
- **1 meter = 1 billion nanometers (nm)**
- Light
- Dual nature of light
    - Particles (photons)
    - Waves
    - For our purposes easiest and most clinically relevant to deal with Waves

- Light
- Light diverges from a source in waves.
-
- Light
- Light diverges from a source in waves
- Light striking a different medium is:
    - reflected
    - refracted
    - absorbed

- Lens Material Characteristics
    - When light strikes a new medium at an angle, the change in speed causes it to change direction.
        - Index of Refraction(n): higher index = slows light more = greater/more effective change in direction
        - Abbe Value: The higher the value = LESS chromatic aberration present in a lens.
            - Higher is better
        - Specific Gravity:
            - The ratio of the weight of a substance/weight of water with the same volume.
            - OR grams/cm^3
                - Higher = heavier per cm^3
                - Lower = lighter per cm^3
    - Lens Material Characteristics
    - Lens Materials

MATERIAL	INDEX	SPEC. GR.	ABBE
Crown	1.52	2.54	59
CR-39	1.498	1.32	58
Trivex	1.53	1.11	45
Thin&Lite	1.60	1.34	36

- Polycarbonate 1.59 1.20 31
- Glass (crown) 1.70 2.99 32
- Impact Resistance:
  Polycarbonate & Trivex
- Tints and Coatings
- Ultraviolet coating: Block UV light to 400nm.
- Tints: Glass - Metal oxides added for color
    - Plastic - Lenses dyed to color
- Photosensitive: UV darkens, IR lightens
- A/R coating / treatment:
    - 1/4 wave length thick (for a given wavelength)
    - material n= equal to square root of lens (magnesium fluoride)
    - Destructive interference

- Tints and Coatings
    - A/R coating: 1/4 wave length thick, material equal to square root of lens (magnesium fluoride)

- Problem Solving
  - Analysis of Vision Errors:
  - Subjective Analysis
  - Verify and Analyze the New Prescription
  - Compare to Previous Pair of Glasses and Observe
  - Check Fit of New Glasses
  - Observe Fitting Characteristics of Previous Pair
  - Vision Problems: Solutions
  - SOAP format
  - Subjective
  - Objective
  - Assessment
  - Plan
  - Vision Errors: Subjective Analysis
  - When did you receive your glasses?
  - How many hours per day have you worn your glasses?
  - Did you experience this problem with your previous glasses?
  - When does the problem occur?
  - Subjective Analysis
  - Does the problem subside or become worse as the glasses are worn?
  - Where does it occur? (Occupational or recreational setting)
  - Have you found a way to solve the problem?

- Vision: Subjective Analysis
  - Blurred vision
  - Double vision

- Perception/Discomfort
- Reflections
- Vision Problems: Solutions
- ADJUST FRAME:
- Pantoscopic tilt
- Vertex distance
- Wrap
- Vision Problems: Solutions
- CHANGE LENS FORM
- Multifocal style
- Frame size
- Base curve
- Aspherics
- 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
- 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
- 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.
        - 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!!!

- 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)

- Lens Power: Examples
    - $\frac{1}{}$
- 1D = 1M
    - $\frac{1}{}$
- 2D = .5M
    - $\frac{1}{}$
- 0 .25D = 4M

- Additional Pairs
- Sunglasses
- Safety Glasses
- Occupational / Recreational lens designs
- Different appearance for different settings.
- Convenience
- SHOEs analogy
- Measurements
  Facial and Frame
- Interpupillary Distance
    - MM Rule
    - Pupilometer
    - Electronic
    - Vertex Distance
    - Distometer
    - Electronic
- Pantoscopic Tilt
    - Manual
    - Electronic
    - Wrap
    - Manual
    - Electronic
- Millimeter Rule
- Pupilometer
- Electronic

- Optical Center Placement
    - Optical Center: Those points on the front and back surface of a lens where the curves are parallel

- Optical Axis: A line which connects those two points.
- Horizontal placement determined by monocular P.D.
- Vertical effects prism and aberrations
- Martins Lens Tilt Formula

- VERTEX COMPENSATION
  - Vertex Compensation
  - Closer? Farther?
  - Plus Lenses? Minus Lenses?
  - (CAP)
  - Closer Add Plus
  - (FAM)
  - Further Add Minus
  - 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
  - VERTEX COMPENSATION
  - VERTEX COMPENSATION
  - Fitting Single Vision Aspherics:
  - Pre-adjust the frame.
  - Dot centers of pupils, measure height and subtract 1mm for every 2 degrees of tilt or tilt head until pantoscopic tilt is eliminated before dotting pupils.
  - Use pupilometer for mono P.D.
  - Fitting Aspheric Lenses: O.C. Height
  - Fitting Aspheric Lenses: O.C. Height
  - Fitting Aspheric Lenses: P.D. Measurements

- Analysis of Spectacle Errors:
  - Comfort
    - Nose, Ears
    - Glasses Slip, Touch Cheeks, Lashes
  - Repair
  - Vision
  - Comfort Errors
  - Frame Selection
  - Lens Selection
  - Adjustment
  - Analysis of Systems and Processes
  - Identify Possible Underlying Systemic Factors (Enablers)
  - Potential Improvements
  - Repairs
  - Patient History
    - Occupational Factors
    - Recreational Factors

- Frame Selection
- Lens Selection
    - Impact Resistance
- Laboratory Work
- Dispensing Instructions
- Vision
- Exam
- Prescription
- Prescription Interpretation
- Frame Selection
- Lens Selection
- Facial Measurements
- Laboratory Work
- Verification
- Adjustments
- Dispensing Instructions
- Adaptation
- Follow Up Care

- Prism
    - Measurement
    - Patient Problems
        - Base Down
        - Base Up
        - Base In or Out
    - Decentration
    - Slab Off
    - Image Jump
    - SINGLE VISION DISPLACEMENT
    - Vertical Prism (Imbalance)
    - Determine the power in the vertical meridian.
    - Determine the power difference between each lens.
    - Determine prism at the reading level (usually 10mm) ^ = P x dcm
    - If the imbalance is greater than 1.50^ consider slab off, base up least plus or highest minus. Reverse for reverse slab.
    - Base Direction - Minus Lens
    - Base Directions - Plus Lens
    - Vertical Imbalance
    - Opposite Prisms Compound
    - Similar Prisms Cancel

- Methods of Correcting Vertical Imbalance
    - Contact Lenses
    - Two Pairs of Glasses

- Adjusting the MRP or Seg Height
- Fresnel Press-On Prism
- Dissimilar Segs
- Compensated “R” Segs
- Slab-Off

- Slab-Off Verification
  - Place lens clock contact points parallel to the slab line on the distance portion and note reading.
  - Place lens clock with one point on the distance portion, one on slab line, and one on lower prism portion.
  - Difference in readings indicates the amount of slab-off prism.
  - Evaluating the Need for Correction
  - Age
  - Amount of Imbalance
  - Cause of Imbalance - Onset
  - Reading Position
  - Case Study # 1
  - 30 year old female six months after refractive surgery.
  - O.D. +3.00 -0.50 x 135 O.S. +2.00 -1.00 x 30

    SPH +3.00 SPH +2.00
    50% CYL -0.25 75% CYL -0.75
    Total +2.75 Total +1.25

    Optical Difference = 1.50
    Reading Level = 10mm
    Vertical Imbalance = P x dcm or 1.50^
  - Case Study # 2
  - 45 year old male with an add power prescription for the first time.
  - O.D. -3.00 -2.00 x 180 O.S. -2.00 -1.00 x 120
  - ADD: +1.25 O.U.

    SPH -3.00 SPH -2.00
    +100% CYL -2.00 + 25% CYL -0.25
    Total -5.00 Total -2.25

    Difference @90 = 2.75
    Reading Level = 10mm
    Vertical Imbalance = 2.75Δ

ABO Advanced Exam Review Domain III

- Explain the use of ophthalmic instrumentation
- Analyze the utilization of dispensing information
- Determine method of fabrication and ordering

- Distinguish the uses of visual assessment instrumentation
- Apply knowledge of legal and professional requirements for equipment maintenance

- ANSI Standards
  - ANSI Z80.1 Prescription Ophthalmic Lenses
  - ANSI Z87.1 Occupational & Safety Eyewear
  - Note on ANSI…generally viewed as "voluntary" standards….However,
    - ANSI Z80 may be a STATE requirement for Opticians
    - ANSI Z87 Adopted by OSHA, so is FEDERAL REQUIREMENT.

- Laws Governing Opticianry
  - Remember that our "RULES" that we have to follow are broken into :
  - **Laws** (passed by lawmakers and signed off on by an executive)
  - **Regulations** (rules and guidelines written to enforce or clarify laws, generally by a specific officer or department, and have the SAME legal standing, and can be enforced, just like "laws")
  - Laws Governing Opticianry
  - And these Laws and Regulations can be passed by:
  - Federal Gov
  - State Gov
  - Local Gov
  - Laws Governing Opticianry
  - **Federal Laws**
  - **Federal Regulations**
  - **State Laws**
  - **State Regulations**
  - **Local Laws and regulation (less applicable normally)**
  - Example of FEDERAL LAW
    - Fairness to Contact Lens Consumer Act
      - Must release CL Rx
      - Online can sell, but must verify (1 business day and is filled)
      - ENFORCED by FEDERAL TRADE COMMITTEE (FTC)
  - Example of FEDERAL REGULATION
    - FTC
      - EYEGLASS RULE
        - ODs and OMDs must give copy of Rx at conclusion of exam, even if not asked for
        - https://www.ftc.gov/business-guidance/resources/complying-eyeglass-rule
    - FDA (food and Drug Agency)
      - Impact resistance standards 1971

- Batch testing of plastic/resin lenses, individual drop ball testing of Glass Lenses

- OSHA (occupational Safety and Health Administration)
  - Require Eye and Face Protection on worksites when required
    - ADOPTED ANSI Z87 for these purposes

- Example of State Laws
  - ALL states have laws and regulations on Optometrists, Dentists, Medical Doctors, nurses, Etc
  - Some states have laws and regulations (ex licensing requirements) for Opticians
    - CT for example adopted ANSI as a STATE law for Opticians
  - Other professional Requirements
  - In addition to
    - Federal Laws (FCLCA, Federal Law)
    - Federal Regulations (FTC eyeglass rule, FDA impact, OSHA)
    - State laws if indicated
    - There are also OTHER requirements:
  - Other professional Requirements
  - It is the against the law to sell any lens other than polycarbonate or trivex lenses for children or monocular patients?
  - TRUE or FALSE
  - Other professional Requirements
  - Actually there is generally no "law" (as far as I am aware).
  - There IS, however, a legal concept called **"duty to warn"**
  - in CIVIL cases, a professional can be held liable for injuries caused to another, if the practitioner had the opportunity to warn the patient of a hazard and failed to do so.
  - **Duty to Warn**
  - Optician has a duty to investigate what a patients needs are and to recommend the appropriate lens or lenses.
  - IN absence of documentation, the practitioner can be held liable AND potentially revocation or action against license
  - Many companies, concerned about liability, especially in minors, will set company policies to mandate using ONLY impact resistant lenses for minors, both to satisfy this "duty to warn" and to mitigate any potential liability (prevent lawsuits from injured patient, especially a child)
  -
  - Back to ANSI
  - Recall that OSHA controls workplace safety (Eye and Face protection)
  - Simply ADOPTED the "voluntary" ANSI Z87 standards to simplify process
  - ANSI Z87

Basic Impact vs High Impact

- ANSI Z87
- Basic Impact — High Impact
- Z-87 markings — Z-87-2 markings (all now)
- 3.0 mm min CT — 2.0 mm min for HI mat
- poly/trivex/tribri
- 3.0 mm for all others
- CR-39, etc

- ANSI Z87
  - Lens Markings:
  - Upper temp corner includes:
  - Manufacturer's initials
  - "+" if Hi Impact Material (Poly, etc)
  - Add'l
    - V for Variable
    - S for Special Purpose
    - etc
- ANSI Z87+
  - 1/4" Steel Ball at 150 Feet/Second
  - Lens Thickness: 2.0mm.
  - Lens Markings: Sandblasted manufacturer's I.D. and "+"
  - All Frames, Basic or High Impact must meet High Impact Standards
  - Frame Markings: Front - A, DBL, Z87-2 or Z87-2+, Manufacturer's I.D. Temples - Length, Z87-2 or Z87-2+, , Manufacturer's I.D. On one temple
  - OSHA: Occupational Safety and Health Administration
  - Federal agency charged with regulating safety practices in the work place and in educational settings.
  - OSHA has adopted the Z-87.1 standards making them a federal requirement.
  - FDA: Food and Drug Administration
  - Began mandating impact resistance of ophthalmic lenses in 1971.
  - Plastic and others can be "batch" Tested
  - Glass ALL have to be
    - Tempered:
      - Either Heat or Chemically
    - Drop Ball Tested
      - FDA: Food and Drug Administration
  - Glass Drop Ball Test:
  - Lenses must be capable of passing Drop-Ball Test:
    - 5/8"steel ball,
    - .56oz,
    - Height of 50 inches
    - Safety Glass, 3.0 = 1.0" steel ball
    - Records must be keep three years after purchase.
      - FDA: Food and Drug Administration
  - Glass drop ball exceptions:

        - Prism Segment Multifocal
        - Slab Off
        - Lenticular Cataract,
        - Iseikonic
        - Depressed segment one-piece multifocal
        - Biconcave
        - Myodisc and minus lenticular
        - Custom laminate
        - Cemented assembly lenses
    - FTC: Federal Trade Commission
    - Established to prevent unfair business practices.
    - Eyeglasses I and Eyeglasses II investigational studies.
    - Doctor must give the patient a copy of their prescription immediately after the exam.

- **The Art and Science of Eyewear Fabrication**
    - Apply formulae used in the manufacture of eyewear.
    - Describe the capabilities and limitations of conventional and digital surfacing.
    - Explain the lens blank selection process.
    - Describe factors that affect lens curves and thickness.
    - List the steps from surface layout to finished lens edging.
    - Apply verification standards in compliance with ANSI and federal regulations.
    - Lens Fabrication
    - Lens Designs
    - Prescription to Lens Blank
    - Material
    - Minimum Blank Size
    - Vertex Power Compensation
    - Resultant Prism
    - Nominal Power
    - Sagittal Depth Formula
    - Thick Lens Back Vertex Power
    - History of Spherical Lens Design
    - Biconvex
    - Biconcave
    - Plano Convex
    - Plano Concave
    - **Meniscus**

- Aberrations
    - Abbe Value
    - Index of Refraction and Abbe Value
    - Aberrations
    - Achromatic Aberrations

- 5 seidel aberrations
    - Spherical Aberration
    - Coma
    - Marginal/Oblique Astigmatism
    - Curvature of Field
    - Distortion
- Achromatic Aberrations
- 5 seidel aberrations
    - Spherical Aberration
        - Not generally a big deal due to pupil size
    - Distortion
- Pincushion Barrel
- Plus lenses minus lenses
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- Base Curves
    - ***Flatter Base Curves***
    - Less Magnification
    - Thinner lenses
    - ***Steeper Base Curves***
    - More Magnification
    - Thicker lenses
- Corrective Curve or "Best Form" Lens Theory
    - Tscherning Ellipse
        - Best Base Curve to eliminate **Marginal** or **Oblique Astigmatism**
    - 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.
    - Tscherning Ellipse: Oswalt Branch
    - The least curved portion is called the Oswalt Branch.
    - Tscherning Ellipse: Wollaston Branch
    - The most curved portion of the ellipse is called the Wollaston Branch.
        - 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
    - Aspheric Curves
    - Instead of a single radius of curvature (same curve throughout surface of the lens), changes towards periphery of lens
    - Aspheric Curves: Three main uses

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

- Aspheric vs Best Form Lenses
    - Aspheric Advantages:
    - 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.
    - Manufacturing
    - Prescription to Lens Blank
    - Material
    - Minimum Blank Size
    - Vertex Power Compensation
    - Resultant Prism
    - Nominal Power
    - Sagittal Depth Formula
    - Specular Magnification
    - Boxing System
- Nominal Power Formula (Thin Lens)
    - F_T = The effective, vertex or lensometer power of the lens in diopters
    - F_1 = The power of the front curve (BC) in diopters
    - F_2 = The power of the back surface power in diopters
    - Example:
    - Front surface (BC) = +6.00D
    - Back Surface = -4.00D
    - Nominal Power = +6.00 + (-4.00) = +2.00D
- Sagittal Depth Formula (Lens Thickness)
    - Sagittal Depth Formula Example
    - Thickness = $\frac{\text{Radius}^2 \times \text{Power}}{2000\ (n - 1)}$
    - N = Index of refraction of lens material used
    - Thickness is mm

        - Step # 1 Decentration x 2 + ED
    - Step # 2 Radius = ½ of amount in Step # 1
    - Step # 3 Calculate thickness using formula
    - Step # 4 Add minimum thickness to answer (1.5 to 2.0mm)
- Sagittal Depth Formula (Lens Thickness)Example
    - Rx = -5.00 A= 54 DBL = 20 Frame GCD = 74 ED = 62mm
    - Mono P.D. O.D. = 30mm Material = CR-39 Index 1.49
    - Thickness = Radius2 x Power
    - 2000 (N – 1)
    - Step # 1 54 + 20 = 74/2 = 37- 30 = 7 x 2 + 62 = 76mm
    - Step # 2 Radius = ½ of amount in Step # 1 = 38mm
    - Step # 3 Calculate thickness using formula
    - Thickness = 382 x -5.00 = 1444 x 5 = 7220 = 7.36mm
    - 2000 (1.49 – 1) 2000 x .49 980
    - Step # 4 Add minimum thickness to answer (1.5 to 2.0mm)
- Specular Magnification

- **Fabrication And Verification**
    - Surfacing Choices
        - Conventional Surfacing
        - Digital Surfacing
        - Conventional Surfacing
            - Spherical, Toric
            - Calculations
            - Layout
            - Blocking
            - Generating
            - Fining
            - Polishing
            - A Basic Surfacing Lab
                - Layout Computer
                - Marker
                - Surface Tape
                - Blocker
                - Generator
                - Cylinder Machine
                - Laps
                - Lens Inventory
            - Calculations
            - Frame Measurements
                - MM Rule
                - “C” Gauge
            - Frame Tracing Unit

- Software
- Data Input : Tracer
  - One or Two Eyes
  - Number of Points
- Software
- Display
- Tracing Points
  - A database of frame information and trace files that allow optical laboratories to select a lens blank and begin surfacing without having the actual frames
- Inventory
- Lens Materials
- Lens Coatings
- Lens Tints
- Blank Sizes
- Prescription Range
- Sag Gauge
- Data Input
- Layout
- Blocking
- Tape
- Alloy ,Wax or Thermoplastic
- Generator
- Fining and Polishing
- Basic Surfacing Lab
- Automated Surfacing Lab
- Surfacing
- In conventional surfacing, a generator grinds away plastic on back of lens creating rough surface
- Final Rx on back surface is produced by rubbing against an aluminum tool and pad in fining and polishing steps
- Surfacing
- Grinding Curve Questions:
- IF you have a -3.00 -2.00 x 180
- Given a lens with a +3.00 Base Curve
- Transpose Rx:
- What are Grinding Curves
- What is Power at 180?
- What is power at 90
- Type of Astigmatism
- Orientation of Astigmatism
- Digital Surfacing or Free Form Machining
- A natural diamond cutting tool produces a very smooth surface that requires only light polishing to create transparency

        - Digital Surfacing or Free Form Machining
            - Each lens may require over 10 million calculations to generate the data file for the free forming machine to create the lens' surface
            - The computer lens design is exact. Several companies use the same machinery. It is each company'ss computer program that determines the end product
    - Schneider HSC 100
    - Free Form Machining
    - Create the Following Curves on the back of lens
        - Spherical
        - Aspheric
        - Atoric
        - Progressive
        - Other?
            - Slab off
            - Round/blended on back side
            - etc
    - 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

- Rx Wrap Sunglasses
    - Oakley
    - Costa Del Mar
    - Maui Jim
    - Bolle'
    - By increasing WRAP, will INCREASE Base OUT prism
    - To counter, will have to ADD BI to counteract
    - Will also change Sphere Power and change Cylinder Power
    - Correction for Wrap Rx Lenses
- Finishing Lab
    - Lens Layout
    - Blocking
    - Tracing (prev used Patterns)
    - Edging
    - Grooving (semi rimless)
    - Drilling (rimless)
    - Polishing/Tinting (optional)
- Inspection & Verification
    - Auto Lensmeter
    - Lens Verification

        - Focus the Eyepiece
        - Check distance prescription with convex surface facing operator and concave against the lens stop.
        - Always start with the lens with the most power in the vertical meridian
        - Prism: The target is always displaced in the direction of the base.
        - Check add power with the concave surface facing the operator.
- Lens Verification
        - Prism: The target is always displaced in the direction of the base.
        - Very important
        - Verifying Prism
        - Target Displaced in Direction of Base
        - Auxiliary Prisms over 5.00 Prism Diopters
        - If you are given a +5.00 and center the lens in the Lensometer (at the Optical center).
        - Assume this is an OD
        - NOW MOVE THE LENS IN 4 mm.
        - What is the prism?
        - Where are the mires found in the lensometer?
- Verification: Progressives
        - Remark Lenses
        - Identifying the Lens
        - Locate all markings
        - The Vision Council Electronic Progressive Lens Identifier
        - Shows picture of each type of progressive lens with all hidden markings.
        - Verification: Progressives
        - Locate laser-engraved circles and add power.
        - Confirm monocular Pd. and fitting height
        - Check distance power
        - Check prism at O.C./P.R.P., unless prescribed, prism should be equal in each lens(Prism used for thinning should equal 2/3 the add power)
        - Verification: Progressives
        - Check Distance RX through Distance Verification Circle
- Verification: Progressive Add Power
        - For Front Surface PAL, Verify with CX Surface against Lens Stop.
        - For Back Surface PAL, Verify with CC Surface against Lens Stop.
        - Verification: Progressives
        - Monocular P.D.
        - Fitting Height