Basic Optometric Math

Lynn Lawrence, CPOT, ABOC, COA, OSC

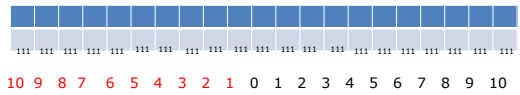
Continuing Ed Opportunity

- **Online Continuing Education Program**
  Continuing education (CE) allows the Paraoptometric to stay current within the eye care field and is especially important in the study of direct patient care and office competency. Additionally, certified paraoptometrics must obtain 18 hours of CE credit from approved education providers to maintain certification designation. The Pararoptometric Section (PS) provides FREE 6 articles each year (one every other month) for PS members that are worth one hour of CE. You read the article, successfully answer the exam questions, and you will receive your CE slips by mail.
- The following articles were designed to cover a broad scope of patient issues ranging from patient care, disease treatment, to ophthalmic dispensing. Participants should review each article and complete the accompanying continuing education examination. Each accurately completed examination is worth one hour of paraoptometric continuing education credit. The corresponding CE exams expire December 31, 2008. **Please allow four to six weeks to receive proof of CE**.

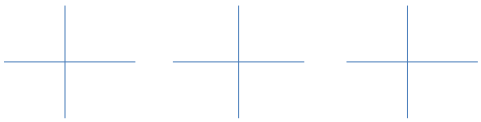
Objectives

- Optical Cross
  - Put on the cross
  - Take off the cross
- Transposition
  - Plus cylinder
  - Minus cylinder
- Spherical Equivalent
- Convert to near and intermediate Rx
- Decentration

Create a number line



Insert 3 hash marks between every number



Determining cylinder power

- Two questions should be asked to determine the cylinder power:
- 1. In what direction on the number line is travel occurring (on the number line) from the sphere to the cylinder (either in the negative direction or in the positive direction)?
- 2. What is the distance traveled from the sphere to the cylinder power (the amount of cylinder present in the prescription)?

Answers on presentation

- Some of the answers in this presentation are intentionally incorrect, so be prepared to defend your answers…

Prescriptions: Optical Cross

- **Optical cross is a diagram that denotes the dioptric power in the two principal meridians of a lens.**

Hint: Think of the value of the numbers as they are read off of the lensmeter wheel.

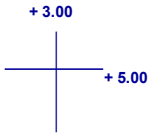
Optical Cross Steps

- Step 1 draw a number line - +

  3 2 1 0 1 2 3
- Step 2 read the question (plus or minus cylinder)
- Start in the direction of the less power…document it
- Document the axis of this power
- Calculate the distance traveled from set number to termination

Prescriptions: Optical Cross

- **Optical Cross Example**



Plus cylinder notation:

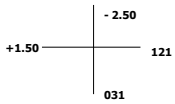
+3.00 +2.00 x 090

Minus cylinder notation:

+5.00 -2.00 x 180

Hint: The sphere is "married" to the axis; the cylinder is the distance between the numbers on the cross

Optical Cross



- To take an RX off the Optical Cross in **Minus Cylinder Form**:
- Step 1 Start with the most plus sphere power (use your number line)
- Step 2 Your axis is "married" to your sphere
- Step 3 Your cylinder is the distance traveled between the sphere and number 90 degrees away

Find the answers to the above equations

Take off the Cross

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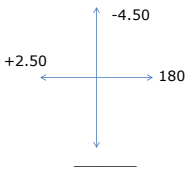
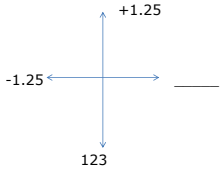
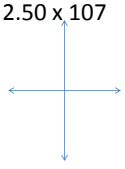
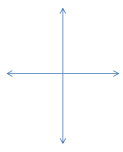




Put on the Cross

- -2.00 -1.00 x 080 -3.00 –
  2.50 x 107

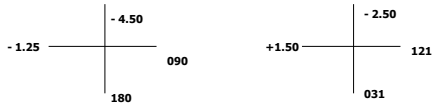




Axis Alignment

- Note: Optical meridians (axis) can only lie between 0 and 180 degrees.
- Example: The following prescription will be placed on the cross: -2.00 -1.50 X 180

1 Minute Optical Cross



- To take an RX off the Optical Cross in **Minus Cylinder Form**:
- Step 1 Start with the most plus sphere power (use your number line)
- Step 2 Your axis is "married" to your sphere
- Step 3 Your cylinder is the distance traveled between the sphere and number 90 degrees away

Find the answers to the above equations, you 1 minute

Prescriptions: Transposition

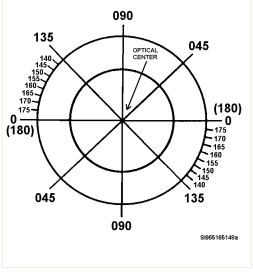
- **Transposition**
  - Step 1 = Combine the sphere and cylinder power mathematically
  - Step 2 = Change the sign of the cylinder
  - Step 3 = Change the axis by 90 degrees

Hint: When combining positive and negative numbers, think in terms of money. Example: -2.00 combined with +0.50 If you are $2.00 "in the hole" and you deposit $0.50, what is your balance?

Answer: $1.50 "in the hole", or -1.50.

Components of an Optical Prescription

- Axis
  - The number in the axis block indicates where the sphere meridian is located on a 180° circle



Prescriptions: Transposition

- -1.00 +2.00 X 160
- +1.25 -0.75 x 030
- Plano +1.00 x 090
- +1.00 -2.00 x 070
- +0.50 +0.75 x 120
- +1.00 -1.00 x 180

Transposition Examples

Transposition 1 Minute Drill

- Step 1 = Combine the sphere and cylinder power mathematically
- Step 2 = Change the sign of the cylinder
- Step 3 = Change the axis by 90 degrees

- 1. + 1.75 – 0.75 X 030
- 2. – 2.25 + 1.00 X 170
- 3. – 1.75 + 2.00 X 125

Spherical Equivalent

-Step 1
Take half the cylinder and add algebraically to sphere
- Step 2
Drop the cylinder and axis and write sphere only

EX. -2.00 -0.50 X 145
(half the cylinder) -0.25
(add to sphere) 0.25 + 2.00
Answer:
-2.25 Sph

Spherical Equivalent 1 Minute drill

-Step 1
Take half the cylinder and add algebraically to sphere
- Step 2
Drop the cylinder and axis and write sphere only

1. – 2.25 – 1.00 X 120
2. + 1.00 – 2.00 X 090
3. + 0.75 – 1.50 X 150 ☺

Convert to NV Only Rx

- Step 1
- Take the add power and algebraically add it the sphere power of the Rx
- Rewrite the Rx with out any add power

-2.50 – 1.25 x 125
- 1.50 – 1.00 x 095
Add +2.50

Convert to IV + NV Rx

- Step 1
- Take the ½ the add power and algebraically add it the sphere power of the Rx
- Rewrite the Rx with ½ the add power remaining in Rx (used for reading)

* Used with computers or intermediate work

-2.50 – 1.25 x 125
- 1.50 – 1.00 x 095
Add +2.50

Convert to SVN or Near Rx only 1 min drill

- + 3.25 – 0.75 X 125
- + 1.75 – 1.00 X 090
  - Add 2.50
- - 4.50 – 1.50 X 035
- - 1.75 – 1.00 X 150
  - Add 2.00

- Step 1
  - Add the add power to the sphere power and write it as the new sphere power
- Step 2
  - Write the new complete Rx Sph, Cyl, and Axis

Review Questions 3 minutes

- -1.00 -1.00 x 090 transpose
  Answer_____
- - 0.50 -2.00 x 008 transpose
  Answer_____
- -1.00 -1.50 x 160 transpose
  Answer_____
- - 5.00 -3.00 x 088 transpose
  Answer_____
- -3.00 -1.50 x 095 transpose
  Answer_____

- - 2.50 + 1.50 x 103 transpose
  Answer_____
- -1.00 + 0.50 x 162 transpose
  Answer_____
- + 2.50 + 2.50 x 103 transpose
  Answer_____
- -2.50 + 1.00 x 029 transpose
  Answer_____

Review Questions 1 minute drill

- Put the following Rx on the Optical Cross

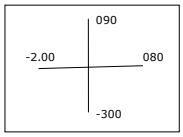
-2.00 -1.00 x 080

-3.00 – 2.50 x 107

Review Questions

- Put the following Rx on the Optical Cross

-2.00 -1.00 x 080



-3.00 – 2.50 x 107

Review Questions 90 Seconds

- Give the spherical equivalent to the following prescripts

-2.00 -1.00 x 080 Answer _____
-1.00 -2.00 x 010 Answer _____
+2.00 -1.00 x030 Answer _____
-3.00 – 0.50 x 070 Answer _____
+3.00- 1.00 x 060 Answer _____

Review Questions

- Convert the following Rx to **Near Vision Only** aka NVO, SVN, reading glasses

- -2.00 -1.00 x 080
- -1.50 -2.00 x 180
- +3.00 OU
- Answer _____
- _____
- -1.00 – 0.50 x 010
- -2.00 -0.75 x 100
- +1.25 OU
- Answer_____
- _____
-

- -4.00 -0.25 x 090
- -1.00 -0.50 x 098
- +2.00 OU
- Answer _____
- _____
- +2.50 -1.00 x 090
- +1.00 -0.75 x 180
- +2.25 OU
- Answer _____
- _____

Review Questions 1 minute drill

- Transpose the following Rx from ***plus cylinder form to minus cylinder*** form

- -2.00 +1.00 x 090
- Answer _____
- -1.00 +3.00 x 070
- Answer _____
-
  -1.00 +1.50 x 010
- Answer_____
- - 0.50 +2.00 x 145
- Answer_____
- -3.00 +2.00 x 095
- Answer_____

Review Questions 1 minute drill

- Convert the following prescription from ***minus cylinder to plus cylinder*** format
- -1.00 -1.00 x 090
  Answer_____
- - 0.50 -2.00 x 008
  Answer_____

  -1.00 -1.50 x 160
  Answer_____
- - 5.00 -3.00 x 088
  Answer_____

  -3.00 -1.50 x 095
- Answer_____

Prescriptions: Decentration

- **Decentration calculations**
  - Eye size *plus* distance between lenses *minus* patient's PD *divided* by 2.
  - Example: 52-20-145 pt PD 62
  - 52+ 20 – 62 = 10 / 2 = 5

Remember the measurements are in mm

Decentration 1 minute drill

- **Decentration calculations**
  - Eye size *plus* distance between lenses *minus* patient's PD *divided* by 2.
  - 1. 48 – 22 – 145 pt/pd 64
  - 2. 52 – 22 – 145 pt/pd 66
  - 3. 58 – 20 – 140 pt/pd 67

Remember the measurements are in mm

Conversion

- **Feet to meters**
  - **Multiply the denominator by .3**
- **Meters to feet**
  - **Divide the denominator by 3**
  - **Add a zero**

One meter = 39.37 inches … one inch is equal to 25.4

Optometric Math

- MULTIPLICATION AND DIVISION OF LIKE AND UNLIKE SIGNS
- When Multiplying or dividing two numbers with like signs i.e., both plus (+) or both (-) the answer will always be a plus (+) sign. This means that if you multiply or divide two plus (+) numbers you will get a plus (+) answer and if you multiply or divide two minus numbers you will get a plus (+) answer

Optometric Math

- MULTIPLICATION AND DIVISION OF DECIMALS

A decimal number is just a whole number and a fraction written together in decimal form. Any multiplication or division by 10, 100, 1000, etc. simply moves the decimal place to the left or right. For example, multiplying a decimal by 10 would move the decimal point 1 place to the right

7.75 x 10 = 77.5

Optometric Math

- MULTIPLICATION OF DECIMALS. Decimals are multiplied exactly like whole numbers and then the decimal point is added. For example, you would multiply 25 x 25 in this way:
- DIVISION OF DECIMALS. Divisions may be written in the form
- a = c c
- b or a/b = c or b/a where "a" is the DIVIDEND, "b" is the DIVISOR, and "c" is the QUOTIENT. As with multiplication, you divide decimals exactly like you do whole numbers and then you find the decimal place. For example: dividing 126 by 6 gives 21 as an answer.

Optometric Math

- METRIC SYSTEM
- The metric system is based on decimals. Changing from one unit to another requires only the movement of the decimal place. The table below shows the meter, which is the standard unit of length, and the parts of a meter that we will be concerned with in Optometry. It also shows the standard abbreviations and the number of units in a meter.
- 1 meter (m) = 1 meter
- 10 decimeters (dm) = 1 meter
- 100 centimeters (cm) = 1 meter
- 1000 millimeters (mm) = 1 meter

Optometric Math

- Dealing with the problem of how many places to move the decimal is relatively easy. Note in the table above that there is a difference of 2 zeros between centimeters and meters, 3 zeros between millimeters and meters, and 1 zero between millimeters and centimeters. This means that when converting between:

a. Meters and centimeters move the decimal 2 places.
b. Meters and millimeters move the decimal 3 places.
c. Centimeters and millimeters move the decimal 1 place

Converting inches into meters

- If you need a length, in inches, converted to centimeters or millimeters, first convert the inches to meters (divide by 40) then convert to the desired unit by moving the decimal place. Conversely, if you wish to convert from cm or mm to inches, then first convert to meters by moving the decimal and multiply by 40 to convert the meters to inches.

Optometric Math

- Deciding on which direction (right or left) to move the decimal requires thinking about whether you should have more or less of the unit that you desire. For example, if you are given a length in meters and require the length in centimeters, then you must have more centimeters than you had meters because each centimeter is smaller than each meter. This means that you would move the decimal 2 places TO THE RIGHT. Conversely if you were converting from centimeters to meters, you have to move the decimal place to the left 2 places. A meter is much larger unit of length than a centimeter, thus you would have to have fewer meters than you had centimeters. All of the possible metric conversions you will have to make are listed on the next page: Memorize them; if necessary

Remember Metric

When Converting	Move Decimal
mm to cm	2 places right
cm to mm	1 place right
m to mm	3 places right
mm to m	3 places left
mm to cm	1 place left
cm to m	2 places left

Practice converting

1. 42 m _____cm
2. 500 mm _____m
3. 80 cm _____mm
4. 0.025 cm _____mm
5. 200 mm _____in
6. 20 cm _____m
7. 25 cm _____m
8. 0.47 m _____mm
9. 10 cm _____in
10. 150 m _____cm

Optometric Math

- ALGEBRAIC ADDITION
- Algebraic addition is simply combining two or more numbers together. If you always think of algebraic addition in terms of dollars and cents you probably won't make any mistakes. It's really amazing that people who are terrible in math always seem to know their bank balance or how much change they should get back from a purchase. Throughout this section the examples will be explained mathematically and where possible, monetarily

Math Rules

- These two rules may be compiled into a table that should be memorized.

- + x + = +
- - x - = +
- + ÷ + = +
- - x + = -
- - ÷ + = -
- - ÷ - = +

martralyn@msn.com

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Thank you very much