

Basic Optometric Math

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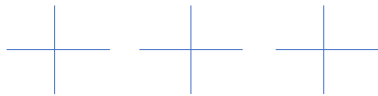
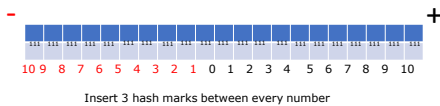
Objectives

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



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Create a number line



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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)?

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Answers on presentation

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



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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.

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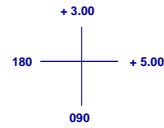
Optical Cross Steps

- Step 1 draw a number line $- \frac{\quad}{3 \ 2 \ 1 \ 0 \ 1 \ 2 \ 3} +$
- 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

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Prescriptions: Optical Cross

• Optical Cross Example



Plus cylinder notation:

$$+3.00 +2.00 \times 090$$

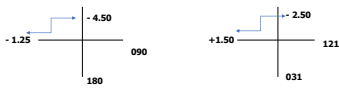
Minus cylinder notation:

$$+5.00 -2.00 \times 180$$

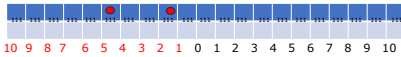
Hint: The sphere is "married" to the axis; the cylinder is the distance between the numbers on the cross

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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



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Optical Cross



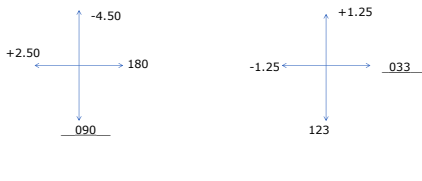
- To take an RX off the Optical Cross in **Minus Cylinder Form:**
- Step 1 Start with the most plus sphere power (use your number line)
- Step 2 Your axis is "married" to your sphere
- Step 3 Your cylinder is the distance traveled between the sphere and number 90 degrees away

Find the answers to the above equations

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Take off the Cross Plus and Minus*

•



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Put on the Cross

$$-2.00 -1.00 \times 080$$

$$-3.00 -2.50 \times 107$$



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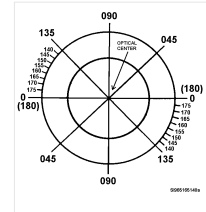
Axis Alignment

- 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
- What is wrong with this SRx: **+2.25 + 1.50 x 210**

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Components of an Optical Prescription

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



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1 Minute Optical Cross in minus



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

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1 Minute Optical Cross in plus



To take an RX off the Optical Cross in **Plus 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

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Prescriptions: Transposition

- **Transposition -1.50 – 2.00 x 030**
 - 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.

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Prescriptions: Transposition

- **Transposition -3.50 + 2.00 x 120**
 - 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.

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Prescriptions: Transposition

• **Transposition + 3.50 – 2.50 x 030**

- 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.

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Prescriptions: Transposition

- $-1.00 + 2.00 \times 160$

- $+1.25 - 0.75 \times 030$

- Plano $+1.00 \times 090$

Transposition Examples

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Prescriptions: Transposition

- $-1.00 + 2.00 \times 160$

- $+1.00 - 2.00 \times 070$

- $+1.25 - 0.75 \times 030$

- $+0.50 + 0.75 \times 120$

- Plano $+1.00 \times 090$

- $+1.00 - 1.00 \times 180$

Transposition Examples

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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. $+ 1.75 - 0.75 \times 030$

- 2. $- 2.25 + 1.00 \times 170$

- 3. $- 1.75 + 2.00 \times 125$ ☺

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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. $-2.00 - 0.50 \times 145$

(half the cylinder) = -0.25

(add to sphere) $0.25 + 2.00$

Answer:

-2.25 Sph

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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. $- 2.25 - 1.00 \times 120$

2. $+ 1.00 - 2.00 \times 090$

3. $+ 0.75 - 1.50 \times 150$ ☺

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Convert to NV Only Rx

- Step 1
- Take the add power and algebraically add it the sphere power of the Rx
 - 2.50 – 1.25 x 125
 - 1.50 – 1.00 x 095
 - Add +2.50
- Rewrite the Rx with out any add power

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Convert to IV + NV Rx

- Step 1
- Take the ½ the add power and algebraically add it the sphere power of the Rx
 - 2.50 – 1.25 x 125
 - 1.50 – 1.00 x 095
 - Add +2.50
- Rewrite the Rx with ½ the add power remaining in add for the Rx (used for reading)
- * Used with computers or intermediate work

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Convert to IN + 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

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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 _____

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Review Questions 3 minutes

- -1.00 -1.00 x 090 transpose
Answer -2.00 +1.00 x 180
- -0.50 -2.00 x 008 transpose
Answer -2.50 +2.00 x 098
- -1.00 -1.50 x 160 transpose
Answer -2.50 +1.50 x 070
- -5.00 -3.00 x 088 transpose
Answer -8.00 +3.00 x 178
- -3.00 -1.50 x 095 transpose
Answer -4.50 + 1.50 x 185
- -2.50 + 1.50 x 103 transpose
Answer -0.75 -1.50 x 013
- -1.00 + 0.50 x 162 transpose
Answer +0.50 -0.50 x 072
- + 2.50 + 2.50 x 103 transpose
Answer +5.00 -2.50 x 013
- -2.50 + 1.00 x 029 transpose
Answer -1.50 -1.00 x 119

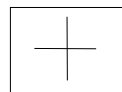
One is incorrect on each side

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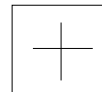
Review Questions 1 minute drill

- Put the following Rx on the Optical Cross

-2.00 -1.00 x 080



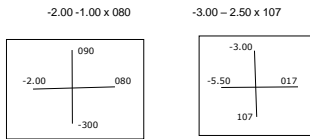
-3.00 – 2.50 x 107



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Review Questions

- Put the following Rx on the Optical Cross



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Review Questions 90 Seconds

- Give the spherical equivalent to the following prescriptions

-2.00 -1.00 x 080
 -1.00 -2.00 x 010
 +2.00 -1.00 x 030
 -3.00 -0.50 x 070
 +3.00 -1.00 x 060

Answer _____
 Answer _____
 Answer _____
 Answer _____
 Answer _____

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Review Questions 90 Seconds

- Give the spherical equivalent to the following prescriptions

-2.00 -1.00 x 080 Answer **-2.50**
 -1.00 -2.00 x 010 Answer **-2.00**
 +2.00 -1.00 x 030 Answer **+1.50**
 -3.00 -0.50 x 070 Answer **-3.25**
 +3.00 -1.00 x 060 Answer **+2.50**

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Review Questions

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

| | |
|---------------------|---------------------|
| • -2.00 -1.00 x 080 | • -4.00 -0.25 x 090 |
| • -1.50 -2.00 x 180 | • -1.00 -0.50 x 098 |
| • +3.00 OU | • +2.00 OU |
| • Answer _____ | • Answer _____ |
| • | • |
| • -1.00 -0.50 x 010 | • +2.50 -1.00 x 090 |
| • -2.00 -0.75 x 100 | • +1.00 -0.75 x 180 |
| • +1.25 OU | • +2.25 OU |
| • Answer _____ | • Answer _____ |
| • | • |
| • | • |

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Review Questions

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

| | |
|-----------------------------------|-----------------------------------|
| • -2.00 -1.00 x 080 | • -4.00 -0.25 x 090 |
| • -1.50 -2.00 x 180 | • -1.00 -0.50 x 098 |
| • +3.00 OU | • +2.00 OU |
| • Answer +1.00 -1.00 x 080 | • Answer -2.00 -0.25 x 090 |
| • | • +1.00 -0.50 x 098 |
| • -1.00 -0.50 x 010 | • +2.50 -1.00 x 090 |
| • -2.00 -0.75 x 100 | • +1.00 -0.75 x 180 |
| • +1.25 OU | • +2.25 OU |
| • Answer +0.25 -0.50 x 010 | • Answer +5.00 -1.00 x 090 |
| • -0.75 -0.75 x 100 | • +3.25 +0.75 x 180 |
| • | • |

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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 _____

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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 -1.00 x180
- 1.00 +3.00 x 070
- Answer: +2.00 -3.00 x 160
- 1.00 +1.50 x 010
- Answer: +0.50 -1.50 x100
- 0.50 +2.00 x 145
- Answer: +1.50 -2.00 x055
- 3.00 +2.00 x 095
- Answer: -1.00 -2.00 x005

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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: _____

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Review Questions 1 minute drill

- Convert the following prescription from **minus cylinder** to **plus cylinder format**

- 1.00 -1.00 x 090
Answer: -2.00 +1.00 x180
- 0.50 -2.00 x 008
Answer: -2.50 +2.00 x098
- 1.00 -1.50 x 160
Answer: -2.50 +1.50 x070
- 5.00 -3.00 x 088
Answer: -8.00 +3.00 x178
- 3.00 -1.50 x 095
Answer: -4.50 +1.50 x005

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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 (you have two eyes)

Remember the measurements are in mm

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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

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Conversion - info section

- 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

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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

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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

$$\overline{a} = c \quad \text{c}$$

- 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.

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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

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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

$$7.75 \times 10 = 77.5$$

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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 |

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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.

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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

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Remember Metric

• When Converting

- mm to cm
- cm to mm
- m to mm
- mm to m
- mm to cm
- cm to m

Move Decimal

- 2 places right
- 1 place right
- 3 places right
- 3 places left
- 1 place left
- 2 places left

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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

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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

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Math Rules

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

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

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<http://lvnslecturehelp.wordpress.com>

Thank you very much



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