HS Physics **Optics Labs**

OPTICS LAB #1

A) Index of Refraction **OS-8515C #10 "Reversibility"**

- Questions: What is the relationship between angle of incidence and angle of refraction when light goes from air into acrylic? Is the relationship still valid when light goes from acrylic into air?
- Hypothesis: Snell's Law of Refraction $n_{air} \sin\theta_{air} = n_D \sin\theta_D$… How would you gather data to verify this equation?
- Procedure/Data/Analysis: Make sure you understand the difference between the rays in Trial 1 and Trial 2. Make the data table. Use a calculator to make a scatter plot of $\sin\theta_{air}$ on the y-axis vs. $\sin\theta_D$ on the x-axis. Do a regression. Why? If Snell's Law really holds, what should the scatter plot look like? What does the slope represent? Use this to find n_D for both Trial 1 and Trial 2. Follow the analysis questions and compare.

B) Making Rainbows. Index of Refraction **OS-8515C #11 "Dispersion"**

- Question: What is the index of refraction for red and for violet?
- Procedure: Describe the procedure with a labeled diagram of when maximum color separation occurs. Label the incident ray, incident angle, refracted angles, red beam, violet beam.
- Analysis: Show your calculations and answer the questions.

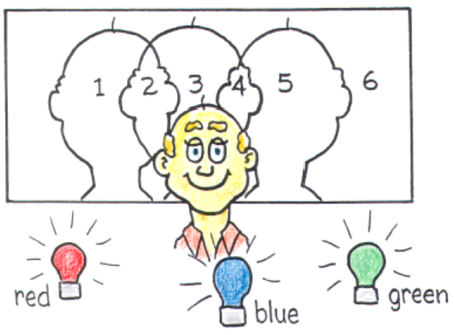
C) Parallel Ray Tracings for Convex and Concave Lenses and Mirrors

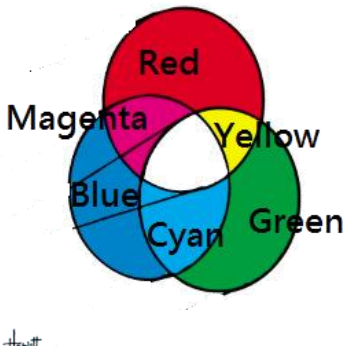
OS-8515C #6 "Convex and Concave Lenses" (and partly #3)

- Sketch the ray diagrams as indicated.
- Add to Question #5: Draw sketches that would indicate the relative strengths of the converging and diverging lenses – when $f_c \approx f_d$, $f_c < f_d$, $f_c > f_d$
- Add another task: Shine parallel rays onto the concave mirror. Sketch. Use a ruler to find the focal point. Label on your sketch.
- Shine parallel rays onto the convex mirror. Sketch. The reflected rays will diverge, and they will not cross. Use a ruler to extend the reflected rays back behind the mirror's surface. The focal point is where these extended rays cross. Label the focal distance on your sketch.

D) Teabox Shadows. Demonstrate and fill in the colors.

When three colored lamps, red, blue and green, illuminate a physics instructor in front of a white screen in a dark room, three slightly-overlapping shadows appear. Specify the colors in regions 1 through 6.





E) Polarizers

Do not bend them! Watch the video.

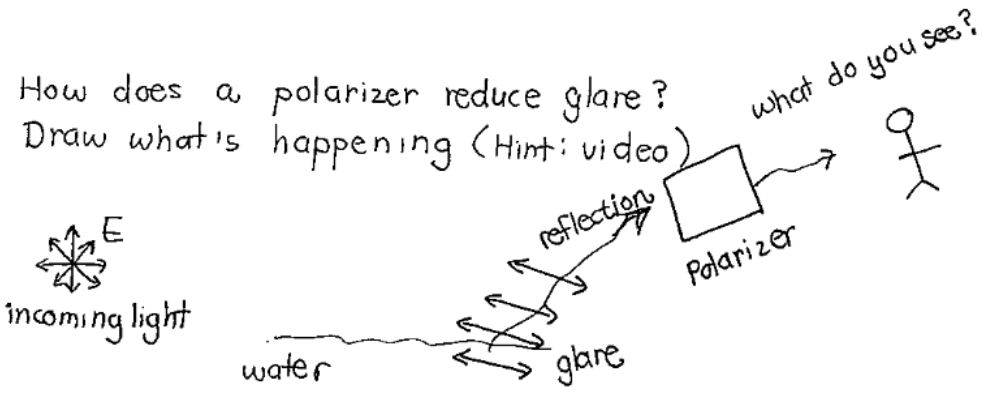
a) Can you reduce glare with the polarizer? Try it and record your observations…

b) Record what you observe.

Observations	Rotate 1 Polarizer	2 Crossed Polarizers
LCD calculator		
Phone Screen		
Computer Screen		
SmartBoard Projection		
LED Flashlight		
Hallway Fluorescent Light		
Incandescent Lightbulb		
Anything Else you can think of?		

c) Why can't you see through two polarizers when they're aligned a certain way?

d)



e)

i) Water absorbs infrared. It also absorbs visible light up into the red end of the color spectrum. Take away red from white light and illuminate the wall. What color is it? How is this related to the color of the ocean?

ii) What color would a white paper look like deep underwater? Why?

iii) What color will a red crab look like if it's deep underwater and you're looking at it from the surface? Why?

OPTICS LAB #2: LENSES AND MIRRORS

A) Converging Lens (Detailed from Scatter Plot)

(Modified but based on **OS-8515 #12**. Read the pdf as a pre-lab and answer its questions in your write-up.)

- ✧ Question: What is the focal point of the thin lens? Also demonstrate all of the ray diagrams in your textbook, Holt Physics P. 497.
- ✧ Procedure: Demonstrate #1~6 from your textbook, Holt Physics P. 497. Fill out the data chart

Ray Diagram (Holt P. 497)	d_o	d_i	$x = 1 / d_o$	$y = 1 / d_i$	m = image/ object	$m = -d_i / d_o$	% difference for m
1				f = ?			
2							
3							
4							
5		No number	Just show				
6		Just show	No number				

- ✧ #2~4 will give you 3 plottable points. Make a scatter plot of $y = 1 / d_i$ vs. $x = 1 / d_o$. Use your calculator to do a regression. Find 2 values for the focal length as hinted in the pdf. Find the % difference between the 2 values. Find the % difference between Average of results from intercepts and result from #1. Answer the analysis questions.

---------- While you are waiting your turn to do Part A, work on the following ----------

B) Converging Lens (Quickly)

Find the focal length of a converging lens quickly. Then use another configuration to check your work. Be sure to show your methods and measurements in labeled diagrams.

***C) Diverging Lens**

*Mandatory for Honors. Hint: OS8515C # 14 Part 1, or the classwork example we discussed earlier.

- ✧ Question: What is the focal length of a diverging lens?
- ✧ Procedure: Show the diagram, calculations, and measurements involved. Hint: You may need a stronger converging lens to help you.

D) Concave Mirror (optional reference: OS-8515 #13, #14 Part 2)

- ✧ Question: What is the focal point of the mirror? Also demonstrate all of the ray diagrams in your textbook, Holt Physics P. 460.
- ✧ Procedure: Demonstrate #1~6 from your textbook, Holt Physics P. 460. Fill out the data chart. Find f.

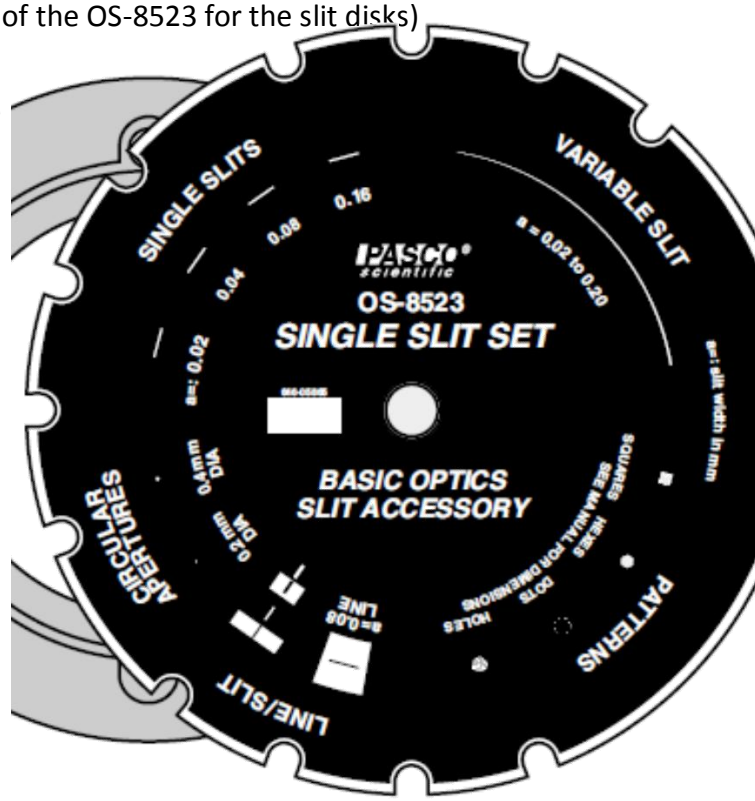
Ray Diagram (Holt P. 460)	d_o	d_i	$1/d_o$	$1/d_i$	Use #1 to find the focal point. #2~4 will give you 3 plottable points. Make a scatter plot of $y = 1 / d_i$ vs. $x = 1 / d_o$. Use your calculator to do a regression. Find 2 values for the focal length as hinted in the pdf "Part A" section. Find the % difference between the 2 values. Find the % difference between Average of results from intercepts and result from #1
1					
2					
3					
4					
5					
6					

OPTICS LAB #3: DIFFRACTION

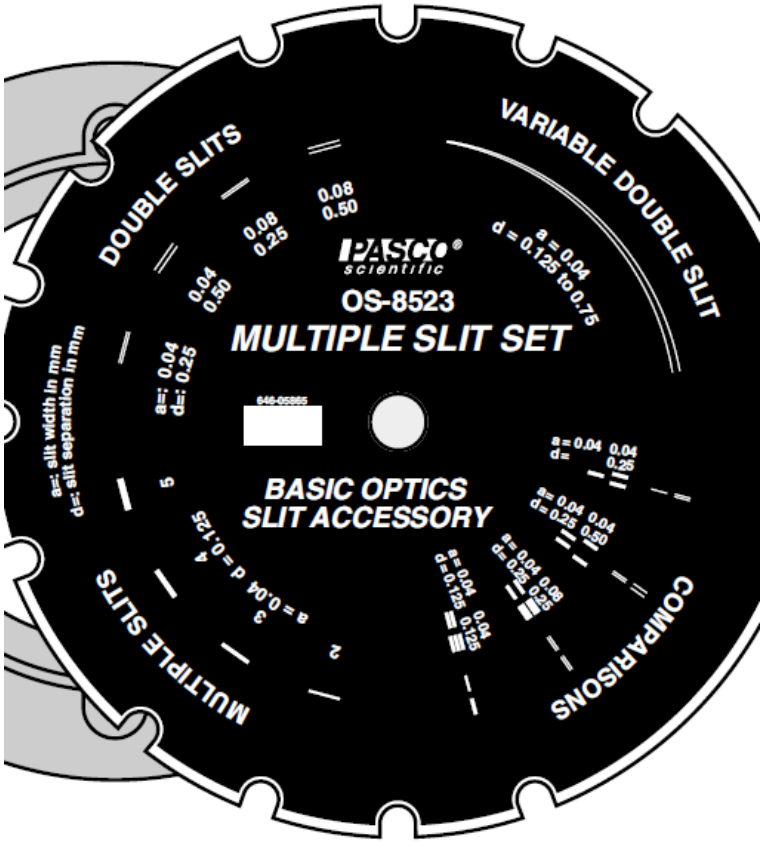
A) Diffraction Demonstrations (See Diagram on PDF p. 4 of the OS-8523 for the slit disks)

Sketch what you see when the laser diffracts through the

- ✧ squares
- ✧ hexes
- ✧ dots
- ✧ holes
- ✧ line/slit
- ✧ circular apertures
- ✧ What happens when the circle gets bigger? Why?
- ✧ Single Slit
- ✧ What happens when the slit gets bigger? Why?



Single Slit Disk



2: Multiple Slit Disk

Sketch and compare

- ✧ Double-slit diffraction. Slits are farther apart, aperture same. Why?
- ✧ Double-slit diffraction. Aperture thicker, slits same distance. Why?
- ✧ Slit number increases. Aperture and distance between slits the same. Why?

B) Question: What is the thickness of one strand of hair?

Procedure/Data/Analysis: Use a laser of known wavelength, a hair, tape, blank paper to mark the diffraction fringes on, and a meterstick. Explain with labeled diagrams and derivations.