Really old 162 test 3 *plus* a couple random extra Q's I made up as quick as possible (no solutions available)
I think you could try to treat questions 1 through 7 as one practice test and question 8 to the end as a second practice test. No clue if the times are close to 2 hour tests, but probably with 30 minutes of that.

***1a) A magnifying glass has a convex lens of focal length 15 cm. At what distance from a postage stamp should you hold this lens to get a magnification of +2. Solve this problem numerically.

distance from stamp to lens	

***1b) Now sketch a ray diagram clearly labeling the object, the image, and the lens. Draw it using a straight edge APPROXIMATELY (not perfectly) to scale. Label the lengths in cm on your diagram.

*1c) final image is: REAL VIRTUAL NEITHER IMPOSSIBLE TO DETERMINE

*1d) final image is: UPRIGHT INVERTED NEITHER IMPOSSIBLE TO DETERMINE

*1e) final image is: ENLARGED DIMINISHED NEITHER IMPOSSIBLE TO DETERMINE

Be sure you practice ray diagrams for convex lens, concave lens, convex mirror, and concave mirror.
Be sure you can handle solving for f (or R), M, d_o, d_i, etc in a word problem.
Problem could be algebraic or with numbers so do some of both.

*2) What is the small angle approximation AND under what conditions does it apply?

*3) When you look at a single slit diffraction pattern produced on a screen by monochromatic light you see a central bright maximum along with several side maxima of decreasing intensity. If the wavelength of light is increased (circle the best answer):

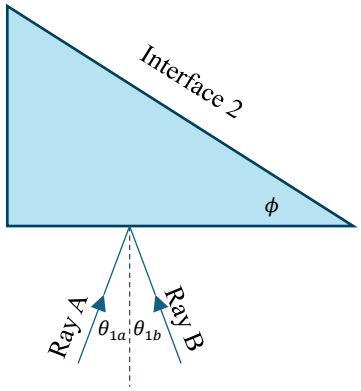
a) The width of the central max decreases while other maxima do not increase in size (positions maxima change due to increase of central width).
b) The width of the central max increases while other maxima do not increase in size (positions maxima change due to increase of central width).
c) The pattern is unaffected.
d) It is impossible to determine what changes should occur to the pattern.
e) The pattern shrinks in size (central max less wide, other maxima closer to it).
f) The pattern increases in size (central max wider, other maxima farther from it).

4) You are observing a double-slit interference pattern made with a monochromatic, coherent light source. As you increase the slit separation, describe any changes to the pattern by circling the appropriate answer in each row:

Distance in cm between fringes:	stays the same	impossible to determine	increases decreases
Width of central max:	stays the same	impossible to determine	increases decreases
Angle from central max to fringes:	stays the same	impossible to determine	increases decreases
Overall brightness of pattern:	stays the same	impossible to determine	increases decreases

5) A right-triangular prism with index $n = 2.00$ is surrounded by air.
Two rays are incident upon the bottom of the prism.

a) Which ray is more likely to experience TIR at interface 2?
b) Suppose rays A & B are normally incident. What angle ϕ is required to cause TIR at interface 2? Is this a minimum or maximum angle?
c) Now consider only Ray B. Assume $\phi = 20.0°$ is known. What range of angles cause TIR for Ray B at interface 2?



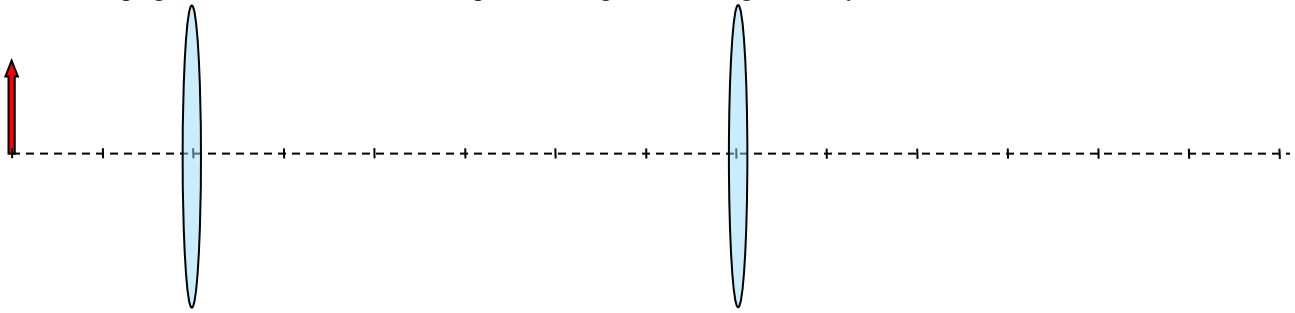
*****6) A uniform film of oil (n=1.31) is floating on water (n=1.33). When sunlight in air is incident normally on the film, an observer finds that the reflected light has a brightness maximum for the wavelength 450 nm and a brightness minimum for the wavelength 600 nm. What is the minimum thickness of the film?

The above question doesn't say anything about thickness being non-constant (so we assume constant thickness).

Depending on the length of all exam questions, I prefer to use questions that use *variable* film thickness. See **35.5**, **35.7**, & **35.8** for examples. Remember: everything is the same as a normal thin film problem with the extra step of deriving an expression for film thickness as a function of position. This process (deriving an expression from geometry) is probably much more useful to scientists and engineers than the rest of the problem.

*****7) A diffraction grating is used with a green laser of wavelength 500nm. The second-order bright spot (the central max is a zeroth order bright spot) is 30 cm from the center of the screen. The screen is 60 cm from the slits. Determine the number of slits per mm in the grating. Include units on your answer for full credit.

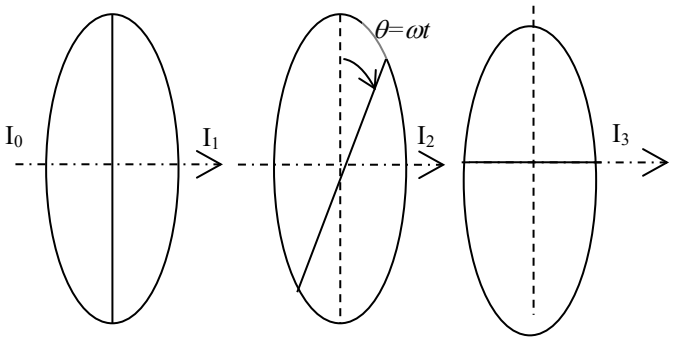
8) Object is 2f to the left of a converging lens with focal length f. A 2nd converging lens with focal length 2f is placed 6f to the right of the first lens. Sketch the ray diagram. The image from the first lens becomes the object for the second lens. Estimate the magnification from the final image. Is the final image enlarged or diminished, inverted or upright, virtual or real? Now compute the magnification algebraically.



Unpolarized light of intensity I_0 is incident upon a vertically oriented polarizer. It then passes through a second polarizer which is rotating with angular speed w. Lastly, any transmitted light passes through a third polarizer that is oriented horizontally. Show that the intensity of the emerging beam is given by

$$I_3 = f I_0(1 - \cos 4\omega t)$$

where *f* is some fraction like 1/3 or 3/8.



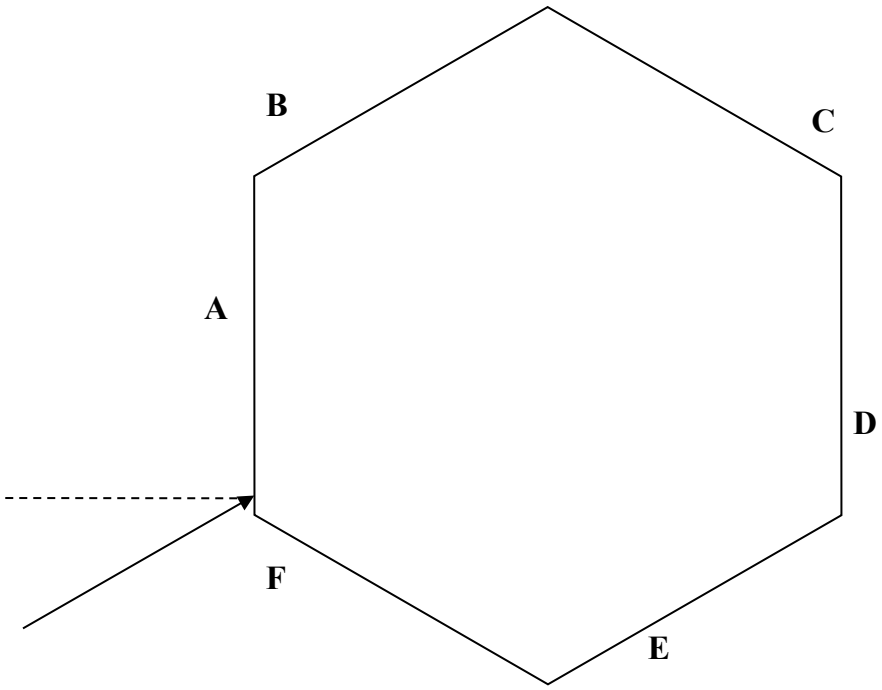
****9a) Find the fraction *f*.**

$\cos^2\theta = \frac{1+\cos 2\theta}{2}$ $\sin^2\theta = \frac{1-\cos 2\theta}{2}$ $\cos(90-\theta) = \sin\theta$ $\sin(90-\theta) = \cos\theta$

**9b) What angle (or angles) causes 3.75% of the initial light to be transmitted.

****10a) A light ray strikes a hexagonal ice crystal floating in air at a 30.0 degree angle to the normal of the face **A**. Assume the index of refraction of ice is 1.30.

- *Determine the critical angle for total internal reflection in the ice crystal.
- *Sketch the path that the light ray takes in the crystal as it travels to the next TWO interfaces.
- *Also clearly indicate is the ray is completely transmitted, completely reflected, or experiences both transmission & reflection at the next faces of the crystal.
- *Provide numerical values (show on your sketch) of each angle for any reflection or transmission at the next faces.



critical angle for total internal reflection	

For fun: will any internal reflections inside the crystal ever be total? Will the beam inside the crystal be strongly visible or not?

10b) As the light ray enters the crystal from air, describe (in four brief statements) what happens to all four of the following: **wavelength, **frequency**, **energy**, and **speed** of the photon.

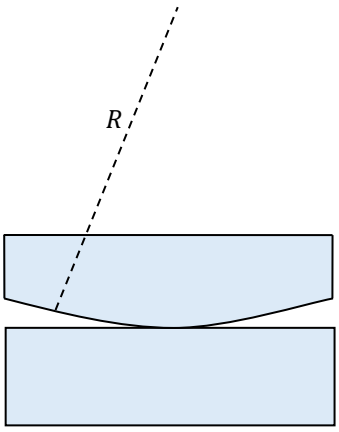
*****11a) Suppose you have two slits separated by distance d. What minimum slit width is required to extinguish the 2nd order bright fringe? I am assuming the zeroth order bright fringe is the central max.

11b) Is the small angle approximation necessary in your derivation?

11c) What happens to the pattern if we use a *smaller* slit width?

11d) What happens to the pattern if we use a *larger* slit width?

A plano-convex lens is set upon a flat piece of glass. The figure at left shows a side view of the set-up. Assume the lens and the glass plate have the same composition and **they are surrounded by water.** Light of a single wavelength is used to illuminate the apparatus from above. An observer looks down from above and sees a sequence of light and dark rings.



12a) Is fringe spacing constant or changing? Explain why for credit.

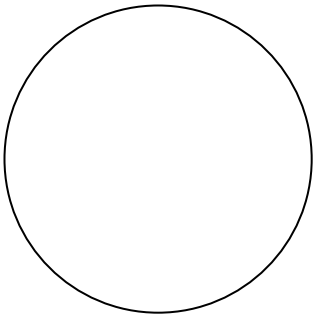
12b) Determine if the center should be bright or dark. Explain why for credit.

12c) State the interference condition for dark fringes.

12d) Derive an expression for the radial position of dark fringes in terms of R.

12e) Sketch a plausible pattern of fringes (as viewed from the top).

Sketch fringe pattern as viewed from the top



12f) If the water is drained out, would the pattern increase in size, decrease in size, or remain constant in size?