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## P360 - Optics

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Alex R. Dzierba

### Instructions for the Final Exam:

- This is a take-home exam
- Show all your work on these sheets
- You may use any reference or source - but not another person
- Please print your name below
- This exam consists of 5 problems each worth 20 points

This exam is being distributed on Monday, May 3 at 9 a.m. and is due back on Wed, May 5 at 5 p.m.  
Cheers, Alex

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**Name (please print)**

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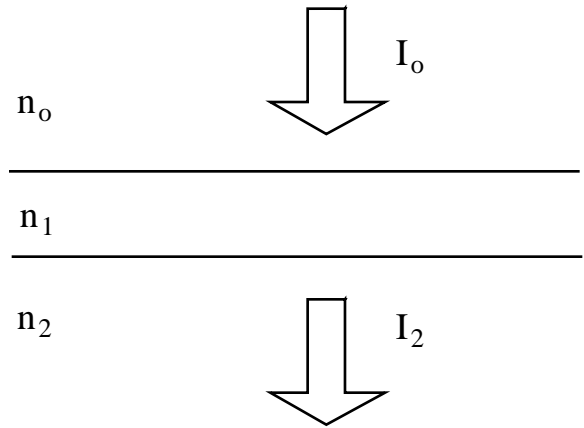
### Problem 1 (20 points)

Explain clearly and succinctly, why, when the moon is low in the sky, it appears to be flattened at the top and the bottom.



**Problem 2 (20 points)**

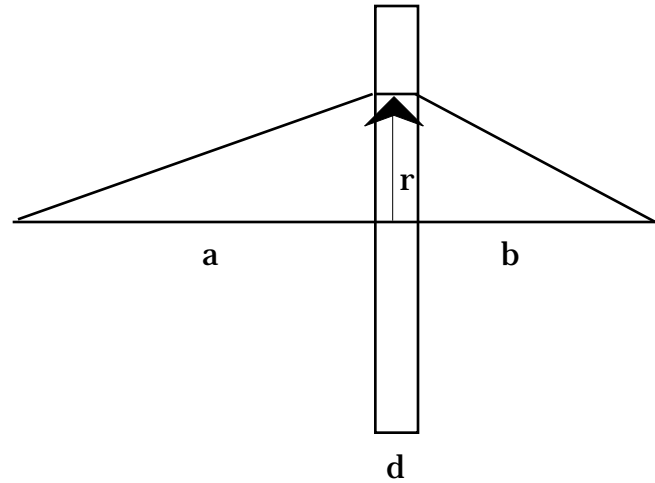
The drawing shows light incident on an interface between two indices of refraction, followed by yet another interface. The light enters normal to the interface. We want the net transmitted intensity to equal the incident ( $I_2 = I_o$ ). How should  $n_1$  be related to  $n_o$  and  $n_2$  ?





**Problem 3 (20 points)**

It is possible to change the index of refraction of glass by introducing impurities. By suitably changing the index of refraction it is possible to make a lens from a thin slab of glass. The drawing shows such a lens which focuses light from a source located on the perpendicular bisector of the slab, a distance  $a$  away - onto a point a distance  $b$  away. The drawing also shows two rays of light. The thickness of the slab is  $d$  and you should assume that both  $a$  and  $b$  are each much larger than  $d$ . Note that the variable  $r$  measures distance within the slab from the bisector.



Find an expression,  $n(r)$ , which specifies how the index of refraction should vary. Assume that the index of refraction at the middle is  $n(0)$ .



**Problem 4 (20 points)**

Chef Jason de Riquer just bought a large and shiny new spherically-shaped spoon. He looks into the concave side and sees his inverted image 4 cm from the spoon. Without changing his distance from the spoon he flips the spoon over so he is looking at the other side and now he sees an erect image of himself 3 cm from the spoon. What is the radius of curvature of the spoon ?





**Problem 5 (20 points)**

The photo shows the projection of light on a screen where the light came from a He-Ne laser after it has passed through a two-slit slide using the PASCO apparatus.

(a) What is the ratio of width of each slit (equal widths) to the separation of the slits?

(b) In the photo you can discern five bright central peaks. Compare the total intensity of the light falling on the three central peaks compared to the total intensity falling on the two (of the central five) outer peaks.







