**ASTR 530 : Homework 4 : Reflection and refraction; lenses (9 pts)**

Due: TBD ALWAYS SHOW YOUR STEPS

1. (1 pt) A light wave approaches from the "air" side of a lens (assume n1=1),

at an angle of 60 degrees from the normal to the surface. After it crosses into a

lens with index of refraction = 1.4, what is its new angle to the normal?

Use Snell's law: n1 sin (θ1) = n2 sin (θ2) where θ is the angle measured from the normal.

(1 pt) 2. If the same light ray approaches from 89 degrees to the normal, what will its new angle be? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

What does that say about the maximum angle from the normal inside a dense medium?

(1 pt) 3. Turn the problem around - now lets go from the denser medium to the less dense medium. Assume the angle from the normal in the DENSE medium is 60 degrees. What happens to the light ray?

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Name two common uses for total internal reflection.\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

(1 pt) 4. For a big refracting telescope such as Yerkes, the focal length might be 9 m.

With a standard eyepiece such as a 32mm eyepiece, what would its magnification be?

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(1 pt) 5. The f number of a lens is its focal length divided by the aperture (size of the objective). For Yerkes with a primary objective of 102 cm diameter, what is its f-ratio?

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(2 pts) 6. A typical telephoto lens on a camera has a focal length of 300mm. If its diameter is 4 cm, what is its f-ratio?

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For a wide angle lens of the same diameter, with a focal length of 28mm, what is its f-ratio?

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Is it possible to make the f-ratio larger? If so, how?

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Is it possible to make the f-ratio smaller? If so, how?

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If not, give two ways can you make a brighter image that would be equivalent to decreasing the f-ratio by a factor of 2.

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And \_\_\_\_\_\_\_\_\_\_\_\_\_

(1 pt) 7. For the two lenses in question 6, if the best time exposure for the wide angle lens is 1/500th of a second, how long would you expose if using the telephoto lens?

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(1 pt) 8. Which binoculars have greater image brightness: a 7x35 or a 12x70? By what ratio?

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Last update: 2/6/2023