PHYS 1512: Week 9

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Equations

$$f = \pm\frac{R}{2} \quad \text{(Concave/Convex mirror)}$$

$$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i} \quad \text{(Mirror Equation)}$$

$$m = -\frac{d_i}{d_o} = -\frac{h_i}{h_o} \quad \text{(Magnification)}$$

$$n_1 sin(\theta_1) = n_2 sin(\theta_2) \quad \text{(Snell's Law)}$$

$$n = \frac{c}{v} \quad \text{(Index of Refraction)}$$

$$sin(\theta_c) = \frac{n_2}{n_1} \quad \text{(Critical Angle)}$$

(Only for $n_1 > n_2$)

$$d' = d(\frac{n_2}{n_1}) \quad \text{(Apparent depth)}$$

(**For an above observer)

Question #1

Objects very very far away

When viewed in a spherical mirror, the image of a setting sun is a virtual image. The image lies 12.0cm behind the mirror.

a) Is the mirror concave or convex? Why?

b) What is the radius of curvature of the mirror?

(Note: The sun is about 150 million kilometers away.)

Question #2

Engineer a mirror

A concave makeup mirror is designed so the virtual image it produces is twice the size of the object when the distance between the object and the mirror is 14 cm. What is the radius of curvature of the mirror?

Question #3

What's the index?

A rectangular slab of glass is d thick (index of refraction n_glass). The slab is placed L_1 in front of a flat plane mirror. A flashlight emits a beam of light is L_2 away but **directly** towards the slab. Find an expression for how long it takes for the light to come back to the flashlight in terms of d, L_1, L_2, n_{glass} and n_{air}.

Question #4

An apparent problem

You decide to go fishing by standing in a shallow, but murky lake. You notice a fish image directly below you at some d'. You attempt to grab it, but find that your hands miss! Because you are a true physicist, you pull out a coin, place it in the lake and measure the coin depth at 0.1524m and image depth at 0.1016m. What was the actual depth of the fish if its image depth is 0.2m?
(Don't assume the lake's index of refraction is that of water)

Question #5

Totally Internal

A glass is half-full of water, with a layer of vegetable oil (n=1.47) floating on top. A ray of light traveling downward through the oil is incident on the water at an angle of 71.4°. Determine the critical angle for the oil-water interface and decide whether the ray will penetrate into the water.

Question #6

Snell's dilemma

Light in a vacuum is incident on a transparent glass slab $n_{glass} = 1.52$. The angle of incidence is $35.0°$. The slab is then immersed in a pool of liquid. When the angle of incidence for the light striking the slab is $20.3°$, the angle of refraction for the light entering the slab is the same as when the slab was in a vacuum. What is the index of refraction of the liquid?