General Physics 204, Section ... Monday, Mar 23, 2015
Quiz #6 Mirrors

Name:

1) CLASS(2)
Alhazen is using a dentist's mirror. Putting the mirror at a distance 2 cm from the tooth, the enlarged image is virtual and located at a distance 5 cm from the mirror. What kind of mirror is used? Find the magnification and the orientation. Calculate the focal length.

$m = -\frac{d_i}{d_o} = -\frac{-5\text{ cm}}{2\text{ cm}} = 2.5 > 1 \rightarrow$ Concave mirror, upright

$\frac{1}{d_o}+\frac{1}{d_i}=\frac{1}{f} \rightarrow \frac{1}{2}+\frac{1}{-5}=\frac{1}{f} \rightarrow f=\frac{10}{3}\text{ cm}.$

2) CLASS(2)
Ibn Sahl is trying to explain how light reflects in the spoon to his friend. Spoon has two sides, which we will model them with concave and convex mirrors, with radius $R = 10$ cm.
a) What is the focal lengths of the concave side and the convex side?
b) Consider you are looking at the concave side. The object is your eye which is at distance $d_o = 30$ cm from the spoon. Find where the image is and calculate the magnification. Is the image upside down? Is the image real or virtual?
c) Repeat the previous part, this time for the convex side.
d) The eye need to be at least 10 cm away from the image diverging light rays to be able to focus and make an image out of it on the retina. How close you can get to concave side of the spoon with your eye, so that you can still see a clear image of your eye? How about the convex side?

a) Concave side: $f = +\frac{1}{2}R = +5\text{ cm}$. convex side: $f = -\frac{1}{2}R = -5\text{ cm}$.

b) $d_o = 30\text{ cm}$, $f = 5\text{cm} \rightarrow \frac{1}{d_o}+\frac{1}{d_i}=\frac{1}{f} \rightarrow \frac{1}{30}+\frac{1}{d_i}=\frac{1}{5} \rightarrow d_i = 6\text{ cm} > 0$ real image

$m = -\frac{d_i}{d_o} = -\frac{1}{5} < 0$ upside-down.

c) $d_o' = 30\text{ cm}$, $f' = 5\text{cm} \rightarrow \frac{1}{d_o'}+\frac{1}{d_i'}=\frac{1}{f'} \rightarrow \frac{1}{30}+\frac{1}{d_i}=\frac{1}{-5} \rightarrow d_i = -\frac{30}{7}\text{ cm} < 0$ virtual image

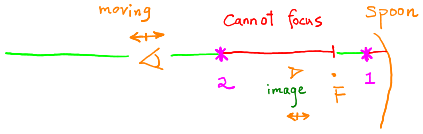
$m' = -\frac{d_i'}{d_o'} = +\frac{1}{7} > 0$ upright.

d) For mirrors the physical distance between the object & the image is $d_o - d_i$ and we need $d_o - d_i \geq 10\text{ cm}$ so the eye (object) can see the image; in other words image must form in front of the eye, as eye cannot make image on the retina from converging light rays.

Concave side: limit
$\begin{cases} d_o - d_i = 10\text{ cm} \\ \frac{1}{d_o}+\frac{1}{d_i}=\frac{1}{5\text{cm}} \end{cases}$

1: $d_o = 3\text{cm}$, $d_i = -7\text{cm}$

2: $d_o = 17\text{cm}$, $d_i = 7\text{cm}$



Convex side: $\begin{cases} d_o' - d_i' = 10\text{ cm} \\ \frac{1}{d_o'}+\frac{1}{d_i'}=\frac{1}{-5\text{ cm}} \end{cases}$

1': $d_o' = 7\text{cm}$, $d_i' = -3\text{cm}$

~~$d_o' = -7\text{ cm}$~~, ~~$d_i' = -17\text{cm}$~~ eye is real