Physics 123 section 2 CID _____

Homework 26

Score _____ / 30

1. (3 pts) A swimmer is a distance h under the water and a distance L from shore and is named Jane. Is it possible for light from the swimmer to reach they eyes of someone on shore, or will this be prevented by total internal reflection? Explain why or why not. (Yes, you *have* been given all of the information you need.)

2. (6 pts) You are standing between two parallel flat mirrors. You are looking into one mirror which is 1 m away from you. The other mirror is 2.5 m behind you. Calculate how far away from you the closest 4 images you see of yourself in the mirror will be and whether you see your face or your back in each of these 4 images.

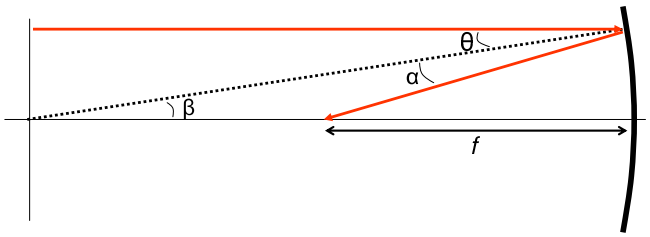
3. (6 pts) Draw ray diagrams for the following two situations. Draw at least 3 rays. In each case state whether the image is real or virtual: (a) An object is placed 20 cm in front of a mirror with a focal length of 10 cm. (b) An object is placed 20 cm in front of a mirror with a focal length of -10 cm. (c) Calculate the position of the image relative to the mirror for the above two situations. Be sure to indicate whether the image is on the same side or the opposite side as the object. Make sure that your calculations agree with your diagrams!

4. (5 pts) In the lobby of the ESC there is a large mirror which projects an $M = -1$ image of a dollar. (a) What is the mirror's focal length? (The dollar is 1.73 m from the mirror). (b) How far should I put a nickel from the mirror if I want to make a real image which is twice as big as the nickel? (c) Will the image be upright or inverted?

5. (4 pts) You look at your reflection in a spoon. Your reflection appears to be 20 cm behind the spoon. Then you flip the spoon over, and your reflection appears to be 25 cm behind the spoon. (a) How far is your face from the spoon? (b) What is the radius of curvature of the spoon?

6. (3 pts) You are standing 0.3 m from a flat mirror. The top of the mirror is at the same height as your eyes. If you are 1.78 m tall, how long must the mirror be for you to see your toes?

7. (3 pts) Lets derive the focal length of a mirror. The curved line in the figure below is a spherical mirror. The dotted line runs from the center of curvature and has a length R. The red line represents a beam of light traveling parallel to the principle axis. It makes an angle θ with respect to the normal of the mirror. (a) In terms of θ and R, what is α? (b) What is β? (c) Find f in the limit that θ is very small (i.e., such that the light represents a paraxial ray).



Extra problems I recommend you work (not to be turned in)

- You are standing with your back to a brick wall which is 3 meters behind you. The bricks are each 15 cm long. You hold up a 10 cm wide mirror a distance of 0.5 meters in front of you and use the mirror to look at a row of bricks. How many bricks will you be able to count in the row?
- A cube which is 1 cm in length is placed 5 cm from a concave mirror with a radius of curvature of 15 cm. Draw what the image of the cube will look like. Will the image of a perfect cube be a perfect cube?
- If I place an object in front of a concave mirror, under what conditions will a real image be created? Under what conditions will a virtual image be created? Under what conditions will the image be inverted? What about a convex mirror?
- In light of the problem you solved above, why is it often difficult to see someone who is swimming under water?