

Physics 142 – Homework 13

Ch. 36, Examples: 36.4, 36.5, 36.9, 36.10

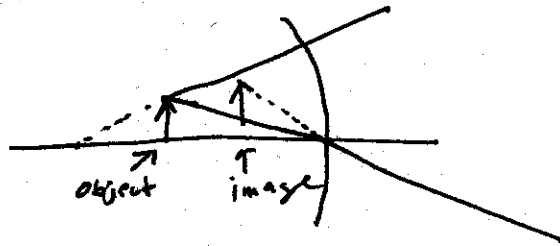
Ch. 36, Q: 5, 15, 16, 22

Ch. 36, P: 5, 8, 36

Questions

5) The stream appears to be shallower than it actually is because the light rays are refracted. As shown in example 36.8, the real depth is $\frac{4}{3}$ of the apparent depth.

15) Because the water and glass have higher indices of refraction than air, the light rays will create an image as shown below.



This image magnifies the fish.

16) Some ambulances have ambulance written backwards so that people who are looking at the ambulance through a mirror (which reverses images) can read what is written.

22) As long as it doesn't melt it can be used as a lens since it has an index of refraction different from zero. Since most of the light travels through the lens it shouldn't heat up the lens very much.

Problems

5) The person is 5 feet from the image on the left, so the first image will be 5 ft behind the mirror or 10 feet from the person.

For the second image the light must travel 10 feet to the mirror on the right, 15 feet to the mirror on the left, so the image will be 25 feet behind the mirror, so it must be 30 feet from the person.

The third image is formed by the image in the mirror on the right, which is 10 feet behind the right mirror, so it must be 35 feet behind the mirror on the left, or 40 feet from the person.

8) We can use the mirror equation to locate the image.

$$\frac{1}{p} + \frac{1}{q} = \frac{2}{R}$$

$$\frac{1}{10.0m} + \frac{1}{q} = -\frac{2}{0.550m}$$

$$q = -0.267m$$

We therefore know that the image is virtual.

$$M = -\frac{q}{p} = -\frac{-0.267m}{10m} = 0.0267$$

Therefore we know that the image is reduced in size, but is upright.

36) First we can find the magnification.

$$M = \frac{h'}{h} = \frac{-1.80m}{0.00240m} = -75$$

Now we know the magnification relates p and q and we know the distance from the object to the image which also relates p and q so we have two equations with two unknowns.

$$M = \frac{-q}{p} = -75$$

$$R = p + q = 3.00m$$

From the first equation, we can solve for q which we can plug into the second.

$$q = 75p$$

$$R = p + 75p = 3.00m$$

$$p = \frac{3.00m}{76} = 0.004m$$

$$q = 2.96m$$

Now we can use the lens equation to solve for the focal length.

$$\frac{1}{p} + \frac{1}{q} = \frac{1}{f} = \frac{1}{2.96m} + \frac{1}{0.004m}$$

$$f = 0.0039m$$