OPTICS I : Homwork #4

(Due: 2 weeks)

[5.12] A meniscus concave glass (n_l=1.5) thin lens (see Fig. 5.12) has radii of curvature of +200 mm and + 100 mm. If an object is placed 200 mm in front of the lens, what is the image distance? Draw a ray diagram.

[5.13] A biconcave lens (n_l=1.5) has radii of curvature of 200 mm and 100 mm and an axial thickness of 50 mm. Describe the image of an object 25 mm tall placed 80 mm from the first vertex. Use the thin-lens equation to see how far off is it in determining the final-image location.

[5.14] A 35 mm camera has a single thin lens having a 50.0-mm focal length. A woman 1.7 m tall stands 10.0 m in front of the camera. (a) Show that the lens-film distance must be 50.3 mm. (b) How tall is her image on the film?

[5.18] A parallel bundle of rays from a very distant point source is incident on a thin negative lens having a focal length of -50.0 cm. The rays make an angle of 6.0° with the optical axis of the lens. Locate the image of the source.

[5.24] The horse is 2.25 m tall, and it stands with its face 15.0 m from the plane of the thin lens whose focal length is 3.00 m.

(a) Determine the location of the image of the equine nose.

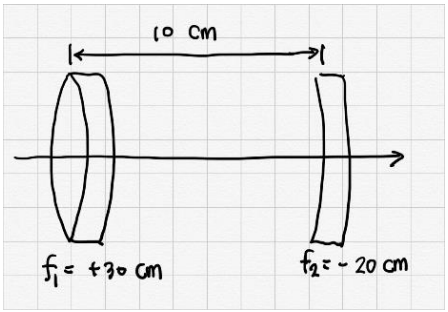
(b) Describe the image in detail – type, orientation, and magnification.

(c) How tall is the image?

(d) If the horse's tail is 17.5 m from the lens, how long, nose-to-tail is the image of the beast?

[5.28] A thin double-convex glass lens (with an index of 1.56) while surrounded by air has a 10-cm focal length. If it is placed under water (having an index of 1.33) 100 cm beyond a small fish, where will the guppy's image be formed?

[5.37] Compute the image location and magnification of an object 30 cm form the front doublet of the thin-lens combination. Do the calculation by finding the effect of each lens separately. Make a sketch of appropriate rays.



[5.44] Consider the case of two positive lenses, L_1 and L_2, separated by 5 cm. Their diameters are 6 and 4 cm, respectively, and their focal lengths are f_1=9 cm and f_2=3 cm. If a diaphragm with a hole 1 cm in diameter is located between them, 2 cm from L_2, find (a) the aperture stop and (b) the locations and sizes of the pupils for an axial point, S, 12 cm in front of (to the left of) L_1.

[5.71] Determine the numerical aperture of a single clad optical fiber, given that the core has an index of 1.62 and the clad 1.52. When immersed in air, what is its maximum acceptance angle? What would happen to a ray incident at 45°?

[5.88] Suppose we wish to make a microscope (that can be used with a relaxed eye) out of two positive lenses, both with a focal length of 25 mm. Assuming the object is positioned 27 mm from the objective, (a) how far apart should the lenses be, and (b) what magnification can we expect?