1051-733-20092 Homework #6 Due 02/17/2010 (W)

1. A plano-concave lens with focal length $|\mathbf{f}_1| = 120\,\text{mm}$ is placed in contact with a plano-convex lens with $|\mathbf{f}_2| = 75\,\text{mm}$. Find the refractive power of the combination.

2. Determine the ratio of the focal lengths of a thin glass with surface radii of curvature R_1 and R_2 if used with both surfaces in water and with both in air. The respective refractive indices of water and air are $n = 1.33$ and $n = 1.0$.

3. The objective lens of a microscope has focal length $\mathbf{f} = +10\,\text{mm}$ and an ocular with $\mathbf{f} = +25\,\text{mm}$. Determine the distance between the lens and the transverse magnfication if the object is in sharp focus when it is located at a distance $z = 10.5\,\text{mm}$ from the objective.

4. A distant object is observed through a telescope consisting of an objective lens with $\mathbf{f} = +300\,\text{mm}$ and a single eyepiece lens with $\mathbf{f} = +50\,\text{mm}$. The telescope is adjusted so that the final image is located at a distance of 400 mm from the eye lens.

   (a) Determine the distance between the two lenses.

   (b) Make a careful diagram of the system that traces a ray bundle from a lateral (off-axis) point on the object to the retina.

   (c) Calculate the magnifying power of the system.

5. A magnifying lens with focal length $\mathbf{f} = 60\,\text{mm}$ is used to view an object by a person whose closest focus is 250 mm. If the person holds the glass close to the eye, determine the best position of the object.

6. An object of diameter 50 mm is placed 333 mm from a double-concave lens with power 8 diopters. Detrmine the position and size of the image and characterize its nature as real or virtual.

7. An optical system is composed of two lenses and a stop. The first lens L_1 has diameter $d_1 = 100\,\text{mm}$ and focal length $\mathbf{f}_1 = 60\,\text{mm}$; the diameter of lens L_2 is $d_2 = 40\,\text{mm}$ and its focal length is $\mathbf{f}_2 = -75\,\text{mm}$. The diameter of the stop (iris) is $d_s = 60\,\text{mm}$. The distance from L_1 to the stop is 10 mm and from the stop to L_2 is 20 mm. Determine the positions of the image-space focal point F', the object-space focal point F, the locations and sizes of the pupils, the locations of the principal points, and the angular field of view. Sketch the system.

8. A thin biconvex lens is supported with its symmetry axis vertical on the surface of a pond of water. The lower surface of the lens with radius of curvature $R = 200\,\text{mm}$ is in contact with the water, while the upper surface in air has radius $R = 500\,\text{mm}$. The refractive index of the water is $n = 1.33$ and of the air is $n = 1.0$. An insect hovering over the lens and a fish in the water each see parallel rays of light.

   (a) Determine the distances of the insect and the fish from the lens.

   (b) Determine the effect of reversing the lens.