HOMEWORK PROBLEM II

Note: Use the attached worksheets for Problems 1, 5, and 6.

1. Find the image of the object for the single concave mirror system shown in Fig.1 (see worksheets) by: (a) measuring the radius R and calculating the focal length for the concave mirror, (b) drawing the focal point into the diagram, and (c) constructing the image of the object graphically with three rays.

What is the magnification in this process?

2. Regarding your own face as a real object, describe the image of your face which is formed when you stand 3 feet from the center of a polished and well-reflecting brass ball 2 feet in diameter hanging in front of a pawn shop. Determine the image of your face both graphically and by calculation.

3. (A) Calculate the focal length of a thin bi-convex lens \( n=1.75 \) in air, having radii of 3 and 9 cm. (B) Locate and describe (magnified? inverted? real?) the image of a real object 6 cm from lens. (C) What changes if the object is virtual instead of real? (D) What changes in (A), (B), and (C) if everything is immersed in water \( n=1.33 \)?

4. A negative meniscus thin lens \( n=1.5 \), with radii of curvature 3 and 7.5 cm, is positioned in contact with a plano-convex lens \( n=1.4 \) of radius 8 cm. (A) What is the effective focal length and refractive power of the lens combination? (B) What image (real or virtual? magnified or minified? inverted or up-right?) will this lens combination produce from a real object located 5 cm away from it? (C) What will be the front focal length and back focal length of the lens combination if the two lenses are separated by \( D=5 \) cm?

5. Two thin lenses \( L_1 \) double-convex with focal points \( F_1 \), and \( L_2 \) double-concave with focal points \( F_2 \) are placed at a distance \( D \) as shown in Fig.2 (see worksheets). Determine the image of object \( S \) using a "two-step process" as discussed in class. Obtain location and magnification of image

(A) Graphically, using the figure below
(B) By numerical calculation using thin lens equations for \( L_1 \) and \( L_2 \)

If done right (with proper signs) results from (A) and (B) should agree.

6. Do the ray-tracing problems on the three systems shown in Fig.3 (see worksheets) using the following procedure:
   (a) Measure the indicated radii of curvature \( R_1 \) and \( R_2 \) and calculate the focal distance for each lens.
   (b) Draw the focal points into the diagram.
   (c) Construct graphically the image of the given object, which each lens produces, by drawing of three rays into the diagram.

Use thin lens approximation and measure the distances from center of lens (dashed line). You get two identical sheets, and can use one for trying out the problem, and one for drawing in your good solution and handing it in.
Fig. 2
Homework II
Problem 5
Worksheet

![Diagram showing two parallel lines L1 and L2 with points S, F1, F1F2, and F2, and a distance D between them.]

- S is located above the line L1 and below the line L2.
- F1 is a point on the line L1, F1F2 is a horizontal line segment between F1 and F2, and F2 is a point on the line L2.
- The distance D is measured between the two parallel lines L1 and L2.

The diagram illustrates a basic geometric setup for a problem related to parallel lines and points.
*Note: Measure all radii and distances from the principal plane.
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