

## EE466 Optical Engineering Homework #1

1. Determine the focal length  $f$  of a biconvex lens with radii 20cm and 30cm and refractive index  $n=1.5$ . What is the focal length when the lens is immersed in water ( $n=1.33$ )?
  
2. The lens in the previous problem is changed to a plano-convex lens. What is the radius of curvature of the lens if it is to have the same focal length?
  
3. A simple 35mm camera has a lens with a focal length of  $f=2\text{cm}$ . A person (the object) is standing 2m from the lens.
  - a. How far from the lens must the film (or CCD) be placed for the person to be in focus?
  - b. What is the magnification?
  - c. Draw the ray diagram for this problem.
  
4. A 5cm tall frog is located 0.6m in front of an equiconvex lens ( $n=1.50$ ). The image that is projected onto a screen (a real image) is 25cm high.
  - a. What are the radii of the lens?
  - b. Draw the ray diagram.
  
5. A candle that is 6cm tall is standing 10cm from a thin concave lens whose focal length is -30cm.
  - a. What is the location of the image?
  - b. Is the image real or imaginary?
  - c. What is the size of the image?
  - d. Draw an appropriate ray diagram.
  
6. A 4 inch tall object is to be projected onto a screen that is 10 feet away from a thin lens. Design an optical system that consists of a single lens that produces an image that is 24 inches tall. (It doesn't matter if the image is inverted or not.) If the lens has only one surface that is curved (the other surface is flat), what is the curvature of the lens if the refractive index of the glass is  $n=1.5$ ? Draw the ray diagram.

7. A 4 inch tall object is placed 0.5m in front of a biconvex lens with a focal length of 0.3m. A biconvex lens with a focal length of 0.2m is placed 0.2m after the first lens. Figure 2 Figure 1 shows the lens system.
- Calculate the location and magnification of the image.
  - Is the image real or imaginary?
  - Draw the ray diagram.

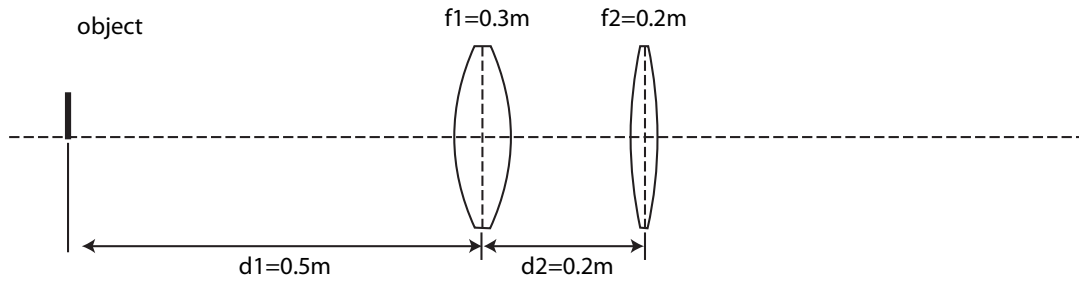


Figure 1

8. A 4 inch tall object is placed 0.2m in front of a biconcave lens with a focal length of -0.3m. A biconvex lens with a focal length of 0.2m is placed 0.4m after the first lens. Figure 2 shows the lens system.
- Calculate the location and magnification of the image.
  - Is the image real or imaginary?
  - Draw the ray diagram.

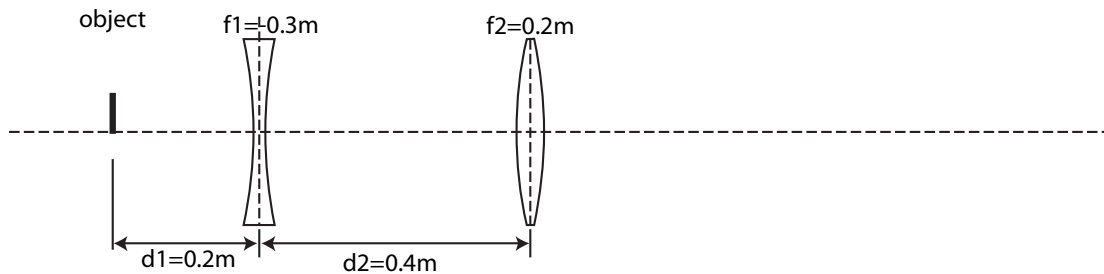


Figure 2

9. A 4 inch tall object is placed 0.2m in front of a biconvex lens with a focal length of 0.3m. A biconcave lens with a focal length of -0.3m is placed 0.4m after the first lens. Figure 3 shows the lens system.
- Calculate the location and magnification of the image.
  - Is the image real or imaginary?
  - Draw the ray diagram.

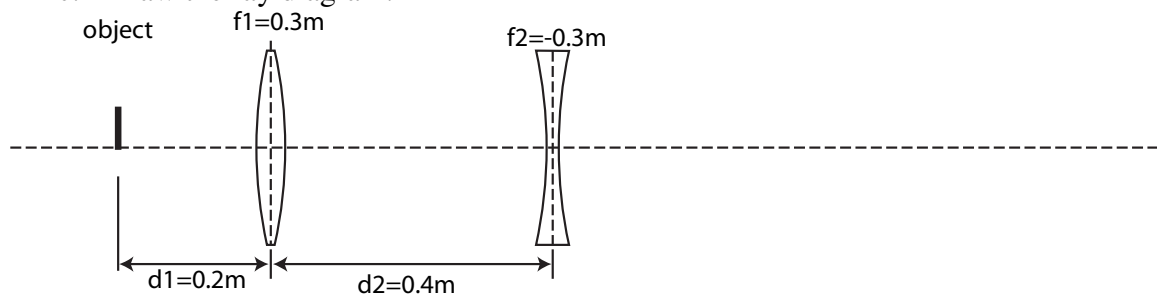


Figure 3