OPAC101-INTRODUCTION TO OPTICS. [Solved Problems (set5)]

[1]. A converging lens a focal length f = 60 mm. Locate, describe and draw the image for the object distance (a) 140 mm (b) 100 mm and (c) 40 mm.

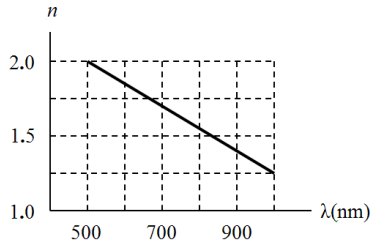
[2]. In a dark room, a burning candle is placed 1.5 m from a white wall. A lens is placed between candle and wall at a location that causes a larger, inverted image to form on the wall. When the lens is moved 90 cm toward the wall, another smaller image of the candle is formed. Find the focal length of the lens.

[3]. The radius of curvature of the spherical surfaces of a bi-convex lens is $R = 20$ cm. The center thickness of the lens is 1 cm. Assume that the lens is made up of a glass whose dispersion curve is a linear function as shown in Figure below.

(a) Suppose that the lens is illuminated by a white light. What is the distance between focal lengths for the blue ($\lambda = 500$ nm) and red ($\lambda = 700$ nm) lights in air?

(b) An object emitting a monochromatic light of $\lambda = 550$ nm is placed at a distance 10 cm in front of the lens.What is the magnification of the lens for this object in air?

(c) The lens is immersed in a liquid. For which values of index of refraction of liquid the lens becomes negative lens?



[4]. Consider a positive meniscus lens with radii of 80 mm and 60 mm. The diameter of the lens is 16 mm and the center thickness of the lens is 6 mm. The dispersion relation of the lens is given by $n(\lambda) = 1.2 + 0.1/\lambda$ where λ is the wavelength in micrometers. An object is placed at a distance 100 mm away from the lens.

(a) Sketch the lens.
(b) Calculate the effective focal length of the lens in mm for $\lambda = 0.5$ μm.
(c) Calculate the f-number of the lens.
(d) Calculate the image distance.
(e) Calculate the magnification.
(f) Draw the ray diagram and describe the image.

[5]. A bi-convex lens has index 1.5 and radius of curvature 200 mm.
(a) Calculate the center thickness of the lens if the focal length is required to be 500 mm.
(b) What is the mass of the lens if its diameter is 25 mm?
(Density of the lens material is 2.4 g/cm^3).

[6]. You have a concave mirror of whose radius of curvature is $|R|$ = 100 cm and aperture diameter is D = 20 cm. This mirror is to be used to visualize the Sun which subtends an angle of 0.5 degrees at the surface of Earth in Gaziantep where the irradiance of the sun is about 1100 W/m^2 (at normal incidence).

(a) Calculate the focal length of the mirror.
(b) Calculate the f-number of the mirror.
(c) What is the image size (diameter) of the sun in the focal plane of the mirror?
(d) What is the irradiance of the image of the sun formed by the mirror?