

Homework Practice 1 - More Lenses

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1. Four lenses of different shape are each made of glass of refractive index 1.6, and each is bounded by surfaces whose radii of curvature are 20 and 30 cm respectively. The lenses have the following shapes:

(a) bi-convex	(+20 cm)
(b) convex meniscus	(+100 cm)
(c) bi-concave	(-20 cm)
(d) concave meniscus	(-100 cm)

 Calculate the focal length in each case.

2. Two lenses, one a positive, the other a negative lens, are placed upon a common principal axis at a distance apart. Find the conditions in order that a parallel beam of rays entering the system by one lens, shall emerge from the other lens as a parallel beam. **(Galilean Telescope)**

3. A thin plano-convex lens of refractive index 1.64 has a power of 0.1 cm^{-1} in air. Find the focal lengths:

(a) when the lens has water (index = 1.33) on the plane side and air on the curved side,	(10.0, 13.3 cm)
(b) when the lens has water on the curved side and air on the plane side.	(27.5, 20.6 cm)

4. Use the paraxial approximation to find the focal length of a mirror of radius R . **($f = R/2$)**

5. (a) The so-called "telephoto" lens system used in a camera consists of a convex lens of focal length 12 cm placed 8 cm in front of a concave lens of focal length 6 cm. The camera is focused on an object 6 metres in front of the convex lens.

(i) What will be the total length of the camera from convex lens to the photographic plate when the image of the object is in focus on the plate.	(22.45 cm)
(ii) What magnification is achieved?	(-0.07)

 (b) The lens system of (a) is now replaced by a single thin converging lens, the focal length of this lens being so chosen that the same magnification results when the distance from the object to the lens remains at 6 metres.

(i) What is the focal length required?	(39.25 cm)
(ii) What will now be the total length of the camera when the image is in focus on the plate?	(42.00 cm)

 (c) Point out one advantage of the telephoto system over the simple lens which emerges from your results.
(0.53 length of single lens camera for same magnification.)

6. An astronomical telescope is made of an object glass of focal length 20 cm and an eyepiece of 5 cm, both converging lenses. Find the magnifying power in the following cases:

(a) When the eye is focused to receive parallel rays, and	(-4)
(b) When the eye sees the image situated at the nearest distance of distinct vision which may be taken as 25 cm.	(-4.8)

 What would the observer notice if he slowly drew his eye back along the axis of the telescope?
(change in brightness and field of view, max. at exit pupil.)