Astronomical Telescopes and Instruments 2010: Exercises on Geometrical Optics 1 (Due on 3 December 2010 at 11:00)

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1 Perfect Lens

Show that the surface of a perfect lens is indeed a hyperbola with eccentricity $e = n$. Assume that $z = 0$ coincides with the vertex of the lens.

2 Spherical Lens

Show that a spherical lens is indeed a paraxial surface when only beams close to the optical axis are considered.

3 Thin-Lens Equation and Gaussian Formula

Derive the thin-lens equation and the Gaussian formula in the paraxial approximation.

4 Focal Length of a Positive Lens

In the dungeons of an observatory you find a positive lens of unknown focal length. How would you determine the focal length of this lens only using a millimeter-scale ruler? Hint: It is a sunny day.

5 Parabolic Mirror

An amateur astronomer polished a spherical mirror with a focal length of 1200 mm and a diameter of 200 mm. Calculate the amount of glass that needs to be removed at the edge of the mirror to make it into a parabolic mirror.