

Notes for Lecture 11

Spherical and plane mirrors

In this lecture, we discussed the spherical and plane mirrors, all of which are described by the following mirror equations, assuming that the object is small or, conversely, the mirror is large, so that the angle of incidence can be considered very small.

$$\frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f} \quad (11.1)$$

$$m = \frac{d_i}{d_o} = -\frac{h_i}{h_o} \quad \text{lateral magnification} \quad (11.2)$$

$$f = \frac{r}{2} \quad \text{imaging point of a distant object} \quad (11.3)$$

The sign conventions of all these quantities must be followed carefully (see your note or the book). I recommend using these equations and at least two ray diagrams.

In all of these treatments, we assume that the mirror is perfect, in which case the specular reflection, $\theta_i = \theta_f$, that follows the law of reflection is the only reflection to consider. For a real mirror, the surface is never perfect, and there will be loss of intensity to diffuse background.

Two types of spherical mirrors exist: concave ($r, f > 0$) and convex ($r, f < 0$). Since I used these two terms in a somewhat confused way in the lecture, here I must repeat some key facts. The rear view mirror or the side view mirror of a car is a convex mirror, while a circular vanity mirror that can be often found in a hotel room is a concave mirror. For a convex mirror, $|m| < 1$ always: in other words, you get a wide view with a small mirror. It always gives you a virtual upright image. For a concave mirror, you can get a real inverted image or a virtual upright image, depending on

where the object is placed. Especially important is the fact when the object is close to the focal point, you get great magnification. Slightly inward past the focal point is the object position for which a vanity mirror can be very useful. Through the focal point, the nature of the image flips: i.e., if the object is placed inside of the focal point, you get a virtual upright image, while if the object is placed outside of the focal point, you get a real inverted image. Please check out these types of mirrors and try to feel their curvatures, next time you see them!

For a plane mirror, $r \rightarrow \pm\infty$, + for concave and – for convex, gives the correct set of equations.