



deviation, but it does suffer lateral displacement/ shift with respect to the incident ray. Another familiar observation is that the bottom of a tank filled with water appears to be raised (Fig. 9.10). For viewing near the normal direction, it can be shown that the apparent depth (h_1) is real depth (h_2) divided by the refractive index of the medium (water).

The refraction of light through the atmosphere is responsible for many interesting phenomena. For example, the Sun is visible a little before the actual sunrise and until a little after the actual sunset due to refraction of light through the atmosphere (Fig. 9.11). By actual sunrise we mean the actual crossing of the horizon by the sun. Figure 9.11 shows the actual and apparent positions of the Sun with respect to the horizon. The figure is highly exaggerated to show the effect. The refractive index of air with respect to vacuum is 1.00029. Due to this, the apparent shift in the direction of the Sun is by about half a degree and the corresponding time difference between actual sunset and apparent sunset is about 2 minutes (see Example 9.5). The apparent flattening (oval shape) of the Sun at sunset and sunrise is also due to the same phenomenon.

