## Physics



**FIGURE 9.25** Rainbow: (a) The sun rays incident on a water drop get refracted twice and reflected internally by a drop; (b) Enlarged view of internal reflection and refraction of a ray of light inside a drop forming primary rainbow; and (c) secondary rainbow is formed by rays undergoing internal reflection twice inside the drop.

When light rays undergoes *two* internal reflections inside a raindrop, instead of *one* as in the primary rainbow, a secondary rainbow is formed as shown in Fig. 9.25(c). It is due to four-step process. The intensity of light is reduced at the second reflection and hence the secondary rainbow is fainter than the primary rainbow. Further, the order of the colours is reversed in it as is clear from Fig. 9.25(c).

## 9.7.2 Scattering of light

As sunlight travels through the earth's atmosphere, it gets *scattered* (changes its direction) by the atmospheric particles. Light of shorter wavelengths is scattered much more than light of longer wavelengths. (The amount of scattering is inversely proportional to the fourth power of the wavelength. This is known as Rayleigh scattering). Hence, the bluish colour predominates in a clear sky, since blue has a shorter wavelength than red and is scattered much more strongly. In fact, violet gets scattered even more than blue, having a shorter wavelength. But since our eyes are more sensitive to blue than violet, we see the sky blue.

Large particles like dust and water droplets present in the atmosphere behave differently. The relevant quantity here is the relative size of the wavelength of light  $\lambda$ , and the scatterer (of typical size, say, *a*). For  $a \ll \lambda$ , one has Rayleigh scattering which is proportional to  $1/\lambda^4$ . For  $a \gg \lambda$ , i.e., large scattering objects (for example, raindrops, large dust or ice particles) this is not true; all wavelengths are scattered nearly equally. Thus, clouds which have droplets of water with  $a \gg \lambda$  are generally white.