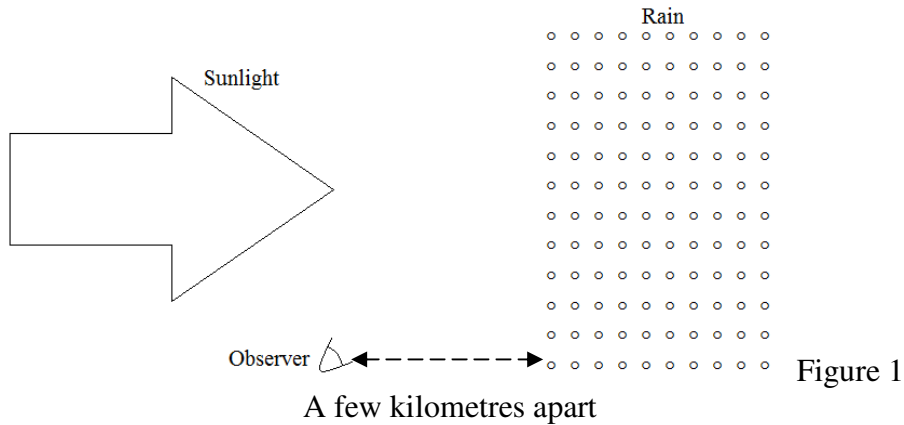


Rainbows

Required conditions for the appearance of a rainbow See Figure 1



A ray entering a raindrop undergoes reflection, refraction and internal reflection

Figure 2 shows a ray entering a spherical raindrop. The sun ray loses its intensity due to some reflection occurring at the surface. Inside the raindrop, besides internal reflection of the rays, there is transmission to the outside resulting in further loss of intensity. The angles of deviation for the most intense emerging ray are 40° approximately for blue ray and 42° for red ray. See Figure 2

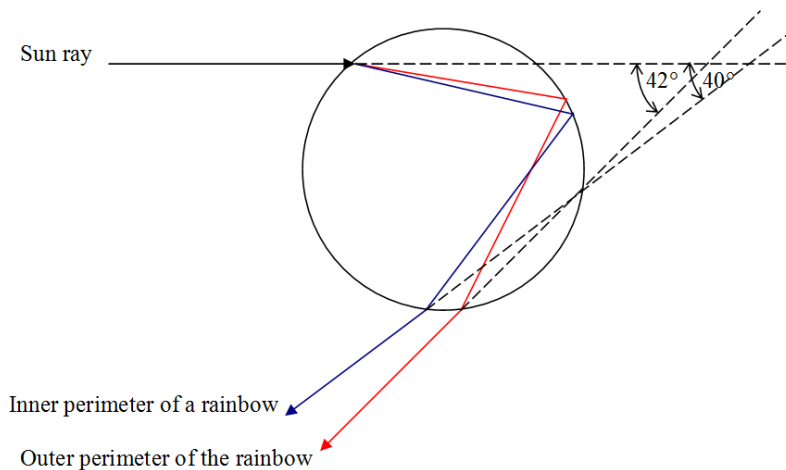


Figure 2

To an observer only those raindrops meeting the required angles of deviation between 40° and 42° display the colours of a rainbow. See Figure 3 (larger arc) and Figure 4 (smaller arc)

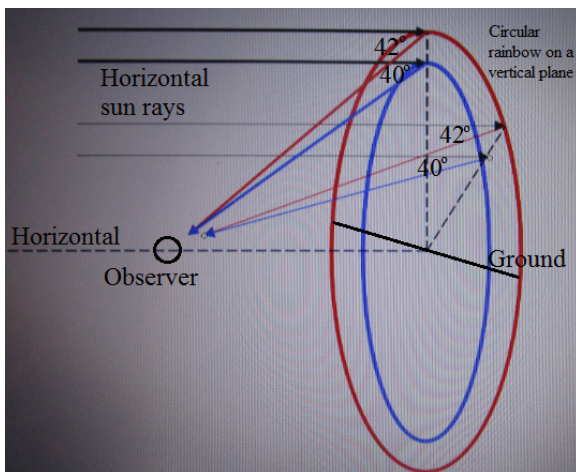


Figure 3

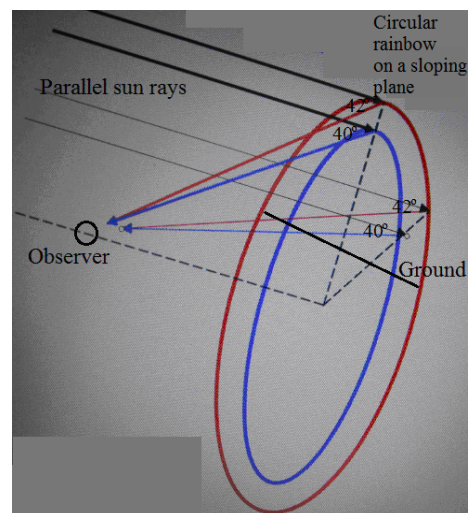


Figure 4

A cone is formed with the circular rainbow as the base of the cone and the observer as the vertex of the cone. See Figure 5

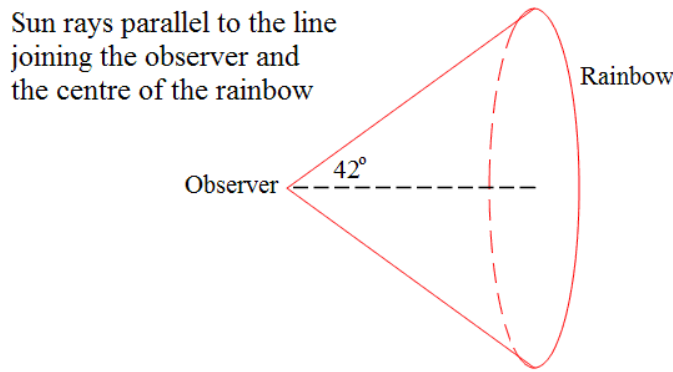


Figure 5

An example of different observers seeing different rainbows

The difference in the angles of deviation between the red and the blue rays from a raindrop is about $2^\circ \approx 0.035$ radians.

Raindrops in a rainbow seen by observers are a few kilometres away (say 5 km).

The two rays from **the same raindrop** will be about 150-200 m apart after propagating that distance. $0.035 \times 5000 \approx 175$ m See Figure 6

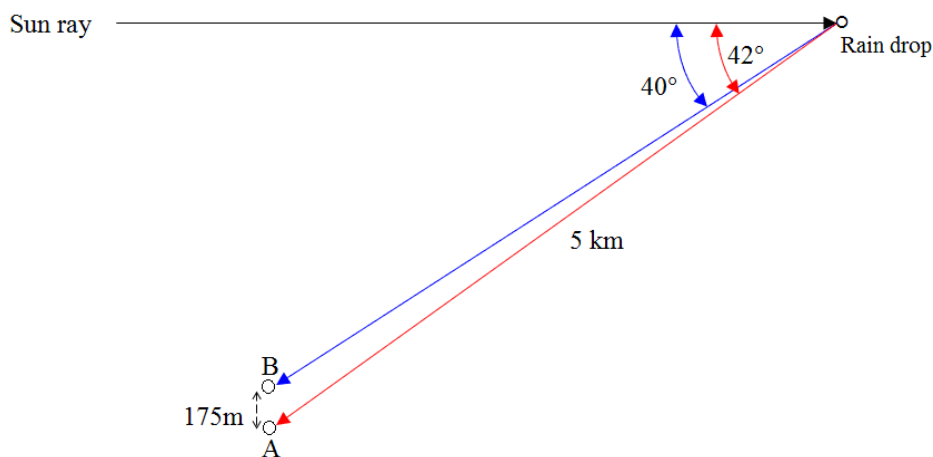


Figure 6

Observer A sees a rainbow with the raindrop in its outer perimeter.

Observer B sees a different rainbow with the same raindrop in its inner perimeter. See Figure 7

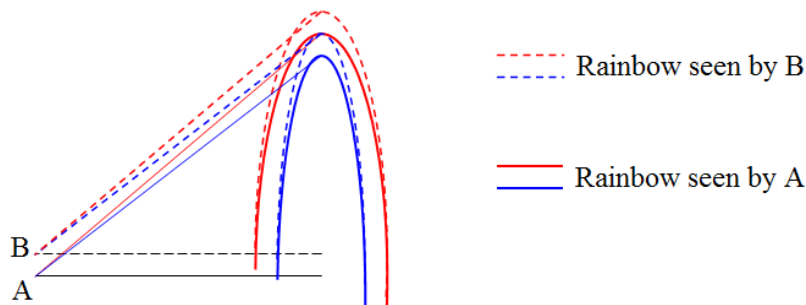


Figure 7