SCIENCE

REFLECTION OF LIGHT

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I. **Definition :** When light rays travelling in one medium are incident on a transparent surface (medium), they are bent as they travel in second medium.

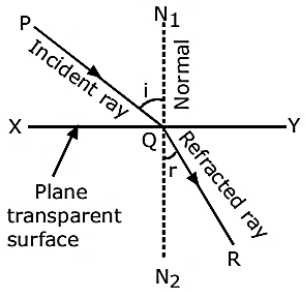


Fig. Refraction of light from a plane transparent denser surface.

II. Definitions of some associated terms

1. Transparent surface : The plane surface which refracts light, is called transparent surface. In diagram, XY is the section of a plane transparent surface.

2. Point of incidence : The point on transparent surface, where the ray of light meets it, is called point of incidence. In diagram, Q is the point of incidence.

3. Normal : Perpendicular drawn on the transparent surface at the point of incidence, is called normal. In diagram, N1QN2 is the normal on surface XY.

4. Incident ray : The ray of light which strikes the transparent surface at the point of incidence, is called incident ray in diagram PQ is the incident ray.

5. Refracted ray : The ray of light which travels from the point of incidence into the other medium, is called refracted ray. In diagram, QR is the refracted ray.

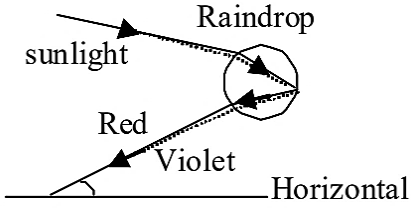
6. Angle of incidence : The angle between the incident ray and the normal on the transparent surface at the point of incidence, is called the angle of incidence. It is represented by the symbol i. In diagram, angle PQN1 is the angle of incidence.

7. Angle of refraction : The angle between the refracted ray and the normal on the transparent surface at the point of incidence, is called angle of refraction. It is represented by symbol r. In diagram angle RQN2 is the angle of refraction.

REFRACTION IN NATURE

(A) FORMATION OF RAINBOW

A rainbow is a natural spectrum appearing in the sky after a rain shower. It is caused by dispersion of sunlight by tiny water droplets, present in the atmosphere. A rainbow is always formed in a direction opposite to that of the Sun. The water droplets act like small prisms. They refract and disperse the incident sunlight, then reflect it internally, and finally refract it again when it comes out of the raindrop. Due to the dispersion of light and internal reflection, different colours reach the observer's eye.



(B) ATMOSPHERIC REFRACTION

We can observe the apparent random wavering or flickering of objects seen through a turbulent stream of hot air rising above a fire or a radiator. The air just above the fire becomes hotter than the air further up. The hotter air is lighter (less dense) than the cooler air above it, and has a refractive index slightly less than that of the cooler air. Since the physical conditions of the refracting medium (air) are not stationary, the apparent position of the object, as seen through the hot air, fluctuates. This wavering is thus an effect of atmospheric refraction (refraction of light by the earth's atmosphere) on a small scale in

our local environment. The twinkling of stars is a similar phenomenon on a much larger scale.

(a) Twinkling of stars :

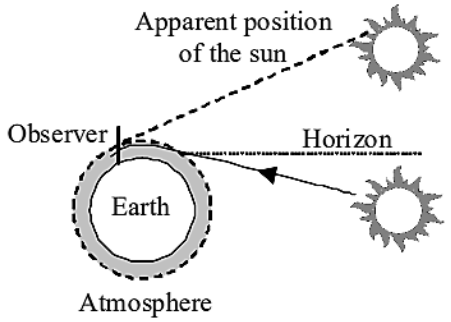
The twinkling of a star is due to atmospheric refraction of starlight. The starlight, on entering the earth's atmosphere, undergoes refraction continuously before it reaches the earth. The atmospheric refraction occurs in a medium of gradually changing refractive index. Since the stars are very distant, they approximate point-sized sources of light. As the path of rays of light coming from the star goes on varying slightly, the apparent position of the star fluctuates and the amount of starlight entering the eye flickers – the star sometimes appears brighter, and at some other time, fainter, which is the twinkling effect.

(b) Why don't the planets twinkle?

The planets are much closer to the earth, and are thus seen as extended sources. If we consider a planet as a collection of a large number of point-sized sources of light, the total variation in the amount of light entering our eye from all the individual point-sized sources will average out to zero, thereby nullifying the twinkling effect.

(c) ADVANCE SUNRISE AND DELAYED SUNSET :

Advance sunrise and delayed sunset The Sun is visible to us about 2 minutes before the actual sunrise, and about 2 minutes after the actual sunset because of atmospheric refraction. By actual sunrise, we mean the actual crossing of the horizon by the Sun. figure shows the actual and apparent positions of the Sun with respect to the horizon. The time difference between actual sunset and the apparent sunset is about 2 minutes. The apparent flattening of the Sun's disc at sunrise and sunset is also due to the same phenomenon.



Atmospheric refraction at sunrise and sunset