Refraction of light through a prism



Dispersion of light: When white light is passed through a glass prism, it splits into its seven constituent colours to form a band of seven colours. This phenomenon is called dispersion.



 \rightarrow The sequence of colours in band of colours is observed as VIBGYOR (Violet, Indigo, Blue, Green, Yellow, Orange and Red). This band of colour is known as spectrum.

 \rightarrow The splitting of white light is due to bending of light rays at different angles.

Rainbow formation: It is caused by dispersion of sunlight by tiny water droplets, present in the atmosphere. It is always formed in a direction opposite to the Sun. The water droplets act like small prisms.

Three phenomenon involved in rainbow formation are:

- (i) Dispersion
- (ii) Refraction
- (iii) Internal reflection

The water droplets first refract and disperse the incident sunlight. The light then reflects internally and again refracts as it come out of the drop to give a band of seven colours that we observer as rainbow.



Atmospheric Refraction: The refraction of light caused by the earth's atmosphere is called Atmospheric Refraction. It is caused by the bending of light rays when they pass through the various layers of the earth's atmosphere having different optical densities.

Advance sunrise and delayed sunset:

Actual sun rise happens when it comes above the horizon in the morning. But the rays of light from the sun below the horizon reach our eyes 2 minutes earlier than actual sunrise due to the refraction of sunlight as it enters the earth's atmosphere. Similarly,

the sun can be seen for about 2 minutes after the actual sun set due to the atmospheric refraction.



Apparent random wavering or flickering of objects placed behind a hot object or

fire: The air just above the fire becomes hotter than the air further up. Hot air is lighter than the cold air above it. Thus, the optical density of hot air is less than that of the cold air. Since, the density does not remain the same, the apparent position of the object as seen through hot air, fluctuates.

Stars near the horizon appear slightly higher than their actual position: Air higher up in the sky is rarer but that near the earth's surface is denser. When the light from a star comes down, the dense air bends the light more. Thus the apparent position of the star is slightly different from its actual position. The star appears slightly higher than its actual position when viewed near the horizon.



Twinkling of stars: The stars are very distant and act like the point sources of light. Since the physical conditions of the earth's atmosphere are not stationary the beam of starlight keeps on deviating from its path. Due to this, the apparent position of star keeps on changing. Therefore, the amount of starlight entering the eye fluctuates sometime brighter and sometime fainter. This is the twinkling effect of star.

Scattering of light: It is the phenomenon by which a beam of light is redirected in different directions on interacting with the particles present in it path.

Tyndall effect: It is the phenomenon of scattering of light by the colloidal particles. \rightarrow The colour of the scattered light depends on the size of the scattering particles.

 \rightarrow Very fine particles scatter mainly blue light (shorter wavelengths) while particles of larger size scatter light of longer wavelengths.

 \rightarrow Large particles scatter all colours of light and thus the scattered light appears white.

Applications of Tyndall Effect in daily life:

Colour of the clear sky appears blue: When sunlight passes through the atmosphere, the fine particles in air scatter the blue colour (shorter wavelengths) more strongly than red. Therefore, the scattered blue light enters our eyes making the sky appear blue.

Sky appears dark to an astronaut: As there is no atmosphere in space so there are no particles to cause scattering of light. Therefore, the sky appears dark instead of blue to an astronaut in space.

Clouds appear white: Clouds are formed by water vapours. Water vapours condense to form water droplets. These water droplets are much bigger than the atmospheric particles due to which they scatter all colours of sunlight almost equally causing the clouds appear white.

Danger signal lights are red in colour: The red is least scattered by the particles of fog or smoke. Therefore, it can be seen in the same colour at a distance.

Colour of the sun appears red during sunrise and sunset: At sunrise or sunset, the sun is located near the horizon, Hence, the light has to travel a long distance through the Earth's atmosphere. Therefore, most of the blue light and shorter wavelengths are scattered away by the suspended particles. Therefore, the light that reaches our eyes is of longer wavelengths, hence the sun appears red.



On the other hand, at noon, the sun is overhead and therefore the light from the sun would have to travel shorter distance. Due to this, only a little of the blue and violet colours are scattered causing the sun to appear white.