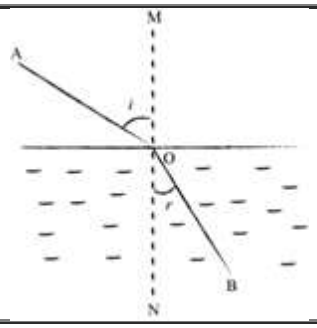
6. Refraction of Light

- **Refraction:** Bending or change in the direction of light as it passes from one medium to another
- Refraction of light occurs because of change in the speed of light due to a change in the medium.
- When light enters an optically denser medium from an optically rarer medium, the speed of light slows down and light bends towards the normal.
- The opposite happens when light enters an optically rarer medium from an optically denser medium.

- **Effect on various characteristics of light on reflection and refraction:**

Characteristics	Partially reflected light	Partially refracted light	
		Rarer to denser	Denser to rarer
Speed of light	No change	Decreases	Increases
Frequency of light (*f*)	No change	No change	No change
Wavelength of light (λ=vf)	No change	Decreases	Increases

- **Refraction Laws**

	AO, OB, and MON are co-planar $\frac{\sin i}{\sin r} = \text{constant}$ (Snell's law)	Incident ray, refracted ray, and normal to the interface at incident point are co-planar

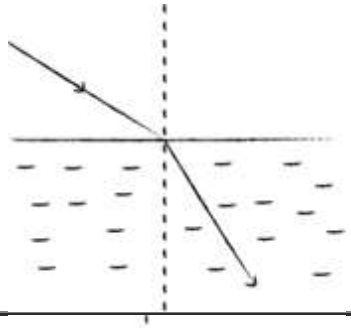
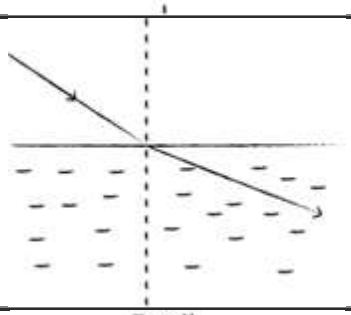
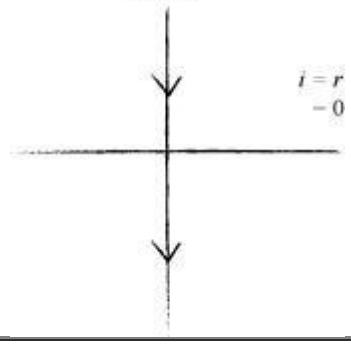
- **Refractive index (RI)**

μ12 (μ of 2 w.r.t 1)=Velocity of light in medium 1Velocity of light in medium 2=v1v2

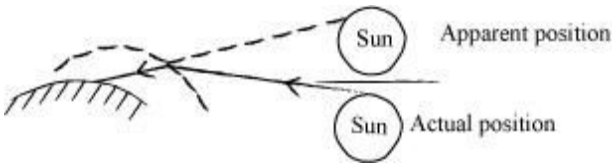
(Absolute RI when medium 1 = Vacuum)

(Light speed in vacuum is = 3×10^8 m/s)

	Medium (Optically denser) = μ > 1

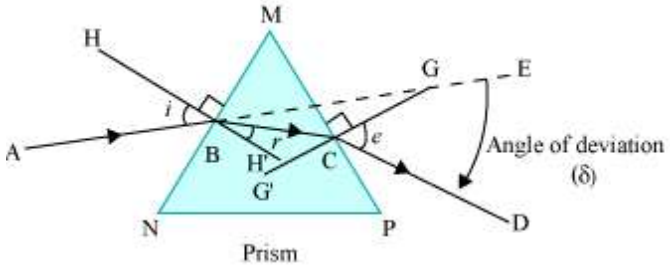
	
	Optically rarer = $\mu < 1$
For all 	path of a ray when there is no change in medium.

- **Flickering of objects -** this is because the air above the fire is relatively hotter than the air further up in the atmosphere.
- **Twinkling of stars –** caused by changing air density in the atmosphere
- **Early sunrise and delayed sunset –** caused by refraction of light through the atmosphere

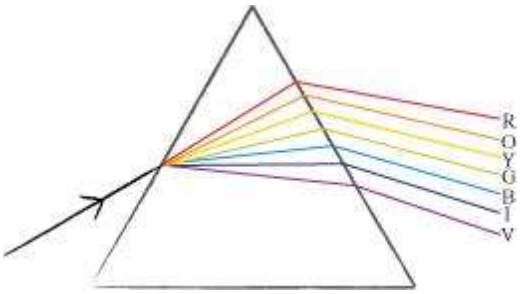


- The sun and the planets do not twinkle because they are not seen as point sources like stars, but are considered as extended sources.

- **Refraction through a prism**
  - Light bends because of refraction that takes place at points **B** and **C .**
  - The extent of deviation of the light ray from its path BE to path CD is known as the angle of deviation (δ)



- The splitting of a beam of white light into its seven constituent colours, when it passes through a glass prism, is called the **dispersion of light.**



  - Red → Disperses least
  - Violet → Disperses most
  - Yellow → Average of all lights
- Formation of rainbow is a natural phenomenon in which white sunlight splits into beautiful colours by water droplets.

- **Condition for total internal reflection:**

If a ray of light travelling from an optically denser medium to an optically rarer medium is incident at an angle greater than the critical angle for the pair of media in contact, the ray is totally reflected back into the denser medium, thereby causing total internal reflection.

μba=1sinC

- **Applications of total internal reflection:**

Multiple internal reflections in diamond ($i_c \cong 24.4°$), totally reflecting prisms and mirage are some examples of total internal reflection.

Optical fibres

- Optical fibres consist of glass fibres coated with a thin layer of material with a lower refractive index 1.5; this is called **cladding**.
- The central part of the fibres,called **core**, is made up of material with refractive index 1.7.
- Any light that is incident at an angle at one end comes out from the other after multiple internal reflections, even if the fibre is bent.
- Optical fibres are used for transmitting audio and video signals to long distances.
- They are used in endoscopes for medical examinations of inner parts of the body of a patient.