# Class 10 ScienceChapter 6 - Refraction Of Light

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**Question 1:**

Fill in the blanks and Explain the completed sentences.
a . Refractive index depends on the ............. of light.
b. The change in ................ of light rays while going from one medium to another is called refraction.

**ANSWER:**

a. Refractive index depends on the wavelength of light.
b. The change in direction of light rays while going from one medium to another is called

refraction.

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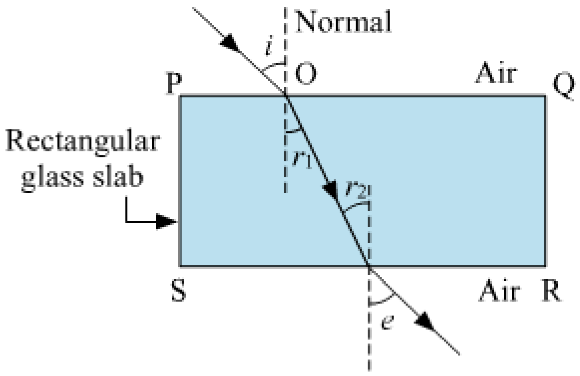
**Question 2:**

Prove the following statements.
a. If the angle of incidence and angle of emergence of a light ray falling on a glass slab are i and e respectively, prove that, i = e.
b. A raibow is the combined effect of the refraction, dispersion, and total internal reflection of light.

**ANSWER:**

a.




Let $\mu$ be the refractive index of the glass slab. Then, according to Snell's law,

$\frac{\sin\ i}{\sin\ r_1} = \mu$ .....(i)

and

$\frac{\sin\ r_2}{\sin\ e} = \frac{1}{\mu}$ .....(ii)

But, $r_1 = r_2$ .....(iii)

Putting (iii) in (i), we have

$\frac{\sin\ i}{\sin\ r_2} = \mu$ .....(iv)

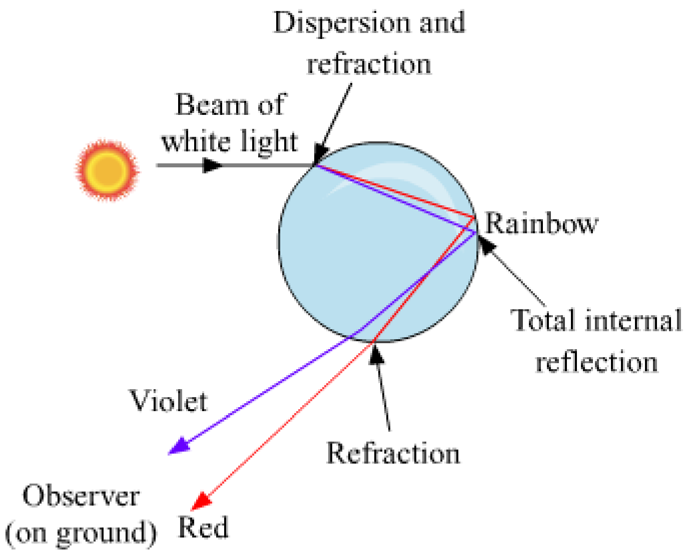
Multiplying (i) and (iv), we have

$\frac{\sin\ i}{\sin\ e} = 1$

or

$i = e$

b.




After rainfall, the tiny droplets of water present in the atmosphere act as a prism for the rays coming from the Sun. Thus, the sunlight after striking the surface of the droplets gets refracted and dispersed into its seven components as shown in the figure (figure showing just two components). After this, the light rays are subjected to total internal reflection. Then the rays are again refracted when they come out of the water droplet. Hence, rainbow formation is the combined effect of the refraction, dispersion, and total internal reflection of light.

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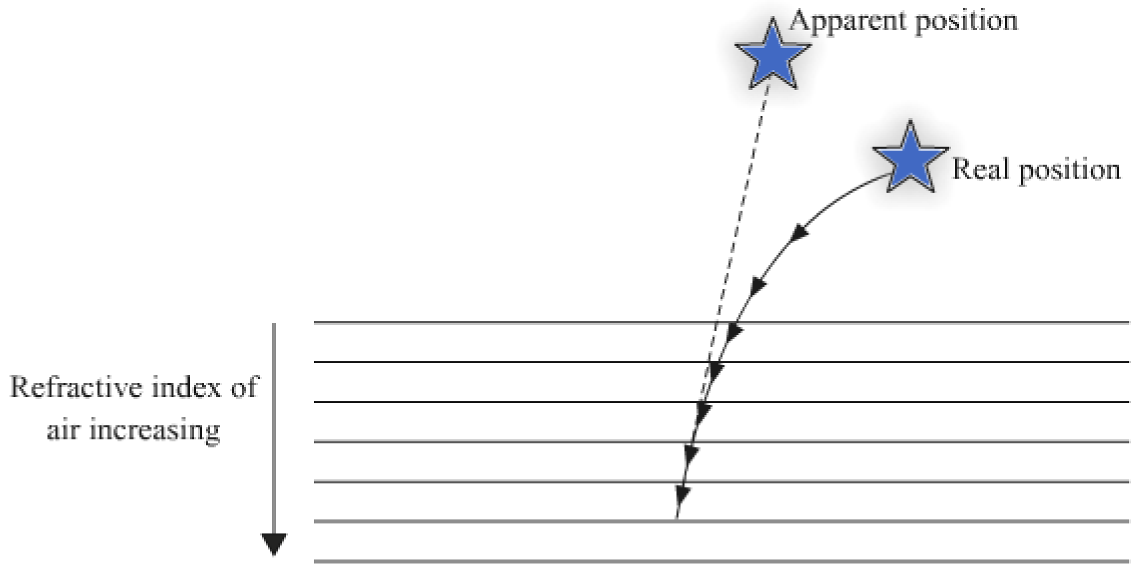
**Question 3:**

Mark the correct answer in the following questions.
A. What is the reason for the twinkling of stars?
i . Explosions occurring in stars from time to time
ii. Absorption of light in the earth's atmosphere
iii. Motion of stars
iv. Changing refractive index of the atmospheric gases
B. We can see the Sun even when it is little below the horizon because of
i. Reflection of light
ii. Refraction of light
iii. Dispersion of light
iv. Absorption of light
C. If the refractive index of glass with respect to air is 3/2, what is the refractive index of air with respect to glass?
a. $\frac{1}{2}$ b. 3
c. $\frac{1}{3}$ d. $\frac{2}{3}$

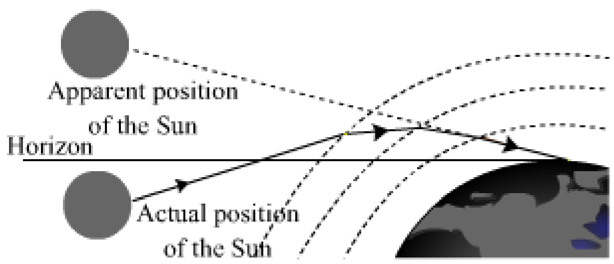
**ANSWER:**

A. The correct reason for the twinkling of stars is changing refractive index of the atmospheric gases.

Light coming from the stars undergoes refraction on entering the Earth's atmosphere. This refraction continues until it reaches the Earth's surface. This happens because of temperature variation of atmospheric air. Hence, the atmospheric air has changing refractive index at various altitudes. In this case, starlight continuously travels from a rarer medium to a denser medium. Hence, it continuously bends towards the normal. The refractive index of air medium gradually increases with a decrease in altitude. The continuous bending of starlight towards the normal results in a slight rise of the apparent position of the star.




B. We can see the Sun even when it is little below the horizon because of refraction of light.




The rays of light from the Sun travel in straight line until they reach the Earth's atmosphere. The rays of light from the Sun enter obliquely in the Earth's atmosphere. The light rays coming from the Sun bend because of refraction, and this bending increases further because of the further increase in the refractive index of the successive layers. This causes the light rays to bend and we see the Sun early. Similarly, at sunset, the apparent position of the Sun is visible to us and not the actual position because of the same bending of light rays effect. Thus, due to refraction we see the Sun rise about two minutes before it is actually there and during sunset, we see it for around two minutes more, even though it has already moved from that position.

C. ${}_a\mu_g = \frac{\mu_g}{\mu_a} = \frac{3}{2}$
where,
$${}_a\mu_g = \text{Refractive index of glass w.r.t. air}$$
$$\mu_{\mathrm{g}} = \text{Refractive index of glass}$$
$$\mu_{\mathrm{a}} = \text{Refractive index of air}$$
Thus,
$${}_g\mu_a = \frac{\mu_a}{\mu} = \frac{2}{3}$$

where, ${}_{g}\mu_{a} = \text{Refractive index of air w.r.t. glass}$
Hence, the correct answer is option d.

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### Question 4:

Solve the following examples.
a. If the speed of light in a medium is 1.5 × $10^8$ m/s, what is the absolute refractive index of the medium?
b. If the absolute refractive indices of glass and water are 3/2 and 4/3 respectively, what is the refractive index of glass with respect to water?

### ANSWER:

a.

$$\text{Absolute refractive index of a medium, } \mu = \frac{\text{Speed of light in air}}{\text{Speed of light in the medium}}$$

$$\Rightarrow \mu = \frac{3\times10^8}{1.5\times10^8} = 2$$

b.

$${}_{\mathrm{a}}\mu_{\mathrm{g}} = \frac{3}{2} \text{ and } {}_{\mathrm{a}}\mu_{\mathrm{w}} = \frac{4}{3}$$

$${}_{\mathrm{w}}\mu_{\mathrm{g}} = ?$$

where,

$${}_{\mathrm{w}}\mu_{\mathrm{g}} = \text{Refractive index of glass w.r.t. water}$$

$${}_{\mathrm{a}}\mu_{\mathrm{g}} = \text{Absolute refractive index of glass}$$

$${}_{\mathrm{a}}\mu_{\mathrm{w}} = \text{Absolute refractive index of water}$$

Now,

$${}_{\mathrm{a}}\mu_{\mathrm{g}} = \frac{3}{2} \text{ and } {}_{\mathrm{a}}\mu_{\mathrm{w}} = \frac{4}{3}$$

$${}_{\mathrm{w}}\mu_{\mathrm{g}} = \frac{{}_{\mathrm{a}}\mu_{\mathrm{g}}}{{}_{\mathrm{a}}\mu_{\mathrm{w}}} = \frac{3}{2} \times \frac{3}{4} = \frac{9}{8}$$