

DPP – 7

Light - Reasoning Questions

1. **What two conditions must be fulfilled for total internal reflection of light to occur?**

Conditions for total internal reflection;

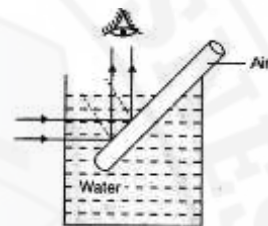
- (i) The ray must strike the interface from denser side.
- (ii) Angle of incidence must be greater than the critical angle.

2. **Can a glass slab disperse light? If not, why?**

No, when the white light is incident on the glass slab, it disperses the white light into different colours but these different colours combine to form white light on emerging from the other parallel face.

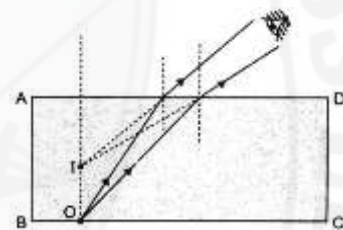
3. **Why does the surface of an empty test tube (kept in a beaker filled with water) shines like a mirror? Explain. .**

The surface of the test tube separates water (denser medium) from air (rarer medium) in the tube. The incident rays on the surface of tube shows the phenomenon of total internal reflection which makes the surface of an empty test tube shiny like a mirror.



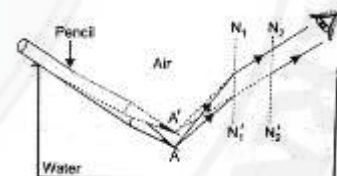
4. **If a glass block is placed over a mark on paper, the mark seems to rise. Explain.**

When a glass block is placed over a mark on a paper, the mark seems to rise due to refraction of light from denser medium to rarer medium at the plane surface separating the two media.



5. **A pencil partially immersed in water in glass, appears bent. Explain with the help of a ray diagram.**

A pencil partially immersed in water in a glass container appears bent as shown in the figure because the rays appear to come from B due to refraction from denser medium (water) to rarer medium (air) at the surface separating two media.



6. **A harpoon used to kill a fish is aimed at a point below the position of the fish. Why?**

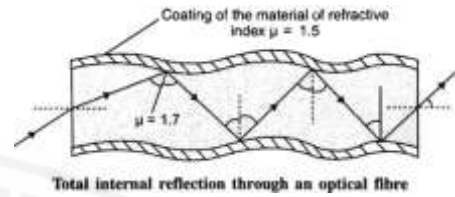
A harpoon used to kill a fish is aimed at a point below the position of the fish because the fish appears to be raised up due to refraction of light from denser medium (water) to rarer medium (air) at the surface separating two media.

7. **How can you account for the brilliance of a diamond?**

Refractive index of diamond is 2.42 and the critical angle is 24° only. The faces of diamond are cut in such a way that the ray of light entering the diamond suffers repeated total internal reflections (angle of incidence is greater than critical angle) from different faces and finally comes out of it. Thus it sparkles.

8. **What do you mean by an optical fibre? Draw a labelled diagram to illustrate its working.**

Optical fibre consists of thousands of long fine quality glass or quartz fibre of high refractive index of 1.7. Optical fibres are coated with a thin layer of a material of low refractive index of about 1.5. When



light is incident on one end of the fibre at small angle, it suffers total internal reflections along the fibre and comes out at the other end of the bent fibre as shown in the figure.

Optical fibre is used in telephone and other signal transmitting cables.

9. **If a monochromatic beam of light undergoes minimum deviation through an equiangular prism, how does the beam pass through the prism, with respect to its base?**

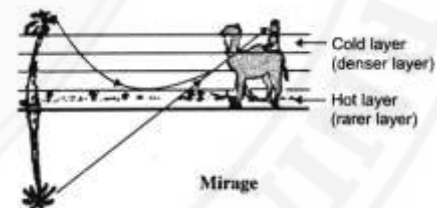
In the position of minimum deviation through an equiangular prism, the angle of incidence is equal to angle of emergence (i.e., $i = e$) hence the refracted beam passes parallel to the base of the prism.

10. **If white light is used in the same way as in above, what change is expected in the emergent beam?**

If white light is used in the same way as in above, dispersion of light takes place. We know that the angle of deviation depends on the wavelength of light. The refractive index of a given transparent material decreases with the increase in the wavelength of the light (i.e., as $\lambda_r > \lambda_v$, $\mu_v > \mu_r$) consequently the given prism deviates the violet light more than the red light (i.e., $\delta_v > \delta_r$)

11. **What do you mean by phenomenon of mirage? Explain it briefly with the help of a ray diagram.**

Mirage is an optical illusion caused due to total internal reflection of light in sandy deserts or in some extended surface like a black tarred road in very hot weather.



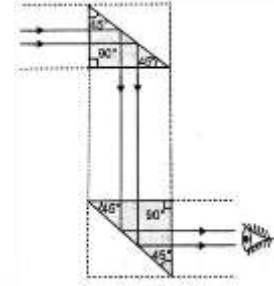
In hot summer days sandy land becomes very hot

during the day time. The air in contact with the ground becomes hot and its density is reduced whereas the density of air at higher level remains unaffected. Therefore, the layers of air near the ground are warmer than the air at the upper level. Thus, the successive upper layers are denser than those below them.

When the ray of light from the top of a tree travels from a denser to a rarer layer, it bends away from a normal and thereby at a stage the angle of incidence becomes greater than the critical angle, the rays suffer total internal reflection and reach the eyes of the observer. Observer sees an inverted image of the tree and concludes that there is water near the tree. Thus it gives an optical illusion.

12. **What is a periscope? Draw a ray diagram using right angled prisms.**

Periscope is an apparatus used to view the objects at a height/depth which are not visible directly. In periscope, if two parallel plane mirrors are used, it works on the principle of reflection or two right angled prisms are placed parallel, then it works on the principle of total internal reflection.



13. **Light passes through a rectangular glass slab and through a triangular glass prism. In what way does the direction of the two emergent beams differ and why?**

In a rectangular glass slab, the emergent ray is laterally displaced because the two refracting surfaces are parallel to each other.

In a triangular glass prism, the emergent ray is deviated because two refracting surfaces are inclined to each other at an angle.

14. **Why do the faces of persons sitting around camp fire appear to shimmer?**

The rays coming from the face of person, sitting across the camp fire, suffer refraction on passing through hot air. Thus, we see apparent image of person. Since hot air is in motion, therefore its optical density changes, which in turn shifts the image rapidly. This rapidly shifting image gives a shimmering effect.

15. **Why do stars twinkle?**

This is due to refraction of light.

Our atmosphere consist of various layers of air. As we go up in atmosphere layers gradually becomes rarer. Due to this reason light coming from stars bends more and more towards normal before reaching the observer. But due to strong wind and convection current the light from the star is refracted in different directions. This causes the star's image to change slightly in brightness and position, hence "twinkle."

16. **Why do stars show twinkling effect whereas planet do not?**

Planet do not twinkle as the stars, as they are much closer to the earth and subtend larger angle on the eyes of the observer. Thus a small variations in their position is not noticeable under low intense light from these planets

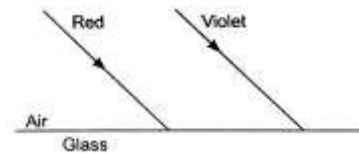
17. **Why does sun appear bigger during sunset and sunrise?**

During sunset or sunrise, the rays of light from sun travel through a long distance through air. Thus, the apparent image of sun is formed closer to eye, which in turn appears bigger.

18. **Why does sun appear reddish during sunset and sunrise?**

19. **During sunset and sunrise, sun is seen even when it is below the horizon. Explain?**

20. Two parallel rays of Red and Violet colour travelling through air, meet the air-glass boundary as shown in the figure



- a) Will their paths inside the glass be parallel? Give a reason for your answer. .
- b) Compare the speeds of the two rays inside the glass.
21. Why upper surface of water contained in a beaker and above eye level appears silvery?
22. Does the depth of tank filled with water appears to change or remain same when viewed normally from above?
23. Does a beam of white light give a spectrum on passing through a hollow prism?
24. Why does welder wear a mask?
25. Rock salt prism is used instead of glass prism to obtain infrared spectrum. Explain why?
26. Why danger signals red?
27. Why does sky appears blue?
28. Why do people prefer light coloured dresses during summer and dark dresses during winter?
29. Why does sky appear dark instead of blue to the passengers at very high altitudes or to an astronaut?
30. Why do clouds appear white?