Science

(<u>www.tiwariacademy.com</u>) (Chapter – 10) (Light – Reflection and Refraction)

(Class – X)

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Question 1:

A ray of light travelling in air enters obliquely into water. Does the light ray bend towards the normal or away from the normal? Why?

Answer 1:

The light ray bends towards the normal.

When a ray of light travels from an optically rarer medium to an optically denser medium, it gets bent towards the normal. Since water is optically denser than air, a ray of light travelling from air into the water will bend towards the normal.

Question 2:

Light enters from air to glass having refractive index 1.50. What is the speed of light in the glass? The speed of light in vacuum is 3×10^8 m s⁻¹.

Answer 2:

Refractive index of a medium n_m is given by,

 $n_{\rm m} = \frac{\text{Speed of light in vacuum}}{\text{Speed of light in the medium}} = \frac{c}{v}$

Speed of light in vacuum, $c = 3 \times 10^8 \text{ m s}^{-1}$

Refractive index of glass, $n_g = 1.50$

Speed of light in the glass, $v = \frac{c}{n_{e}} = \frac{3 \times 10^{8}}{1.50} = 2 \times 10^{8} \,\mathrm{m \, s^{-1}}$



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Question 3:

Find out, from Table 10.3, the medium having highest optical density. Also find the medium with lowest optical density.

Table 10.3 Absolute refractive index of some material media					
Material medium	Refractive index	Material medium	Refractive index		
Air	1.0003	Canada Balsam	1.53		
Ice	1.31		8		
Water	1.33	Rock salt	1.54 🚬		
Alcohol	1.36				
Kerosene	1.44	Carbon disulphide	1.63		
Fused	1.46		Q		
quartz		Dense flint glass	1.65		
Turpentine oil	1.47	Ruby	1.71		
Benzene	1.50	Sapphire	1.77		
Crown glass	1.52	Diamond	2.42		

Answer 3:

Highest optical density = Diamond

Lowest optical density = Air

Optical density of a medium is directly related with the refractive index of that medium. A medium which has the highest refractive index will have the highest optical density and vice-versa.

It can be observed from table 10.3 that diamond and air respectively have the highest and lowest refractive index. Therefore, diamond has the highest optical density and air has the lowest optical density.



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Question 4:

You are given kerosene, turpentine and water. In which of these does the light travel fastest? Use the information given in Table.

Table 10.3 Absolute refractive index of some material media					
Material medium	Refractive index	Material medium	Refractive index		
Air	1.0003	Canada Balsam	1.53		
Ice Water Alcohol	1.31 1.33 1.36	Rock salt	1.54		
Kerosene	1.44	Carbon disulphide	1.63		
Fused quartz	1.46	Dense	1.65		
Turpentine oil	1.47	Ruby	1.71		
Benzene	1.50	Sapphire	1.77		
glass	1.52	Diamond	2.42		

Answer 4:

Speed of light in a medium is given by the relation for refractive index (n_m) . The relation is given as

 $n_{\rm m} = \frac{\text{Speed of light in air}}{\text{Speed of light in the medium}} = \frac{c}{v}$ $v = \frac{c}{n_{\rm m}}$ $v \propto \frac{1}{n_{\rm m}}$

It can be inferred from the relation that light will travel the slowest in the material which has the highest refractive index and travel the fastest in the material which has the lowest refractive index.

It can be observed from table 10.3 that the refractive indices of kerosene, turpentine, and water are 1.44, 1.47, and 1.33 respectively. Therefore, light travels the fastest in water.



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Question 5:

The refractive index of diamond is 2.42. What is the meaning of this statement?

Answer 5:

Refractive index of a medium n_m is related to the speed of light in that medium v by the relation:

 $n_{\rm m} = \frac{\text{Speed of light in air}}{\text{Speed of light in the medium}} = \frac{c}{v}$

Where, c is the speed of light in vacuum/air

The refractive index of diamond is 2.42. This suggests that the speed of light in diamond will reduce by a factor 2.42 compared to its speed in air.



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