

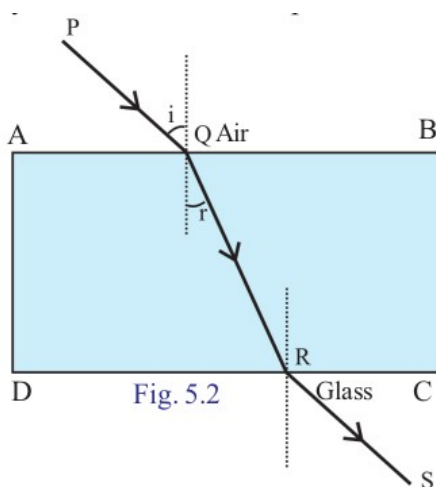
## UNIT 5

### Refraction of Light

21/12/2020 – Class 41

#### Assignment Answer

Draw the refraction of light through the glass slab?



#### Activity 1

In the previous class we studied laws of refraction.

#### Discussion

- The ratio of the sine of the angle of incidence to the sine of the angle of refraction ( $\sin i / \sin r$ ) will be a constant. This constant is known as? **Refractive index.**

#### From air to glass

Sl. No.	Angle of incidence (i)	Angle of refraction (r)	$\sin i$	$\sin r$	$\sin i / \sin r$
1	20°	13°	0.34	0.22	1.5
2	30°	19.45°	0.5	0.33	1.5
3	45°	28°	0.7	0.47	1.5
4	60°	35°	0.86	0.57	1.5

- When light enters from air to glass, what is the value of ( $\sin i / \sin r$ )? **1.5**
- This value (**1.5**) is the refractive index of which medium? **Refractive index of glass with respect to air.**

#### Activity 2.a

How is the refractive index of a medium related to the speed of light?

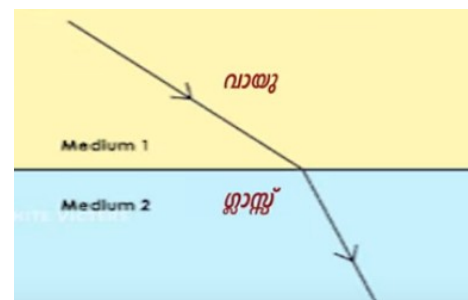
Observe the figure, which shows light ray passes from air to glass.

#### Discussion

- Which is the medium 1? **Air.**
- Which is the medium 2? **Glass.**

Let speed of the light in **medium 1**(air) is  $V_1$  and **medium 2**(glass) is  $V_2$ .

- What is the speed of light in air ( $V_1$ )?  **$3 \times 10^8$  m/s**



- What is the speed of light in glass ( $V_2$ )?  $2 \times 10^8 \text{ m/s}$
- What is the value of ( $V_1 / V_2$ )?  $(3 \times 10^8) / (2 \times 10^8) = 1.5$

$$\frac{v_1}{v_2} = \frac{\text{Speed of light in air}}{\text{Speed of light in glass}} = \frac{3 \times 10^8 \text{ m/s}}{2 \times 10^8 \text{ m/s}} = 1.5$$

- What is the relation between ( $\sin i / \sin r$ ) and ( $V_1 / V_2$ )? **They are equal.**

**Inference**

Refractive index of glass with respect to air = ( $\sin i / \sin r$ )  
= (speed of light in air / speed of light in glass) = 1.5

- Refractive index of medium 1 with respect to medium 2 is denoted as?  $n_{21}$

**Refractive index  $n_{21} = \frac{\text{Speed of light in Medium 1, } V_1}{\text{Speed of light in Medium 2, } V_2}$**

$n_{21}$  = refractive index of second medium with respect to first medium

$$n_{21} = \frac{V_1}{V_2}$$

**Activity 2.b**

- What you mean by  $n_{12}$ ? **Refractive index of medium 1 with respect to medium 2.**

**$n_{12}$  = Refractive index of first medium with respect to second**

$$n_{12} = \frac{V_2}{V_1}$$

**Relative refractive index**

The refractive index of one medium with respect to another is called **relative refractive index**.

**Absolute refractive index ( $n_m$ )**

The refractive index of a medium with respect to vacuum is called **absolute refractive index**.

If the speed of light in air (in vacuum) is considered as 'c' and that in a medium is considered as 'v',

$$\text{then the absolute refractive index of the medium} = \frac{\text{Speed of light in air}}{\text{Speed of light in the medium}} = \frac{c}{v}$$

### Activity 3

Find the absolute refractive index of water?

$$\text{Speed of light in air (c)} = 3 \times 10^8 \text{ m/s}$$

$$\text{Speed of light in water (v)} = 2.25 \times 10^8 \text{ m/s}$$

$$\text{Absolute refractive index of water} = \frac{\text{speed of light in air}}{\text{speed of light in water}} = \frac{3 \times 10^8}{2.25 \times 10^8} = 1.33$$

### Activity 4

Find the absolute refractive index of diamond?

$$\text{Speed of light in air (c)} = 3 \times 10^8 \text{ m/s}$$

$$\text{Speed of light in diamond (v)} = 1.25 \times 10^8 \text{ m/s}$$

$$\text{Refractive index of Diamond (n}_m\text{)} = \frac{3 \times 10^8}{1.25 \times 10^8} = 2.4$$

### Activity 5

Observe the figure, which shows light ray passes from water to glass.

Find the relative refractive index of glass with respect to water and relative refractive index of water with respect to glass.



$$\text{Speed of light in water } V_1 = 2.25 \times 10^8 \text{ m/s}$$

$$\text{Speed of light in glass } V_2 = 2 \times 10^8 \text{ m/s}$$

$$\begin{aligned} \text{Refractive index of glass with respect water (n}_{21}\text{)} &= V_1 / V_2 \\ &= (2.25 \times 10^8) / (2 \times 10^8) = 1.13 \end{aligned}$$

$$\begin{aligned} \text{Refractive index of water with respect glass (n}_{12}\text{)} &= V_2 / V_1 \\ &= (2 \times 10^8) / (2.25 \times 10^8) = 0.89 \end{aligned}$$

### Assignment

1) Refractive index of some media are given below. Analyse the table and answer the following questions.

Medium	Refractive index
Water	1.33
Sunflower oil	1.47
Diamond	2.42
Kerosene	1.44

- a) Choose the media of highest and lowest optical density from the table?  
b) What are the media having highest and lowest velocity of light?  
c) If the refractive index of diamond with respect to water is 1.8 then, what is the refractive index of water with respect to diamond?

2) Refractive index of some media are given below.

<b>Media</b>	<b>Refractive index</b>
Water	<b>1.33</b>
Sunflower oil	<b>1.47</b>
Pyrex glass	<b>1.47</b>
Glycerine	<b>1.47</b>

Glycerine, water and sunflower oil are taken in two beakers. A glass rod is dipped in one and a Pyrex glass rod is dipped in the other.

- a) Do the glass rod and Pyrex glass rod appear in the same way?  
b) In which media are they visible. Justify your answer?