SUBJECT: PHYSICS

CHAPTER: LIGHT – REFLECTION AND REFRACTION

GUIDELINES:

Dear Students,

- There is only **1 Assignment**.
  Assignment 6: Based on **Refraction of Light, Refraction through a Rectangular Glass Slab and Refractive Index**
- Complete the Assignment in Physics Notebook.
- **Video links** have been provided for better understanding of the concept through visuals. Watch the videos carefully as these will help you do the assignment.
- Read the lesson from the **NCERT textbook** also.
- Link for the lesson: http://ncert.nic.in/textbook/pdf/jesc110.pdf (page no. 171 to 176)

SUB TOPICS:

1. **Refraction of Light**
2. **Refraction through a Rectangular Glass Slab**
3. **Refractive Index**

Let's begin the journey of learning:

1. REFRACTION OF LIGHT

The phenomenon of change in the path of ray of light when it travels obliquely from one medium to another is known as **refraction of light.**

Cause of Refraction: Light travels at different speed in different mediums. For example light travels faster in air than in a glass. Refraction is due to change in the speed of light as it enters from one transparent medium to another.

Rules for Refraction of light

Case 1: When light rays travel obliquely from optically rarer medium to denser medium, they bend towards normal. In this case, angle of refraction is smaller than angle of incidence.
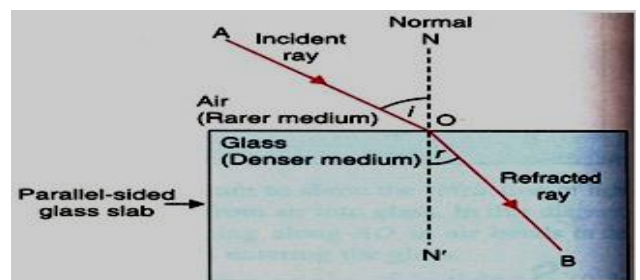
Case 2: When light rays travel obliquely from optically denser medium to rarer medium, they bend away from the normal. In this case, the angle of refraction is greater than the angle of incidence.
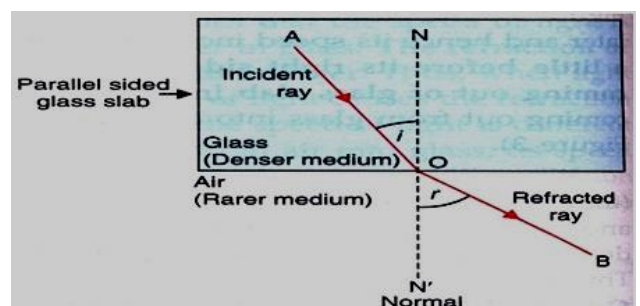
Some Examples of Refraction **are**:

- A swimming pool appears shallower than its actual depth. (fig i)
- The pencil partially immersed in water appears to be bent at the interface of water and air. (fig ii)
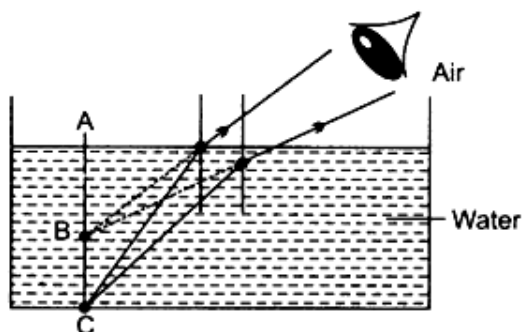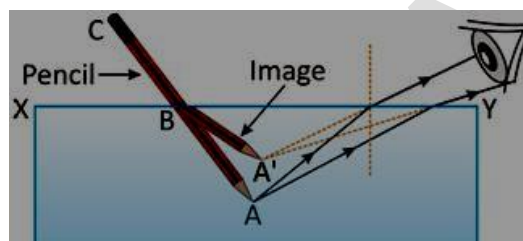- A lemon placed in a glass tumbler appears bigger. (fig iii)
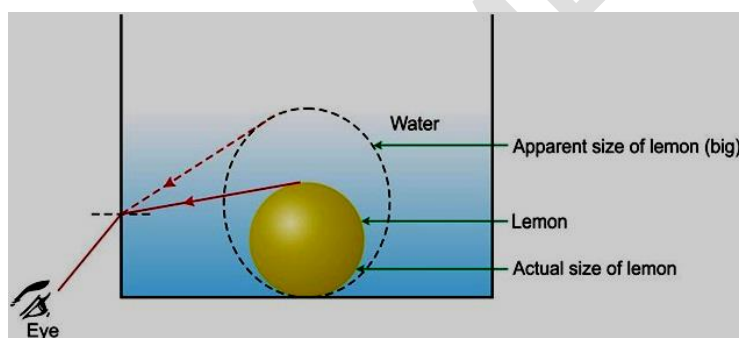

Fig. i

Fig. ii

Fig. iii

For better understanding, kindly go through the video link given below:

2. REFRACTION THROUGH A RECTANGULAR GLASS SLAB

In this case, refraction of light takes place two times. Once when it enters the glass slab from air and second time when it enters the air through the glass slab.

When light rays travelling through air enter the glass slab, they get refracted and bend towards the normal. Now the direction of refracted ray changes again when it comes out of the glass slab into air. Since the ray of light travels from denser medium to rarer medium, it bends away from the normal.

When a ray of light passes through a rectangular glass slab, **the emergent ray is parallel to the incident ray** produced *because the extent of bending of the ray of light at the opposite parallel faces of glass slab is equal and opposite*. Now, the angle of deviation is the angle between the emergent ray and the incident ray produced. Since, these two rays are parallel, the *angle of deviation is 0 degree.*
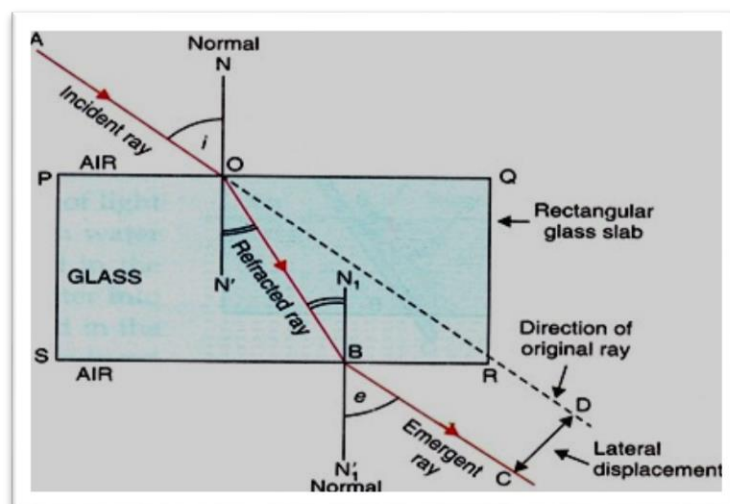
The ray of light gets laterally displaced from its original path. The perpendicular distance between the original path of the incident ray and the emergent ray coming out of the glass slab is called *lateral displacement of the emergent ray of light*

Factors Affecting Lateral Displacement:

(i)   Angle of incidence (Lateral displacement increases with increase in the angle of incidence)

(ii)   Thickness of glass slab (Lateral displacement increases with the increase in the thickness of glass slab)

NOTE: Consider the case when a ray of light is incident normally to the interface of two media.

When light falls perpendicularly or normally on the surface of a glass slab, it goes straight. There is no bending of the ray of light on entering the glass slab or coming out of it. In this case, angle of incidence and angle of refraction is zero.
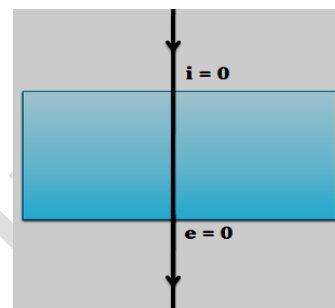
Following are the **Laws of Refraction of Light**:

(i)   The incident ray, the refracted ray and the normal to the interface of two transparent media at the point of incidence, all lie in the same plane.

(ii)   The ratio of sine of angle of incidence to the sine of angle of refraction is a constant, for the light of a given colour and for the given pair of media. This law is also known as *Snell's Law of Refraction.* (This is true for angle 0 < i < 90 degree).

If i is the angle of incidence and r is the angle of refraction, then **sin i /sin r= constant.**

This constant value is called the *refractive index of the second medium with respect to the first.*
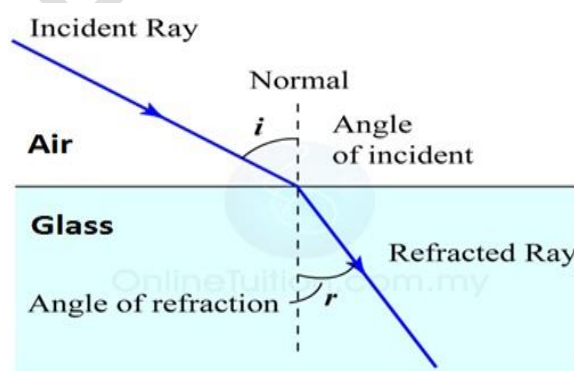
3.   REFRACTIVE INDEX

Refractive index is the measure of bending of a light ray when passing from one medium to another.

The value of the refractive index for a given pair of media depends upon the speed of light in the two media

$$n_{21} = \frac{\text{Speed of light in medium 1}}{\text{Speed of light in medium 2}} = \frac{v_1}{v_2}$$

Where n_{21} is the **refractive index of medium 2 with respect to medium 1**

Similarly refractive index of medium 1 with respect to medium 2 is given by n_{12}

$$n_{12} = \frac{\text{Speed of light in medium 2}}{\text{Speed of light in medium 1}} = \frac{v_2}{v_1}$$

Absolute Refractive Index: Refractive index of a medium with respect to vacuum

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

Note:

- ❖ Optically denser medium does not mean that the medium possesses greater mass density.
- ❖ In comparing two media, the one with the larger refractive index is optically denser medium than the other. The other medium of lower refractive index is optically rarer. The speed of light is higher in a rarer medium than a denser medium.

For Better understanding, kindly go through the video link given below:

https://youtu.be/VuWpK2zBDtE   : For Refractive Index

ASSIGNMENT 6

Q.1   What is the refractive index of the medium in which the speed of light is 1.5×10^8 m/s?

Q. 2   Draw a ray diagram to show the refraction of light through a glass slab and mark the angle of refraction and the lateral shift suffered by the ray of light while passing through the slab.

Q.3   The refractive index of A with respect to B is 2/3 and B with respect to C is 3/4. Calculate the refractive index of A with respect to C .

Q.4   With respect to air, the refractive index of ice and that of rock salts are 1.31 and 1.54 respectively. Calculate the refractive index of rock salt with respect to ice.

Q.5   Why does a lemon kept in water in a glass tumbler appear to be bigger than its actual size? Draw the corresponding ray diagram also.

Q.6   "The refractive index of carbon disulphide is 1.63." What is the meaning of this statement in relation to speed of light?

Q.7   If the refractive index of glass for light going from air to glass is 3/2, find the refractive index of air for light going from glass to air.

Q.8   State the Laws of Refraction of Light. Write an expression to relate absolute refractive index of a medium with the speed of light in vacuum.

Q.9   A ray of light falls normally on the surface of a transparent glass slab. Draw a ray diagram to show its path and also mark the angle of incidence and angle of emergence.

Q.10   A ray of light travelling in air enters obliquely into water. Does the light ray bend towards or away from the normal? Why? Draw a ray diagram to show refraction of light in this situation.

****

S. NO.	CONTENT	VIDEO LINK
1	Real and Apparent Depth	https://youtu.be/KUCOJbQB7-0
2.	Refractive Index	https://youtu.be/VuWpK2zBDtE