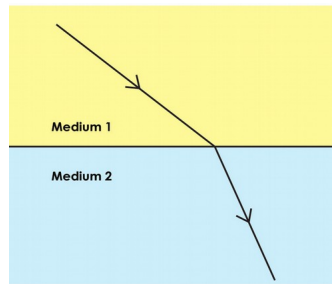


PHYSICS - X-PART-3 CLASS 41



Speed of light in media and refractive index



- * It is shown that the ray of light enters from medium 1 to medium 2.
- * Imagine that the speed of light in medium 1 is v_1 and that in medium 2 is v_2 .
- * The refractive index of medium 1 with respect to medium 2 is represented as n_{12} and of medium 2 with respect to medium 1 is represented as n_{21} . If so

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

$$\text{Refractive index } n_{12} = \frac{\text{Speed of light in Medium 2, } V_2}{\text{Speed of light in Medium 1, } V_1}$$

- * The refractive index of one medium with respect to another is called relative refractive index.
- * 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', then

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

$$n_m = c / v$$

Based on the details given in Table 5.1, find out the refractive index of the given media and complete Table 5.6 (a).

| Medium | Refractive index (n) |
|---------|--|
| Glass | $3 \times 10^8 / 2 \times 10^8 = 3/2 = 1.5$ |
| Water | $3 \times 10^8 / 2.25 \times 10^8 = 3/2.25 = 1.33$ |
| Diamond | $3 \times 10^8 / 1.25 \times 10^8 = 3/1.25 = 2.4$ |

The refractive index of glass and water are given in Table 5.6 (b).

| Medium | Refractive index (n) |
|--------|----------------------|
| Glass | 3/2 |
| Water | 4/3 |

If the speed of light in water is 2.25×10^8 m/s

(a) Calculate the speed of light in vacuum

$$\begin{aligned} \text{The speed of light in vacuum} &= \text{Speed of light in water} \times \text{refractive index} \\ &= 2.25 \times 10^8 \times 4/3 = 3 \times 10^8 \text{ m/s} \end{aligned}$$

(b) Calculate the speed of light in glass

$$\text{Speed of light in glass} = \frac{\text{Speed of light in air}}{\text{Refractive index}}$$

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

* When a light ray passing from water to glass. Find out the refractive index of water with respect to glass and refractive index of glass with respect to water (Speed of light in glass = 2×10^8 m/s and Speed of light in water = 2.25×10^8 m/s)

a) Refractive index of water with respect to glass

$$\text{Refractive index } n_{wg} = \frac{\text{Speed of light in glass}}{\text{Speed of light in water}} = \frac{2 \times 10^8 \text{ m/s}}{2.25 \times 10^8 \text{ m/s}} = 0.89$$

b) Refractive index of glass with respect to water

$$\text{Refractive index } n_{gw} = \frac{\text{Speed of light in water}}{\text{Speed of light in glass}} = \frac{2.25 \times 10^8 \text{ m/s}}{2 \times 10^8 \text{ m/s}} = 1.125$$

Worksheet

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. The refractive index of some media are given below.

| Medium | Refractive index |
|---------------|------------------|
| Water | 1.33 |
| Sunflower oil | 1.47 |
| Pyrex glass | 1.47 |
| Glycerine | 1.47 |

Glycerine, water and Sunflower oil are taken in two beakers. A glass rod is in dipped in one and pyrex glass rod is in dipped in the other.

- a) Do the glass road and pyrex glass rod appear in the same way?**
- b) In which media are they visible, justify your answer?**