Numerical Problems on refraction of light

Numerical Problem 1

The refractive index of a material is 1.33. If the velocity of light in vacuum is 3×10^8 m/s , find the velocity of light in the material.

Solution : $\mu = \dfrac{Velocity\ of\ light\ in\ vacuum}{Velocity\ of\ light\ in\ the\ material}$

$1.33 = \dfrac{3 \times 10^8}{Velocity\ of\ light\ in\ the\ material}$

Velocity of light in the material $= \dfrac{3 \times 10^8}{1.33} =$ **2.25×10^8 m/s**

Practice Problem 1 :

1. Refractive index of water is 4/3 .Calculate the speed of light in water. Speed of light in vacuum is 3×10^8 m/s.   [2.25×10^8 m/s]
2. The velocity of light in air is 3×10^8 m/s and 2×10^8 m/s. Find the refractive index of glass.   [1.5]

3. The velocity of light in air is 3×10^8 m/s. Calculate the velocity of light in diamond of refractive index 2.5.   [1.2×10^8 m/s]

Numerical Problem 2

The angle of incidence in air for a ray of light is $40°$.If the ray travels through water of refractive index 4/3, find the angle of refraction.

$^{a}\mu_{w} = \dfrac{\sin i}{\sin r}$

$\sin r = \dfrac{\sin i}{^{a}_{w}\mu} = \dfrac{\sin 40}{4/3} = \dfrac{3 \times 0.6427}{4}$

$\sin r = 0.4820$

$r = \sin^{-1}(0.4820) = 28.82°$

Practice Problem 2:

1. For a ray of light passing from air to glass the angle of incidence is 50°, the corresponding angle of refraction being 30°. Find the refractive index of glass.

[1.5]

2. The angle of refraction in a glass block of refractive index 1.5 is 19°. Calculate the angle of incidence. **[29.23°]**

3. A ray of light travelling in air strikes the glass surface at an angle of incidence 60°. Find the angle of refraction in glass if refractive index of glass is 3/2. Given sin 35° = 1/$\sqrt{3}$ **[35°]**

Numerical Problem 3

The refractive index of water is 4/3 and of glass is 3/2. What is the refractive index of glass with respect to water ?

$^a\mu_w = 4/3$ $\qquad$ $^a\mu_g = 3/2$

Let speed of light in air be c.

Speed of light in water $v_w = \dfrac{c}{^a_w\mu}$

Speed of light in glass $v_g = \dfrac{c}{^a_g\mu}$

Refractive index of glass with respect to water

$^w\mu_g = v_w / v_g = \dfrac{c}{^a_w\mu} / \dfrac{c}{^a_g\mu}$ $\qquad$ or $\ ^a\mu_g / \ ^a\mu_w = \dfrac{3/2}{4/3} = 9/8 = $ **1.125**

Practice Problem 3

1. The refractive index of water with respect to air is 4/3. What is the refractive index of air with respect to water. **[0.75]**

2.The refractive index of glass, when a ray of light travels from air to glass is 1.5. Calculate the refractive index when light travels from glass to air. **[0.67]**