Light

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(12) Ans)

(a) Absolute refractive index of flint glass = speed of light in vaccum / speed of light in flint glass

$$= \frac{3.00 \times 10^8}{1.86 \times 10^8}$$

$$= 1.61$$

Absolute refractive index of crown glass = speed of light in vaccum / speed of light in crown glass

$$= \frac{(3.00 \times 10^8)}{(1.97 \times 10^8)}$$

$$= 1.52$$

(b) Relative refractive index for light going from crown glass to flint glass is given by:

(speed of light in crown glass) / (speed of light in flint glass)

$$= \frac{1.97 \times 10^8}{1.86 \times 10^8}$$

$$= 1.059$$

13. (a) Ans) $a_{ir}h_x = \frac{\text{(Speed of light in air)}}{\text{Speed of light in medium x)}}$

$= \frac{(3 \times 10^8)}{(2 \times 10^8)} = 1.5$

(b) $a_{ir}h_y = \frac{\text{(speed of light in air)}}{\text{speed of light in medium y)}}$

$= \frac{3 \times 10^8}{2.5 \times 10^8} = 1.2$

(c) $x^{h}y = \frac{\text{(Speed of light medium X)}}{\text{speed of light medium Y)}}$

$= \left(\frac{2 \times 10^8}{2.5 \times 10^8}\right)$

$= 0.8$

14. Ans) Speed of light in air = 3,00,000 Km/s

Refractive index of the medium $= \frac{6}{5}$

speed of light in the given medium = ?

Applying formula for refractive index, we get!

Refractive index of a medium = $\frac{\text{(Speed of light in air)}}{\text{Refractive index of a medium)}}$

Refractive index of a medium = (speed of light in air) / (speed of light in medium)

or

(speed of light in medium) = (speed of light in air) / (Refractive index of a medium)

$= \frac{3,00,000}{\left(\frac{6}{5}\right)}$

$= 2,50,000$ km/s.

(16) Ans) speed of light in water $= 2.25 \times 10^8$ m/s

speed of light in vaccum $= 3 \times 10^8$ m/s

Refractive index of water = ?

Applying the formula for refractive index, we get!

Refractive index of a medium = (speed of light in vaccum) / (speed of light in water)

$= (3 \times 10^8) / (2.25 \times 10^8)$

$= 1.33$

Thus, a refractive index of a water is 1.33.

(2) Ans) Refractive index = $\frac{\text{speed of light in air}}{\text{speed of light in diamond.}}$

Let x be the speed of light in diamond
Now, we have:

$2.42 = 3.0 \times 10^8 ms^{-1} / x$

$x = 1.24 \times 10^8 ms^{-1}$

(18) MCQs

(19) Ans - (d) 8
Refractive index (n) = $\frac{\text{speed of light in air}}{\text{speed of light in vaccum}}$

(20) Ans) According to this formula, speed of light will be maximum in substance 8 whose refractive index is 1.31.

(20) Ans) (c) Material C

The refraction in a material depends on it refractive index. Refractive index is calculated by $\frac{\sin i}{\sin r}$

This ratio is maximum for material C.

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therefore it produces maximum refraction.

(21) Ans (B) $1/c$

Explanation
Refractive index of material 2 with respect to material 1 is given by:

$$1n_2 = \frac{\text{Speed light in medium 1}}{\text{speed of light in medium 2}}$$

By the same argument, refractive index of medium 1 with respect to medium 2 is given by:

$$2n1 = \frac{\text{Speed of light in medium 2}}{\text{Speed of light in medium 1}} = \frac{1}{1n2}$$

$1n2$ is $\frac{3}{2}$ Therefore, $2n1$ will be $\frac{1}{3/2}$

Therefore, refractive index of light going from glass to air will be $\frac{1}{c}$.

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(22) Ans → (c) $\frac{4}{6}$

Refractive index of material 2 with respect to material 1 is given by:

$$_1n_2 = \frac{\text{Speed of light in medium 1}}{\text{Speed of light in medium 2.}}$$

By the same argument, refractive index of medium 1 with respect to medium 2 is given by:

$$_2n_1 = \frac{\text{Speed of light in medium 2}}{\text{speed of light in medium 1}} = \frac{1}{_1n_2}$$

$_1n_2$ is $\frac{3}{2}$ therefore, $_2n_1$ will be $\frac{1}{3/2}$

Therefore, refractive index of light going from glass to air will be $\frac{4}{6}$.

(23) Ans → (a) 2.4

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

$$= \frac{3 \times 10^8 \text{ m/s}}{1.25 \times 10^8 \text{ m/s}} = 2.4$$

29. Ans → (d) Substance S

Refractive index = $\frac{\sin i}{\sin r}$

The value of ($\sin i$) is same in all the cases; therefore, the value ($\sin r$) will be maximum refractive index. This means that the angle of refraction will be maximum for minimum refractive index and substance S has minimum refractive index.

25. Ans → 1.33

Velocity of light in water = 225,563,010 m/s

Velocity of light in air = 300,000,000 m/s

Refractive index = $\frac{\text{velocity of light in air}}{\text{velocity of light in water}}$

$\frac{300,000,000}{225,563,010} = 1.33$

26. Ans → 0.75

Refractive index of air with respect to water = $\frac{1}{\text{Refractive index of water with respect to air}}$

Refractive index of air with respect to water = $\frac{3}{4} = 0.75$

27. Ans> (d) carbondisulphide

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

Speed of light in the medium is slowest, therefore refractive index will be maximum as the speed of light in air is constant. Thus, light will travel slowest in the substance with refractive index 1.63.

28. Ans> (d) 1.125

Refractive index of glass with respect to water

$= \frac{\text{Refractive index of glass with respect to air}}{\text{Refractive index of water with respect to air}}$

$\frac{3/2}{4/5} = ?$

$\Rightarrow \frac{3}{2} \times \frac{3}{4} = \frac{9}{8} = 1.125$