SHIKSHA CLASSES

Subject : Science -I **Answer Paper** **Total Marks : 20**

Class : X **6. Refraction of Light**

Q.1: A) Choose the correct alternative : 2

1) When white sunlight passes through a glass prism ------ ray deviates the most.

Ans. : c) Violet

2) When ray of light are incident on glass slab then incident ray and emergent ray are ------ to each other.

Ans. : b) Parallel

B) Solve the following questions. (Any One) 1

1) Give the corelation.

Refractive index of air : _____ : : Refractive index of glass : 1.52

Ans. : Refractive index of air : **1** : : Refractive index of glass : 1.52

2) State whether the following statement are true or false.

The wavelength of light depends on velcity of light in that medium.

Ans. : True

3) Define - Refraction of light.

Ans. : Refraction of light :

Light changes its direction when going from one transparent medium to another transparent medium. This is called refraction of light.

Q.2: A) Give scientific reason. (Any One) 2

1) Stars twinkle at night.

Ans. : i) Stars are self luminous and can be seen at night in the absense of sunlight.

ii) The stars are point sources of light. The light coming from the stars travels from rarer medium to denser medium and costantly bends towards the normal.

iii) So the apparent position of star is slightly higher than actual position.

iv) Due to motion of atmospheric air refractive index of air keeps changing continuously.

v) When the atmosphere refracts more light towards us star is seen bright and when the atmosphere refracts less light towards us star is seen dim. Thus due to change in refractive index of atomosphere stars twinkle at night.

2) The sun is seen on the horizon a little before sunrise and even after sunset for same time.

Ans. : i) Ths earth is surrounded by the atmosphere which is denser near the surface of the earth.

ii) When the rays of sun enters the earth's atmosphere from outer space they travel from rare medium to denser medium.

iii) Therefore light rays bends towards the normal due to refraction i.e. the light rays travels a curved path.

iv) The apparent position of sun is appears above the horizon.

v) Thus even when rising or seting the sun is seen on the horizon before sunrise and after sunset for sometimes.

B) Solve the following question. (Any Two) 4

1) The absolute refractive index of water is 1.36. What is the velocity of light in water? (velocity of light in vacuum 3 x 10^8 m/s)

Ans. : Given :

$V_1 = 3 \times 10^8 \text{ m/s}$

$n = 1.36$

$n = \frac{v_1}{v_2}$

$\therefore 1.36 = \frac{3 \times 10^8}{V_2}$

$v_2 = \frac{3 \times 10^8}{1.36}$

$= 2.21 \times 10^8 \text{ m/s}$

2) Define : a) Dispersion of light

b) Absolute refractive index.

Ans. : a) Dispersion of light : The process of separation of white light into it's component colours while passing through a medium is called the dispersion of light.

b) Absolute refractive index : The refractive index of a medium with respect to vaccum is called absolute refractive index.

3) State the laws of refraction.

Ans. : Following are the laws of refraction.

i) Incident ray & refracted ray lie on the opposite sides of the normal whereas all the three lie in the same plane.

ii) For a given pair of media, the ratio of sini to sinr is a constant where i & r are angle of incidence & angle of refraction respectively.

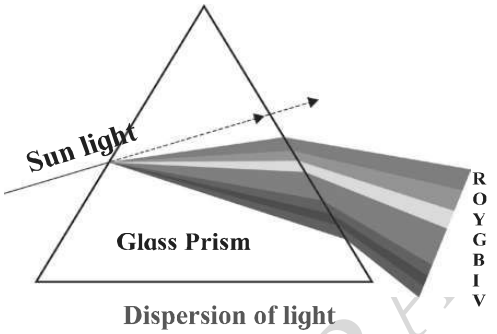
4) Explain the concept of mirage.

Ans. : i) A mirage which is an illusion of appearance of water on hot road or desert surface. ii) The air near hot road or desert surface is hot and hence rarer than air above it. The refractive index of air keeps on increasing with increasing heights. iii) In this case direction of light rays coming from distance keeps changing according to laws of refraction. iv) The rays appears to be coming from the image of object inside the ground. This is called mirage.

Q.3: Solve the following questions. (Any Two) 6

1) With neat diagram explain the dispersion of light

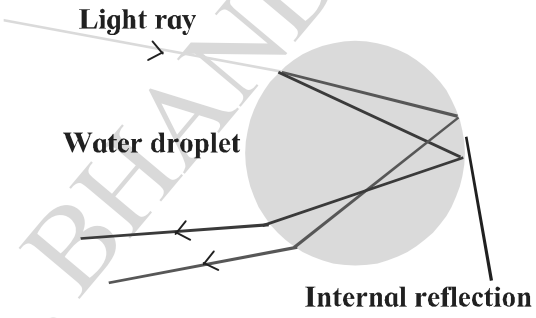
Ans. : i) The process of seperation of light into its component colours while passing throught a medium is called the dispersion of light. ii) When white light is incident on the prism different colours bend through different angles. Among the seven colours red bends the least while violet bends the most. Thus as shown in fig. the seven colours emerge along different paths and get seperated and we get a spectrum of seven colours.



Dispersion of light

2) Explain. A rainbow is the combined effect of refraction, dispersion and total internal reflection of light.

Ans. : i) A rainbow is seen mainly after a rainfall. It is always formed in a direction opposite to the sun. ii) When light ray enters the water droplet it enters from rarer medium air to denser medium water and hence bends towards normal. Thus refraction takes place inside the water droplet. iii) This process continues till the angle of refraction becomes 90^0 for angle of incidence larger than critical angle the angle of refraction is larger than 90^0 and so the rays return to water and gets reflected back in the same medium. Thus total internal reflection takes place inside water droplet. iv) Now the sun light is consisting of white light, when light rays from the sun enter the water droplet it act as small prisms. v) So a spectrum of seven colors is obtained. Here violet light bends the most and red light bends the least. Thus the phenomenon of dispersion takes place. vi) The combined effect of refraction, dispersion and total internal reflection of light produces a rainbow.



Rainbow production

3) Will the light travels through glass slab with same velocity as it travels in air? Why?

Ans. : i) The refractive index of a medium depends on velocity of light in the medium. The refractive index is given by

$$\text{Refractive index } {}_2n_1 = \frac{\text{Velocity of light in medium 1 } (V_1)}{\text{Velocity of light in medium 2 } (V_2)}$$

${}_2n_1$ is the refractive index of second medium with respect to first medium.

ii) The refractive index of glass is 1.52 while refractive index of air is 1.00. Thus due to different refractive index the velocity of light in glass slab is different than in air.

4) What is refractive index of second medium wrt first medium, if light moves through first medium with a velocity 2×10^8 m/s which changes to 1.25×10^8 m/s second medium?

Ans. : Given :

$V_1 = 2 \times 10^8$ m/s

$V_2 = 1.25 \times 10^8$ m/s

$$^2n_1 = \frac{V_1}{V_2}$$

$$= \frac{2\times10^8}{1.25\times10^8}$$

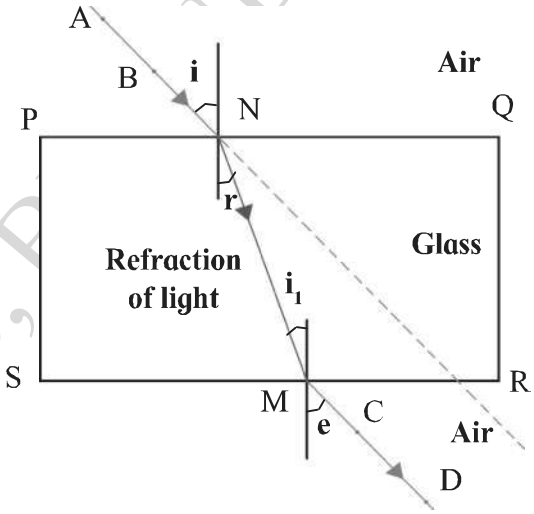
$$^2n_1 = 1.6$$

The refractive index of second medium wrt first is 1.6.

Q. 4: Solve the following question. (Any One) 5

1) If the angle of incidence and angle of emergence of a light ray falling on a glass slab are i and e respectively prove that i = e.

Ans. : i) Consider a ray of light AN incident on a glass slab at a point N. Where i is the angle of incidence. ii) When the ray passes from air to glass i.e. rarer medium to denser it bends towards normal. Here r is the angle of refraction. iii) Now this ray NM inside the glass slab passes through it to the rarer medium i.e. denser to rarer and hence bends away from normal. Here i, is angle of incidence at M and e is the angle of refraction i.e. angle of emergence e. By snell's law at point N



Refraction of light passing through a glass slab

$$\frac{\sin i}{\sin r} = n_1 \qquad ---(i)$$

Where n_1 is refractive index of glass with respect to air.

By snells law at point M

$$\frac{\sin i_1}{\sin e} = n_2 \qquad ---(ii)$$

Where n_2 is refractive index of air with respect to glass.

Now the two normals at point M and N form two parallel lines and NM is transversal then

$r = i_1$ (alternate angles)

$\therefore$ from (ii)

$$\frac{\sin r}{\sin e} = n_2 \qquad ---(iii)$$

eq^n(i) $\times$ eq^n(ii)

$$n_1 \times n_2 = \frac{\sin i}{\cancel{\sin r}} \times \frac{\cancel{\sin r}}{\sin e}$$

$$n_1 \times n_2 = \frac{\sin i}{\sin e}$$

$\because$ n_1 and n_2 are constants

$$n_1 \times n_2 = n$$

$\therefore$ $\sin i = \sin e$

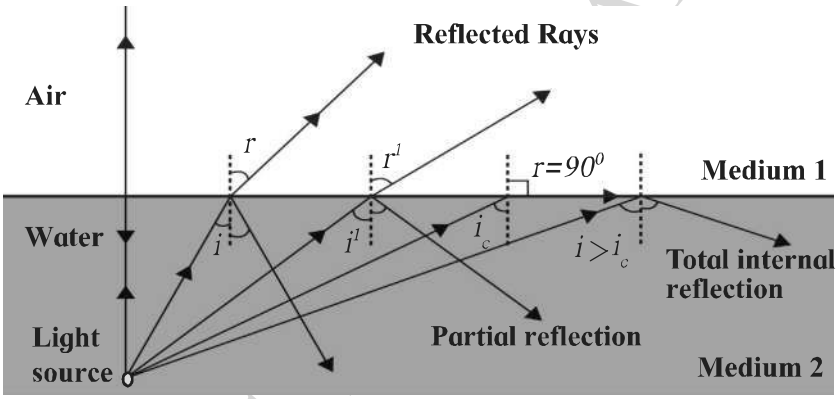
for small angles $(\sin \theta = \theta)$

$\therefore$ $i = e$

Hence proved.

2) Explain with neat diagram partial and total internal reflection.

Ans. : i) When light enters a rarer medium to a denser medium it gets partially reflected i.e. part of light gets reflected and comes back into the denser medium as per laws of reflection. this called partial reflection. The rest of light gets refracted and goes into rarer medium ii) As light goes from denser medium to rarer medium it bends away from normal i.e. $i < r$ if we increase i, r will also increase according to snell's law. iii) For a particular value of i the value of r becomes 90^0. This value of i is called critical angle. For angle of incidence larger than 90^0 such rays return to the denser medium as shown in fig. iv) Thus all the light rays gets reflected back into the denser medium. This is called total internal reflection. v) The value of critical angle can be determined as.



Partial and total internal reflection

$$1^{n_2} = \frac{\sin i}{\sin r}$$

for total internal reflection

i = critical angle r = 90^0

$$1^{n_2} = \frac{\sin i}{\sin 90}$$

$1\,1^{n_2} = \sin i$ ($\because$ $\sin 90 = 1$).

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