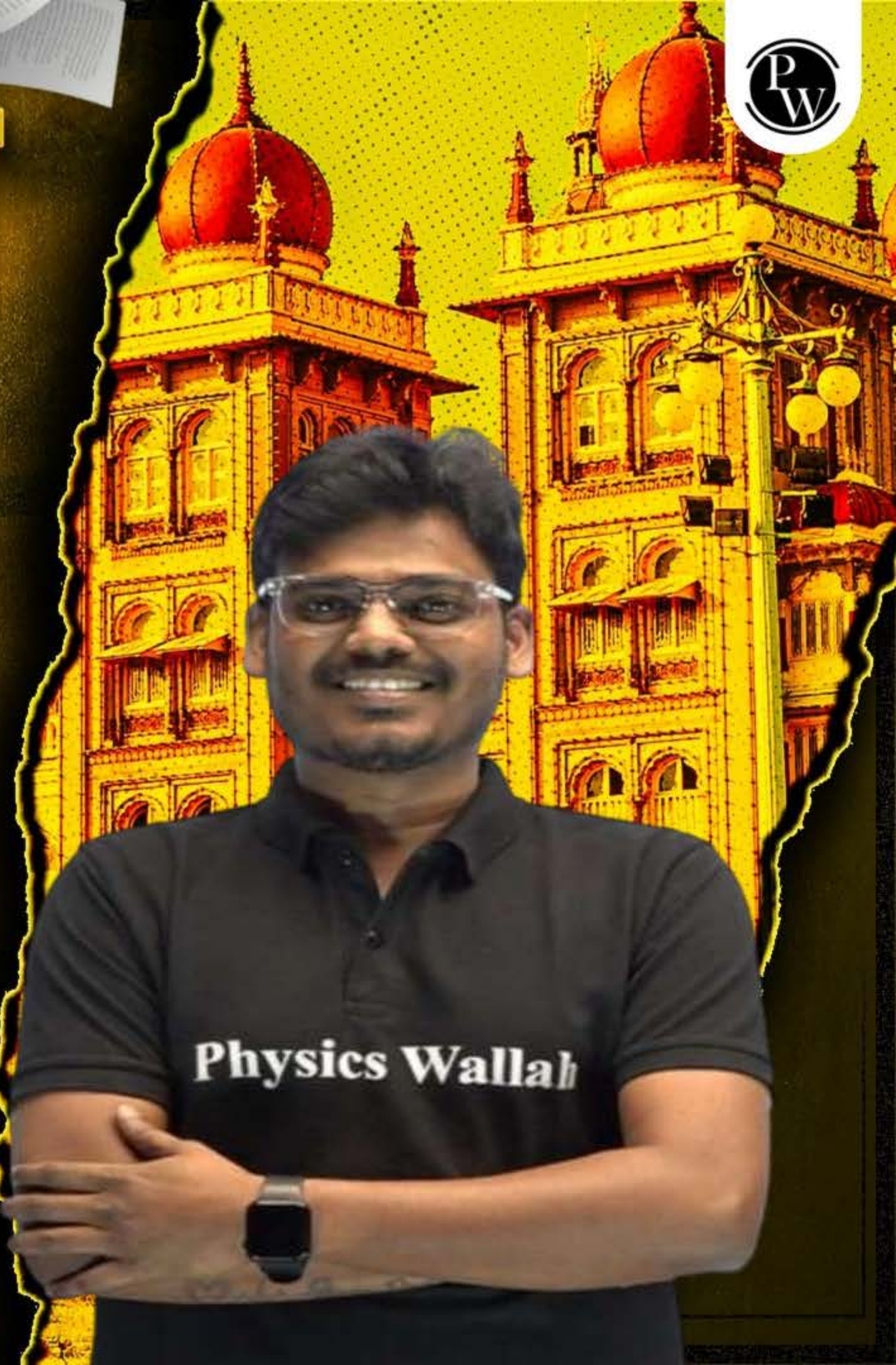
ULTIMATE KCET

CRASH COURSE 2026

PHYSICS | LECTURE NO-2

RAY OPTICS AND OPTICAL INSTRUMENTS

By – AK SIR



Recap *of previous lecture*

1. LIGHT REFLECTION AND ITS LAWS
2. FOCAL LENGTH AND MIRROR FORMULA
3. IMAGE FORMATION BY SPHERICAL MIRRORS
4. LIGHT REFRACTION AND ITS LAWS

Topics *to be covered*

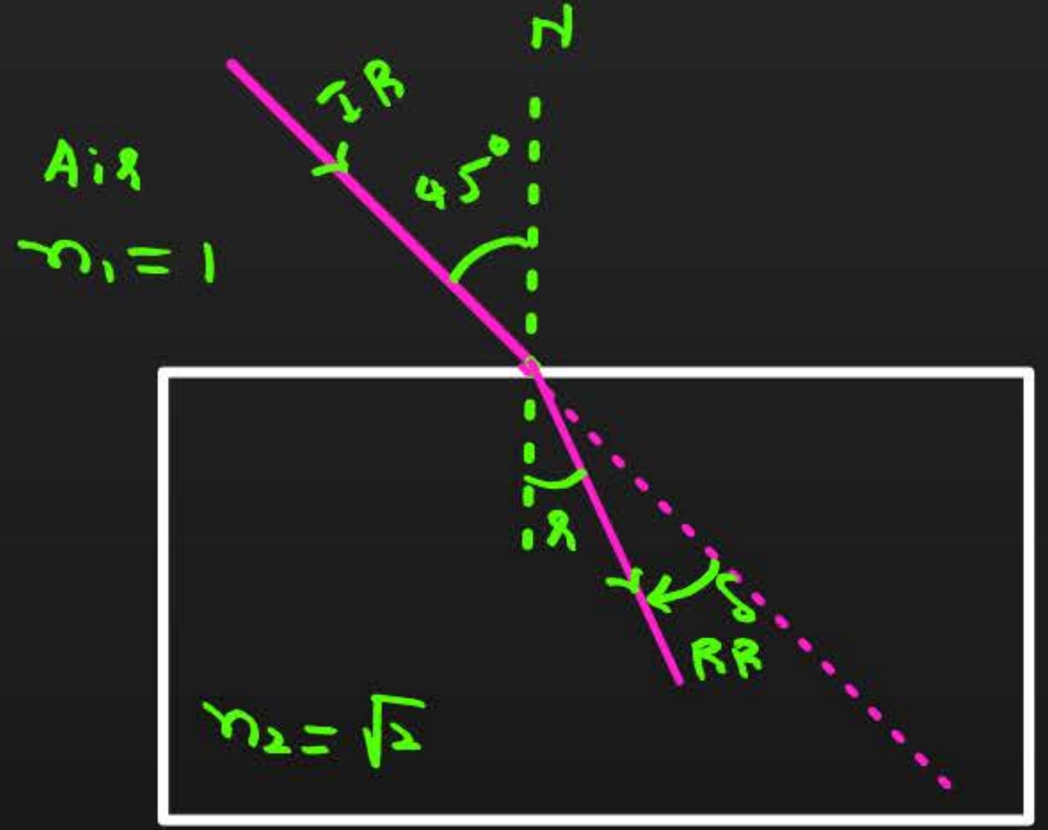
1. QUESTIONS ON REFRACTION OF LIGHT
2. REAL AND APPARENT DEPTH (DISTANCE)
3. CRITICAL ANGLE AND TOTAL INTERNAL REFLECTION
4. REFRACTION AT CURVED SURFACE AND LENSES

Question

A light ray incident on a glass surface of refractive index $\sqrt{2}$ from air at an angle of incidence 45°. Find out:

(i) Angle of refraction

(ii) Angle of deviation.



(i) Snell's law

$$n_1 \sin i = n_2 \sin r.$$

$$1 \times \sin 45° = \sqrt{2} \times \sin r.$$

$$\frac{1}{\sqrt{2}} \times \frac{1}{\sqrt{2}} = \sin r.$$

$$\frac{1}{2} = \sin r$$

$$\sin 30° = \sin r.$$

$$\boxed{r = 30°}$$

(ii) $\delta = i - r = 45° - 30°$

$\boxed{\delta = 15°}$ clockwise

Question

When a ray of light enters a medium of refractive index μ, it is observed that the angle of refraction is half of the angle of incidence is then angle of incidence is

(A) $2\cos^{-1}(\mu/2)$

(B) $\cos^{-1}(\mu/2)$

(C) $2\cos^{-1}(\mu)$

(D) $2\sin^{-1}(\mu/2)$

$r = \frac{i}{2}$

Snell's law

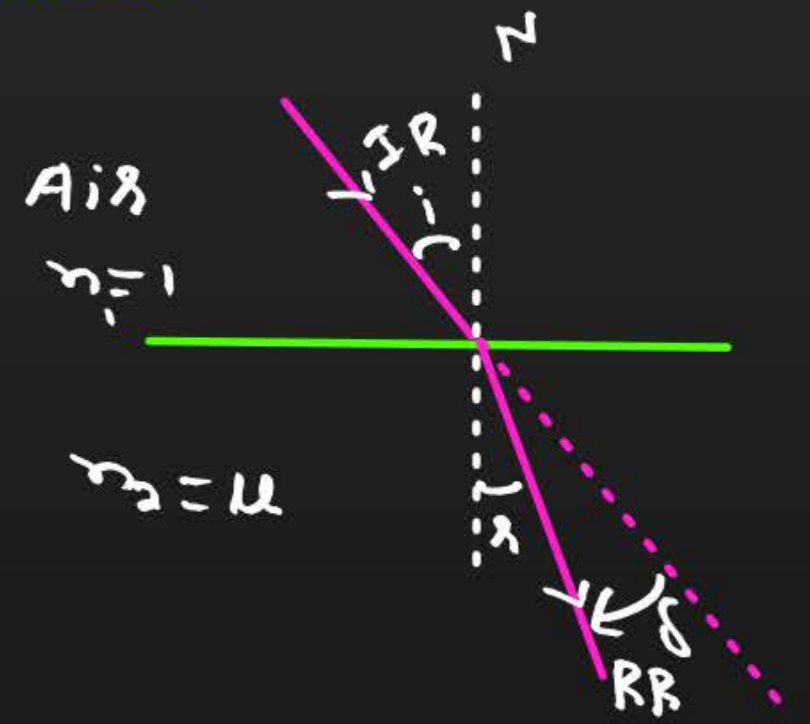
$n_1 \sin i = n_2 \sin r$

$1 \times \sin i = \mu \sin(\frac{i}{2})$

$2\sin(\frac{i}{2})\cos(\frac{i}{2}) = \mu \sin(\frac{i}{2})$

$2\cos(\frac{i}{2}) = \mu$

$\cos(\frac{i}{2}) = \frac{\mu}{2} \Rightarrow \frac{i}{2} = \cos^{-1}(\frac{\mu}{2}) \Rightarrow i = 2\cos^{-1}(\frac{\mu}{2})$



$\sin\theta = 2\sin(\frac{\theta}{2})\cos(\frac{\theta}{2})$

Question

δ

Find out total angle of deviation after two refraction through glass sphere of refractive index $\sqrt{3}$.

At face-1

$n_1 \sin i = n_2 \sin r$

$1 \times \sin 60° = \sqrt{3} \sin r$

$\frac{\sqrt{3}}{2} = \sqrt{3} \sin r$

$\sin r = \frac{1}{2}$

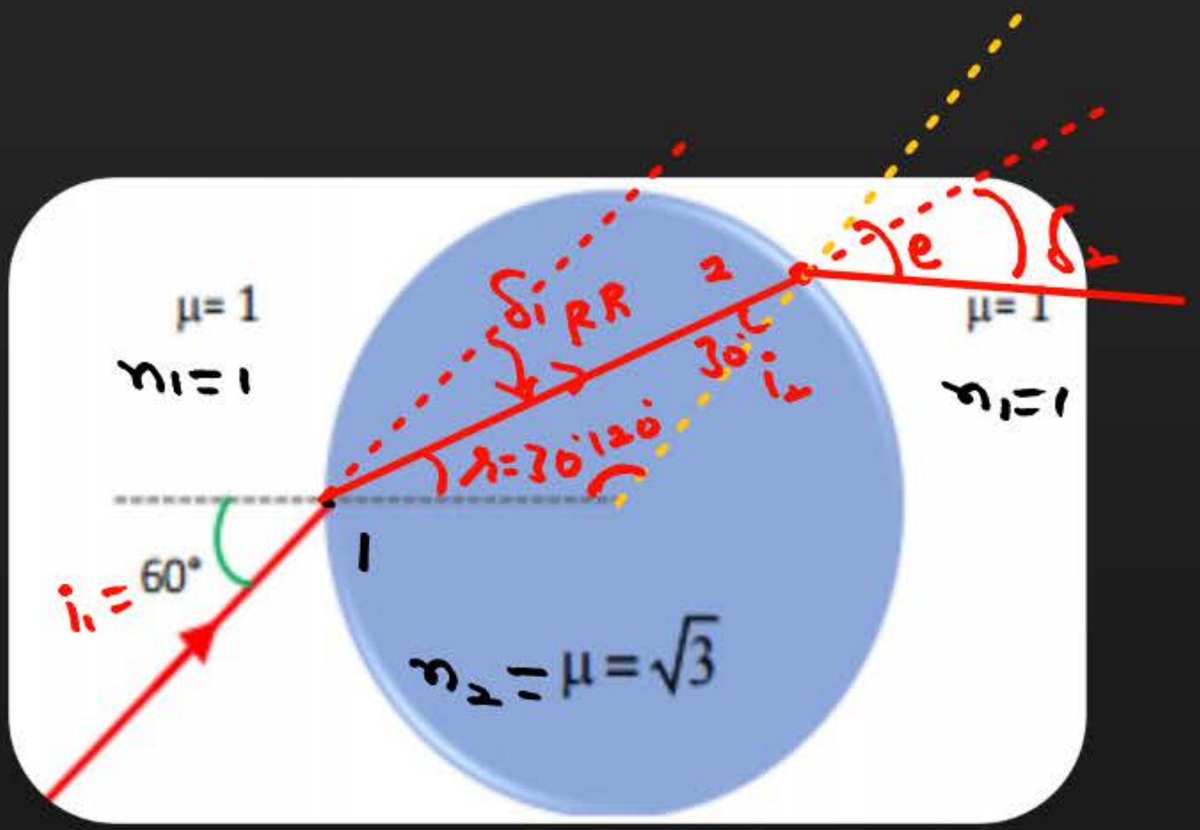
$r = 30°$

At face-2

$\sqrt{3} \times \sin 30° = 1 \times \sin e$

$\sqrt{3} \times \frac{1}{2} = \sin e$

$e = 60°$



$\delta_1 = i_1 - r$

$\delta_1 = 60° - 30°$

$\delta_1 = 30°$

$\delta_2 = e - i_2$

$\delta_2 = 60° - 30°$

$\delta_2 = 30°$

$\delta = \delta_1 + \delta_2 = 30° + 30°$

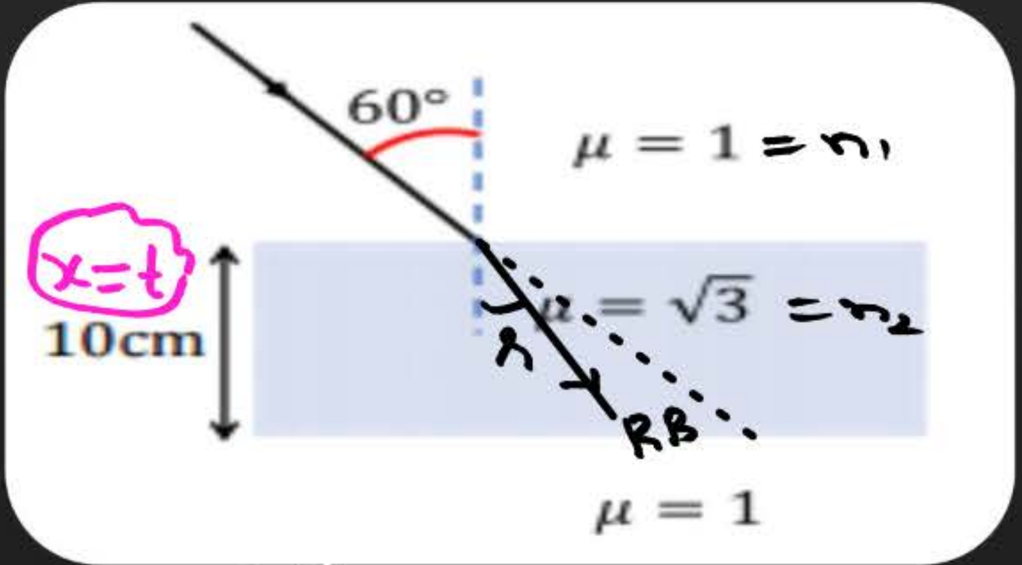
$\delta = 60°$ Clockwise

Question

Find out

(i) Lateral Shift

(ii) Time taken by light ray to cross the slab



$$L.S = \frac{t \sin(i-r)}{\cos r}$$

(i) Snell's law

$n_1 \sin i = n_2 \sin r$

$1 \times \sin 60° = \sqrt{3} \sin r$

$\frac{\sqrt{3}}{2} = \sqrt{3} \sin r$

$r = 30°$

$L.S = 10 \times \frac{\sin(60° - 30°)}{\cos 30°}$

$L.S = 10 \times \frac{\sin 30°}{\cos 30} = 10 \tan 30°$

$L.S = \frac{10}{\sqrt{3}}$ cm

(ii) $T = \frac{x\mu}{c.\cos r}$

$T = \frac{10 \times 10^{-2} \times \sqrt{3}}{3 \times 10^8 \times \cos 30°}$

$T = \frac{10^{-9}}{3} \times \frac{\sqrt{3}}{\frac{\sqrt{3}}{2}} = \frac{2}{3} 10^{-9}$

$T = 0.67 \times 10^{-9} = 6.67 \times 10^{-10}$ s

Question

If frequency (v) is 5×10^{16} Hz and speed of light in air is 3×10^{8} m/s. Find the ratio of wavelength of light in medium of refractive index of 2 to air

↳ 1

(A) 1/2

(B) 3

(C) 3/2

(D) 2

$$\frac{\sin i}{\sin r} = \frac{n_2}{n_1} = \frac{v_1}{v_2} = \frac{\lambda_1}{\lambda_2}$$

$$\frac{n_2}{n_1} = \frac{\lambda_1}{\lambda_2}$$

$$\frac{2}{1} = \frac{\lambda_1}{\lambda_2}$$

$$\frac{\lambda_2}{\lambda_1} = \frac{1}{2}$$

Question

The time required for the light to pass through a glass slab (refractive index $= 1.5$) of thickness 4 mm is ($c = 3 \times 10^{8}\ \mathrm{ms}^{-1}$, speed of light in free space)

(A) 10^{-11} s

(B) 2×10^{-11} s

(C) 2×10^{11} s

(D) 2×10^{-5} s

$$\text{Speed} = \frac{\text{Length}}{\text{time}}$$

$$v_g = \frac{t}{T}$$

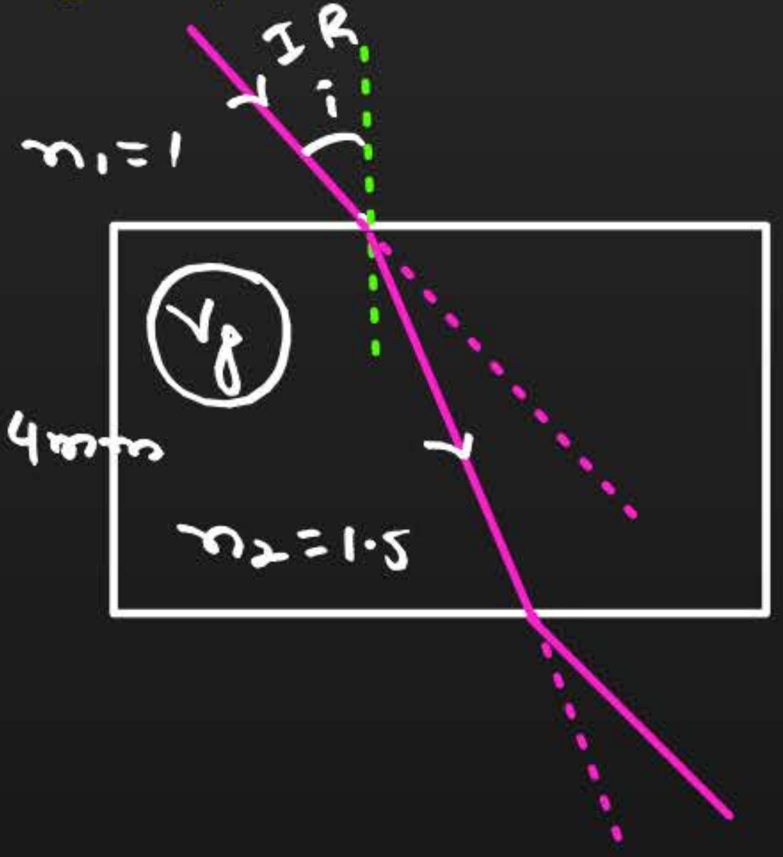
$$\frac{c}{\mu} = \frac{t}{T}$$

$$T = \frac{t\mu}{c} = \frac{4 \times 10^{-3} \times \frac{3}{2}}{3 \times 10^{8}}$$

$$T = 2 \times 10^{-11}\ \text{s}$$

$$\mu = \frac{c}{v_g}$$

$t = 4\ \text{mm}$



Question

White light is incident normally on a glass slab. Inside the glass slab,

$\mu_V > \mu_R$ $v \propto \frac{1}{\mu}$

$v_V < v_R$

$v_R > v_V$

(A) All colours travel with the same speed ✗

(B) Red light travels faster than other colours ✓

(C) Violet light travels faster than other colours ✗

(D) Yellow light travels faster than other colours ✗

Question

A ray of light is incident on a surface of glass slab at an angle 45°. If the lateral shift produced per unit thickness is $\frac{1}{\sqrt{3}}\,m$, the angle of refraction produced is

(A) $\tan^{-1}\left(\frac{\sqrt{3}}{2}\right)$

(B) $\tan^{-1}\left(1-\sqrt{\frac{2}{3}}\right)$

(C) $\sin^{-1}\left(1-\sqrt{\frac{2}{3}}\right)$

(D) $\tan^{-1}\left(\sqrt{\frac{2}{\sqrt{3}-1}}\right)$

$$L.S = \frac{t \sin(i-r)}{\cos r}$$

$$\frac{L.S}{t} = \frac{1}{\sqrt{3}} = \frac{\sin i \cos r - \cos i \sin r}{\cos r}$$

$$\frac{1}{\sqrt{3}} = \frac{\sin 45^\circ \cos r - \cos 45^\circ \sin r}{\cos r}$$

$$\frac{1}{\sqrt{3}} = \frac{\frac{1}{\sqrt{2}} \cos r - \frac{1}{\sqrt{2}} \sin r}{\cos r}$$

$$\frac{1}{\sqrt{3}} = \frac{1}{\sqrt{2}} \left[\frac{\cos r - \sin r}{\cos r} \right]$$

$$\sqrt{\frac{2}{3}} = \frac{\cos r}{\cos r} - \frac{\sin r}{\cos r}$$

$$\sqrt{\frac{2}{3}} = 1 - \tan r.$$

$$\tan r = 1 - \sqrt{\frac{2}{3}}$$

$$r = \tan^{-1}\left(1 - \sqrt{\frac{2}{3}}\right)$$

Apparent depth → Distance [A.D]

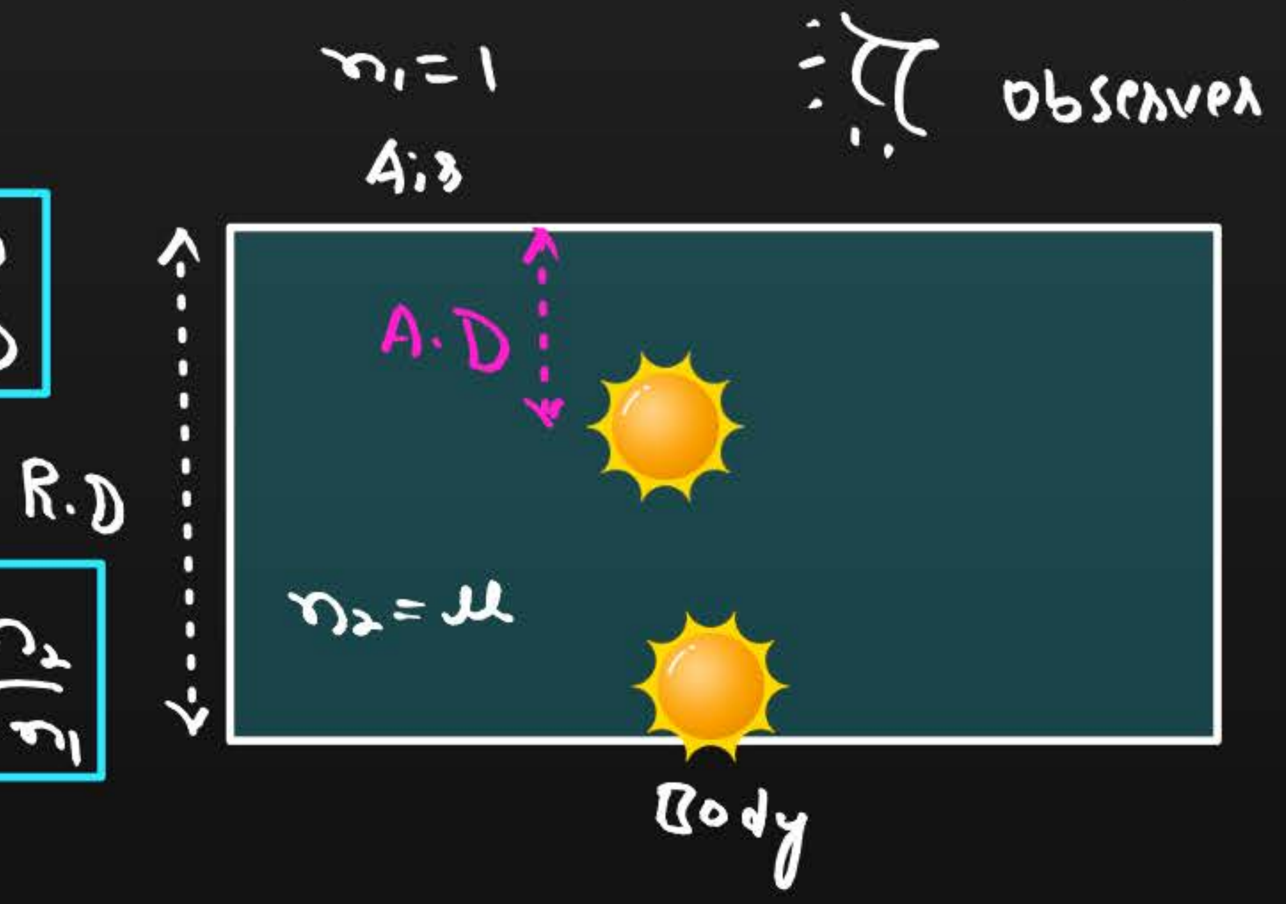
The apparent shift in the position of the object along the normal when the object placed in one medium and viewed from other medium is called normal shift

If a point object in denser medium is observed from rare medium and boundary is plane.
From Snell's Law

$$\frac{n_2}{n_1} = \frac{R.D}{A.D}$$

$$* \quad \boxed{\mu = \frac{R.D}{A.D}}$$

$$\frac{\text{R.I of medium where object is placed}}{\text{R.I of medium where observer is present}} = \boxed{\frac{R.D}{A.D} = \frac{n_2}{n_1}}$$



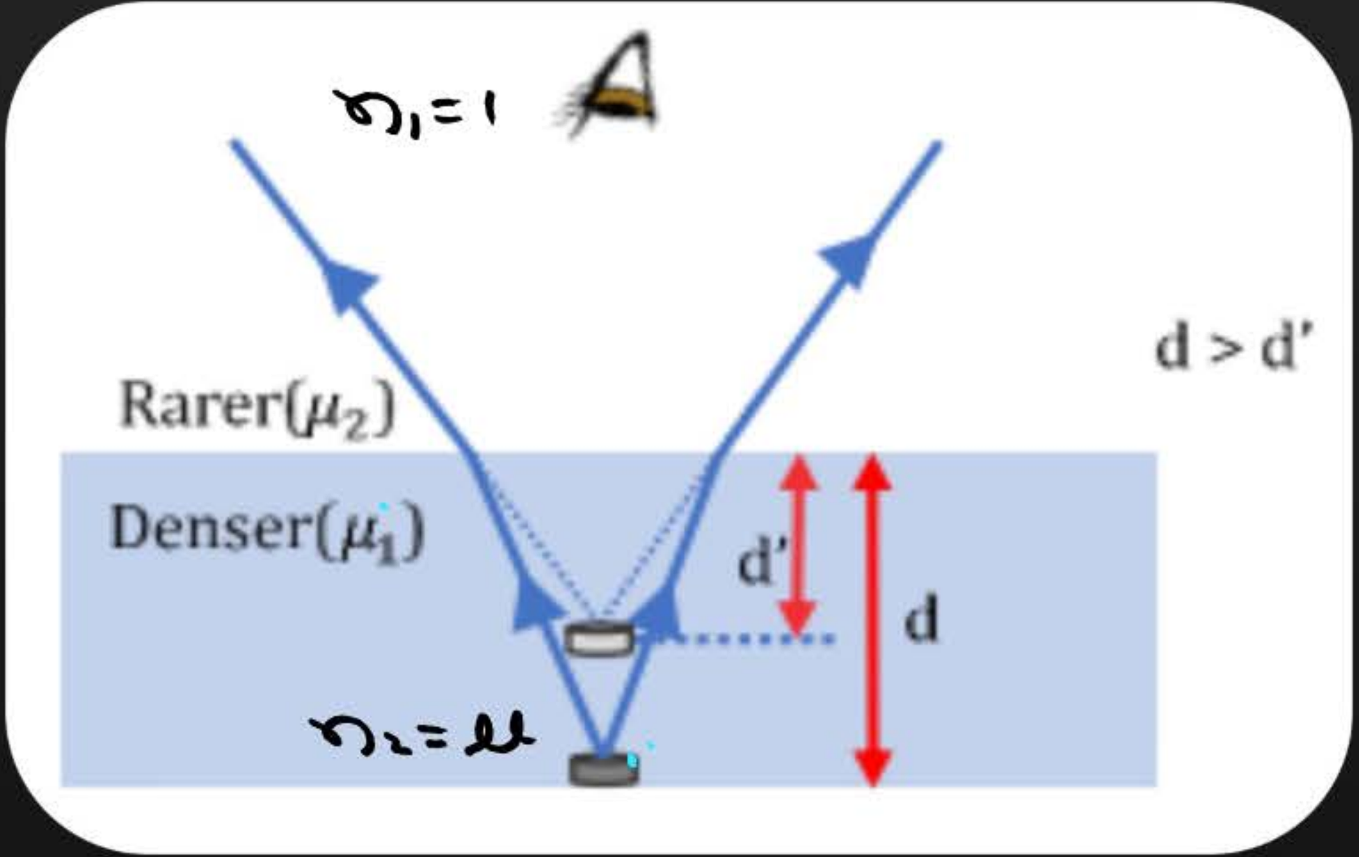
Different situations of observer

Case 1: If observer is in rarer medium and object is in denser medium

$$\frac{n_2}{n_1} = \frac{R.D}{A.D} = \frac{d}{d'}$$

$d > d'$

object appears shorter / less distance compared to original distance



d > d'

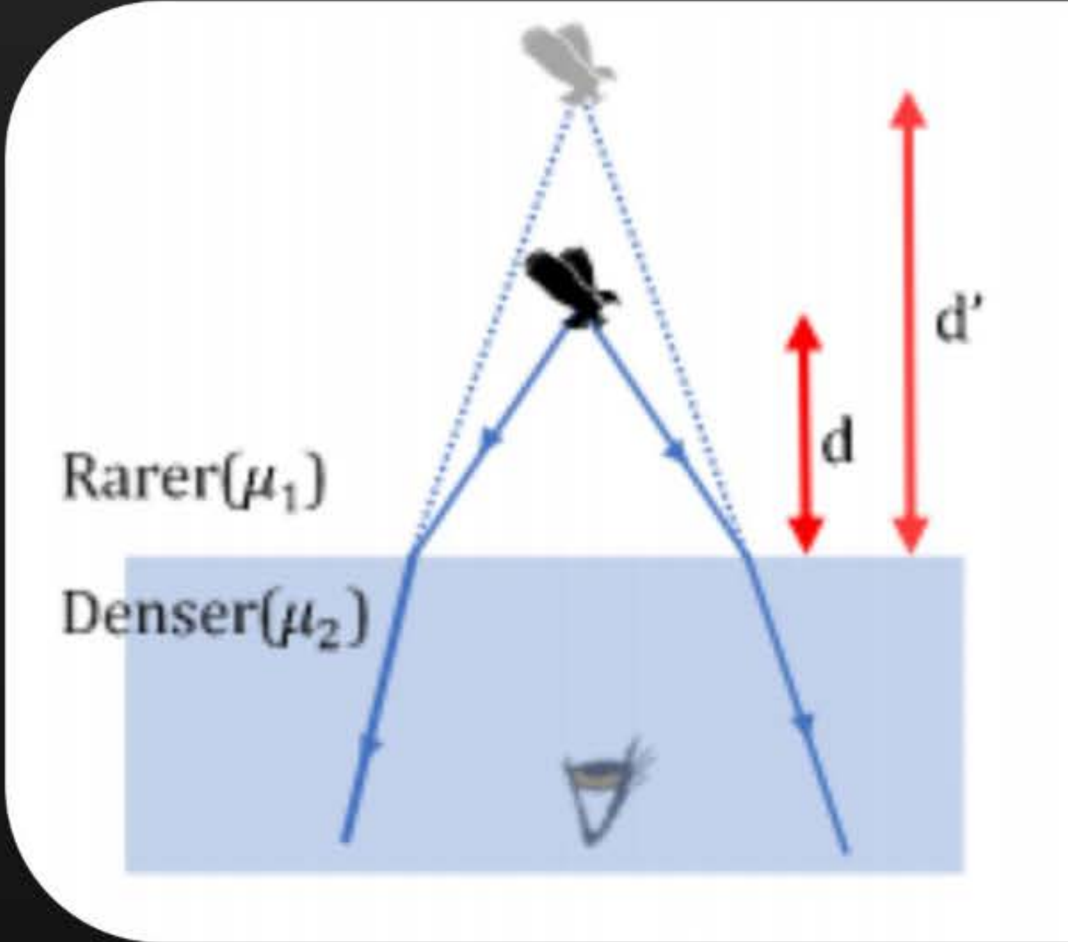
Different situations of observer

Case 2: If observer is in denser medium and object is in rarer medium

$$\frac{n_2}{n_1} = \frac{R.D}{A.D}$$

d' > d

↳ Object is appears more high compare to original hight.



d' > d

Question

To a fish under water, viewing obliquely a fisherman standing on the bank of a lake, the man looks

(A) Taller than what he actually is

(B) Shorter that what he actually is

(C) The same height as he actually is

(D) Depends on the obliquity

Question

Find out apparent distance between bird and fish as seen by bird.

observer

$$\frac{n_2}{n_1} = \frac{R.D}{A.D}$$

$$\frac{\frac{4}{3}}{1} = \frac{24}{A.D}$$

$$\frac{4}{3} = \frac{24}{A.D}$$

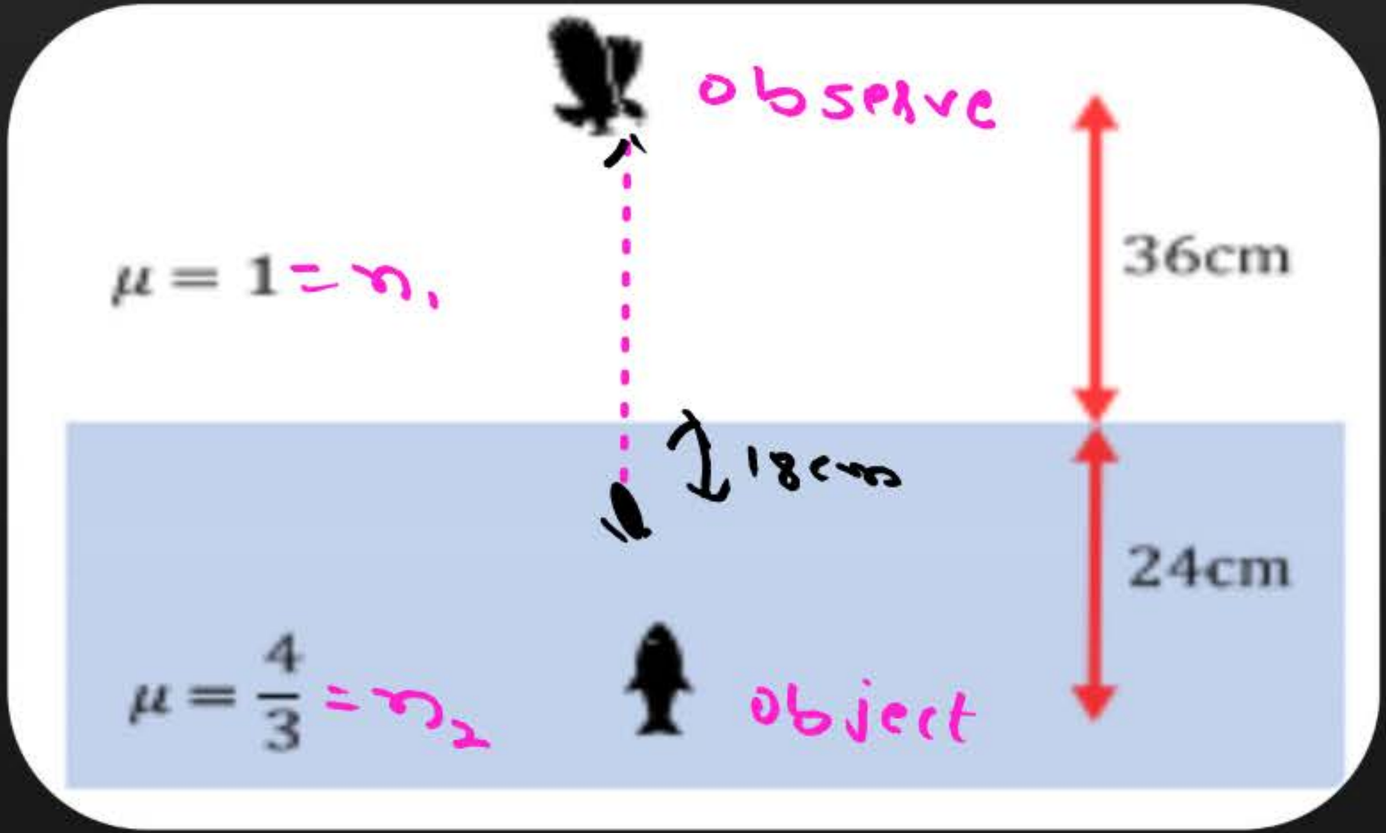
$$A.D = 6 \times 3$$

$$A.D = 18\text{ cm}$$

Distance

$= 18 + 36$

$= 54\text{ cm}$



Question

Find out apparent distance between bird and fish as seen by fish.

$$\frac{n_2}{n_1} = \frac{R.D}{A.D}$$

$$\frac{1}{\frac{4}{3}} = \frac{36}{A.D}$$

$$A.D = 36 \times \frac{4}{3}$$

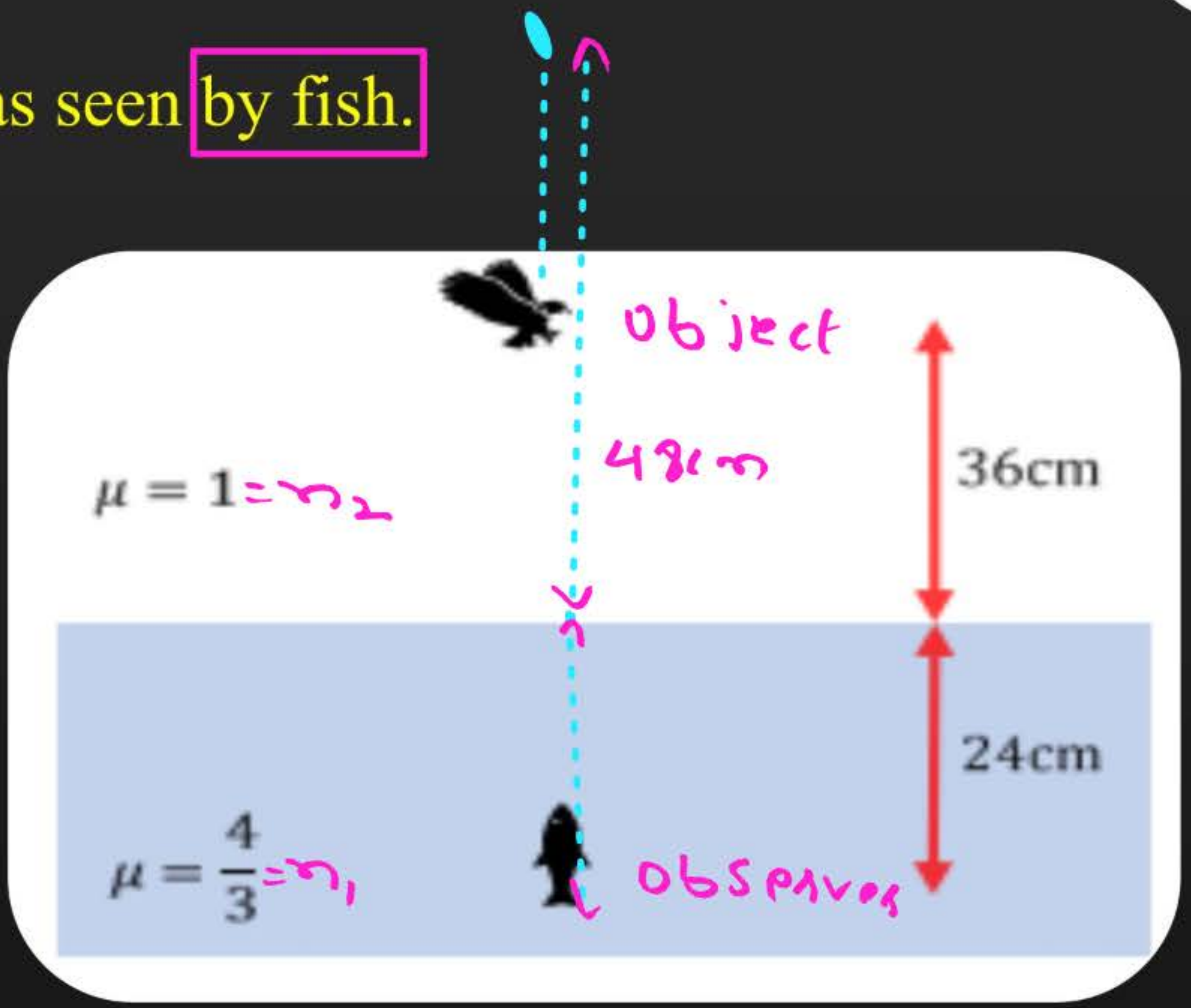
$$A.D = 12 \times 4$$

$$A.D = 48\,cm$$

Distance

$$= 48 + 24$$

$$= 72\,cm$$



Question

A fish in water (refractive index n) looks at a bird vertically above in the air. If y is the height of the bird and x is the depth of the fish from the surface, then the distance of the bird as estimated by the fish is

(A) $x + y\left(1 - \frac{1}{n}\right)$

(B) $x + ny$

(C) $x + y\left(1 + \frac{1}{n}\right)$

(D) $y + x\left(1 - \frac{1}{n}\right)$

observer = $n_1 = n$ → object, $n_2 = 1$, R.D

$\frac{n_2}{n_1} = \frac{R.D}{A.D}$

$\frac{1}{n} = \frac{y}{A.D}$

$A.D = ny$

Distance = $x + A.D$

$= x + ny$

Question

An air bubble in a glass slab with refractive index 1.5 (near normal incidence) is 5 cm deep When viewed from one surface and 3 cm deep when viewed from the opposite surface. The thickness (in cm) of the slab is:

(A) 12

(B) 16

(C) 8

(D) 10

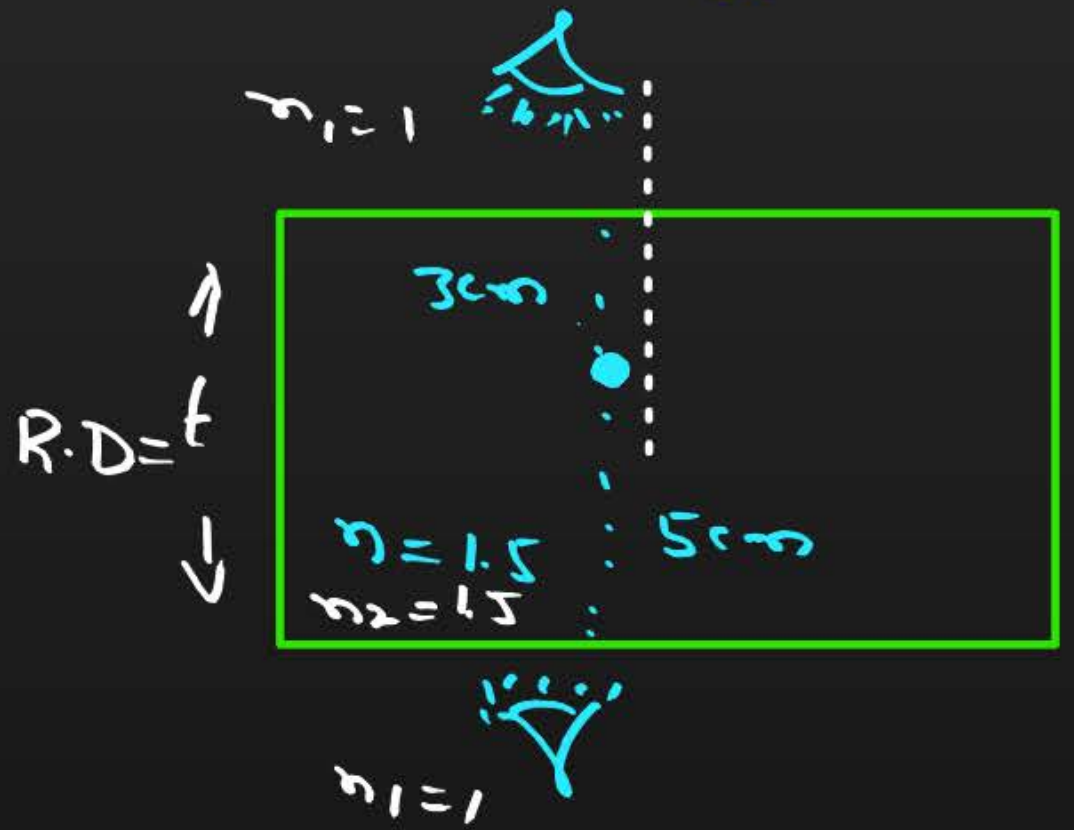
$$\frac{n_2}{n_1} = \frac{R.D}{A.D}$$

$$\frac{1.5}{1} = \frac{R.D}{(3+5)}$$

$$R.D = 1.5 \times 8$$

$$= \frac{3}{2} \times 8$$

R.D = Thickness = 12 cm



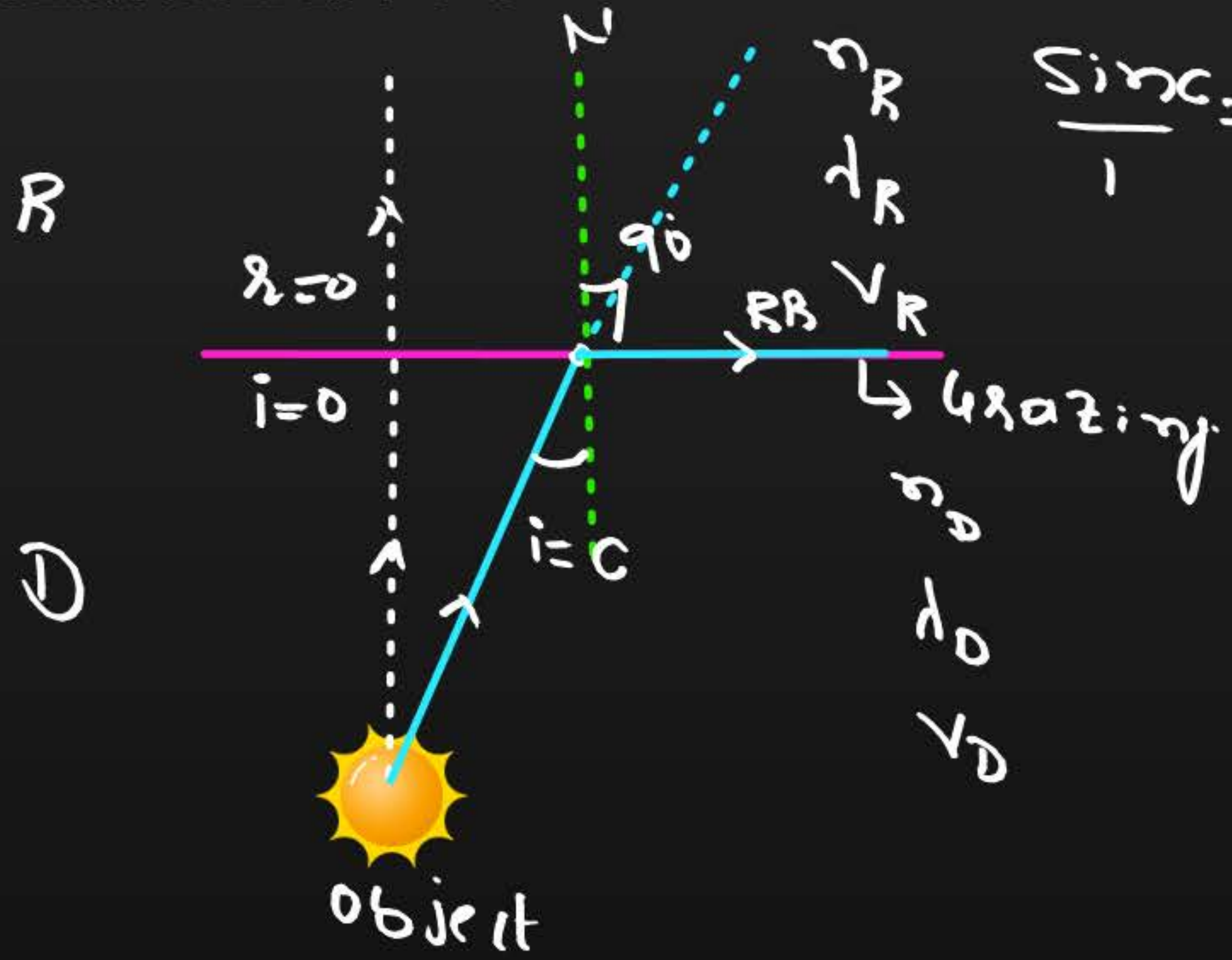
Critical angle (C)

$n_D \sin i = n_R \sin r$

$$\frac{\sin c}{\sin r} = \frac{n_R}{n_D}$$

$$\sin c = \frac{1}{\mu}$$

Critical angle for a pair of media is defined as angle of incidence in the denser medium for which the angle of refraction is 90°.



$$\frac{\sin c}{1} = \frac{\sin i}{\sin r} = \frac{n_R}{n_D} = \frac{D}{V_R} = \frac{\lambda_D}{\lambda_R}$$

*

$$\sin c = \frac{n_R}{n_D} = \frac{V_D}{V_R} = \frac{\lambda_D}{\lambda_R}$$

Total internal reflection

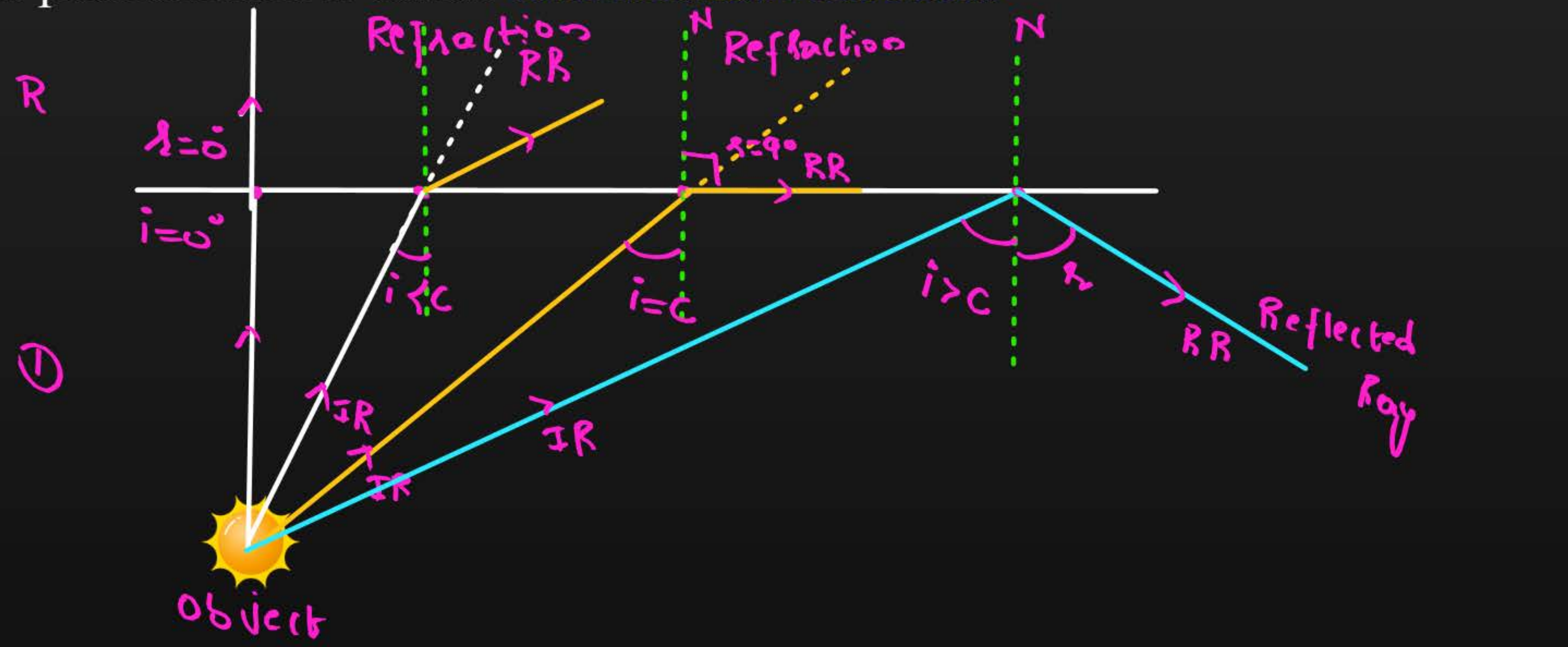
Conclusion

$i < c \rightarrow$ Refraction

$i = c \rightarrow$ Refraction Grazing

$i > c \rightarrow$ TIR

When a ray of light travelling from denser medium to rarer medium and is incident at an angle greater than critical angle the ray does not undergo refraction. It undergoes only reflection. This phenomenon is called total internal reflection.



Total internal reflection

State the condition for total internal reflection of light.

(i) The ray must travel denser medium to rarer medium.

(ii) The angle of incidence in the denser medium must be greater than critical angle.

Importance of critical angle and applications of total internal reflection of light.

1. Mirage
2. Brilliancy of Diamonds
3. Totally Reflecting Prisms
4. Optical fibre

Question

$n_R = 1 \quad n_D = \mu$

For a given pair of transparent media, the critical angle for which colour is maximum?

(A) Green

(B) Red

(C) Blue

(D) Violet

$$\sin C = \frac{n_R}{n_D} = \frac{V_D}{V_R} = \frac{\lambda_D}{\lambda_R}$$

$$\sin C \propto \frac{1}{\mu}$$

$\mu_V > \mu_R$

$C_V < C_R$

$C_R > C_V$

VIBGYOR

$\mu_V \to \max$

$\mu_R \to \min.$

$\sin C \propto \frac{1}{\mu}$

Question

Optical fiber are based on:

(A) Total internal reflection

(B) Less scattering

(C) Refraction

(D) Less absorption coefficient

Question

The speed of light in media M_1 and M_2 are $1.5 \times 10^8\ \text{ms}^{-1}$ and $2 \times 10^8\ \text{ms}^{-1}$ respectively. A ray travels from medium M_1 to the medium M_2 with an angle of incidence θ. The ray suffers total internal reflection. Then the value of the angle of incidence θ is

(A) $> \sin^{-1}\left(\frac{3}{4}\right)$

(B) $< \sin^{-1}\left(\frac{3}{4}\right)$

(C) $= \sin^{-1}\left(\frac{3}{4}\right)$

(D) $\leq \sin^{-1}\left(\frac{3}{4}\right)$

$\theta = i > C \Rightarrow TIR$

$$\sin C = \frac{n_R}{n_D} = \frac{v_D}{v_R} = \frac{\lambda_D}{\lambda_R}$$

$$\sin C = \frac{1.5 \times 10^8}{2 \times 10^8} = \frac{1.5}{2} \times \frac{10}{10} = \frac{15}{20} = \frac{3}{4}$$

$$C = \sin^{-1}\left(\frac{3}{4}\right)$$

$$\theta = i > C = \sin^{-1}\left(\frac{3}{4}\right)$$

Question

$v \propto \lambda$ λ_R λ_D

Wavelength of given light waves in air and in a medium are 6000Å and 4000Å respectively. The critical angle is

$$\sin c = \frac{\lambda_D}{\lambda_R} = \frac{4000}{6000} = \frac{4}{6} = \frac{2}{3}$$

(A) $\tan^{-1}\left(\frac{2}{3}\right)$

(B) $\sin^{-1}\left(\frac{2}{3}\right)$

(C) $\tan^{-1}\left(\frac{3}{2}\right)$

(D) $\sin^{-1}\left(\frac{3}{2}\right)$

$$c = \sin^{-1}\left(\frac{2}{3}\right)$$

Question

If the critical angle for a certain medium and vacuum is 30°. Find out the velocity of light in the medium?

$$\sin c = \frac{n_R}{n_D} = \frac{v_D}{v_R}$$

$$\sin c = \frac{v_D}{v_R}$$

$$\sin 30^\circ = \frac{v_D}{3\times10^8} \Rightarrow v_D = \frac{1}{2}\times 3\times10^8$$

$$v_D = 1.5\times10^8\ m/s$$

Question

Calculate the critical angle for glass-air interface if a ray of light incident on a glass surface is deviated through 15° when angle of incidence is 45°?

Question

$\frac{1}{\sqrt{2}} = \frac{1}{\mu}$ $\mu = \sqrt{2}$

What should be the range of refractive index of prism so that light ray suffers total internal reflection at surface AB?

$i > C \rightarrow TIR$

$\sin C = \frac{1}{\mu}$

$\sin 45° = \frac{1}{\mu}$

$\frac{1}{\sqrt{2}} = \frac{1}{\mu}$

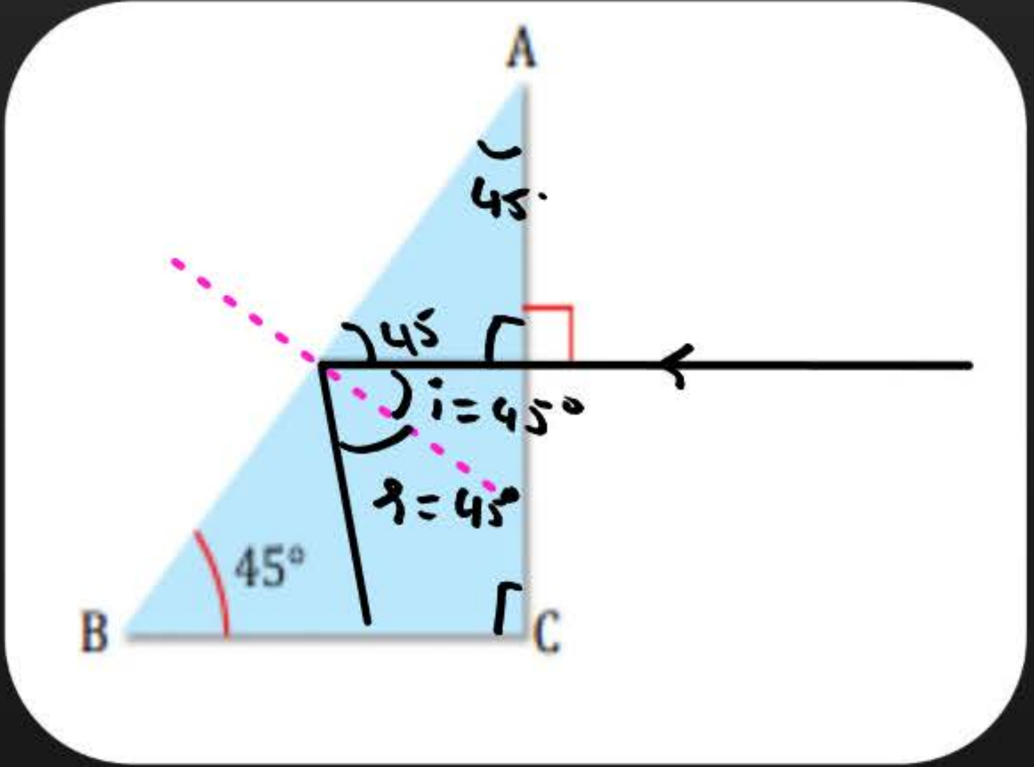
$i > C$

(i) $\mu > \sqrt{2}$

$\frac{1}{\sqrt{2}} > \frac{1}{\mu}$

$\sqrt{2} > \mu$

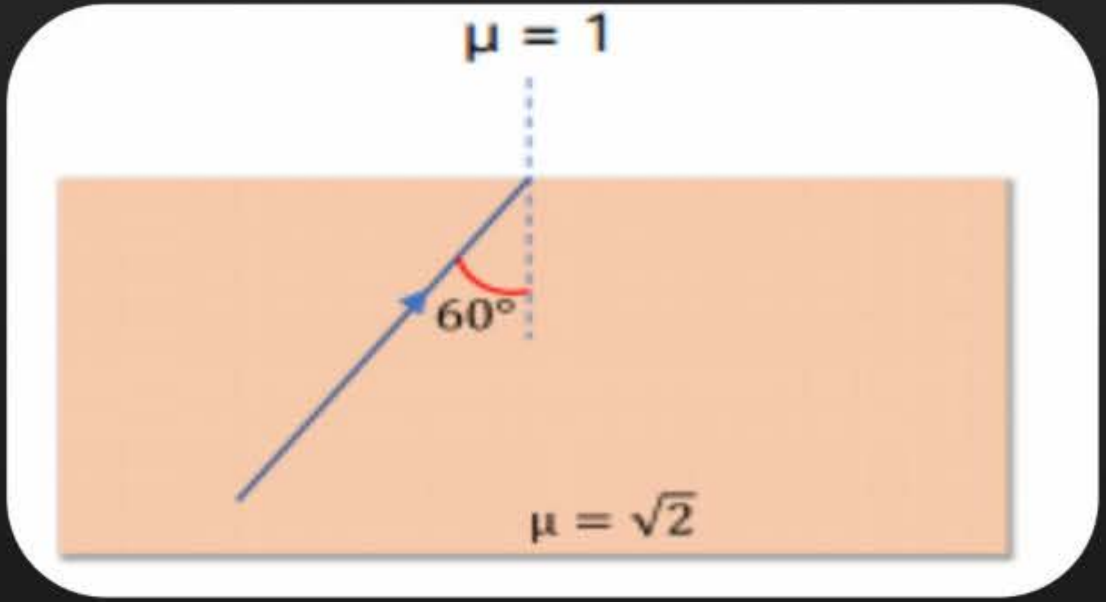
Or (ii) $\mu < \sqrt{2}$



Question

Find out angle of deviation? δ

H.W



Circle of illuminance

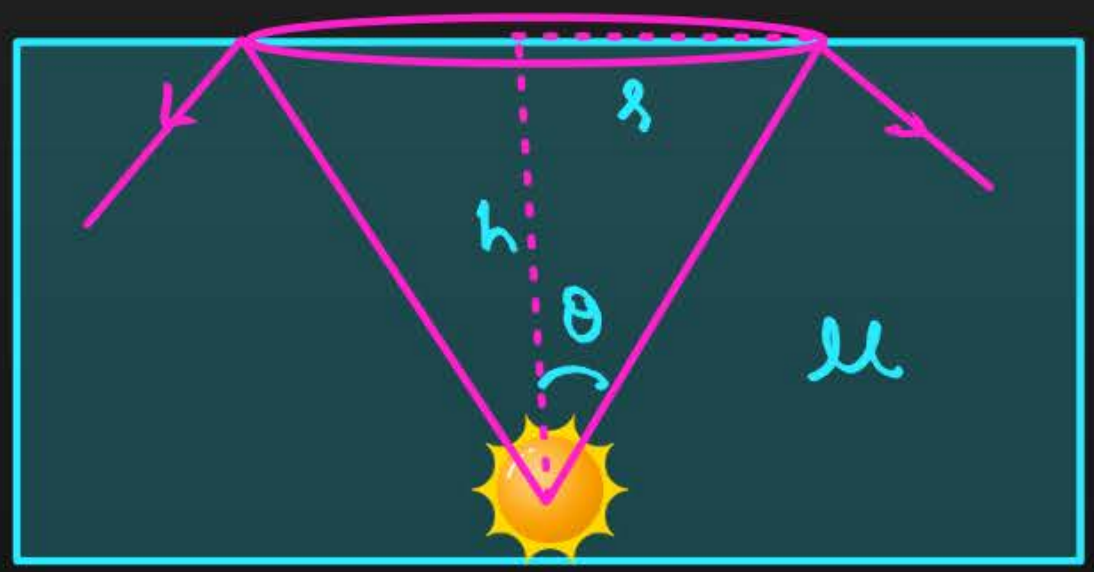
A point source is situated at the bottom of a tank filled with a liquid of refractive index μ upto h height. It is found that light comes out of liquid surface through a circular portion above the source.

$i < C$ – Refraction

$i = C$ – Grazing

$i > C$ – TRI

$$r = \frac{h}{\sqrt{\mu^2 - 1}}$$



Question

A disc is placed on a surface of pond which has refractive index $\frac{5}{3}$ A source of light is placed 4 m below the surface of liquid. The minimum radius of disc will be so light is not coming out:

(A) ∞

(B) 3 m

(C) 6 m

(D) 4 m

$A = ?$

$$r = \frac{h}{\sqrt{\mu^2 - 1}} = \frac{4}{\sqrt{\left(\frac{5}{3}\right)^2 - 1}}$$

$$A = \pi r^2$$

$$r = \frac{4}{\sqrt{\frac{25}{9} - 1}} = \frac{4}{\sqrt{\frac{25-9}{9}}} = \frac{4}{\frac{4}{3}} = 3$$

$r = 3\,m$

Question

A point source of light is kept below the surface of water ($n_w = 4/3$) at a depth of $\sqrt{7}\ m$. The radius of the circular bright patch of light noticed on the surface of water is

(A) $\sqrt{7}$m

(B) $\frac{3}{\sqrt{7}}$m

(C) 3 m

(D) $\frac{\sqrt{7}}{3}$ m

$$r = \frac{h}{\sqrt{\mu^2 - 1}} = \frac{\sqrt{7}}{\sqrt{\left(\frac{4}{3}\right)^2 - 1}}$$

$$r = \frac{\sqrt{7}}{\sqrt{\frac{7}{9}}} = \frac{\sqrt{7}}{\frac{\sqrt{7}}{3}}$$

$$r = 3\ m$$

Refraction Through Prism

In prism light ray crosses two plane inclined surfaces. These surfaces are called the 'refracting surfaces' and the angle between them is called the 'refracting angle' or the 'angle of prism'.

*
$$\mu_p = \frac{\sin\left(\frac{A+D}{2}\right)}{\sin\left(\frac{A}{2}\right)}$$

$$D = i + e - A$$

$$D = 2i - A$$

$$A = r_1 + r_2$$

$$i = e$$

$$r_1 = r_2$$

Question

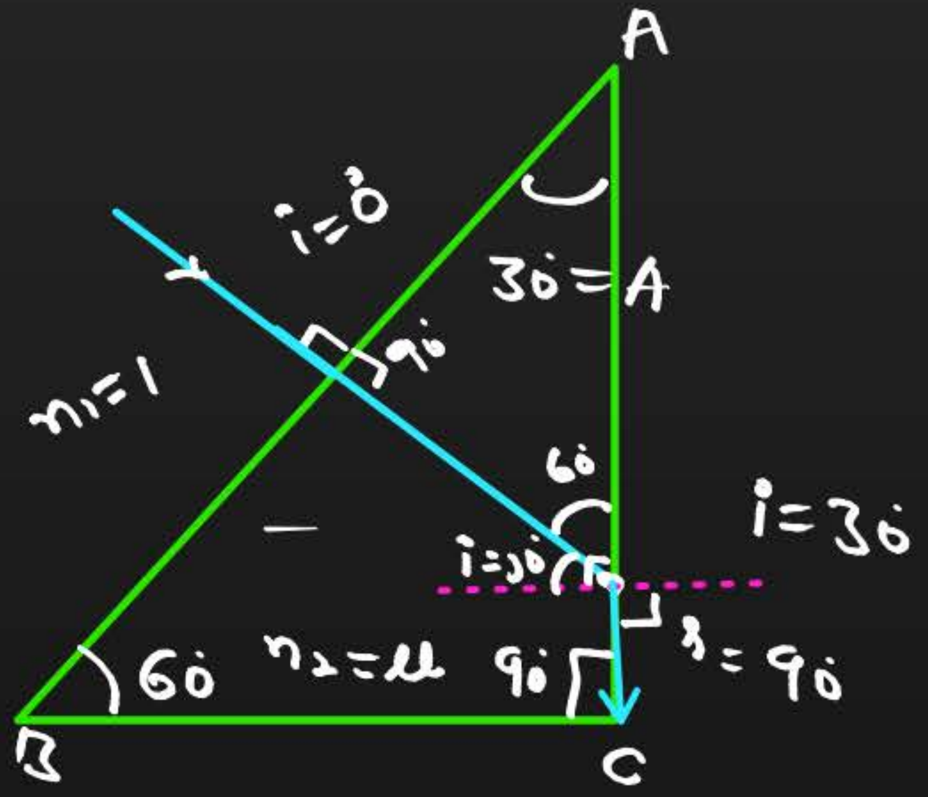
A ray of light incident normally on the surface of a prism having $A = 30°$. If the emergent light ray is grazed on the opposite surface of the prism then find out the refractive index of prism.

Snell's law — Face AC

$\mu \sin 30° = 1 \times \sin 90°$

$\mu \times \frac{1}{2} = 1$

$\mu = 2$



Question

A prism having refractive index 1.414 and refracting angle 30° has one of the refracting surface silvered. A beam of light incident on the other refracting surfaces silvered. A beam of the light incident on the other refracting surface will retrace its path, if the angle of incidence is

(A) 0°

(B) 30°

(C) 60°

(D) 45°

At AB-face

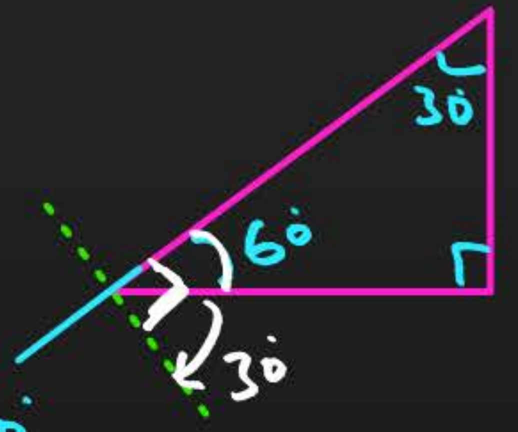
$n_1 \sin i = n_2 \sin r$

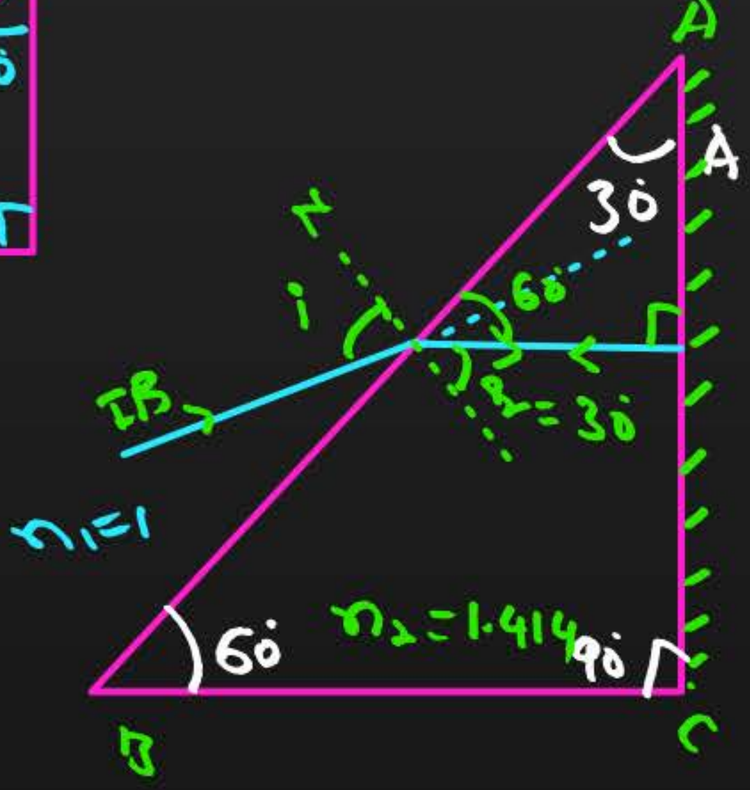
$1 \times \sin i = 1.414 \times \sin 30°$

$= \sqrt{2} \times \frac{1}{2} = \sqrt{\frac{2}{4}} = \frac{1}{\sqrt{2}}$

$\sin i = \frac{1}{\sqrt{2}}$

$i = 45°$





Question

A ray of light suffers a minimum deviation when incident on an equilateral prism of refractive index $\sqrt{2}$. The angle of deviation is

(A) 30°

(B) 45°

(C) 60°

(D) 50°

$$\mu = \frac{\sin\left(\frac{A+D}{2}\right)}{\sin\left(\frac{A}{2}\right)}$$

$$\sqrt{2} = \frac{\sin\left(\frac{60^\circ+D}{2}\right)}{\sin\left(\frac{60^\circ}{2}\right)}$$

$$\sqrt{2} = \frac{\sin\left(\frac{60^\circ+D}{2}\right)}{\sin 30^\circ}$$

$$\sqrt{2} \times \frac{1}{2} = \sin\left(\frac{60^\circ+D}{2}\right)$$

$$\frac{1}{\sqrt{2}} = \sin\left(\frac{60^\circ+D}{2}\right)$$

$$\sin 45^\circ = \sin\left(\frac{60^\circ+D}{2}\right)$$

$$45^\circ = \frac{60^\circ+D}{2} \Rightarrow 90^\circ = 60+D \Rightarrow D = 90^\circ - 60^\circ = 30^\circ$$

Question

The refracting angle of prism is A and refractive index of material of prism is $\cot A/2$. The angle of minimum deviation is

$$\sin\left(90^\circ - \frac{A}{2}\right) = \sin\left(\frac{A+D}{2}\right)$$

$$\mu = \frac{\sin\left(\frac{A+D}{2}\right)}{\sin\left(\frac{A}{2}\right)}$$

(A) $180^\circ - 3A$

$$\frac{180^\circ - A}{2} = \frac{A+D}{2}$$

$$\cot\left(\frac{A}{2}\right) = \frac{\sin\left(\frac{A+D}{2}\right)}{\sin\left(\frac{A}{2}\right)}$$

(B) $180^\circ + 2A$

$$180^\circ - A - A = D$$

(C) $90^\circ - A$

$$\frac{\cos\left(\frac{A}{2}\right)}{\sin\frac{A}{2}} = \frac{\sin\left(\frac{A+D}{2}\right)}{\sin\left(\frac{A}{2}\right)}$$

$$D = 180^\circ - 2A$$

(D) $180^\circ - 2A$

Thin Prism

For a thin prism, prism angle (A) is very small i.e $A < 10^o$

$$\delta = (\mu - 1)A$$

$$\mu = \frac{\sin\left(\frac{A+D}{2}\right)}{\sin\left(\frac{A}{2}\right)} = \frac{\frac{A+D}{2}}{\frac{A}{2}}$$

$$\frac{\mu A}{2} = \frac{A+D}{2}$$

$$\mu A - A = D$$

$$(\mu - 1)A = D = \delta$$

Question

If r and r' denote the angles inside the prism having angle of prism $50°$, considering that during the interval of time from $t = 0$ to $t = T$, r varies with time as $r = 10° + t^2$. During this time r' will vary with time as

(A) $50° + t^2$

(B) $40° - t^2$

(C) $40° + t^2$

(D) $50° - t^2$

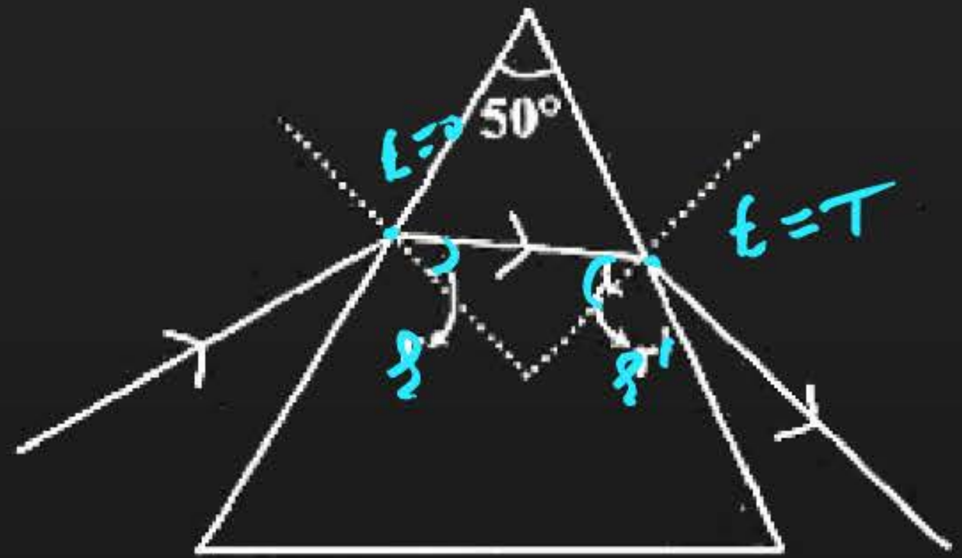
$A = r_1 + r_2$

$A = r + r'$

$50° = 10° + t^2 + r'$

$r' = 50° - 10° - t^2$

$r' = 40° - t^2$



Question

A thin prism of angle 15° made of glass of refractive index $\mu_1 = 1.5$ is combined with another prism of glass of refractive index ($\mu_2 = 1.75$). The combination of the prisms produces dispersion without deviation. The angle of the second prism should be:

(A) 7°

(B) 10°

(C) 12°

(D) 5°

$\delta = 0 \quad \delta_1 = \delta_2$

$\delta = (\mu - 1)A$

$\delta_1 = (\mu_1 - 1)A_1$

$\delta_1 = (1.5 - 1)15°$

$\delta_1 = 0.5 \times 15°$

$\delta_1 = 7.5°$

$\delta_2 = (\mu_2 - 1)A_2$

$\delta_2 = (1.75 - 1)A_2$

$\delta_2 = 0.75 A_2$

$\delta_1 = \delta_2$

$7.5 = 0.75 A_2$

$A_2 = \frac{7.5}{0.75} = 10°$

Question

If the angle of minimum deviation is equal to angle of a prism for an equilateral prism, then the speed of light inside the prism is ________

(A) $3 \times 10^8\ \text{ms}^{-1}$

(B) $2\sqrt{3} \times 10^8\ \text{ms}^{-1}$

(C) $\sqrt{3} \times 10^8\ \text{ms}^{-1}$

(D) $\frac{\sqrt{3}}{2} \times 10^8\ \text{ms}^{-1}$

$$\mu_p = \frac{\sin\left(\frac{A+D}{2}\right)}{\sin\left(\frac{A}{2}\right)} = \frac{\sin\left(\frac{A+A}{2}\right)}{\sin\left(\frac{A}{2}\right)} = \frac{\sin A}{\sin \frac{A}{2}}$$

$$\mu_p = \frac{\sin 60^\circ}{\sin 30^\circ} = \frac{\sqrt{3}}{2} \times \frac{1}{\frac{1}{2}} = \sqrt{3}$$

$$\mu = \frac{c}{v} \quad v_g = \frac{c}{\mu} = \frac{3 \times 10^8}{\sqrt{3}} = \sqrt{3} \times 10^8$$

Question

$A = D$

The angle of minimum deviation for an incident light ray on an equilateral prism is equal to its refracting angle. The refractive index of its material is

(A) $\frac{1}{\sqrt{2}}$

(B) $\sqrt{3}$

(C) $\frac{\sqrt{3}}{2}$

(D) $\frac{3}{2}$

$$\mu_p = \frac{\sin\left(\frac{A+D}{2}\right)}{\sin\left(\frac{A}{2}\right)}$$

$A = D$

$$\mu_p = \frac{\sin 60^\circ}{\sin 30^\circ} = \sqrt{3}$$

Question

A thin prism of 5° angle gives a deviation of 3.2°. Find the refractive index of the material

A   D = δ

$$\delta = (\mu - 1)A$$

$$3.2^\circ = (\mu - 1)5^\circ$$

$$\mu - 1 = \frac{3.2^\circ}{5^\circ} = 0.64$$

$$\mu = 0.64 + 1$$

$$\boxed{\mu = 1.64}$$

Thank

You