PARISHRAM

2026

Lecture - 01

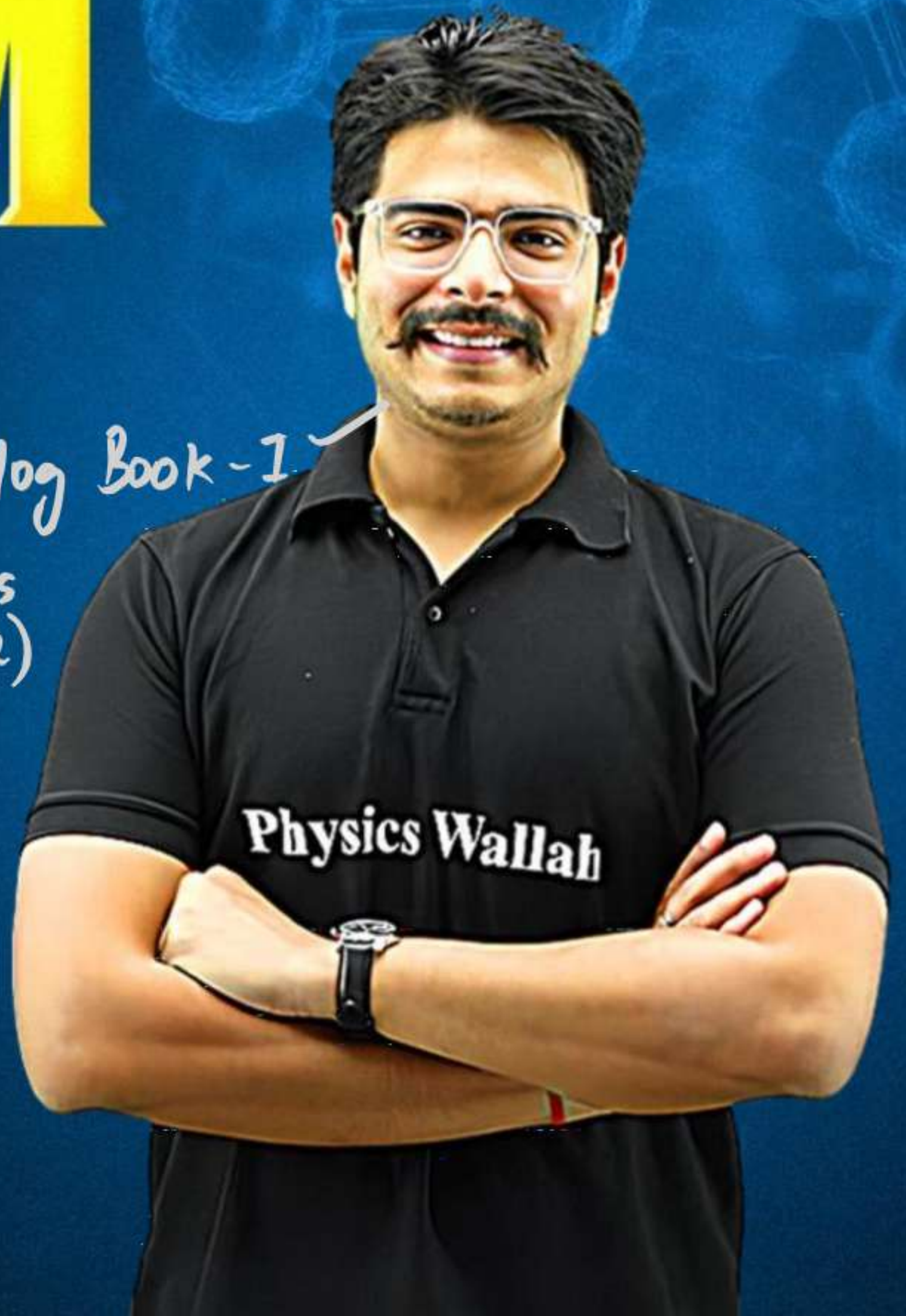
Wave Optics

Any Backlog Book - I

Waves Basics
(eqn of wave)
Class XI

PHYSICS Lecture - 1

BY - RAKSHAK SIR



Topics *to be covered*

1 Theories of Light

Huygens Principle

2 Wavefronts

Unit–V	**Electromagnetic Waves** 3 Book - 1	18
	Chapter–8: Electromagnetic Waves	
Unit–VI	**Optics** → Book - 2	
	Chapter–9: Ray Optics and Optical Instruments 9	
	Chapter–10: Wave Optics 6	

Chapter–10: Wave Optics

Wave optics: Wave front and Huygen's principle, reflection and refraction of plane wave at a plane surface using wave fronts. Proof of laws of reflection and refraction using Huygen's principle. Interference, Young's double slit experiment and expression for fringe width (No derivation final expression only), coherent sources and sustained interference of light, diffraction due to a single slit, width of central maxima (qualitative treatment only).

Theories of Light

particle

1. **Newton Corpuscle theory (1675)** : According to this theory, light consists of tiny elastic material particles called corpuscles.

2. **Huygens Wave theory (1678)**
Supported by Young (1801) :
   - Light is a wave.
   - Longitudinal wave

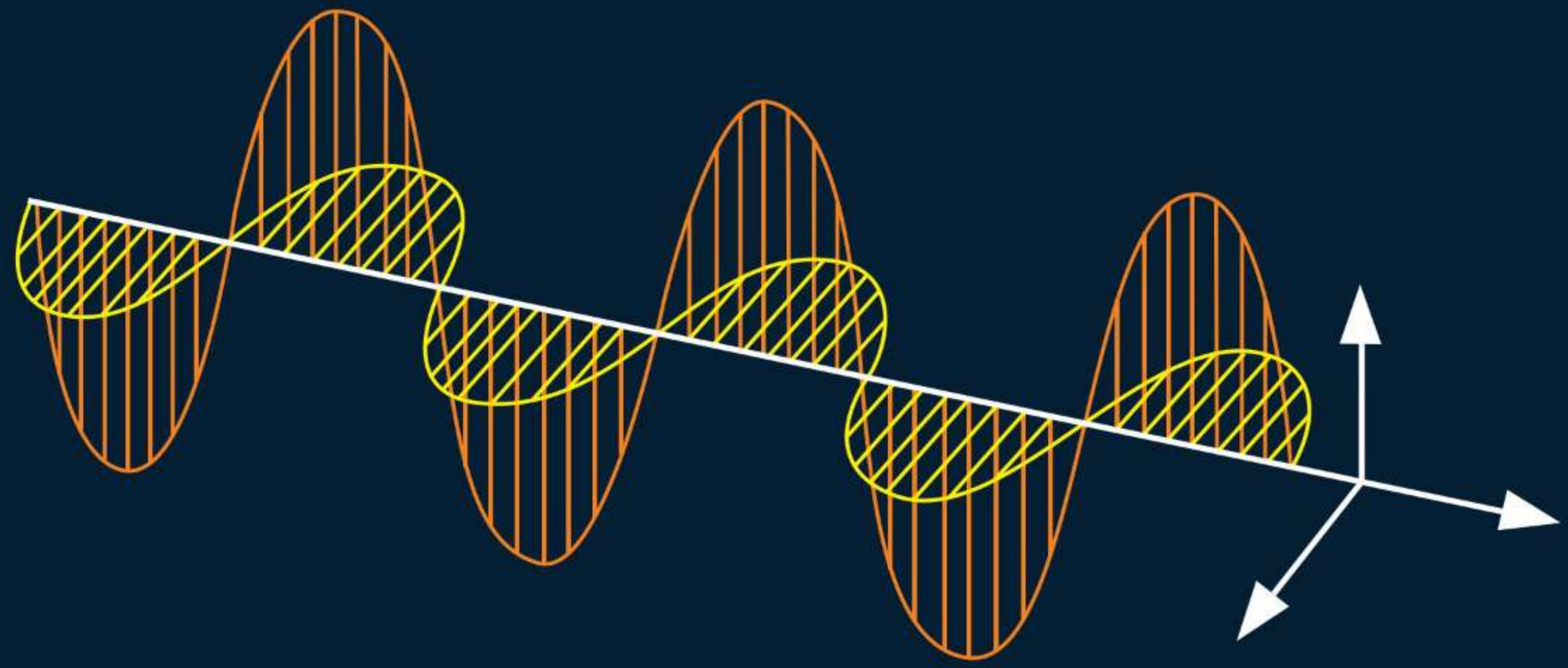
Y.D.S.E.

✓ Reflection ✓
✓ Refraction ✓
✓ Dispersion ✓
✓ Interference X
✓ Diffraction X
X Polarisation X

3. Maxwell's Electromagnetic theory (1873)

Longi ✗

Transverse ✓



Reflection ✓

Refraction ✓

Dispersion ✓

Interference ✓

Diffraction ✓

Polarization ✓

Photo-electric effect ✗

Quantum = packet of Energy = Photon
Quanta = packets of Energy = Photons

4. **Plank's Quantum theory (Einstein's use in 1905):** Light propagates in the form of packets of light energy called quanta.

Photo-electric effect ✓

5. **De-Broglie theory (1924) :** Light shows dual nature.

'Dogli'

Interference ×

Diff ×

Pol ×

QUESTION

Electromagnetic wave theory could not explain..........

A. Interference

B. Diffraction

C. Polarization

D. Photoelectric effect

QUESTION

According to quantum theory light propagates in the form of ......

A. Particle

B. Wave

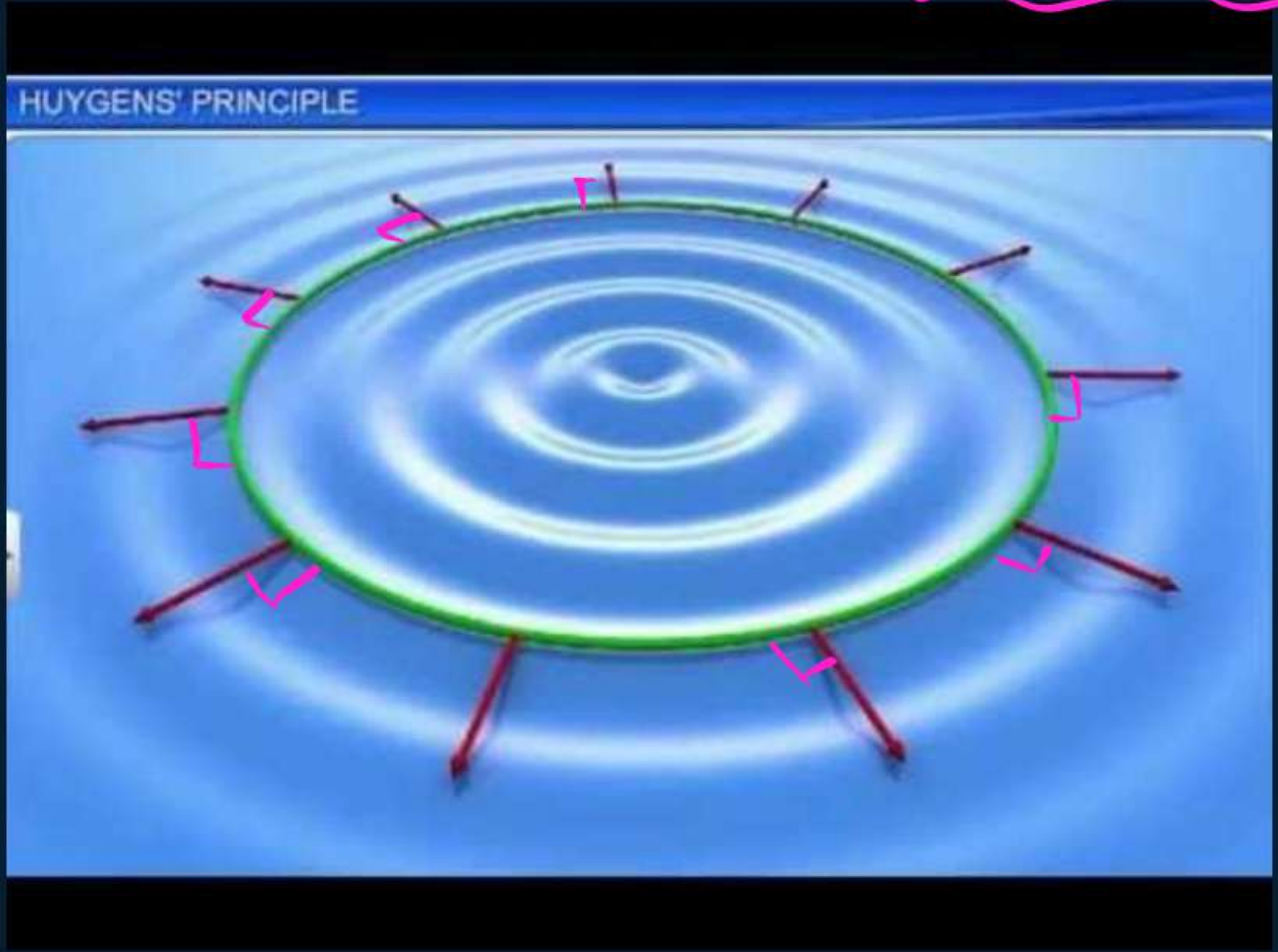
C. Packet of energy (photon)

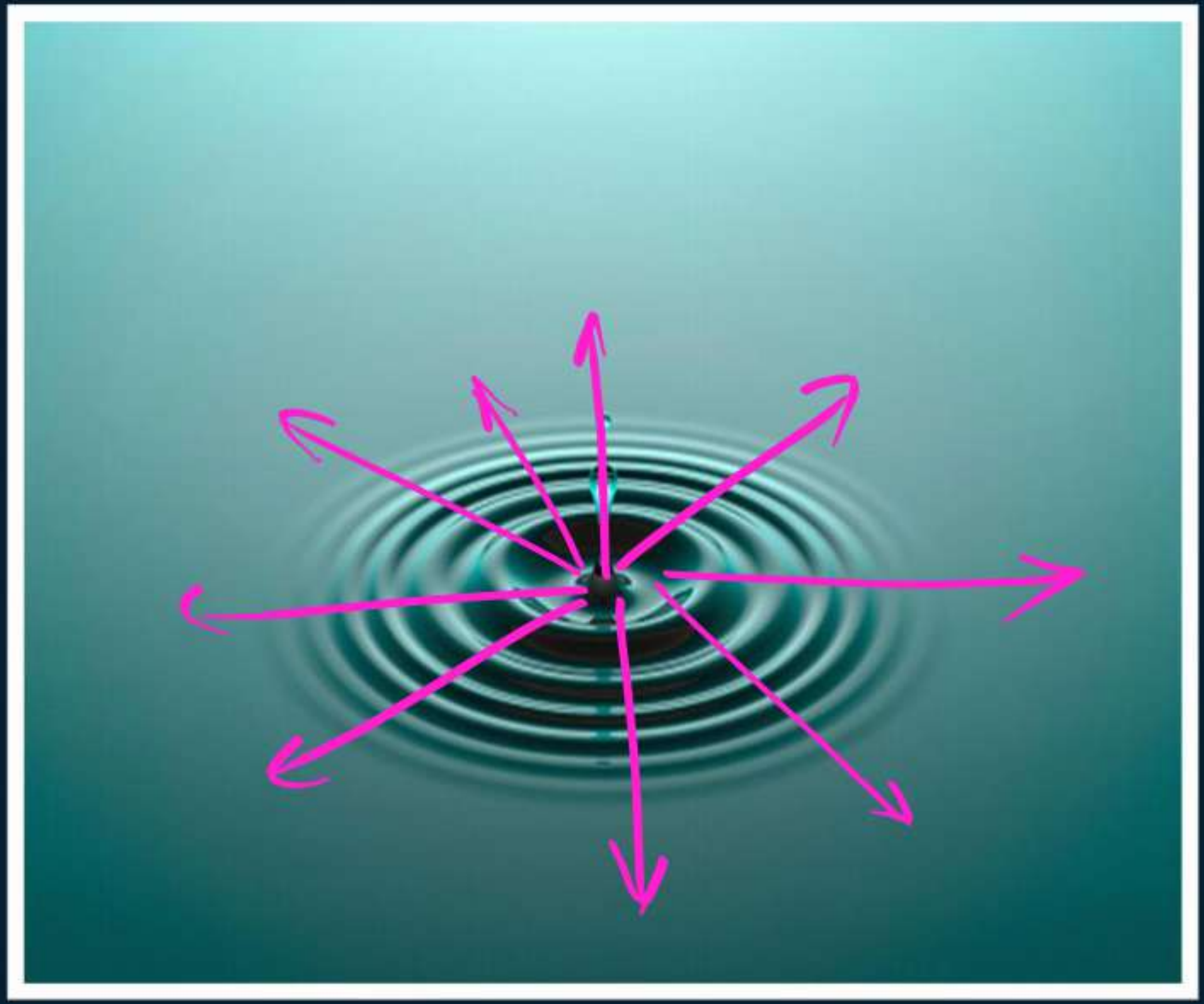
D. None of the above

Wave-Front

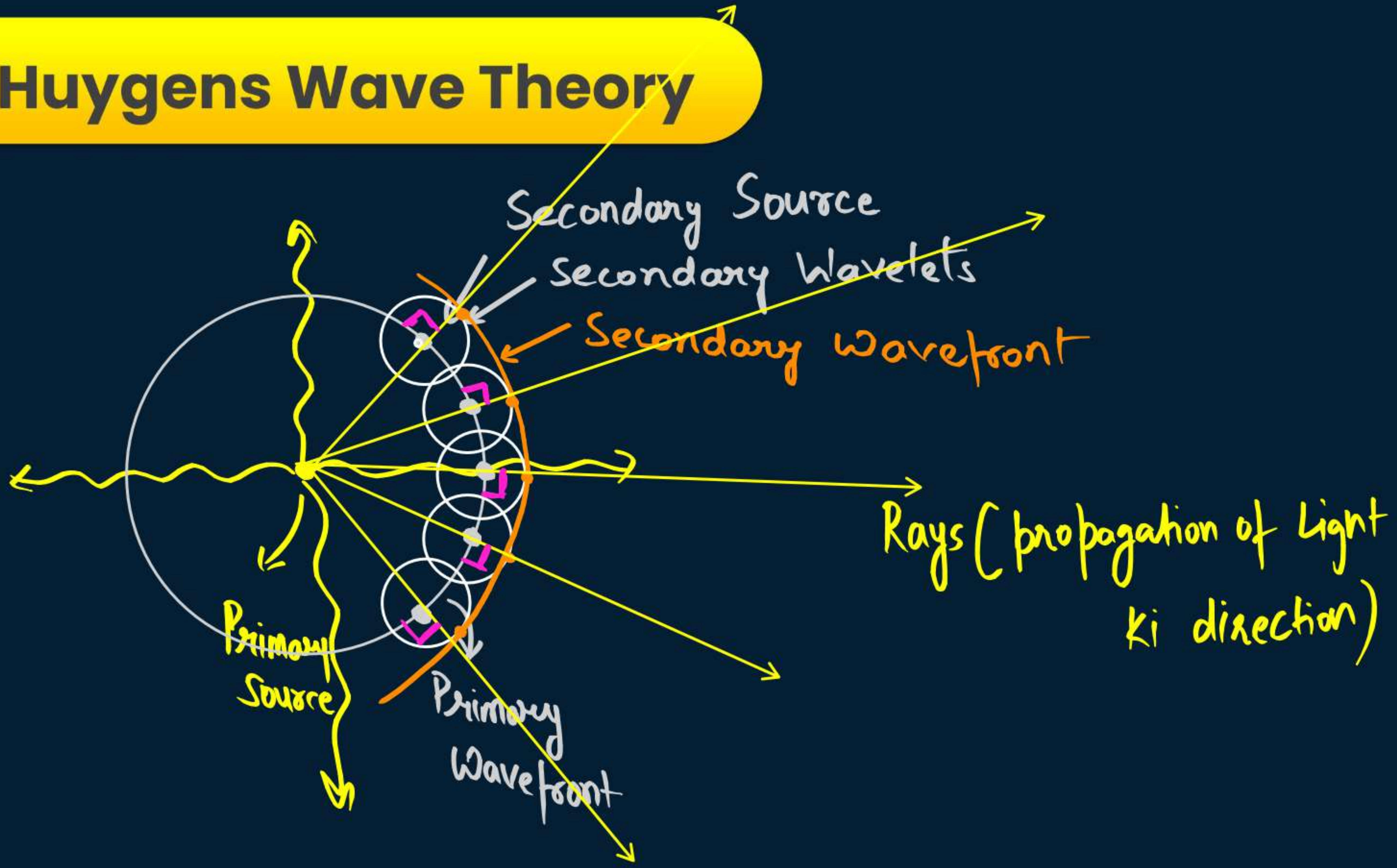
1. The locus of all the points vibrating in the same phase is called wave-front

2. It is always perpendicular to the direction of propagation of wave.





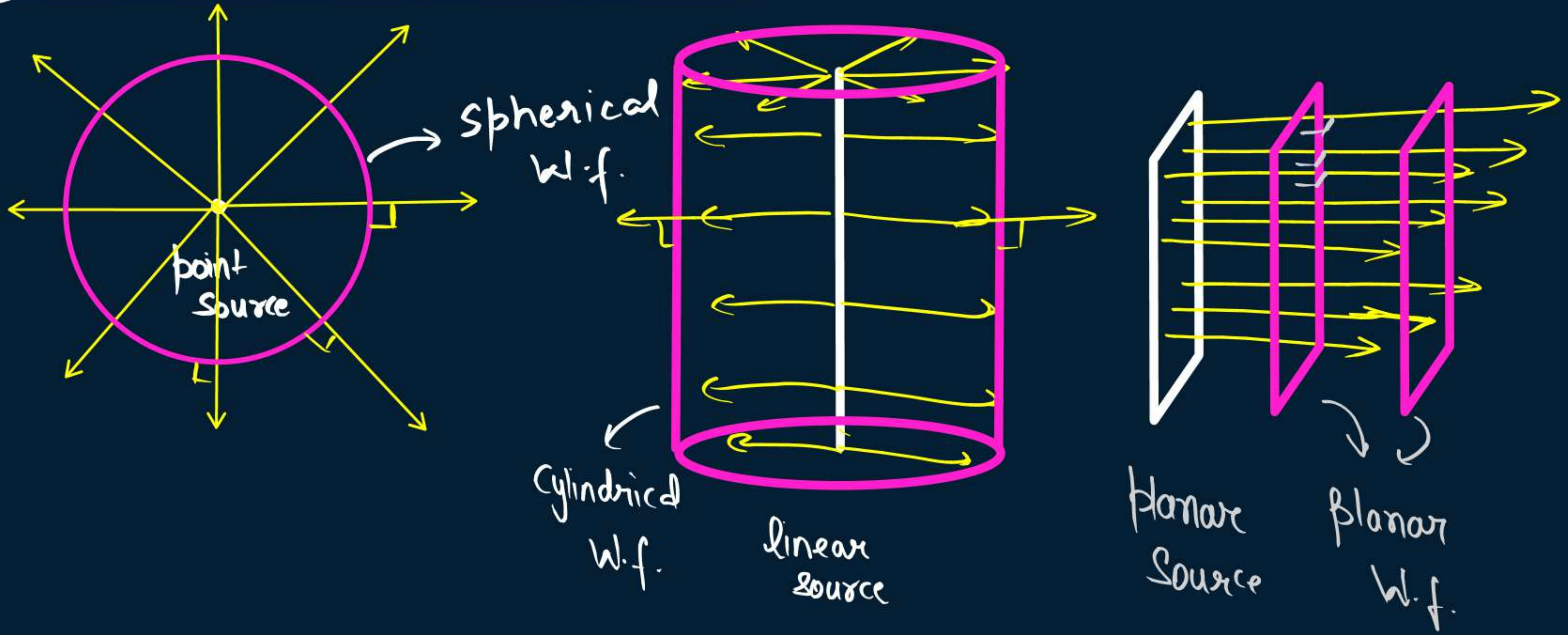
Huygens Wave Theory



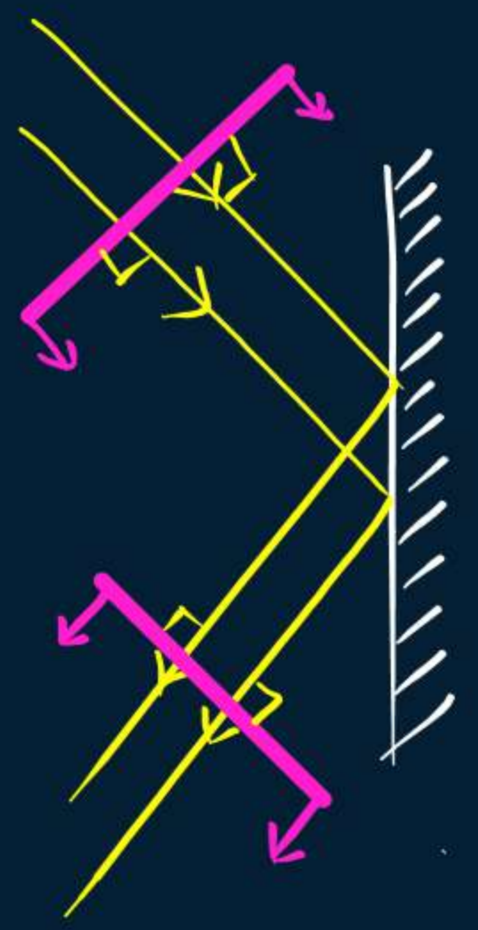
1. Each point on wavefront acts as source of secondary disturbance/wavelets, which travel uniformly in all the directions with speed of light.

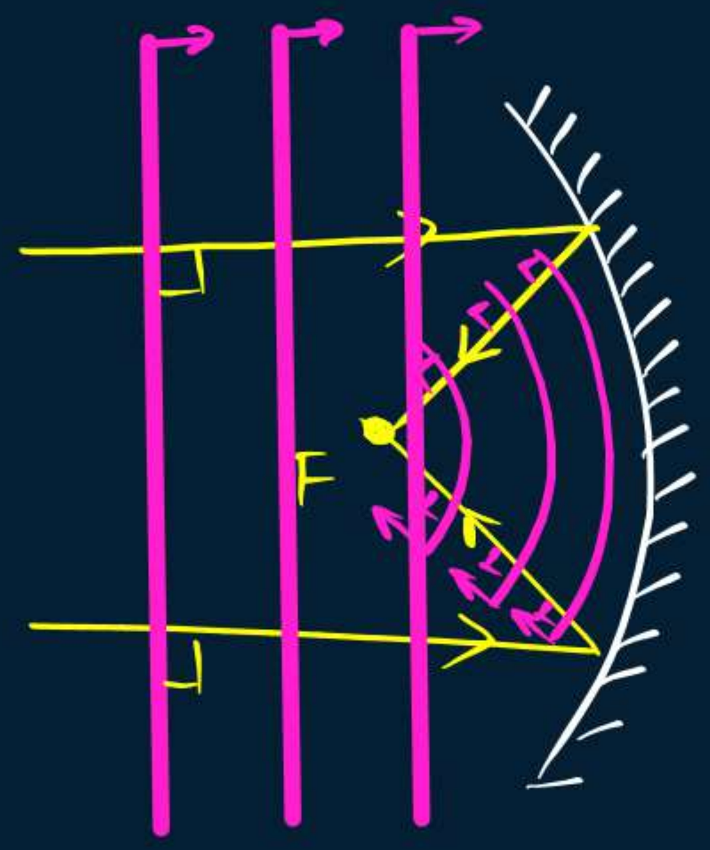
2. The common tangent to these wavelets in the forward direction is called wavefront (Forward Envelope).

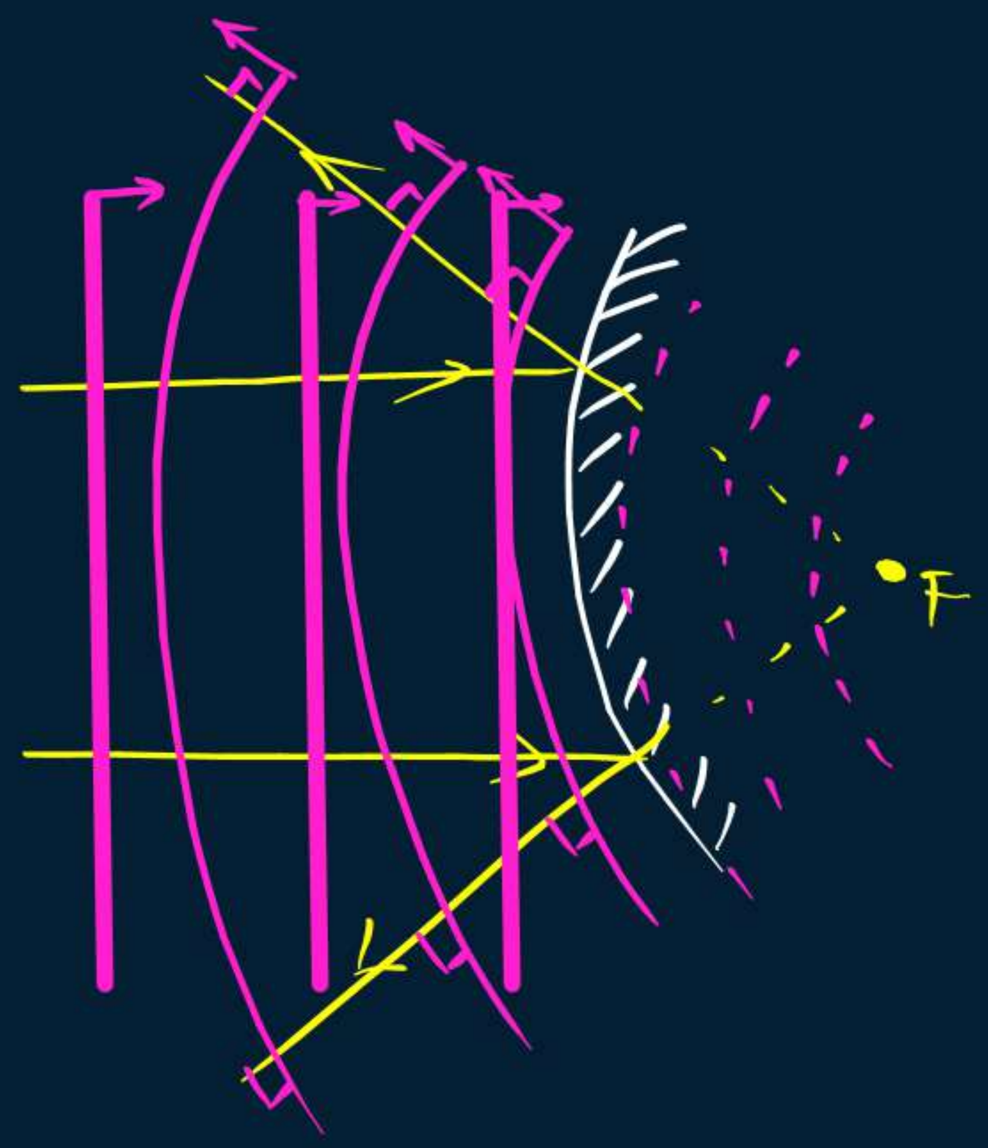
Shape of Wavefronts



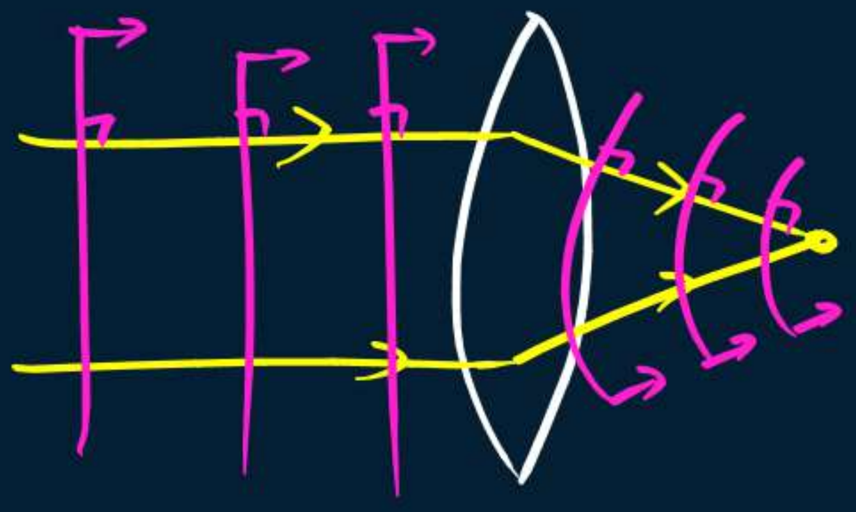
Homework

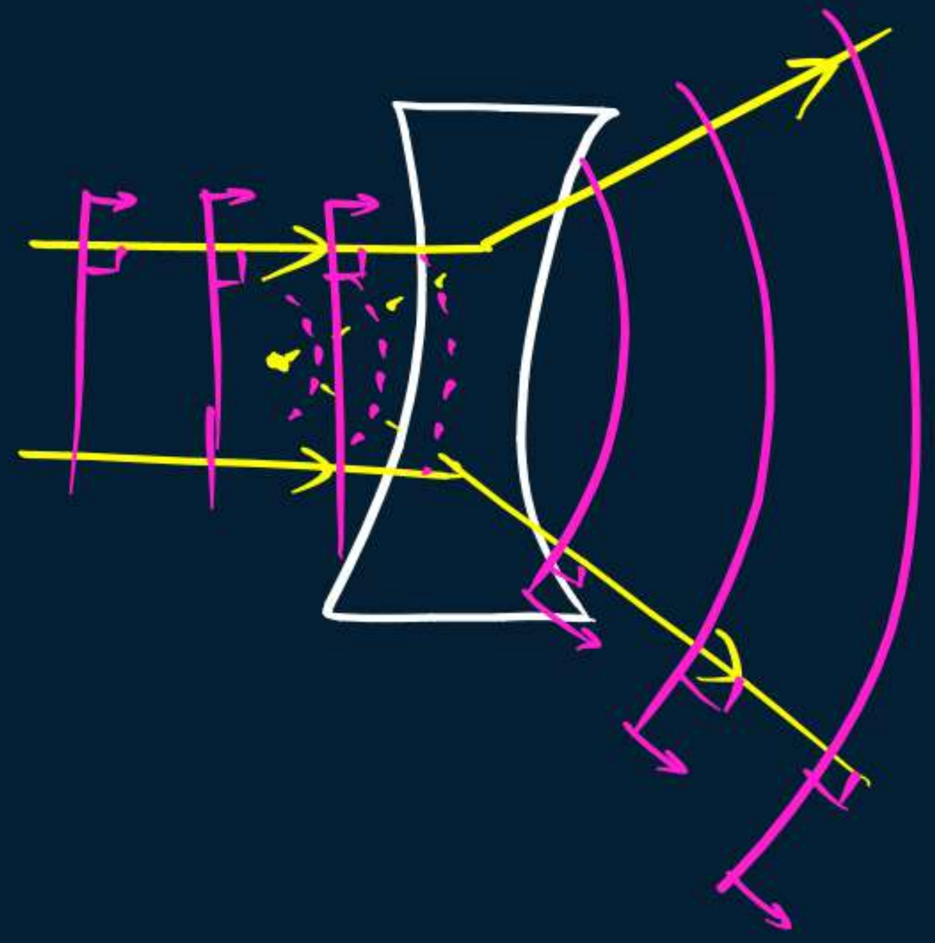


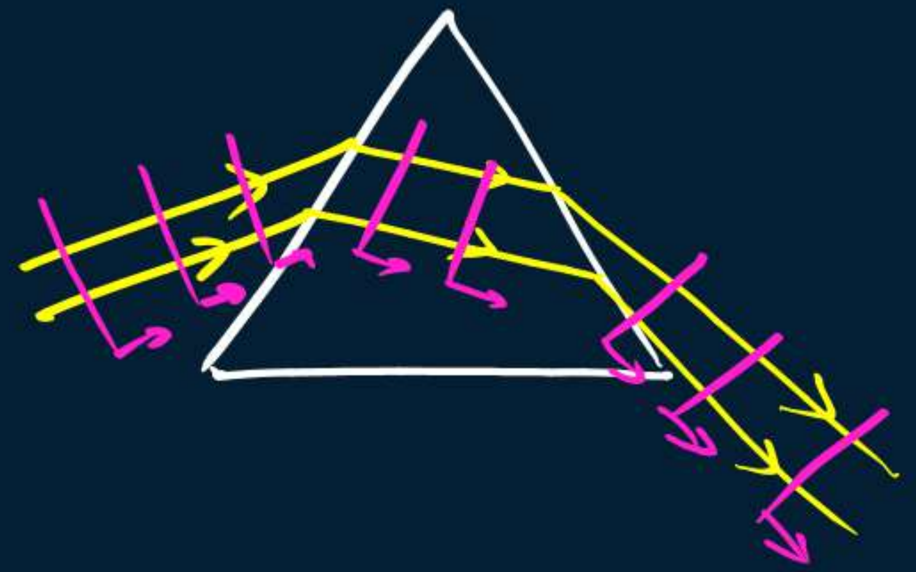


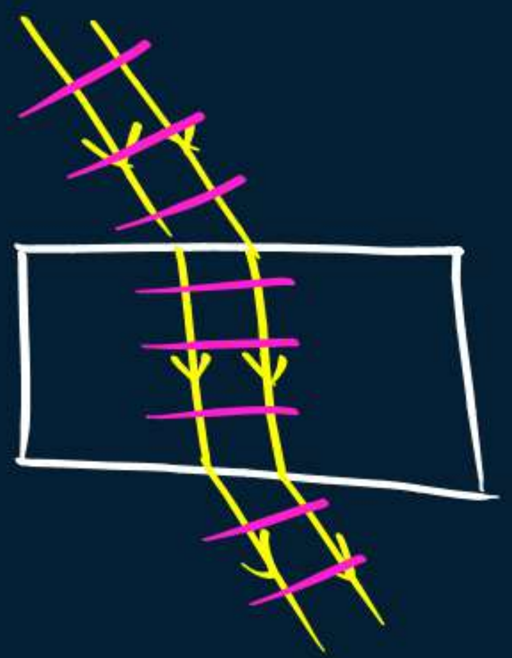


~~Homework~~









QUESTION

Huygen's principle of secondary wavelets may be used to

(A) Explain Snell's law (Law of refraction)

(B) Find velocity of light in vacuum X

(C) Find new position of a wavefront

(D) Both (a) and (c) are correct

QUESTION

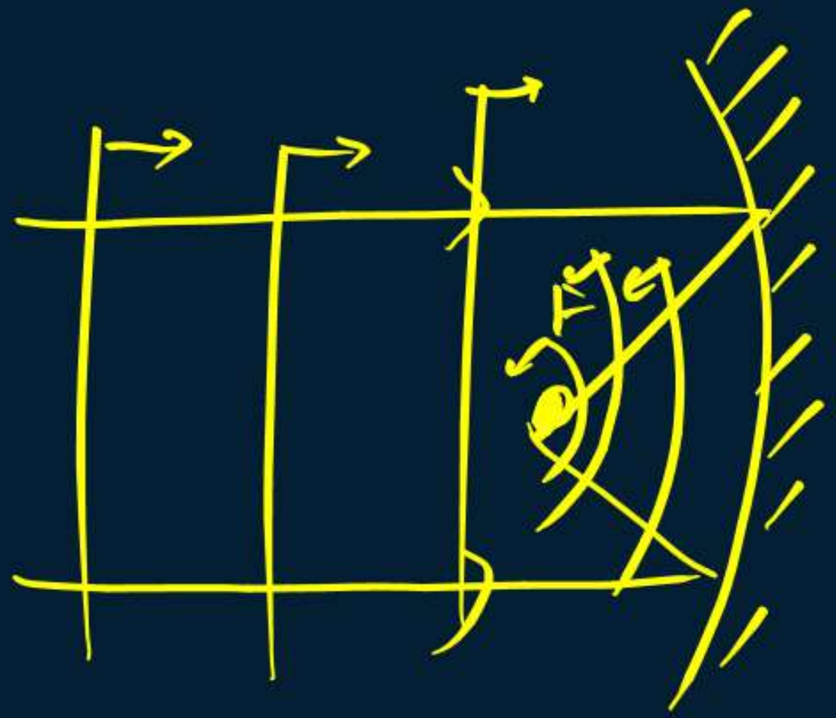
The shape of reflected wavefronts in case of reflection of plane wave from concave mirror is

A. Spherical

B. Plane

C. Cylindrical

D. Both (B) and (C)



QUESTION

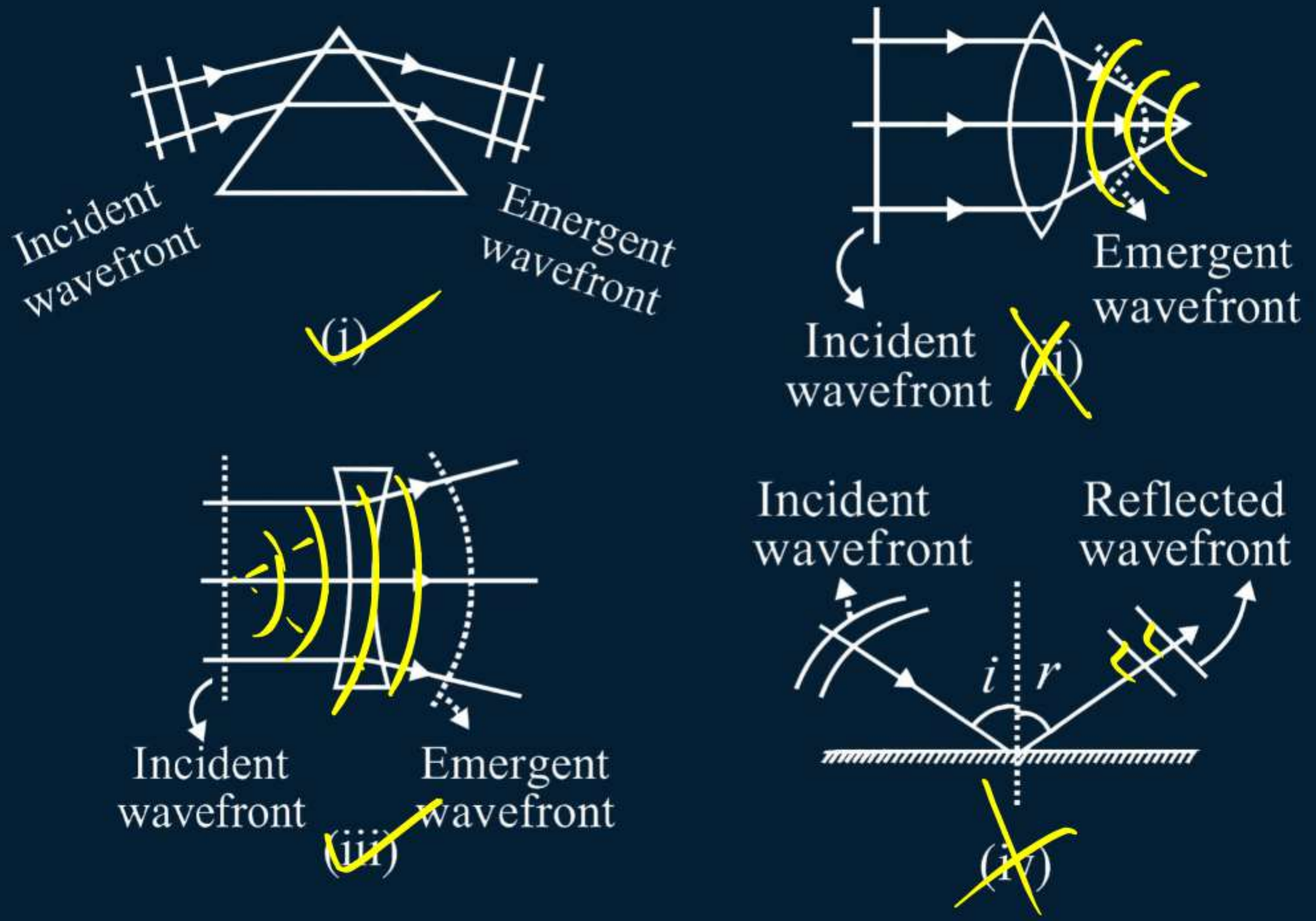
Shapes of wavefront is shown in following figures. The correct shape of wavefront according to the directions of rays are represented in figures

A (i) and (ii) both

B (ii) and (iii) both

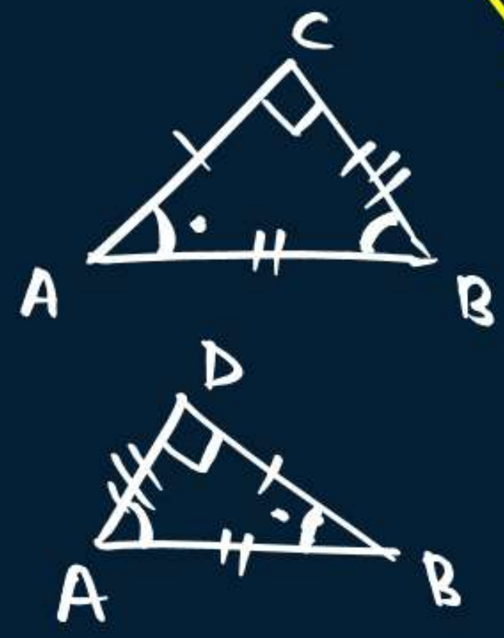
C (i) and (iii) both

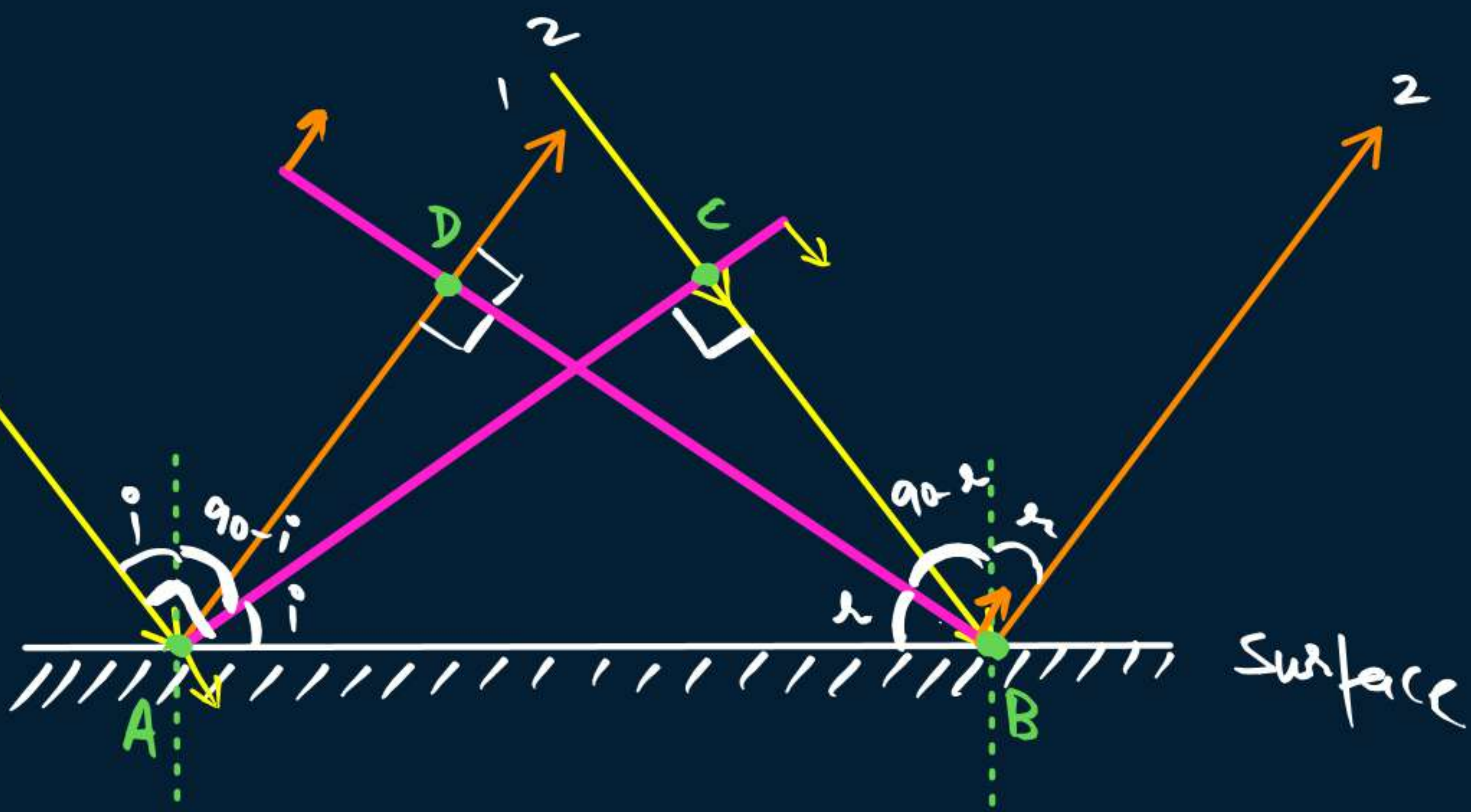
D (iii) and (iv) both



Reflection of Light : Huygens Principle

To prove :- $\angle i = \angle r$





time taken by the two rays,

$$t_{AD} = t_{CB}$$

$$\frac{d_{AD}}{v_{AD}} = \frac{d_{CB}}{v_{CB}}$$

$$\frac{AD}{\cancel{c}} = \frac{CB}{\cancel{c}}$$

$$\boxed{AD = CB}$$

In ΔACB and ΔADB,

$\angle ACB = \angle ADB$ (Both 90°) $AD = BC$

$AB = AB$ (common) Both Δs are congruent.

~~Homework~~

We can say,

$$\angle CAB = \angle DBA$$

$$\boxed{\angle i = \angle r}$$

hence, from huygens Theory,

Laws of reflection of light

is Verified.

Refraction of Light : Huygens Principle

To prove :-

Snell's Law

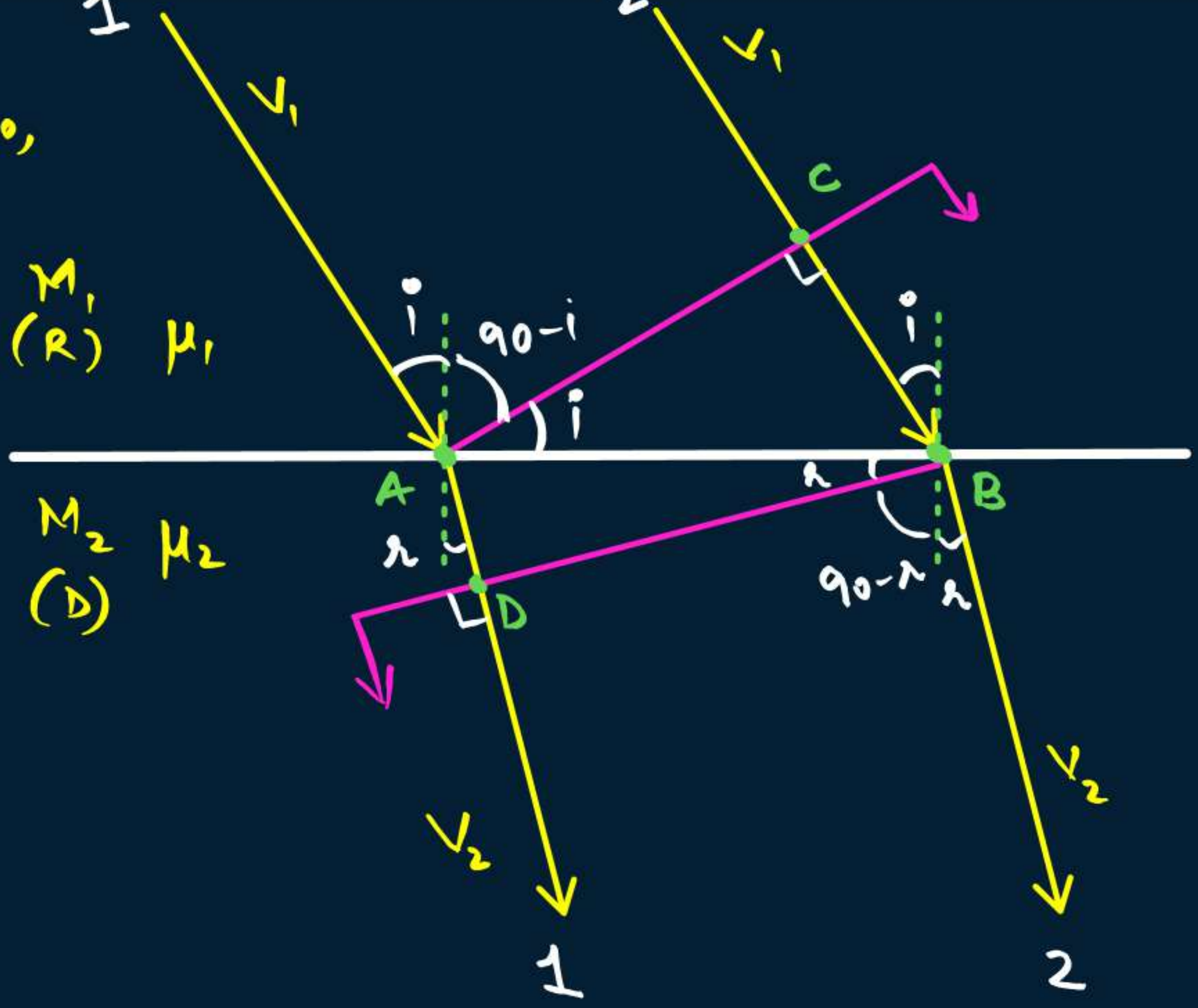
$\mu_1 \sin i = \mu_2 \sin r$

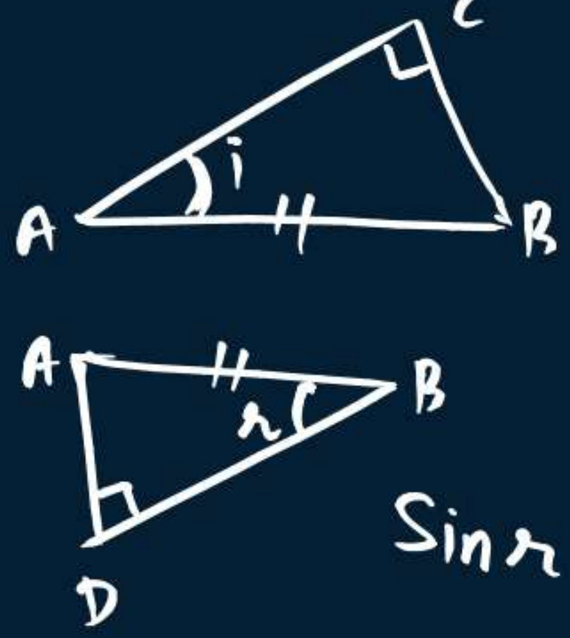
v remains same,

$t_{AD} = t_{CB}$

$\frac{AD}{V_2} = \frac{CB}{V_1}$

$\frac{BC}{AD} = \frac{V_1}{V_2}$





$\sin i = \frac{P}{H} = \frac{BC}{AB}$

$\sin r = \frac{P}{H} = \frac{AD}{AB}$

$\frac{\sin i}{\sin r} = \frac{\frac{BC}{\cancel{AB}}}{\frac{AD}{\cancel{AB}}} = \frac{BC}{AD}$

~~Homework~~

$$\frac{\sin i}{\sin r} = \frac{BC}{AD}$$

$$\frac{\sin i}{\sin r} = \frac{V_1}{V_2}$$

$$\frac{\sin i}{\sin r} = \frac{\mu_2}{\mu_1}$$

$$\boxed{\mu_1 \sin i = \mu_2 \sin r}$$

hence, by huygens wave theory, snell's law is proved.

Homework → Notes

→ W.f. × 2

→ Derivations × 3

AAKHRI

SAAL HAI

JAAN

LAGA DE

PARISHRAM

2026

Lecture - 02

Wave Optics

PHYSICS Lecture - 2

BY - RAKSHAK SIR

Topics *to be covered*

1. Interference
2. YDSE

Coherent Sources

The sources which have zero phase difference or constant phase difference between them (i.e. time independent)

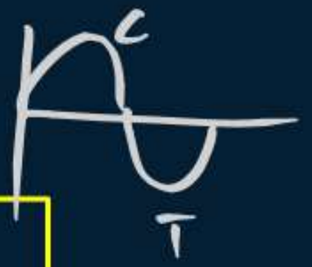
ex→ Laser (mono-chromatic) : high degree of Coherence.

Generally Obtained from single parent source

* Incoherent Sources

↳ Variable phase difference

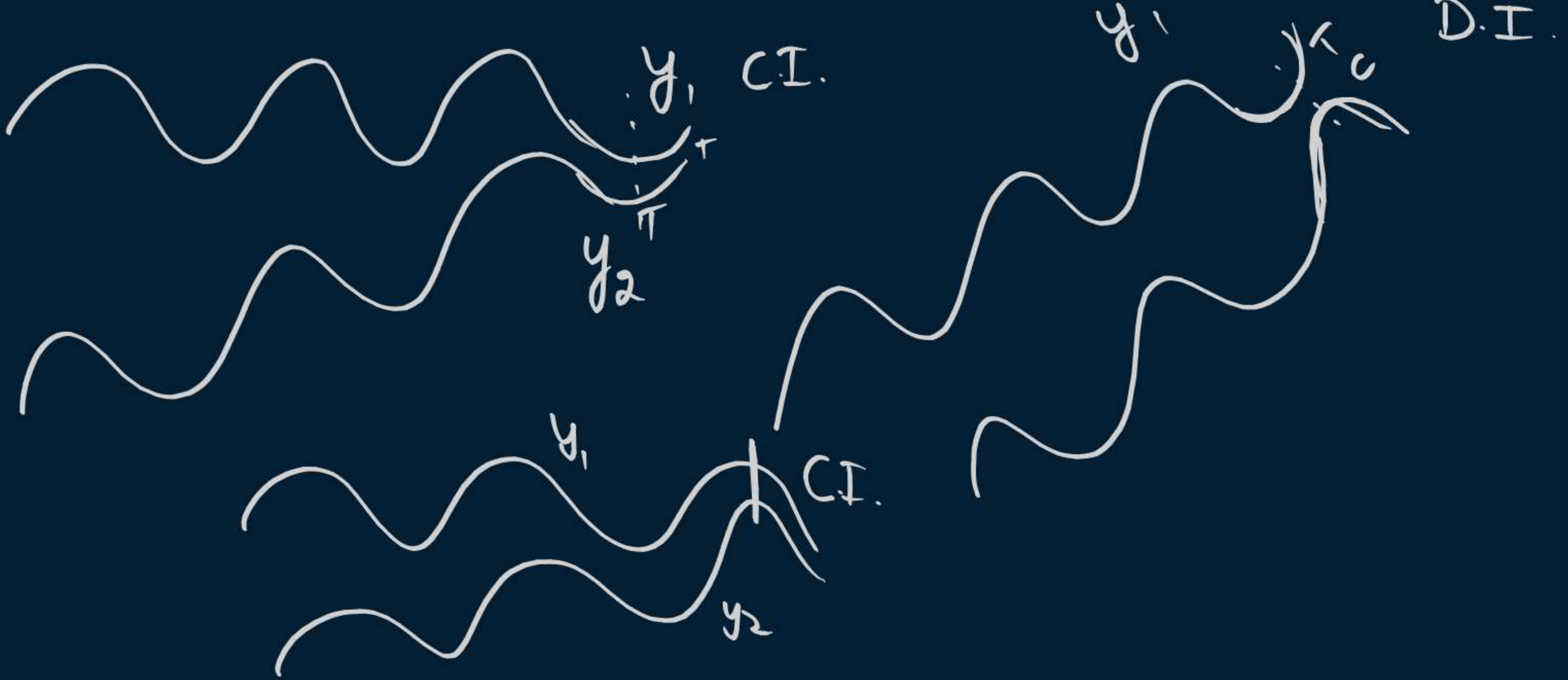
XI Y.K.B.

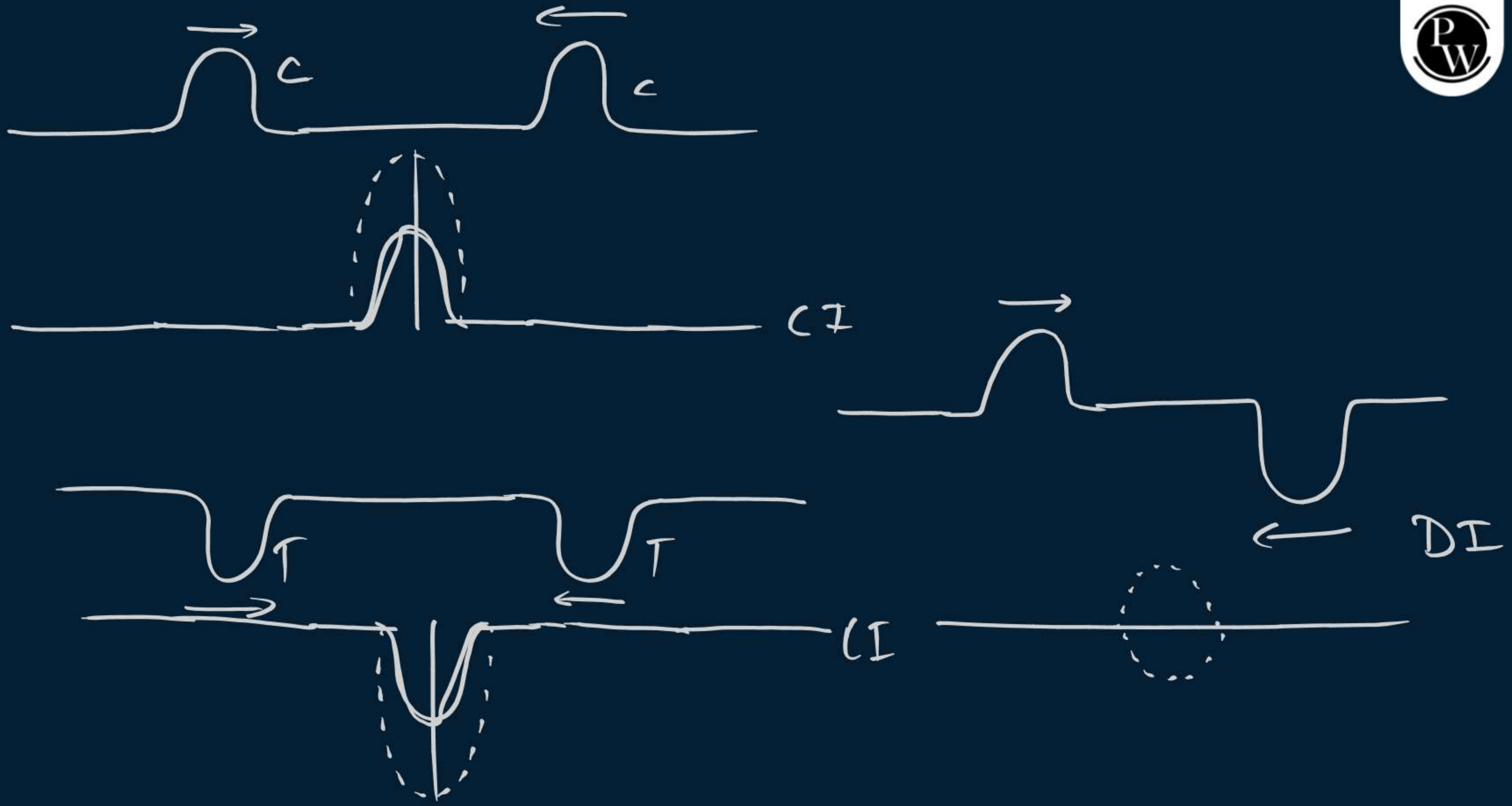


Super-position of waves

$$\boxed{y_{net} = y_1 + y_2}$$

The resultant displacement of a wave at any instant is the vector addition of the displacement due to individual waves.

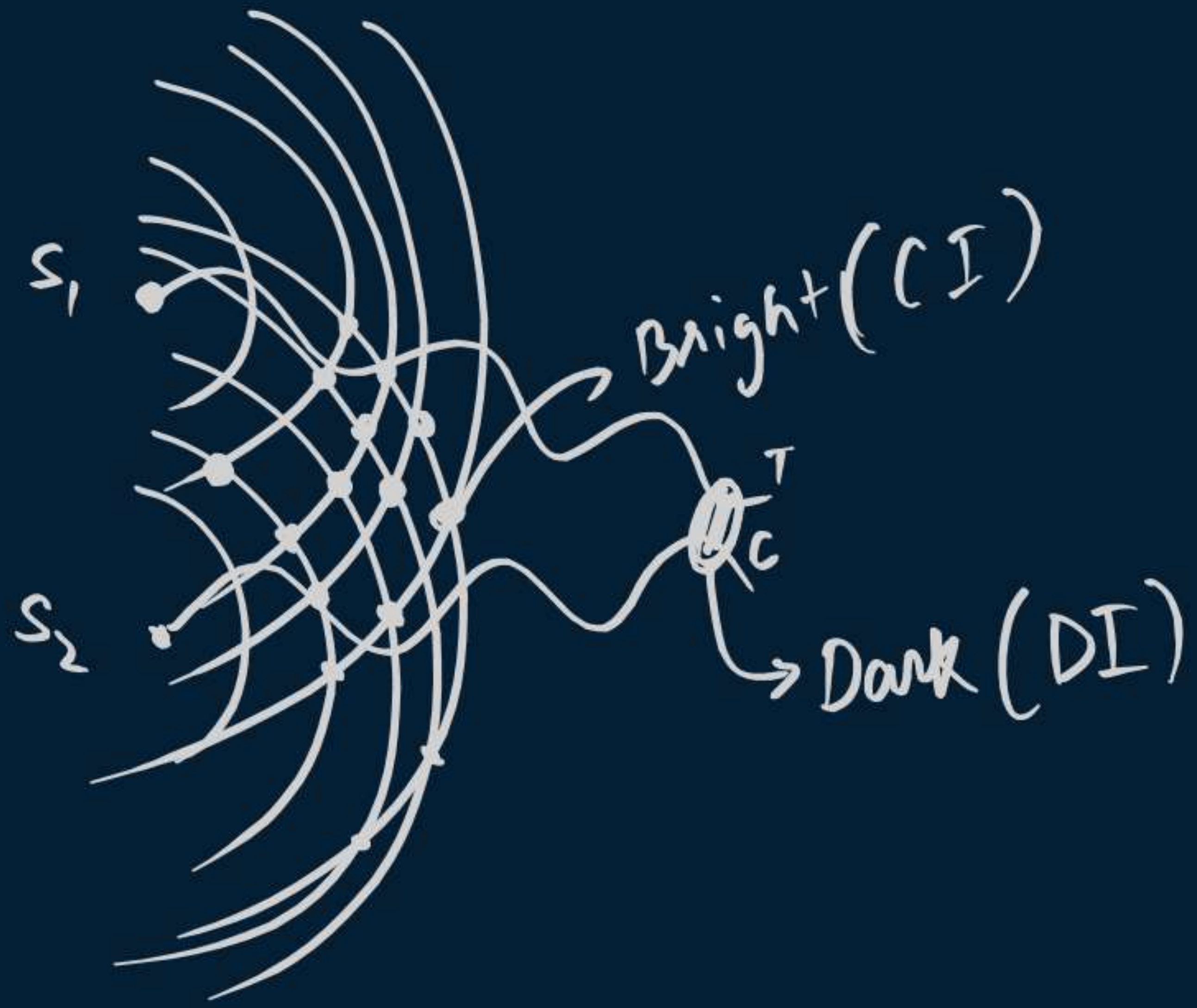



C
c
CI
T
T
CI
DI

Interference

ν λ

The superposition of waves with same frequency and same wavelength.

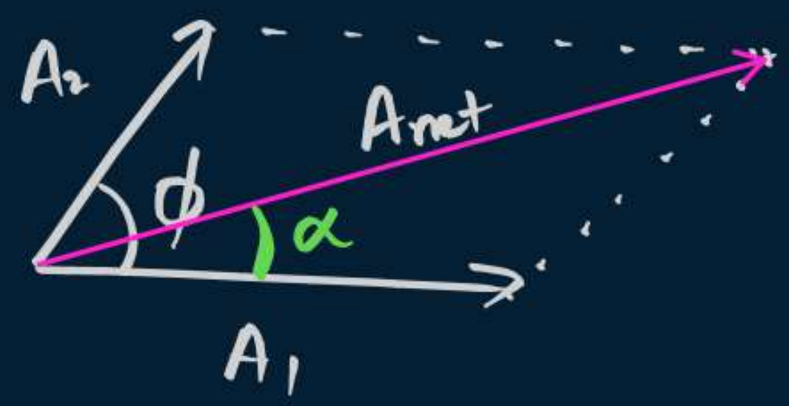


Calculations :-

$$y_1 = A_1 \sin \omega t$$

$$y_2 = A_2 \sin(\omega t + \phi)$$

$\phi \rightarrow$ phase diff



resultant Amplitude $(R) = \sqrt{A^2 + B^2 + 2AB\cos\theta}$

$$\boxed{A_{net} = \sqrt{A_1^2 + A_2^2 + 2A_1A_2\cos\phi}}$$

$$\tan\alpha = \frac{B\sin\theta}{A + B\cos\theta}$$

$$\boxed{\tan\alpha = \frac{A_2\sin\phi}{A_1 + A_2\cos\phi}}$$

SBS Sawaal

Q. $y_1 = \overset{A_1}{\underline{3}} \sin \omega t$

$y_2 = \overset{A_2}{\underline{4}} \sin\left(\omega t + \underbrace{\boxed{\frac{\pi}{2}}}_{\phi}\right)$

find the resultant Amplitude = ?

$$A_{net} = \sqrt{A_1^2 + A_2^2 + 2A_1A_2\cos\phi}$$

$$= \sqrt{(3)^2 + (4)^2 + 2.3.4.\cos\frac{\pi}{2}}$$

$$= \sqrt{9+16}$$

$$= \sqrt{25} = 5$$

$\alpha = ?$

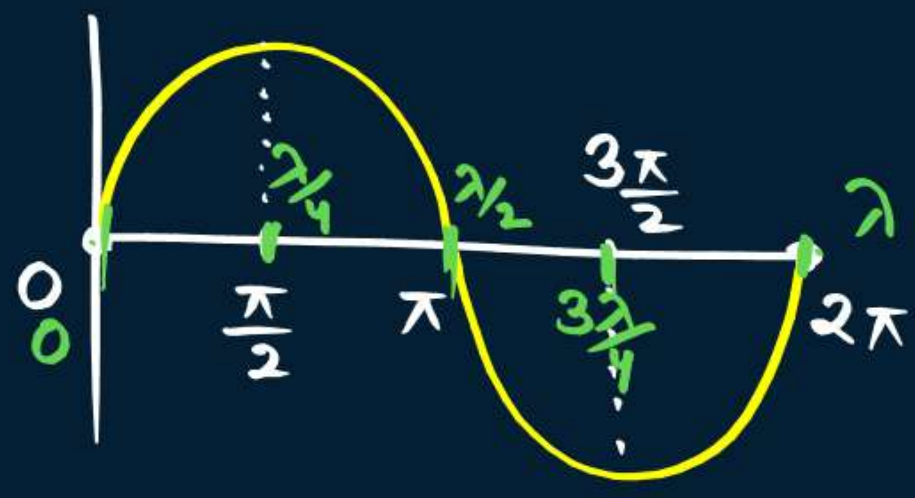
$$\tan\alpha = \frac{A_2 \sin\phi}{A_1 + A_2\cos\phi}$$

$$= \frac{4\sin\pi/2}{3 + 4\cos\frac{\pi}{2}} = \frac{4}{3}$$

$$\alpha = \tan^{-1}\left(\frac{4}{3}\right)$$

Path Difference and Phase Difference

Δx $\quad$ $\Delta\phi$



path Diff.		phase Diff.
λ	$\longrightarrow$	2π
1	$\longrightarrow$	$\frac{2\pi}{\lambda}$
Δx	$\longrightarrow$	$\left(\frac{2\pi}{\lambda}\cdot\Delta x\right) = \Delta\phi$

RDx *

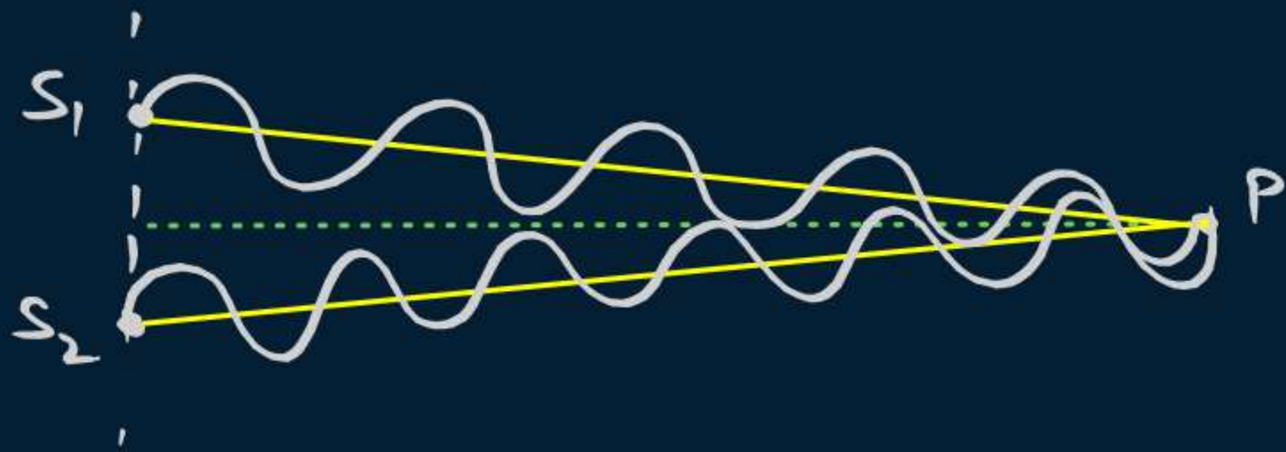
$$\boxed{\frac{2\pi}{\Delta\phi} = \frac{\lambda}{\Delta x}}$$

RDx Ratta *

$$\boxed{\Delta\phi = \frac{2\pi}{\lambda}\Delta x}$$

Phase diff. $\quad$ Path Diff.

RDx Feel of Path Diff. (Δx)



$S_1P = S_2P$

$S_2P > S_1P$

$\Delta x = S_2P - S_1P$

$$\boxed{\Delta x = S_2P - S_1P}$$

$$\boxed{\Delta x = 0}$$

QUESTION

The ratio of phase difference and the corresponding path difference is.....

(A) $\lambda/2\pi$

(B) π/λ

(C) λ/π

(D) $2\pi/\lambda$

$$\frac{\Delta\phi}{\Delta x} = \frac{2\pi}{\lambda}$$

Calculations on Maxima and Minima

Maxima (Constructive Interference)

$$A_{net} = \sqrt{A_1^2 + A_2^2 + 2A_1A_2\cos\phi}$$

for maximum: $\cos\phi = +1$

$\phi = 0, 2\pi, 4\pi, 6\pi \cdots 2n\pi$

$$\boxed{\phi = \pm 2n\pi}$$

Minima (Destructive Interference)

$$A_{net} = \sqrt{A_1^2 + A_2^2 + 2A_1A_2\cos\phi}$$

for minimum: $\cos\phi = -1$

$\phi = \pi, 3\pi, 5\pi, 7\pi$

$$\boxed{\phi = (2n \pm 1)\pi}$$

$$A_{net} = \sqrt{A_1^2 + A_2^2 + 2A_1A_2(+1)}$$

$$= \sqrt{A_1^2 + A_2^2 + 2A_1A_2}$$

$$= \sqrt{(A_1 + A_2)^2}$$

$$\boxed{A_{net} = A_1 + A_2}$$

Maxima
of
resultant
Amplitude

$$A_{net} = \sqrt{A_1^2 + A_2^2 + 2A_1A_2(-1)}$$

$$= \sqrt{A_1^2 + A_2^2 - 2A_1A_2}$$

$$= \sqrt{(A_1 - A_2)^2}$$

$$\boxed{A_{net} = A_1 - A_2}$$

Minima
of
resultant
Amplitude

Path & Phase Diff (C I)

$$\Delta x = \frac{\lambda}{2\pi}\Delta\phi$$

for C.I. : $\Delta\phi = 2n\pi$

$$\Delta x = \frac{\lambda}{\cancel{2\pi}}(\cancel{2n\pi})$$

$$\boxed{\Delta x = n\lambda}$$

$$\Delta x = 0, \lambda, 2\lambda, 3\lambda, 4\lambda \ldots n\lambda$$

Path & Phase Diff (DI)

$$\Delta x = \frac{\lambda}{2\pi}\Delta\phi$$

for DI : $\Delta\phi = (2n\pm1)\pi$

$$\Delta x = \frac{\lambda}{2\cancel{\pi}}(2n\pm1)\cancel{\pi}$$

$$\boxed{\Delta x = (2n\pm1)\frac{\lambda}{2}}$$

$$\Delta x = \frac{\lambda}{2}, \frac{3\lambda}{2}, \frac{5\lambda}{2}, \frac{7\lambda}{2} \ldots$$

* Relation between Intensity and Amplitude :- Intensity $\propto (\text{Amplitude})^2$

$$I \propto A^2$$

$$\boxed{I = kA^2}$$

$$\sqrt{I} = \sqrt{k}\,A$$

* $$\boxed{A_{net} = \sqrt{A_1^2 + A_2^2 + 2A_1A_2\cos\phi}}$$

$$A_{net}^2 = A_1^2 + A_2^2 + 2A_1A_2\cos\phi$$

$$kA_{net}^2 = kA_1^2 + kA_2^2 + 2\sqrt{k}A_1\sqrt{k}A_2\cos\phi$$

* $$\boxed{I_{net} = I_1 + I_2 + 2\sqrt{I_1}\sqrt{I_2}\cos\phi}$$

Maxima (C I) $\qquad I \propto A^2 \qquad$ Minima (D.I.)

$\sqrt{I} \propto A$

$$\boxed{A_{max} = A_1 + A_2}$$

$$\sqrt{I_{max}} = \sqrt{I_1} + \sqrt{I_2}$$

$$\boxed{I_{max} = \left(\sqrt{I_1} + \sqrt{I_2}\right)^2}$$

$$\boxed{A_{min} = A_1 - A_2}$$

$$\sqrt{I_{min}} = \sqrt{I_1} - \sqrt{I_2}$$

$$\boxed{I_{min} = \left(\sqrt{I_1} - \sqrt{I_2}\right)^2}$$

$$\boxed{\frac{A_{max}}{A_{min}} = \frac{A_1 + A_2}{A_1 - A_2}}$$

$$\boxed{\frac{I_{max}}{I_{min}} = \left(\frac{\sqrt{I_1} + \sqrt{I_2}}{\sqrt{I_1} - \sqrt{I_2}}\right)^2}$$

* <u>spl. condition</u> (Both the sources have same Amplitude)

$A_1 = A_2 = A$

$I_1 = I_2 = I$

$$A_{net} = \sqrt{A_1^2 + A_2^2 + 2A_1A_2\cos\phi}$$

$$A_{net} = \sqrt{A^2 + A^2 + 2AA\cos\phi}$$

$$= \sqrt{A^2 + A^2 + 2A^2\cos\phi}$$

$$= \sqrt{2A^2(1+\cos\phi)}$$

$$= \sqrt{2A^2\, 2\cos^2\phi/2}$$

$$\boxed{A_{net} = 2A\cos\phi/2}$$

$$I_{net} = I_1 + I_2 + 2\sqrt{I_1}\sqrt{I_2}\cos\phi$$

$$I_{net} = I + I + 2\sqrt{I}\sqrt{I}\cos\phi$$

$$= 2I + 2I\cos\phi$$

$$= 2I(1+\cos\phi)$$

$$= 2I\, 2\cos^2\phi/2$$

$$\boxed{I_{net} = 4I\cos^2\phi/2}$$

Maxima

$$A_{max} = A_1 + A_2$$

$$A_{max} = A + A = 2A$$

$$\boxed{A_{max} = 2A}$$

$$I_{max} = \left(\sqrt{I_1} + \sqrt{I_2}\right)^2$$

$$= \left(\sqrt{I} + \sqrt{I}\right)^2$$

$$= \left(2\sqrt{I}\right)^2 = 4I$$

$$\boxed{I_{max} = 4I} \rightarrow \text{Brightness}$$

Minima

$$A_{min} = A_1 - A_2$$

$$A_{min} = A - A$$

$$\boxed{A_{min} = 0}$$

$$I_{min} = \left(\sqrt{I_1} - \sqrt{I_2}\right)^2$$

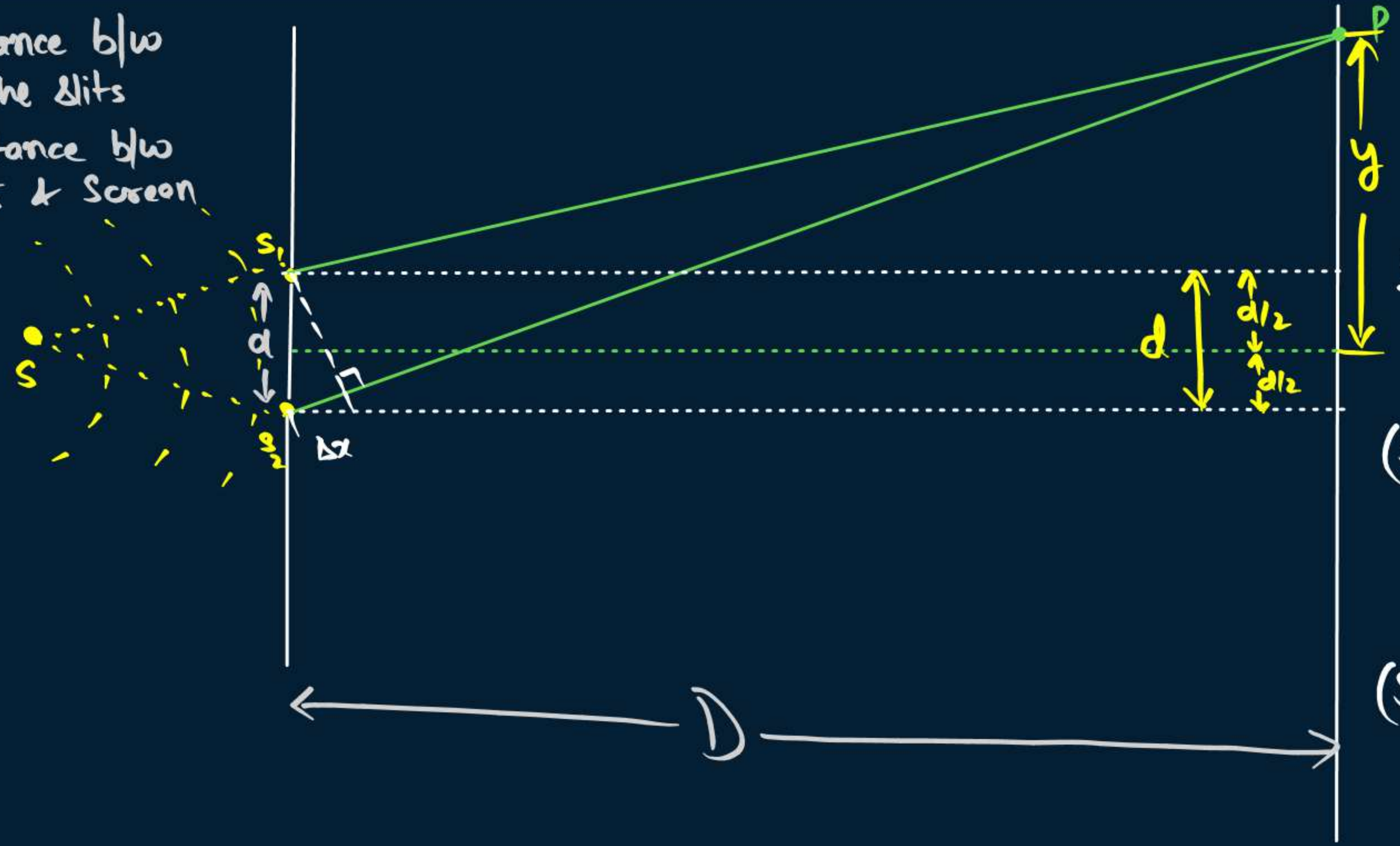
$$= \left(\sqrt{I} - \sqrt{I}\right)^2$$

$$\boxed{I_{min} = 0} \rightarrow \text{Darkness}$$

Young's Double Slit Experiment (YDSE)

$d \rightarrow$ distance b/w the slits

$D \rightarrow$ distance b/w slits & Screen



for path diff :-

$$\Delta x = S_2P - S_1P$$

for S_2P :-

$$H^2 = P^2 + B^2$$

$$(S_2P)^2 = \left(y + \frac{d}{2}\right)^2 + D^2 \quad \cdots (1)$$

for S_1P :-

$$(S_1P)^2 = \left(y - \frac{d}{2}\right)^2 + D^2 \quad \cdots (2)$$

Subtract (2) from (1)

$$(S_2P)^2-(S_1P)^2=\left(y+\frac{d}{2}\right)^2+D^2-\left[\left(y-\frac{d}{2}\right)^2+D^2\right]$$

$$(S_2P+S_1P)(S_2P-S_1P)=y^2+\frac{d^2}{4}+\cancel{2}y\frac{d}{\cancel{2}}+D^2-\left(y^2+\frac{d^2}{4}-\cancel{2}y\frac{d}{\cancel{2}}+D^2\right)$$

[Assuming $S_1P\approx S_2P\approx D$]

$$(D+D)(\Delta x)=\cancel{y^2}+\cancel{\frac{d^2}{4}}+yd+\cancel{D^2}-\cancel{y^2}-\cancel{\frac{d^2}{4}}+yd-\cancel{D^2}$$

$$\cancel{2}D\,\Delta x=\cancel{2}yd$$

$$\boxed{\Delta x=\frac{yd}{D}}$$

Path Diff.

YDSE

Homework

→ Revision once ✓

→ Self handwritten calculation Y.D.S.E. × 2

→ DPP try ×

PARISHRAM

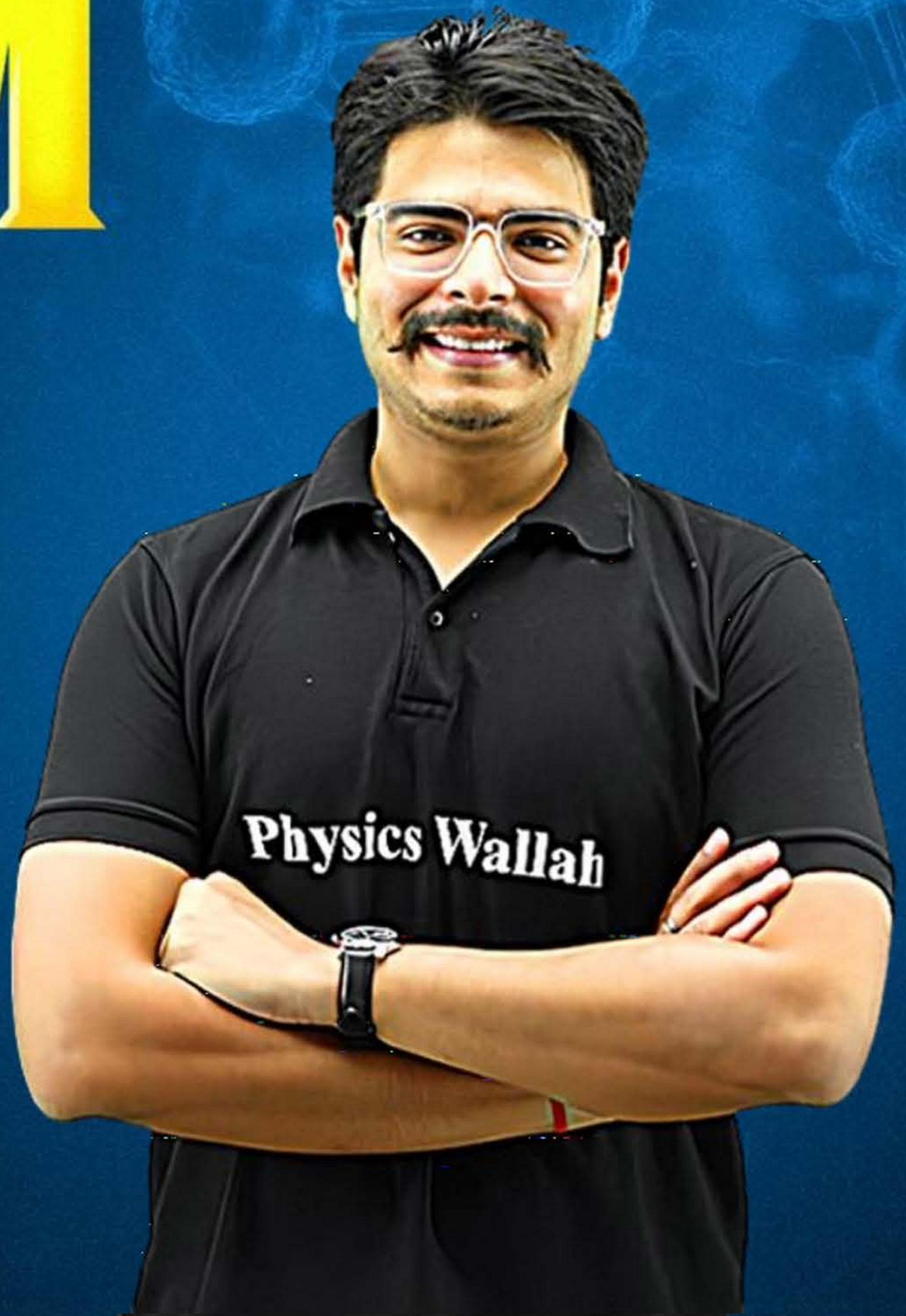
2026

Lecture - 03

Wave Optics

PHYSICS | **Lecture : 03**

BY - RAKSHAK SIR



Topics *to be covered*

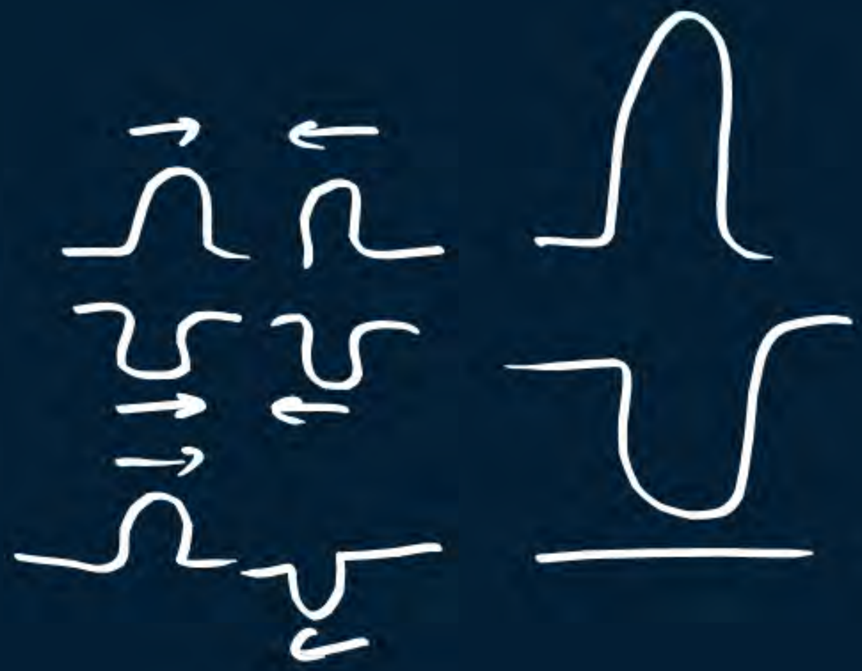
1. YDSE (Part 2)
2. Diffraction

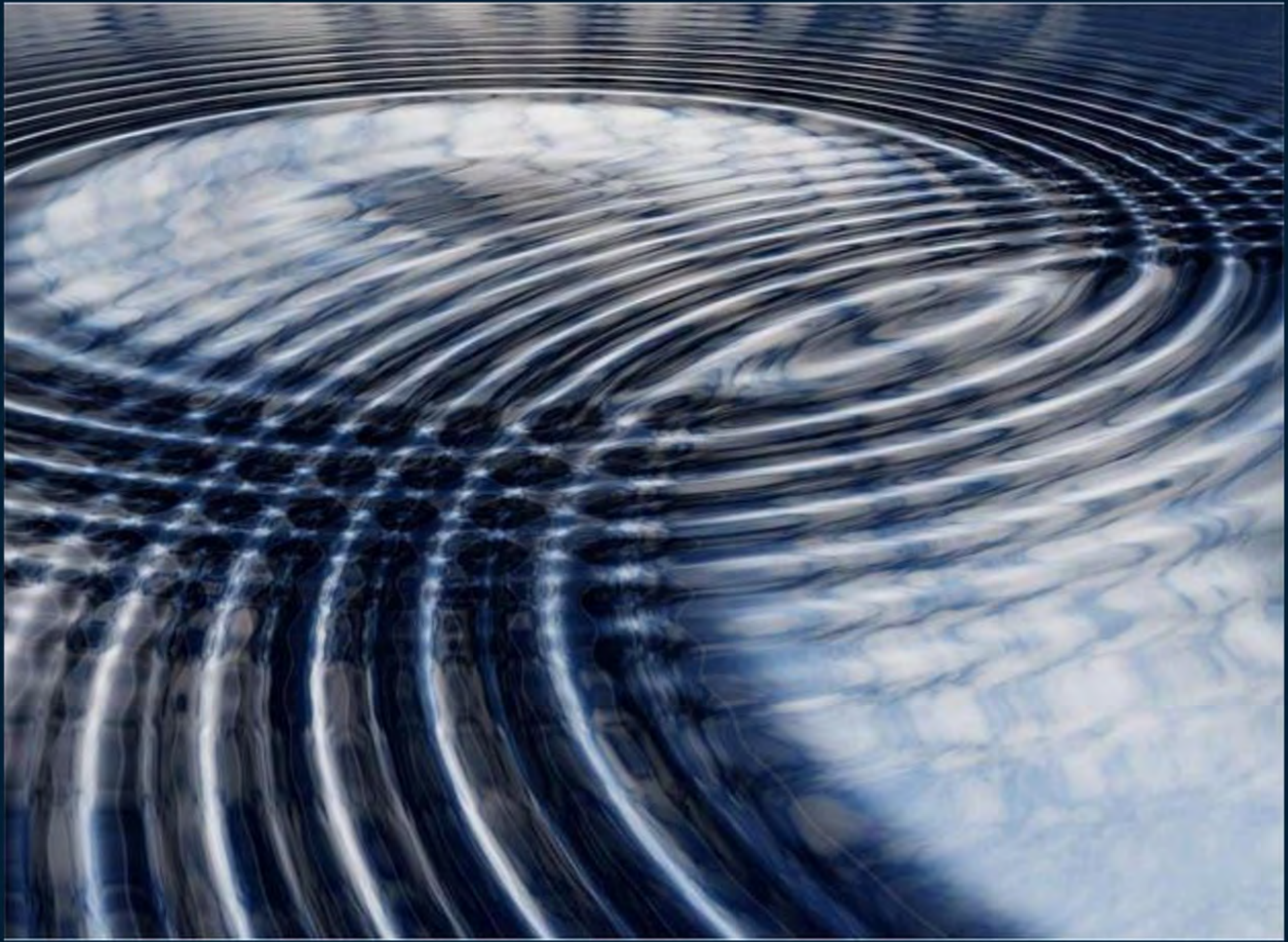
Waves

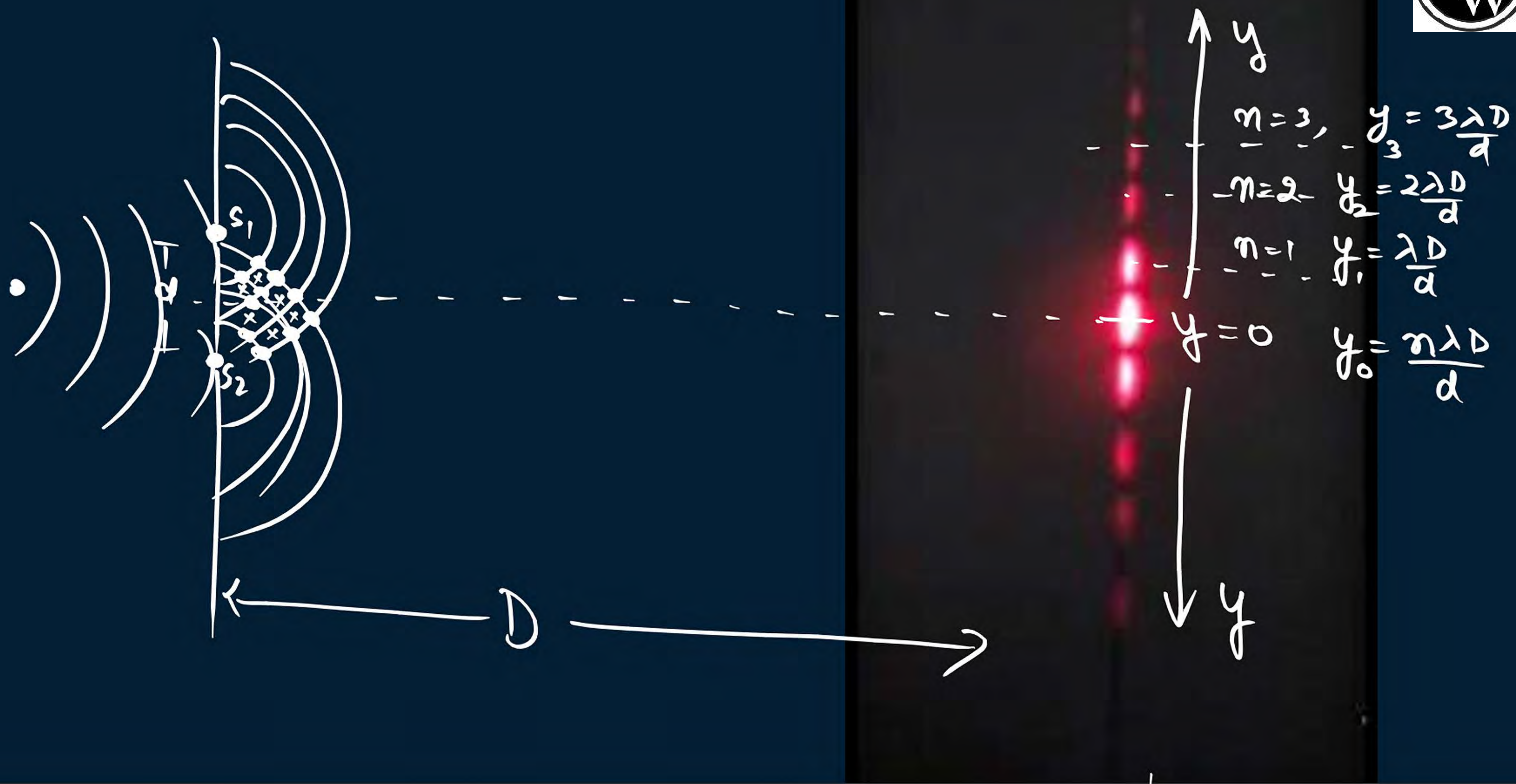
Interference

C.I.

D.I.







y
n = 3, $y_3 = 3\frac{\lambda D}{d}$
n = 2 $y_2 = 2\frac{\lambda D}{d}$
n = 1 $y_1 = \frac{\lambda D}{d}$
y = 0
$y_0 = \frac{n\lambda D}{d}$
S_1
S_2
d
D
y

QUESTION

Two sources with intensity I_0 and $4I_0$ interfere constructively at a point. The intensity at that point would be

A $5I_0$

B $3I_0$

C $2I_0$

D $9I_0$

RDx^2 :- $I_{max} = (\sqrt{1} + \sqrt{4})^2$
$= (1+2)^2$
$= (3)^2 = 9$

$$I_{net} = I_1 + I_2 + 2\sqrt{I_1}\sqrt{I_2}\cos\phi$$
$$= I_0 + 4I_0 + 2\sqrt{I_0}\sqrt{4I_0}\cos 0^\circ$$
$$= I_0 + 4I_0 + 2\times 2 I_0 \times 1$$
$$= I_0 + 4I_0 + 4I_0$$
$$= 9I_0$$

RDx

$$I_{max} = \left(\sqrt{I_1} + \sqrt{I_2}\right)^2$$
$$= \left(\sqrt{I_0} + \sqrt{4I_0}\right)^2$$
$$= \left(\sqrt{I_0} + 2\sqrt{I_0}\right)^2$$
$$= \left(3\sqrt{I_0}\right)^2$$
$$= 9I_0 \checkmark$$

QUESTION

Intensity of two waves are 9I and I respectively. Find out resultant intensity if phase difference between them is pie (π) $\longrightarrow$ D.I.

A 3I

B 4I

C 5I

D 6I

$$I_{net} = I_1 + I_2 + 2\sqrt{I_1}\sqrt{I_2}\cos\phi$$

$$= 9I + I + 2\sqrt{9I}\sqrt{I}\cos\pi$$

$$= 4I$$

Ans

RD x^2 :-

$$I_{min} = (\sqrt{9} - \sqrt{1})^2$$

$$= (3-1)^2 = 2^2$$

$$= 4$$

QUESTION

$9I, \; I$

The ratio of intensities of two waves is 9 : 1. They are producing interference. The ratio of maximum and minimum intensities will be

(A) 10 : 8

(B) 9 : 1

(C) 4 : 1

(D) 2 : 1

$$\frac{I_{max}}{I_{min}} = \left(\frac{\sqrt{I_1}+\sqrt{I_2}}{\sqrt{I_1}-\sqrt{I_2}}\right)^2$$

$$= \left(\frac{\sqrt{9}+\sqrt{1}}{\sqrt{9}-\sqrt{1}}\right)^2$$

$$= \left(\frac{3+1}{3-1}\right)^2 = \left(\frac{\cancel{4}^{2}}{\cancel{2}}\right)^2 = 4$$

QUESTION

Two waves having amplitudes in the ratio 5 : 1 produce interference. The ratio of the maximum to the minimum intensity is________

A 25 : 1

B 6 : 4

C 9 : 4

D 9 : 2

$$\frac{I_{max}}{I_{min}} = \left(\frac{A_1 + A_2}{A_1 - A_2}\right)^2$$

$$= \left(\frac{5+1}{5-1}\right)^2 = \left(\frac{\cancel{6}\,3}{\cancel{4}\,2}\right)^2$$

$$= \frac{9}{4}$$ Ans

QUESTION

$\Delta x = ?$

The $\boxed{\text{path length difference}}$ between two waves coming from coherent sources for destructive interference should be

C.I.

$\Delta x = n\lambda$

D.I.

$\Delta x = (2n \pm 1)\frac{\lambda}{2}$

$= (2n+1)\frac{\lambda}{2}$

(A) Zero ✗

(B) $(2n)\lambda$ ✗

(C) $(2n-1)\frac{\lambda}{3}$ ✗

(D) $(2n+1)\frac{\lambda}{2}$ ✓

Young's Double Slit Experiment (YDSE) Contd.

$$\boxed{\Delta x = y\frac{d}{D}}$$

for Bright Fringe (C.I.) :-

$$\Delta x = n\lambda$$

$$\Delta x = y\frac{d}{D}$$

$$y\frac{d}{D} = n\lambda$$

$$\boxed{y = \frac{n\lambda D}{d}}$$

$n=0 : y_1 = 0$ (C.B.)

$n=1 : y_2 = \frac{\lambda D}{d}$

positions of Bright fringes :- $y = 0, \frac{\lambda D}{d}, \frac{2\lambda D}{d}, 3\frac{\lambda D}{d}, 4\frac{\lambda D}{d}, 5\frac{\lambda D}{d} \ldots$

$2\lambda\frac{D}{d}$, $\frac{3\lambda D}{d} \ldots$

for Dark fringe (D.I.) :-

$$\Delta x = (2n+1)\frac{\lambda}{2}$$

$$\Delta x = y\frac{d}{D}$$

$$y\frac{d}{D} = (2n+1)\frac{\lambda}{2}$$

$$\boxed{y = (2n+1)\frac{\lambda}{2}\frac{D}{d}}$$

positions of Dark fringes : $n=0,\ y_1 = \frac{\lambda}{2}\frac{D}{d}$

$n=1,\ y_2 = \frac{3}{2}\lambda D/d$

$n=2,\ y_3 = \frac{5}{2}\lambda\frac{D}{d}$

$n=3,\ y_4 = \frac{7}{2}\lambda\frac{D}{d}$

Fringe Width

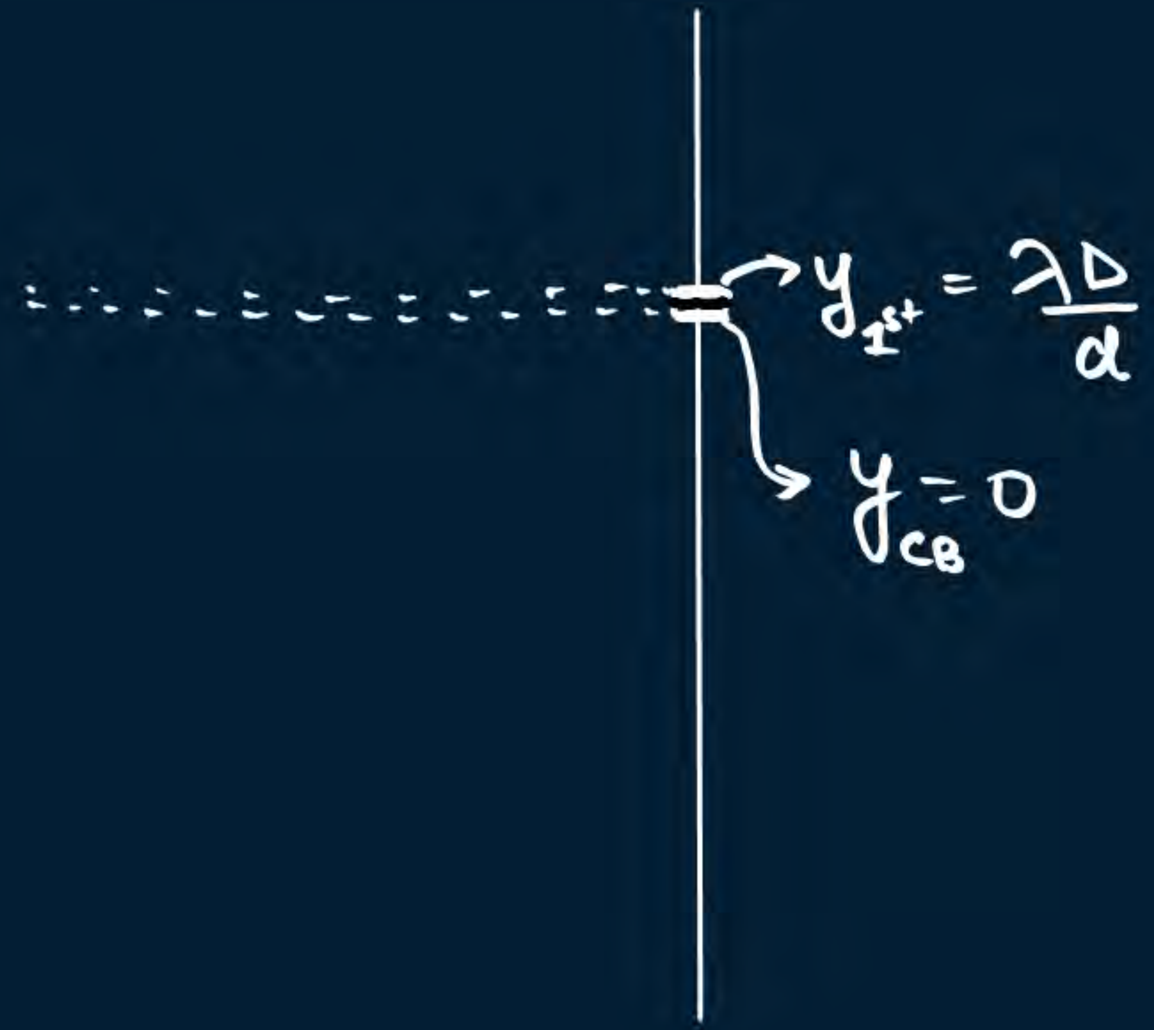
→ formula ✓

→ Derivation ×

$$\beta = y_{1^{st}} - y_{C.B.}$$

$$= \frac{\lambda D}{d} - 0$$

$$\boxed{\beta = \frac{\lambda D}{d}}$$



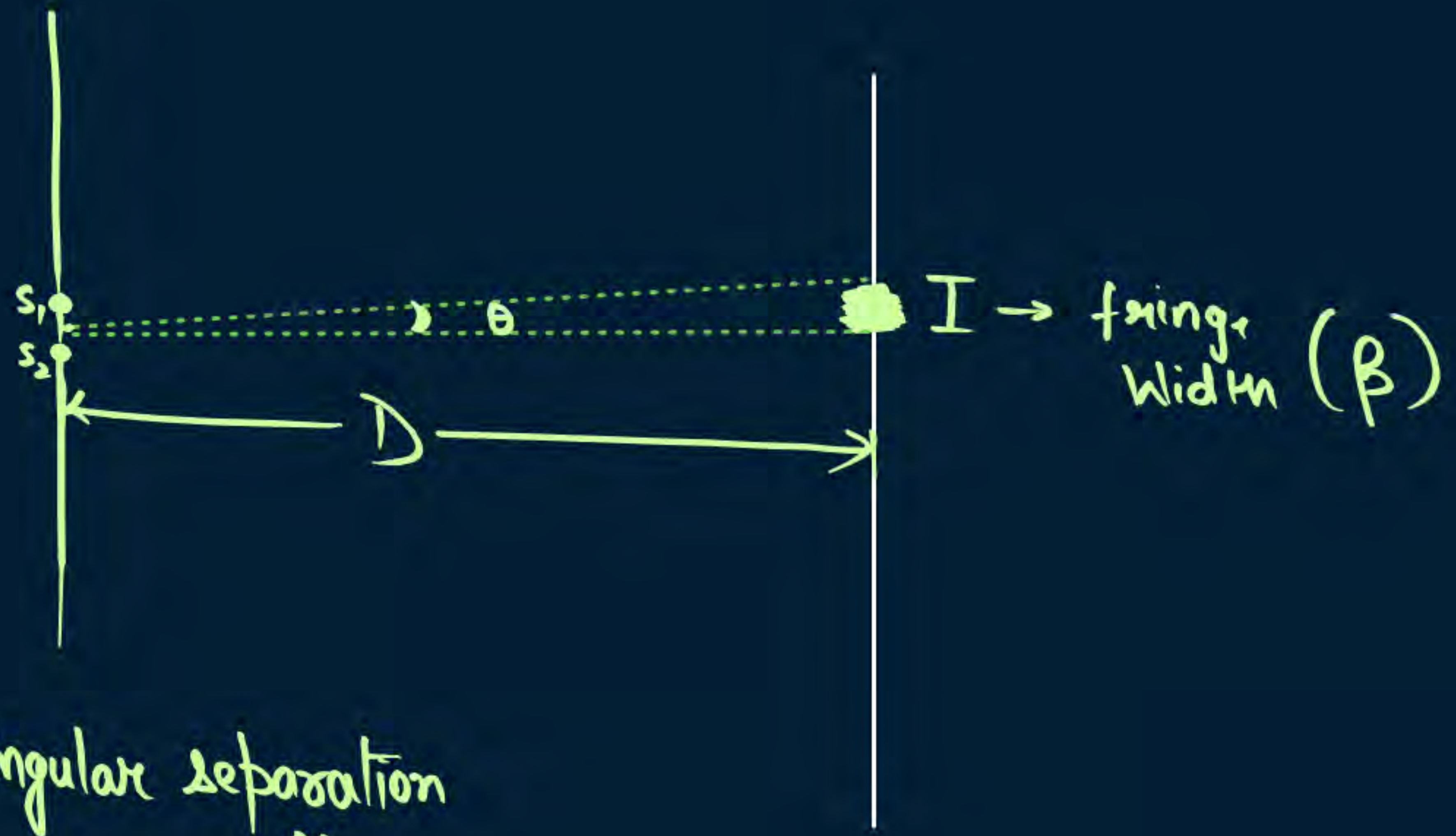
Angular Fringe Width

$$\tan\theta = \frac{P}{B}$$

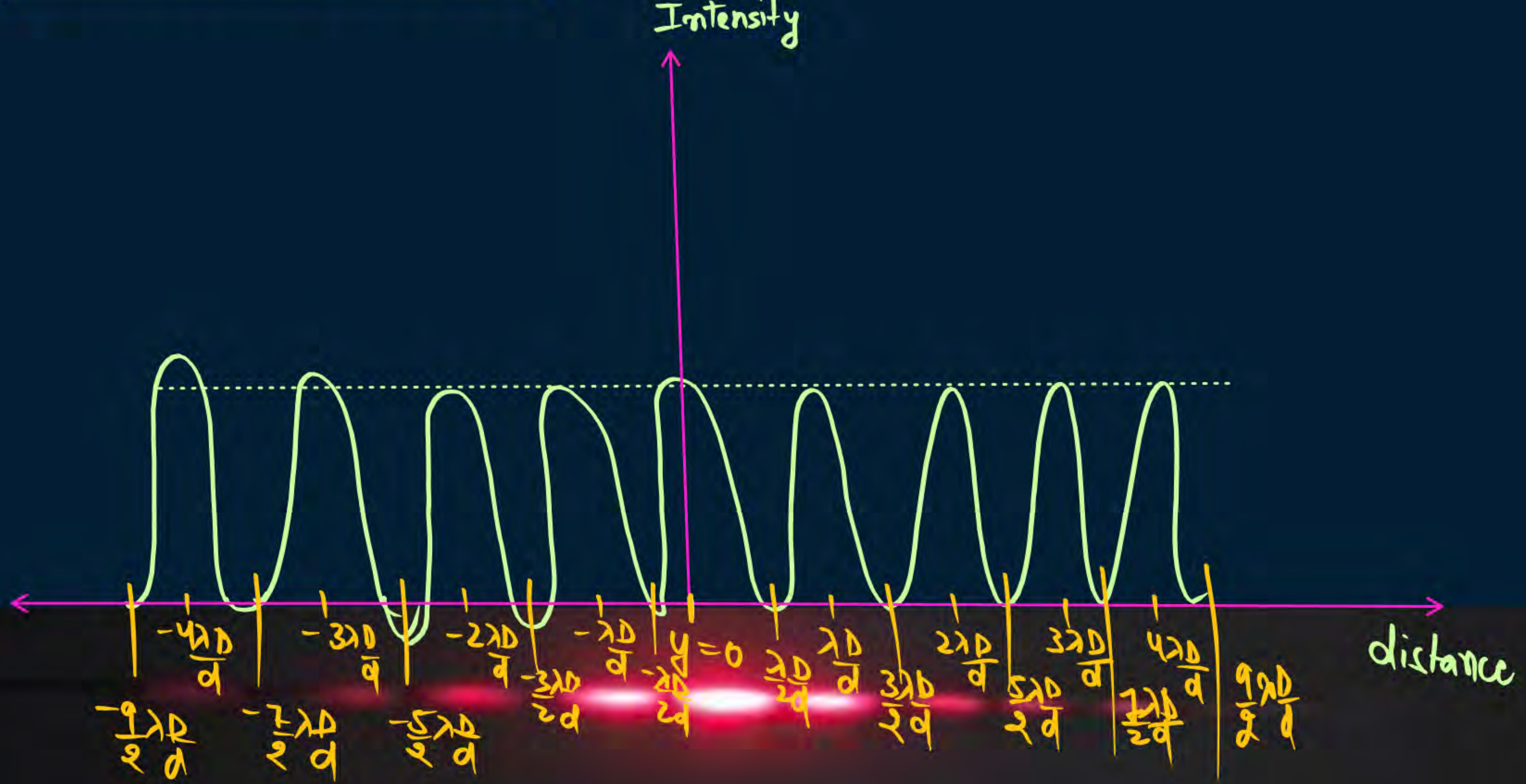
$$\tan\theta = \frac{\beta}{D}$$

$$\tan\theta = \frac{\lambda \cancel{D}}{d \cancel{D}}$$

$$\tan\theta \approx \boxed{\theta = \frac{\lambda}{d}}$$ → Angular separation or fringe width



Intensity Graph



QUESTION

In Young's double slit experiment, if the separation between coherent sources is halved and the distance of the screen from the coherent sources is doubled, then the fringe width becomes: [NEET-2020 (Phase-1)]

(A) Half

(B) Four times

(C) One-fourth

(D) Double

d

$d \qquad \frac{d}{2}$

$D \qquad 2D$

$\beta = \frac{\lambda D}{d} \qquad \beta' = \frac{\lambda\, 2D}{\frac{d}{2}}$

$= 4\frac{\lambda D}{d} = 4\beta$ ✓

QUESTION

VIBGYOR

$\longleftarrow$

In young's experiment, if yellow light is replaced by blue light without distributing the other arrangements

$\beta \downarrow \propto \lambda \downarrow$

(A) Fringe width will increase

(B) Fringe width will decrease

(C) Fringe width will remain unchanged

(D) Fringe width will disappear

QUESTION

H.W.

Two coherent sources of light interfere and produce fringe pattern on a screen. For central maximum the phase difference between the two waves will be,

[NEET-2020 (Phase-2)]

A π

B Zero

C 2π

D $3\pi/2$

QUESTION

During interference of light.......

A. Energy is destroyed at the dark bands

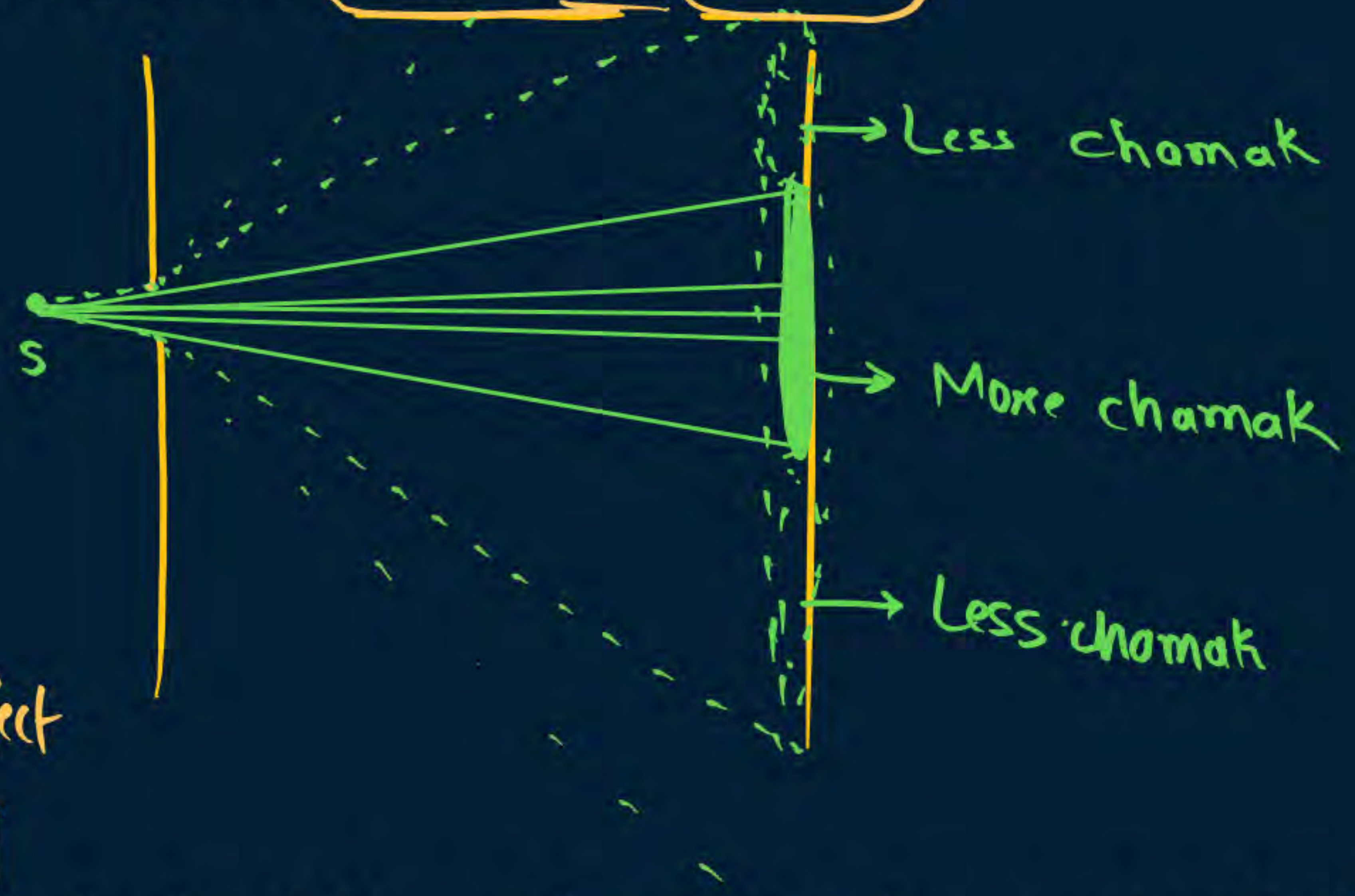
B. Energy is created at the bright bands

C. Energy is conserved but distributed among bright and dark bands

D. All the above are true

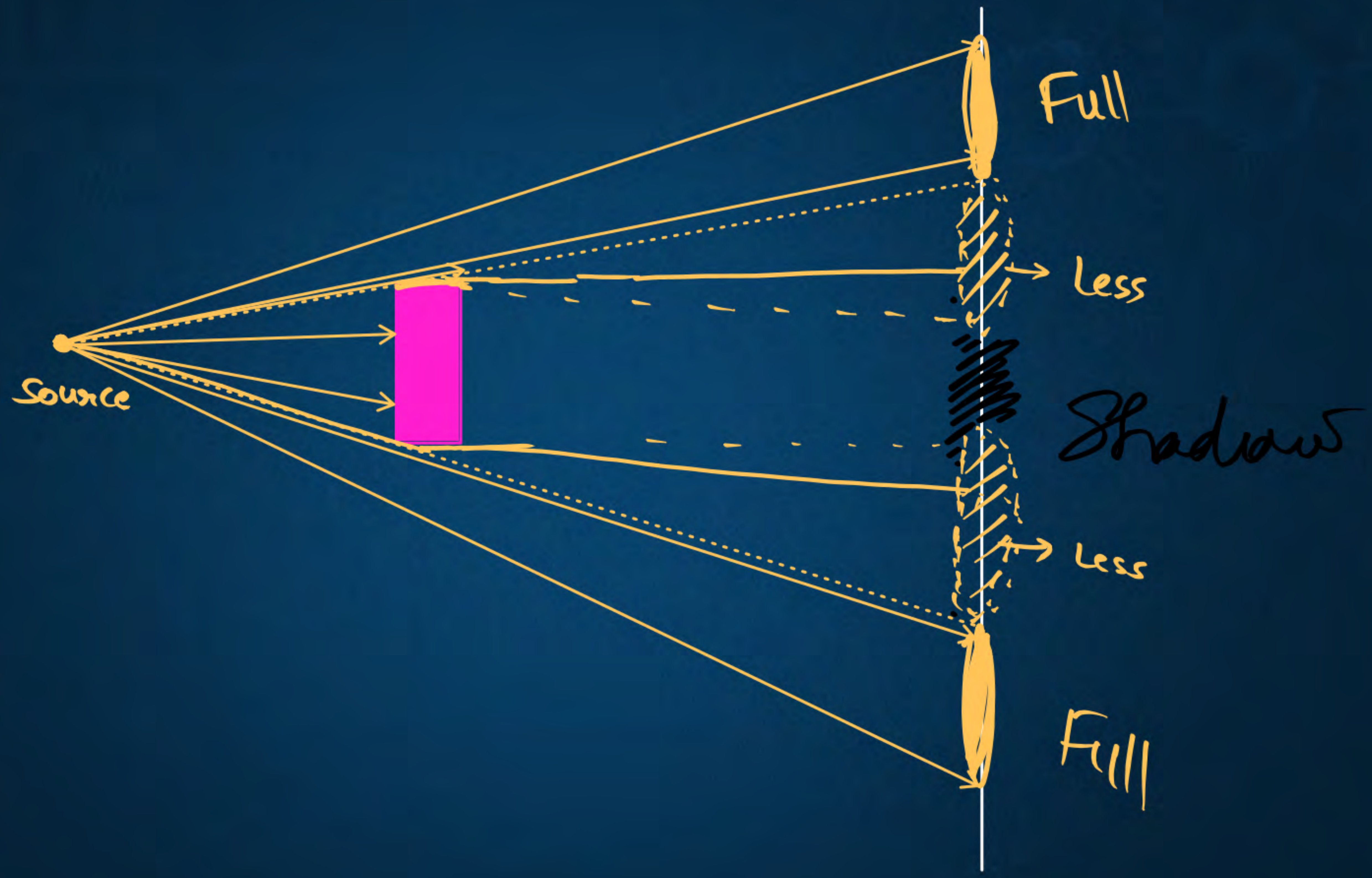
Diffraction

The bending of light rays around the sharp edges/corners.

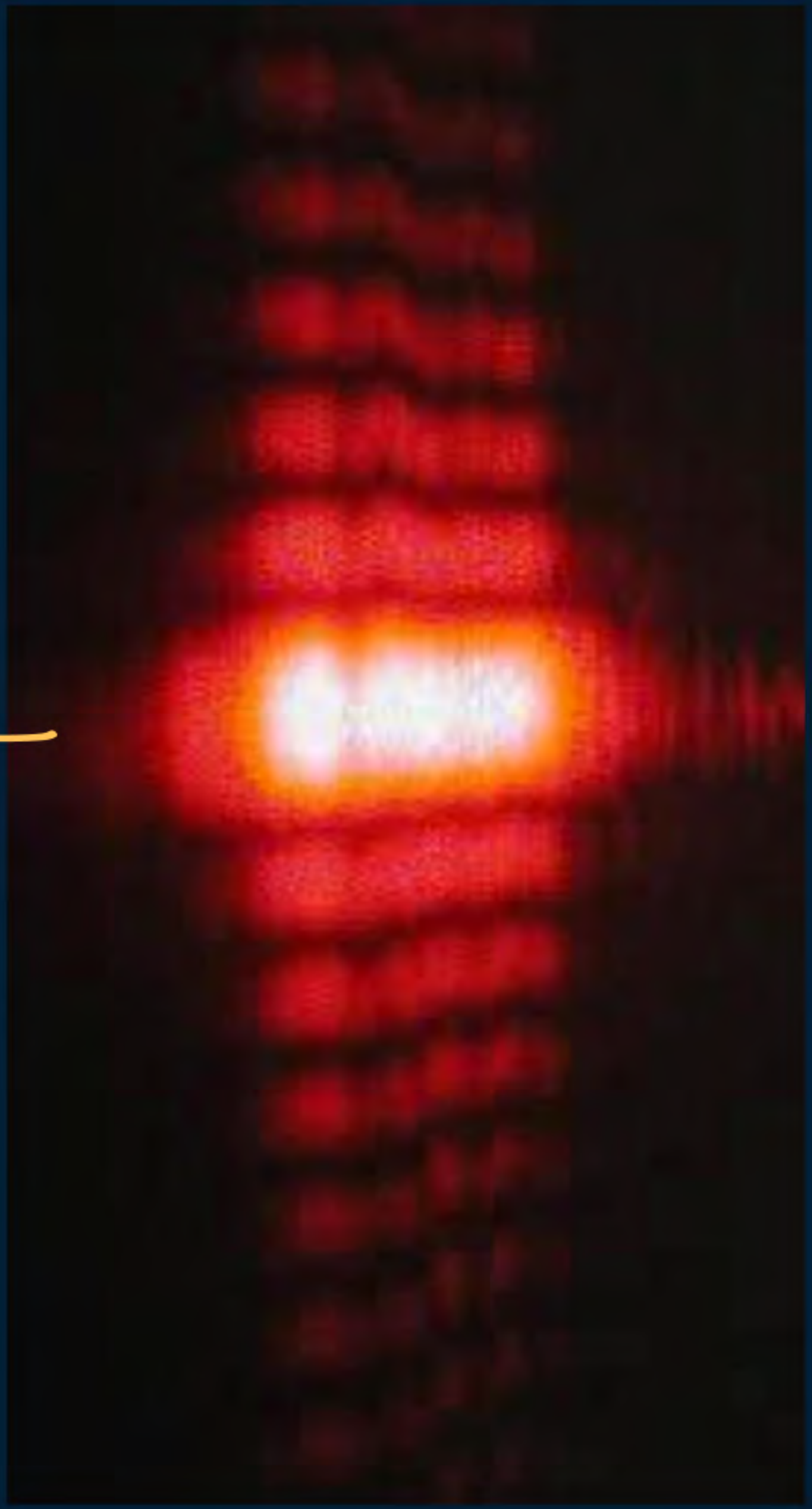


hole   Object

Size of the Aperture/Obstacle should be nearly equal to the wavelength of the light


Full
Less
Source
Shadow
Less
Full

C.B.



Types of Diffraction

1. **Fresnel Diffraction (1788-1827):** The screen and the source are at finite distance from each other.

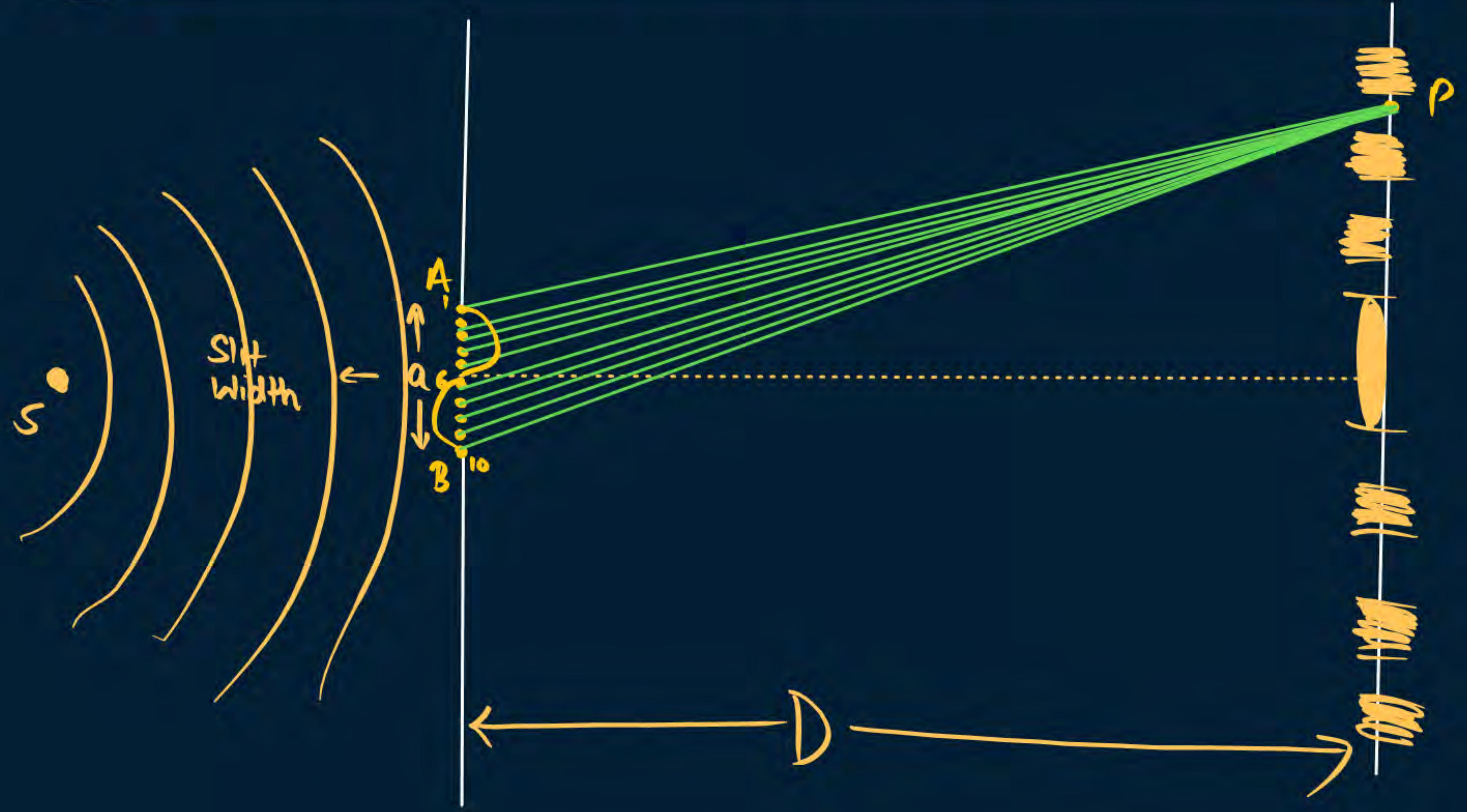
2. **Fraunhofer Diffraction (1787 – 1826):** The screen and the source are at infinite distance from each other.

We study only Fraunhofer diffraction. (S.S.D.)

S → Single
S → Slit
D → Diffⁿ

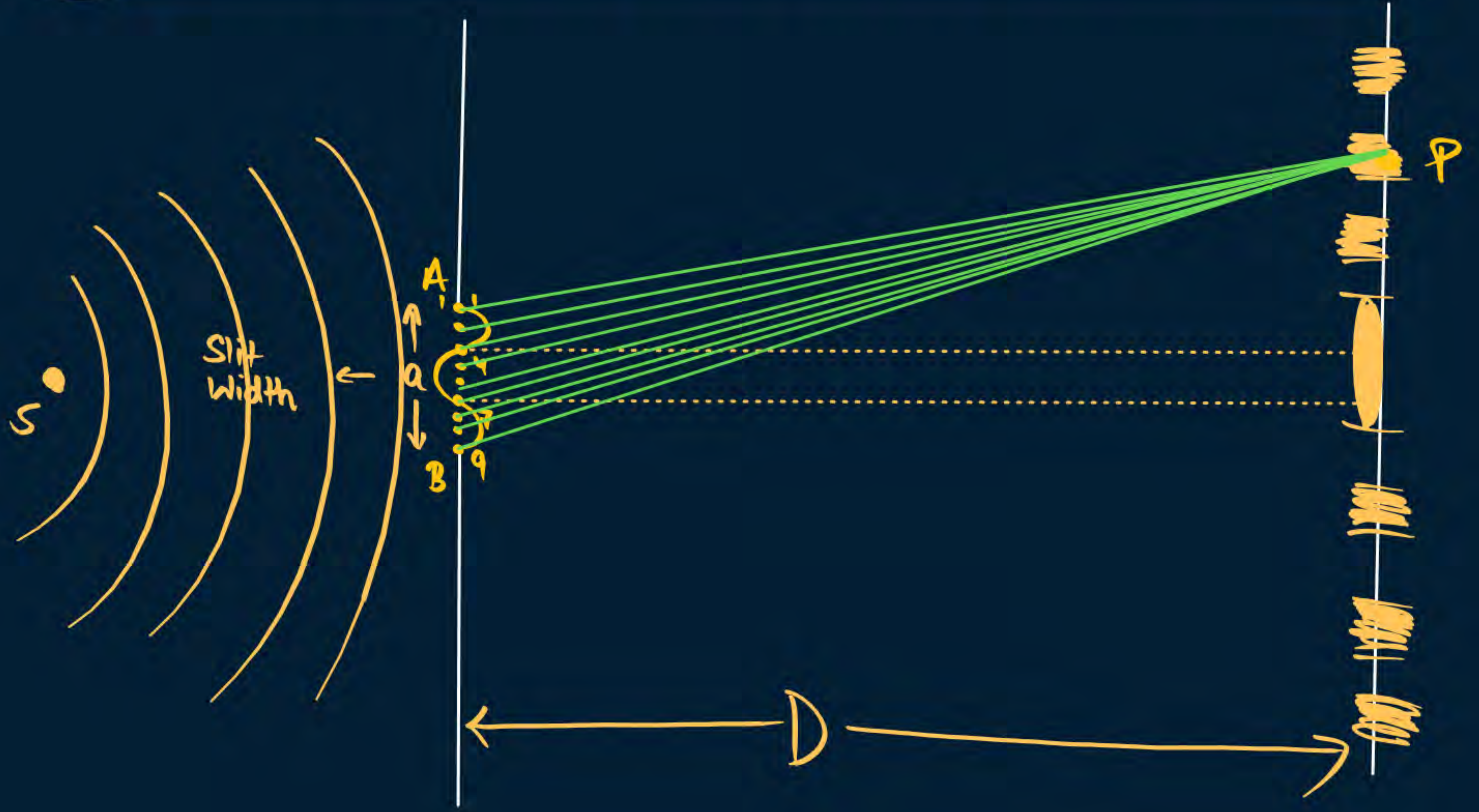
Maxima and Minima in Diffraction

Dark Explain
`1λ'



Maxima and Minima in Diffraction

Bright Explain
(1.5λ)



Homework

→ Notes ✓

→ Revision ✓

PARISHRAM

2026

Lecture-04

Wave Optics

PHYSICS Lecture : 04

BY - RAKSHAK SIR

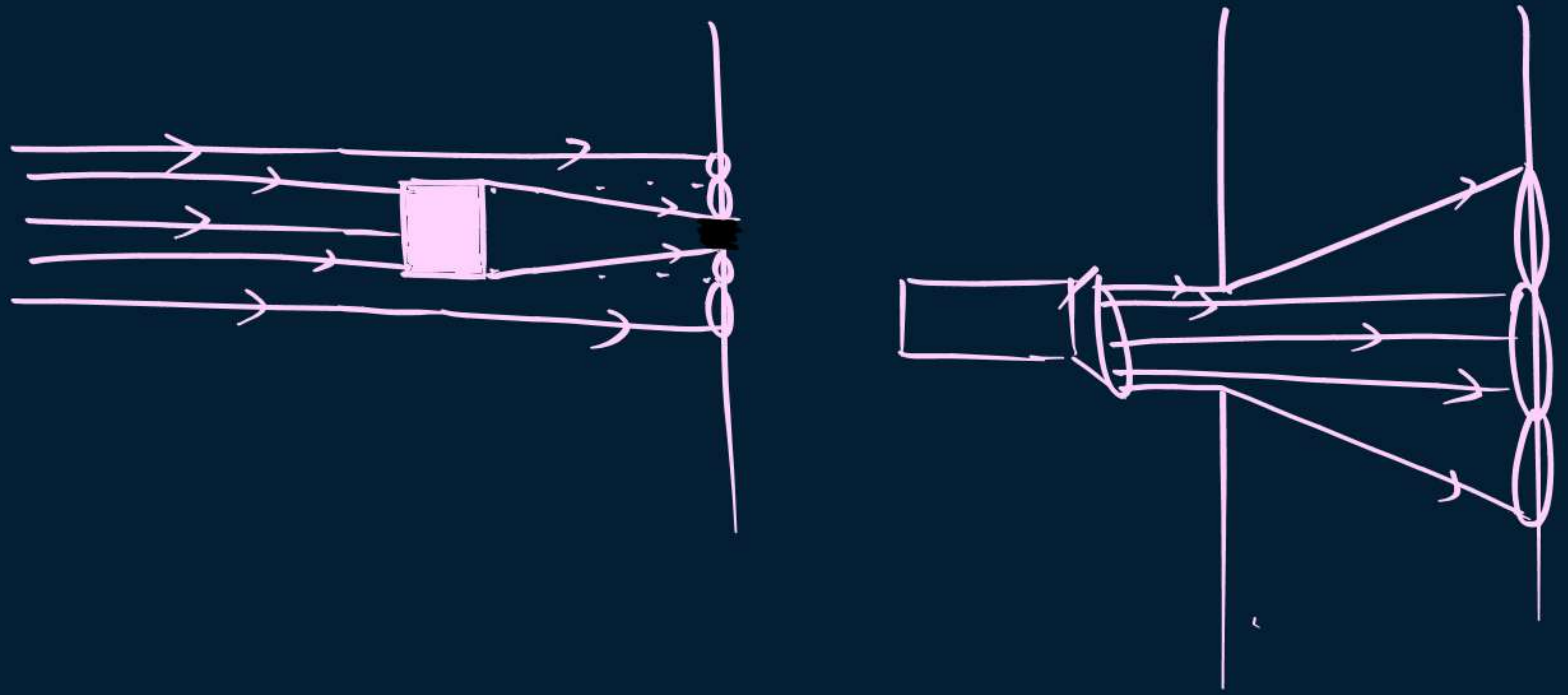
Topics *to be covered*

1 Diffraction (contd.)

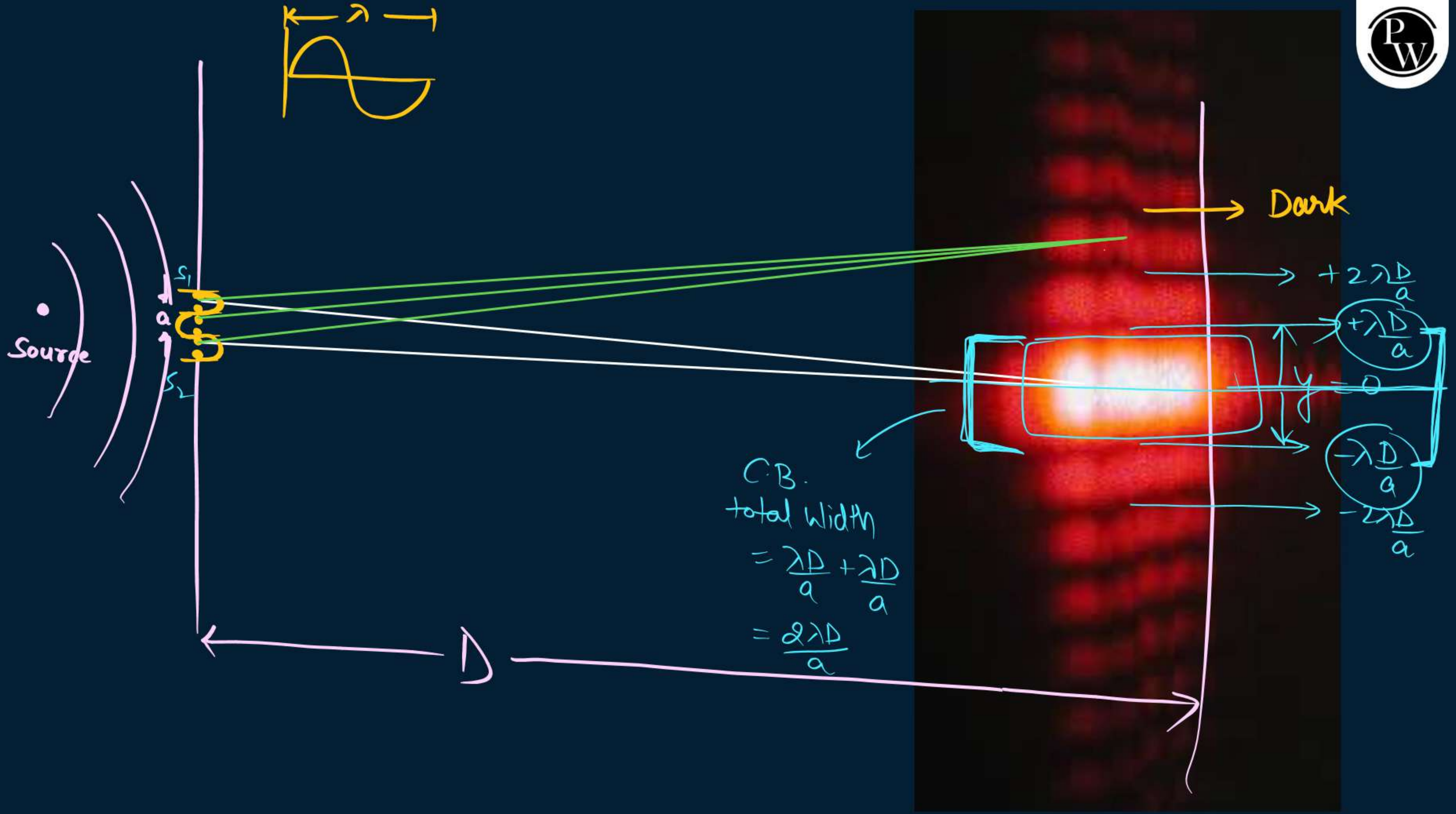
2 Polarization

Diffraction

The bending of light rays around the sharp edges/corners.



Size of the Aperture/Obstacle should be nearly equal to the wavelength of the light



C.B.

total width

$= \frac{\lambda D}{a} + \frac{\lambda D}{a}$

$= \frac{2\lambda D}{a}$

Types of Diffraction

1. **Fresnel Diffraction (1788-1827):** The screen and the source are at finite distance from each other.

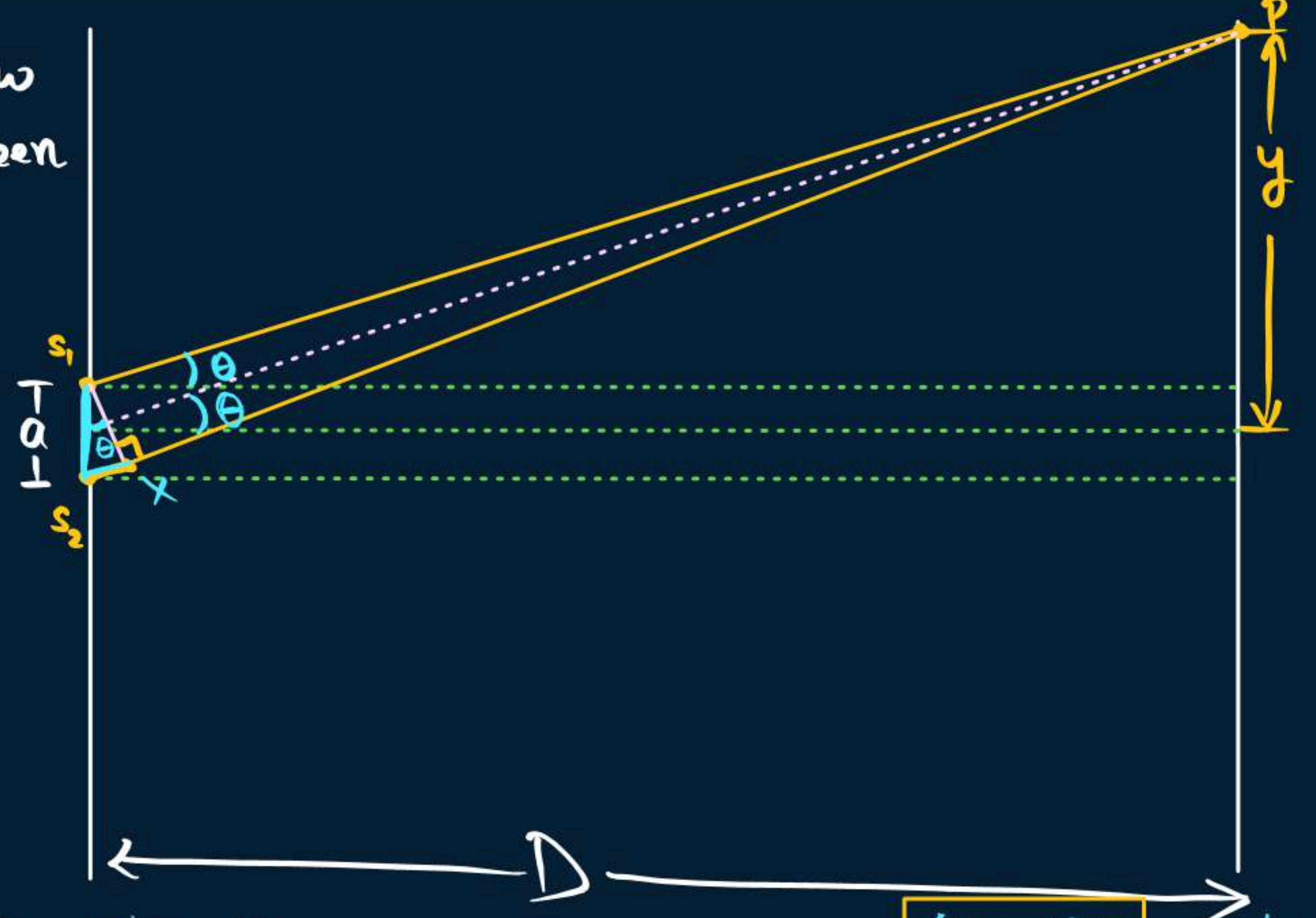
2. **Fraunhofer Diffraction (1787 – 1826):** The screen and the source are at infinite distance from each other. $(a << D)$

We study only Fraunhofer diffraction.

Maxima and Minima in Diffraction

$D \rightarrow$ Distance b/w slit & Screen

$a \rightarrow$ slit Width



There is a path Diff b/w the two sources,

$$\Delta x = S_2P - S_1P$$

$$\Delta x = a\sin\theta$$

With small angle approx.

$$\sin\theta \approx \theta \approx \tan\theta$$

$$\boxed{\Delta x = a\theta} \quad \text{---} \ (1)$$

$$\tan\theta = \frac{P}{B} = \frac{y}{D}$$

$$\theta = \frac{y}{D} \quad \text{----} \ (2)$$

put (2) in (1)

$$\boxed{\Delta x = \frac{ay}{D}}$$

$$\sin\theta = \frac{P}{H} = \frac{\Delta x}{a}$$

$$\Delta x = a\sin\theta$$

(D.I.) Minima (C.I.) (Secondary) Maxima

① Central Bright

$$\Delta x = 0$$
$$\Delta x = \frac{ay}{D}$$
$$\frac{ay}{D} = 0$$
$$y = 0$$

$\underline{RDx}$ (Δx)

YDSE Dift

Bright $\to n\lambda$ $(2n+1)\frac{\lambda}{2}$

Dark $\to (2n\pm1)\frac{\lambda}{2}$ $n\lambda$

② Dark Fringe

$$\boxed{\Delta x = n\lambda}$$
$$\Delta x = \frac{ay}{D}$$
$$\frac{ay}{D} = n\lambda$$
$$\boxed{y = \frac{n\lambda D}{a}}$$

for 1st Dark :- $n=1$, $y = \frac{\lambda D}{a}$

2nd " :- $n=2$, $y = \frac{2\lambda D}{a}$

$\frac{3\lambda D}{a}$

$\frac{4\lambda D}{a}$

③ Bright fringe

$$\boxed{\Delta x = (2n+1)\frac{\lambda}{2}}$$
$$\Delta x = \frac{ay}{D}$$
$$\frac{ay}{D} = (2n+1)\frac{\lambda}{2}$$
$$\boxed{y = (2n+1)\frac{\lambda}{2}\frac{D}{a}}$$

for 1st Bright :- $n=1$, $y = \frac{3\lambda}{2}\frac{D}{a}$

$n=2$, $y = \frac{5}{2}\frac{\lambda D}{a}$

$y = \frac{7}{2}\frac{\lambda D}{a}$

QUESTION

A beam of light of λ = 600 nm from a distant source falls on a single slit 1 mm wide and the resulting diffraction pattern is observed on a screen 2 m away. The distance between first dark fringes on either side of the central bright fringe is [2014]

(A) 1.2 cm

(B) 1.2 mm

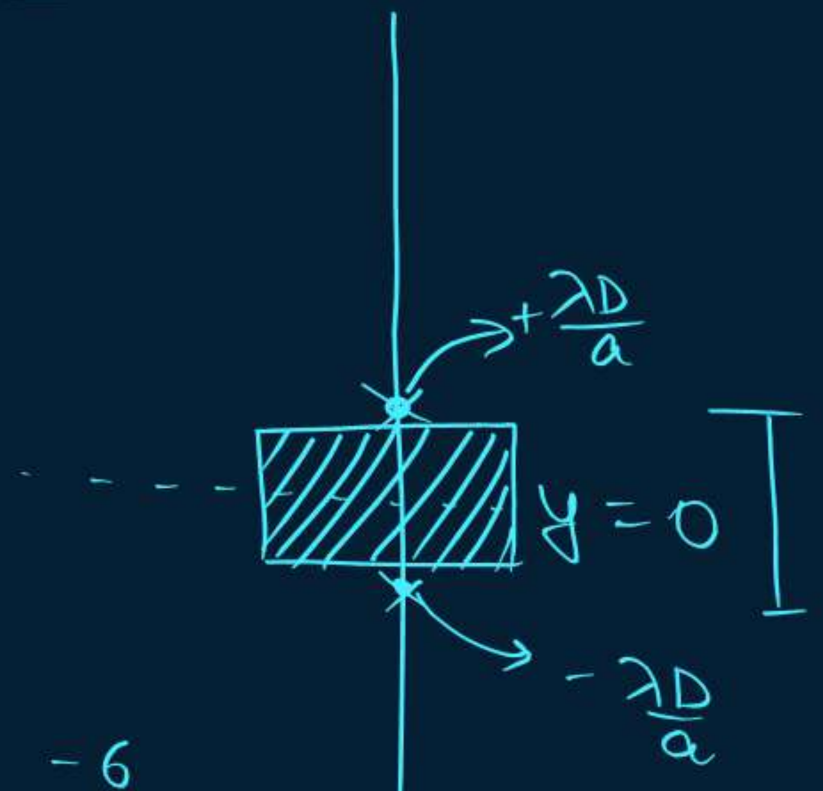
(C) 2.4 cm

(D) 2.4 mm

$\lambda = 600\ nm = 600 \times 10^{-9}\ m$

$a = 1\ mm = 1 \times 10^{-3}\ m$

$D = 2\ m$

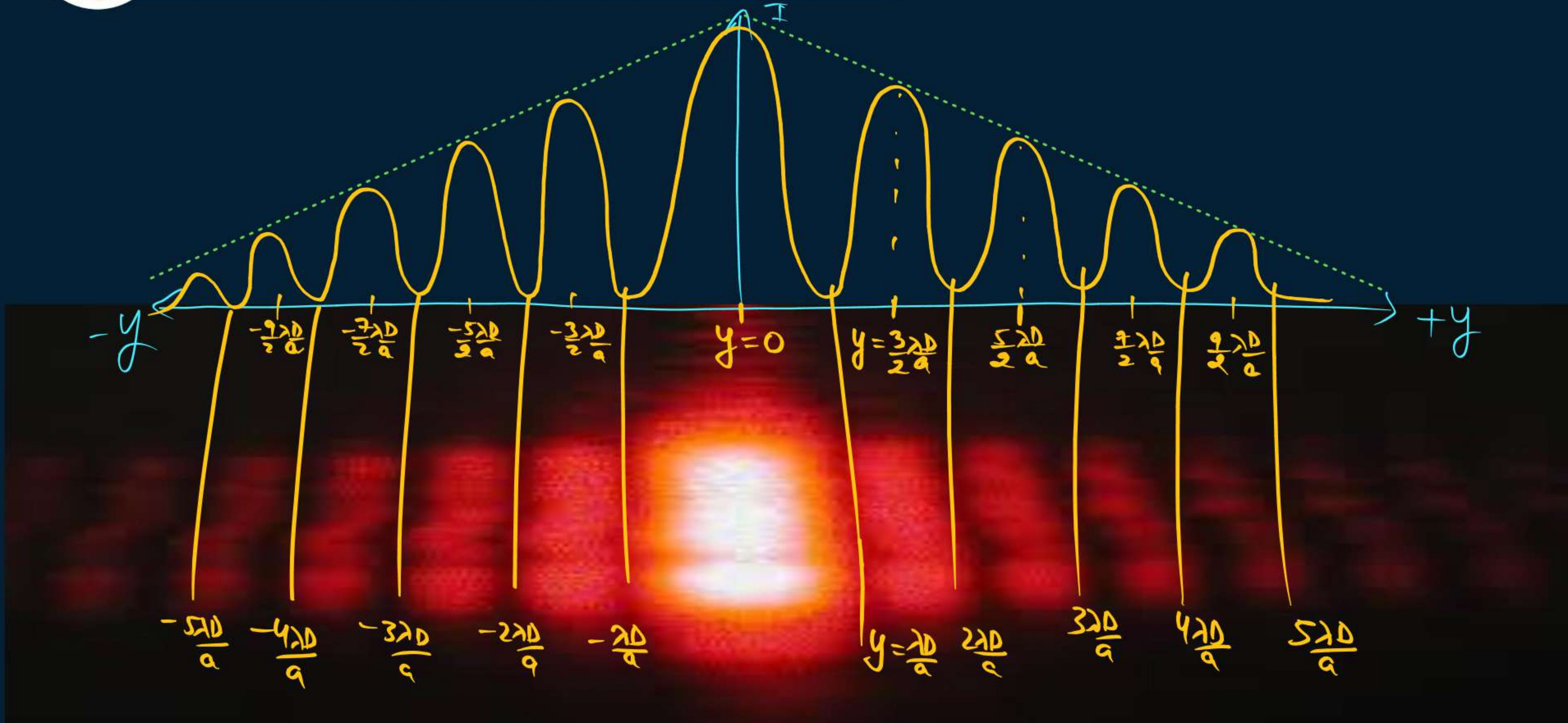


C.B. (width) $\Rightarrow \frac{\lambda D}{a} + \frac{\lambda D}{a} = \frac{2\lambda D}{a}$

$= \frac{2 \times 600 \times \cancel{10^{-9}}^{-6} \times 2}{\cancel{10^{-3}}}$

$= 24 \times 10^{-4} = 2.4 \times 10^{-3} = 2.4\ mm$

Intensity Distribution Graph



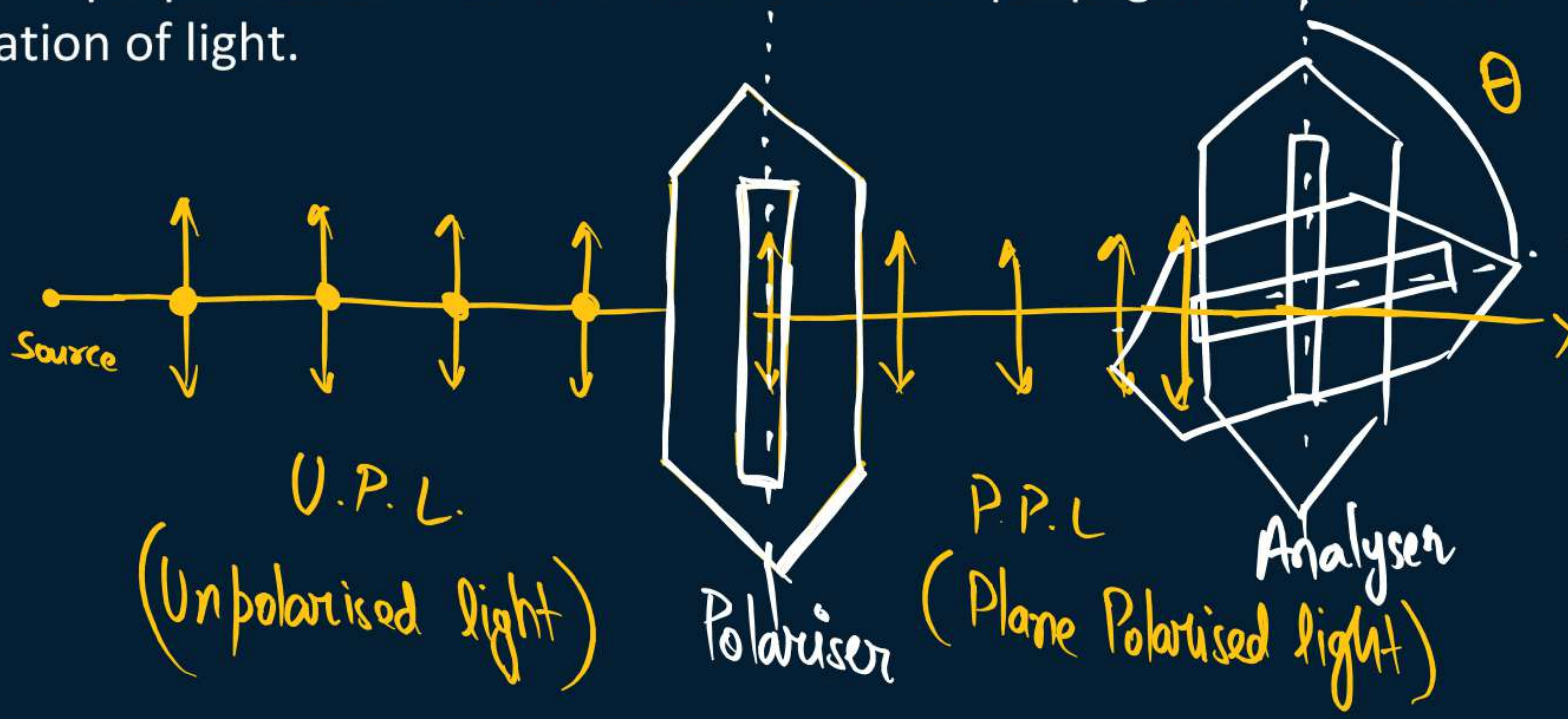
Polarization (Not in CBSE)

Light → EM wave

$\downarrow \downarrow$

$\vec{E}$ & $\vec{B}$

The phenomenon of restricting the vibration of light (electric vector) in a particular direction perpendicular to the direction of propagation of wave is called polarization of light.



Law of Malus :-

$I \propto (\cos\theta)^2$

$\boxed{I = I_0 \cos^2\theta}$

$I = 0$

Homework

Notes ✓

Revision ✓

AAKHRI SAAL HAI JAAN LAGA DE