Modern Physics

① Photoelectric effect
② Matter wave
③ Atomic structure
④ X-rays

⑤ Nuclear physics
⑥ Radioactivity

कहानी for light:

सबसे पहले आए Newton sir (corpuscle theory) he supported particle nature of light.

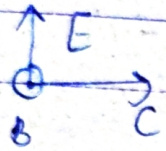
Hygens principle ⇒ he supported wave nature of light (wave optics)

Maxwell electromagnetic wave theory ⇒ it also supported wave nature. (~~Max~~)

Max Planck's quantum theory ⇒ Black body radiation, he supported particle nature.

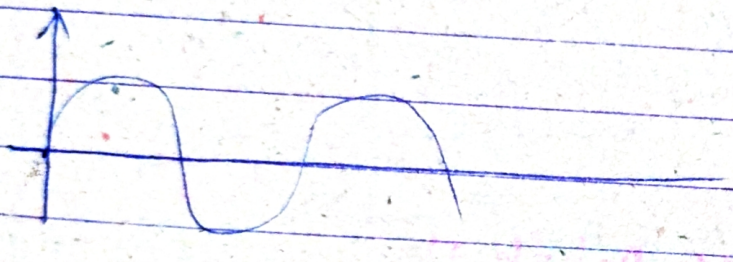
De broglie ⇒ he stated that light is made of photons (particle) whose momentum = $\frac{h}{\lambda}$ and energy of one photon = $\frac{hc}{\lambda}$ where λ is the wavelength if we consider as a wave and c is speed of wave or speed of photon. i.e. how he correlate particle nature and wave

nature and states that light has a dual nature.



Radio Microwave infrared ROYGBIV

U.V. X ray Gamma ray



$V = \nu\lambda$

$c = \nu\lambda$

$y_1 = A_1 \sin(\omega t + \phi_1 + kx)$

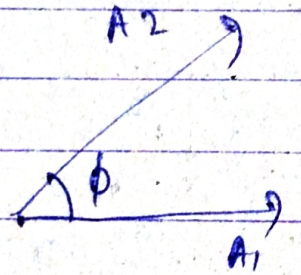
x_1

$A_1 \sin(\omega t + kx_1 + \phi_1)$

$A_2 \sin(\omega t + kx_2 + \phi_2)$

x_2

$y = A_2 \sin(\omega t + \phi_2 + kx)$



$$\phi = \phi_2 - \phi_1 + k(x_2 - x_1)$$

Intensity $= I = 2\pi^2 A^2 f^2 \rho V = \frac{A^2 \omega^2 \rho V}{2}$

$I \propto A^2$

Generally,

$\phi_2 = \phi_1$

$\therefore \phi = \frac{2\pi \Delta x}{\lambda}$ → path difference

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

$I_1 \propto A_1^2$

$I_2 \propto A_2^2$

$I_{net} \propto A_{net}^2$

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

$\frac{I_{net}}{k} = \frac{I_1}{k} + \frac{I_2}{k} + \frac{2\sqrt{I_1I_2}\cos\phi}{k}$

$$\boxed{I_{net} = I_1 + I_2 + 2\sqrt{I_1I_2}\cos\phi}$$

if $I_1 = I_2 = I$

$I_{net} = 4I\cos^2\frac{\Delta\phi}{2}$

Constructive interference →

I_{net} = Maximum

$\cos\Delta\phi = 1$

$\Delta\phi = 2n\pi$

$\frac{2\pi}{\lambda} \cdot \Delta x = 2n\pi$

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

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

if $I_1 = I_2 = I$

$I_{max} = 4I$

note: Diffraction के लिए maxima और minima की condition interference के opposite होती है।

Distructive interference →

I_{net} = Minimum

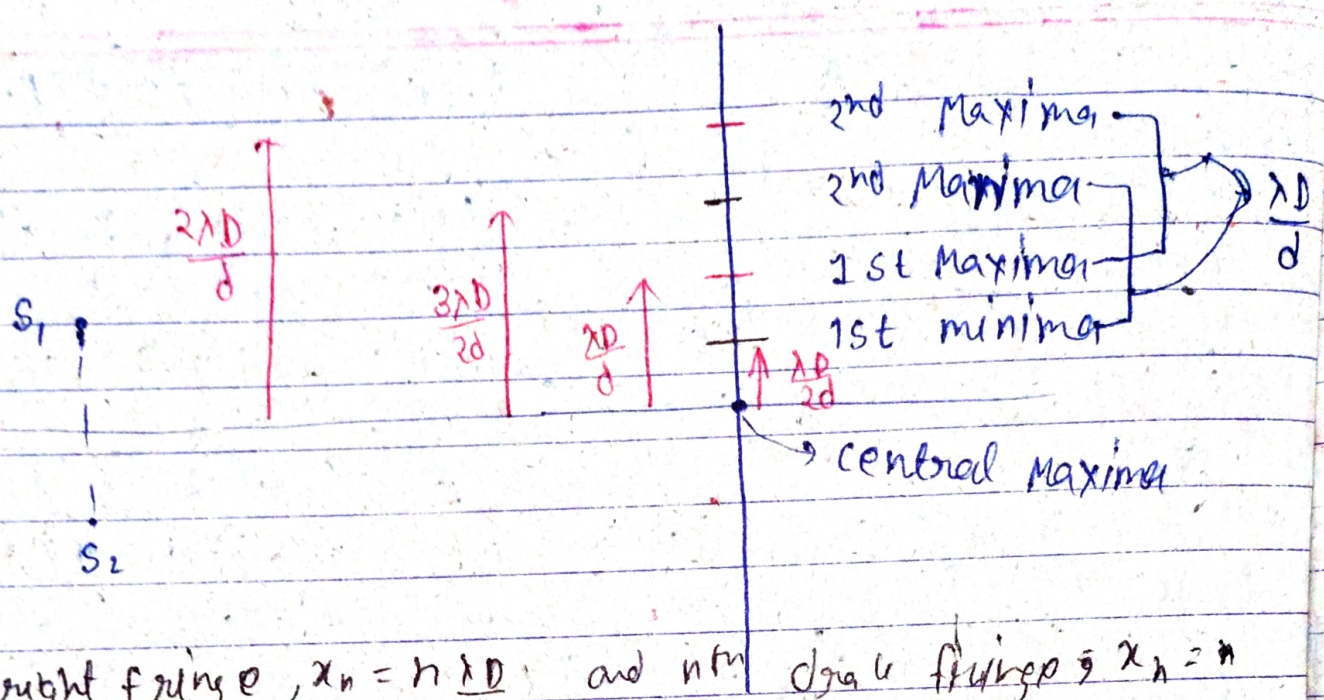
$\cos\Delta\phi = -1$

$\Delta\phi = (2n+1)\pi$

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

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

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

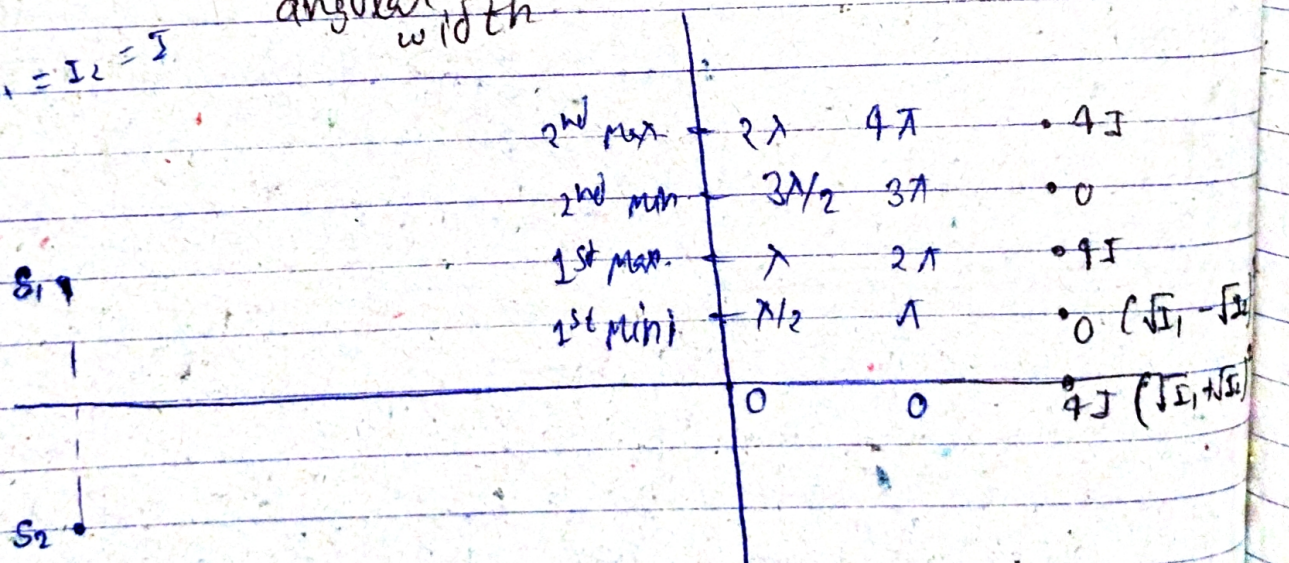


nth bright fringe, $x_n = n\frac{\lambda D}{d}$ and nth dark fringe $x_n = (2n-1)\frac{1}{2}\frac{\lambda D}{d}$

$\frac{\lambda D}{d} = \beta$ → fring width

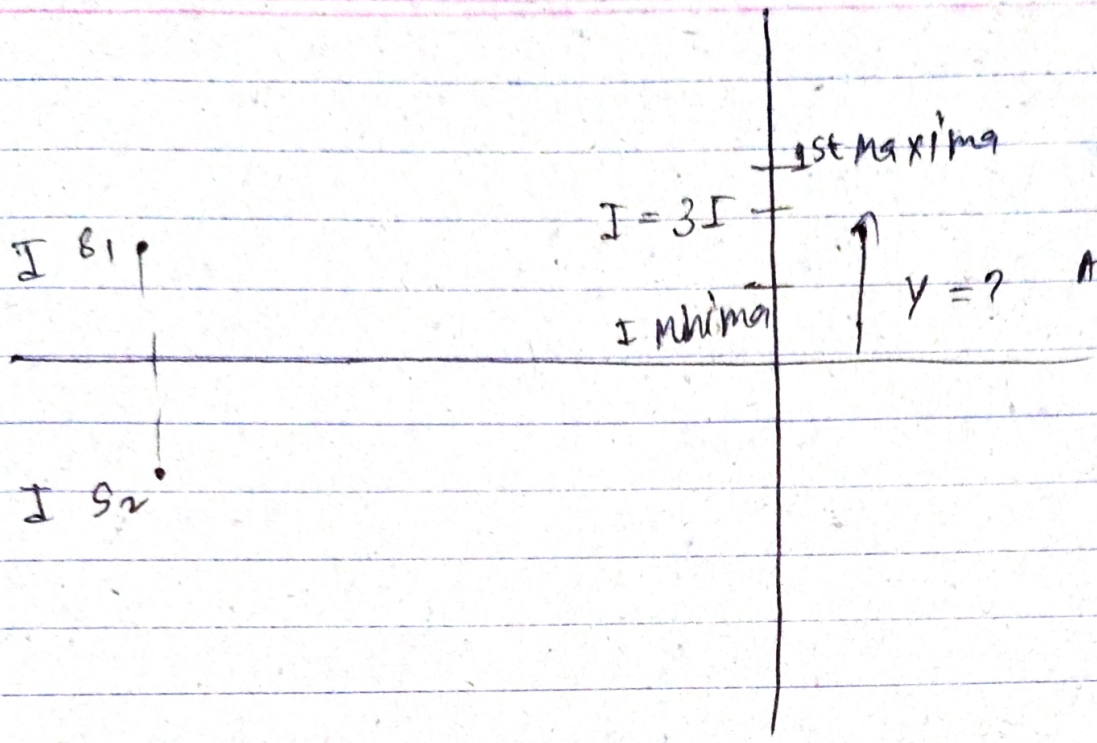
angular width $\theta = \frac{\beta}{D} = \frac{\lambda}{d}$

$I_1 = I_2 = I$



- when the entire apparatus is immersed in a transparent medium of refractive index μ, fring width

$$\beta' = \frac{\lambda' D}{d} = \frac{\lambda D}{\mu d} = \frac{\beta}{\mu}$$



Ans. in D, λ d

$$3I = 4I \cos^2 \frac{\phi}{2}$$

$$\cos \frac{\phi}{2} = \pm \frac{\sqrt{3}}{2}$$

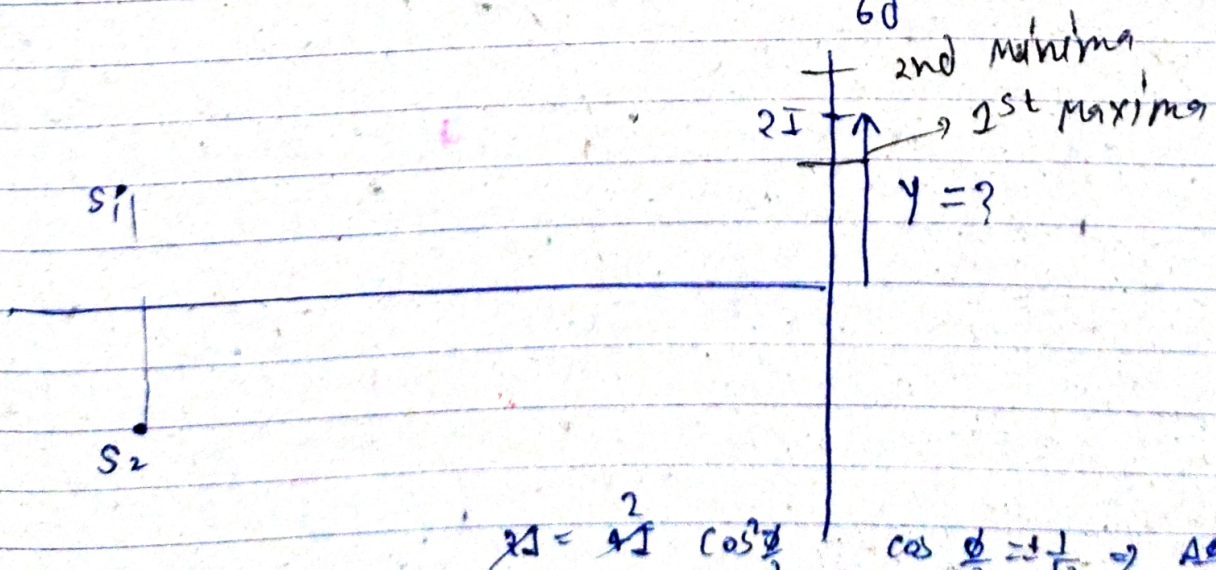
~~$\phi = 15, 75$~~

$$\frac{\phi}{2} = \frac{5\pi}{6}$$

$$\Delta x = \frac{dy}{D}$$

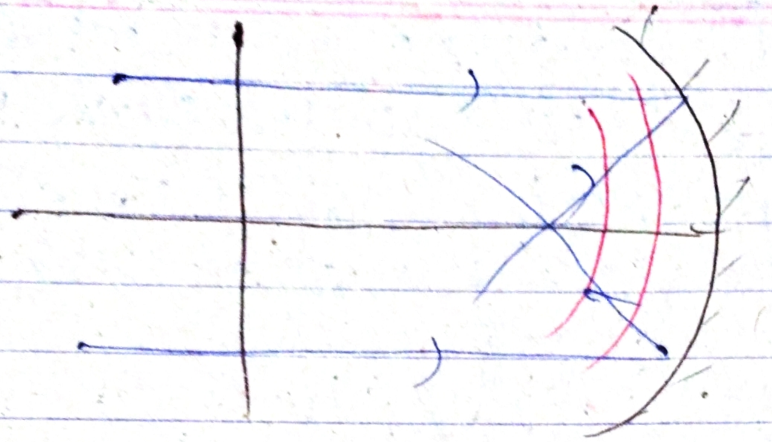
$$\phi = \frac{5\pi}{3} = \frac{2\pi}{\lambda} \frac{dy}{D}$$

$$y = \frac{5\lambda D}{6d}$$

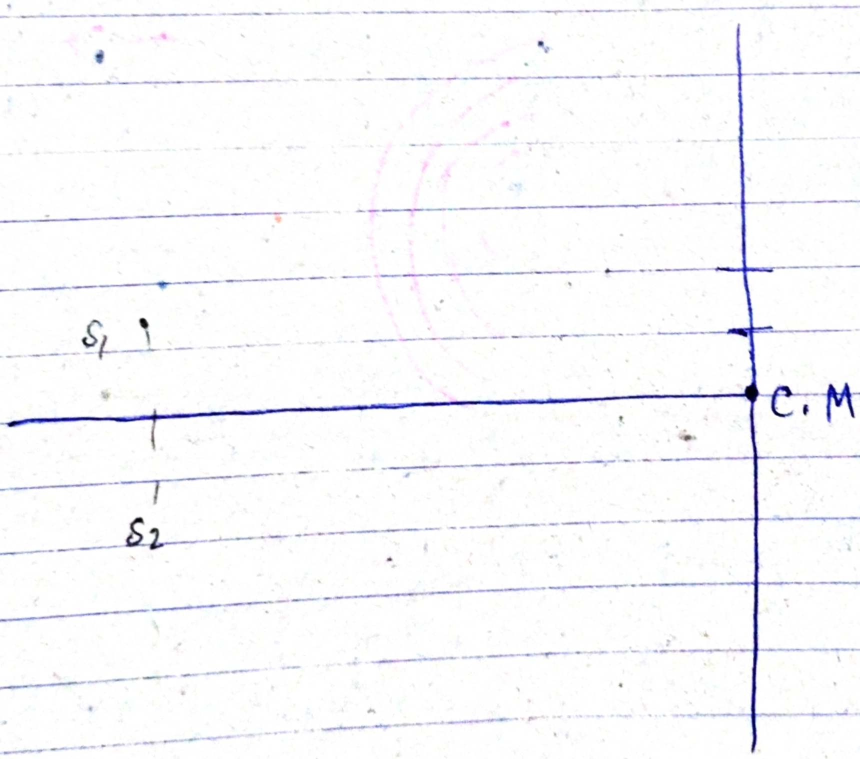


$$\cancel{2}I = \cancel{4}I \cos^2 \frac{\phi}{2} \qquad \cos \frac{\phi}{2} = \pm \frac{1}{\sqrt{2}} \Rightarrow \frac{\Delta\phi}{2} = \frac{5\pi}{4}$$

$$\Delta D = \frac{5\pi}{2}$$



Young's Double slit experiment ⇒

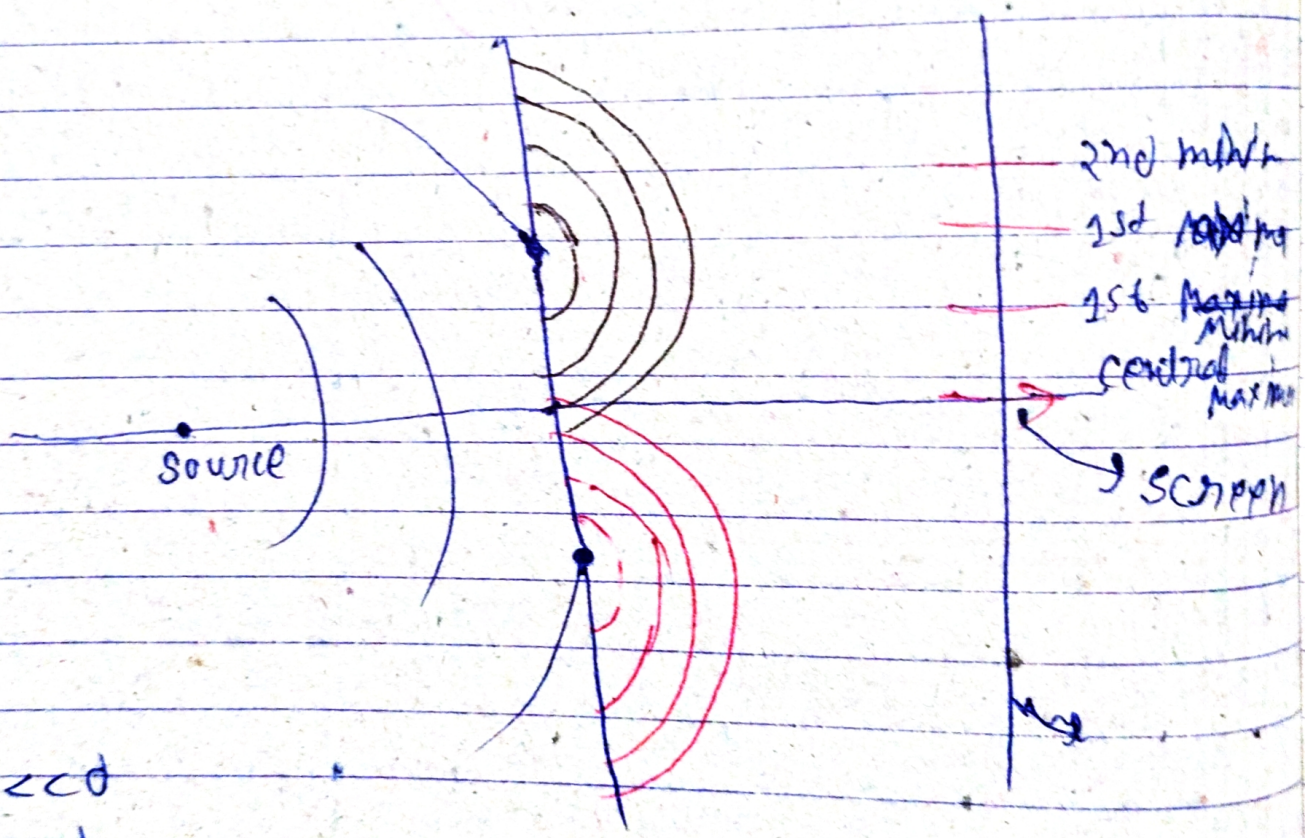


Coherent and incoherent sources ⇒

Coherent — in these Type of sources phase difference remains same. with position or and time.
(coherent source का अन्तर phase constant 0 होना कोई जरूरी नहीं है वह constant होना चाहिए।)

Incoherent — In these Types of source phase diff. change with time and location both.

Normal life में हमें Bright - dark, Bright - dark इस लिए नजर नहीं आता है क्योंकि sources incoherent होते हैं इसलिए Maxima, Minima एक ही location पर इतनी जल्दी - २ बनते हैं कि हमें पता नहीं पड़ता।



$\lambda << d$

$D >> d$

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

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

Maximas $0, \frac{\lambda D}{d}, 2\frac{\lambda D}{d}$

Imp points

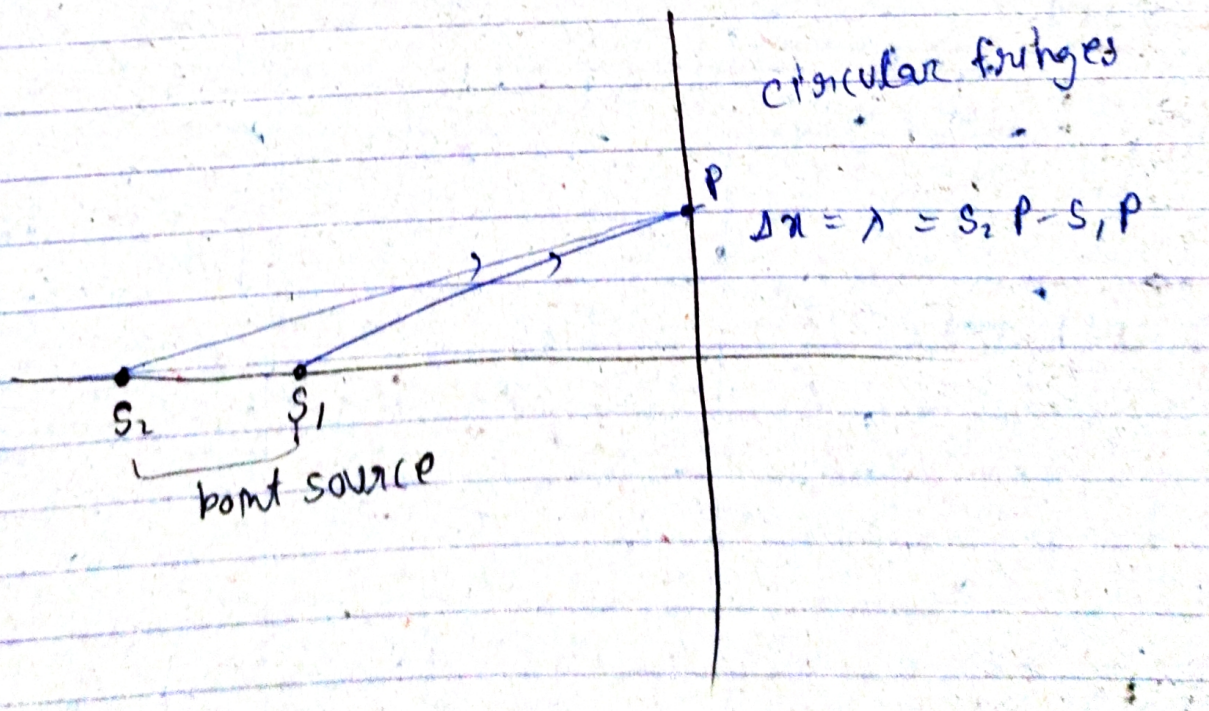
i- Sources should be coherent.

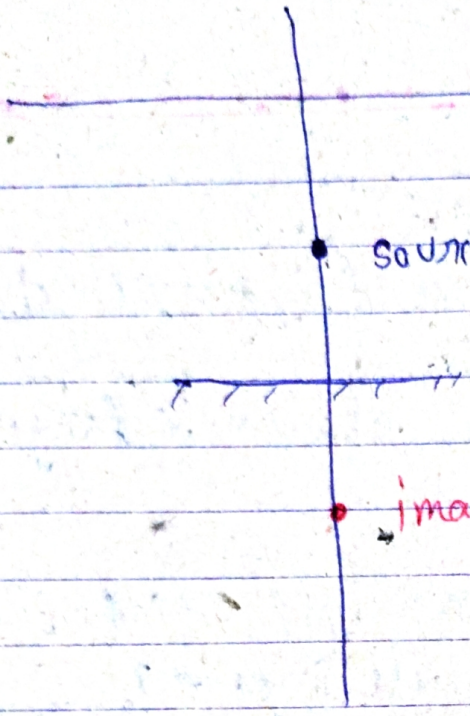
ii- fringe width and angular fringe width should be significant

iii - Ratio of I_{max} and I_{min} should be large.

If we replace slit by pin hole in YDSE then what will be shape of interference?

1. St. line
2. circular
3. ellipse
4. Hyperbola (↳)
5. parabola

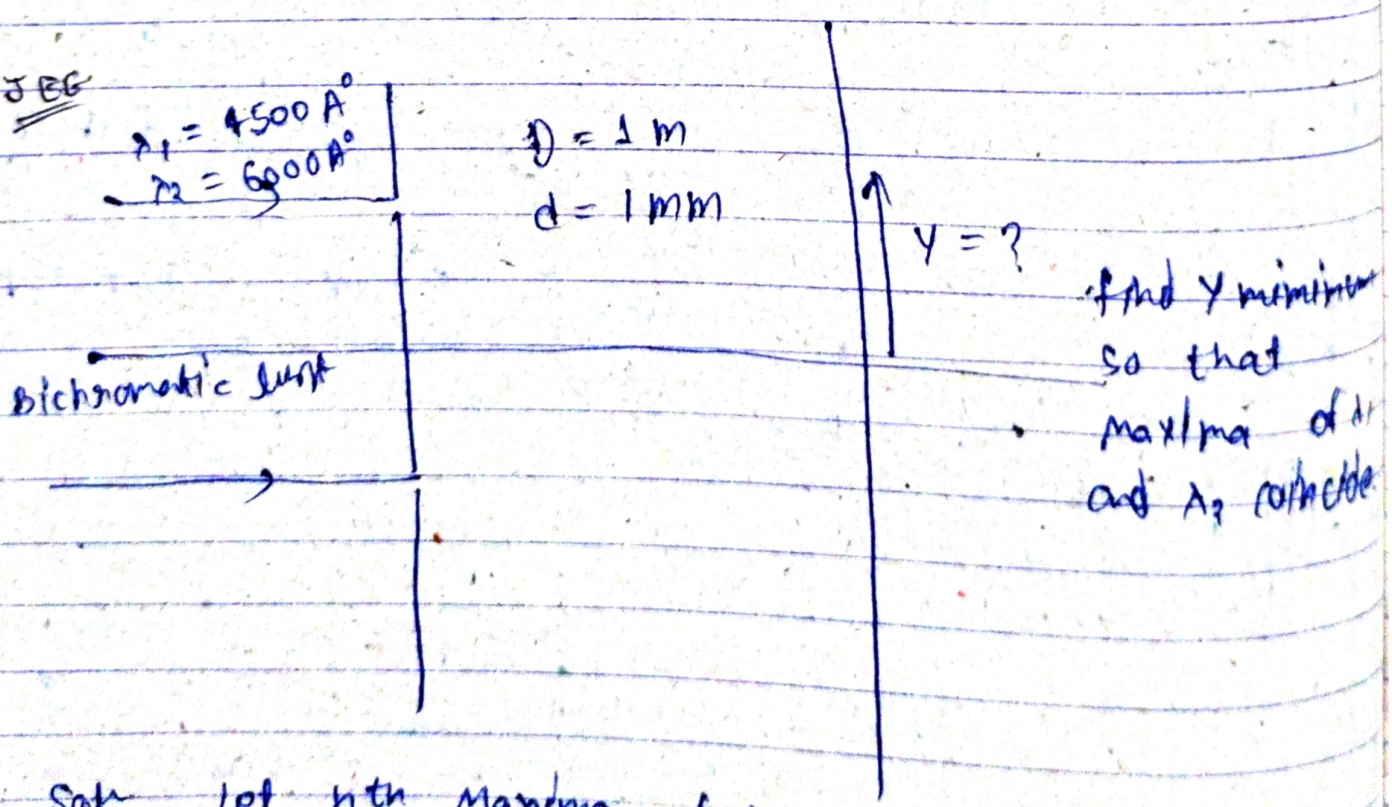




कौनसी fringes form होगी
Ans → circular

Monochromatic light ⇒ only one wavelength.
bichromatic " ⇒ two wavelength
polychromatic " ⇒ many "

JEE



Sol^n Let nth Maxima of λ_1 coincide with mth maxima of λ_2.

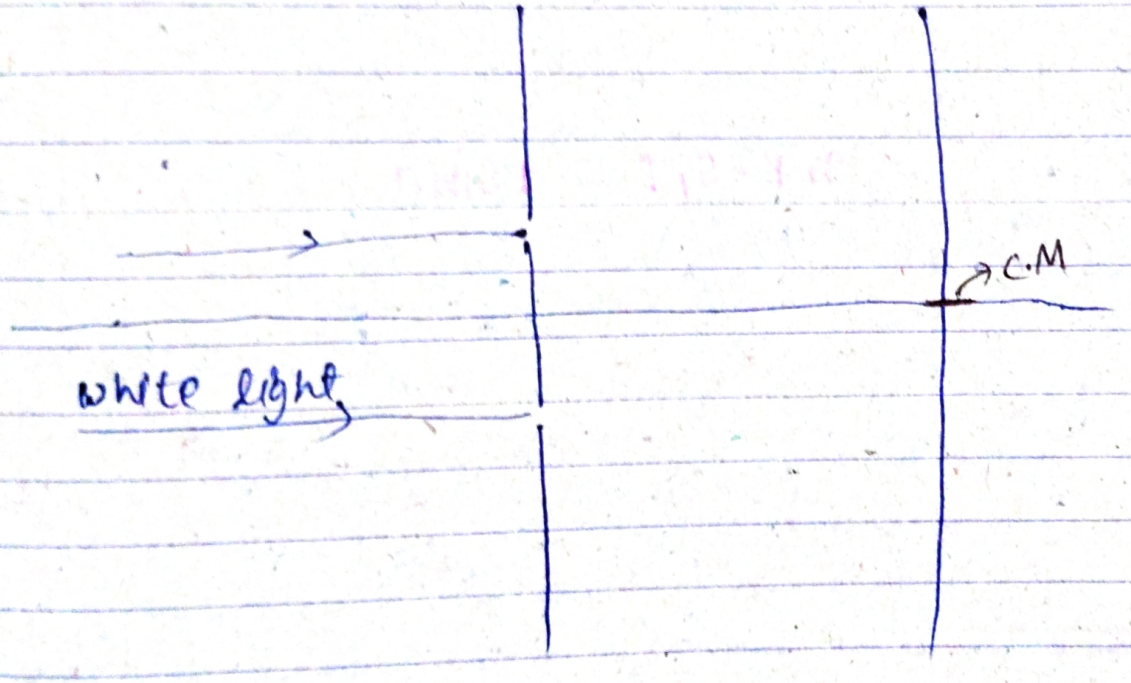
$$Y = \frac{n\lambda_1 D}{d} = \frac{m\lambda_2 D}{d} \Rightarrow n\lambda_1 = m\lambda_2$$

$n_{4500} = n_{6000}$

$\frac{n}{m} = \frac{3}{4}$

$Y = 4 \times 4500 \times 10^{-7} \times 1000 = 1.88\ mm$

white light in YDSE ⇒



अगर हम YDSE set up में white light डालें तो पूरी screen पर only एक point देखा होगा जहां पर white spot बनेगा ! i.e. central Maxima. that is why .. white light is used to central Maxima In YDSE set up अगर हम central Maxima से ऊपर चले तो पहली Maxima voilent का आएगा और पहली minima भी violet का होगा ऊपर चलने पर जो सबसे पहली colour हमें Appear होगा वह AIEEE → voilet { Think } JEE → Red