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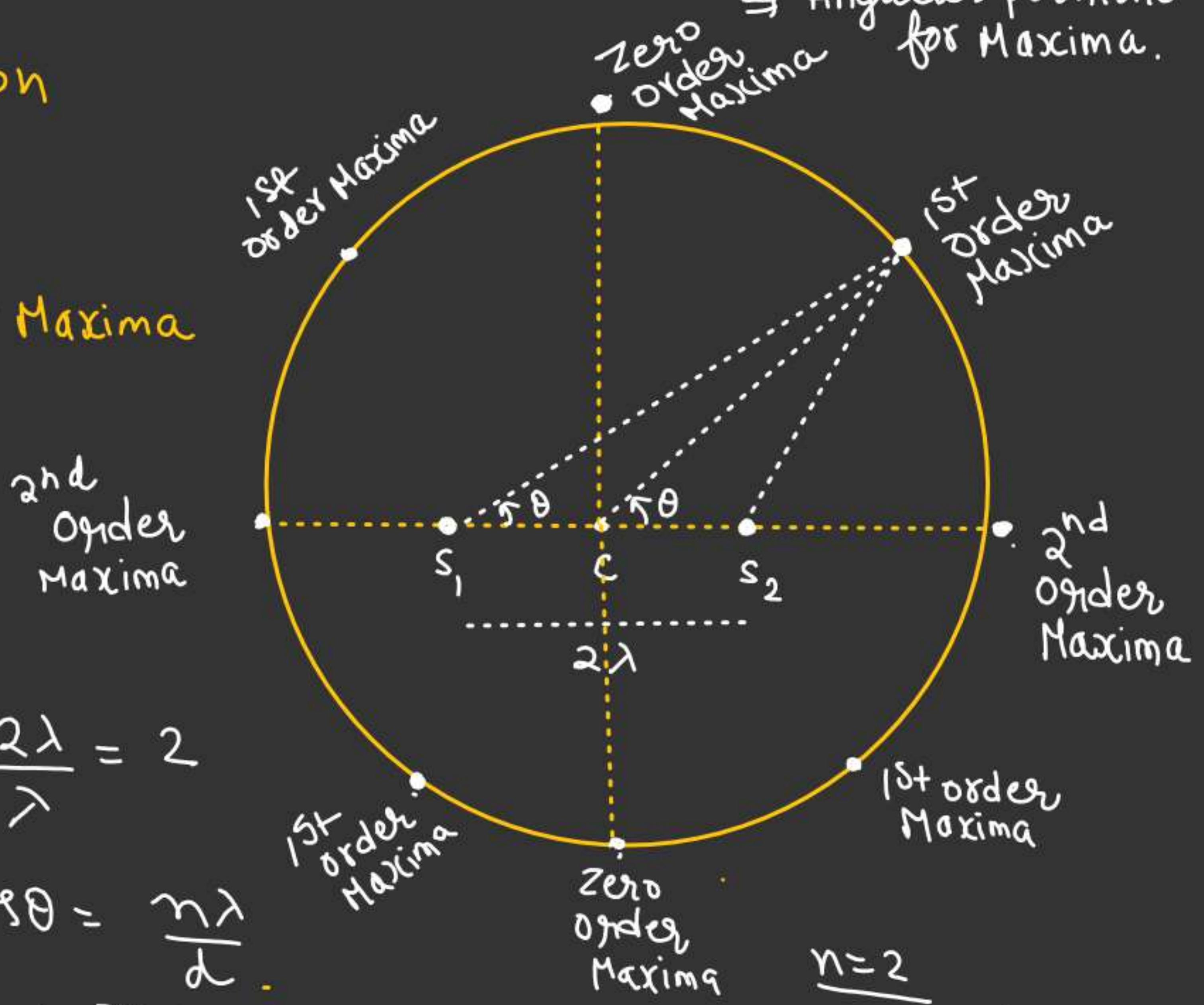
Two Source S_1 and S_2 placed Symmetrically w.r.t Center C having Seperation $d = 2\lambda$.
Radius of Circle is $R = 100\lambda$.
Find the angular positions for Maxima

$0^\circ, \pi/2, \frac{\pi}{3}, \frac{2\pi}{3}, \frac{4\pi}{3}, \frac{5\pi}{3}$

↳ Angular positions for Maxima.



$\Delta x = d\cos\theta$

For Maxima
$d\cos\theta = n\lambda$

Maximum order of Maxima $= \frac{d}{\lambda} = \frac{2\lambda}{\lambda} = 2$

At $\theta = \frac{\pi}{2}$, zero order Maxima

Total No of Maxima = 8

$\cos\theta = \frac{n\lambda}{d}$.

$\underline{n=0}$
$\theta = \frac{\pi}{2}$, $\underline{n=1}$

$\theta = \cos^{-1}\left(\frac{\lambda}{d}\right) = \cos^{-1}\left(\frac{1}{2}\right) = \pi/3$.

$\underline{n=2}$

$\theta = \cos^{-1}\left(\frac{2\lambda}{2\lambda}\right) = 0^\circ$

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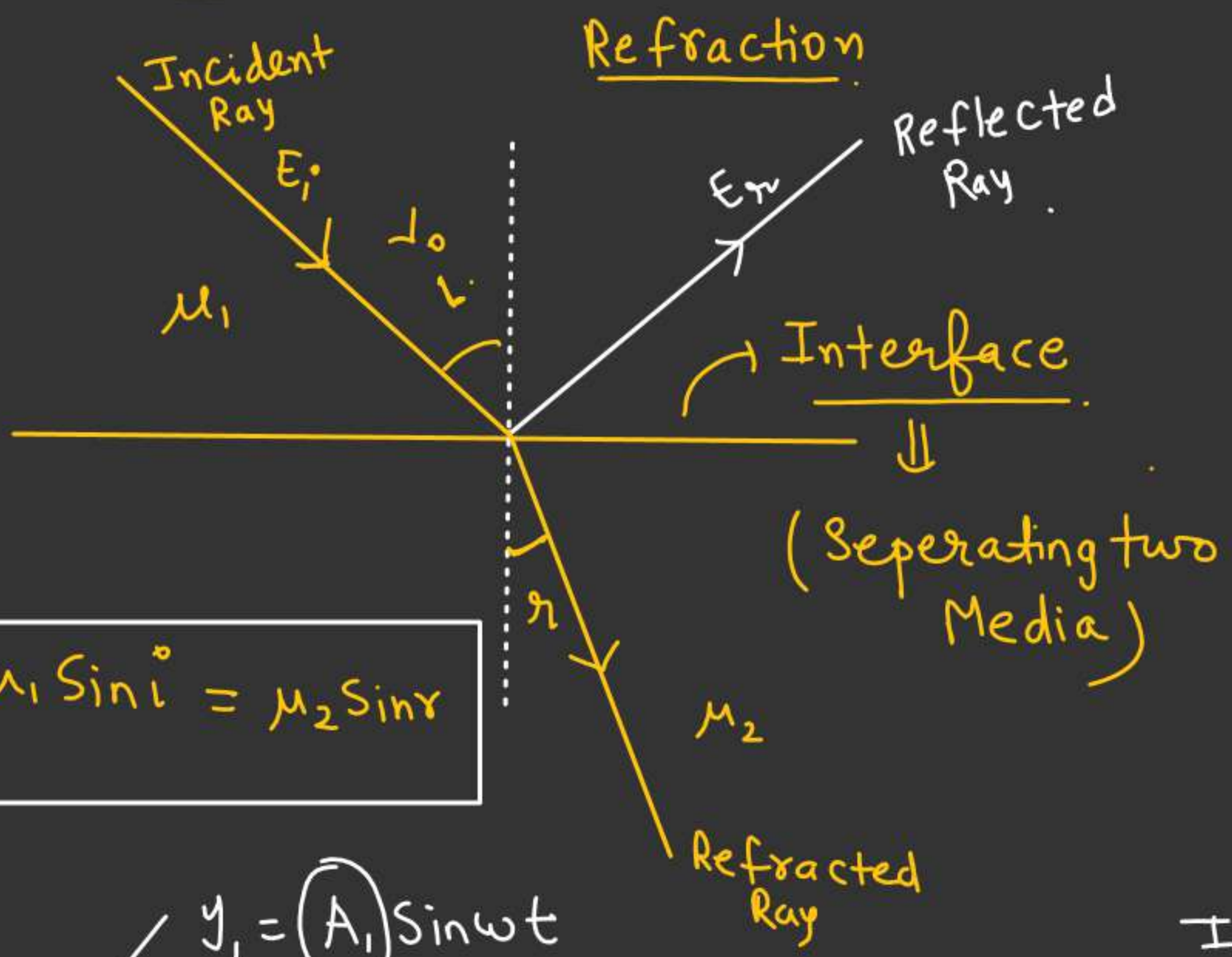
Snell's Law :-



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

$$E_r = \left(\frac{\mu_1 - \mu_2}{\mu_1 + \mu_2}\right) E_i$$

E_r ⇓ Amplitude of Reflected ray

E_i ⇓ Amplitude of Incident Ray.

If $\mu_1 > \mu_2$

$\Rightarrow$ E_r & E_i of Same Sign

Both incident and reflected ray of same phase.

If $\mu_1 < \mu_2$ (light ray travel from rarer to denser Medium)

E_r and E_i of opposite sign.

i.e Incident and reflected have a phase difference of π.

$\Delta\phi = \pi \leftarrow$

$y_1 = A_1 \sin\omega t$

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

$y_2 = -A_2 \sin\omega t$

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** **Note** :- If there is a reflection of light from rarer to denser Medium light ray Suffer a phase Change of π. or path difference $\frac{\lambda}{2}$.

$$\Delta\phi = \pi$$

$$\frac{2\pi}{\lambda}\cdot\Delta x = \pi \quad \text{or} \left(\Delta x = \frac{\lambda}{2}\right)$$

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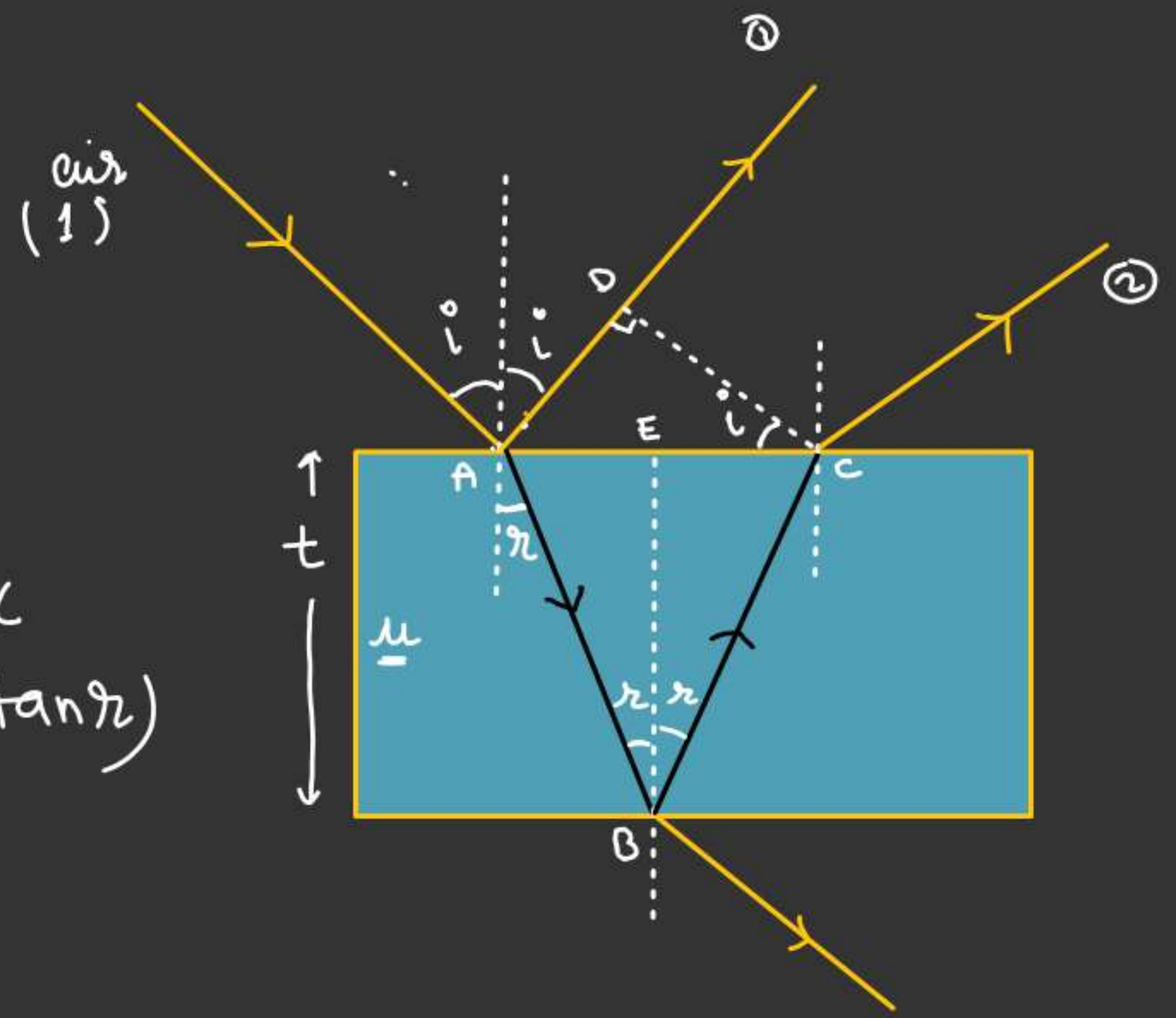
INTERFERENCE DUE TO THIN FILM

Interference of Reflected rays.

Ray 1 have reflection from rarer to denser so it has an extra path difference of $\frac{\lambda}{2}$.



$AB = BC = t\sec r$

$AE = EC = t\tan r$

$AC = AE + EC = (2t\cdot\tan r)$

In ΔACD

$\sin i = \frac{AD}{AC}$

$AD = AD\sin i = (2t\tan r\cdot\sin i)$

$\Delta x = \underbrace{\mu(AB+BC)}_{\text{Optical path length}} - \left(AD + \frac{\lambda}{2}\right)$

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$$\Delta x = \left(2\mu t \sec r - 2t \tan r \sin i\right) - \frac{\lambda}{2}$$

By Snell's Law

$$1 \cdot \sin i = \mu \cdot \sin r$$
$$\sin i = (\mu \sin r)$$

$$\Delta x = \left[\frac{2\mu t}{\cos r} - 2t \tan r \times \mu \sin r\right] - \frac{\lambda}{2}$$

$$\Delta x = \left[\frac{2\mu t}{\cos r} - \frac{2\mu t}{\cos r}\sin^2 r\right] - \frac{\lambda}{2}$$

$$= \frac{2\mu t}{\cos r}(1 - \sin^2 r) - \frac{\lambda}{2}$$

$$\boxed{\Delta x = 2\mu t \cos r - \frac{\lambda}{2}}$$

Condition for Maxima ✓

$$\Delta x = n\lambda$$

$$2\mu t \cos r - \frac{\lambda}{2} = n\lambda$$

$$\boxed{2\mu t \cos r = (2n+1)\frac{\lambda}{2}}$$

$n = 0, 1, 2, 3 \ldots$

Condition for Minima ✓

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

$$2\mu t \cos r - \frac{\lambda}{2} = (2n-1)\frac{\lambda}{2}$$

$$\boxed{2\mu t \cos r = n\lambda}$$

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Interference due to transmitted ray

$BC = CD = t\sec r$

$BE = BD \cdot \sin i$

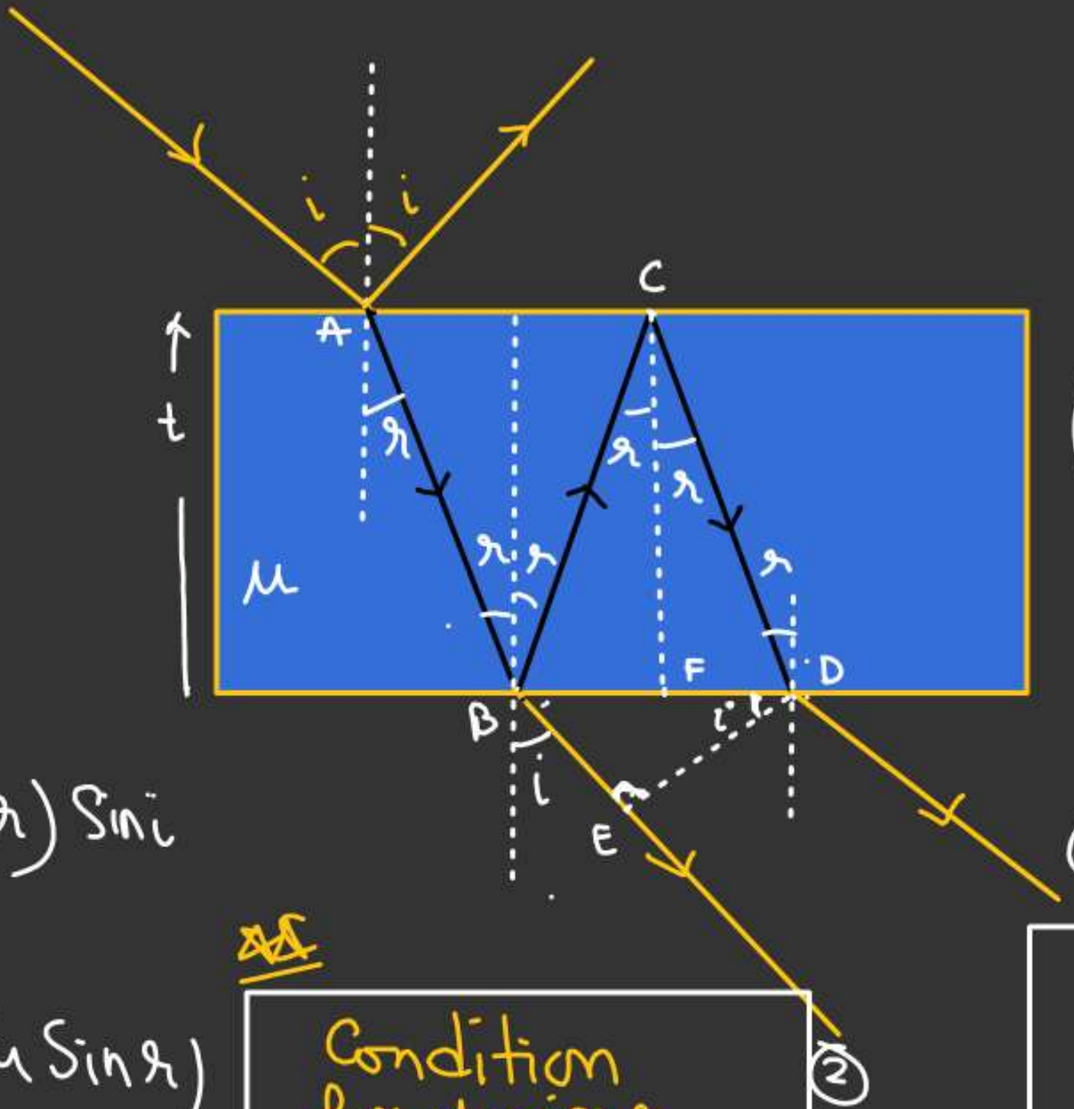
$= (2t\tan r)\sin i$

$\Delta x = \mu(BC + CD) - BE$

$\Delta x = \mu(2t\sec r) - (2t\tan r)\sin i$

$\Delta x = \dfrac{2\mu t}{\cos r} - (2t\tan r)(\mu\sin r)$

$$\boxed{\Delta x = (2\mu t\cos r)}$$



By Snell's Law

$(\mu\sin r = 1\cdot\sin i)$

Condition for Maxima

$2\mu t\cos r = n\lambda$

Condition for Minima

$2\mu t\cos r = (2n+1)\dfrac{\lambda}{2}$