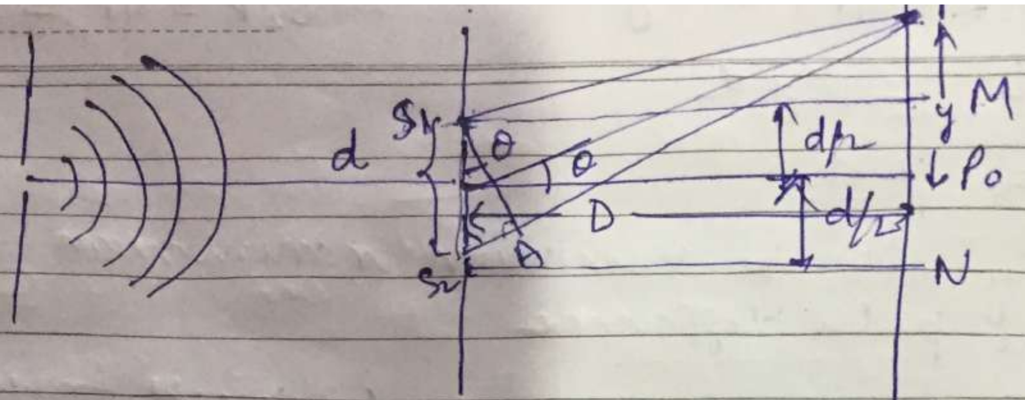


$\boxed{S_2A = d\sin\theta = d\tan\theta \quad \tan\theta = y/D}$

y = distance of P from P_0 the central point of screen.

d = seperation of two slits S_1 and S_2

D = Distance of slits from the screen

The path difference is $S_2P - S_1P$ we have to find out. upper right angle tringle S_1PM

$$(S_1P)^2 = (y - d/2)^2 + D^2 \qquad \text{---} \quad (1)$$

lower right angle tringle S_2PN

$$(S_2P)^2 = (y + d/2)^2 + D^2 \qquad \text{---} \quad (2)$$

tract eq (2) $-$ eq (1) then

$$(S_2P)^2 - (S_1P)^2 = (y + d/2)^2 - (y - d/2)^2$$

$$(S_2P - S_1P)(S_2P + S_1P) = (y + d/2 + y - d/2)(y + d/2 - y +$$

$$(S_2P - S_1P)(S_2P + S_1P) = 2yd \qquad S_2P \approx S_1P \approx D$$

$$(S_2P - S_1P)\,\cancel{2}D = \cancel{2}yd$$

$$S_2P - S_1P = y\frac{d}{D}$$

The intensity will be maximum or minimum accordingly the path difference

$$y\frac{d}{D} = m\lambda \qquad m = 0, 1, 2, \text{ for bright fringes}$$

$$\boxed{y = \frac{mD\lambda}{d}} \quad \text{———— (3)}$$

For dark fringe the path diff will be

$$y\frac{d}{D} = \left(m + \frac{1}{2}\right)\lambda \qquad \text{where } m \text{ is the order of fringe}$$

$$y = \left(m + \frac{1}{2}\right)\frac{\lambda D}{d} \quad \text{———— (4)}$$

<u>Fringe width</u>: if y_n and y_{n+1} denote the distance of nth and $(n+1)$ bright fringes then

$$y_n = \frac{Dn\lambda}{d}$$

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

The spacing between nth and $(n+1)$ fringes is

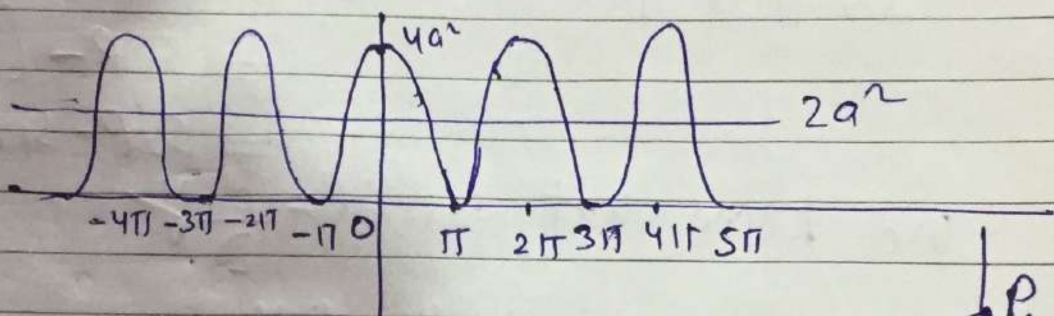
$$y_{n+1} - y_n = \frac{D}{d}(n+1)\lambda - \frac{Dn\lambda}{d}$$

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

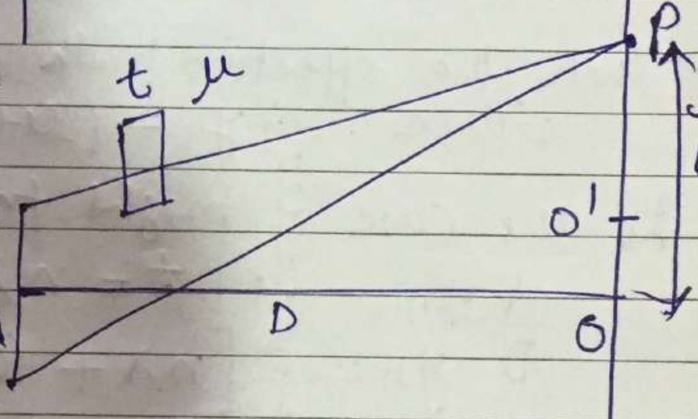
<u>Shape of interference ~~frg~~ fringe.</u> We know that the path diff $S_2P - S_1P = n\lambda$ or $(n+\frac{1}{2})\frac{\lambda}{2}$

Intensity distribution in the fringe system. To find the intensity we can take $a_1 = a_2$ so

$$I = A^2 = 2a^2(1+\cos\delta)$$
$$= 4a^2\cos^2\delta/2$$



<u>Displacement of ~~fringes~~ Fringes.</u>



Suppose thin transparent plate of thickness t and refractive index μ is introduced in the path of S_1P

So we have to find the time taken by light to reach from S_1 to P

$$T = \frac{S_1P - t}{c} + \frac{t}{v}$$

$$T = \frac{S_1P - t}{c} + \frac{t}{v}$$

$$\boxed{\frac{c}{v} = \mu}$$

$$T = \frac{S_1P - t}{c} + \frac{t}{v}$$

$$T = \frac{S_1P - t}{c} + \frac{t\mu}{c}$$

$$T = \frac{S_1P - t + \mu t}{c}$$, Time in $S_2P = \frac{S_2P}{c}$

So the distance travel by $S_1P = S_1P - t + \mu t$

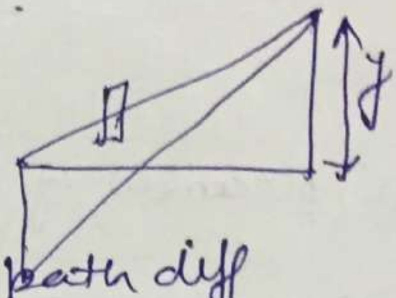
and distance travel by $S_2P = S_2P$

So the path diff $= S_2P - S_1P$

$$= S_2P - [S_1P + (\mu-1)t]$$

$$= S_2P - S_1P - (\mu-1)t$$

We know that $S_2P - S_1P = \frac{d}{D}y$



then the effective path diff will be $\frac{d}{D}y - (\mu-1)t$

In the case of bright fringe effective path diff

$$\frac{d}{D}y_n - (\mu-1)t = n\lambda$$

$$y_n = \frac{D}{d}\left[n\lambda + (\mu-1)t\right]$$

In absence of plate $t = 0$

$$y_n = \frac{D}{d}(n\lambda)$$

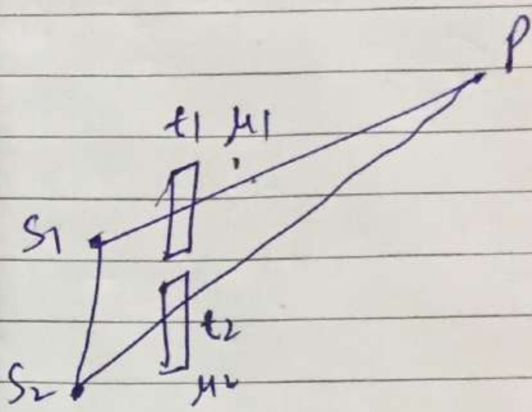
Displacement of fringe $= \frac{D}{d}\left[n\lambda + (\mu-1)t\right] - \frac{D}{d}n\lambda$

$$= \frac{D}{d}(\mu-1)t$$

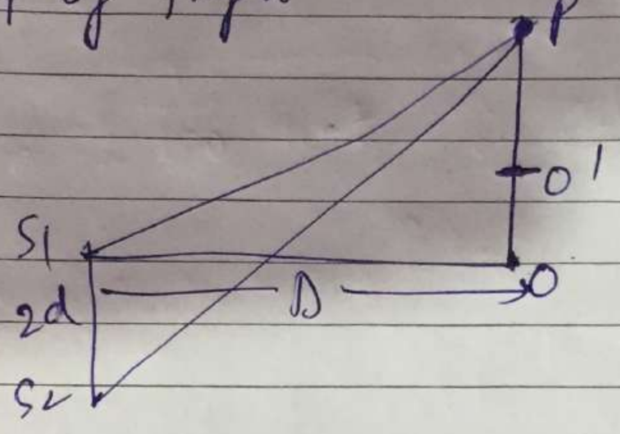
Fringe width $= y_{n+1} - y_n$

$$= \frac{D}{d}\left[(n+1)\lambda + (\mu-1)t\right] - \frac{D}{d}\left[n\lambda + (\mu-1)t\right]$$

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



Shifting of fringes



$S_1P - t_1 + \mu_1 t_1$

$S_2P - t_2 + \mu_2 t_2$