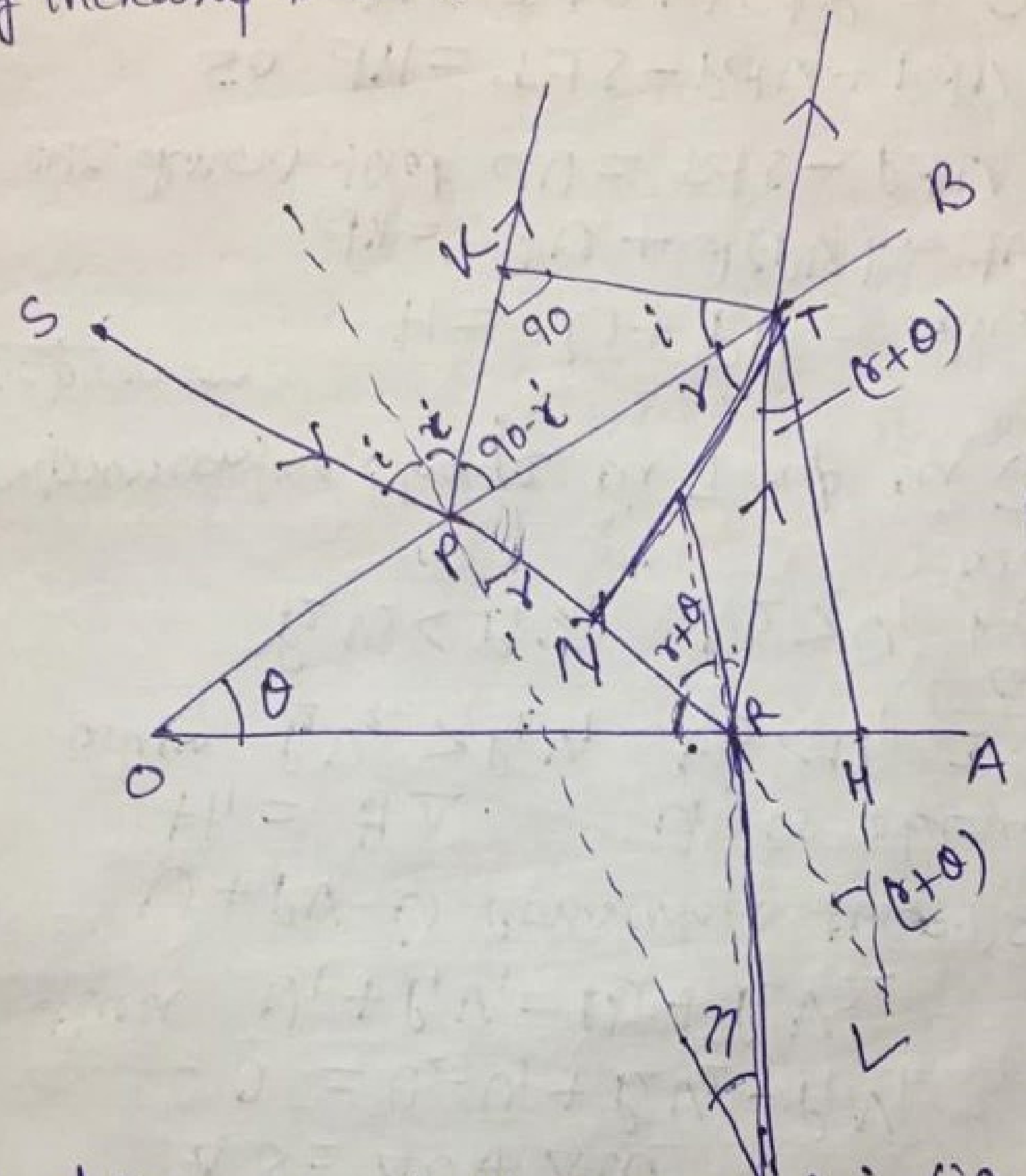
Interference due to wedge shaped thin film of increasing thickness.



RTH and

Path difference = Path (PR + RT) in film − PK in air

$$= \mu (PR + RT) - PK$$

$PR = PN + NR$

We know that $\sin i = \frac{PK}{PT}$

$$\sin r = \frac{PN}{PT}$$

Therfore $\mu = \frac{\sin i}{\sin r} = \frac{PK}{PN}$

$$PK = \mu PN$$

Path diff $= \mu(PN + NR + RT) - \mu PN$

$$= \mu(NR + RT)$$

Properties of congruent triangle RT and RHL

$$RT = HL$$

Path difference

$$= \mu(NL)$$

$\boxed{TH = HL = t}$ thickness

$$\frac{NL}{TL} = \cos(r+\theta)$$

$$NL = \underline{TL}\cos(r+\theta)$$

$$NL = 2t\cos(r+\theta)$$

Path diff $= 2\mu t\cos(r+\theta)$

so the reflected waves Path diff

$$= 2\mu t\cos(r+\theta) + \lambda/2$$

condition for maxima and minima

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

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

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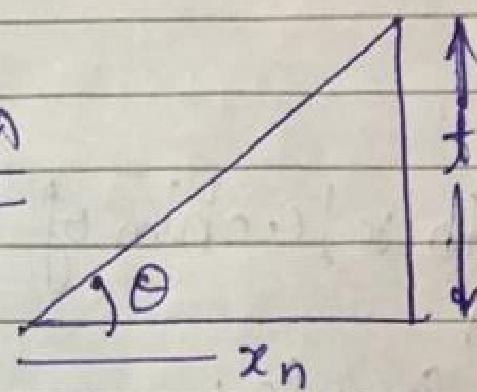
Nature of fringe, $\mu, r, \theta \rightarrow$ are const
the t will vary the particular point
the film vary. Straight fringe
Calculation of Fringe width.

condition for bright fringe

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



$$\frac{t}{x_n} = \tan\theta$$

$$2\mu x_n \tan\theta \cos(r+\theta) = (2n-1)\frac{\lambda}{2} \quad \text{--- (1)}$$

Similarly for $n+1$ Distance x_{n+1}

$$2\mu x_{n+1} \tan\theta \cos(r+\theta) = (2n+1)\frac{\lambda}{2} \quad \text{--- (2)}$$

Subtracting (2) $-$ (1)

$$2\mu(x_{n+1} - x_n)\tan\theta \cdot \cos(r+\theta) = \lambda$$

$$\beta = x_{n+1} - x_n = \frac{\lambda}{2\mu \tan\theta \cos(r+\theta)}$$

for normal incidence $i = r = 0$

$$\cos(r+\theta) = \cos\theta$$

$$\beta = \frac{\lambda}{2\mu \sin\theta}$$

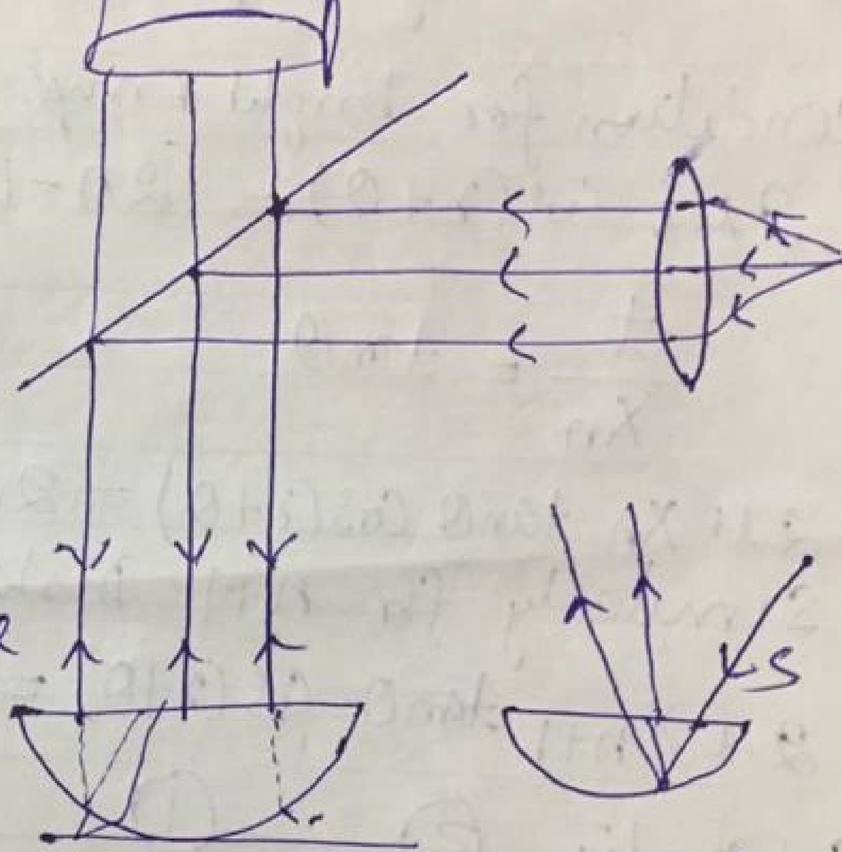
if θ is very small then $\sin\theta \simeq \theta$

$$\boxed{\beta = \frac{\lambda}{2\mu\theta}}$$

Newton's Rings

Special case of interference in air film. of variable thickness.

Plano - convex lens (large focal lens)



Due to reflection of Light

The formula.

$2\mu t \cos(r+\theta) \pm \frac{\lambda}{2}$

at normal incidence

$i = r = 0$

$2\mu t \cos(r+\theta) + \frac{\lambda}{2}$

the angle made by wedge is very small

i.e $\theta = 0$

then $2\mu t + \frac{\lambda}{2} = n\lambda$ for bright

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

at the Point of contact $t=0$ effective Path diff $= \frac{\lambda}{2}$ hence the centre of Newton Rings is dark.

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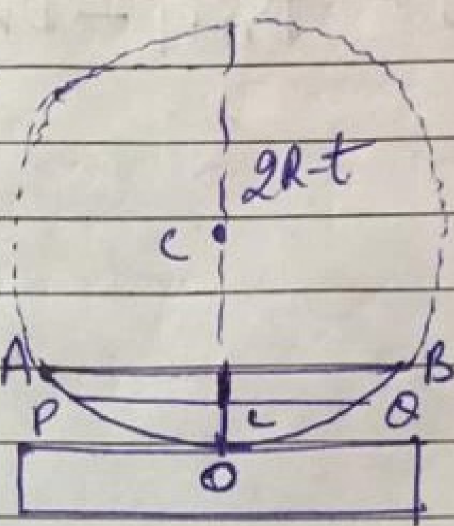
Diameters of the Rings:

$PL = QL = r$
radius of circular rings $GL = 2R - t$



From the Geometry

$PL \times QL = OL \times GL$

$r \times r = t(2R - t)$

$r^2 = 2Rt - t^2$

$t << R$ t^2 may be neglected compared to $2Rt$

$r^2 = 2Rt$

$t = \frac{r^2}{2R}$

Diameter of Bright fringe:

$2\mu \times \frac{r_n^2}{2R} = (2n-1)\frac{\lambda}{2}$

$r_n^2 = \frac{(2n-1)\lambda R}{2\mu}$

$\left(\frac{D_n}{2}\right)^2 = \frac{(2n-1)\lambda R}{2\mu}$

$D_n^2 = \frac{2(2n-1)\lambda R}{\mu}$

$D_n = \sqrt{2\mu R(2n-1)}$