Induction

Spring - 2018

(DONA)

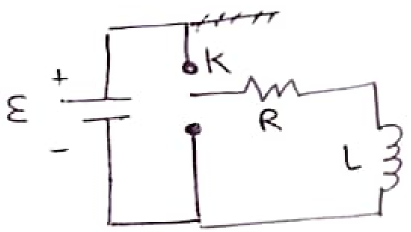
(*) **Electromagnetic Induction:** The creation of an electro-motive force (emf) by a moving magnetic field around an electric conductor and conversely the creation of current by moving an electric conductor through a static magnetic field.

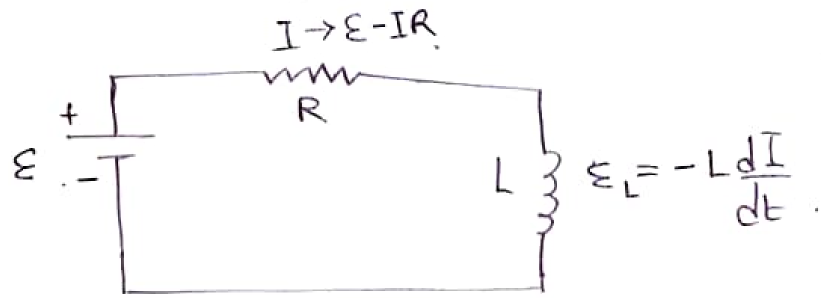
Faradays laws: ① Whenever the magnetic flux associated with any closed circuit changes, an induced current flows through the circuit which lasts ~~only~~.. An increase in the magnetic flux produces inverse current, while a decrease of such flux a direct current.

② The magnitude of the induced emf produced in a coil is directly proportional to rate of change of the magnetic flux through the coil.

$$\varepsilon \propto \frac{d\Phi_B}{dt}.$$

(*) **Growth of current / Rise of current:**





when the k key is depressed, current in R starts to increase.. If the inductor (L) was not present the current would rise rapidly to a maximum value $I_0 = \mathcal{E}/R$. Because of inductance, a self induced emf $-L\frac{dI}{dt}$ appears and opposes the rise of current.

Now, according to Kirchhoff's 2nd law:

$$\mathcal{E} - IR - L\frac{dI}{dt} = 0$$

$$\Rightarrow (\mathcal{E} - IR) = L\frac{dI}{dt}$$

$$\Rightarrow \frac{dI}{\mathcal{E} - IR} = \frac{dt}{L}$$

$$\Rightarrow \int_0^I \frac{dI}{\mathcal{E} - IR} = \int_0^t \frac{dt}{L}$$

let, $\mathcal{E} - IR = z$ when $I = 0$, $z = \mathcal{E}$

$\Rightarrow -R\,dI = dz$ $I = I$, $z = \mathcal{E} - IR$

$$\Rightarrow dI = -\frac{dz}{R}$$

So, $$-\frac{1}{R}\int_{\mathcal{E}}^{\mathcal{E}-IR} \frac{dz}{z} = \frac{1}{L}\int_0^t dt.$$

$$\Rightarrow [\ln z]_{\mathcal{E}}^{\mathcal{E}-IR} = -\frac{R}{L}t.$$

$$\Rightarrow \ln(\mathcal{E} - IR) - \ln\mathcal{E} = -\frac{R}{L}t.$$

$$\Rightarrow \ln\frac{\mathcal{E} - IR}{\mathcal{E}} = -R/L\,t.$$

$$\Rightarrow \frac{\mathcal{E} - IR}{\mathcal{E}} = e^{-Rt/L}$$

$$\Rightarrow \mathcal{E} - IR = \mathcal{E}e^{-Rt/L}$$

$$\Rightarrow IR = \mathcal{E} - \mathcal{E}e^{-Rt/L}$$

$$\Rightarrow IR = \varepsilon\left(1 - e^{-\frac{Rt}{L}}\right)$$

$$\Rightarrow I = \frac{\varepsilon}{R}\left(1 - e^{-\frac{Rt}{L}}\right)$$

$$\Rightarrow I = I_0\left(1 - e^{-t/\lambda}\right) \quad \left[\because \lambda = \frac{L}{R}\ ;\ I_0 = \varepsilon/R\right]$$

[Showed]

λ is time constant, if it is greater the rise in current is slo

Decay of Current :

When the key k is released, the source of emf is withdrawn

In Kirchhoff's 2nd law, putting $\varepsilon = 0$,

$$\varepsilon - IR - L\frac{dI}{dt} = 0$$

$$\Rightarrow IR + L\frac{dI}{dt} = 0$$

$$\Rightarrow \frac{dI}{dt} = -\frac{IR}{L}$$

$$\Rightarrow \int_{I_0}^{I}\frac{dI}{I} = -\int_0^t\frac{dt\,R}{L}.$$

$$\Rightarrow [\ln I]_{I_0}^{I} = -\frac{R}{L}t$$

$$\Rightarrow \ln I - \ln I_0 = -\frac{R}{L}t.$$

$$\Rightarrow \ln \frac{I}{I_0} = -\frac{R}{L}t.$$

$$\Rightarrow I/I_0 = e^{-\frac{Rt}{L}}$$

$$\Rightarrow I = I_0 e^{-\frac{Rt}{L}}$$

[Showed]

Spring-2017

Calculate Inductance for Solenoid:

Given, A is the cross sectional area.
let l be it's length, N be the total number of turns.
When current I flows through ~~the~~ it. the magnetic field inside is, $B = \mu_0 \frac{NI}{l}$.
When A is the area, magnetic flux ~~will be~~ in each turn will be $\rightarrow \mu_0 \frac{NIA}{l}$

Total magnetic flux, $\Phi_B = \mu_0 \frac{N}{l} IAN = \mu_0 \frac{N^2 IA}{l}$

When I varies; flux changes giving rise to induced emf,

$$\varepsilon = -\frac{d}{dt}\left(\mu_0 \frac{N^2 I A}{l}\right)$$

$$= -\frac{\mu_0 N^2 A}{l} \cdot \frac{dI}{dt}.$$

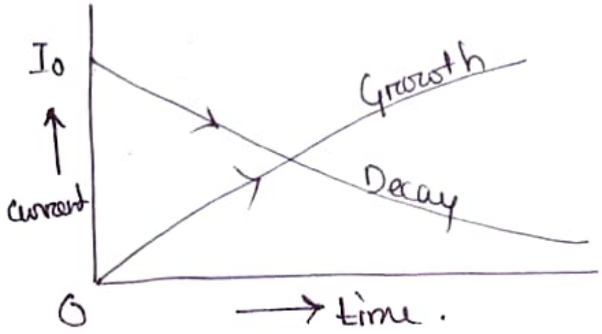
$\Rightarrow$ [illegible]

we know, self inductance is $-L\frac{dI}{dt}$.

So, $L = \frac{\mu_0 N^2 A}{l}$. (Ans)

Spring - 2016

* Unit of inductance is Henry.
* Graph of growth and decay of current with time



* Meaning of the inductive time constant:

Time constant, denoted by λ, of the circuit is the time during which the current rises to $2/3$rd of its final value that means 64% of the maximum current. The rate of growth of current depends on time constant L/R which is λ. If λ is greater the rise in current is slow.

Interference + Newtons Ring :

2018 Spring

Interference of light → It is the phenomenon of superimposition of two or more waves having same frequency emitted by coherent sources. such that amplitude of resultant wave is equal to the sum of the amplitude of the individual waves

Conditions : (1) The sources of light must be coherent
[Same η, same (A) ~~with~~ in same phase]

(2) Phase diff. between the sources must remain ~~be~~ constant

(3) The frequencies of the emitted light from the sources must be equal.

✓ coherent
✓ phase diff same
✓ frequency equal

Determine wavelength using Newston's ring.

⇒ Diameter of n^{th} ring $= D_n$; radius, $r_n^2 = n\lambda R$

or, $r_n = \frac{D_n}{2}$.

For, bright ring,

$\frac{(D_n)^2}{4} = n\lambda R$ or, $D_n^2 = 4n\lambda R$ —(i).

For ~~Dark ring~~ $(n+m)$th Dark ring,

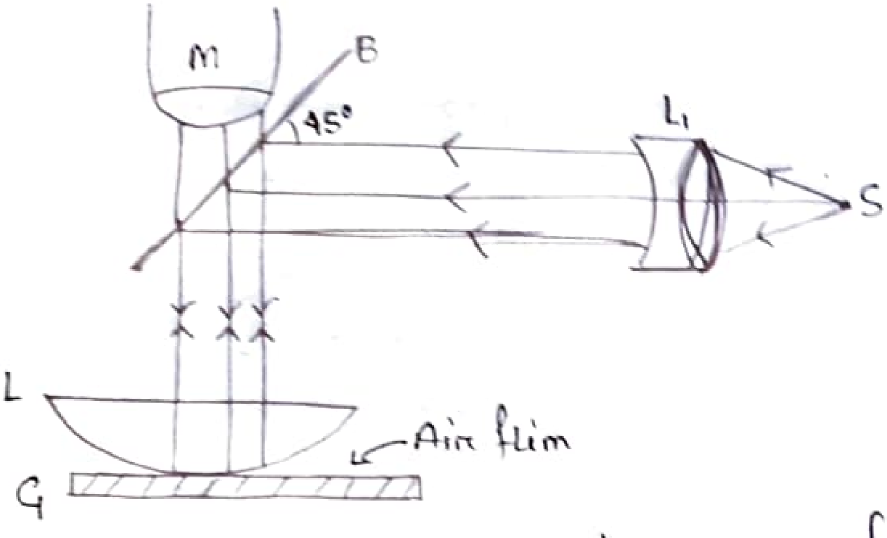
$(D_{n+m})^2 = 4(n+m)\lambda R$ —(ii)

subtracting (i) from (ii),

$(D_{n+m})^2 - (D_n)^2 = 4m\lambda R$

or, $\lambda = \frac{(D_{n+m})^2 - (D_n)^2}{4mR}$ (showed)

Explanation of the formation of Newton's rings:



When a plano-convex lens of long focal length is placed on a plane glass plate, a thin film of air is enclosed between the lower surface of the lens and the upper surface of the plate. The thickness of the air film is very small at the point of contact and gradually increases from the center outwards. The fringes produced with monochromatic light are circular

In the above figure, S is a source of monochromatic light at the focus of the lens L_1. A horizontal beam of light falls on the glass plate B at 45°. The glass plate B reflects a part of the incident light towards the air film enclosed by the lens L and the plane glass plate G. The reflected beam from the air film is viewed with a microscope. Interference takes place and dark and bright circular fringes are produced. This is due to the interference between the light reflected from the lower surface of the lens and the upper surface of the glass plate G.

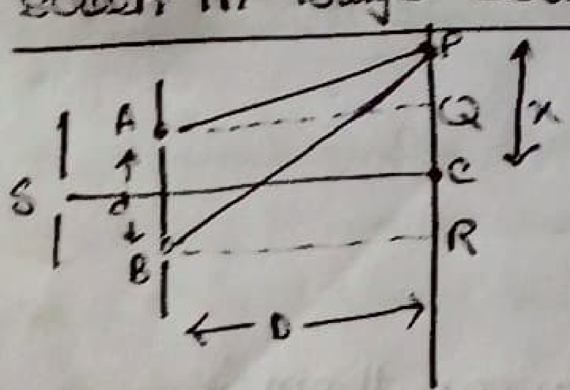
The fringes are concentric circles, uniform in thickness and with the point of contact as the center. When viewed with the white light, the fringes are coloured. But with monochromatic light; dark and bright fringes are produced.

Spring-2017

(*) Huygen's Principle: All points on the primary wavefront are the sources of secondary disturbance. These secondary waves travel through space with same velocity as the original wave and the envelope of all the secondary wavelets after any given interval of time gives rise to the secondary wavefront.

Fringes width are Equal:

(*) Position of bright and dark fringes ~~through~~ on screen in Young's double slit experiment:



Here, in ΔAPQ, $AP^2 = AQ^2 + PQ^2$

$$= D^2 + \left(x - \frac{d}{2}\right)^2$$

in ΔBPR, $BP^2 = BR^2 + PR^2$

$$= D^2 + \left(x + \frac{d}{2}\right)^2$$

Now, $BP^2 - AP^2 = \left[D^2 + \left(x + \frac{d}{2}\right)^2\right] - \left[D^2 + \left(x - \frac{d}{2}\right)^2\right]$

$\Rightarrow (BP + AP)(BP - AP) = 2xd$

$\Rightarrow (BP - AP) = \dfrac{2xd}{(BP + AP)}$

$= \dfrac{2xd}{2D} \quad [\because BP = AP = D]$

$\therefore$ Path dif. $= \dfrac{xd}{D}$.

Phase diff, $\delta = \dfrac{2\pi}{\lambda}\left(\dfrac{xd}{D}\right)$

~~Now~~ <u>Bright fringes</u>: If path diff is a whole number multiple of λ, the point P is bright.

$\dfrac{xd}{D} = n\lambda$; $n = 0, 1, 2, 3.$

$\therefore$ So, $x = \dfrac{n\lambda D}{d}$

This equation helps us to calculate distance of bright fringe from C.

When, $n = 1$; $x_1 = \dfrac{\lambda D}{d}$

$n = 2$; $x_2 = \dfrac{2\lambda D}{d}$

The consecutive distance between them is

$x_2 - x_1 = \dfrac{\lambda D}{d}$.

Dark fringes: If path diff is an odd no. of multiple of half λ, the point P is dark.

$$\frac{xd}{D} = (2n+1)\frac{\lambda}{2} \quad \text{where, } n = 0, 1, 2, 3 \ldots$$

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

$$x_1 = \frac{3\lambda D}{2d}$$

$$x_2 = \frac{5\lambda D}{2d}.$$

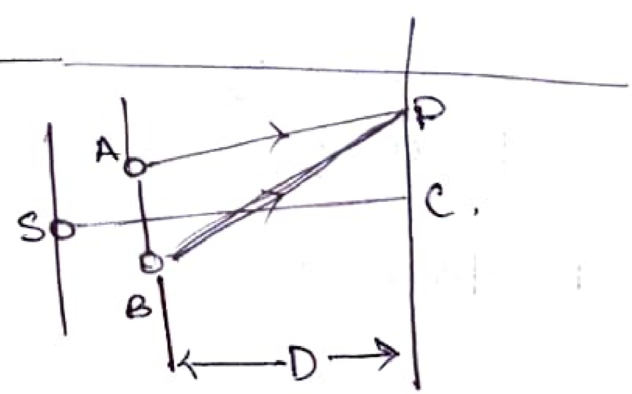
So, $x_2 - x_1 = \frac{\lambda D}{d}$.

What are Newton's rings:

The circular fringes which are dark and bright and appears under ~~the~~ the use of monochromatic light due to interference between a plano-convex lens and a glass plate are Newton's rings.

Spring-2016

Expression of intensity for interference pattern, in the case of Young's double slit experiment:



S is the monochromatic light source. A and B are the coherent sources. 'a' is the amplitude

Now, $A \rightarrow y_1 = a\sin\omega t$

$B \rightarrow y_2 = a\sin(\omega t + \delta)$

at P, $Y = Y_1 + Y_2$

$= a\sin\omega t + a\sin(\omega t + \delta)$.

$= a\sin\omega t + a\sin\omega t\cos\delta + a\cos\omega t\sin\delta$

$= a\sin\omega t\,(1+\cos\delta) + a\cos\omega t\sin\delta$.

let, $a(1+\cos\delta) = \cos\theta \times R$. —(I) ; $a\sin\delta = R\sin\theta$ —(II)

So, $= R\cos\theta\sin\omega t + \cancel{R\cos\theta\sin\delta} R\cos\omega t\sin\theta$.

$Y = R\sin(\omega t + \theta)$.

$= a\sin\omega t$.

$I = (\text{amplitude})^2$ or $I = a^2$

Resultant replacement at P.

$\boxed{I = R^2}$ $[\because a = R]$

(I) + (II).

$R^2(\cos^2\theta + \sin^2\theta) = a^2(1+\cos\delta)^2 + a^2\sin^2\delta$

$\Rightarrow R^2 = a^2(1 + 2\cos\delta + \cos^2\delta) + a^2\sin^2\delta$

$= a^2 + 2a^2\cos\delta + a^2\cos^2\delta + a^2\sin^2\delta$

$= a^2 + 2a^2\cos\delta + a^2\cdot 1$

$= 2a^2 + 2a^2\cos\delta$

$= 2a^2(1+\cos\delta)$

$= 2a^2\cdot 2\cos^2\delta/2$

$= 4a^2\cos^2\delta/2$.

So, $I = 4a^2\cos^2\delta/2$.

Special cases:

When phase diff, $\delta = 0, 2\pi, 2(2\pi) \ldots \ldots n(2\pi)$

and path diff $x = 0, \lambda, 2\lambda \ldots \ldots n\lambda$.

phase diff $= \frac{2\pi}{\lambda} \times$ Path diff.

So, $\delta = \frac{2\pi}{\lambda} x$.

$I = 4a^2 \cos^2 \delta/2$

$= 4a^2 \left(\cos \frac{2\pi}{2}\right)^2$

$\boxed{I = 4a^2}$ → maximum intensity in bright.

When phase diff, $\delta = \pi, 3\pi, 5\pi \ldots \ldots (2n+1)\pi$.

and path ", $x = \lambda/2, \frac{3\lambda}{2}, \frac{5\lambda}{2} \ldots (2n+1)\lambda/2$

$\boxed{I = 0}$ → minimum.

Intensity is maximum when phase difference is a whole number and minimum when " " is an odd number.

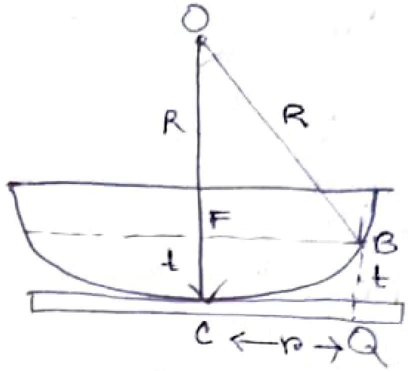
Fall - 2015

Importance of coherent force in interference:

We know that one of the conditions for interference is that the two sources must be coherent. It is because coherent sources offer lights with same frequency, same amplitude and that travels in the same phase. Or else the interfering waves will changes continously and the interference patter will not be obtained.

Expressions for the diameter of the dark and bright rings ~~for~~ in Newton's rings due to reflected light :

Suppose, R is the radius of curvature and t is the thickness of the film



From, the figure, ΔOFB

$OB^2 = FB^2 + OF^2$

$\Rightarrow R^2 = r^2 + (R-t)^2$

$\Rightarrow \cancel{R^2} = r^2 + \cancel{R^2} - 2Rt + t^2$

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

$\Rightarrow t = \frac{r^2}{2R}$ [$\because t^2$ is negligible]

Now for bright rings,

$2\mu t \cos\theta = (2n-1)\lambda/2$

here θ is small that we can say $\theta = 0°$,

$\therefore \cos\theta = 1$.

For air, $\mu = 1$

$\therefore 2t = (2n-1)\lambda/2$

$\Rightarrow \frac{\cancel{2}r^2}{\cancel{2}R} = (2n-1)\lambda/2$

$\Rightarrow r^2 = (2n-1)R\lambda/2$

$\Rightarrow r = \sqrt{(2n-1)R\lambda/2}$

So, $D = 2r = 2\sqrt{(2n-1)R\lambda/2}$

For dark rings

$2\mu t\cos\theta = n\lambda$. where θ is 0° so $\cos\theta = 1$ and μ is 1

So, $2t = n\lambda$

$\Rightarrow \cancel{2}\frac{r^2}{\cancel{2}R} = n\lambda$

$\Rightarrow r^2 = nR\lambda$

$\Rightarrow r = \sqrt{nR\lambda}$

$\therefore D = 2r = 2\sqrt{nR\lambda}$

Here, when $n=0$, the radius of the dark ring is zero and radius of bright ring will be $\sqrt{\frac{\lambda R}{2}}$. Therefore, the center is dark.

Also, For first dark ring, $n=1$, $D_1 = 2\sqrt{R\lambda}$

" 2nd " " $n=2$, $D_2 = 2\sqrt{2R\lambda}$

" 4th " " $n=4$, $D_4 = 2\sqrt{4R\lambda} = 4\sqrt{R\lambda}$

$n=9$, $D_9 = 2\sqrt{9R\lambda} = 6\sqrt{R\lambda}$

$n=16$, $D_{16} = 2\sqrt{16R\lambda} = 8\sqrt{R\lambda}$

Now, $D_4 - D_1 = 4\sqrt{R\lambda} - 2\sqrt{R\lambda} = 2\sqrt{R\lambda}$

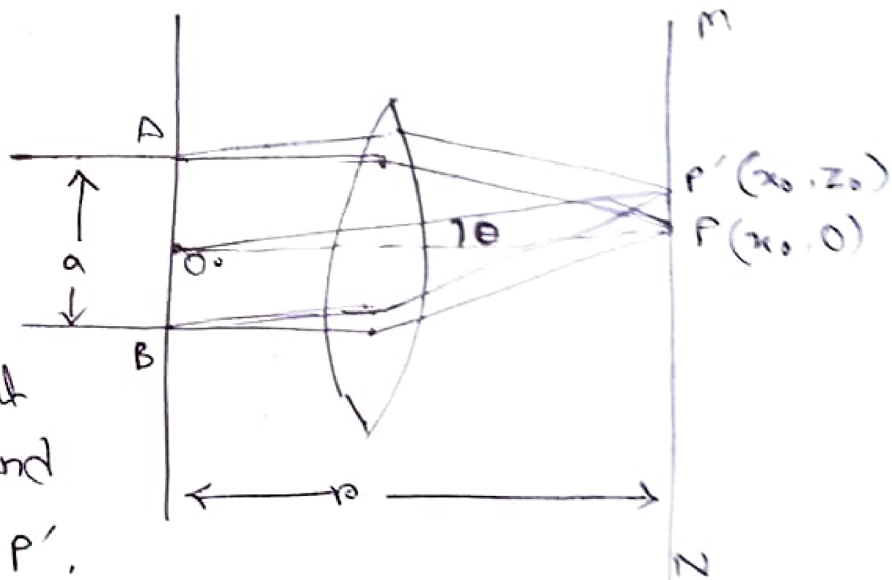
$D_{16} - D_9 = 8\sqrt{R\lambda} - 6\sqrt{R\lambda} = 2\sqrt{R\lambda}$

Therefore, fringe width decreases as the number of order increases and the fringes get closer with increase in their order

Diffraction: The bending of beam of light into the geometrical shadow region round the edges of an obstacle is known as diffraction.

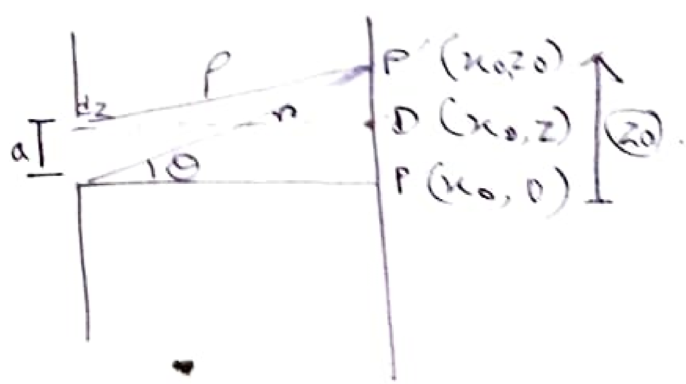
Polarization: The process by which light vibrations are confined to one particular direction is known as polarization.

Intensity of Fraunhofer diffraction pattern by a single slit:



Let a monochromatic parallel beam of light be incident on the slit AB of width a. The secondary waves travelling in the same direction as the incident light meet at a focus P and those with angle θ meet at P'.

The screen is at r_0 from the slit. O is the origin of the co-ordinates. Small element dz of the wavefront with co-ordinates $(0, z)$



The coordinates of the point P' is (x_0, z_0) and distance of element dz from P' is ρ

The displacement ~~due~~ at P′ due to dz is

$$dy = k\,dz \sin(\omega t - \alpha)$$

$$= K\,dz \sin\left(\frac{2\pi t}{T} - \frac{2\pi\rho}{\lambda}\right) \quad \left[\because \alpha = \left(\frac{2\pi}{\lambda}\right)x \;,\; \omega = \frac{2\pi}{T}\right]$$

$$= k\,dz \sin 2\pi\left(\frac{t}{T} - \frac{\rho}{\lambda}\right) \quad \text{--- (I)}$$

The resultant displacement at P′ due to the whole wave front is

$$Y = k\int_{-a/2}^{+a/2} \sin 2\pi\left(\frac{t}{T} - \frac{\rho}{\lambda}\right) dz \quad \text{--- (II)}$$

From $\Delta dzP'D$, $\rho^2 = x_0^2 + (z_0 - z)^2$ --- (III)

From $\Delta OP'P$, $r_0^2 = x_0^2 + z_0^2$

or, $x_0^2 = r_0^2 - z_0^2$ --- (IV)

Putting the value of x_0^2 from (IV) in (III),

$$\rho^2 = r^2 - \cancel{z_0^2} + \cancel{z_0^2} - 2zz_0 + z^2$$

$$= r_0^2 + z^2 - 2zz_0$$

$$= r_0^2\left(1 - \frac{2zz_0}{r_0^2} + \frac{z^2}{r_0^2}\right)$$

Here, $r_0 \gg z$ so, $\frac{z^2}{r_0^2}$ is negligible.

So, $\rho^2 = r_0^2\left(1 - \frac{2zz_0}{r_0^2}\right)$

$$\Rightarrow \rho = r_0\sqrt{\left(1 - \frac{2zz_0}{r_0^2}\right)}$$

$$= r_0\left(1 - \frac{1}{2}\frac{2zz_0}{r_0^2}\right) \quad \left[\because (1+x)^n = 1 + nx + \ldots \text{negligible}\right]$$

$$= r_0 - \frac{zz_0}{r_0}$$

We know from $\Delta OP'P$,

$$\frac{z_0}{r_0} = \sin\theta$$

So, $\rho = r_0 - z\sin\theta$.

$$Y = K\int_{-a/2}^{+a/2} \sin\left[2\pi\left(\frac{t}{T} - \frac{r}{\lambda} + \frac{z\sin\theta}{\lambda}\right)\right] dz$$

$$= -\frac{K\lambda}{2\pi\sin\theta}\left[\cos\left\{2\pi\left(\frac{t}{T} - \frac{r}{\lambda} + \frac{z\sin\theta}{\lambda}\right)\right\}\right]_{-a/2}^{+a/2}$$

$$= -\frac{K\lambda}{2\pi\sin\theta}\left[\cos 2\pi\left(\frac{t}{T} - \frac{r}{\lambda} + \frac{a\sin\theta}{2\lambda}\right) - \cos 2\pi\left(\frac{t}{T} - \frac{r}{\lambda} - \frac{a\sin\theta}{2\lambda}\right)\right]$$

$$= -\frac{K\lambda}{2\pi\sin\theta}\left[2\sin 2\pi\left(\frac{t}{T} - \frac{r}{\lambda}\right)\sin 2\pi\left(-\frac{a\sin\theta}{2\lambda}\right)\right]$$

$$= \frac{K\lambda}{2\pi\sin\theta}\left[\sin 2\pi\left(\frac{t}{T} - \frac{r}{\lambda}\right)\sin 2\pi\left(\frac{a\sin\theta}{2\lambda}\right)\right]$$

let $\frac{\pi a\sin\theta}{\lambda} = \alpha$.

Now, $y = \frac{Ka\lambda}{a\pi\sin\theta}\left[\sin 2\pi\left(\frac{t}{T} - \frac{r}{\lambda}\right)\sin \cancel{2\pi}\left(\frac{a\cdot\lambda\cdot\alpha}{2\lambda\cdot\pi a}\right)\right]$

$$= \frac{Ka}{\alpha}\left[\sin 2\pi\left(\frac{t}{T} - \frac{r}{\lambda}\right)\sin\alpha\right]$$

$$= \frac{Ka}{}\left(\frac{\sin\alpha}{\alpha}\right)\cdot\sin 2\pi\left(\frac{t}{T} - \frac{r}{\lambda}\right).$$

The Amplitude of P' is $Ka\left(\frac{\sin\alpha}{\alpha}\right)$.

Intensity at P' is $I = K^2a^2\frac{\sin^2\alpha}{\alpha^2}$

Here, $I_0 = K^2a^2$ and so $\boxed{I = I_0\frac{\sin^2\alpha}{\alpha}}$

for central Maxima. $\theta = 0$;

and $\alpha = \frac{\pi a\sin\theta}{\lambda}$ So, $\alpha = 0$.

So, $\frac{\sin\alpha}{\alpha} = 1$; $I = I_0(1)^2$

$\Rightarrow I = I_0$ (Maximum).

Secondary Maxima:

We get the directions of maxima by, $\sin\theta = \left(\frac{2n+1}{2a}\right)\lambda$.

So, $\alpha = \frac{\pi a \sin\theta}{\lambda} = \frac{\pi}{\lambda} \frac{(2n+1)\lambda}{2} = \frac{(2n+1)}{2}\pi$.

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

$\alpha = \frac{3\pi}{2}, \frac{5\pi}{2}, \frac{7\pi}{2} \ldots\ldots$

For, $\alpha = \frac{3\pi}{2}$; $I = I_0\left(\frac{\sin\alpha}{\alpha}\right)^2 = I_0\left(\frac{\sin\frac{3\pi}{2}}{\frac{3\pi}{2}}\right)^2 = \frac{4I_0}{\pi^2}$.

For, $\alpha = \frac{5\pi}{2}$, $I = \frac{4I_0}{25\pi^2}$

So, secondary maxima are of decreasing intensity.

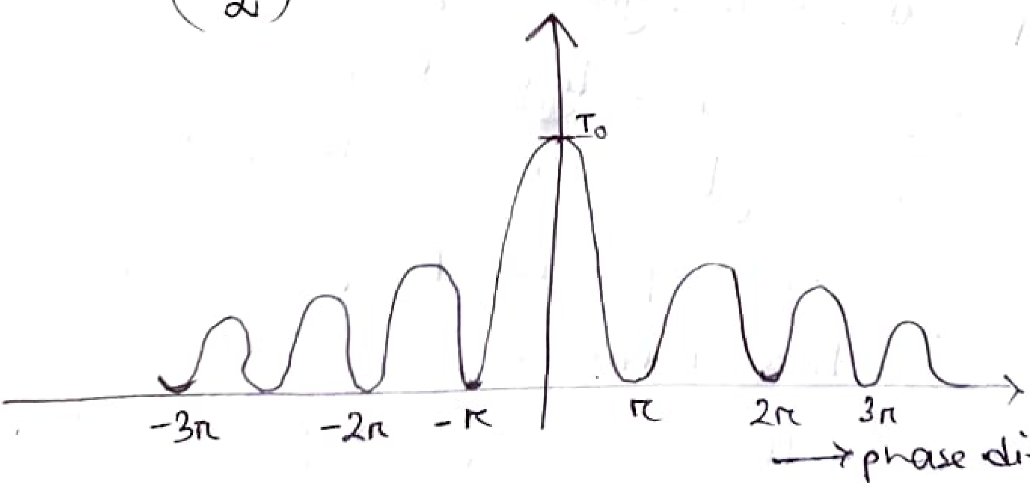
Secondary Minima:

Direction of secn minima is given by $\sin\theta = \frac{n\lambda}{a}$.

So, $\alpha = \frac{\pi a \sin\theta}{\lambda} = \frac{\pi \cancel{a}\, n\cancel{\lambda}}{\cancel{\lambda}\cancel{a}} = n\pi$

$\therefore n = 1, 2, 3 \ldots\ldots$, $\alpha = \pi, 2\pi, 3\pi \ldots\ldots$

$I = I_0\left(\frac{\sin\alpha}{\alpha}\right)^2$; $I = 0$.



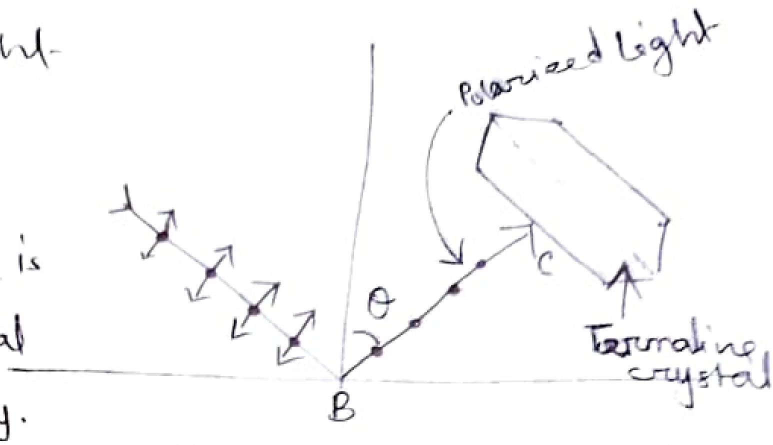
Position of maxima will be $x = 0$.

and minima will be $x = \pm\pi, \pm 2\pi, \pm 3\pi \ldots$, Spring-2017

* Polarization by reflection from a glass surface:

It was discovered by Malus.

Consider the ~~incident~~ light incident along AB on the glass surface. Light is reflected along BC. There is a ~~torma~~ tourmaline crystal and it is rotated slowly.



It will be observed that light is completely extinguished only at one particular angle of incidence which is equal to 57.5° for a glass surface and is known as polarizing angle.

Here, the vibrations of the incident light can be resolved into components parallel to the glass surface and perpendicular to the glass surface. Light due to the components parallel to the glass surface is reflected whereas light due to the components perpendicular to the glass surface is transmitted.

Thus light reflected by the glass is plane polarized which is detected by the tourmaline crystal.

Spring - 2016

Difference between interference and diffraction :

Interference	Diffraction
① Superposition of two waves	① Bending of waves around edges
② " of waves from two coherent sources	② Superposition wavefronts emitted from various points of the same wavefront
③ All the fringes are of equal width	③ Fringes of are of unequal width
④ Intensity of all the bright fringes are same.	⑤ Intensity falls rapidly for higher order.
⑤ Intensity of dark fringe is zero.	⑤ Intensity of dark fringe is not zero.
⑥ Path difference of bright fringes → $x = n\lambda$. and dark freinges → $x = (2n-1)\lambda/2$	⑥ Path difference for bright fringes → $(2n-1)\lambda/2 = x$ dark fringes → $2n\lambda/2 = x$
⑦ Phase difference of bright fringe → $\delta = 2n\pi$ dark fringe → $\delta = (2n-1)\pi$	⑦ Phase differencee of bright → $\delta = (2n-1)\pi$ dark → $2n\pi$.

Spring - 2011

(*) Difference between Fresnel and Fraunhofer Diffraction:

Fresnel	Fraunhofer
① The ~~obstacle to~~ distance between source and obstacle and screen and obstacle is finite.	① The distance between source and obstacle and screen and obstacle is infinite
② No lenses are required to study it	② Convex lenses are required to study it.
③ Both the incident wavefront on the aperture and diffracted wavefront is either cylinderical or spherical.	③ Both the incident wavefront on the aperture and diffracted wavefront is plane.
④ Difficult to observe and analyse	④ Easy
⑤ The initial phase of secondary wavelets is different at different points in the plane of aperture	⑤ The initial phase of secondary wavelets is same at all points in the plane of the aperture.

⑥