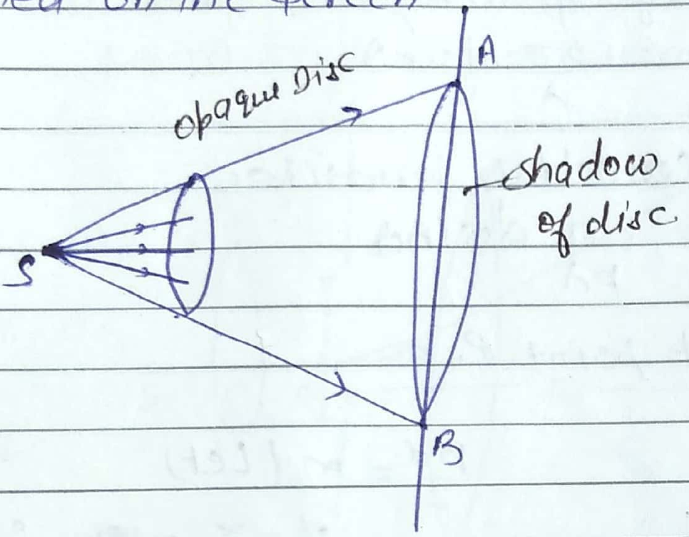
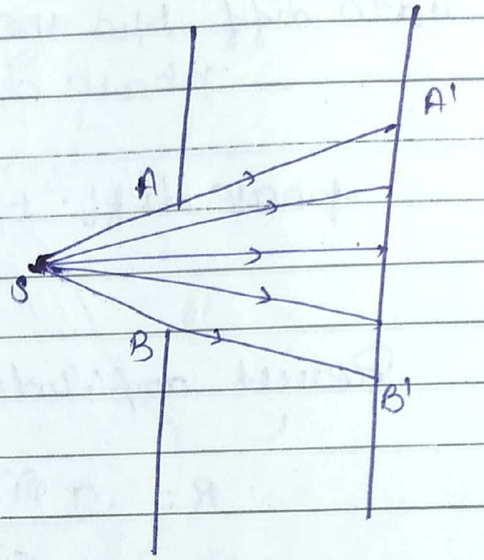
only for Main's

Diffraction

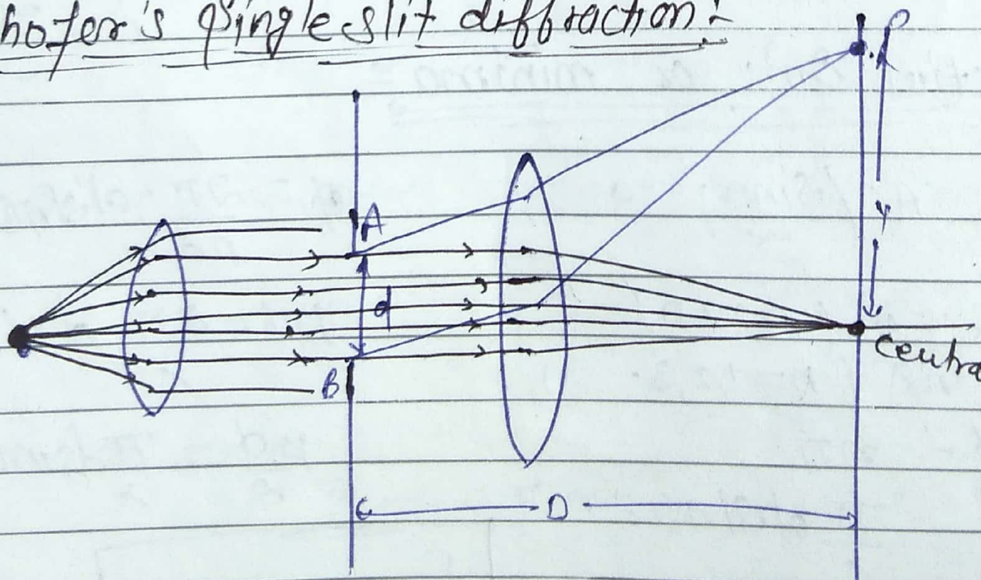
When an opaque object is placed b/w source and screen due rectalinear Propagation of Light a shark image of object is formed on the screen





if size of opstacle is comparable to the wavelength of light then Light wave deviate from its path at the adge of opsctale and enter the gemotrical shadow of object.
the Phenomina of deviation of Light at the shark edges of size comparable to wavelength of Light known as diffraction.

* Fraunhofer's single slit diffraction:-



All the Particles in the slit become new source of light sending light on the screen.

cond. Imp.

Let p = total No. of particles b/w A & B $\quad p \to \infty$

a – amplitude of wave from one particle

a – very small $\to 0$

Net Amp. $= pa = A$ (Let)

Path diff b/w the rays from A & B $= d\sin\theta$

phase diff. $= \frac{2\pi}{\lambda} d\sin\theta$

phase diff. b/w consecutive particles

$\phi = \frac{2\pi}{p\lambda} d\sin\theta$

Result amplitude at point P.

$$R = \frac{a \sin\frac{p\phi}{2}}{\sin\phi/2} \qquad \frac{p\phi}{2} = \alpha \text{ (Let)}$$

$\frac{\phi}{2} = \frac{\alpha}{p}$ – very Small

$$R = \frac{a\sin\alpha}{\sin\left(\frac{\alpha}{p}\right)} \qquad \sin\frac{\alpha}{p} \approx \frac{\alpha}{p}$$

$$R = \frac{a\sin\alpha}{\alpha/p} = pa\frac{\sin\alpha}{\alpha}$$

$$R = A\left(\frac{\sin\alpha}{\alpha}\right)$$

Intensity at P $I \propto R^2$

$$I \propto A^2\left(\frac{\sin\alpha}{\alpha}\right)^2$$

For distructive Int or minima:

$I = 0 \qquad A^2\left(\frac{\sin\alpha}{\alpha}\right)^2 = 0 \qquad \phi = \frac{2\pi}{p\lambda} d\sin\theta$

when

$\sin\alpha = 0 \quad (\alpha \neq 0) \qquad p\phi = \frac{2\pi}{\lambda} d\sin\theta$

$\alpha = n\pi \quad (n = 1, 2, 3 \ldots)$

$\frac{p\phi}{2} = n\pi \qquad \frac{p\phi}{2} = \frac{\pi}{\lambda} d\sin\theta$

$\frac{\pi}{\lambda} d\sin\theta = n\pi$

$$\boxed{d\sin\theta = n\lambda} \text{ — minima}$$

$\frac{\sin 0}{0} = 1$

1st minima

$d \sin\theta = \lambda$

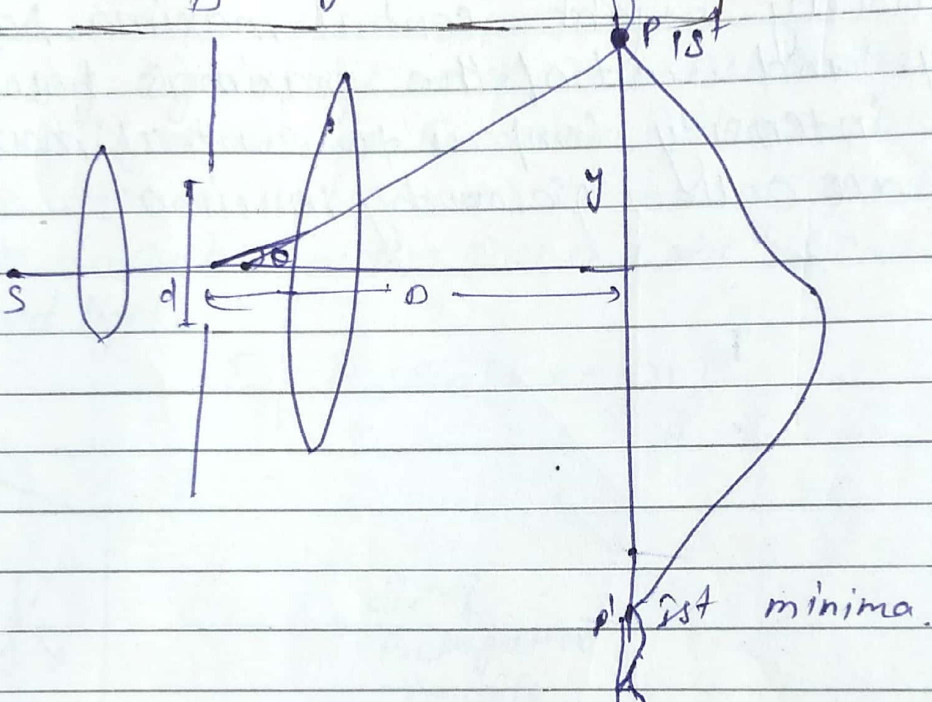
$\sin\theta = \frac{\lambda}{d}$

2nd minima

$\sin\theta = \frac{2\lambda}{d}$

Width of central maxima $= 2y$

$\tan\theta = \frac{y}{D}$ $y = D\tan\theta$ — Imp.



(ii) for Constructive interference: $I = max$

$I \propto A^2 \left(\frac{\sin\alpha}{\alpha}\right)^2$

$\frac{dI}{d\alpha} = 0$ $\frac{d}{d\alpha}\left(\frac{\sin\alpha}{\alpha}\right) = \frac{\alpha\cos\alpha - \sin\alpha}{\alpha^2}$

$\sin\alpha = \alpha\cos\alpha$ $\boxed{\tan\alpha = \alpha}$

$\alpha = 0, \frac{3\pi}{2}, \frac{5\pi}{2}, \frac{7\pi}{2}$

Central max

$I \propto A^2 \left(\frac{\sin 0}{0}\right)^2 \propto A^2$

1st max $I \propto A^2 \left(\frac{\sin 3\pi/2}{3\pi/2}\right)^2 \propto \frac{4A^2}{9\pi^2}$

width.

2nd max

$$I \propto A^2 \left(\frac{\sin \frac{5\pi}{2}}{\frac{5\pi}{2}} \right)^2 \propto \frac{4A^2}{25\pi^2}$$ secondary maxima.

In single slit differection all the maxima's are not equally bright central maxima have maximum Intensity and rest of the maxima's have very small intensity compare to central maxima. Hence these are called secondary maxima's.