Ex: In the figure below, there are two coherent sources emit light of a wavelength λ=0.1m, and the emitted waves interfered at point p in the same time. What is the type of the obtained interference at this point when one of the two waves travel an optical path (3.2m), and the other an optical path (3m).

Sol.

l_1=3m,l_2=3.2m

prob.1:$\mathbf{\Delta l=(m+1/2)\lambda}$(dest.int.)

$\Delta l = l_2 - l_1$

Δl=3.2-3=0.2m

$\Delta l=(m+1/2)\lambda$

0.2=(m+1/2)*0.1=m+1/2

m=11/2

This value do not satisfy int. conditions

Because m=1, 2, 3,……..

prob.2: $\mathbf{\Delta l=m\lambda}$ **(cons. Int.)**

0.2=m*0.1

m= 2

This value satisfy int. conditions

The interference is **constructive.**

Ex: if the distance between two slits in young s experiment (0.1mm), a monochromatic light of λ= (500nm) is used. The distance between the two slits and the screen is (1.2m), find the distance between the first bright fringe and the central fringe

Sol

D=1.2m, m=1, λ=500nm, d=0.1mm

Δx=?

Xd/D=mλ

$X*0.1*10^{-3}/1.2=1*500*10^{-9}$

$\Delta X=1*500*10^{-9}*1.2 /0.1*10^{-3}$ =6mm.

EX: In young s experiment if the distance between the two slits is 0.2mm, and the distance between these two slits and the screen is 1m. If the monochromatic light (λ=600nm) is incident the slits, find the distance between two successive dark fringes

d=0.2mm,D=1m, λ=600nm , ΔX=?

Sol.: the condition for obtaining dark fringes

dsinϴ =(m+1/2)λ

d (λ/D**)=(m+1/2)λ**

ΔX=(m+1/2+1) λ/D-(m+1/2) λ/D

$\Delta X=\lambda D/d =5.6*10^{-7}*1.2/3*10^{-5}=2.2*10^{-2}$m

Ex: If the distance between the first and the tenth dark fringes in young's experiment is2.4mm, and the distance between the slits is 0.15mm, and the screen is at 50cm from the two slits , find the value of light wavelength.

Sol: for the dark fringes:

$d\sin\theta = (m+1/2)\lambda$ $=(2m+1/2)\ \boldsymbol{\lambda}$

For the tenth dark fringe: $d\sin\theta_{10} = (21/2)\ \boldsymbol{\lambda}$ m=10

For the first dark fringe: $d\sin\theta_1 = (3/2)\ \boldsymbol{\lambda}$ m=1

$\Delta X = d\sin\theta_{10} - d\sin\theta_1 = (21/2-3/2)\ \boldsymbol{\lambda} = \mathbf{(10.5-1.5)}\ \boldsymbol{\lambda}$

$d\ (x_{10}/D) - (x_1/D) = 9\ \boldsymbol{\lambda}$

$d[(x_{10}-x_1)/D] = 9\lambda$

$0.15*2.4/500 = 9\ \boldsymbol{\lambda}$

$\boldsymbol{\lambda} = 8*10^{-5}$mm

Ex: In young's experiment, the light wavelength is 546mm, and the distance between the slits is 0.1mm, the distance between the two slits and the screen is 20cm, find the distance between the fifth bright fringe and the seventh dark fringe.

Sol: for the bright fringe: $d\sin\theta = m\lambda$

For the dark fringe: $d\sin\theta = (m+1/2)\lambda$

For small angles: $\sin\theta = \tan\theta = x/D$

For the bright fringe: $d\, x/D = m\lambda$--------- (1)

For the dark fringe: $d\, x/D = (m+1/2)\lambda$ ----- (2)

$X_{max} = 5\lambda D/d$, $Xin = (7+1/2)\lambda D/d$

$\Delta x = x_{min} - x_{max} = 7.5\lambda D/d - 5\lambda D/d = \lambda D/d\,(7.5-5)) = 2.5\lambda D/d$

$\Delta X = 2.5*20*10*546*10^{-6}/0.1 = 2.73mm$