YOUNG'S DOUBLES SLIT EXPERIMENT

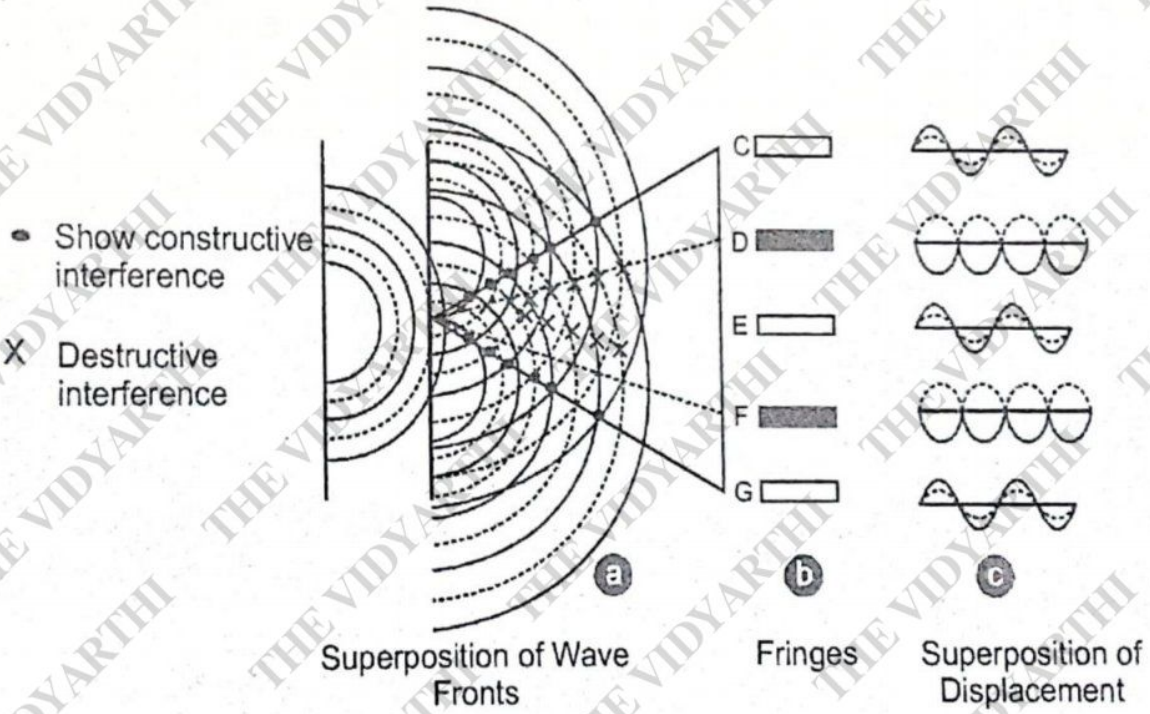
In this experiment a single slit is divided to two slits.

This experiment verifies the wave nature of light.

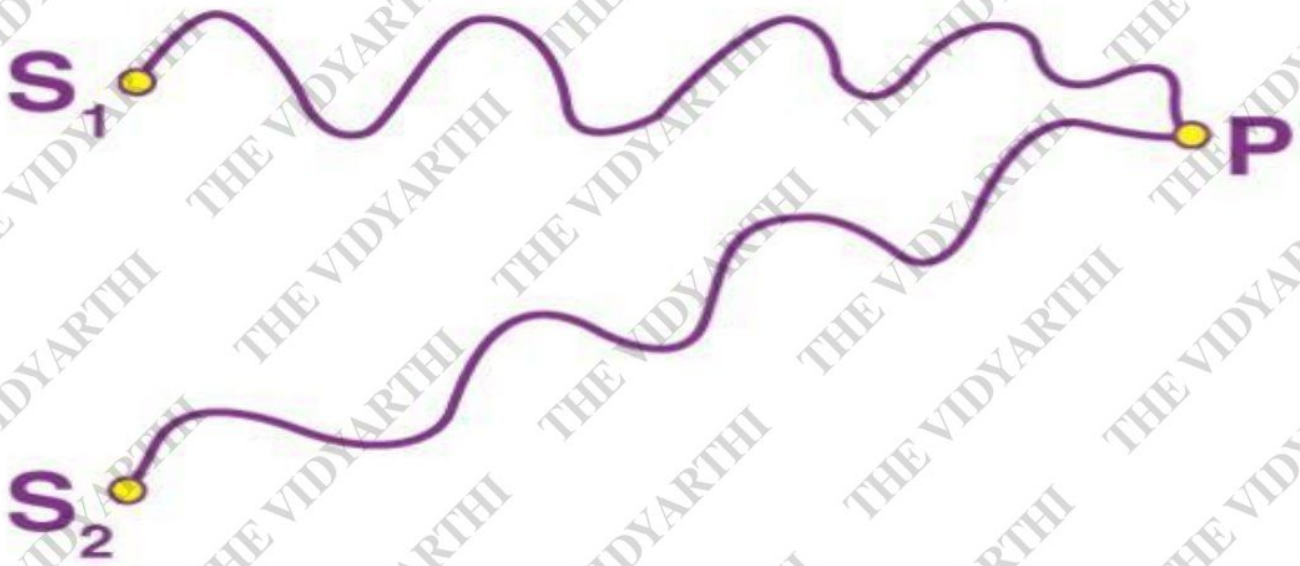
The slit S, and S, behaves as coherent sources.

The bright and dark fringes are obtained alternately.

The bright fringes are the result of constructive interference where as dark fringes are the Result of destructive interference.



Condition for Constructive and Destructive Interference



Let

The equation of the ray S1-

$$y1 = a1Sin\omega t$$

Equation of the ray S2-

$$y2 = a2Sin(\omega t + \phi)$$

$$[where\ \phi\ is\ the\ phase\ difference.]$$

Equation of the resultant ray-

$$y = y1 + y2$$

$$y = a1Sin\omega t + a2Sin(\omega t + \phi)$$

$$y = a1Sin\omega t + a2Sin\omega tCos\phi + a2CostωtSin\phi$$

[Sin(A+B)= SinACosB+CosASinB]

$$y = Sin\omega t(a1 + a2Cos\phi) + a2Sin\phi Cost\omega t$$

Let-

$$(a1 + a2Cos\phi) = ACos\theta - (1)$$

$$a2Sin\phi = ASin\theta - (2)$$

$$y = ASin\omega tCos\theta + ASin\theta Cost\omega t$$

$$y = ASin(\omega t + \theta)$$

Squaring and adding equation (1) and (2)-

$$(a1 + a2Cos\Phi)^2 + a2^2Sin\Phi^2 = A^2Cos^2\theta + A^2Sin^2\theta$$

$$a1^2 + a2^2Cos^2\Phi + 2a1a2Cos\Phi + a2^2Sin^2\Phi = A^2$$

$$a1^2 + a2^2 + 2a1a2Cos\Phi = A^2$$

Intensity =KA²

$$Intensity = K(a1^2 + a2^2 + 2a1a2Cos\Phi)$$

So If –

CosΦ= 2nπ (Constructive Interference)

CosΦ= (2n-1)π (Destructive Interference)