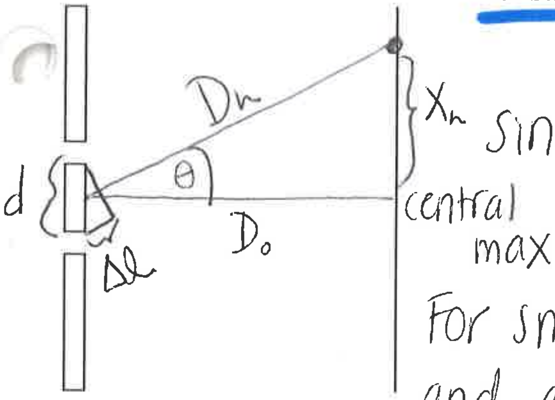
## The Fringe Equations

(anti-node) **Constructive Interference** (node) **Destructive Interference**




Constructive: $\sin\theta = \dfrac{n\lambda}{d} = \dfrac{x_n}{D_n}$

Destructive: $\sin\theta = \dfrac{(n+\frac{1}{2})\lambda}{d} = \dfrac{x_n}{D_n}$

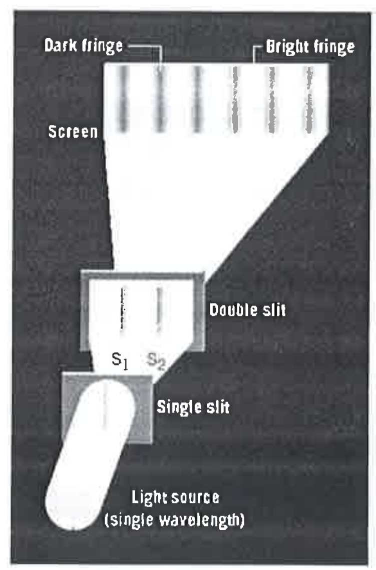
For small angles, $D_o \approx D_n$ and all "x" distances are the same for spacing

$\dfrac{x_n}{D_n} = \dfrac{x_n}{D_o}$

| Variable: | $x$ | $\theta$ | $D$ | $d$ | $\lambda$ |
|---|---|---|---|---|---|
| Quantity: | linear displacement from central max | angular displacement from central max | distance between sources and screen | distance between sources | wavelength |
| Units: | m | degrees or radians | m | m | m |

For light: $\boxed{\dfrac{\Delta x}{D} = \dfrac{\lambda}{d}}$

### Thomas Young's Double Slit Diffraction




In 1801 the English scientist Thomas Young (1773–1829) performed an historic experiment that demonstrated the wave nature of light by showing that two overlapping light waves interfered with each other.

Importance of experiment:

1. demonstrated that light acts as a wave
2. first measurement of wavelength of light

What is the reason for first having a single and then a double slit?

The single slit acts as a point source to ensure that the waves from the double slits are coherent.

In a double slit experiment, light whose wavelength is 6.0 x $10^{-7}$ m is shone through two slits that are 0.10 mm apart onto a screen that is 2.5 m away. What is the distance between the central maximum and the first bright band?

$n = 1$

$D_n = D_o = 2.5\,m \qquad d = 1.0 \times 10^{-4}\,m$

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$\dfrac{x_n}{D_n} = \dfrac{n\lambda}{d}$

$x_n = \dfrac{(1)(6.0\times10^{-7}\,m)(2.5\,m)}{(1.0\times10^{-4}\,m)} = \boxed{0.015\,m}$

$x_n = \dfrac{n\lambda D_n}{d}$