Interference of Light Waves

Like other waves, light waves can interfere with each other.

This interference can be either constructive (bright lines called **maxima**) or destructive (dark lines called **minima**).

In order to get light waves to interfere it is easiest to cause light to **diffract** through narrow slits.

As long as the size of the slit is close to the size of the light wavelength, the light will diffract and form an interference pattern (see p. 426).

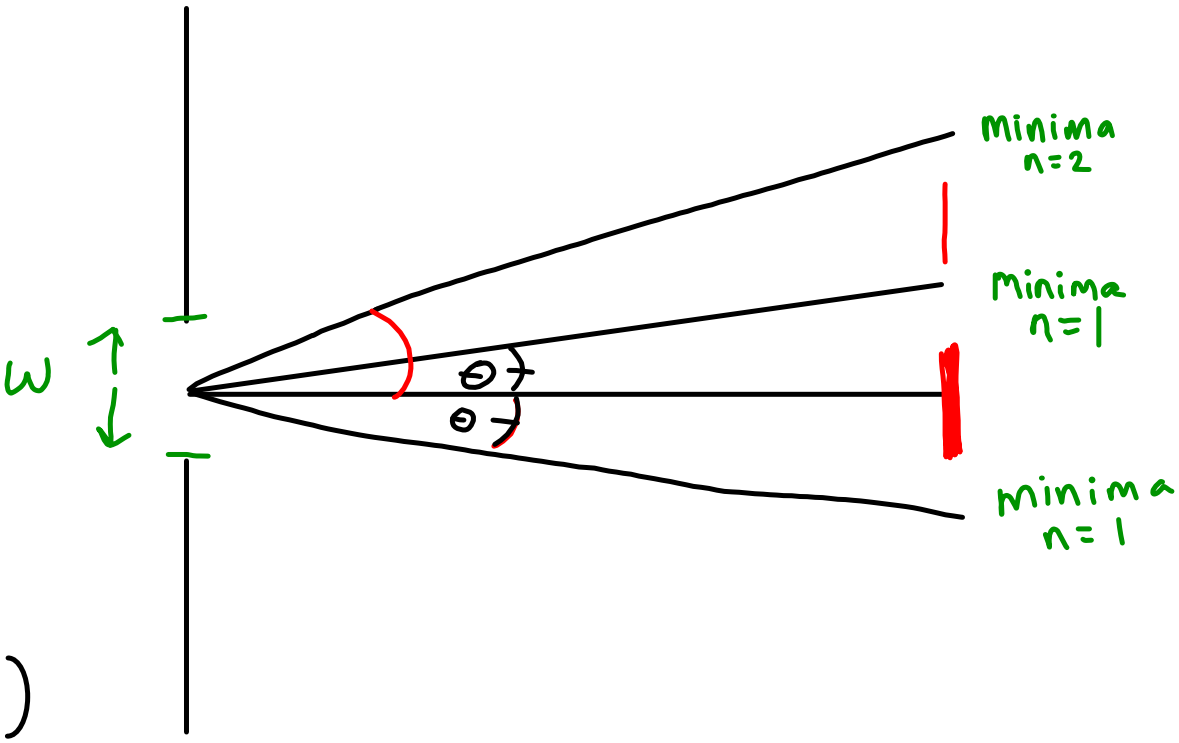
Single Slit interference

Gives the location of the **minima** (dark) (nodal lines)

$$n\lambda = w \sin\theta_n$$

where: n is the number of the minima
λ is wavelength of light (m)
w width opening (m)
θn is the angle from centre (°)

**See diagram 10.78 top of 431*


w
θ
θ
Minima
n=2
Minima
n=1
Minima
n=1

http://www.phys.hawaii.edu/~teb/optics/java/slitdiffr/

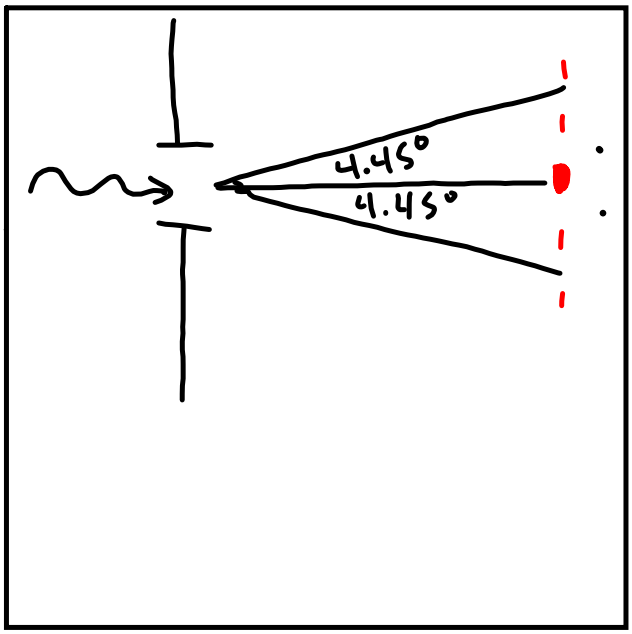
Single Slit Diffraction Pattern

Example: A **single slit** with a width of 1.7×10^{-5} m is illuminated with red light with a wavelength of 660 nm. At what angle does the 2nd order **minima** occur?

Given: $w = 1.7 \times 10^{-5}$ m

$\lambda = 660$ nm $= 660 \times 10^{-9}$ m

$n = 2$



Double Slit interference

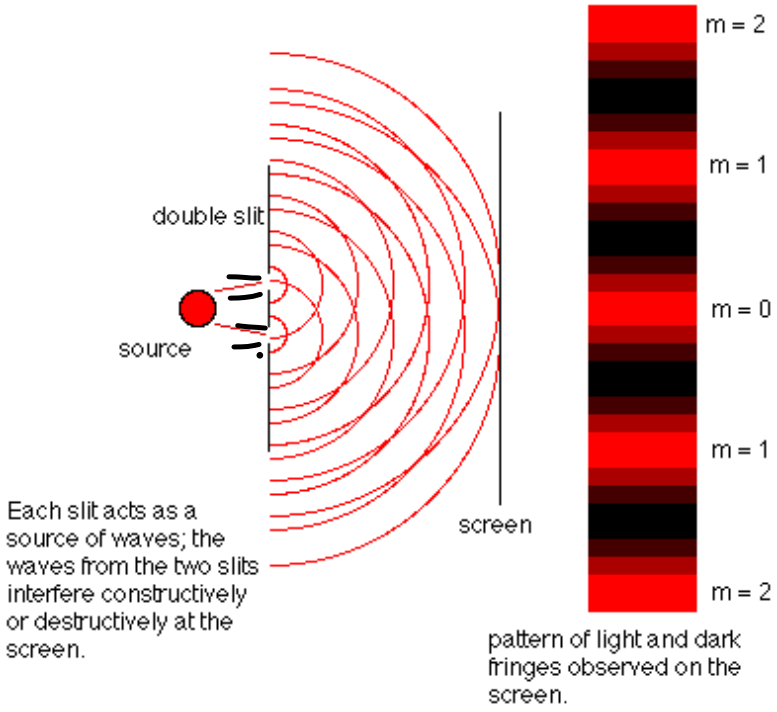
Gives the location of the **maxima** (bright lines)

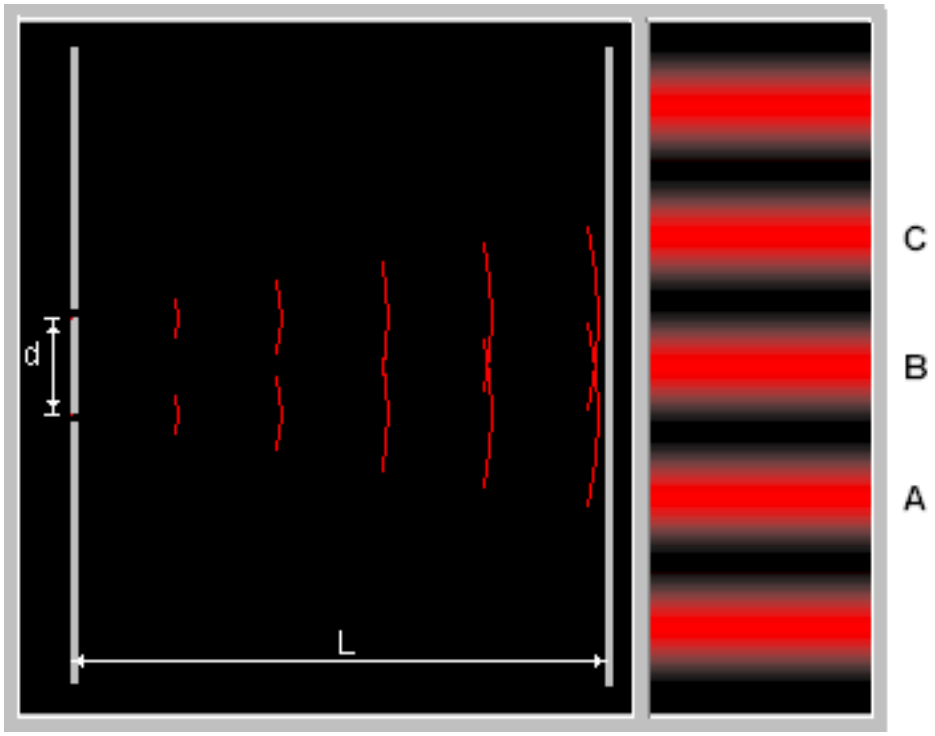
$n\lambda = d \sin \theta_n$ OR $= \frac{dx_n}{L}$

$n\lambda = \frac{dx_n}{L}$

n is the number of the maxima
λ is wavelength of light (m)
x_n distance from centre line to bright
d is slit separation (m)
θ_n is the angle from centre (°)
L is distance from slit to maxima (m)

**Draw diagram 10.73 top of 427*


m = 2
m = 1
m = 0
m = 1
m = 2
double slit
source
screen
Each slit acts as a source of waves; the waves from the two slits interfere constructively or destructively at the screen.
pattern of light and dark fringes observed on the screen.

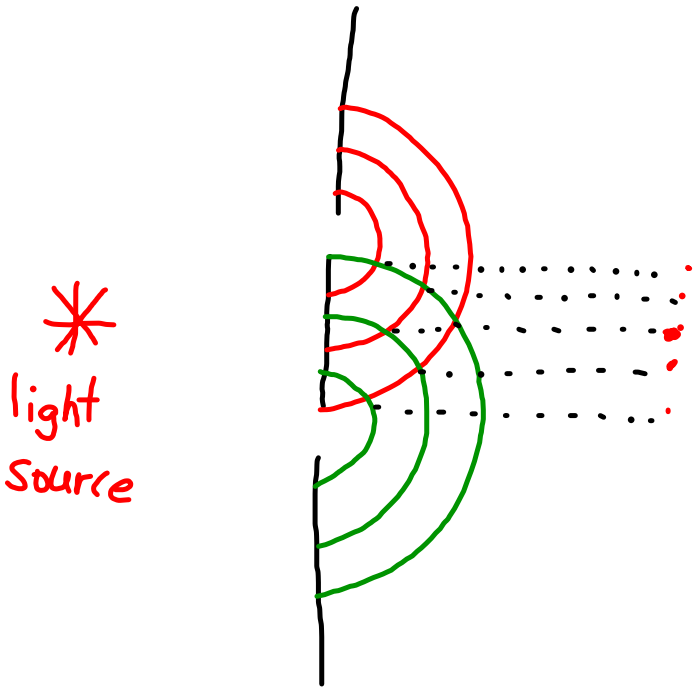

d
L
C
B
A

Double slit wave theory
http://www.physics.mclarenhigh.com/ntnujava/doubleSlit/doubleSlit.html
http://www.matter.org.uk/schools/Content/Interference/laserinterference.html
http://www.colorado.edu/physics/2000/schroedinger/two-slit2.html

Example 2: Double Slit Maxima

A 550 nm light source illuminates **double slits** that are 3.0×10^{-6} m apart. For a screen that is 0.9 m away from the slits, how far will the first order **maxima** (n = 1) appear from the centerline?

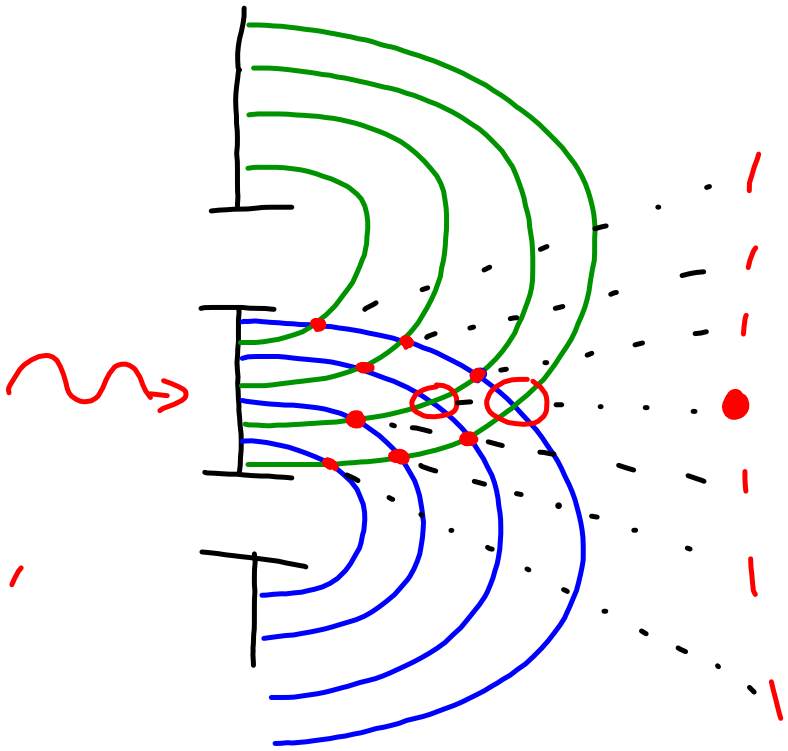
Hwk:
Read p. 424 - 431
Do p. 429 #2a, 3
431 #2b
441 #100 a, 101



when 2 light waves in the same place at the same time → interference

constructive interference makes brighter light (brightspots)

destructive make light less bright or no light at all (dark spaces)



* When 2 waves overlap
  - constructive interference
  - bright spots (maxima)
* destructive interference creates dark spots (minima)