**Interference - Single and Double Slit Worksheet** Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Show your work**.

1. What part does diffraction play in Young's double slit experiment?

The diagram below shows the intensity curve for a double slit interference pattern. The dotted line shows the diffraction effects that result from the diffraction that occurs at each of the two slits



Describe how the pattern would change if the slits were:

(a) closer together without any change in their size.

(b) kept the same distance apart but made thinner.

1. The five diagrams below represent the double slit interference patterns (we could also call them diffraction patterns) obtained using the same source of monochromatic light. In each case the distance to the screen was the same.



(a) In which case was the distance between the slits the largest?

(b) In which case was the distance between the slits the smallest?

(c) In which case were the slits the thinnest?

(d) In which case is the fourth order interference maximum missing?

1. In a double slit experiment the distance between slits is d = 5.0 mm and the distance to the screen is D = 1.0 m. There are two interference patterns on the screen: one due to light with λ1 = 480 nm and another due light with λ2 = 600 nm. What is the separation between third order (m=3) bright fringes of the two patterns?
2. In a Young’s double slit experiment, sodium light of wavelength 0.59 x 10-6 m was used to illuminate a double slit with separation 0.36mm. If the fringes are observed at a distance of 30.0 cm from the double slits, calculate the fringe separation.
3. In an experiment using Young’s slits, six fringes were found to occupy 3.0mm when viewed at a distance 36 cm from the double slits. If the wavelength of the light used is 0.59 μm, calculate the separation of the double slits. (None fringe means one fringe separation.)
4. When red monochromatic light of wavelength 0.70 μm is used in a Young’s double slit experiment, fringes with separation 0.60 mm are observed. The slit separation is 0.40 mm. Find the fringe spacing if (independently):
   1. yellow light of wavelength 0.60 μm is used;
   2. the slit separation becomes 0.30 mm;
   3. the slit separation is 0.30 mm and the slits-fringe distance is doubled.

Answers:

1. Diffraction at the first slit causes the light to spread out and illuminate the double slits S1 and S2. If these two slits are close together compared with their distance from S then effectively a single wave front will illuminate them and so light from S1 and S2 will be coherent. i.e. there will be a constant phase difference (possibly 0) between them. Diffraction at S1 and S2 causes the light from them to spread out and overlap so that the light can interfere



1. (a) Bringing the slits closer together changes the bandwidth of the interference pattern without changing the diffraction envelope. There will be fewer bands under the dotted line.

(b) The thinner slits will diffract the light more. This will cause the diffraction envelope shown by the dotted line to broaden. As the spacing of the slits is unchanged the bandwidth will remain the same.

1. (a) largest d means smallest bandwidth - E

(b) smallest d means largest bandwidth - A

(c) thinnest slits means the largest amount of diffraction. i.e. the widest diffraction envelope. - they all look about the same!

(d) C

1. for λ1 =480 nm, y3 = 2.88 x 10-4 m for λ2 =600 nm, y3 = 3.60 x 10-4 m hence difference is .072 mm
2. 4.9x10-4 m
3. 4.25x10-4 m
4. a. 5.1x10-4 m b. 8.0x10-4 m c. 1.6x10-4 m