Experiment 1 report

Design

Introduction

The purpose of this experiment was to observe the diffraction patterns formed by laser light passing through a single slit and verify the position of minima and determine the position matches with the theoretically predicted position. This was ascertained by comparing the value calculated slit width with selected slit width of 0. 04mm. It was hypothesized that there would be variations in calculated value and selected value.

Materials

- Track and screen from Basic Optic System (OS-8515)
- Diode laser (OS-8525)
- Single Slit Disk (OS-8523)
- White paper
- Metric rule

Procedure

The laser was placed at one end of the optical bench and a single slit disk mounted on its holder placed 3 cm away from the laser. A screen covered with white paper was placed on the other end of the bench with white paper facing the laser. The 0. 04mm slit width was selected by rotating the slit disk until it was centered on the holder. The position of the laser was adjusted until the beam was centered on the slit. The distance from the slit to the screen was determined by getting the difference between the screen position and slit position. This difference was recorded. The light was turned off and the positions of the minima marked. The light was turned on again and the distance between the first order marks and second order marks was

measured and recorded. The slit with was changed to 0. 02mm and 0. 08mm and the diffraction patterns sketched.

Results

Slit to Screen distance (D) = 8. 4 X 1. 0-1 m

Diffraction patterns

Slit width = 0. 04mm

Slit width = 0. 02mm

Slit width = 0. 08mm

Analysis

The slit width a =

Where m = 1, 2, 3, 4.

λ = Wavelength

ϒ= Slit separation

D = Distance from slit to screen

Slit width using first order

(1 X 670 X 10-9 X 8. 4 X 1. 0-1) ÷ (8. 5 X 1. 0-3)

6. 62 X 1. 0-5 m

Slit width using second order

(2 X 670 X 10-9 X 8. 4 X 1. 0-1) ÷ (1. 25 X 1. 0-2)

9. 00 X 10-5 m

Discussion

The calculated slit widths were greater than the selected slit width of 0.

04mm by 65% for the first order and 125% for the second order minima. This

was an indication that errors were made during the marking of the positions of minima. It was observed that different slit width produced different diffraction patents. The increase of slit width led to a decrease in the distance between minima. Consequently, a slit with 0. 02 mm width produced widest spacing between minima.

Conclusion

The hypothesis was upheld because there was a variation in calculated slit width and selected slit width of 0. 04 mm. The increase in distance between minima when the slit width was reduced was also in line with the theory of single slit diffraction.

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EXPERIMENT 2

Introduction

The purpose of the experiment was to observe the diffraction and interference patterns formed by laser passing through two slits and verifies the positions of maxima and determine if the position match with the theoretically predicted position. This was ascertained by comparing the value calculated slit separation and the selected slit separation 0. 25 mm. It was hypothesized that there would be variations in calculated value and selected value.

Introduction

Materials

- Track and screen from Basic Optic System (OS-8515)
- Diode laser (OS-8525)
- Multiple Slit Disk (OS-8523)

- White paper

- Metric rule

Procedure

The laser was placed at one end of the optic bench and a multiple slit disk mounted on its holder placed 3 cm away from the laser. A screen covered with white paper was placed on the other end of the bench with white paper facing the laser. The 0. 04mm slit width and 0. 25 slits separation was selected by rotating the slit disk until it was centered on the holder. The position of the laser was adjusted until the beam was centered on the double slit. The distance from the slit to the screen was determined by getting the difference between the screen position and slit position. This difference was recorded. The light was turned off and the positions of the maxima marked. The light was turned on again and the distance between the first order marks and second order marks was measured and recorded.

Results

Slit to Screen distance (D) = 8. 4 X 1. 0-1 m

Analysis

The slit separation d =

Where m = 0, 1, 2, 3, 4.

λ = Wavelength

ϒ= Slit separation

D = Distance from slit to screen

Slit width using first order

(1 X 670 X 10-9 X 8. 4 X 1. 0-1) ÷ (4. 0 X 1. 0-3)

1. 4 X 1. 0-4 m

Slit width using second order

(2 X 670 X 10-9 X 8. 4 X 1. 0-1) ÷ (5. 0 X 1. 0-3)

2. 25 X 10-4 m

Discussion

There was a variation in calculated values of slit separation and selected slit separation value of 0. 25mm (2. 5 X 10-4 m). These variations were 44% and 10% for first order and second order maxima. The variations were caused by measurement errors encountered during the marking of the positions of maxima.

The distance to the first minima decreased when the slit separation was increased. Again, the same distance decreased when the slit width was increased. Diffraction is more pronounced when the slit width or separation is decreased than when they are increased.

Conclusion

The hypothesis that there would be variations in the calculated value of slit separation and selected value of slit separation was upheld. The double slit method is more appropriate for investigating diffraction and interference than single slit method. This is because greater interference occurs in double slit. This explains why the percentage differences in values of double slit experiment were less than those obtained from single slit experiment.

EXPERIMENT 3

Introduction

The purpose of the experiment was to compare diffraction and interference patterns formed by layer light passing through various combinations of slits.

It was hypothesized clear patterns would be observed when the number of slits were increased.

Materials

- Track and screen from Basic Optic System (OS-8515)
- Diode laser (OS-8525)
- Single and Multiple Slit Disk (OS-8523)
- White paper
- Metric rule

Procedure

The laser was placed at one end of optic bench and multiple slit disk mounted on a holder placed 3 cm in front of the laser. A screen covered with a sheet of white paper was placed on the other end with paper facing the laser. A double slit comparison was selected by rotating the slit disk until the slit was centered on the holder. The beam was adjusted until it was centered on the slit set. Bothe single and double slits were confirmed to be illuminated then a two side by side pattern was sketched. The slit was rotated to the double slit comparison with same slit width but different slit separation and two side by side pattern sketched. This procedure was repeated for the following combinations. Two double slits with the same slit separation but different slit width and double slit/triple slit with same slit separation and same slit width. The multiple slit was replaced with a single slit and line/slit comparison was selected and two side by side pattern sketched. The dot pattern was selected on the single slit and resulting diffraction pattern sketched. This procedure was repeated for hole pattern.

Results

Two double slits with same slit width but different slit separation

Two double slits with same slit separation bur different slit width

Single slit-line pattern

Single slit-dot pattern

Single slit-hole pattern

Discussion

Double slit produced greater interference than single slit. Therefore, patterns produced by double slit had distinct boundaries. In single slit, the boundaries between dark and bright fringes overlapped. The width of the fringes produced by double slit diffraction reduced when the slit separation increased. The same phenomenon was observed when slit width was reduced. The width of the patterns reduced. Triple slit produced clear patterns than double slit because of increased interference of light.

Conclusion

The diffraction pattern produced by tripple slit was clearer than those produced by single or double slits. Hence, the hypothesis was upheld. Moreover, the behavior of diffraction patterns was consistent with theory of diffraction.