Physics Light and Waves Summary

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1 Properties of Light Waves

2 Bubbles

3 Single and Double Slits

Question 1

If Young's Double Slit Experiment were to be submerged in water, how would the fringe pattern change?

Answer 1

The length of a wave (λ) is strongly dependant on it's medium. If the experiment was to be submerged in water (a slower medium than air), then the wavelength of the light would decrease and the fringe pattern would become closer together.

Question 2

For diffraction by a single slit, what is the effect of increasing (a) the slit width, and (b) the wavelength?

Answer 2

(a) Increasing the slit width (d) would decrease the width of the central maxima. This is proven by the equation: $\Delta y = \left(\frac{(\lambda)(L)}{d}\right)$

(b) Increasing the wavelength (λ) would increase the sie of the central maxima. This is proven by the equation: $\Delta y = \left(\frac{(\lambda)(L)}{d}\right)$

4 Diffraction Grading

5 Polarization

Light waves have both vertical and horizontal components. The horizontal component is called the "electric field oscillation" and the vertical component is called the "magnetic field oscillation".

scale=0.25, scale=0.25,
, , path=images/wave/polarized path=images/wave/polarized_lenses As a light wave travels through a polarized lense, either the magnetic field component or the electric field component is eliminated, leaving only one of the two components.

As an example, if you put together vertically polarized lense and a horizontally polarized lense in their corresponding directions, the light will not be able to move through the lense.

If you rotate one of the lenses 90 degrees, the light will be able to pass through the lense because the polarized component is now the same as the other.

6 Double Slit Equations (1)

Monochromatic light falls on two slits 0.024 mm apart. The fringes on a screen 3.00 m away are 6.7 cm apart. What is the wavelength of light?

Givens

- $d = 2.4 \times 20^{-5}\ m$
- $L = 3.00\ m$
- $\Delta x = 6.7 \times 10^{-2}\ m$

Solve

To solve for the wavelength of the light, we can use the equation $\lambda = \left(\frac{(\Delta x)(d)}{L}\right)$ Our result should be in meters, but if converted, the result should be in nanometers.

$$\lambda = \left(\frac{(\Delta x)(d)}{L}\right) = \left(\frac{(6.7 \times 10^{-2})(2.4 \times 10^{-5})}{3.00}\right) \approx 5.20 \times 10^{-7}\ m$$

7 Double Slit Equations (2)

A parallel beam of 700 nm light falls on two small slits 6.0×10^{-2} mm apart. How wide would a pattern of eight bright fringes be on a screen 3.0 m away?

Givens

- $d = 6.0 \times 10^{-5}\ m$
- $\lambda = 7.0 \times 10^{-7}\ m$
- $L = 3.0\ m$

Solve

To solve for the width of the pattern of eight bright fringes, we must first solve for the distance between two (Δx). After solving for Δx we can multiply it's value by eight to get the final distance.

$$\Delta x = \frac{(\lambda)(L)}{d} = \left(\frac{(7.0 \times 10^{-7})(3.0)}{6.0 \times 10^{-5}}\right) \approx 3.5 \times 10^{-2}\ m$$

$$\therefore\ \ (8)\Delta x = (8)(3.5 \times 10^{-2}) \approx 2.8 \times 10^{-1}$$

8 Single Slit Equations (1)

How wide is the central diffraction peak on a screen 2.50 m behind a 0.0212 mm wide slit illuminated by 550 nm light?

Givens

- $L = 2.50\ m$
- $d = 2.12 \times 10^{-5}\ m$
- $\lambda = 5.5 \times 10^{-7}\ m$

Solve

To solve for the width of the central maxima we use a formula very similar to the one used in the double slit calculations: $\Delta y = \left(\frac{(\lambda)(L)}{d}\right)$ Where Δy is the width of the central maxima.

$$\therefore \ \Delta y = \left(\frac{(\lambda)(L)}{d}\right) = \left(\frac{(5.5\times10^{-7})(2.50)}{2.12\times10^{-5}}\right) \approx 6.5\times10^{-2}\ m$$

9 Single Slit Equations (2)

How wide is a slit if it diffracts 690 nm light so that its central peak is 3.0 cm wide on a screen 2.80 m away?

Givens

- $L = 2.80\ m$
- $\Delta y = 3.0\times10^{-2}\ m$
- $\lambda = 6.9\times10^{-7}\ m$

Solve

To solve for the width of the single slit we can rearrange the formula from the solve above. $\Delta y = \left(\frac{(\lambda)(L)}{d}\right) \to d = \left(\frac{(\lambda)(L)}{\Delta y}\right)$.

$$\therefore \ d = \left(\frac{(\lambda)(L)}{\Delta y}\right) = \left(\frac{(6.9\times10^{-7})(2.80)}{3.0\times10^{-2}}\right) \approx 6.44\times10^{-5}\ m$$