

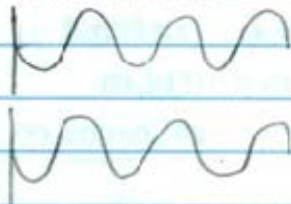
Thank You, Puja Patel, for these notes.

Interference of Light:

- SUPERPOSITION
- Constructive Interference \rightarrow Brighter light
- Destructive Interference \rightarrow no light.

- sound: all wavelengths travel at the same speed
NOT TRUE FOR LIGHT!

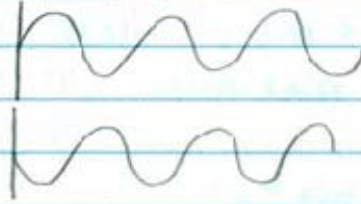
- Constructive Interference



* in phase with
one another

* phase difference
of one wavelength

- Total Destructive Interference



* phase difference of
half a wavelength ($\frac{1}{2}\lambda, \frac{3}{2}\lambda$ etc).

- Diffraction: waves go out in all directions when going through an opening that is about the wavelength of the wave.

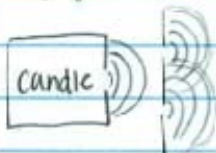
- Coherence: two light sources in phase with one another

- mono-chromatic light: one wavelength or one color

Thomas Young's Double Slit Experiment: 1801

An interference pattern

Light is a wave



Constructive Interference

an interference maximum (singular)

interference maxima (plural)

Central maximum \Rightarrow middle one

phase difference of one wavelength

Central maximum = 0

first order maximum = 1 **Bright Fringe**

2nd order maximum = 2

$$d \sin \theta = m \lambda$$

θ = angle between the ray & normal

d = distance between the 2 slits. "slit separation"

$m = 0, \pm 1, \pm 2, \pm 3$

$m \Rightarrow$ order number

Destructive Interference

an interference minimum (singular)

interference minima (plural)

Dark Fringe

phase difference of $\frac{1}{2} \lambda$

$m = 0, \pm 1, \pm 2$

$$d \sin \theta = (m + \frac{1}{2}) \lambda$$

* the 1st dark fringe above the central maximum

$m = 0 \Rightarrow$ zeroth minimum

$m = 1 \Rightarrow$ 1st order minimum

Video Lecture #4 – Chapter 16.1 - Page 604 #2 A Problem - Finding the Angle for an Interference Maximum in a Double Slit Experiment

p.604 #2

$d = 0.25 \text{ mm}$

$\theta = ?$

$d = 0.250 \times 10^{-3} \text{ m}$

$\lambda = 546.1 \text{ Nm}$

$m = 1$

$\lambda = 546.1 \times 10^{-9} \text{ m}$

$$d \sin \theta = m \lambda$$

$$\sin \theta = \frac{m \lambda}{d}$$

$$\theta = \sin^{-1} \left(\frac{m \lambda}{d} \right)$$

$$\theta = \sin^{-1} \left(\frac{1 \cdot 546.1 \times 10^{-9}}{0.250 \times 10^{-3}} \right)$$

$\theta = 0.1251570003^\circ$

$\theta \approx 0.125^\circ$

Video Lecture #5 – Chapter 16.1 - Page 604 #3 A Problem - Finding the Angle for an Interference Minimum in a Double Slit Experiment

p. 604 #3)

$$m = 1 \text{ (2nd dark fringe from the central maximum)}$$

$$\lambda = 546.1 \times 10^{-9} \text{ m}$$

$$d = 0.250 \times 10^{-3} \text{ m}$$

$$\frac{d \sin \theta}{d} = \frac{(m + \frac{1}{2}) \lambda}{d}$$

$$\sin \theta = \frac{(1 + \frac{1}{2})(546.1 \times 10^{-9})}{0.250 \times 10^{-3}}$$

$$\sin \theta = 0.0032766$$

$$\theta = \sin^{-1}(0.0032766)$$

$$\theta = 0.1877356871 \quad \boxed{\theta \approx 0.188^\circ}$$

Video Lecture #6 – Chapter 16.2 - Introduction to a Diffraction Grating and Interference Maxima and Minima

Diffraction Grating

$$d \sin \theta = m \lambda$$

$d =$ grating spacing ($\frac{m}{\text{line}}$)

Video Lecture #7 – Chapter 16.2 - Page 611 #1 A Problem - Determining the Number of Lines per Centimeter on a Diffraction Grating

p. 611 #1)

$$\lambda = 546.1 \times 10^{-9} \text{ m}$$

$$m = 1$$

$$\theta = 21.2^\circ$$

$$\frac{1}{d} = ? \left(\frac{\text{lines}}{\text{cm}} \right)$$

$$\frac{d \sin \theta}{\sin \theta} = \frac{m \lambda}{\sin \theta}$$

$$d = \frac{m \lambda}{\sin \theta}$$

$$d = \frac{(1)(546.1 \times 10^{-9})}{\sin 21.2^\circ}$$

$$d = 1.51012969 \times 10^{-7} \frac{\text{m}}{\text{line}}$$

$$\frac{1}{d} = \frac{1}{1.51012969 \times 10^{-7}}$$

$$\frac{1}{d} = 6621.9$$

$$\boxed{\frac{1}{d} \approx 6620 \frac{\text{lines}}{\text{cm}}}$$