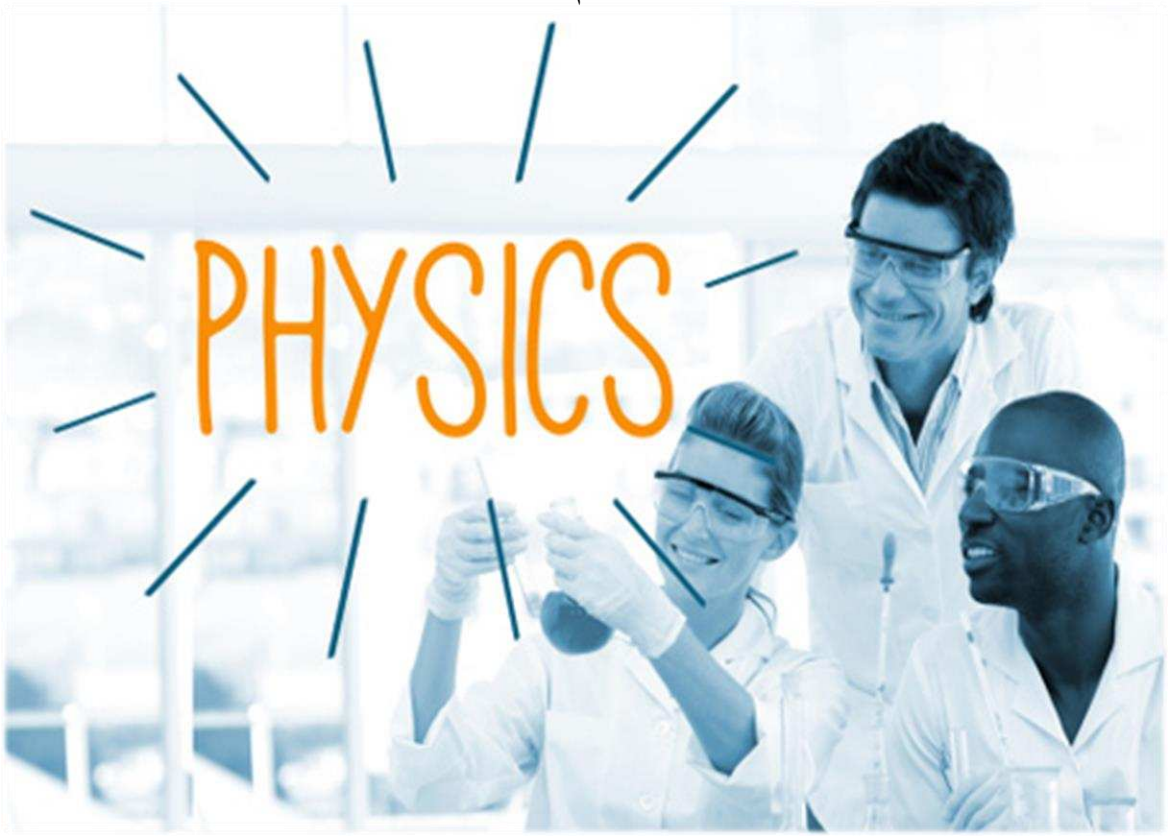
مركز أم الامارات



Grade 12 General / physics

Trimester 2 / Academic Year 2019-2020

I Physics

Interference part 1

Incoherent and Coherent Light

1- What led scientists to believe that light has wave properties?

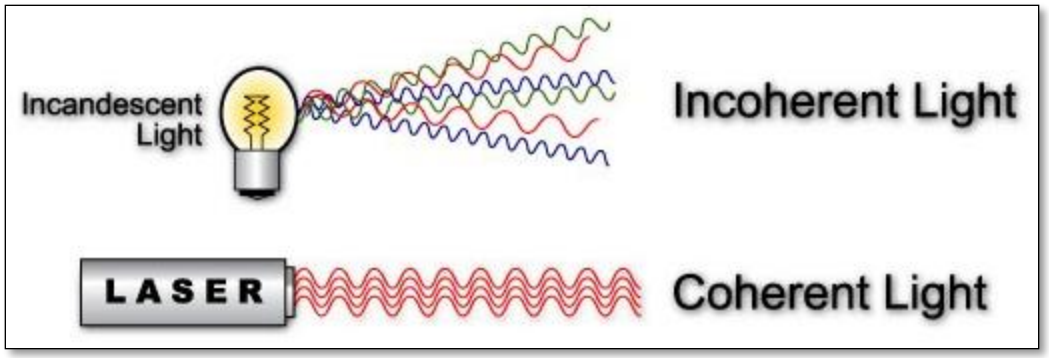
They discovered that light could be made to interfere, which results from the superposition of waves

2- Define the incoherent light?

It is light whose waves are not in phase

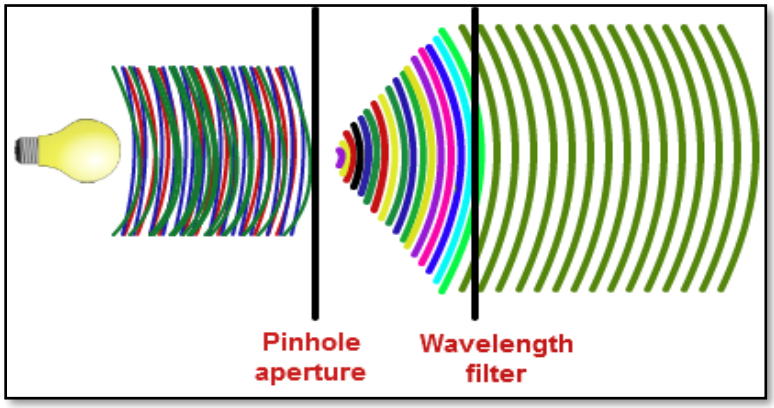
3- Define the coherent light?

It is Light made up of waves of the same wavelength that are in phase with each other



4- How we can create a coherent light?

- ✓ It can be created by a single point source.
- ✓ It can be created by multiple point sources when all point sources are in phase. This type of coherent light is produced by a laser.

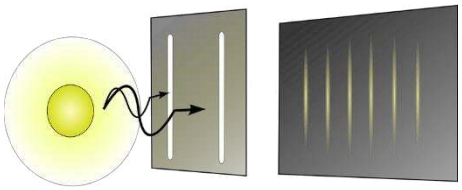


Interference of Coherent Light

1- What is the prerequisite for a clear interference of light waves?

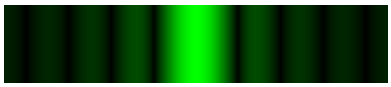
The light waves should be from coherent sources.

2- What was Thomas Young experiment?



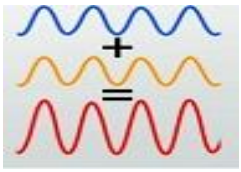
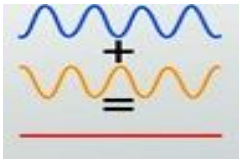
In his experiment, monochromatic light from a small source (single point source). was passed through two closely spaced slits and produced an interference pattern.

3- Define interference fringes



The pattern of bright and dark band

- **Note1:** There are two types of waves interference (constructive – destructive)

Constructive	Destructive
When two waves meet in such a way that their crests line up together.	When two waves meet in such a way that the crest of one wave meets the trough of another.
	

- **Note2:** In the interference pattern:

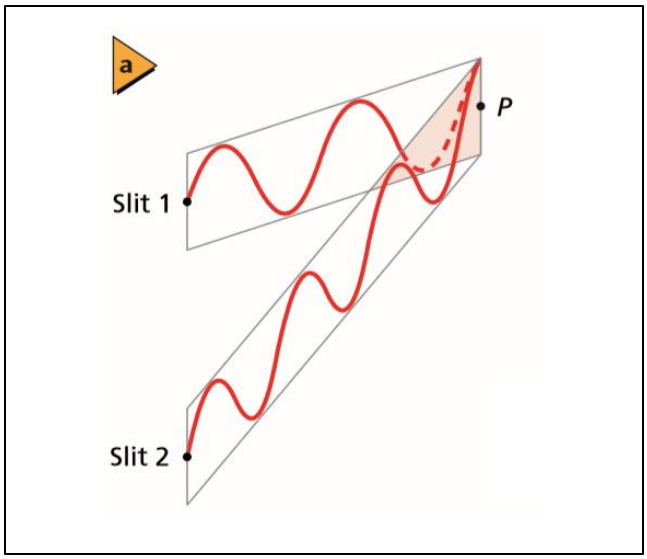
  - ✓ The Bright band represents an area where a constructive interference occurs.
  - ✓ The dark area represents an area where a destructive interference occurs.

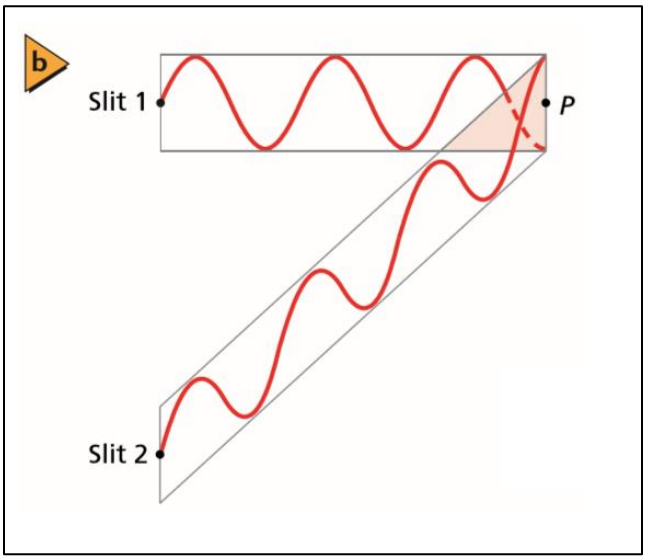
Exercises:

- **Rely on the following figure to fill in the table.**

The areas of constructive interference	The areas of destructive interference

- **Rely on the following figure to fill in the table.**





At point "p"	
Case a	Case b
What is the type of interference? Answer:	What is the type of interference? Answer:
What is the type of the band? Answer:	What is the type of the band? Answer:

4- Describe the pattern that Thomas Young gets in his experiment (Double-Slit Interference)

https://www.youtube.com/watch?v=9D8cPrEAGyc

(0:00-1:08 min)

- ✓ A bright central band of the given color on the screen
- ✓ Other bright bands of near-equal spacing and near-equal width on either side
- ✓ The intensity of the bright bands decreases the farther the band is from the central band
- ✓ Between the bright bands are dark areas where destructive interference occurs.

- ➢ **Note**: The positions of the constructive and destructive interference bands depend on the light's wavelength

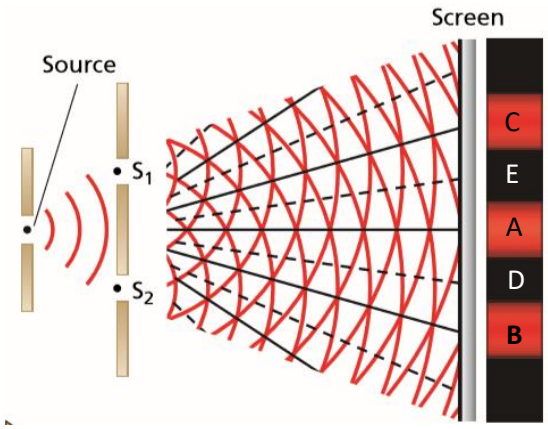
5- Describe the changes in the interference pattern when we use a green light instead of a red one.

- ✓ The distance between the bright fringes decreases.
- ✓ The width of the bright fringes decreases.

6- Describe the pattern that Thomas Young gets in his experiment (Double-Slit Interference) when he uses a white light.

✓ A bright central band of white color on the screen.
✓ Colored spectra on either side of the central band.

7- Use the figure to answer the following questions



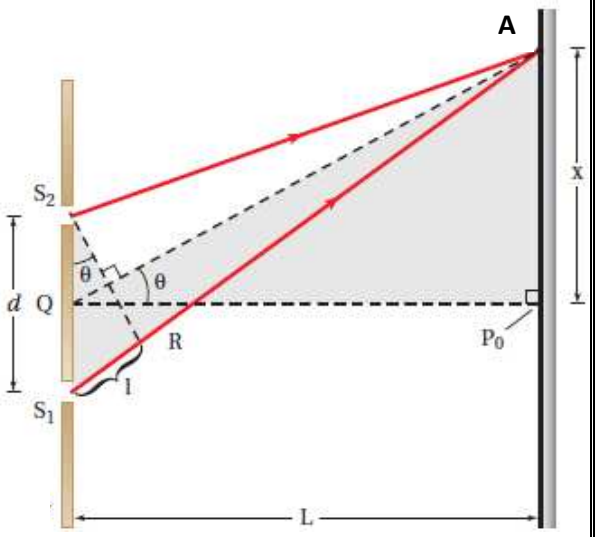
a. What is the useful of each of the single slit and the double slit barriers in the double slit experiment?

The single slit barrier	The double slit barrier

b. Name the following areas?

The area	The name
A	
B,C	
D,E	

8- In the figure, the distance "1" represent the path difference between the two waves coming from the two slits when they met at point A.



- What is the value of distance "1" if the two waves meet at point P_0?

……
……
……

- If the two waves met at point A, complete the following table

Path difference Distance 1 value	Type of the band (bright- dark)	The order of the band $m = 1, 2, 3, \ldots$
1λ		
2λ		
$\lambda/2$		
$3\lambda/2$		

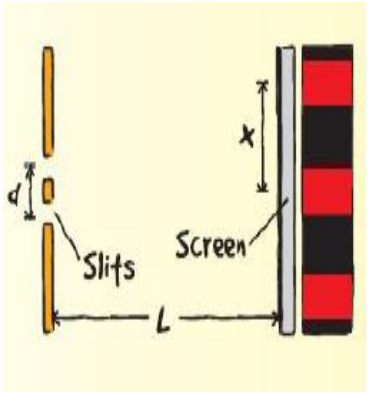
9- What is the equation of the wavelength from the Double-Slit Experiment?

$$m\lambda = \frac{x_m . d}{L}$$

N	The symbol	The physical quantity
1	m	The order of the fringe
2	x_m	The Distance from the central bright band to the bright band
3	λ	The wavelength of the light
4	d	The distance between the slits
5	L	The distance to the screen
Note: all the quantities are measured in meter except m which is dimensionless quantity		

Applications

1- **A double-slit experiment is performed to measure the wavelength of red light. The slits are 0.0190 mm apart. A screen is placed 0.600 m away, and the first-order bright band is found to be 21.1 mm from the central bright band. What is the wavelength of the red light?**



2- **Violet light falls on two slits separated by 1.90×10^{-5} m. A first-order bright band appears 13.2 mm from the central bright band on a screen 0.600 m from the slits. What is λ?**

3- **Yellow-orange light from a sodium lamp of wavelength 596 nm is aimed at two slits that are separated by 1.90×10–5 m. What is the distance from the central band to the first-order yellow band if the screen is 0.600 m from the slits?**

4- In a double-slit investigation, physics students use a laser with λ = 632.8 nm. A student places the screen 1.000 m from the slits and finds the first-order bright band 65.5 mm from the central line. What is the slit separation?

5- Yellow-orange light with a wavelength of 596 nm passes through two slits that are separated by 2.25×10^{-5} m and makes an interference pattern on a screen. If the distance from the central line to the first-order yellow band is 2.00×10^{-2} m, how far is the screen from the slits?

6- A flat screen is placed 4.200 m from a pair of slits that are illuminated by a beam of monochromatic light. On the screen, the separation between the central bright band and the second-order bright band is 0.082 m. The distance between the slits is 5.3×10^{-5} m. Determine the wavelength of the light

Part 1 end