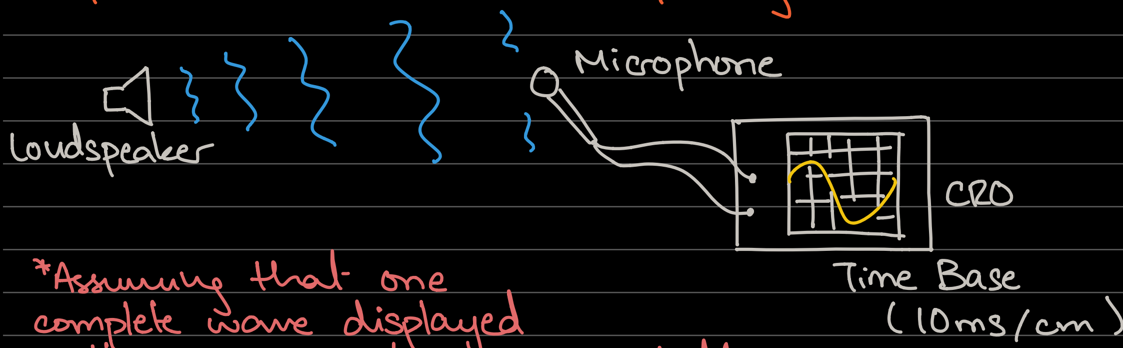
COMMON EXPERIMENTS : WAVES

1. Experiment to calculate the frequency of soundwaves



*Assuming that one complete wave displayed on the CRO occupied 4cm horizontally

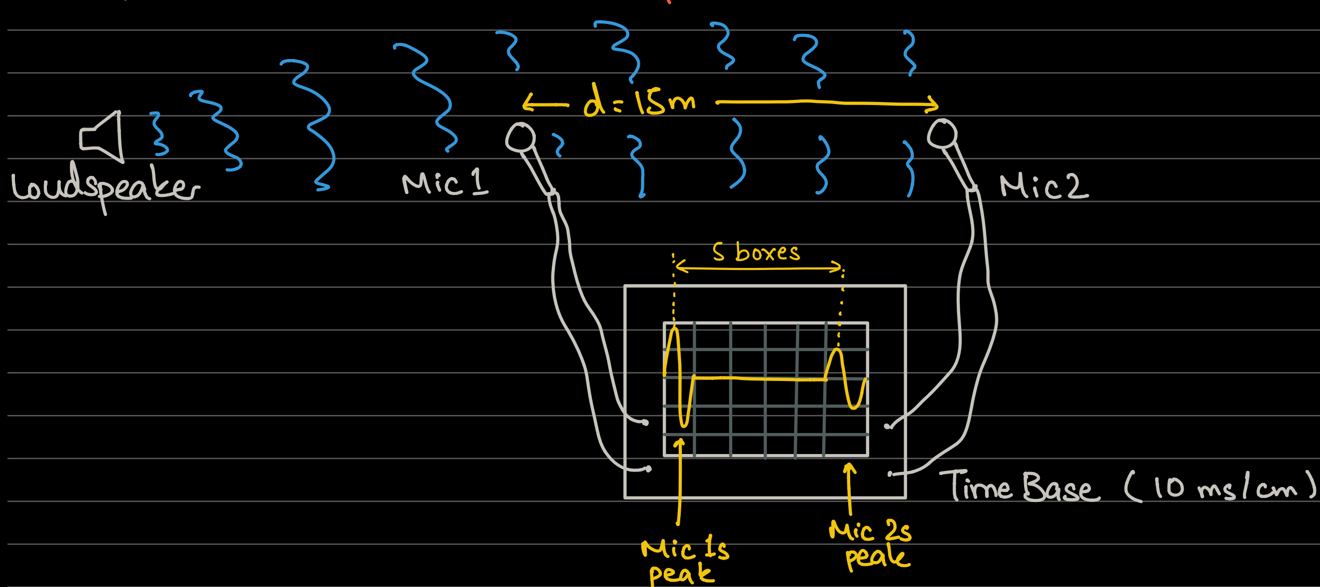
1cm ⟶ 10ms
4cm ⟶ 40ms
$T = 40ms$

$$f = \frac{1}{T} = \frac{1}{40 \times 10^{-3}} = 25Hz$$

List of apparatus :
1. Loudspeaker
2. Microphone
3. CRO and connecting wires

Precautions :
1. Frequency of source should remain constant
2. Experiment should be conducted in a sound proof room
3. There must be no echo

2. Experiment to calculate the speed of sound



1 cm → 10ms
5cm → 50 ms
=0.05s → the time period taken for sound wave to travel the 15 m between the two mics

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

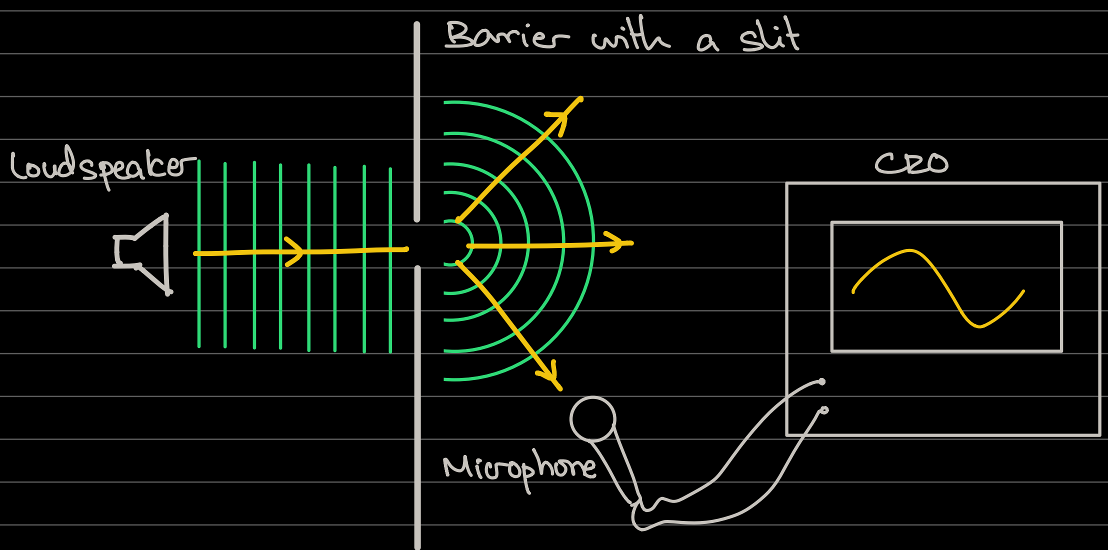
$$\text{speed} = \frac{15}{0.05}$$

$$= 300\,ms^{-1}$$

↳ the calculated speed of sound

DIFFRACTION EXPERIMENTS

EXPERIMENT TO SHOW DIFFRACTION OF SOUND WAVES

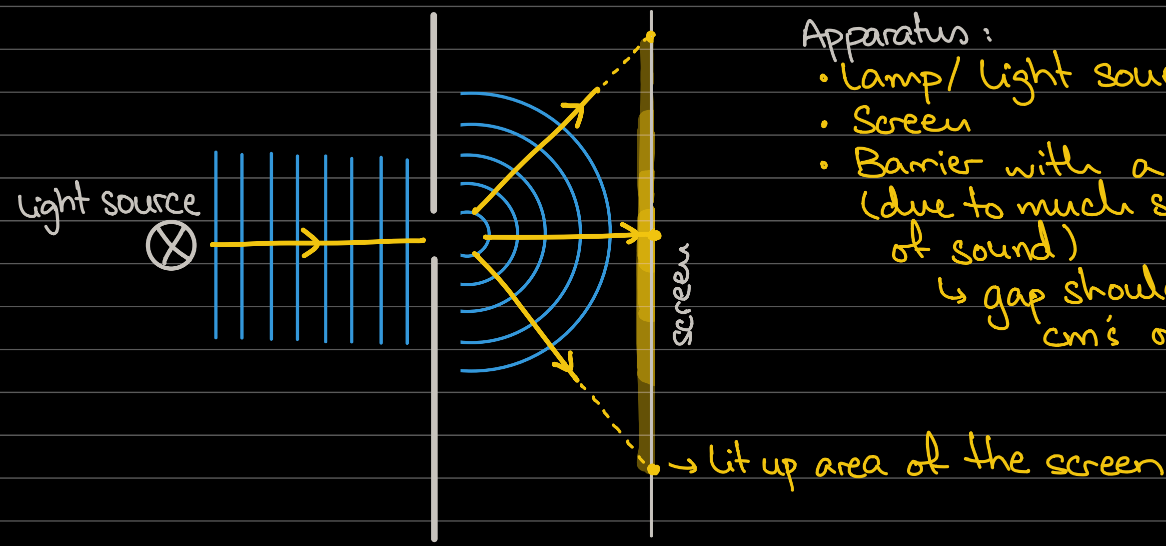


Apparatus Required
- Loudspeaker
- Receiver (Microphone + CRO)
- Barrier with an opening that's about 0.5m wide (roughly the wavelength of sound waves)

Precaution
- Sound proof room

Observation
- A waveform is displayed on the screen of the CRO indicating that sound undergoes diffraction

EXPERIMENT TO SHOW DIFFRACTION OF LIGHT WAVES



Apparatus:
- Lamp/ Light source
- Screen
- Barrier with a very small slit (due to much shorter wavelength of sound)
  ↳ gap should be of a few cm's or mm's

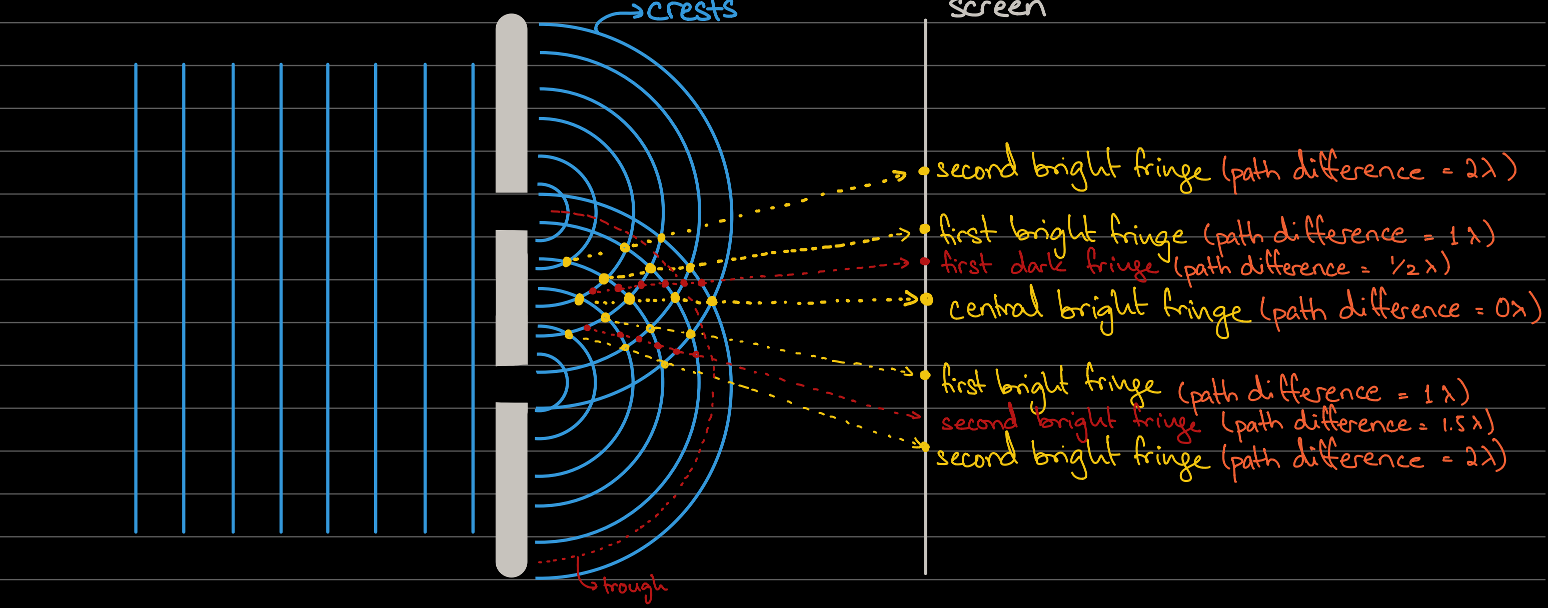
Observation: A large area on the screen is "Lit up", indicating that the light waves are spreading much beyond the width of the slit

YOUNG'S DOUBLE SLIT INTERFERENCE PATTERN : WAVES

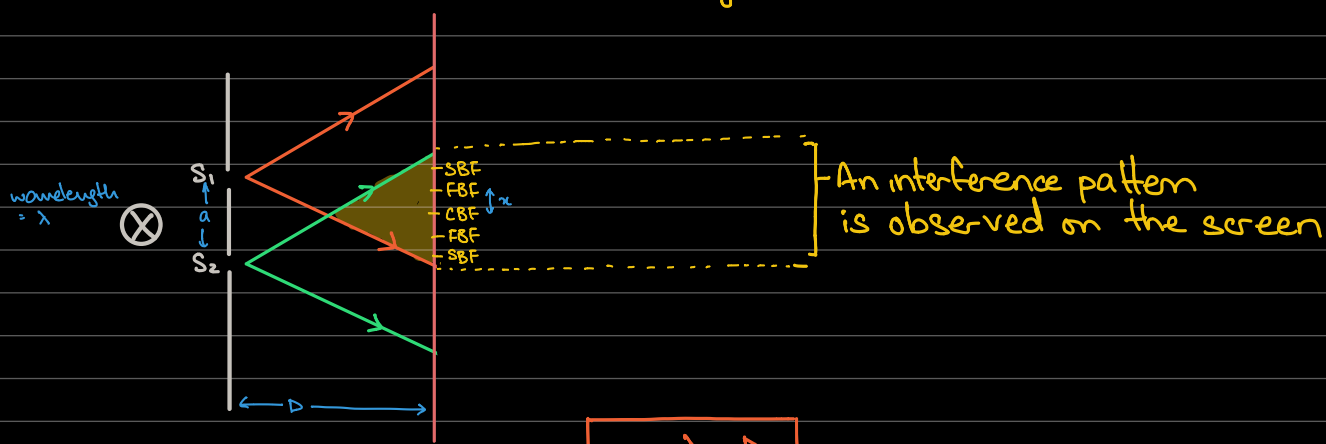
Purpose:
To observe the interference of light

Procedure:
- Light is allowed to pass through two slits S_1 and S_2.
- Diffraction occurs as shown below
- This causes light from one slit to interfere with the light from the other slit

Observation:
- Bright and dark spots, also called fringes, are seen on the screen
- Bright fringes will be observed due to constructive interference
- Dark fringes will be due to destructive interference



SIMPLIFIED VERSION
of the diagram



$$\boxed{x = \frac{\lambda \cdot D}{a}}$$

Typical values for λ, D, and a so that an interference pattern can be observed on the screen?

Learn the following typical values:

λ = 400nm (red) to 700nm (violet) (4×10^{-7}m to 7×10^{-7}m)

D = 1m to 3m

a = 0.5mm to 1.5mm

Example Question:

Q. Calculate the distance between two successive bright fringes using the following values:

$\lambda = 5 \times 10^{-7} m$, $D = 1.2 m$, $a = 0.75 mm$

$$x = \frac{D \cdot \lambda}{a}$$

$$x = \frac{(5 \times 10^{-7})(1.2)}{(0.75 \times 10^{-3})}$$

$x = 0.0008 m$ or $8 \times 10^{-4} m$ or $0.8 mm$

Q. Calculate the distance between two successive dark fringes
It is equal to x.
The distance between two bright fringes is equal to the distance between two successive dark fringes

Q. Calculate the distance between a bright fringe and the next dark fringe.

$\frac{1}{2}x$, because dark fringes occur exactly in the middle of two successive bright fringes, and vice versa