SPH4U UNIVERSITY PHYSICS

THE WAVE NATURE OF LIGHT

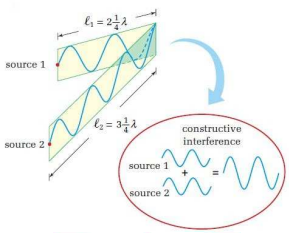
- Interference of Water Waves (P.462-469)

Interference

*When two waves cross paths and become superimposed, they interact in different ways. The interaction between waves in the same medium is called **interference**.*

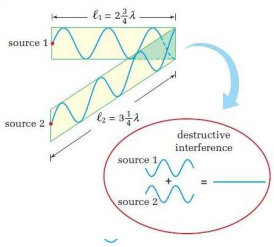
Interference

*If the crest of one wave coincides with the crest of the other, then the waves are in phase and combine to create a resultant wave with an amplitude that is greater than the amplitude of either individual wave. This phenomenon is called **constructive interference** and the point where the constructive interference occurs is referred to as an **anti-node**.*



Interference

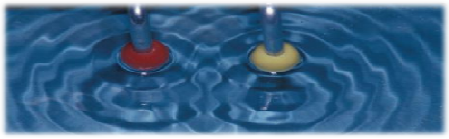
For two waves that differ in phase by ½λ (or 180°), the crest of one wave coincides with the trough of the other wave. The two waves combine and create a resultant wave with an amplitude that is smaller than either of the individual waves. This phenomenon is called ***destructive interference*** *and the point where the destructive interference occurs is referred to as a* ***node****.*



Interference

NOTE!

In order for interference to occur, the waves must have the same frequency and a fixed phase difference. Waves that meet this condition are said to be ***coherent****.*



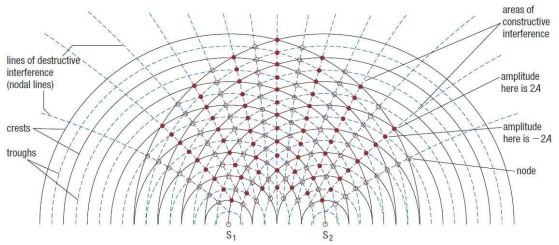
Interference

INTERFERENCE

- phenomenon that occurs when two waves in the same medium interact
- waves must be coherent (same frequency and a fixed phase difference)
- two types:
  - ① constructive – waves have displacements in the same direction
  - ② destructive – waves have displacements in opposite directions

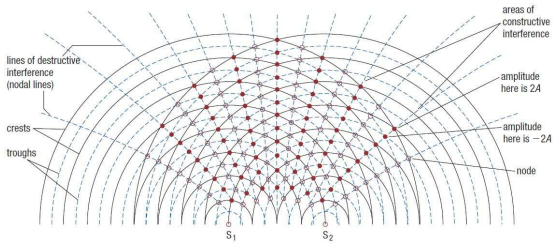
Two-Point Interference

In the diagram below, the two points sources are coherent (i.e. same frequency and phase) and have equal amplitudes. Successive wave fronts travel out from the two sources and interfere with each other, producing a symmetrical line pattern of constructive and destructive interference.



Two-Point Interference

*The interference pattern includes lines of maximum displacement (**anti-nodal lines**), caused by constructive interference, separated by lines of zero displacement (**nodal lines**), caused by destructive interference.*

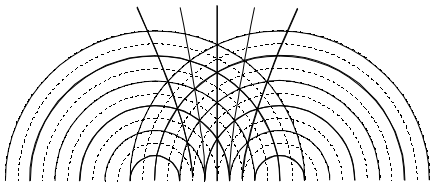


Two-Point Interference

PRACTICE

1. What happens to the pattern when the frequency increases?

- the nodal (and anti-nodal) lines come closer together
- the number of nodal (and anti-nodal) lines increases
- the symmetry of the pattern remains constant

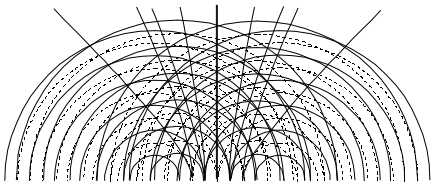


Two-Point Interference

PRACTICE

2. What happens when the distance between the sources increases?

- the nodal (and anti-nodal) lines come closer together
- the number of nodal (and anti-nodal) lines increases
- the symmetry of the pattern remains constant

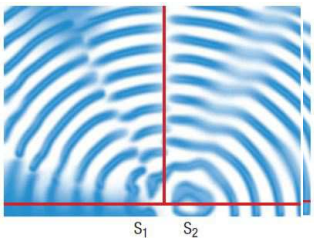


Two-Point Interference

PRACTICE

3. What happens when the relative phase of the two sources changes.

the pattern shifts, but the number of nodal lines stays the same

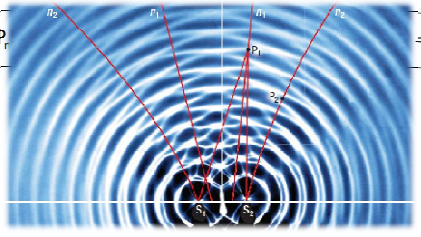


Two-Point Interference – The Mathematics

NOTE!

You can measure wavelength using the interference pattern produced by two point sources and develop some mathematical relationships for studying the interference of other waves.

$$|P_nS_1 - P_nS_2| = \left(\frac{x_n}{L}\right)$$



✔ Check Your Learning

TEXTBOOK

P.468 Q.1-3

WIKI (LIGHT)

✎.... 4U4 - WS#1 (2-Point Interference)