

CH 21-5 – Interference and Path Difference

Important Ideas

- Suppose that there are two sources of sinusoidal waves that are in phase and produce waves with the same frequency. (Being in phase means that they produce a peak at the same instant.) If the difference between the distance from one source to a location and the distance from the second source to the same location is equal to an integer multiple of the wavelength, then the waves will give total (or complete) constructive interference at this location.

$$\text{Constructive Interference:} \quad \text{path-length difference} = |L_1 - L_2| = \Delta L = m\lambda$$

If the difference in the distance from two sources to a location in space is equal to a half-integer multiple of the wavelength, the waves will give total (or complete) destructive interference at this location.

$$\text{Destructive Interference:} \quad \text{path-length difference} = |L_1 - L_2| = \Delta L = \left(m + \frac{1}{2}\right)\lambda$$

In the equations above, $m = 0, 1, 2, \dots$

1. If these two waves add together, will the result be constructive or destructive interference?

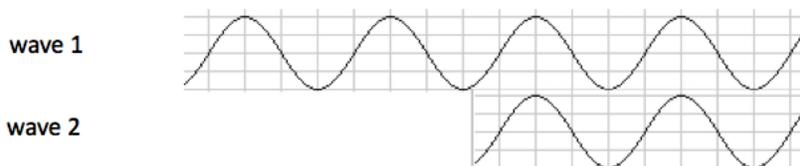


Figure 1: Superposition of two sinusoidal waves.

2. What is the path difference (in terms of λ) between the two waves in the previous question?
3. If these two waves add together, will the result be constructive or destructive interference?

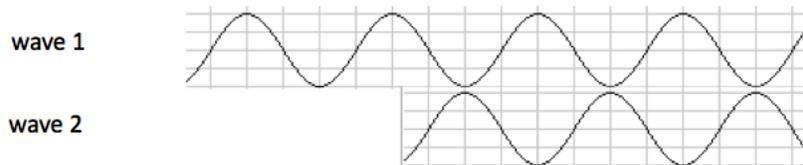


Figure 2: Superposition of two sinusoidal waves.

4. What is the path difference (in terms of λ) between the two waves in the previous question?

5. Suppose that two speakers are lined up to both emit sound in the same direction along the $+x$ axis. If they each emit sound of frequency 100 Hz and are in phase, what is the smallest distance between the speakers so that you won't hear any sound along the $+x$ axis?

6. Suppose that two speakers are lined up along the $+x$ axis but are facing the $+y$ direction. The speakers are 3 m apart and emit sound in phase. If you stand 4 m directly in front of one speaker, what frequency will result in total destructive interference?