

Model: Single Waves**Act 8.1.8 Wave Wrap-Up: FNT 1 & 2ab(No Activity Sheet)****(~60 min)****Learning Goals:**

- Solidify understanding of the graphical representation of a wave
- Solidify understanding of how to move from a graphical representation to an algebraic representation
- Solidify understanding of the wavefront representation of a wave

Model: Superposition of Waves**Act 8.2.1 Introduction to Superposition of Waves****(~30 min)****Learning Goals:**

- Getting the picture of superposition of waves being two waves at the same point at the same time
- Understanding that the wave displacements add algebraically when waves interfere:
 $y_{\text{tot}}(x,t) = y_1(x,t) + y_2(x,t)$
- Understanding the various terms and terminology used to express the result of superposition: constructive interference, destructive interference, partial interference

Act 8.2.2 Interference with Sound Waves I**(~70 min)****Learning Goals:**

- To get acquainted with interference effects that occur when superposing sound waves of the same frequency
- Understand how the total phase difference $\Delta\Phi(x,t)$ can depend on the fixed phase constant difference $\Delta\Phi$ alone
- Understand how the total phase difference $\Delta\Phi(x,t)$ can depend on the path length difference Δx alone
- Connecting the total phase difference $\Delta\Phi(x,t)$ to constructive and destructive interference

For Questions 1 through 3: Choose a multiple choice answer and write **at least one sentence** explaining your reasoning.

1) (Solidification) Two 1-D waves of amplitude A and period T and constant phase ϕ are superposed. If wave 1 travels 13.5 wavelengths farther than wave 2, will the interference be:

- A. constructive B. destructive C. partial

2) (Solidification) Two 1-D waves of amplitude A and period T are superposed. The difference between their fixed phase constants, $\Delta\phi$, is $1/2$ cycle (π or 180°). If wave 2 travels 37 wavelengths farther than wave 1, will the interference be:

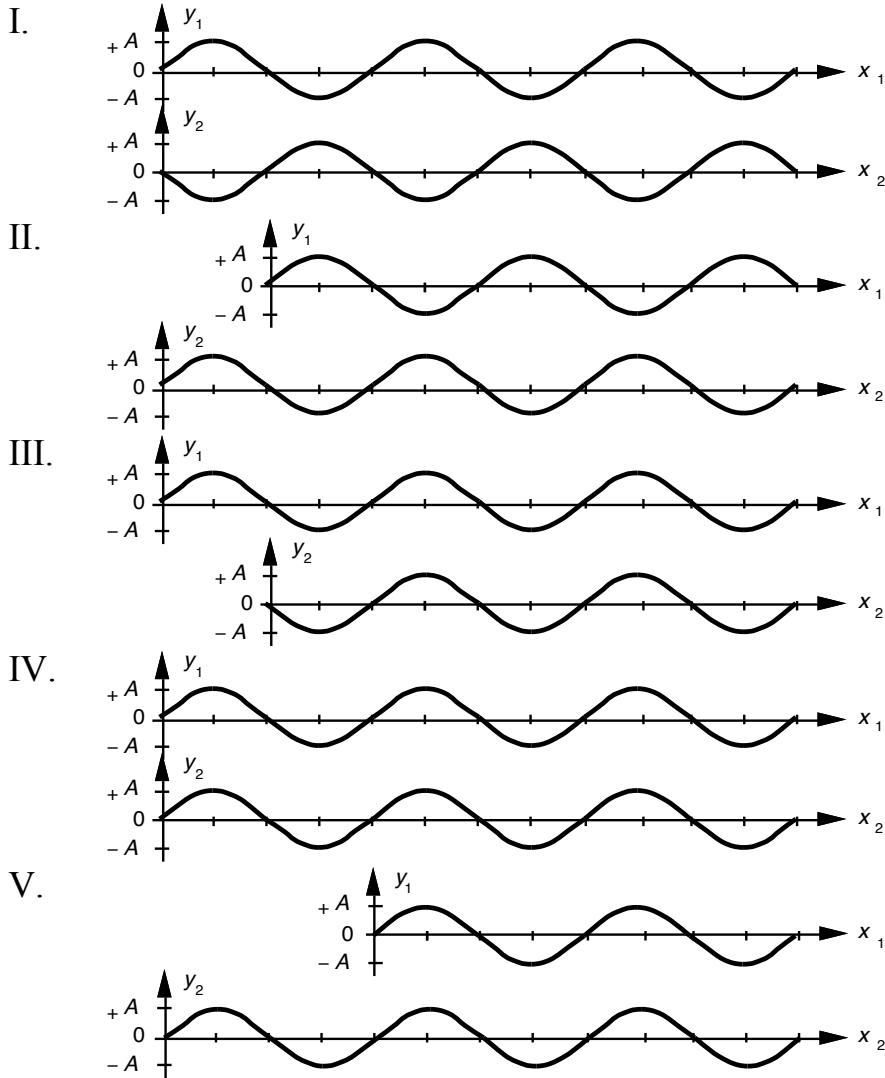
- A. constructive B. destructive C. partial

3) (Solidification) If there is no difference between the fixed phase constants of two 1-D waves with the same frequency, then which of the following path length differences would lead to completely *constructive* interference?

- A. $\Delta x = 0$ C. $\Delta x = \lambda$ E. $\Delta x = 2\lambda$
 B. $\Delta x = 0.5\lambda$ D. $\Delta x = 1.5\lambda$

4) (Application) This problem is based on Activity 8.2.2. Each pair of 1-D $y(x)$ graphs shown below represents sound waves superposed from a pair of speakers. All graphs end at the same point in space, but may start at different places.

FNT 4 Graphs



- a) In each case, describe the speaker setup that would create the sound waves shown in the graphs. That is, are the speakers wired the same way or oppositely? Are they standing face to face or separated by a distance (what distance?). A sample description is “Two speakers are plugged into the same wave function generator, *wired oppositely*, both facing you, but one speaker is *a full wavelength* in front of the other.” Explain how you can tell.
- b) Below is a list of parameters. Match each parameter set to the physical descriptions you wrote in part a.
- c) What type of interference does each speaker setup create? Explain your answer in two ways:
- i) Using a phase chart to find total phase
 - ii) Using the graphs

FNT 4 Parameters:

- 1) $x_1 = x; x_2 = x + \lambda$
 $\phi_1 = \phi_2$
- 2) $x_1 = x; x_2 = x$
 $\phi_1 = \phi_2 + \pi$
- 3) $x_1 = x; x_2 = x + \lambda/2$
 $\phi_1 = \phi_2$
- 4) $x_1 = x; x_2 = x$
 $\phi_1 = \phi_2$
- 5) $x_1 = x + \lambda/2; x_2 = x$
 $\phi_1 = \phi_2 + \pi$