Model: Plane Waves

Act 8.1.5 Phase Chart Representation of a Wave (~20 min)

Learning Goals:

- Solidify idea of the total phase $\Phi(x,t)$
- Introduction to Phase Charts representation

Act 8.1.6 Solidifying Plane Waves: FNTs 2-6 (No Activity Sheet) (~70 min)

Learning Goals:

- Understand how to separately analyze relevant parts of the wave equation
- Understand how to use apply the ideas of the Plane Waves model to a physical situation

Act 8.1.7 Wavefront Representation of a Wave (~50 min)

Learning Goals:

- Understand that a sound wave is fluctuating pressure in a medium
- Understand that energy is transmitted via waves
- Understand the relationship between the power of a wave and the energy of a wave
- Understand the relationship between the power of a wavefront and the intensity of a wavefront

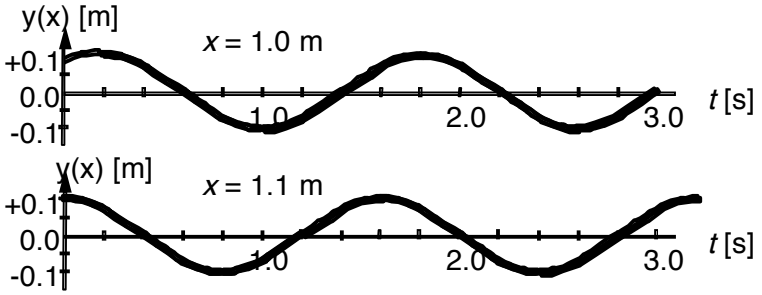
Reading Assignment

- Start reading the second portion of the Course Notes (8-2) on Superposition and Interference.
- A reminder: You may only miss one DLM. You may make up in another lab up to three times in the quarter.

0) Finish any parts of today's activities that you did not complete in DL.

1) (Challenge)

(Similar to FNT 6 from DLM02)
Two graphs depict a one-dimensional water wave, as a function of time, for *two separate positions*. The top graph represents x = 1.0 m and the bottom graph represents x = 1.1 m.

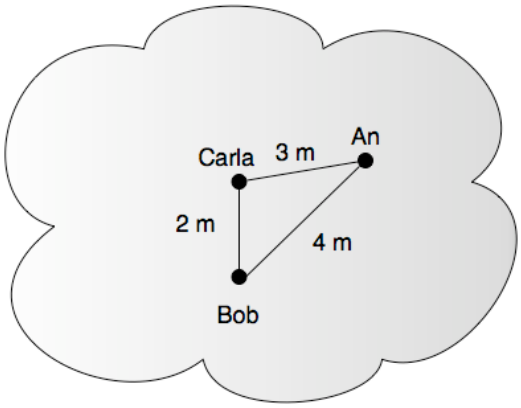


a) Provide a detailed description of how you know which direction the wave is traveling. This includes a careful description of what the graphs represent. Also, be prepared to describe what assumption(s) you are making in order to answer the questions. (Comment: Once you can make clear, well-thought descriptions for the above, you can feel comfortable that you have a pretty good understanding of the graphical representation of 1-D simple harmonic waves.)

b) Write an equation of the motion y(x,t) for this wave. Specify values of A, T, λ, and ϕ.

2) (Application/Introduction) Three people (An, Bob, and Carla) are in a very still pond. Bob generates waves by moving up and down in the water. The speed of water waves in this pond is 3 m/s.

a) Suppose it takes Bob 4/3 seconds to travel through a cycle. Determine the wavelength of the resulting waves and use the wavefront representation to draw in the wave crests and troughs generated by Bob. Label the wavelength on your sketch.



b) Compare the motion of An and Carla. Be as detailed as possible. (i.e. Do they move up and down at the same rate? Are they both at a crest at the same time?)

c) The group allows the water to become calm, then An and Carla move up and down with the same frequency as each other (different from Bob's in part b), starting their motion at the same instant. They wish to team up so that each person's wave crests arrive at Bob at the same time. With what frequency should they move? (Note that more then one answer is possible—you only need to find one possibility!)

d) Use the wavefront representation to draw in the wave crests and troughs generated by An and by Carla. Please do this on a different sketch than you used for part a!

e) Describe Bob's motion in a sentence or two (no equation necessary). How does his motion differ from how it would be if only Carla were making waves?