PHY250: 1D Waves - Examples

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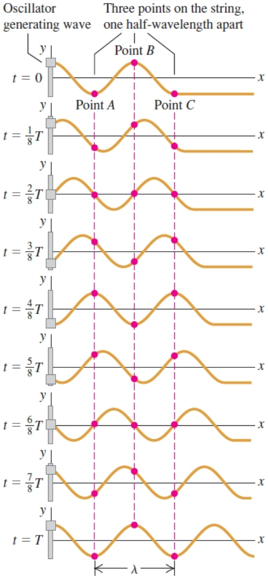
Fall 2021

Example 1



(a) At which time is point A on the string moving upward with maximum speed? (b) At which time does point B on the string have the greatest upward acceleration? (c) At which time does point C on the string have a downward acceleration but an upward velocity?

Example 2

One type of steel has density $\rho = 7.8 \times 10^3\ kg/m^3$ and will break if the tensile stress exceeds $7 \times 10^8\ N/m^2$. You want to make a guitar string from 4.0 g of this type of steel. In use, the guitar string must be able to withstand a tension of 900 N without breaking. Your job is the following: (a) Determine the maximum length and minimum radius the string can have. (b) Determine the highest possible fundamental frequency of standing waves on this string, if the entire length of the string is free to vibrate.

Example 3

Two waves travel on the same string. Is it possible for them to have (a) different frequencies; (b) different wavelengths; (c) different speeds; (d) different amplitudes; (e) the same frequency but different wavelengths? Explain your reasoning.

Example 4

A tuning fork produces a steady 400 Hz tone. When this tuning fork is struck and held near a vibrating guitar string, twenty beats are counted in five seconds. What are the possible frequencies produced by the guitar string?

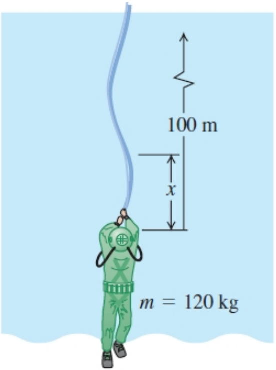
Example 5

While a guitar string is vibrating, you gently touch the midpoint of the string to ensure that the string does not vibrate at that point. Which normal modes cannot be present on the string while you are touching it in this way?

Example 6

When a massive aluminum sculpture is hung from a steel wire, the fundamental frequency for transverse standing waves on the wire is 250.0 Hz. The sculpture (but not the wire) is then completely submerged in water. (a) What is the new fundamental frequency? (b) Why is it a good approximation to treat the wire as being fixed at both ends?

Example 7



A deep-sea diver jerks the end of the cable back and forth to send transverse waves up the cable as a signal to his companions in the boat. (a) What is the tension in the cable at its lower end, where it is attached to the diver? (b) Calculate the tension in the cable a distance x above the diver. (c) Find the time required for the first signal to reach the surface.
(The volume, the mass of the diver are known and the cross section of the cable too.)

Example 8