Chapter 15 Tutorial

Waves I

Chapter 15 : Mechanical Waves

Question 1: On December 26, 2004, a great earthquake occurred off the coast of Sumatra and triggered immense waves (tsunami) that killed some 200,000 people. Satellites observing these waves from space measured 800 km from one wave crest to the next and a period between waves of 1.0 hour. What was the speed of these waves in m/s and in km/h? Does your answer help you understand why the waves caused such devastation?

Question 2: A transverse wave on a string has amplitude 0.300 cm, wavelength 12.0 cm, and speed 6.00 cm/s. It is represented by following equation.

$$y(x,\ t) = A\ \mathrm{Cos}\left[\frac{2\pi}{\lambda}(x - vt)\right]$$

(a) At time t = 0, compute y at 1.5-cm intervals of x (that is, x = 0, x = 1.5 cm, x = 3 cm, and so on) from x = 0 to x = 12 cm. Graph the results. This is the shape of the string at time t = 0.

(b) Repeat the calculations for the same values of x at times t = 0.400 s and t = 0.800s. Graph the shape of the string at these instants. In what direction is he wave travelling?

Question 3: A 1.50-m string of weight 0.0125 N is tied to the ceiling at its upper end, and the lower end supports a weight W. Neglect the very small variation in tension along the length of the string that is produced by the weight of the string. When you pluck the string slightly, the waves traveling up the string obey the equation

$$y(x,\ t) = (8.50\ \mathrm{mm})\ \mathrm{Cos}(172\ \mathrm{m^{-1}}x\ -\ 4830\ \mathrm{s^{-1}}t)$$

Assume that the tension of the string is constant and equal to W.

(a) How much time does it take a pulse to travel the full length of the string?

(b) What is the weight W?

(c) How many wavelengths are on the string at any instant of time?

(d) What is the equation for waves traveling down the string?

Question 4: A piano wire with mass 3.00 g and length 80.0 cm is stretched with a tension of 25.0 N. A wave with frequency 120.0 Hz and amplitude 1.6 mm travels along the wire.

(a) Calculate the average power carried by the wave.

(b) What happens to the average power if the wave amplitude is halved?