**Chapter-16**

1. A seismographic station receives S and P waves from an earthquake, separated in time by 17.3 s. Assume the waves have traveled over the same path at speeds of 4.50 km/s and 7.80 km/s. Find the distance from the seismograph to the focus of the quake

 The distance the waves have traveled is *d* = (7.80 km/s)*t* =
(4.50 km/s)(*t* + 17.3 s), where *t* is the travel time for the faster wave.

 Then, 

 or 

 and the distance is 

1. A sinusoidal wave traveling in the negative x direction (to the left) has an amplitude of 20.0 cm, a wavelength of 35.0 cm, and a frequency of 12.0 Hz. The transverse position of an element of the medium at t 5 0, x 5 0 is y 5 23.00 cm, and the element has a positive velocity here. We wish to find an expression for the wave function describing this wave. (a) Sketch the wave at t 5 0. (b) Find the angular wave number k from the wavelength. (c) Find the period T from the frequency. Find (d) the angular frequency v and (e) the wave speed v. (f) From the information about t 5 0, find the phase constant f. (g) Write an expression for the wave function y(x, t).

 (a) ANS. FIG. P16.8 (a) shows a sketch of the wave at *t* = 0.

 

ans FIG. P16.8 (a)

 (b) 

 (c) 

 (d) 

 (e) 

 (f)  specializes to

 

 (g) At x = 0, t = 0 we require

 

 so

 

1. Transverse waves are being generated on a rope under constant tension. By what factor is the required power increased or decreased if (a) the length of the rope is doubled and the angular frequency remains constant, (b) the amplitude is doubled and the angular frequency is halved, (c) both the wavelength and the amplitude are doubled, and (d) both the length of the rope and the wavelength are halved?

 We are given T = constant; we use the equation for the speed of a wave on a string,  and the power supplied to a vibrating string,  (a) If *L* is doubled, *μ* is still the same, so v remains constant: therefore *P* is constant: 

 (b) If *A* is doubled and *ω* is halved,  remains constant: 

 (c) If *λ* and *A* are doubled, the product  remains constant, so 

 (d) If *L* and *λ* are halved, *μ* is still the same, and  is quadrupled, so *P* 

1. A sinusoidal sound wave moves through a medium and is described by the displacement wave function

 s(x, t) = 2.00 cos (15.7x - 858t)

where s is in micrometers, x is in meters, and t is in seconds.Find (a) the amplitude, (b) the wavelength, and (c) the speed of this wave. (d) Determine the instantaneous displacement from equilibrium of the elements of the medium at the position x = 0.050 0 m at t = 3.00 ms. (e) Determine the maximum speed of the element’s oscillatory motion.

 (a) 

 (b) 

 (c) 

 (d) 

 (e) 

1. A 150-g glider moves at v1 5 2.30 m/s on an air track toward an originally stationary 200-g glider as shown in Figure P16.53. The gliders undergo a completely inelastic collision and latch together over a time interval of 7.00 ms. A student suggests roughly half the decrease in mechanical energy of the two-glider system is transferred to the environment by sound. Is this suggestion reasonable? To evaluate the idea, find the implied sound level at a position 0.800 m from the gliders. If the student’s idea is unreasonable, suggest a better idea.

The gliders stick together and move with final speed given by momentum conservation for the two-glider system:

 

 The missing mechanical energy is

 

 We imagine one-half of 227 mJ going into internal energy and half into sound radiated isotropically in 7.00 ms. Its intensity 0.800 m away is

 

 Its intensity level is

 

 