CHAPTER 16

Q1 A sinusoidal wave, given by the equation: $y(x,t) = 0.07 \cos(6.0\, x - 30\, t)$, Where x and y are in meters and t is in seconds, is moving in a string of linear density = 1.2 g/m. At what rate is the energy transferred by the wave? Ans: 1.32×10^{-2} W.

Q2 A wave in a string, of linear density 0.13 g/m, is given by the equation: $y(x,t) = 0.018 \sin(3.0\, x - 24\, t)$, where x and y are in meters and t is in seconds. The tension in the string is: Ans: 8.32×10^{-3} N.

Q3 Two identical sinusoidal waves, are out of phase with each other, travel in the same direction. They interfere and produce a resultant wave given by the equation: $y(x,t)= 8.0\times10^{-4} \sin(4.0\, x - 8.0\, t + 1.57 \text{ rad})$,where x and y are in meters and t is in seconds. What is the amplitude of the two interfering waves? Ans: 0.5 m.

Q4 A string has linear density = 5.1 g/m and is under a tension of 120 N. If the vibrating length of the string is 60 cm, what is the lowest resonant frequency? Ans: 128 Hz.

Q5 A water wave is described by the equation: $y(x,t) = 0.40 \cos[0.10(x + 3t)]$, where x and y are in meters and t is in seconds. The maximum transverse speed of the water molecules is Ans: 0.12 m/s.

Q6 Two identical waves, moving in the same direction, have a phase difference of $\pi/2$. The amplitude of each of the two waves is 0.10 m. If they interfere, then the amplitude of the resultant wave is: Ans 0.14 m.

Q7 A wave of speed 20 m/s on a string, fixed at both ends, has an equation for a standing wave given by: $y(x,t) = 0.05 \sin(k\, x) \cos(30\, t)$, where x and y are in meters and t is in seconds. What is the distance between two consecutive nodes? Ans: 2.1 m.

Q8 A 40 cm string of linear mass density 8.0 g/m is fixed at both ends. The string is driven by a variable frequency audio oscillator ranged from 300 Hz to 800 Hz. It was found that the string is set in oscillation only at the frequencies 440 Hz and 660 Hz. What is the tension in the string? Ans: 248 N.

Q9 Consider a wave described by the equation: $y(x,t) = A \cos(kx-wt)$. At t = 0, the displacement is zero at x= Ans: 1/4 wavelength, 3/4 wavelength, . . .

Q10 A wave in a string, is given by the equation: $y(x,t) = 0.24\sin(3.0x-24t)$, where x and y are in meters and t is in seconds. Calculate the magnitude of the transverse speed at x = 2.0 m and t = 1.0 s. Ans: 3.8 m/s.

Q11 A transverse sinusoidal wave is traveling on a string with a speed of 300 m/s. If the wave has a frequency of 100 Hz, what is the phase difference between two particles on the string that are 85 cm apart? Ans: 1.8 radians.

Q12 A 50 cm long string with a mass of 0.01 kg is stretched with a tension of 18 N between two fixed supports. What is the resonant frequency of the longest wavelength on this string? Ans: 30 Hz.

Q13 A transverse sinusoidal wave of frequency 100 Hz is traveling along a stretched string with a speed of 20.0 m/s. What is the shortest distance between a crest and a point of zero transverse acceleration? Ans: 0.05 m.

Q14 A sinusoidal wave of frequency 400 Hz has a speed of 330 m/s. How far apart are two points that differ in phase by π/2? Ans: 0.206 m

Q15 The equation for a transverse wave on a string is: $y(x,t) = 0.025[\sin(25x - 500t)]$, where x and y are in meters and t is in seconds. The tension in the string is 20 N. Find the linear density of this string. Ans: 0.05 kg/m

Q16 Sinusoidal waves are generated on a string under constant tension by a source vibrating at a constant frequency. If the power delivered by the vibrating source is reduced to one half of the initial value, what is the ratio of the final amplitude to the initial amplitude? Ans: 0.71

Q17 Two identical sinusoidal traveling waves are moving in the same direction along a stretched string. The amplitude of the resultant wave is 1.80 times that of the common amplitude of the two combining waves. What is the phase difference between the two waves? Ans: 51.7 degrees

Q18 A string fixed at both ends vibrates in three loops. The string has a length of 1.0 m, a mass of 8.0 g and is under a tension of 15 N. What is the frequency? Ans: 65 Hz

Q19 A transverse sinusoidal wave travels along a string of linear mass density 5.00 g/m. The amplitude of the wave is 2.00 cm, its frequency is 60.0 Hz, and the tension in the string is 20.0 N. What is the power transmitted by this wave? Ans: 8.99 W

Q20 The equation of a wave traveling along a string, under a tension of 10 N, is given by: $y = (6.0\text{ cm})\sin(0.02\pi x+40.0\pi t)$, where x is in centimeters and t is in seconds. Determine the mass per unit length of the string. Ans: 25 g/m

Q21 A transverse sinusoidal wave traveling in the negative x direction has an amplitude of 10.0 cm, a wavelength of 20.0 cm, and a frequency of 8.00 Hz. Write the expression for y as a function of x(in meters) and t(in seconds)if y(0,0) = 10.0 cm. Ans: $y = (0.1\text{ m})\sin[31.4x+50.3t+(\pi/2)]$

Q22 A sinusoidal transverse wave travels along a string. The time for a particle on the string to move from maximum displacement to zero displacement is 0.170 seconds. What is the frequency of the source? Ans: 1.47 Hz

Q23 The equation of a transverse wave traveling along a stretched string is given by: $y(x,t) = (2.0\text{ mm})\sin(20x - 600t)$, where x is in meter and t in sec. What is the transverse speed at x = 1 m and t = 0.5 seconds? Ans: 1.1 m/s

Q24 The speed of a transverse wave on a string is 170 m/s when the tension in the string is 120 N. What must be the tension to produce waves with a speed of 180 m/s if the amplitude is doubled? Ans: 135 N