

Chapter 15 and 16 Tutorial

Waves I & II

Chapter 15 : Mechanical Waves

Chapter 16: Sound and Hearing

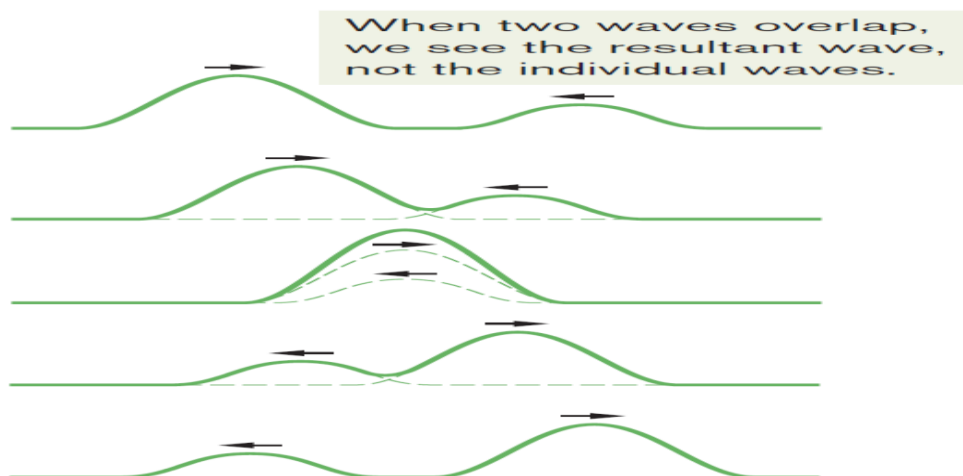
Question 1: A certain transverse wave is described by;

$$y(x, t) = (6.50 \text{ mm}) \cos 2\pi \left(\frac{x}{28.0 \text{ cm}} - \frac{t}{0.0260 \text{ s}} \right)$$

Determine the wave's

- (a) Amplitude
- (b) Wavelength
- (c) Frequency
- (d) Speed of propagation
- (e) Direction of propagation

Question 2: Discuss in few line the figure below in reference to principle of superposition, also write suitable mathematical equation in support to support your explanation (assume wave travelling from left to right is having amplitude of y_1 and wave travelling from right to left to left is having amplitude of y_2).



Question 3: 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?

Question 4: A flexible stick 2.0 m long is not fixed in any way and is free to vibrate. Make clear drawings of this stick vibrating in its first three harmonics, and then use your drawings to find the wavelengths of each of these harmonics. (Hint: Should the ends be nodes or antinodes?)

Question 5: Three pieces of string, each of length L , are joined together end to end, to make a combined string of length $3L$. The first piece of string has mass per unit length μ_1 the second piece has mass per unit length $\mu_2 = 4\mu_1$ and the third piece has mass per unit length $\mu_3 = \mu_1/4$.

- (a) If the combined string is under tension F , how much time does it take a transverse wave to travel the entire length $3L$? Give your answer in terms of L , F , and μ_1 .
- (b) Does your answer to part (a) depend on the order in which the three pieces are joined together? Explain.

Question 6: A 1.50m long rope is stretched between two supports with a tension that makes the speed of transverse waves 48 m/s. What are the wavelength and frequency of;

- (a) the fundamental.
- (b) the second overtone.
- (c) the fourth harmonic?

Question 7: An airplane is flying at Mach 1.75 at an altitude of 8000m, where the speed of sound is 320 m/s. How long after the plane passes directly overhead will you hear the sonic boom? As shown in figure below.

Question 8: A jet plane flies overhead at Mach 1.70 and at a constant altitude of 950 m.

- (a) What is the angle of the shock-wave cone?
- (b) How much time after the plane passes directly overhead do you hear the sonic boom? Neglect the variation of the speed of sound with altitude.

Question 9: Define Mach number, and also write its mathematical formula and explain in few lines that what it indicates if Mach number >1 , Mach number <1 , Mach number $= 1$?

Question 10: A swimming duck paddles the water with its feet once every 1.6 s, producing surface waves with this period. The duck is moving at constant speed in a pond where the speed of surface waves is 0.32 m/s, and the crests of the waves ahead of the duck are spaced 0.12 m apart.

- (a) What is the duck's speed?
- (b) How far apart are the crests behind the duck?

Question 11: What is mean by red shift and blue shift of electromagnetic waves, explain on the basis of Doppler effect.

Question 12: A standing wave with a frequency of 1100 Hz in a column of methane (CH_4) at 20.0°C produces nodes that are 0.200 m apart. What is the value of Y for methane? (The molar mass of methane is 16.0 g/mol.)