

KEY EQUATIONS

13.2 Wave Properties: Speed, Amplitude, Frequency, and Period

wave velocity $v_w = \frac{\lambda}{T}$ or $v_w = f\lambda$

period $T = \frac{1}{f}$

frequency $f = \frac{1}{T}$

CHAPTER REVIEW

Concept Items

13.1 Types of Waves

- Do water waves push water from one place to another? Explain.
 - No, water waves transfer only energy from one place to another.
 - Yes, water waves transfer water from one place to another.
- With reference to waves, what is a trough?
 - the lowermost position of a wave
 - the uppermost position of a wave
 - the final position of a wave
 - the initial position of the wave
- Give an example of longitudinal waves.
 - light waves
 - water waves in a lake
 - sound waves in air
 - seismic waves in Earth's surface
- What does the speed of a mechanical wave depend on?
 - the properties of the material through which it travels
 - the shape of the material through which it travels
 - the size of the material through which it travels
 - the color of the material through which it travels

13.2 Wave Properties: Speed, Amplitude, Frequency, and Period

- Which characteristic of a transverse wave is measured along the direction of propagation?
 - The amplitude of a transverse wave is measured along the direction of propagation.
 - The amplitude and the wavelength of a transverse wave are measured along the direction of propagation.
 - The wavelength of a transverse wave is measured along the direction of propagation.
 - The displacement of the particles of the medium in a transverse wave is measured along the direction of propagation.

- What is the period of a wave?
 - the time that a wave takes to complete a half cycle
 - the time that a wave takes to complete one cycle
 - the time that a wave takes to complete two cycles
 - the time that a wave takes to complete four cycles
- When the period of a wave increases, what happens to its frequency?
 - Its frequency decreases.
 - Its frequency increases.
 - Its frequency remains the same.

13.3 Wave Interaction: Superposition and Interference

- Is this statement true or false? The amplitudes of waves add up only if they are propagating in the same line.
 - True
 - False
- Why is sound from a stereo louder in one part of the room and softer in another?
 - Sound is louder in parts of the room where the density is greatest. Sound is softer in parts of the room where density is smallest.
 - Sound is louder in parts of the room where the density is smallest. Sound is softer in parts of the room where density is greatest.
 - Sound is louder in parts of the room where constructive interference occurs and softer in parts where destructive interference occurs.
 - Sound is louder in parts of the room where destructive interference occurs and softer in parts where constructive interference occurs.

12. Is the following statement true or false? Refraction is useful in fiber optic cables for transmitting signals.
- False
 - True
13. What is refraction?
- Refraction is the phenomenon in which waves change their path of propagation at the interface of two media with different densities.
 - Refraction is the phenomenon in which waves change their path of propagation at the interface of two media with the same density.
 - Refraction is the phenomenon in which waves become non-periodic at the boundary of two media with different densities.
 - Refraction is the phenomenon in which waves become non-periodic at the boundary of two media with the same density.

Critical Thinking Items

13.1 Types of Waves

- 14.
15. Can mechanical waves be periodic waves?
- No, mechanical waves cannot be periodic waves.
 - Yes, mechanical waves can be periodic.

20. Two identical waves superimpose in pure constructive interference. What is the height of the resultant wave if the amplitude of each of the waves is 1 m?
- 1 m
 - 2 m
 - 3 m
 - 4 m

13.3 Wave Interaction: Superposition and Interference

13.2 Wave Properties: Speed, Amplitude, Frequency, and Period

18. If the horizontal distance, that is, the distance in the direction of propagation, between a crest and the adjacent trough of a sine wave is 1 m, what is the wavelength of the wave?
- 0.5 m
 - 1 m
 - 2 m
 - 4 m
21. Two identical waves with an amplitude X superimpose in a way that pure constructive interference occurs. What is the amplitude of the resultant wave?
- $\frac{X}{2}$
 - X
 - $2X$
 - X^2
- 22.
23. Which property of a medium causes refraction?
- Conductivity
 - Opacity
 - Ductility

- d. Density
24. What is added together when two waves superimpose?
- Amplitudes

Problems

13.2 Wave Properties: Speed, Amplitude, Frequency, and Period

25. If a seagull sitting in water bobs up and down once every 2 seconds and the distance between two crests of the water wave is 3 m, what is the velocity of the wave?
- 1.5 m/s
 - 3 m/s
 - 6 m/s

- Wavelengths
- Velocities

d. 12 m/s

26. A boat in the trough of a wave takes 3 seconds to reach the highest point of the wave. The velocity of the wave is 5 m/s. What is its wavelength?
- 0.83 m
 - 15 m
 - 30 m
 - 180 m

TEST PREP

Multiple Choice

13.1 Types of Waves

28. What kind of waves are sound waves?
- Mechanical waves
 - Electromagnetic waves
29. What kind of a wave does a tuning fork create?
- Pulse wave
 - Periodic wave
 - Electromagnetic wave
30. What kind of waves are electromagnetic waves?
- Longitudinal waves
 - Transverse waves
 - Mechanical waves
 - P-waves
31. With reference to waves, what is a *disturbance*?
- It refers to the resistance produced by some particles of a material.
 - It refers to an oscillation produced by some energy

that creates a wave.

- It refers to the wavelength of the wave.
- It refers to the speed of the wave.

13.2 Wave Properties: Speed, Amplitude, Frequency, and Period

32. Which of these is not a characteristic of a wave?
- amplitude
 - period
 - mass
 - velocity
33. If you are in a boat at a resting position, how much will your height change when you are hit by the peak of a wave with a height of 2 m?
- 0 m
 - 1 m
 - 2 m
 - 4 m
34. What is the period of a wave with a frequency of 0.5 Hz?

- a. 0.5 s
- b. 1 s
- c. 2 s
- d. 3 s

35. What is the relation between the amplitude of a wave and its speed?
- a. The amplitude of a wave is independent of its speed.
 - b. The amplitude of a wave is directly proportional to its speed.
 - c. The amplitude of a wave is directly proportional to the square of the inverse of its speed.
 - d. The amplitude of a wave is directly proportional to the inverse of its speed.

13.3 Wave Interaction: Superposition and Interference

37. What is added together when two waves superimpose?
- a. amplitudes
 - b. wavelengths
 - c. velocities
38. Pure constructive interference occurs between two waves when they have the same _____.

Short Answer

13.1 Types of Waves

43. Give an example of a non-mechanical wave.
- a. A radio wave is an example of a nonmechanical wave.
 - b. A sound wave is an example of a nonmechanical wave.
 - c. A surface wave is an example of a nonmechanical wave.
 - d. A seismic wave is an example of a nonmechanical wave.
44. How is sound produced by an electronic speaker?
- a. The cone of a speaker vibrates to create small changes in the temperature of the air.
 - b. The cone of a speaker vibrates to create small changes in the pressure of the air.
 - c. The cone of a speaker vibrates to create small changes in the volume of the air.

- a. frequency and are in phase
- b. frequency and are out of phase
- c. amplitude and are in phase
- d. amplitude and are out of phase

39. What kind(s) of interference can occur between two identical waves moving in opposite directions?
- a. Constructive interference only
 - b. Destructive interference only
 - c. Both constructive and destructive interference
 - d. Neither constructive nor destructive interference
40. What term refers to the bending of light at the junction of two media?
- a. interference
 - b. diffraction
 - c. scattering
 - d. refraction
41. Which parameter of a wave gets affected after superposition?
- a. wavelength
 - b. direction
 - c. amplitude
 - d. frequency

- d. The cone of a speaker vibrates to create small changes in the resistance of the air.

- 45.
46. Are all ocean waves perfectly sinusoidal?
- a. No, all ocean waves are not perfectly sinusoidal.
 - b. Yes, all ocean waves are perfectly sinusoidal.

- b. 2 m
- c. 0.5 m
- d. 1 m

13.2 Wave Properties: Speed, Amplitude, Frequency, and Period

49. What is the relation between the amplitude and height of a transverse wave?
- a. The height of a wave is half of its amplitude.
 - b. The height of a wave is equal to its amplitude.
 - c. The height of a wave is twice its amplitude.
 - d. The height of a wave is four times its amplitude.
50. If the amplitude of a water wave is 0.2 m and its frequency is 2 Hz, how much distance would a bird sitting on the water's surface move with every wave? How many times will it do this every second?
- a. The bird will go up and down a distance of 0.4 m. It will do this twice per second.
 - b. The bird will go up and down a distance of 0.2 m. It will do this twice per second.
 - c. The bird will go up and down a distance of 0.4 m. It will do this once per second.
 - d. The bird will go up and down a distance of 0.2 m. It will do this once per second.
51. What is the relation between the amplitude and the frequency of a wave?
- a. The amplitude and the frequency of a wave are independent of each other.
 - b. The amplitude and the frequency of a wave are equal.
 - c. The amplitude decreases with an increase in the frequency of a wave.
 - d. The amplitude increases with an increase in the frequency of a wave.
52. What is the relation between a wave's energy and its amplitude?
- a. There is no relation between the energy and the amplitude of a wave.
 - b. The magnitude of the energy is equal to the magnitude of the amplitude of a wave.
 - c. The energy of a wave increases with an increase in the amplitude of the wave.
 - d. The energy of a wave decreases with an increase in the amplitude of a wave.
53. A wave travels 2 m every 2 cycles. What is its wavelength?
- a. 4 m

13.3 Wave Interaction: Superposition and Interference

- 55.
56. Is this statement true or false? Waves can superimpose if their frequencies are different.
- a. True
 - b. False
57. When does pure destructive interference occur?
- a. When two waves with equal frequencies that are perfectly in phase and propagating along the same line superimpose.
 - b. When two waves with unequal frequencies that are perfectly in phase and propagating along the same line superimpose.
 - c. When two waves with unequal frequencies that are perfectly out of phase and propagating along the same line superimpose.
 - d. When two waves with equal frequencies that are perfectly out of phase and propagating along the same line superimpose.
58. Is this statement true or false? The amplitude of one wave is affected by the amplitude of another wave only when they are precisely aligned.
- a. True
 - b. False

61. Why do water waves traveling from the deep end to the shallow end of a swimming pool experience refraction?
- Because the pressure of water at the two ends of the pool is same
 - Because the pressures of water at the two ends of the pool are different

Extended Response

13.1 Types of Waves

63. Why can light travel through outer space while sound cannot?
- Sound waves are mechanical waves and require a medium to propagate. Light waves can travel through a vacuum.
 - Sound waves are electromagnetic waves and require a medium to propagate. Light waves can travel through a vacuum.
 - Light waves are mechanical waves and do not require a medium to propagate; sound waves require a medium to propagate.
 - Light waves are longitudinal waves and do not require a medium to propagate; sound waves require a medium to propagate.
64. Do periodic waves require a medium to travel through?
- No, the requirement of a medium for propagation does not depend on whether the waves are pulse waves or periodic waves.
 - Yes, the requirement of a medium for propagation depends on whether the waves are pulse waves or periodic waves.

13.2 Wave Properties: Speed, Amplitude, Frequency, and Period

66. A seagull is sitting in the water surface and a simple water wave passes under it. What sort of motion does the gull experience? Why?
- The gull experiences mostly side-to-side motion

- Because the density of water at the two ends of the pool is same
- Because the density of water at the two ends of the pool is different

and moves with the wave in its direction.

- The gull experiences mostly side-to-side motion but does not move with the wave in its direction.
- The gull experiences mostly up-and-down motion and moves with the wave in its direction.
- The gull experiences mostly up-and-down motion but does not move in the direction of the wave.

13.3 Wave Interaction: Superposition and Interference

69.

70. What happens when two dissimilar waves interfere?
- pure constructive interference
 - pure destructive interference
 - a combination of constructive and destructive interference

71.

72. Why does an object appear to be distorted when you view it through a glass of water?
- a. The glass and the water reflect the light in different directions. Hence, the object appears to be distorted.
 - b. The glass and the water absorb the light by different amounts. Hence, the object appears to be distorted.
 - c. Water, air, and glass are media with different densities. Light rays refract and bend when they pass from one medium to another. Hence, the object appears to be distorted.
 - d. The glass and the water disperse the light into its components. Hence, the object appears to be distorted.