Chapter 11 Waves Lecture Notes

Chapter 11

Objectives

**Fill-in the yellow printed words in your note packet

- **Distinguish** local particle vibrations from overall wave motion.
- **Differentiate** between pulse waves and periodic waves.
- **Interpret** waveforms of transverse and longitudinal waves.
- **Apply** the relationship among wave speed, frequency, and wavelength to solve problems.
- **Relate** energy and amplitude.

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Section 3 Properties of Waves

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Wave Motion

- A _____ is the motion of a disturbance.
- A _____ is a physical environment through which a disturbance can travel. For example, water is the medium for ripple waves in a pond.
- Waves that require a medium through which to travel are called _____**.** Water waves and sound waves are mechanical waves.
- _____ such as visible light do not require a medium.

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Wave Types

- A wave that consists of a single traveling pulse is called a _____**.**
- Whenever the source of a wave's motion is a periodic motion, such as the motion of your hand moving up and down repeatedly, a _____ is produced.
- A wave whose source vibrates with simple harmonic motion is called a _____**.** Thus, a sine wave is a special case of a periodic wave in which the periodic motion is simple harmonic.

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Section 3 Properties of Waves

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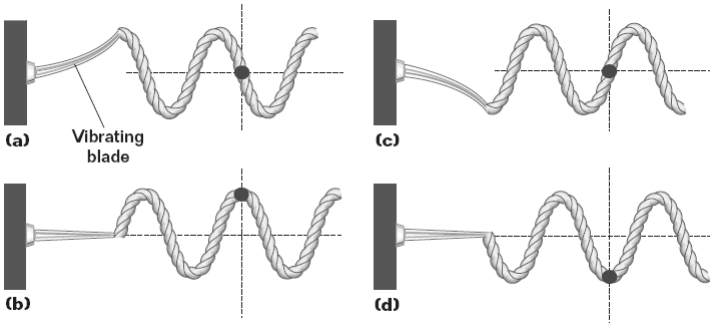
Relationship Between SHM and Wave Motion



As the sine wave created by this vibrating blade travels to the right, a single point on the string vibrates up and down with simple harmonic motion.

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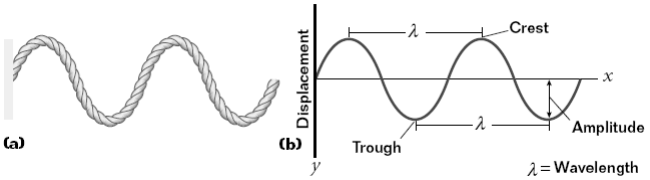
Wave Types, *continued*

- A _____ is a wave whose particles vibrate _____ to the direction of the wave motion.
- The _____ is the _____ point above the equilibrium position, and the _____ is the _____ point below the equilibrium position.
- The _____ is the distance between two adjacent similar points of a wave.



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Section 3 Properties of Waves

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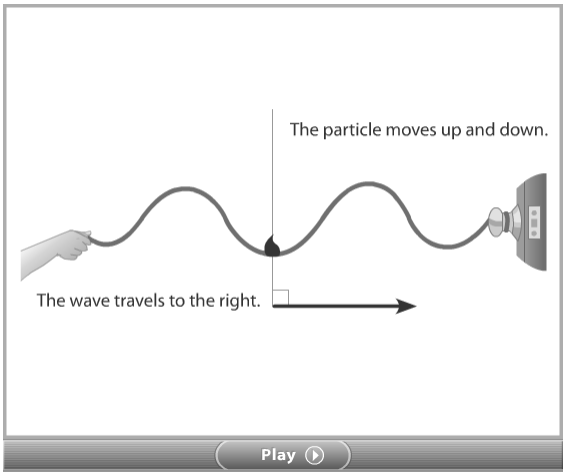
Transverse Waves



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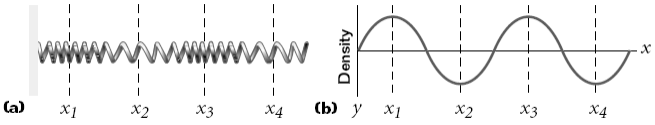
Wave Types, *continued*

- A _____ is a wave whose particles vibrate parallel to the direction the wave is traveling.
- A longitudinal wave on a spring at some instant *t* can be represented by a graph. The _____ correspond to compressed regions, and the _____ correspond to stretched regions.
- The _____ are regions of _____ (relative to the equilibrium density or pressure of the medium), and the _____ are regions of _____.



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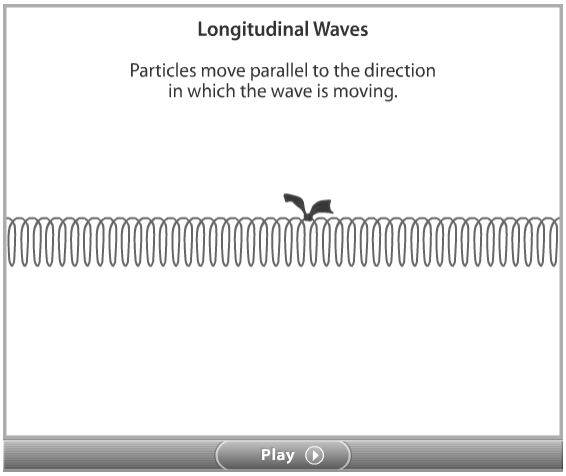
Longitudinal Waves



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Period, Frequency, and Wave Speed

- The _____ describes the number of waves that pass a given point in a unit of time.
- The _____ describes the time it takes for a complete wavelength to pass a given point.
- The relationship between period and frequency in SHM holds true for waves as well; the period of a wave is _____ to its frequency.

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Section 3 Properties of Waves

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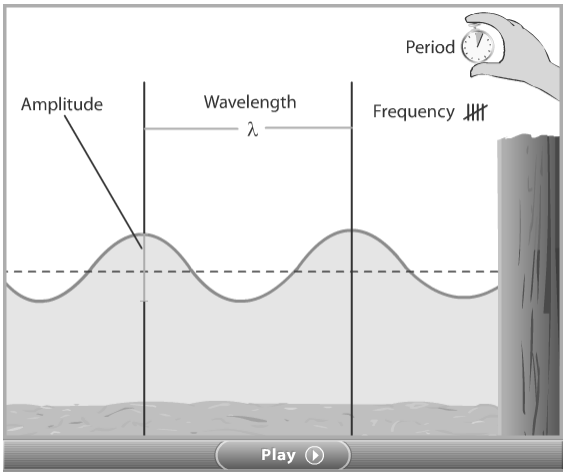
Characteristics of a Wave



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Period, Frequency, and Wave Speed, *continued*

- The _____ is constant for any given medium.
- The _____ is given by the following equation:

- This equation applies to both mechanical and electromagnetic waves.

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Section 3 Properties of Waves

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Waves and Energy Transfer

- Waves _____ by the vibration of matter.
- Waves are often able to transport energy efficiently.
- The rate at which a wave transfers energy depends on the _____.
  - _____ _____
  - _____ _____
- The amplitude of a wave gradually diminishes over time as its energy is dissipated.

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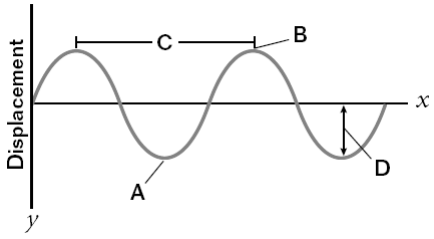
Multiple Choice, *continued*

Base your answers to questions 11–13 on the graph.



11. What kind of wave does this graph represent?

A. transverse wave
B. longitudinal wave
C. electromagnetic wave
D. pulse wave

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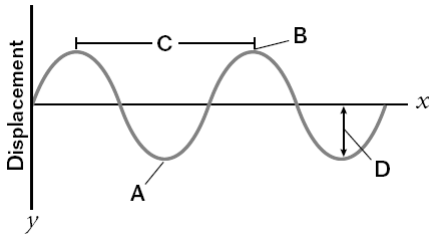
Multiple Choice, *continued*

Base your answers to questions 11–13 on the graph.



12. Which letter on the graph represents wavelength?

F. A
G. B
H. C
J. D

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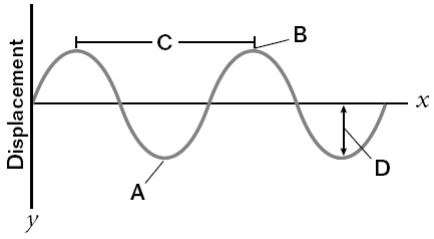
Multiple Choice, *continued*

Base your answers to questions 11–13 on the graph.



13. Which letter on the graph is used for a trough?

A. A
B. B
C. C
D. D

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Multiple Choice, *continued*

16. Two successive crests of a transverse wave 1.20 m apart. Eight crests pass a given point 12.0 s. What is the wave speed?

F. 0.667 m/s
G. 0.800 m/s
H. 1.80 m/s
J. 9.60 m/s

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Objectives

**Fill-in the yellow printed words in your note packet

- **Apply** the superposition principle.
- **Differentiate** between constructive and destructive interference.
- **Predict** when a reflected wave will be inverted.
- **Predict** whether specific traveling waves will produce a standing wave.
- **Identify** nodes and antinodes of a standing wave.

Section 4 Wave Interactions

Chapter 11

Wave Interference

- Two different material objects can never occupy the same space at the same time.
- Because mechanical waves are not matter but rather are displacements of matter, _____ _____
- The combination of two overlapping waves is called _____

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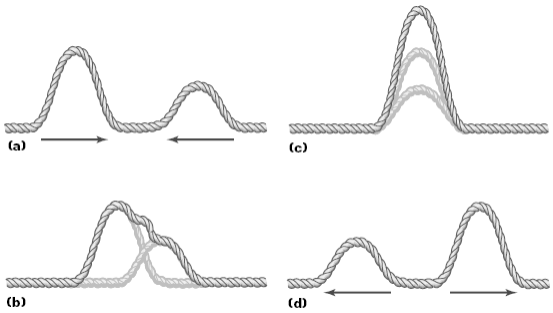
Wave Interference, *continued*

In _____, individual displacements on the _____ of the equilibrium position are added together to form the resultant wave.



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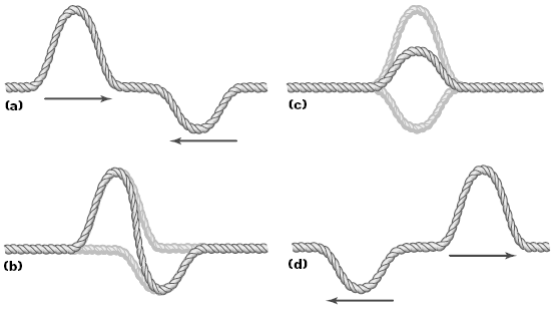
Section 4 Wave Interactions

Chapter 11

Wave Interference, *continued*

In _____, individual displacements on _____ of the equilibrium position are added together to form the resultant wave.



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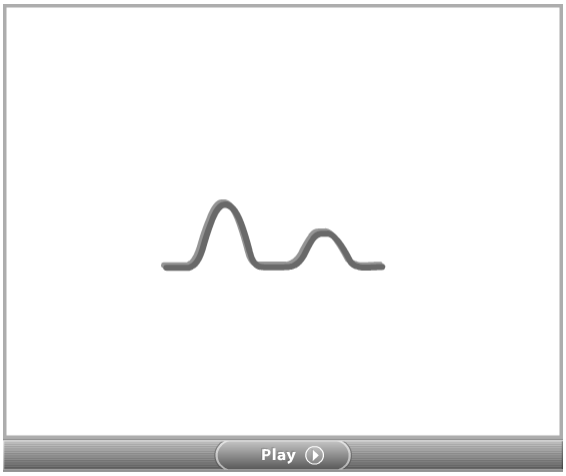
Comparing Constructive and Destructive Interference



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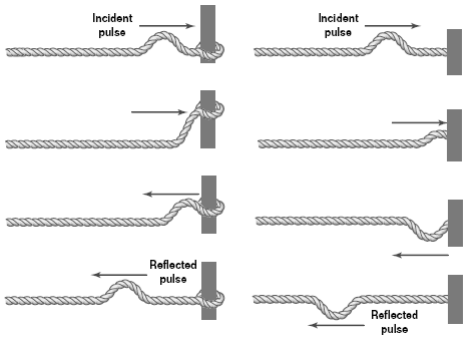
Reflection

- What happens to the motion of a wave when it reaches a boundary?
- At a _____ boundary, waves are _____.
- At a _____ boundary, waves are _____ _____



Free boundary Fixed boundary

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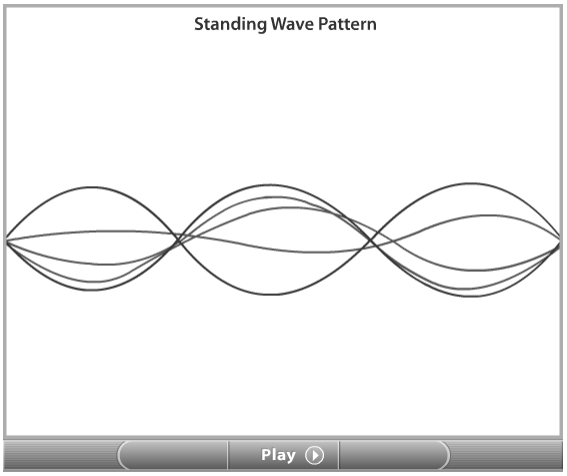
Standing Waves



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Section 4 Wave Interactions

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Standing Waves

- A _____ is a wave pattern that results when two waves of the same frequency, wavelength, and amplitude travel in opposite directions and interfere.

- Standing waves have nodes and antinodes.
  - A _____ is a point in a standing wave that maintains _____.
  - An _____ is a point in a standing wave, halfway between two nodes, at which the _____ _____ occurs.

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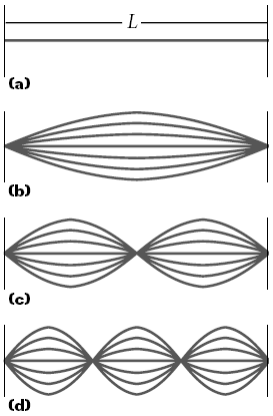
Chapter 11

Standing Waves, *continued*

- Only _____ produce standing wave patterns.
- The _____ of the string must be _____ because these points cannot vibrate.
- A standing wave can be produced for any wavelength that allows both ends to be nodes.
- In the diagram, possible wavelengths include __ (b), __ (c), and _____ (d).



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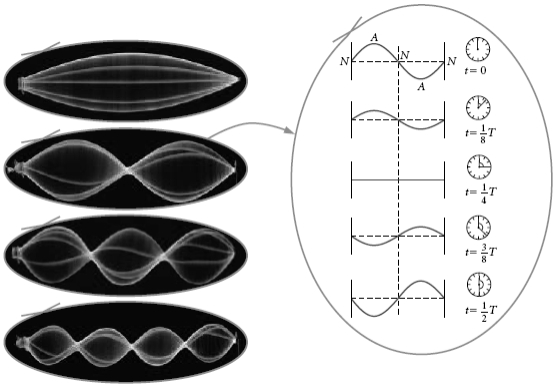
Standing Waves

This photograph shows four possible standing waves that can exist on a given string. The diagram shows the progression of the second standing wave for one-half of a cycle.



Multiple Choice, *continued*

Base your answers to questions 14–15 on the passage.

A wave with an amplitude of 0.75 m has the same wavelength as a second wave with an amplitude of 0.53 m. The two waves interfere.

14. What is the amplitude of the resultant wave if the interference is constructive?

F. 0.22 m
G. 0.53 m
H. 0.75 m
J. 1.28 m

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Multiple Choice, *continued*

Base your answers to questions 14–15 on the passage.

A wave with an amplitude of 0.75 m has the same wavelength as a second wave with an amplitude of 0.53 m. The two waves interfere.

15. What is the amplitude of the resultant wave if the interference is destructive?

A. 0.22 m
B. 0.53 m
C. 0.75 m
D. 1.28 m

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Short Response, *continued*

18. What kind of wave does not need a medium through which to travel?

Chapter 11 Standardized Test Prep

Short Response, *continued*

19. List three wavelengths that could form standing waves on a 2.0 m string that is fixed at both ends.

Extended Response

20. A visitor to a lighthouse wishes to find out the height of the tower. The visitor ties a spool of thread to a small rock to make a simple pendulum. Then, the visitor hangs the pendulum down a spiral staircase in the center of the tower. The period of oscillation is 9.49 s. What is the height of the tower? Show all of your work.

Extended Response, *continued*

21. A harmonic wave is traveling along a rope. The oscillator that generates the wave completes 40.0 vibrations in 30.0 s. A given crest of the wave travels 425 cm along the rope in a period of 10.0 s. What is the wavelength? Show all of your work.