Name _____ Date _____ Class _____

Assess Your Understanding

What Are Waves?

What Forms Mechanical Waves?

got it?

○ **I get it!** Now I know that a mechanical wave forms when _____

_____

○ **I need extra help with** _____

_____

What Are the Types of Mechanical Waves?

1a. REVIEW Compared to the direction it travels, at what angle does a transverse wave vibrate a medium?

_____

_____

b. COMPARE AND CONTRAST How are transverse and longitudinal waves alike and different?

_____

_____

got it?

○ **I get it!** Now I know that the three types of mechanical waves are _____

_____

_____

○ **I need extra help with** _____

_____

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Name _____ Date _____ Class _____

Key Concept Summaries

What Are Waves?

What Forms Mechanical Waves?

A **wave** is a disturbance involving the transfer of energy from place to place. In science, **energy** is defined as the ability to do work. Waves that can travel either with or without a medium are called electromagnetic waves. Waves that require a medium to travel through are called **mechanical waves.** The material through which a mechanical wave travels is called a **medium.** Gases, liquids, and solids can act as mediums.

Mechanical waves form when a source of energy causes a medium to vibrate. A **vibration** is a repeated back-and-forth or up-and-down motion. Moving objects have energy, which they can transfer to a medium to produce waves.

What Are the Types of Mechanical Waves?

The three types of mechanical waves are transverse waves, longitudinal waves, and surface waves. These waves are classified by how they move through mediums. A wave that moves the medium at right angles, or perpendicular, to the direction in which the wave travels is called a **transverse wave.** You can make a transverse wave on a rope. The high point on a transverse wave is called a **crest.** The low point is called a **trough.**

A **longitudinal wave** moves the medium in the same direction as the wave travels. You can make a longitudinal wave on a spring toy. The coils in the spring move back and forth in the same direction, or parallel, to the wave's motion. An area where the coils are close together is called a **compression.** An area where the coils are spread out is called a **rarefaction.**

Surface waves are combinations of transverse and longitudinal waves. This type of wave travels along a surface that separates two mediums. Ocean waves are the most familiar surface waves. They travel at the surface between water and air. When a wave passes through water, the water moves up and down. Although the water does not compress, it moves back and forth slightly in the direction that the wave is traveling. The up-and-down and back-and-forth movements combine to make each particle of water move in a circle.

On a separate sheet of paper, describe the three kinds of mechanical waves and give an example of each.

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Name _____ Date _____ Class _____

Lesson Quiz

What Are Waves?

Write the letter of the correct answer on the line at the left.

1. ___ The highest parts of a transverse wave are called
   A transversals
   B summits
   C troughs
   D crests

2. ___ The lowest parts of a transverse wave are called
   A transversals
   B summits
   C troughs
   D crests

3. ___ In longitudinal waves in a spring, the parts where the coils are close together are called
   A compressions
   B rarefactions
   C longitudes
   D contractions

4. ___ In longitudinal waves in a spring, the parts where the coils are spread out are called
   A compressions
   B rarefactions
   C longitudes
   D contractions

If the statement is true, write *true*. If the statement is false, change the underlined word or words to make the statement true.

5. _____ Waves that can travel with or without a medium are called mechanical waves.

6. _____ Mechanical waves form when a source of energy causes a medium to compress.

7. _____ The three types of mechanical waves are transverse waves, latitudinal waves, and surface waves.

8. _____ A(n) surface wave moves the medium in the same direction as the wave travels.

9. _____ Each particle of water in an ocean wave moves in a(n) circle.

10. _____ A transverse wave moves a medium at a(n) obtuse angle to the wave.

Name _____ Date _____ Class _____

Assess Your Understanding

Properties of Waves

What Are the Amplitude, Wavelength, Frequency, and Speed of a Wave?

got it?

○ **I get it!** Now I know that for any wave, amplitude describes _____

_____,

wavelength describes _____, frequency describes

_____,

and speed describes _____

_____

○ **I need extra help with** _____

_____

How Are Frequency, Wavelength, and Speed Related?

1a. ANSWER What are the properties of waves?

_____

_____

b. CALCULATE A wave's frequency is 2 Hz and its wavelength is 4 m. What is the wave's speed?

_____

got it?

○ **I get it!** Now I know that wavelength, frequency, and speed are related by the formula _____

_____

○ **I need extra help with** _____

_____

Name _____ Date _____ Class _____

Key Concept Summaries

Properties of Waves

What Are the Amplitude, Wavelength, Frequency, and Speed of a Wave?

Amplitude describes a wave's energy, wavelength describes its length, and frequency describes how often it occurs. Speed describes how quickly a wave moves. The height of a wave's crest depends on its amplitude. **Amplitude** is the maximum distance the medium moves from the rest position.

A wave travels a certain distance before it starts to repeat. The distance between two corresponding parts of a wave is its **wavelength.** You can find the wavelength of a transverse wave by measuring the distance from crest to crest. For a longitudinal wave, the wavelength is the distance between compressions.

The **frequency** of a wave is the number of complete waves that pass a given point in a certain amount of time. Frequency is measured in units called **hertz (Hz),** which is defined as the number of waves per second.

The speed of a wave is how far the wave travels in a given amount of time. You can determine a wave's speed by dividing the distance it travels by the time it takes to travel that distance.

How Are Frequency, Wavelength, and Speed Related?

The speed, wavelength, and frequency of a wave are related by a mathematical formula.

$$\text{Frequency} = \frac{\text{Speed}}{\text{Wavelength}}$$

$$\text{Wavelength} = \frac{\text{Speed}}{\text{Frequency}}$$

$$\text{Speed} = \text{Wavelength} \times \text{Frequency}$$

If you know two quantities in the formula, you can calculate the third quantity.

The speed of a wave remains constant if the medium, temperature, and pressure do not change. For example, all sound waves travel at the same speed in air at a given temperature and pressure.

On a separate sheet of paper, explain how you can calculate a wave's speed, wavelength, or frequency, if you know two of the three quantities.

Name _____ Date _____ Class _____

Lesson Quiz

Properties of Waves

Write the letter of the correct answer on the line at the left.

1. ___ The distance between two corresponding parts of a wave is its
   A trough
   B frequency
   C wavelength
   D amplitude

2. ___ How often a wave occurs is the wave's
   A crest
   B frequency
   C wavelength
   D amplitude

3. ___ The less energy a wave has, the smaller its
   A crest
   B frequency
   C wavelength
   D amplitude

4. ___ Frequency is measured in units called
   A periods
   B nanoseconds
   C hertz
   D eras

If the statement is true, write *true*. If the statement is false, change the underlined word or words to make the statement true.

5. _____ All waves have wavelength, frequency, rest point, and speed.

6. _____ The frequency of a wave remains constant if the medium, temperature, and pressure do not change.

7. _____ The speed, wavelength, and frequency of a wave are related by a scientific theory.

8. _____ The height of a wave's wavelength depends on its amplitude.

9. _____ The amplitude of a(n) transverse wave is a measure of how compressed or rarefied the medium becomes.

10. _____ Dividing the distance a wave travels by the time it takes to travel that distance gives you the wave's speed.

Name _____ Date _____ Class _____

Assess Your Understanding

Interactions of Waves

What Changes the Direction of a Wave?

1a. DEFINE What is diffraction?

_____

_____

b. CLASSIFY A wave bends after entering a new medium. What type of interaction is this? _____

got it?

○ **I get it!** Now I know that a wave's direction can be changed by _____

_____

○ **I need extra help with** _____

_____

What Are the Two Types of Wave Interference?

got it?

○ **I get it!** Now I know that the two types of wave interference are _____

_____

○ **I need extra help with** _____

_____

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Name _____ Date _____ Class _____

Assess Your Understanding

Interactions of Waves

How Do Standing Waves Form?

2a. DESCRIBE What causes resonance to occur?

_____

_____

b. RELATE CAUSE AND EFFECT What causes nodes to form in a standing wave?

_____

_____

got it?

○ **I get it!** Now I know that standing waves form when _____

_____

_____

_____

○ **I need extra help with** _____

_____

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Name _____ Date _____ Class _____

Interactions of Waves

What Changes the Direction of a Wave?

Waves change direction by reflection, refraction, and diffraction. When a wave hits a surface, any part of the wave that cannot pass through the surface bounces back. This interaction with a surface is called **reflection.**

When a wave enters a new medium at any angle other than a right angle, one side of the wave changes speed before the other side. This causes the wave to bend. Bending occurs because different parts of the wave travel at different speeds. **Refraction** is the bending of waves due to a change in speed.

When a wave moves around a barrier or through an opening in a barrier, it bends and spreads out. These wave interactions are called **diffraction.**

What Are the Two Types of Wave Interference?

Interference is the interaction between waves that meet. **There are two types of interference: constructive and destructive.** Interference in which two waves combine to form a wave with a larger amplitude than either individual wave had is called **constructive interference.** Interference in which two waves combine to form a wave with a smaller amplitude than either original wave had is called **destructive interference.**

How Do Standing Waves Form?

If the incoming wave and reflected wave have just the right frequency, they combine to form a wave that appears to stand still. This wave is called a standing wave. A **standing wave** is a wave that appears to stand in one place, even though it is two waves interfering as they pass through each other. In a standing wave, destructive interference produces points with zero amplitude, called **nodes.** The nodes are always evenly spaced along the wave.

At points in the standing wave where constructive interference occurs, the amplitude is greater than zero. Points of maximum amplitude on a standing wave are called **antinodes.** The antinodes, which always occur halfway between two nodes, are points of maximum energy on the wave.

Most objects have at least one natural frequency of vibration. Standing waves occur in an object when it vibrates at a natural frequency. If a nearby object vibrates at the same frequency, it can cause resonance. **Resonance** is an increase in the amplitude of a vibration that occurs when external vibrations match an object's natural frequency.

On a separate sheet of paper, explain how standing waves form.

Name _____ Date _____ Class _____

Lesson Quiz

Interactions of Waves

Write the letter of the correct answer on the line at the left.

1. ___ Reflection occurs when a wave
   - A bends due to a change in speed
   - B hits a surface and bounces back
   - C passes through an opening
   - D bends around a barrier

2. ___ Refraction occurs when a wave
   - A bends due to a change in speed
   - B hits a surface and bounces back
   - C passes through an opening
   - D bends around a barrier

3. ___ Interference in which waves combine to form a wave with a larger amplitude than either wave originally had is called
   - A destructive interference
   - B amplitude enhancement
   - C constructive interference
   - D resonance

4. ___ Points of maximum amplitude on a standing wave are called
   - A crests
   - B incidence
   - C apexes
   - D antinodes

Fill in the blank to complete each statement.

5. Destructive interference in a standing wave produces points with zero amplitude called _____.

6. Waves do not bend when entering a new medium at a(n) _____ angle.

7. A wave refracts because one side of the wave changes _____ before the other side.

8. A wave _____ and spreads out in diffraction.

9. When the crest of one wave overlaps the trough of another wave, _____ can occur.

10. A standing wave is actually two waves _____ as they pass through each other.