**Waves and Sound**

**Questions from a Conceptual Course**

**Category 1: Wave Categories, Quantities, Behaviors and Relationships**

**Question 1:**

aa. A long Slinky™ is stretched between two distant points. One of its ends is vibrated until a wave is observed to be moving to the right through the slinky™. Which statement describes the manner by which the wave moves through the Slinky™?

a. Slinky™ coils begin moving along a continuously curved path from the left to the right.

b. The first coil trades positions with the second; the second coil trades with the third coil; and so forth.

c. The first coil pushes or pulls on the second coil; the second coil pushes or pulls on the third coil; and so forth.

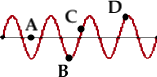
**Question 2:**

aa. Which one of the following statements describes how a wave moves through a Slinky™ from one end to the other end?

a. Coils of the Slinky™ move from one end to the other end along a curved path.

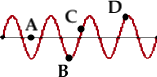
b. Coils of the Slinky™ interact with the neighboring coil, causing the disturbance to move.

c. Coils of the Slinky™ begin to trade places with one another until all the coils are vibrating.



**Question 3:**

aa. Consider the diagram at the right. Which of the labeled points is a *crest*?

**Question 4:**

aa. Consider the diagram at the right. Which of the labeled points is a *trough*?

**Question 5:**

aa. A wave is moving through a coiled Slinky™. The time for a single coil to complete one full back and forth vibration is known as the \_\_\_\_\_.

a. speed b. period

c. amplitude d. frequency

**Question 6:**

aa. A wave is moving through a coiled Slinky™. The number full back and forth vibrations of a coil per unit of time is known as the \_\_\_\_\_.

a. speed b. period

c. amplitude d. frequency

**Question 7:**

aa. A wave is moving through a coiled Slinky™. The distance traveled by a crest on the wave per unit of time is known as the \_\_\_\_\_.

a. speed b. amplitude

c. frequency d. wavelength

**Question 8:**

aa. A long rope is vibrated on one of its ends in order to produce a wave. A single point on the rope makes a complete up and down vibration every 0.20 seconds. The quantity 0.20 refers to the \_\_\_\_\_ of the wave.

a. speed b. period

c. amplitude d. frequency

**Question 9:**

aa. A long rope is vibrated on one of its ends in order to produce a wave. A single point on the rope makes 4.0 complete vibrations every second. The quantity 4.0 refers to the \_\_\_\_\_ of the wave.

a. speed b. period

c. amplitude d. frequency

**Question 10:**

aa. A long rope is vibrated on one of its ends in order to produce a wave. A crest on the wave travels along the medium a distance of 2.2 meters each second. The quantity 2.2 refers to the \_\_\_\_\_ of the wave.

a. speed b. period

c. amplitude d. frequency

**Question 11:**

aa. What wave quantity is equal to the distance measured from a crest of a wave to the next adjacent crest?

a. speed b. period

c. amplitude d. frequency

e. wavelength

**Question 12:**

aa. What wave quantity is equal to the distance measured from a crest of a wave to the usual resting position of the medium?

a. speed b. period

c. amplitude d. frequency

e. wavelength

**Question 13:**

aa. What wave quantity is defined as the number of complete cycles of vibration per unit of time?

a. speed b. period

c. amplitude d. frequency

e. wavelength

**Question 14:**

aa. What wave quantity is defined as the amount of time it takes a particle of the medium to complete one cycle of vibration?

a. speed b. period

c. amplitude d. frequency

e. wavelength

**Question 15:**

aa. What wave quantity refers to the distance that a particle of the medium moves when it going from the rest position to a crest position?

a. speed b. period

c. amplitude d. frequency

e. wavelength

**Question 16:**

aa. What is the standard metric unit for the period of a wave?

a. second b. meter

c. Hertz d. meter/second

**Question 17:**

aa. What is the standard metric unit for the wavelength of a wave?

a. second b. meter

c. Hertz d. meter/second

**Question 18:**

aa. What is the standard metric unit for the frequency of a wave?

a. second b. meter

c. Hertz d. meter/second

**Question 19:**

aa. What is the standard metric unit for the speed of a wave?

a. second b. meter

c. Hertz d. meter/second

**Question 20:**

aa. What is the standard metric unit for the amplitude of a wave?

a. second b. meter

c. Hertz d. meter/second

**Question 21:**

aa. As you’ve learned, several phrases can be used to describe wave motion. Such phrases include *how often*, *how much time*, *how fast*, *how high*, and *how long*. Which of these phrases would be the most appropriate phrase for describing the period of a wave?

a. *how often* b. *how much time*

c. *how fast* d. *how high*

e. *how long*

**Question 22:**

aa. As you’ve learned, several phrases can be used to describe wave motion. Such phrases include *how often*, *how much time*, *how fast*, *how high*, and *how long*. Which of these phrases would be the most appropriate phrase for describing the frequency of a wave?

a. *how often* b. *how much time*

c. *how fast* d. *how high*

e. *how long*

**Question 23:**

aa. As you’ve learned, several phrases can be used to describe wave motion. Such phrases include *how often*, *how much time*, *how fast*, *how high*, and *how long*. Which of these phrases would be the most appropriate phrase for describing the wavelength of a wave?

a. *how often* b. *how much time*

c. *how fast* d. *how high*

e. *how long*

**Question 24:**

aa. As you’ve learned, several phrases can be used to describe wave motion. Such phrases include *how often*, *how much time*, *how fast*, *how high*, and *how long*. Which of these phrases would be the most appropriate phrase for describing the speed of a wave?

a. *how often* b. *how much time*

c. *how fast* d. *how high*

e. *how long*

**Question 25:**

aa. As you’ve learned, several phrases can be used to describe wave motion. Such phrases include *how often*, *how much time*, *how fast*, *how high*, and *how long*. Which of these phrases would be the most appropriate phrase for describing the amplitude of a wave?

a. *how often* b. *how much time*

c. *how fast* d. *how high*

e. *how long*

**Question 26:**

aa. A wave is introduced into a coiled Slinky™. Each coil of the medium is observed to make many back and forth vibrations in a small amount of time. This observation would lead one to believe that the wave has a \_\_\_\_\_.

a. high amplitude b. long wavelength

c. high frequency d. a fast speed

**Question 27:**

aa. A wave is introduced into a coiled Slinky™. A crest on the wave is observed to move a relatively long distance in a short amount of time. This observation would lead one to believe that the wave has a \_\_\_\_\_.

a. high amplitude b. long wavelength

c. high frequency d. a fast speed

**Question 28:**

aa. What does the frequency of a wave refer to?

a. How fast a crest of the wave moves along the medium.

b. How long the repeating pattern of crests and troughs is.

c. How far particles of the medium are displaced from their rest position.

d. How much time it takes a particle of the medium to complete a full cycle of vibration.

**Question 29:**

aa. What does the period of a wave refer to?

a. How fast a crest of the wave moves along the medium.

b. How long the repeating pattern of crests and troughs is.

c. How far particles of the medium are displaced from their rest position.

d. How much time it takes a particle of the medium to complete a full cycle of vibration.

**Question 30:**

aa. What does the speed of a wave refer to?

a. How fast a crest of the wave moves along the medium.

b. How long the repeating pattern of crests and troughs is.

c. How far particles of the medium are displaced from their rest position.

d. How much time it takes a particle of the medium to complete a full cycle of vibration.

**Question 31:**

aa. What does the wavelength of a wave refer to?

a. How fast a crest of the wave moves along the medium.

b. How long the repeating pattern of crests and troughs is.

c. How far particles of the medium are displaced from their rest position.

d. How much time it takes a particle of the medium to complete a full cycle of vibration.

**Question 32:**

aa. A wave that is traveling fast is said to have a high \_\_\_\_\_.

a. speed b. frequency

c. period d. wavelength

**Question 33:**

aa. A wave that is vibrating up and down a large number of times in a second is said to have a high \_\_\_\_\_.

a. speed b. frequency

c. period d. wavelength

**Question 34:**

aa. A vibrating object makes 10 complete back and forth vibrations in 30 seconds. The period of vibration of the object is \_\_\_\_\_ seconds.

a. 0.33 b. 3.0

c. 10 d. 30

**Question 35:**

aa. A vibrating object makes 10 complete back and forth vibrations in 40 seconds. The period of vibration of the object is \_\_\_\_\_ seconds.

a. 0.25 b. 4.0

c. 10 d. 40

**Question 36:**

aa. A vibrating object makes 20 complete back and forth vibrations in 5 seconds. The period of vibration of the object is \_\_\_\_\_ seconds.

a. 0.25 b. 4.0

c. 5 d. 20

**Question 37:**

aa. A vibrating object makes 20 complete back and forth vibrations in 10 seconds. The period of vibration of the object is \_\_\_\_\_ seconds.

a. 0.50 b. 2.0

c. 10 d. 20

**Question 38:**

aa. A vibrating object makes 10 complete back and forth vibrations in 30 seconds. The frequency of vibration of the object is \_\_\_\_\_ Hertz.

a. 0.33 b. 3.0

c. 10 d. 30

**Question 39:**

aa. A vibrating object makes 10 complete back and forth vibrations in 40 seconds. The frequency of vibration of the object is \_\_\_\_\_ Hertz.

a. 0.25 b. 4.0

c. 10 d. 40

**Question 40:**

aa. A vibrating object makes 20 complete back and forth vibrations in 5 seconds. The frequency of vibration of the object is \_\_\_\_\_ Hertz.

a. 0.25 b. 4.0

c. 5 d. 20

**Question 41:**

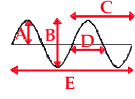
aa. A vibrating object makes 20 complete back and forth vibrations in 10 seconds. The frequency of vibration of the object is \_\_\_\_\_ Hertz.

a. 0.50 b. 2.0

c. 10 d. 20

**Question 42:**

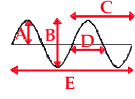
aa. A rope is being vibrated to create a wave within it. The diagram below represents the orientation of a rope at a moment in time.



The wavelength of the wave is equal to \_\_\_\_\_.

**Question 43:**

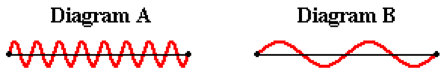
aa. A rope is being vibrated to create a wave within it. The diagram below represents the orientation of a rope at a moment in time.



The amplitude of the wave is equal to \_\_\_\_\_.

**Question 44:**

aa. Consider **Diagram A** and **Diagram B** below:



Compared to the wave in **Diagram B**, the wave in **Diagram A** has \_\_\_\_\_.

a. the same amplitude by a larger wavelength

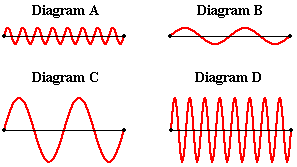
b. a larger amplitude and a smaller wavelength

c. a smaller amplitude and the same wavelength

d. the same amplitude and a smaller wavelength

**Question 45:**

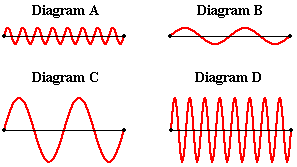
aa. Consider the waves in the four diagrams below.



Which diagram shows a wave with the longest wavelength and the lowest amplitude?

**Question 46:**

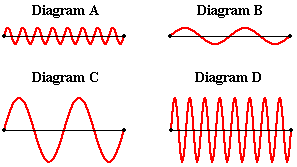
aa. Consider the waves in the four diagrams below.



Which diagram shows a wave with the shortest wavelength and the lowest amplitude?

**Question 47:**

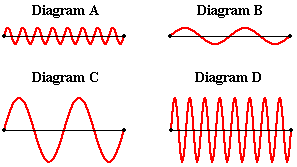
aa. Consider the waves in the four diagrams below.



Which diagram shows a wave with the longest wavelength and the largest amplitude?

**Question 48:**

aa. Consider the waves in the four diagrams below.



Which diagram shows a wave with the shortest wavelength and the largest amplitude?

**Question 49:**

aa. If a longitudinal wave is created in a medium that extends horizontally from left to right, then the particles of the medium will vibrate in a \_\_\_\_ direction.

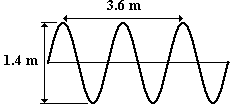
a. horizontal

b. vertical

c. diagonal (both horizontal and vertical)

d. circular

**Question 50:**

aa. Consider the diagram shown at the right. The wavelength of the wave shown in the diagram is \_\_\_\_\_.

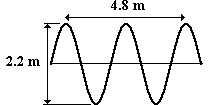
a. 0.7 m

b. 1.4 m

c. 1.8 m

d. 3.6 m

e. 7.2 m

**Question 51:**

aa. Consider the diagram shown at the right. The wavelength of the wave shown in the diagram is \_\_\_\_\_.

a. 1.1 m

b. 2.2 m

c. 2.4 m

d. 4.8 m

e. 9.6 m

**Question 52:**

aa. If a transverse wave is created in a medium that extends horizontally from left to right, then the particles of the medium will vibrate in a \_\_\_\_ direction.

a. horizontal

b. vertical

c. diagonal (both horizontal and vertical)

d. circular

**Question 53:**

aa. What distinguishes a longitudinal wave from a transverse wave?

a. The distinction has to do with whether there are nodes and antinodes.

b. The distinction has to do with how the wavelength and frequency compares to the speed.

c. The distinction has to do with how the particles of the medium move relative to the wave.

**Question 54:**

aa. A slinky is stretched out along the floor from the west side of the room to the east side of the room. The slinky is vibrated and a transverse wave begins moving through the slinky. The individual coils of the slinky will \_\_\_\_\_.

a. vibrate eastward and westward about a fixed position.

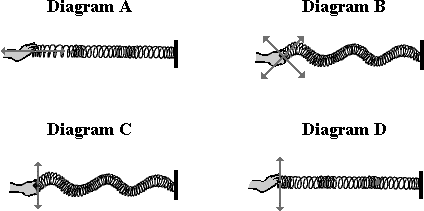
b. vibrate northward and southward about a fixed position.

c. move along a curved path from the west side of the room to the east side of the room

d. move along a straight line path from the west side of the room to the east side of the room

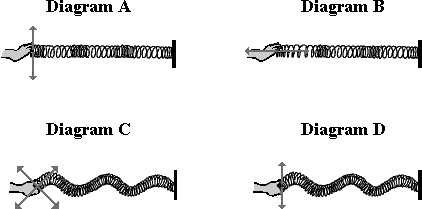
**Question 55:**

aa. The diagrams below depict various wave patterns in a slinky. The arrows represent potential direction of hand movements for the creation of such patterns. Which diagram - A, B, C, or D - represents the appropriate hand movements and patterns for a transverse wave?



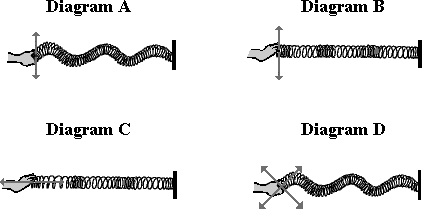
**Question 56:**

aa. The diagrams below depict various wave patterns in a slinky. The arrows represent potential direction of hand movements for the creation of such patterns. Which diagram - A, B, C, or D - represents the appropriate hand movements and patterns for a transverse wave?



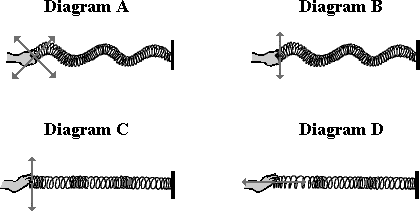
**Question 57:**

aa. The diagrams below depict various wave patterns in a slinky. The arrows represent potential direction of hand movements for the creation of such patterns. Which diagram - A, B, C, or D - represents the appropriate hand movements and patterns for a longitudinal wave?



**Question 58:**

aa. The diagrams below depict various wave patterns in a slinky. The arrows represent potential direction of hand movements for the creation of such patterns. Which diagram - A, B, C, or D - represents the appropriate hand movements and patterns for a longitudinal wave?



**Question 59:**

aa. What behavior occurs when a crest of one wave meets a crest of a second wave while moving along the same medium?

a. The Doppler effect b. Resonance.

c. Constructive interference d. Destructive interference

**Question 60:**

aa. What behavior occurs when a trough of one wave meets a crest of a second wave while moving along the same medium?

a. The Doppler effect b. Resonance.

c. Constructive interference d. Destructive interference

**Question 61:**

aa. What behavior occurs when a trough of one wave meets a trough of a second wave while moving along the same medium?

a. The Doppler effect b. Resonance.

c. Constructive interference d. Destructive interference

**Question 62:**

aa. The two pulses shown at the right are moving in opposite directions along the same medium. When they meet, \_\_\_\_\_ interference will occur.

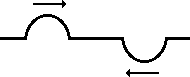
a. doppler

b. resonant

c. destructive

d. constructive

**Question 63:**

aa. The two pulses shown at the right are moving in opposite directions along the same medium. When they meet, \_\_\_\_\_ interference will occur.

a. doppler

b. resonant

c. destructive

d. constructive

**Question 64:**

aa. The two pulses shown at the right are moving in opposite directions along the same medium. When they meet, \_\_\_\_\_ interference will occur.

a. Doppler

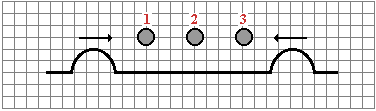
b. resonant

c. destructive

d. constructive

**Question 65:**

aa. A demonstration of interference is done in class. A Slinky™ is stretched out from end to end. Three cups are placed on the ground, positioned just to the side of the Slinky™. Two pulses are introduced into each end at the same time. The pulses travel towards each other as shown in the diagram.



What will be observed after the pulses pass by each other?

a. All three cups will be knocked over.

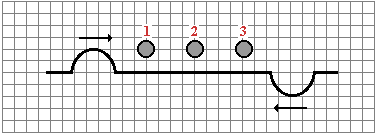
b. Cups 1 and 3 will be knocked over; cup 2 will be left standing.

c. Only cup 2 will be knocked over; cups 1 and 3 will be left standing.

d. Nothing will happen to any of the cups; they will all be left standing.

**Question 66:**

aa. A demonstration of interference is done in class. A Slinky™ is stretched out from end to end. Three cups are placed on the ground, positioned just to the side of the Slinky™. Two pulses are introduced into each end at the same time. The pulses travel towards each other as shown in the diagram.



What will be observed after the pulses pass by each other?

a. All three cups will be knocked over.

b. Cups 1 and 3 will be knocked over; cup 2 will be left standing.

c. Only cup 2 will be knocked over; cups 1 and 3 will be left standing.

d. Nothing will happen to any of the cups; they will all be left standing.

**Question 67:**

aa. Which one of the following statements about high-pitched sounds is true?

a. A high-pitched sound is a sound that moves at high speed through the medium.

b. A high-pitched sound is created by an object that is vibrating with a high frequency.

c. A high-pitched sound is created by an object that is vibrating with a high amplitude.

**Question 68:**

aa. Which one of the following statements about loud sounds is true?

a. A loud sound is a sound that moves at high speed through the medium.

b. A loud sound is created by an object that is vibrating with a high frequency.

c. A loud sound is created by an object that is vibrating with a high amplitude.

**Question 69:**

aa. Which characteristic of a wave contributes to the loudness of a sound?

a. The speed. b. The frequency.

c. The wavelength. d. The amplitude.

**Question 70:**

aa. Which characteristic of a wave contributes to the pitch of a sound?

a. The speed. b. The frequency.

c. The wavelength. d. The amplitude.

**Question 71:**

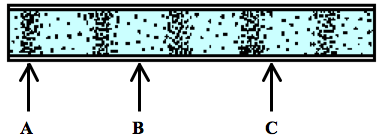
aa. What is meant by the *fundamental frequency* of a string?

a. The *fundamental frequency* is the frequency that sounds the loudest to most people.

b. The *fundamental frequency* is the lowest frequency at which the string can naturally vibrate.

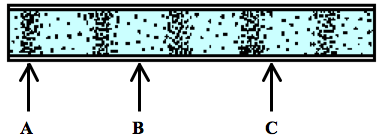
c. The *fundamental frequency* is the whole number integer that describes the number of loops in the standing wave pattern.

**Question 72:**

aa. As a tuning fork vibrates, it creates compressions and rarefactions in the air that surrounds it. The diagram shows these compressions and rarefactions moving through a column of air.

Which position along the air column is a compression?

**Question 73:**

aa. As a tuning fork vibrates, it creates compressions and rarefactions in the air that surrounds it. The diagram shows these compressions and rarefactions moving through a column of air.

Which position along the air column is a rarefaction?

**Question 74:**

aa. Which of the following statements describes a compression?

a. A compression is a location along a medium where particles do not vibrate.

b. A compression if a location along a medium where particles are close together.

c. A compression is a location along the medium where constructive interference occurs.

**Question 75:**

aa. Which of the following statements describes a rarefaction?

a. A rarefaction is a location along a medium where particles do not vibrate.

b. A rarefaction if a location along a medium where particles are relatively far apart.

c. A rarefaction is a location along the medium where destructive interference occurs.

**Category 2: Resonating Strings and Air Columns**

**Question 76:**

aa. Which statement below describes the behavior of resonance?

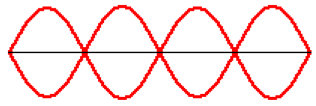
a. An object is plucked and begins vibrating.

b. A crest of a wave interferes with a crest of another wave.

c. Two sounds are played at the same time and have a pleasant *feel about them*.

d. A vibrating object forces another object to vibrate together at the same frequency.

**Question 77:**

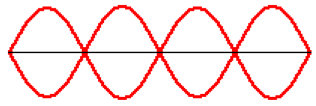
aa. A rope is vibrating so as to form the standing wave pattern shown at the right. How many nodes are present in the rope?

a. 3 b. 4

c. 5 d. 8

e. 10

**Question 78:**

aa. A rope is vibrating so as to form the standing wave pattern shown at the right. How many antinodes are present in the rope?

a. 3 b. 4

c. 5 d. 8

e. 10

**Question 79:**

aa. A rope is vibrating so as to form the standing wave pattern shown at the right. How many nodes are present in the rope?

a. 6 b. 7

c. 8 d. 12

e. 14

**Question 80:**

aa. A rope is vibrating so as to form the standing wave pattern shown at the right. How many antinodes are present in the rope?

a. 6 b. 7

c. 8 d. 12

e. 14

**Question 81:**

aa. A rope is vibrating so as to form the standing wave pattern shown at the right. How many nodes are present in the rope?

a. 5 b. 6

c. 7 d. 10

e. 12

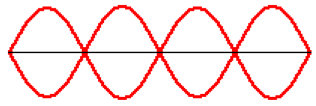
**Question 82:**

aa. A rope is vibrating so as to form the standing wave pattern shown at the right. How many antinodes are present in the rope?

a. 5 b. 6

c. 7 d. 10

e. 12



**Question 83:**

aa. A rope is vibrating so as to form the standing wave pattern shown at the right. What harmonic is shown in the pattern?

a. third b. fourth

c. fifth d. eighth

**Question 84:**

aa. A rope is vibrating so as to form the standing wave pattern shown at the right. What harmonic is shown in the pattern?

a. sixth b. seventh

c. eighth d. ninth

**Question 85:**

aa. A rope is vibrating so as to form the standing wave pattern shown at the right. What harmonic is shown in the pattern?

a. fifth b. sixth

c. seventh d. eighth

**Question 86:**

aa. A guitar string has a fundamental frequency of 120 Hz. What is the frequency of the third harmonic of the string?

a. 40 Hz b. 80 Hz

c. 160 Hz d. 180 Hz

e. 360 Hz

**Question 87:**

aa. A guitar string has a fundamental frequency of 120 Hz. What is the frequency of the fourth harmonic of the string?

a. 30 Hz b. 60 Hz

c. 180 Hz d. 240 Hz

e. 480 Hz

**Question 88:**

aa. A guitar string has a fundamental frequency of 120 Hz. What is the frequency of the fifth harmonic of the string?

a. 24 Hz b. 48 Hz

c. 144 Hz d. 300 Hz

e. 600 Hz

**Question 89:**

aa. The diagram at the right depicts a standing wave pattern in a closed-end air column. This is the pattern for the \_\_\_\_\_ harmonic.

a. fourth b. fifth

c. sixth d. seventh

e. ninth

**Question 90:**

aa. The diagram at the right depicts a standing wave pattern in a closed-end air column. This is the pattern for the \_\_\_\_\_ harmonic.

a. third b. fourth

c. fifth d. sixth

e. seventh

**Question 91:**

aa. The diagram at the right depicts a standing wave pattern in a closed-end air column. This is the pattern for the \_\_\_\_\_ harmonic.

a. first b. second

c. third d. fourth

e. fifth

**Question 92:**

aa. The diagram at the right depicts a standing wave pattern in a closed-end air column. This is the pattern for the \_\_\_\_\_ harmonic.

a. fifth b. sixth

c. seventh d. ninth

e. eleventh

**Question 93:**

aa. The diagram at the right depicts a standing wave pattern in a closed-end air column. This is the pattern for the \_\_\_\_\_ harmonic.

a. sixth b. seventh

c. ninth d. eleventh

e. thirteenth

**Question 94:**

aa. The diagram at the right depicts a standing wave pattern in a closed-end air column. How many nodes are present in this pattern?

a. 4 b. 5

c. 6 d. 8

e. 10

**Question 95:**

aa. The diagram at the right depicts a standing wave pattern in a closed-end air column. How many antinodes are present in this pattern?

a. 4 b. 5

c. 6 d. 8

e. 10

**Question 96:**

aa. The diagram at the right depicts a standing wave pattern in a closed-end air column. How many nodes are present in this pattern?

a. 2 b. 3

c. 4 d. 5

e. 6

**Question 97:**

aa. The diagram at the right depicts a standing wave pattern in a closed-end air column. How many antinodes are present in this pattern?

a. 2 b. 3

c. 4 d. 5

e. 6

**Question 98:**

aa. The diagram at the right depicts a standing wave pattern in a closed-end air column. How many nodes are present in this pattern?

a. 1 b. 2

c. 3 d. 4

e. 5

**Question 99:**

aa. The diagram at the right depicts a standing wave pattern in a closed-end air column. How many antinodes are present in this pattern?

a. 1 b. 2

c. 3 d. 4

e. 5

**Question 100:**

aa. The diagram at the right depicts a standing wave pattern in a closed-end air column. How many nodes are present in this pattern?

a. 5 b. 6

c. 7 d. 10

e. 12

**Question 101:**

aa. The diagram at the right depicts a standing wave pattern in a closed-end air column. How many antinodes are present in this pattern?

a. 5 b. 6

c. 7 d. 10

e. 12

**Question 102:**

aa. The diagram at the right depicts a standing wave pattern in a closed-end air column. How many nodes are present in this pattern?

a. 6 b. 7

c. 8 d. 12

e. 14

**Question 103:**

aa. The diagram at the right depicts a standing wave pattern in a closed-end air column. How many antinodes are present in this pattern?

a. 6 b. 7

c. 8 d. 12

e. 14

**Question 104:**

aa. A closed-end air column has a fundamental frequency of 120 Hz. What is the frequency of the third harmonic of the air column?

a. 30 Hz b. 40 Hz

c. 160 Hz d. 360 Hz

e. 480 Hz

**Question 105:**

aa. A closed-end air column has a fundamental frequency of 120 Hz. What is the frequency of the fifth harmonic of the air column?

a. 24 Hz b. 48 Hz

c. 144 Hz d. 300 Hz

e. 600 Hz

**Question 106:**

aa. A closed-end air column has a fundamental frequency of 120 Hz. What are the frequencies of the next two harmonics of the air column?

a. 240 Hz and 360 Hz b. 240 Hz and 360 Hz

c. 360 Hz and 600 Hz d. 360 Hz and 720 Hz

e. 360 Hz and 1800 Hz

**Question 107:**

aa. The diagram at the right depicts a standing wave pattern in an open-end air column. This is the pattern for the \_\_\_\_\_ harmonic.

a. third b. fourth

c. fifth d. sixth

e. seventh

**Question 108:**

aa. The diagram at the right depicts a standing wave pattern in an open-end air column. This is the pattern for the \_\_\_\_\_ harmonic.

a. first b. second

c. third d. fourth

e. fifth

**Question 109:**

aa. The diagram at the right depicts a standing wave pattern in an open-end air column. This is the pattern for the \_\_\_\_\_ harmonic.

a. fourth b. fifth

c. sixth d. seventh

e. ninth

**Question 110:**

aa. The diagram at the right depicts a standing wave pattern in an open-end air column. This is the pattern for the \_\_\_\_\_ harmonic.

a. fifth b. sixth

c. seventh d. eleventh

e. thirteenth

**Question 111:**

aa. The diagram at the right depicts a standing wave pattern in an open-end air column. This is the pattern for the \_\_\_\_\_ harmonic.

a. sixth b. seventh

c. eighth d. thirteenth

e. fifteenth

**Question 112:**

aa. The diagram at the right depicts a standing wave pattern in an open-end air column. This is the pattern for the \_\_\_\_\_ harmonic.

a. seventh b. eighth

c. ninth d. thirteenth

e. fifteenth

**Question 113:**

aa. The diagram at the right depicts a standing wave pattern in an open-end air column. How many nodes are present in the pattern?

a. 2 b. 3

c. 4 d. 5

e. 6

**Question 114:**

aa. The diagram at the right depicts a standing wave pattern in an open-end air column. How many antinodes are present in the pattern?

a. 2 b. 3

c. 4 d. 5

e. 6

**Question 115:**

aa. The diagram at the right depicts a standing wave pattern in an open-end air column. How many nodes are present in the pattern?

a. 3 b. 4

c. 5 d. 6

e. 10

**Question 116:**

aa. The diagram at the right depicts a standing wave pattern in an open-end air column. How many antinodes are present in the pattern?

a. 3 b. 4

c. 5 d. 6

e. 10

**Question 117:**

aa. The diagram at the right depicts a standing wave pattern in an open-end air column. How many nodes are present in the pattern?

a. 5 b. 6

c. 7 d. 10

e. 14

**Question 118:**

aa. The diagram at the right depicts a standing wave pattern in an open-end air column. How many antinodes are present in the pattern?

a. 5 b. 6

c. 7 d. 10

e. 14

**Question 119:**

aa. The diagram at the right depicts a standing wave pattern in an open-end air column. How many nodes are present in the pattern?

a. 5 b. 6

c. 7 d. 10

e. 14

**Question 120:**

aa. The diagram at the right depicts a standing wave pattern in an open-end air column. How many antinodes are present in the pattern?

a. 5 b. 6

c. 7 d. 10

e. 14

**Question 121:**

aa. The diagram at the right depicts a standing wave pattern in an open-end air column. How many nodes are present in the pattern?

a. 6 b. 7

c. 8 d. 12

e. 16

**Question 122:**

aa. The diagram at the right depicts a standing wave pattern in an open-end air column. How many antinodes are present in the pattern?

a. 6 b. 7

c. 8 d. 12

e. 16

**Question 123:**

aa. The diagram at the right depicts a standing wave pattern in an open-end air column. How many nodes are present in the pattern?

a. 7 b. 8

c. 9 d. 14

e. 18

**Question 124:**

aa. The diagram at the right depicts a standing wave pattern in an open-end air column. How many antinodes are present in the pattern?

a. 7 b. 8

c. 9 d. 14

e. 18