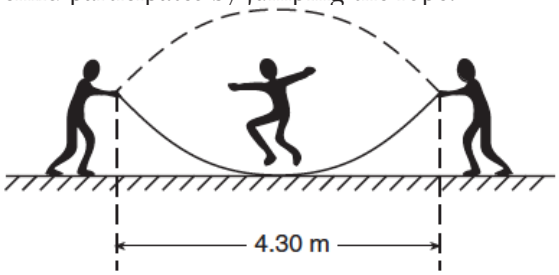
Name: _____ Period: _____

Waves-Wave Behaviors

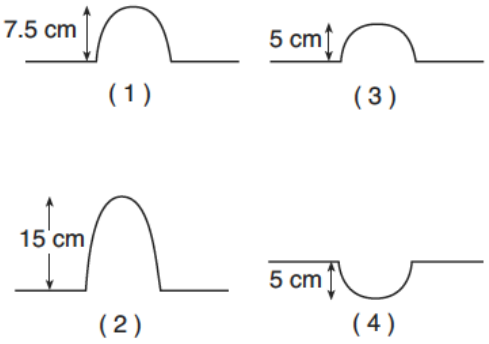
1. While playing, two children create a standing wave in a rope, as shown in the diagram below. A third child participates by jumping the rope.



What is the wavelength of this standing wave?
1. 2.15 m
2. 4.30 m
3. 6.45 m
4. 8.60 m

2. The diagram below shows two pulses approaching each other in a uniform medium.

Which diagram best represents the superposition of the two pulses?



3. Sound waves strike a glass and cause it to shatter. This phenomenon illustrates
   1. resonance
   2. refraction
   3. reflection
   4. diffraction

4. A sound of constant frequency is produced by the siren on top of a firehouse. Compared to the frequency produced by the siren, the frequency observed by a firefighter approaching the firehouse is
   1. lower
   2. higher
   3. the same

5. The superposition of two waves traveling in the same medium produces a standing wave pattern if the two waves have
   1. the same frequency, the same amplitude, and travel in the same direction
   2. the same frequency, the same amplitude, and travel in opposite directions
   3. the same frequency, different amplitudes, and travel in the same direction
   4. the same frequency, different amplitudes, and travel in opposite directions

6. The diagram below represents a standing wave.

The number of nodes and antinodes shown in the diagram is
   1. 4 nodes and 5 antinodes
   2. 5 nodes and 6 antinodes
   3. 6 nodes and 5 antinodes
   4. 6 nodes and 10 antinodes

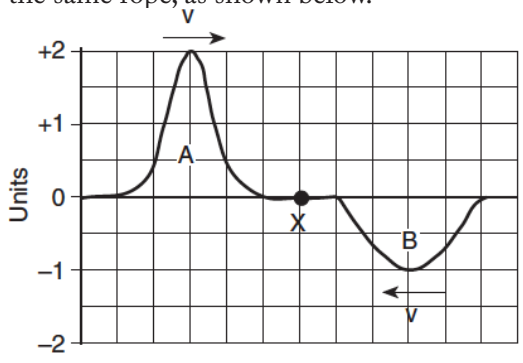
7. A car's horn is producing a sound wave having a constant frequency of 350 hertz. If the car moves toward a stationary observer at constant speed, the frequency of the car's horn detected by this observer may be
   1. 320 Hz
   2. 330 Hz
   3. 350 Hz
   4. 380 Hz

8. Standing waves in water are produced most often by periodic water waves
   1. being absorbed at the boundary with a new medium
   2. refracting at a boundary with a new medium
   3. diffracting around a barrier
   4. reflecting from a barrier

Name: _____ Period: _____

Waves-Wave Behaviors

9. Two pulses, A and B, travel toward each other along the same rope, as shown below.

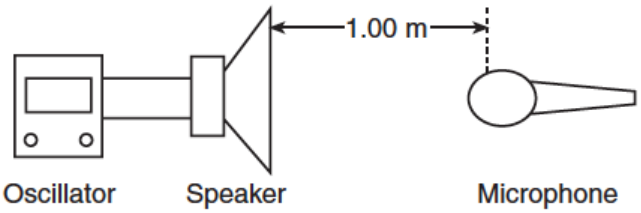


When the centers of the two pulses meet at point X, the amplitude at the center of the resultant pulse will be
1. +1 unit
2. +2 units
3. 0
4. -1 unit

10. A car's horn produces a sound wave of constant frequency. As the car speeds up going away from a stationary spectator, the sound wave detected by the spectator
    1. decreases in amplitude and decreases in frequency
    2. decreases in amplitude and increases in frequency
    3. increases in amplitude and decreases in frequency
    4. increases in amplitude and increases in frequency

11. Playing a certain musical note on a trumpet causes the spring on the bottom of a nearby snare drum to vibrate. This phenomenon is an example of
    1. resonance
    2. refraction
    3. reflection
    4. diffraction

A system consists of an oscillator and a speaker that emits a 1000-hertz sound wave. A microphone detects the sound wave 1.00 meter from the speaker.



12. Which type of wave is emitted by the speaker?
    1. transverse
    2. longitudinal
    3. circular
    4. electromagnetic

13. The microphone is moved to a new fixed location 0.50 meter in front of the speaker. Compared to the sound waves detected at the 1.00-meter position, the sound waves detected at the 0.50-meter position have a different
    1. wave speed
    2. frequency
    3. wavelength
    4. amplitude

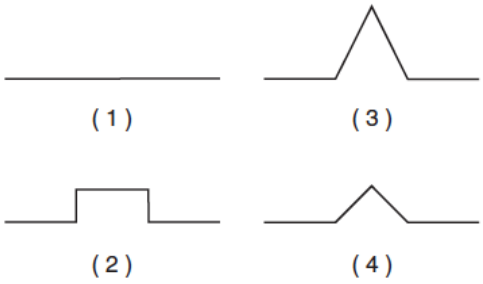
14. The microphone is moved at constant speed from the 0.50-meter position back to its original position 1.00 meter from the speaker. Compared to the 1000-hertz frequency emitted by the speaker, the frequency detected by the moving microphone is
    1. lower
    2. higher
    3. the same

Name: _____ Period: _____

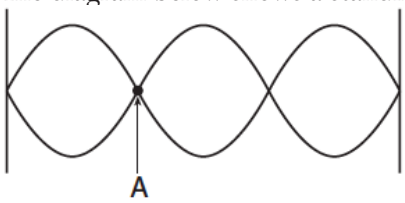
Waves-Wave Behaviors

15. Two pulses traveling in the same uniform medium approach each other, as shown in the diagram below.

Which diagram best represents the superposition of the two pulses?



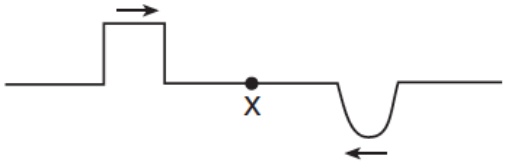
16. The diagram below shows a standing wave.



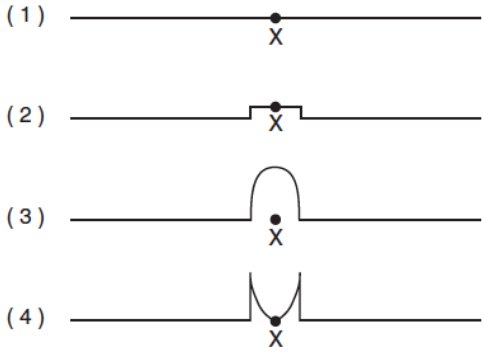
Point A on the standing wave is
1. a node resulting from constructive interference
2. a node resulting from destructive interference
3. an antinode resulting from constructive interference
4. an antinode resulting from destructive interference

17. A source of waves and an observer are moving relative to each other. The observer will detect a steadily increasing frequency if
1. he moves toward the source at a constant speed
2. the source moves away from him at a constant speed
3. he accelerates toward the source
4. the source accelerates away from him

18. The diagram below shows two pulses traveling toward each other in a uniform medium.

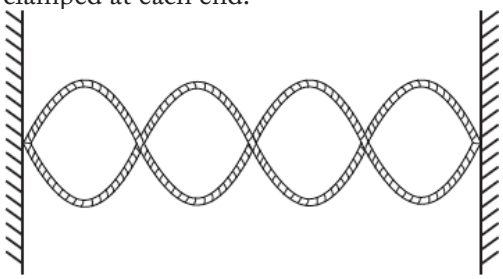


Which diagram best represents the medium when the pulses meet at point X?



19. A dampened fingertip rubbed around the rim of a crystal stemware glass causes the glass to vibrate and produce a musical note. This effect is due to
1. resonance
2. refraction
3. reflection
4. rarefaction

20. The diagram below shows a standing wave in a string clamped at each end.



What is the total number of nodes and antinodes in the standing wave?
1. 3 nodes and 2 antinodes
2. 2 nodes and 3 antinodes
3. 5 nodes and 4 antinodes
4. 4 nodes and 5 antinodes

Name: _____ Period: _____

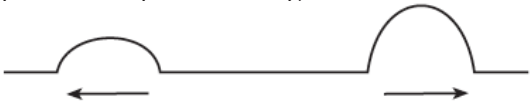
Waves-Wave Behaviors

21. A radar gun can determine the speed of a moving automobile by measuring the difference in frequency between emitted and reflected radar waves. This process illustrates
    1. resonance
    2. the Doppler effect
    3. diffraction
    4. refraction

22. A 256-hertz vibrating tuning fork is brought near a nonvibrating 256-hertz tuning fork. The second tuning fork begins to vibrate. Which phenomenon causes the nonvibrating tuning fork to begin to vibrate?
    1. resistance
    2. resonance
    3. refraction
    4. reflection

23. The diagram below represents two pulses approaching each other from opposite directions in the same medium.

Which diagram best represents the medium after the pulses have passed through each other?



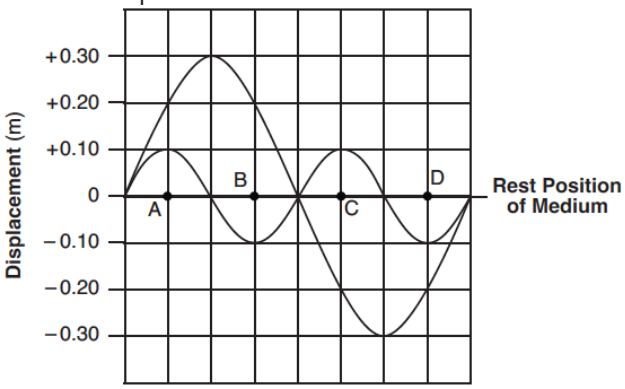
(1)

(2)

(3)

(4)

24. The diagram below shows two waves traveling in the same medium. Points A, B, C, and D are located along the rest position of the medium. The waves interfere to produce a resultant wave.



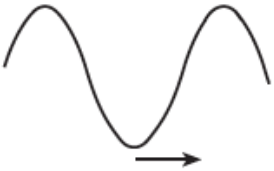
The superposition of the waves produces the greatest positive displacement of the medium from its rest position at point
    1. A
    2. B
    3. C
    4. D

25. The diagram below represents a wave moving toward the right side of this page.

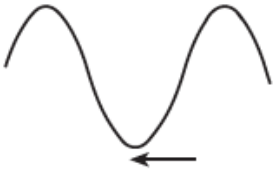
Which wave shown below could produce a standing wave with the original wave?

(1)

(3)



(2)



(4)

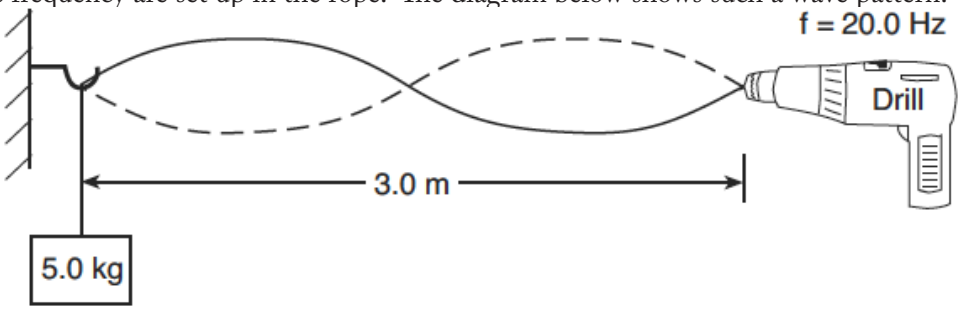
26. Which wave phenomenon occurs when vibrations in one object cause vibrations in a second object?
    1. reflection
    2. resonance
    3. intensity
    4. tuning

Name: _____ Period: _____

Waves-Wave Behaviors

Base your answers to questions 27 and 28 on the information below.

One end of a rope is attached to a variable-speed drill and the other end is attached to a 5.0-kilogram mass. The rope is draped over a hook on a wall opposite the drill. When the drill rotates at a frequency of 20.0 Hz, standing waves of the same frequency are set up in the rope. The diagram below shows such a wave pattern.



27. Determine the wavelength of the waves producing the standing wave pattern.

28. Calculate the speed of the wave in the rope. [Show all work, including the equation and substitution with units.]

Base your answers to questions 29 and 30 on the information below.

Shattering Glass

An old television commercial for audio recording tape showed a singer breaking a wine glass with her voice. The question was then asked if this was actually her voice or a recording. The inference is that the tape is of such high quality that the excellent reproduction of the sound is able to break glass.

This is a demonstration of resonance. It is certainly possibly to break a wine glass with an amplified singing voice. If the frequency of the voice is the same as the natural frequency of the glass, and the sound is loud enough, the glass can be set into a resonant vibration whose amplitude is large enough to surpass the elastic limit of the glass. But the inference that high-quality reproduction is necessary is not justified. All that is important is that the frequency is recorded and played back correctly. The waveform of the sound can be altered as long as the frequency remains the same. Suppose, for example, that the singer sings a perfect sine wave, but the tape records it as a square wave. If the tape player plays the sound back at the right speed, the glass will still receive energy at the resonance frequency and will be set into vibration leading to breakage, even though the tape reproduction was terrible. Thus, this phenomenon does not require high-quality reproduction and, thus, does not demonstrate the quality of the recording tape. What it does demonstrate is the quality of the tape player, in that it played back the tape at an accurate speed!

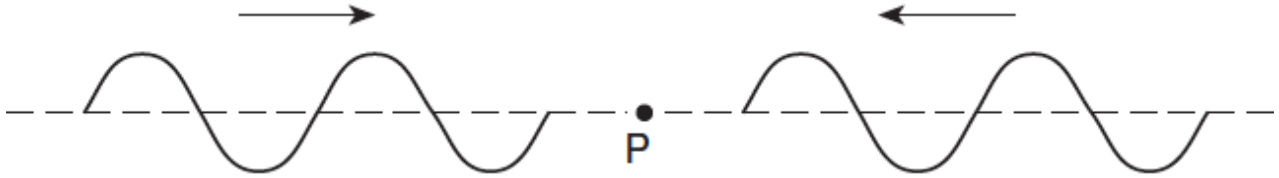
29. List two properties that a singer's voice must have in order to shatter a glass.

30. Explain why the glass would not break if the tape player did not play back at an accurate speed.

Name: _____ Period: _____

Waves-Wave Behaviors

31. The diagram below represents two waves of equal amplitude and frequency approaching point P as they move through the same medium.

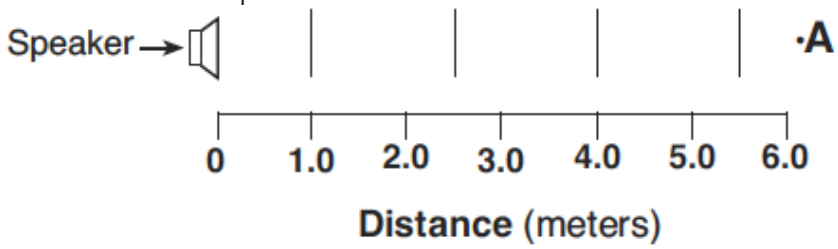


As the two waves pass through each other, the medium at point P will

1. vibrate up and down
2. vibrate left and right
3. vibrate into and out of the page
4. remain stationary

Base your answers to questions 32 and 33 on the information and diagrams below.

The vertical lines in the diagram represent compressions in a sound wave of constant frequency propagating to the right from a speaker toward an observer at point A.



32. Determine the length of this sound wave.

33. The speaker is then moved at constant speed toward the observer at A. Compare the wavelength of the sound wave received by the observer while the speaker is moving to the wavelength observed when the speaker was at rest.

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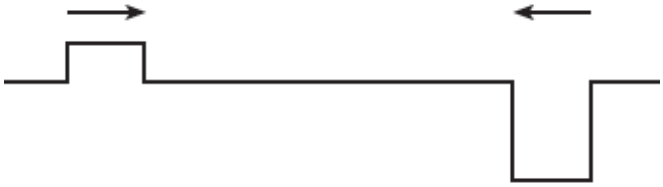
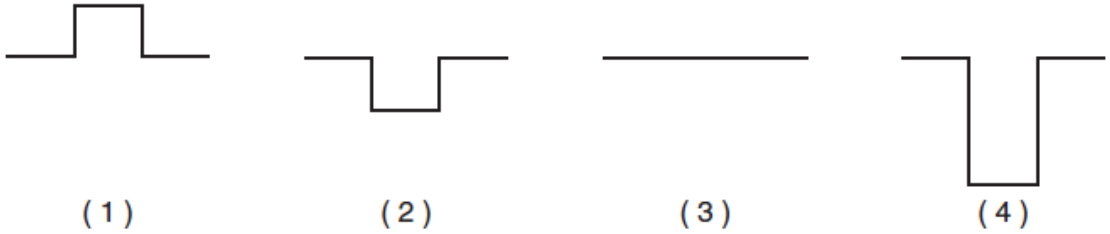
34. The diagram below represents two pulses approaching each other.



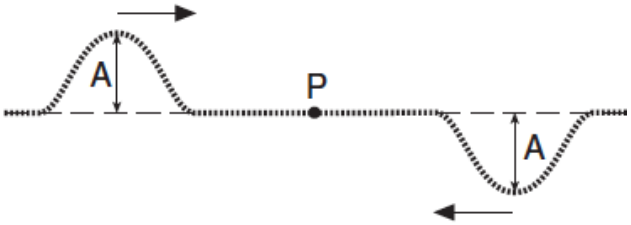
Which diagram best represents the resultant pulse at the instant the pulses are passing through each other?



Name: _____ Period: _____

Waves-Wave Behaviors

35. The diagram below shows two pulses of equal amplitude, A, approaching point P along a uniform string.



When the two pulses meet at P, the vertical displacement of the string at P will be
1. A
2. 2A
3. 0
4. A/2

36. A student in a band notices that a drum vibrates when another instrument emits a certain frequency note. This phenomenon illustrates
1. reflection
2. resonance
3. refraction
4. diffraction

37. A train sounds a whistle of constant frequency as it leaves the train station. Compared to the sound emitted by the whistle, the sound that the passengers standing on the platform hear has a frequency that is
1. lower, because the sound-wave fronts reach the platform at a frequency lower than the frequency at which they are produced
2. lower, because the sound waves travel more slowly in the still air above the platform than in the rushing air near the train
3. higher, because the sound-wave fronts reach the platform at a frequency higher than the frequency at which they are produced
4. higher, because the sound waves travel faster in the still air above the platform than in the rushing air near the train

38. A girl on a swing may increase the amplitude of the swing's oscillations if she moves her legs at the natural frequency of the swing. This is an example of
1. the Doppler effect
2. destructive interference
3. wave transmission
4. resonance

39. Wave X travels eastward with a frequency f and amplitude A. Wave Y, traveling in the same medium, interacts with wave X and produces a standing wave. Which statement about wave Y is correct?
1. Wave Y must have a frequency of f, an amplitude of A, and be traveling eastward.
2. Wave Y must have a frequency of 2f, an amplitude of 3A, and be traveling eastward.
3. Wave Y must have a frequency of 3f, an amplitude of 2A, and be traveling westward.
4. Wave Y must have a frequency of f, an amplitude of A, and be traveling westward.

40. Two waves traveling in the same medium and having the same wavelength (λ) interfere to create a standing wave. What is the distance between two consecutive nodes on this standing wave?
1. λ
2. $3\lambda/4$
3. $\lambda/2$
4. $\lambda/4$

41. Two waves having the same amplitude and frequency are traveling in the same medium. Maximum destructive interference will occur when the phase difference between the waves is
1. 0°
2. 90°
3. 180°
4. 270°

Name: _____ Period: _____

Waves-Wave Behaviors

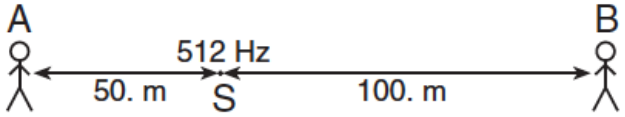
42. Which phenomenon occurs when an object absorbs wave energy that matches the object's natural frequency?
    1. reflection
    2. diffraction
    3. resonance
    4. interference

43. When observed from Earth, the wavelengths of light emitted by a star are shifted toward the red end of the electromagnetic spectrum. This redshift occurs because the star is
    1. at rest relative to Earth
    2. moving away from Earth
    3. moving toward Earth at decreasing speed
    4. moving toward Earth at increasing speed

44. Ultrasound is a medical technique that transmits sound waves through soft tissue in the human body. Ultrasound waves can break kidney stones into tiny fragments, making it easier for them to be excreted without pain. The shattering of kidney stones with specific frequencies of sound waves is an application of which wave phenomenon?
    1. the Doppler effect
    2. reflection
    3. refraction
    4. resonance

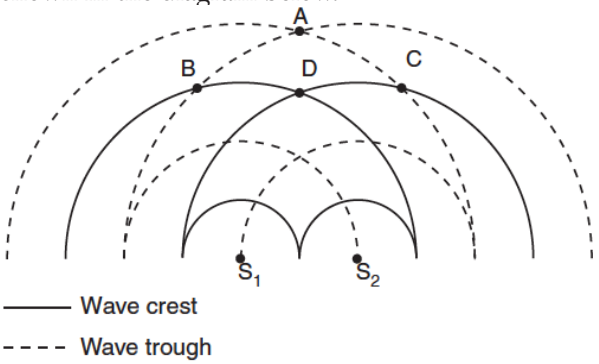
45. A wave passes through an opening in a barrier. The amount of diffraction experienced by the wave depends on the size of the opening and the wave's
    1. amplitude
    2. wavelength
    3. velocity
    4. phase

46. In the diagram below, a stationary source located at point S produces sound having a constant frequency of 512 hertz. Observer A, 50 meters to the left of S, hears a frequency of 512 hertz. Observer B, 100 meters to the right of S, hears a frequency lower than 512 hertz.



Which statement best describes the motion of the observers?
    1. Observer A is moving toward point S, and observer B is stationary.
    2. Observer A is moving away from point S, and observer B is stationary.
    3. Observer A is stationary and observer B is moving toward point S.
    4. Observer A is stationary, and observer B is moving away from point S.

47. Two speakers, S_1 and S_2, operating in phase in the same medium produce the circular wave patterns shown in the diagram below.



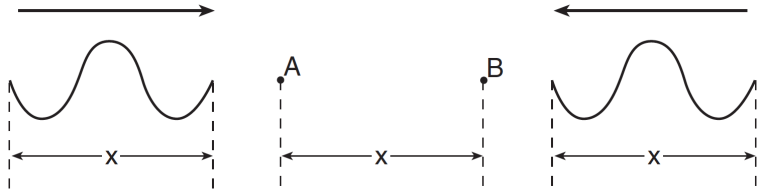
At which two points is constructive interference occurring?
    1. A and B
    2. A and D
    3. B and C
    4. B and D

48. One vibrating 256-hertz tuning fork transfers energy to another 256-hertz tuning fork, causing the second tuning fork to vibrate. This phenomenon is an example of
    1. diffraction
    2. reflection
    3. refraction
    4. resonance

Name: _____ Period: _____

Waves-Wave Behaviors

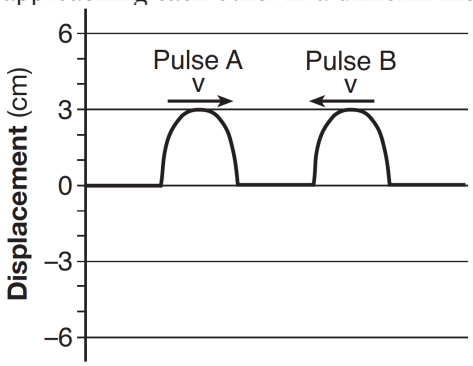
49. The diagram below shows two waves traveling toward each other at equal speed in a uniform medium.



When both waves are in the region between points A and B, they will undergo
1. diffraction
2. the Doppler effect
3. destructive interference
4. constructive interference

50. Sound waves are produced by the horn of a truck that is approaching a stationary observer. Compared to the sound waves detected by the driver of the truck, the sound waves detected by the observer have a greater
1. wavelength
2. frequency
3. period
4. speed

51. The diagram below represents two identical pulses approaching each other in a uniform medium.

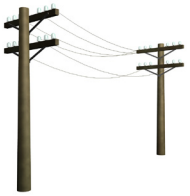


As the pulses meet and are superposed, the maximum displacement of the medium is
1. -6 cm
2. 0 cm
3. 3 cm
4. 6 cm

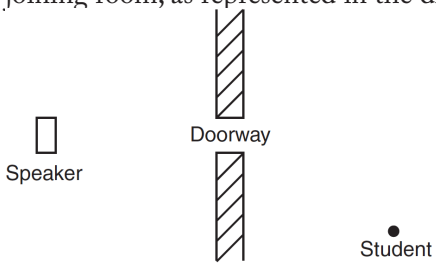
52. As a car approaches a pedestrian crossing the road, the driver blows the horn. Compared to the sound wave emitted by the horn, the sound wave detected by the pedestrian has a
1. higher frequency and a lower pitch
2. higher frequency and a higher pitch
3. lower frequency and a higher pitch
4. lower frequency and a lower pitch

53. When air is blown across the top of an open water bottle, air molecules in the bottle vibrate at a particular frequency and sound is produced. This phenomenon is called
1. diffraction
2. refraction
3. resonance
4. the Doppler effect

54. Wind blowing across suspended power lines may cause the power lines to vibrate at their natural frequency. This often produces audible sound waves. This phenomenon, often called an Aeolian harp, is an example of
1. diffraction
2. the Doppler effect
3. refraction
4. resonance



55. A student listens to music from a speaker in an adjoining room, as represented in the diagram below.

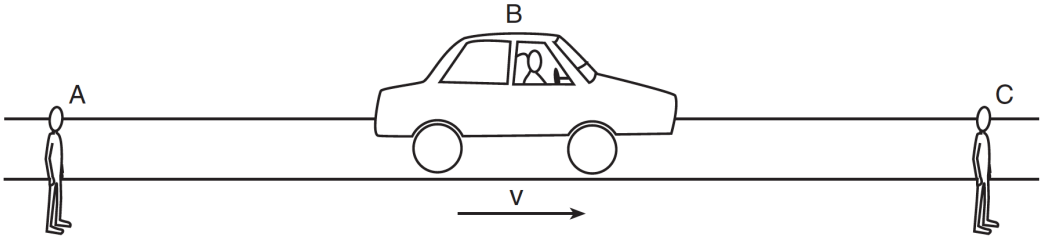


She notices that she does not have to be directly in front of the doorway to hear the music. This spreading of sound waves beyond the doorway is an example of
1. the Doppler effect
2. resonance
3. refraction
4. diffraction

Name: _____ Period: _____

Waves-Wave Behaviors

56. The horn of a moving vehicle produces a sound of constant frequency. Two stationary observers, A and C, and the vehicle's driver, B, positioned as represented in the diagram below, hear the sound of the horn.



Compared to the frequency of the sound of the horn heard by driver B, the frequency heard by observer A is

1. lower and the frequency heard by observer C is lower
2. lower and the frequency heard by observer C is higher
3. higher and the frequency heard by observer C is lower
4. higher and the frequency heard by observer C is higher

57. Two pulses approach each other in the same medium. The diagram below represents the displacements caused by each pulse.

Which diagram best represents the resultant displacement of the medium as the pulses pass through each other?