



PHYSICS

BOOKS - MTG IIT JEE FOUNDATION

SOUND

Illustrations

1. How sound is produced in Musical Instruments?



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2. A boat anchor is rocked by waves whose consecutive crests are $100m$ apart. If the wave speed of the moving crests is $20m/s$, calculate the frequency at which the boat rocks.



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3. Audible ranges of frequencies is 20 Hz to $20,000\text{ Hz}$. Find the range of wavelengths

corresponding to this frequency. Given,
velocity of sound = 340m s^{-1} .



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4. A child hears an echo from a cliff 4 seconds after the sound from a powerful cracker is produced. How far away is the cliff from the child? Velocity of sound in air at 20°C is 344m s^{-1} .



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5. The pressure amplitude in a sound wave from a radio receiver is $2.0 \times 10^{-2} \text{N m}^{-2}$ and the intensity at a point is $5.0 \times 10^{-7} \text{W m}^{-2}$. If by turning the volume knob the pressure amplitude is increased to $2.5 \times 10^{-2} \text{N m}^{-2}$, evaluate the intensity.



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6. At normal temperature and pressure, 4g of He occupies a volume of 22.4 litre. Determine the speed of sound in helium. Take 1

atmospheric pressure $= 10^5 \text{ N/m}^2$ and γ for helium $= 1.67$.



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7. The velocity of sound in a tube containing air at 27°C and a pressure 76 cm of mercury is 330 m s^{-1} . What will be the velocity of sound when pressure is increased to 100 cm of mercury and the temperature is kept constant?



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8. Sound is heard over longer distances on rainy days because



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9. Explain why sound travels faster in warm air than in cool air.



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10. An investigator team transmit an ultrasound signal to the sea bed. The signal is received back in 12 second. If the speed of sound in water is 1000 m/s, then the depth of sea is



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11. A train moves towards a stationary observer with speed $34m / s$. The train sounds a whistle and its frequency registered by the

observer is f_1 . If the train's speed is reduced to 17m/s , the frequency registered is f_2 . If the speed of sound of 340m/s , then the ratio f_1 / f_2 is



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12. When a train blowing its whistle passes by you, you first hear a high pitched note later a low pitched note. Why?



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Solved Examples

1. A construction worker's helmet slips and he hears the sound of the helmet hitting the ground 4.23 seconds after it slipped. Find the speed of sound in air.



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2. Your friend is listening to Lata Mangeshkar concert live at New York. The distance between the stage and your friend is 50 m. The same

program is also being broadcast live on the All India Radio. You too are listening to the same program at Hyderabad. The distance between Hyderabad and New York is approximately 10,000 km. Who will hear Lata Mangeshkar 's voice first, you or your friend?



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3. A source is producing 1500 sound waves in 3 seconds. If the distance covered by a compression and an adjacent rarefaction be

68 cm, find: (a) frequency, (b) wavelength, and (c) velocity, of the sound wave.



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4. A source is producing 1500 sound waves in 3 seconds. If the distance covered by a compression and an adjacent rarefaction be 68 cm, find: (a) frequency, (b) wavelength, and (c) velocity, of the sound wave.



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5. A source is producing 1500 sound waves in 3 seconds. If the distance covered by a compression and an adjacent rarefaction be 68 cm, find: (a) frequency, (b) wavelength, and (c) velocity, of the sound wave.



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6. A engine is approaching a hill at constant speed. When it is at a distance of 0.9km , it blows a whistle, whose echo is heard by the

driver after $5s$. If the speed of sound is $340m / s$, calculate the speed of the engine.



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7. Figure shows a snap-shot of a wave-form of frequency 50 Hz . For this wave motion, find wavelength



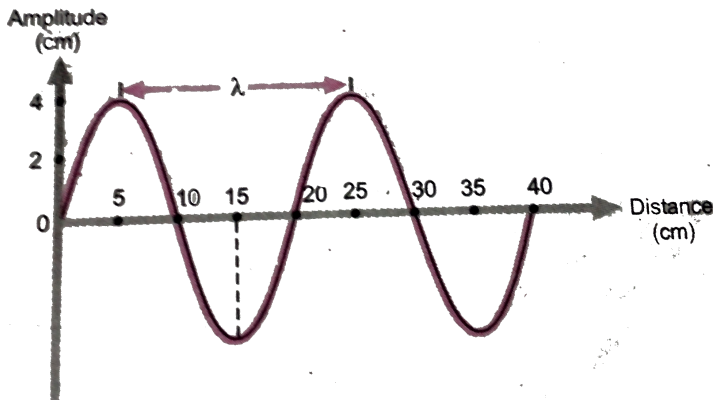
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8. shows a snapshot of a wave-form of frequency 50Hz . For this wave motion, find

(a) wavelength

(b) amplitude

(c) velocity.



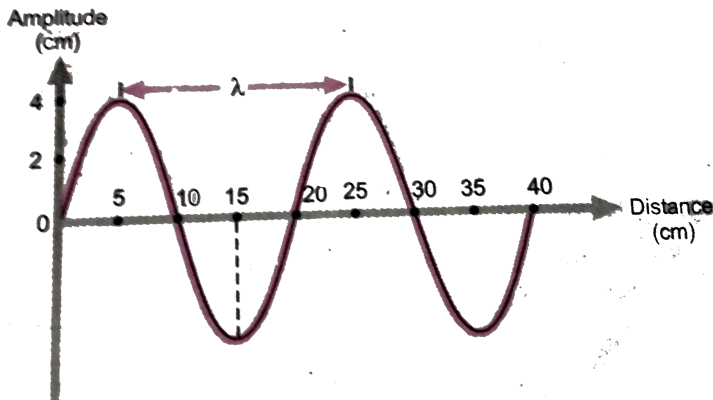
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9. shows a snapshot of a wave-form of frequency 50Hz . For this wave motion, find

(a) wavelength

(b) amplitude

(c) velocity.



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10. The speed of sound in moist air is greater than that in dry air, why? Will the speed of sound in moist hydrogen be greater than that in dry hydrogen?



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11. Estimate the speed of sound in air at standard temperature and pressure by using (i) Newton's formula and (ii) Laplace formula.

The mass of 1 mole of air = 29.0×10^{-3} kg.

For air, $\gamma = 1.4$.



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12. A wave pulse on a string moves a distance of 8 m in 0.05 s.

Find the velocity of the pulse.



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13. A wave pulse on a string moves a distance of 8 m in 0.05 s.

What would be the wavelength of the wave on the same string if its frequency is 200 Hz?



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14. The apparent frequency, of the whistle of an approaching train engine, changes in the ratio 9 : 8 as the engine crosses a stationary

observer on the platform. If the speed of sound is 340 m s^{-1} , find the speed of the train.



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15. AM and FM radio waves are transverse waves that consist of electric and magnetic disturbances. These waves travel at a speed of 3.00×10^8 m/s.

A station broadcasts an AM radio wave whose frequency is 1230×10^3 Hz (1230 kHz on the dial) and an FM radio wave whose frequency is

91.9×10^6 Hz (91.9 MHz on the dial). Find the distance between adjacent crests in each wave.



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Ncert Section

1. How does the sound produced by a vibrating object in a medium reach your ear ?



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2. Explain how sound is produced by your school bell ?



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3. Why are sound waves called mechanical waves ?



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4. Suppose you and your friend are on the Moon. Will you be able to hear any sound produced by your friend ?



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5. Which wave property determines

(a) loudness

(b) Pitch ?



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6. Which wave property determines

(a) loudness

(b) Pitch ?



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7. Guess which has a higher pitch : a guitar or a car horn ?



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8. What are wavelength, frequency, time period and amplitude of a sound wave ?



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9. How are the wavelength and frequency of a sound wave related to its speed ?



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10. Calculate the wavelength of a sound wave whose frequency is 220Hz and speed is 440m/s in a given medium.



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11. A person is listening to a tone of 500Hz sitting at a distance of 450m from the source of the sound. What is the time interval between successive compressions from the source ?





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12. Distinguish between loudness and intensity of sound.



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13. In which of the three media : air, water or iron , does sound travel the fastest at a particular temperature ?



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14. An echo is returned in $3s$. What is the distance of the reflecting surface from the source, given that the speed of sound is $342m / s$.



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15. Why are the ceilings of concert halls curved ?



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16. What is the audible range of the average human ear ?



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17. What is the range of frequencies associated with

(a) infra sound

(b) ultrasound ?



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18. Write the (approximate) range of frequencies of ultrasound.



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19. A submarine emits a sonar pulse, which returns from an underwater cliff in $1.02s$. If the speed of sound in water is $1531m/s$, how far away is the cliff ?



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20. What is sound and how is it produced ?



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21. Describe with the help of a diagram, how compressions and rarefactions are produced in air near a source of sound.



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22. Cite an experiment to show that sound needs a material for its propagation.



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23. Why is sound wave called a longitudinal wave ?



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24. Which characteristic of the sound helps you to identify your friend by his voice while sitting with others in a dark room ?



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25. Flash and thunder are produced simultaneously. But thunder is heard a few seconds after the flash is seen, why ?



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26. A person has a hearing range from $20Hz$ to $20kHz$. What are the typical wavelength of sound waves in air corresponding to these two frequencies ? Take the speed of sound in air as $344m / s$.



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27. Two children are at opposite ends of an aluminium rod. One strikes the end of the rod with a stone. Find the ratio of times taken by

the sound wave in air and in aluminium to reach the second child.



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28. The frequency of a source of sound is 100Hz . How many times does it vibrate in a minute ?



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29. Does sound follow the same laws of reflection as light does ? Explain.



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30. When a sound is reflected from a distant object, an echo is produced. Let the distance between the reflecting surface and the source of sound production remain the same. Do you hear echo sound on a hotter day ?



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31. Give two practical applications of reflection of sound waves.



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32. A stone is dropped from the top of a tower $500m$ high into a pond of water at the base of the tower. When is the splash heard at the top ? Given, $g = 10m/s^2$ and speed of sound $= 340m/s$.



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33. A sound wave travels at a speed of 339m/s . If its wavelength is 1.5cm , what is the frequency of the wave ? Will it be audible ?



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34. What is reverberation ? How can it be reduced ?



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35. What is loudness of sound ? What factors does it depend on ?



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36. Explain how bats use ultrasound to catch a prey.



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37. How is ultrasound used for cleaning ?





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38. Explain the working and application of a sonar.



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39. A sonar device on a submarine sends out a signal and receives an echo $5s$ later. Calculate the speed of sound in water if the distance of the object from the submarine is $3625m$,



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40. Explain how defects in a metal block can be detected using ultrasound.



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41. Explain how the human ear works.



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1. Which is not the condition for hearing sound?

A. There must be a vibrating body capable of transferring energy.

B. There must be a material medium to pick up and propagate energy.

C. The medium must have a large density.

D. There must be receiver to receive the energy and interpret it.

Answer: C



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2. Name the device which is used to produced sound in laboratory experiments.

A. sonar

B. electric bell

C. tuning fork

D. a stretched wire

Answer: C



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3. When a sound wave travels in air, the physical quantity which is transferred from one place to the other is

A. mass

B. force

C. momentum

D. energy

Answer: D



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4. What is the direction of oscillations of the particle of the medium through which a longitudinal wave is propagating ?

A. in the direction of wave propagation

B. opposite to the direction of wave propagation

C. at right angles to the direction of wave propagation

D. none of the above

Answer: A



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5. In a transverse wave, the particles of the medium

A. in the direction of wave propagation

B. opposite to the direction of wave propagation

C. at the right angles to the direction of wave propagation

D. none of the above

Answer: C



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6. In the region of compression or rarefaction, in a longitudinal wave the physical quantity which does not change is

A. pressure

B. mass

C. density

D. volume

Answer: B



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7. A slinky can produce in laboratory

- A. transverse waves only
- B. longitudinal waves only
- C. both (a) and (b)
- D. none of the above

Answer: C



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8. The change in density/pressure of a medium from maximum value to minimum value and again to maximum value, due to the propagation of a longitudinal wave is called a complete

A. oscillation

B. frequency

C. amplitude

D. none of these

Answer: A



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9. A stretched slinky is given a sharp push along its length. A wave travels from one end to another. The wave so produced is

- A. transverse wave
- B. longitudinal wave
- C. stationary wave
- D. none of the above

Answer: B



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10. Calculate the wavelength of radio waves of frequency 10^9 Hz . The speed of radio waves is $3 \times 10^8 \text{ m s}^{-1}$.

A. 60 cm

B. 40 cm

C. 30 cm

D. 10 cm

Answer: C



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11. A source of wave produces 20 crests and 20 troughs in 0.2 s. Find the frequency of the wave.

A. 200 Hz

B. 500 Hz

C. 100 Hz

D. 300 Hz

Answer: C



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12. If the density of air at a point through which a sound wave is passing is maximum at an instant, the pressure at that point will be

A. minimum

B. same as the density of air

C. equal to the atmospheric pressure

D. maximum

Answer: D



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13. A body travelling with a speed of more than the velocity of sound in air is said to travel with

- A. ultrasonic speed
- B. sonic speed
- C. infrasonic speed
- D. supersonic speed

Answer: D



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14. An object is 11 km below sea level. A research vessel sends down a sonar signal to confirm this depth. After how long can it expect to get the echo? (Take the speed of sound in sea water as $1,520\text{m s}^{-1}$.)

A. 15.30 s

B. 14.47 s

C. 12.20 s

D. 11.13 s

Answer: B



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15. Which of the following is an elastic wave?

A. Sound waves

B. Light waves

C. X-rays

D. Radio waves

Answer: A



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16. An echo is returned in $3s$. What is the distance of the reflecting surface from the source, given that the speed of sound is $342m / s$.

A. 351 m

B. 513 m

C. 153

D. none of these

Answer: B



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17. A boat anchor is rocked by waves whose consecutive crests are $100m$ apart. If the wave speed of the moving crests is $20m/s$, calculate the frequency at which the boat rocks.

A. 2 Hz

B. 1 Hz

C. 0.5 Hz

D. 0.2 Hz

Answer: D



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18. Which of the following properties of sound is affected by change in the temperature of air ?

A. frequency

B. amplitude

C. intensity

D. wavelength

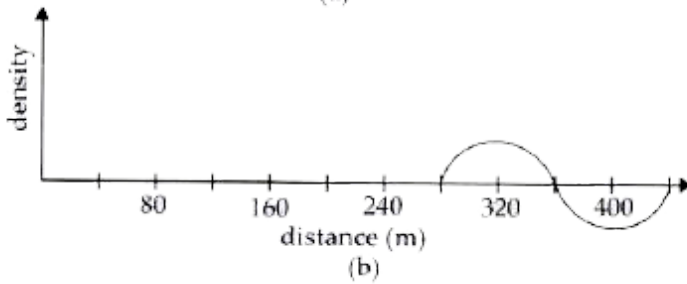
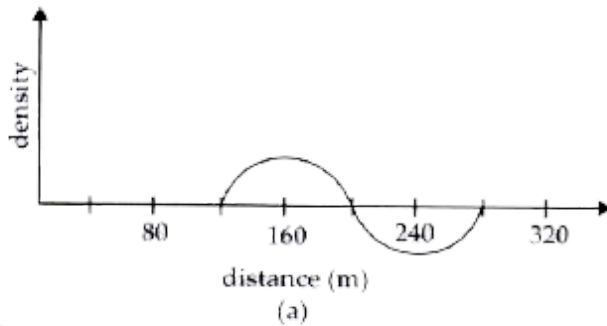
Answer: D



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19. A wave pulse moving through air causes change in the density of air. The variation of density at two different instants are shown in

the figure. The figure (a) corresponds to, $t = 10\text{s}$ and figure (b) to $t = 10\text{s}$.



The

speed of the wave pulse is

A. 520m s^{-1}

B. 320m s^{-1}

C. 300m s^{-1}

D. 220m s^{-1}

Answer: B



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20. Two waves having sinusoidal waveforms have different wavelengths and different amplitude. They will be having

A. same pitch and different intensity

B. same quality and different intensity

C. different quality and different intensity

D. same quality and different pitch

Answer: A



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21. A source of sound of frequency 600 Hz is placed inside water. The speed of sound in water is 1500m/s and in air it is 300m/s . The frequency of sounds recorded by an observer who is standing in air is :-

A. 200 Hz

B. 300 Hz

C. 120 Hz

D. 600 Hz

Answer: D



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22. Each of the properties of sound listed in column A primarily depends on one of the quantities in column B. Choose the matching

pairs from two columns

Column A	Column B
Pitch	Waveform
Quality	Frequency
Loudness	Intensity

A. Pitch-waveform, Quality-frequency,
Loudness-intensity

B. Pitch-frequency, Quality-waveform,
Loudness-intensity

C. Pitch-intensity, Quality-waveform,
Loudness-frequency

D. Pitch-waveform,

Quality-intensity,

Loudness-frequency

Answer: B



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23. A light pointer fixed to one prong of a tuning fork touches gently a smoked vertical plate. The fork is set vibrating and the plate is allowed to fall freely. 8 complete oscillations

are counted when the plate falls through 10cm. What is the frequency of the tuning fork?

A. 360 Hz

B. 280 Hz

C. 560 Hz

D. 56 Hz

Answer: D



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24. The highest frequency produced by a man is 1700 Hz and that of a woman is 2780 Hz . The ratio of wavelengths of sound of man and woman are (speed of sound is 340m.s^{-1})

A. 1 : 0.60

B. 1 : 0.61

C. 1 : 0.62

D. 1 : 0.59

Answer: B



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25. The wavelength and frequency of a sound wave in medium A is 20 cm and 1650 Hz. Keeping the medium same, if wavelength is changed to 16 cm, then new frequency is

A. 2060 Hz

B. 2062.5 Hz

C. 2061 Hz

D. 2063.0 Hz

Answer: B



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26. A man stands between two cliffs and fires a gun. He hears two successive echoes after 3 s and 5 s. The distance between two cliffs is

A. 1310 m

B. 1320 m

C. 1315 m

D. 1312 m

Answer: B



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27. Water waves are

A. longitudinal

B. transverse

C. both longitudinal and transverse

D. neither longitudinal nor transverse

Answer: C



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28. An echo repeats two syllables. If the velocity of sound is 330m s^{-1} , then the distance of the reflecting surface is

A. 66.0 m

B. 33.0 m

C. 99.0 m

D. 16.5 m

Answer: A



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29. A plane wave of sound travelling in air is incident upon a plane water surface. The angle of incidence is 30° . If the velocity of sound in water is 1400m s^{-1} , and the velocity of sound in air is 330m s^{-1} , there will be

A. Reflection only

B. Refraction only

C. both reflection and refraction

D. neither reflection nor refraction

Answer: A



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30. If you go on increasing the stretching force on a wire in a guitar, its frequency

A. increases

B. decreases

C. remains unchanged

D. none of the above

Answer: A



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Exercise Multiple Choice Questions Level 2

1. A bat emits ultrasonic sound of frequency 100 kHz in air. If this sound meets a water surface, the wavelengths of the reflected and

transmitted sound are (Speed of sound in air = 340 m s^{-1} and in water = 1500 m s^{-1})

A. 3.4 mm, 30 mm

B. 6.8 mm, 15 mm

C. 3.4 mm, 15 mm

D. 6.8 mm, 30 mm

Answer: C



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2. During night, distant sounds such as that of traffic and loudspeakers become louder. This is due to

A. reflection of sound waves

B. refraction of sound waves

C. absence of other sounds

D. clear perception of hearing

Answer: B



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3. A longitudinal wave is produced on a slinky. The wave travels at a speed of 30 cm/s and the frequency of the wave is 20 Hz . What is the minimum separation between two consecutive compressions of the slinky?

A. 1.0 cm

B. 1.5 cm

C. 2.5 cm

D. 3.0 cm

Answer: B



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4. Sound travels at a speed of 334m s^{-1} in air.

This means that

- A. the source of sound moves 334 m in one second
- B. the listener moves 334 m in one second
- C. air moves 334 m in one second
- D. the disturbance in. air moves 334 m in one second

Answer: D



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5. Non-mechanical wave can travel

- A. in vacuum as well as in a medium
- B. in vacuum but not in a medium
- C. in medium but not in vacuum
- D. neither in a medium nor in vacuum

Answer: A



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6. In case of a travelling wave, the reflection at a rigid boundary will take place with a phase change of

A. $\frac{\pi}{2}$ radian

B. $\frac{\pi}{4}$ radian

C. $\frac{\pi}{6}$ radian

D. π radian

Answer: D



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7. When sound is produced in an aeroplane with a velocity of 200 m/s horizontally its echo is heard after $10\sqrt{5}$ seconds. If velocity of sound in air is 300 m s^{-1} the elevation of aircraft is

A. 250 m

B. $250\sqrt{5} \text{ m}$

C. 1250 m

D. 2500 m

Answer: D



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8. A tuning fork of frequency 250 Hz produces a beat frequency of 10 Hz when sounded with a sonometer vibrating in its fundamental frequency. When the tuning fork is filed, the beat frequency decreases. If the length of

sonometer wire is 0.5 m, the speed of transverse wave is

A. 260m s^{-1}

B. 250m s^{-1}

C. 240m s^{-1}

D. 500m s^{-1}

Answer: A



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9. If man were standing unsymmetrically between parallel cliffs, claps his hands and starts hearing a series of echoes at intervals of 1 s. If speed of sound in air is 340m s^{-1} , the distance between two cliffs would be

A. 340 m

B. 510 m

C. 170 m

D. 680 m

Answer: B



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10. A man is watching two trains, one leaving and the other coming in with equal speeds of 4m s^{-1} . If they sound their whistles, each of frequency 240 Hz, the number of beats per second heard by the man is (velocity of sound in air = 330m s^{-1})

A. 6

B. 3

C. 0

D. 12

Answer: A



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11. When two waves of almost equal frequencies v_1 and v_2 reach at a point simultaneously, the time interval between successive maxima is

A. $v_1 + v_2$

B. $v_1 - v_2$

C. $\frac{1}{v_1 + v_2}$

D. $\frac{1}{v_1 - v_2}$

Answer: D



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12. Blowing a horn of 500 Hz frequency, a car A is moving in the opposite direction to car B. Both the cars are approaching each other at 30km h^{-1} . The person in the car B hears the

horn of A which according to B has a frequency ν_A . Given $30\text{km h}^{-1} = \frac{25}{3}\text{m s}^{-1}$.

The frequency ν_A as measured by B when they are approaching each other is

- A. 500 Hz
- B. 526 Hz
- C. less than 500 Hz
- D. none of these

Answer: B



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13. When a siren of a fire engine approaches an observer at a speed of 10m s^{-1} , taking the velocity of sound is 340m s^{-1} , if the frequency of the siren is 600 Hz, the frequency heard by the observer is

A. 580 Hz

B. 620 Hz

C. 600 Hz

D. none of these

Answer: B



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14. A bus is moving with a velocity of 5ms^{-1} towards a huge wall. The driver sound a horn of frequency 165 Hz. If the speed of sound in air is 335ms^{-1} , the number of beats heard per second by a passenger inside the bus will be

A. 3

B. 4

C. 5

D. 6

Answer: A



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15. A source of sound produces wave of 60 cm wavelength. This source is moving towards north with a speed one-fifth the sound speed.

Find the apparent wavelength of the waves in the north and south directions.

A. 72 cm and 48 cm

B. 48 cm and 72 cm

C. 82 cm and 52 cm

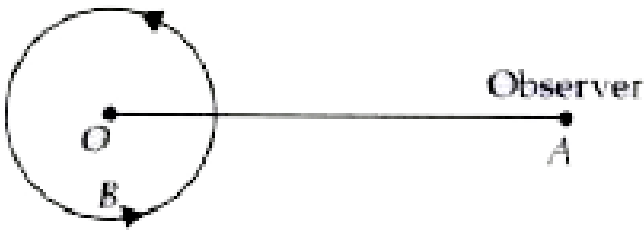
D. none of these

Answer: B



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16. A source of sound is rotating in the anticlockwise direction on a circle of radius 3 m, with an angular velocity of 10 rad s^{-1} , given the frequency of the sound produced is 340 Hz and the velocity of sound is 330 m s^{-1} . The maximum frequency heard by the observer in the plane of the circle at a large distance will be



A. 300 Hz

B. 374 Hz

C. 474 Hz

D. none of these

Answer: B



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17. Two tuning forks, A and B, produce notes of frequencies 258 Hz and 262 Hz. An unknown note sounded with A produces certain beats.

When the same note is sounded with B, the beat frequency gets doubled. The unknown frequency is

A. 250 Hz

B. 252 Hz

C. 254 Hz

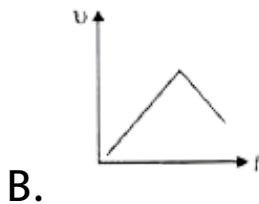
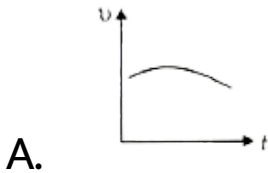
D. 256 Hz

Answer: C

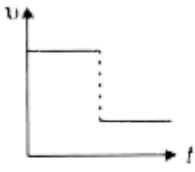


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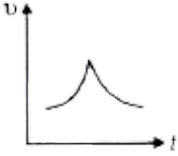
18. A train whistling at constant frequency is moving towards a station at a constant speed v . The train goes past a stationary observer on the station. The frequency ν of the sound as heard by the observer is plotted as a function of time t . Identify the expected curve.



C.



D.



Answer: C

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19. Earthquakes generate sound waves inside the earth. Unlike a gas, the earth can experience both transverse (S) and

longitudinal (P) sound waves. Typically, the speed of S wave is about 4.0 km s^{-1} , and that of P wave is 8.0 km s^{-1} . A seismograph records P and S waves from an earthquake. The first P wave arrives 4 min before the first S wave. Assuming the waves travel in straight line, how far away does the earthquake occur?

A. 1140 km

B. 1745 km

C. 2145 km

D. 1920 km

Answer: D



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20. A SONAR system fixed in a submarine operates at a frequency 40.0kHz . An enemy submarine moves towards the SONAR with a speed of 360 kmh^{-1} . What is the frequency of sound reflected by the submarine ? Take the speed of sound in water to be 1450 ms^{-1} .

A. 38.21 kHz

B. 48.16 kHz

C. 51.17 kHz

D. 45.93 kHz

Answer: D



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Exercise Match The Following

1. In this section, each question has two matching lists. Choices for the correct

combination of elements from List-I and List-II are given as options (a), (b), (c) and (d) out of which one is correct.

List-I	List-II
(P) High pitch	1. Faint sound
(Q) Low pitch	2. Loud sound
(R) Small amplitude	3. High frequency
(S) Large amplitude	4. Low frequency

A. P-1, Q-4, R-3, S-2

B. P-2, Q-3, R-1, S-4

C. P-4, Q-3, R-2, S-1

D. P-3, Q-4, R-1, S-2

Answer: D



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2. In this section, each question has two matching lists. Choices for the correct combination of elements from List-I and List-II are given as options (a), (b), (c) and (d) out of which one is correct.

...

List-I	List-II
(P) Megaphone	1. 17.2 m
(Q) Minimum distance for echo	2. 3000 m
(R) Depth of sea if ultrasonic wave comes back in 4 s.	3. Multiple reflection of sound
(S) Echo heard after 5 s distance of reflecting surface	4. 850 m

A. P-3, Q-1, R-2, S-4

B. P-3, Q-4, R-1, S-2

C. P-1, Q-3, R-2, S-4

D. P-4, Q-2, R-4, S-3

Answer: A



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3. In this section, each question has two matching lists. Choices for the correct combination of elements from List-I and List-II

are given as options (a), (b), (c) and (d) out of which one is correct.

List-I

- (P) Elephants
- (Q) Ultrasound
- (R) Sonar
- (S) Reverberation

List-II

- 1. Reflection of sound
- 2. Infrasonic waves
- 3. Multiple reflection of sound
- 4. Welding purpose

A. P-2, Q-4, R-1, S-3

B. P-3, Q-1, R-4, S-3

C. P-2, Q-1, R-3, S-4

D. P-3, Q-1, R-4, S-2

Answer: A





4. In this section, each question has two matching lists. Choices for the correct combination of elements from List-I and List-II are given as options (a), (b), (c) and (d) out of which one is correct.

List-I	List-II
(P) Slinky when jerked	1. Longitudinal wave
(Q) Quality of sound	2. Loudness
(R) Slinky pushed or pulled	3. Transverse wave
(S) Amplitude	4. Timbre

A. P-1, Q-4, R-3, S-2

B. P-3, Q-1, R-4, S-2

C. P-2, Q-1, R-3, S-4

D. P-3, Q-4, R-1, S-2

Answer: D



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Exercise Assertion Reason Type

1. Assertion : Two persons on the surface of moon cannot talk to each other.

Reason : There is no atmosphere on moon.

A. If both assertion and reason are true and reason is the correct explanation of assertion.

B. If both assertion and reason are true but reason is not the correct explanation of assertion.

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: A



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2. . Assertion: The velocity of sound increases with increases in humidity.

Reason: Velocity of sound does not depend upon the medium.

A. If both assertion and reason are true and reason is the correct explanation of assertion.

B. If both assertion and reason are true but reason is not the correct explanation of assertion.

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: C



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3. Assertion : Compression and rarefaction involve changes in density and pressure.

Reason : When particles are compressed, density of medium increases and when they are rarefied, density of medium decreases.

A. If both assertion and reason are true and reason is the correct explanation of assertion.

B. If both assertion and reason are true but reason is not the correct explanation of

assertion.

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: A



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4. Assertion : Transverse waves travel through air in an organ pipe.

Reason : Air possesses only volume elasticity.

A. If both assertion and reason are true and reason is the correct explanation of assertion.

B. If both assertion and reason are true but reason is not the correct explanation of assertion.

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: D



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5. Assertion : The velocity of sound in hydrogen gas is less than the velocity of sound in oxygen gas.

Reason : The density of oxygen is more than the density of hydrogen.

A. If both assertion and reason are true and reason is the correct explanation of assertion.

B. If both assertion and reason are true but reason is not the correct explanation of assertion.

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: D



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6. Assertion : Sound would travel faster on a not summer day than on a cold winter day,

Reason : Velocity of sound is directly proportional to the square of its absolute temperature.

A. If both assertion and reason are true and reason is the correct explanation of assertion.

B. If both assertion and reason are true but reason is not the correct explanation of

assertion.

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: C



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7. Assertion : Waves produced in a cylinder containing a liquid by moving its piston back and forth are longitudinal waves.

Reason : In longitudinal waves, the particles of

the medium oscillate parallel to the direction of propagation of the wave.

A. If both assertion and reason are true and reason is the correct explanation of assertion.

B. If both assertion and reason are true but reason is not the correct explanation of assertion.

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: B



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8. Assertion: A vibrating tuning fork sounds louder when its stem is pressed against a desk top.

Reason : When a wave reaches another denser medium, part of the wave is reflected.

A. If both assertion and reason are true and reason is the correct explanation of

assertion.

B. If both assertion and reason are true but reason is not the correct explanation of assertion.

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: C



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9. Assertion : Waves produced by a motor boat sailing in water are both longitudinal and transverse in nature.

Reason : The longitudinal and transverse waves cannot be produced simultaneously.

A. If both assertion and reason are true and reason is the correct explanation of assertion.

B. If both assertion and reason are true but reason is not the correct explanation of

assertion.

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: C



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10. Assertion : The speed of sound in solids is maximum though density is large.

Reason : The coefficient of elasticity of solid is large.

A. If both assertion and reason are true and reason is the correct explanation of assertion.

B. If both assertion and reason are true but reason is not the correct explanation of assertion.

C. If assertion is true but reason is false.

D. If both assertion and reason are false.

Answer: A



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Exercise Comprehension Type

1. PASSAGE-I: Words are either in single syllables or a combination of syllables. A single syllable takes about $\frac{1}{5}$ th of a second to utter. The least distance of a hillock necessary for hearing the echo of a word with two syllables is two times that in case of a single syllable, for a trisyllabic word it is three times and so on.

The minimum distance to hear the echo of a single syllable word clearly should be

A. 33.2 m

B. 33.4 m

C. 33.6 m

D. 33.8 m

Answer: A



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2. PASSAGE-I: Words are either in single syllables or a combination of syllables. A single syllable takes about $\frac{1}{5}$ th of a second to utter. The least distance of a hillock necessary for hearing the echo of a word with two syllables is two times that in case of a single syllable, for a trisyllabic word it is three times and so on.

The number of syllable in the word Saritha

A. 1

B. 2

C. 3

D. 4

Answer: C



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3. PASSAGE-I: Words are either in single syllables or a combination of syllables. A single syllable takes about $\frac{1}{5}$ th of a second to utter. The least distance of a hillock necessary for hearing the echo of a word with two syllables

is two times that in case of a single syllable, for a trisyllabic word it is three times and so on.

The least distance to hear an echo of the word

Seema

A. 33.2 m

B. 66.4 m

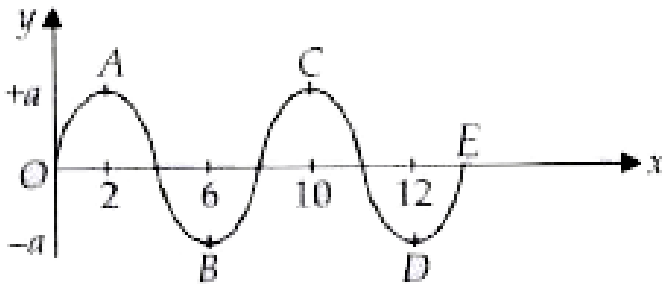
C. 68.4 m

D. 72 m

Answer: B



4. PASSAGE-II: For the wave shown below, the time period is 0.8 s. energy?



The wavelength of wave is

- A. 12 m
- B. 8 m
- C. 16 m

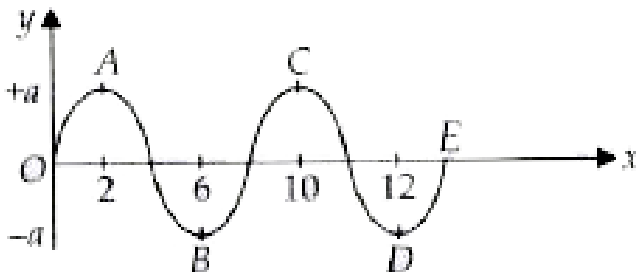
D. 4 m

Answer: B



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5. PASSAGE-II: For the wave shown below, the time period is 0.8 s. energy?



The time taken by wave to travel from O to E is

A. 1.6 s

B. 0.8 s

C. 1.0 s

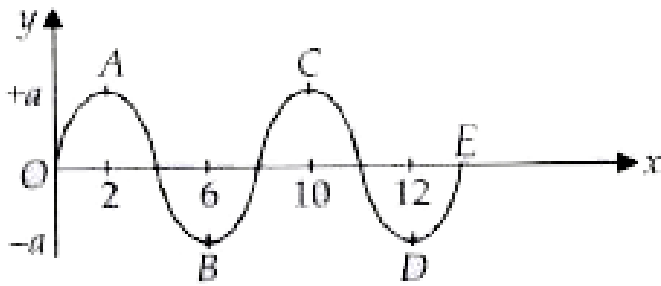
D. 0.24 s

Answer: A



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6. PASSAGE-II: For the wave shown below, the time period is 0.8 s. energy?



The velocity of the wave is

A. 4 m s^{-1}

B. 8 m s^{-1}

C. 10 m s^{-1}

D. 12 m s^{-1}

Answer: C



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7. PASSAGE-III: An Unidentified Flying Object (UFO) lands on a planet at a point 5 kilometres from an active volcano. There is a volcanic explosion. The time interval between the flash of light from the volcanic explosion and the sound of eruption was registered as 100 s. The time period of wave is 2 s.

The speed of sound on the planet is

A. 25m s^{-1}

B. 50m s^{-1}

C. 75m s^{-1}

D. 100m s^{-1}

Answer: B



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8. PASSAGE-III: An Unidentified Flying Object (UFO) lands on a planet at a point 5 kilometres from an active volcano. There is a volcanic explosion. The time interval between the flash of light from the volcanic explosion and the

sound of eruption was registered as 100 s. The time period of wave is 2 s.

The wavelength of the wave is

A. 100 m

B. 200 m

C. 300 m

D. 400 m

Answer: A



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9. PASSAGE-III: An Unidentified Flying Object (UFO) lands on a planet at a point 5 kilometres from an active volcano. There is a volcanic explosion. The time interval between the flash of light from the volcanic explosion and the sound of eruption was registered as 100 s. The time period of wave is 2 s.

Frequency of the wave is

A. 0.001 Hz

B. 0.01 Hz

C. 0.5 Hz

D. 1.0 Hz

Answer: C



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Exercise Subjective Problems Very Short Answer Type

1. How does a high pitch sound differ from a low pitch sound?



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2. Name the waves used to break small stones formed in the kidneys into fine grains.



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3. What is a sonic boom ?



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4. Can you produce sound without utilizing energy ?



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5. What is the relation between wavelength, speed and time period for a sound wave?



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6. What is the principle behind working of sonar ?



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7. What is quality of sound ?



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8. A gun is fired at a distance. Why is the sound heard after the flash is seen?



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9. What is a note ?



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10. What happens to the medium through which sound travels?



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11. What do you mean by loudness and pitch of sound?



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12. Why cannot we hear an echo in a small room ?



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13. What is a mechanical wave ?



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14. The velocity of sound in air increases by about. for $1\text{ }^{\circ}\text{C}$ rise in temperature.



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15. Have you ever thought why we hear sound of the horn of an approaching car before the car reaches us?



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Exercise Subjective Problems Short Answer Type

1. The sound of distant horses can be heard by applying the ear to the ground whereas it is inaudible if the ear is held a little distance above the ground. Explain.



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2. The sound of an explosion on the surface of a lake is heard by a boatman 100 m away and

by a diver 100 m below the point of explosion.

Who will hear the sound of explosion first?



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3. The sound of an explosion on the surface of a lake is heard by a boatman 100 m away and by a diver 100 m below the point of explosion.

If sound takes time t s to reach the boatman, how much time (approximately) will it take to reach the diver?



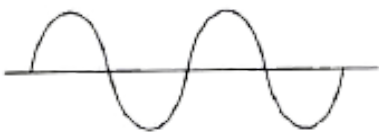
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4. A large auditorium has a curved back. Explain.



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5. Two waves are shown below. Which of the two corresponds to lower decibel level?



(a)



(b)



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6. What is the difference between an echo and a reverberation ?



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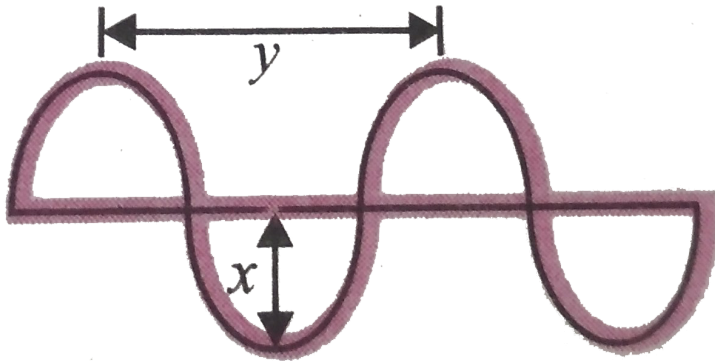
7. (a) A sound wave travelling in a medium is represented .

(i) Which letter represents the amplitude of the wave ?

(ii) Which letter represents the wavelength of the wave ?

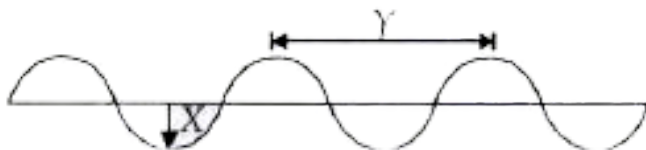
(iii) What is the frequency of the source of sound if the vibrating sound makes 360 oscillations in 2 minute ?

(b) Describe an experiment to show the reflection of sound.



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8. A sound wave travelling in a medium is represented as shown in the figure:



Which letter represents the wavelength of wave?



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9. (a) A sound wave travelling in a medium is represented .

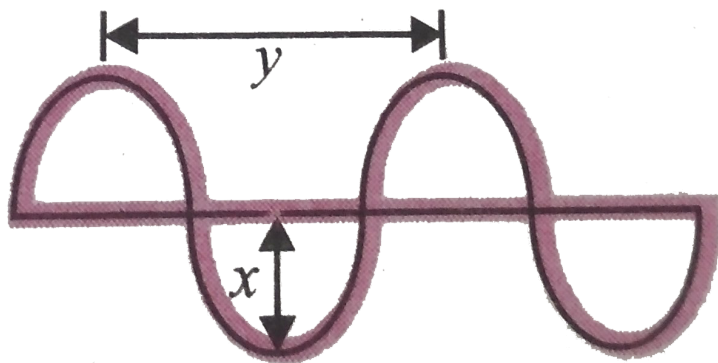
(i) Which letter represents the amplitude of

the wave ?

(ii) Which letter represents the wavelength of the wave ?

(iii) What is the frequency of the source of sound if the vibrating sound makes 360 oscillations in 2 minute ?

(b) Describe an experiment to show the reflection of sound.





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10. A big explosion on the moon cannot be heard on the earth because



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11. Where is reverberation desirable and where is this to be avoided ?



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12. A narrow sound pulse (for example, a short pip by a whistle) is sent across a medium. (a) Does the pulse have a definite (i) wavelength, (ii) frequency, (iii) speed of propagation ? (b) If the pulse rate is 1 after every 20s, (i.e. the whistle is blown for a split second after every 20s) is the frequency of the note produced by the whistle equal to $\frac{1}{20} = 0.05Hz$?



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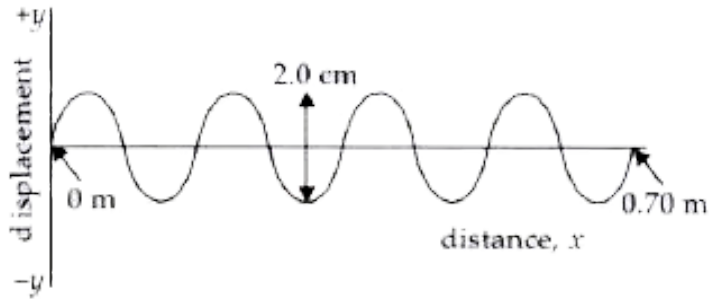
13. A narrow pulse (for example, a short pip by a whistle) is sent across a medium. If the pulse rate is 1 after every 20 s (that is the whistle is blow for a split of second after every 20 s). Is the frequency of the note produced by the whistle equal to $1/20$ or 0.05Hz ?



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14. A snapshot is taken of a periodic wave travelling on a string as shown below. What is

the amplitude and wavelength of the wave?



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15. The frequency of a source of sound is 100 Hz . How many times does it vibrate in a minute?



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16. When we nibble at a rusk, we hear a noise that is simply deafening. But for some reason, our neighbor makes hardly any noise though he is doing the same. Why ?



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17. A sonar device on a submarine sends out a signal and receives an echo $5s$ later. Calculate the speed of sound in water if the distance of the object from the submarine is $3625m$,



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18. Waves of higher frequencies are used for cleaning hard-to-reach places. These are also used to detect and find the distance of object under water.

Name these waves.



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19. Waves of higher frequencies are used for cleaning hard-to-reach places. These are also

used to detect and find the distance of object under water.

What is the frequency of these waves?

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20. Waves of higher frequencies are used for cleaning hard-to-reach places. These are also used to detect and find the distance of object under water.

Mention one more use of these waves.

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21. An observer notes that there is a 6 second interval between seeing a flash of lightning and hearing the clap of thunder. How far away is the storm?



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Exercise Subjective Problems Long Answer Type

1. What is SONAR ? How is it used to detect an underwater object and measure its distance ?



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2. A man stationed between two parallel cliffs fires a gun. He hears the first echo after $1.5s$ and the next after $2.5s$. What is the distance between the cliffs and when does he hear the third echo? Take the speed of sound in air as $340m/s$.



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3. A man fires a gun towards a hill and hears its echo after $5s$. He then moves $340m$ towards the hill and fires his gun again. This time he hears the echo after $3s$. Calculate the speed of sound.



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4. A stone is dropped into a well, 44.1 metres deep. The sound of the splash is heard 3.13

seconds after the stone is dropped. Find the velocity of sound in air.



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5. Audible frequencies have a range 40 hertz to 30,000 hertz. Express this range in terms of

(i) period T

(ii) wavelength λ in air, and

(iii) angular frequency,

Given velocity of sound in air is 350 m s^{-1}



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6. If the frequency of a tuning fork is 400, find how far the sound travels when the fork makes 30 vibrations. Given velocity of sound in air is 320 metres/sec.



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7. What is an echo? How is it produced?



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8. It was observed that at a receiving station at Ahmedabad, the longitudinal waves and transverse waves produced during the Gujarat earthquake arrived at speeds of x m/s and y m/s respectively. The two waves are received at an interval of t seconds. Find the distance between the receiving station and Bhuj where the epicentre of the earthquake was located. ($x > y$)



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9. A man fires a shot and hears an echo from a cliff after $2s$. He walks $85m$ towards the cliff and the echo of a second shot is now heard after $1.4s$. What is the velocity of sound and how far was the man from the cliff when he first heard the echo ?



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10. What is the maximum time taken by the particle in an ultrasonic wave to go from one

extreme to another during its oscillation?



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Exercise Integer Numerical Value Type

1. A light pointer fixed to one prong of a tuning fork touches a vertical plate. The fork is set vibrating at a frequency of 56 Hz and allowed to free fall. Calculate how many complete oscillation are counted when plate falls st 10 cm



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2. Calculate the wavelength of a sound wave whose frequency is 220Hz and speed is 440m/s in a given medium.



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3. A sound wave has a frequency 1000Hz and wavelength 34cm . How long will it take to move through 1km ?



Olympiad Hots Corner

1. An aeroplane pilot hears a slow beat from the two engines of his plane. He increases the speed of the right engine and now hears a slower beat. What should be the pilot now do, to eliminate the beat?

A. Increase the speed of the left engine.

B. Decrease the speed of the right engine.

C. Increase the speed of both engines.

D. Increase the speed of the right engine.

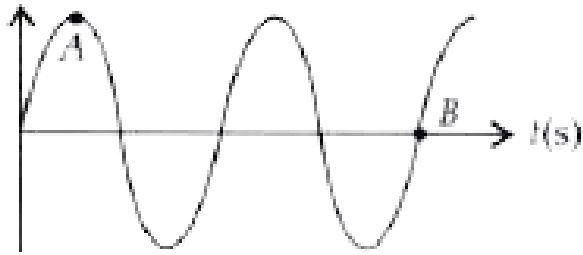
Answer: D



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2. A violin string emits sound waves with a frequency of 850 Hz as shown in the given figure.

Wave disturbance



If the speed of sound in air is 340 m s^{-1} , the distance between points A and B is

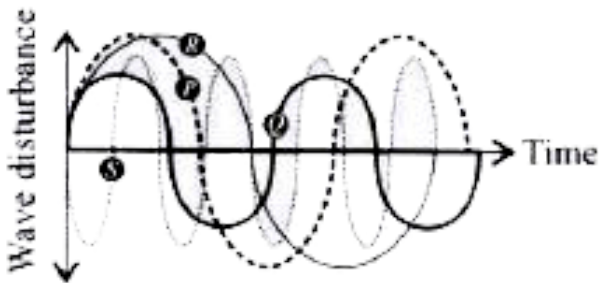
- A. 6 m
- B. 7 m
- C. 60 cm
- D. 70 cm

Answer: D



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3. Refer to the graph given here:



Which of the following sound waves is high-pitched but soft ?

A. P

B. Q

C. R

D. S

Answer: D



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4. The frequency of a source is 20 kHz. The frequencies of sound wave produced by it in water and air will be

A. be the same as that of the source

B. depend upon the velocity of the waves in these media

C. depend upon the wavelength of the waves in these media

D. depend upon the density of the media.

Answer: A



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5. A pandubbi sends a sonar signal to locate a body and receives the echo after 5 s. If the velocity of sound is 340 m/s. What is the distance of the body?

A. 0.85 km

B. 3.5 km

C. 0.425 km

D. 4.25 km

Answer: A



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6. Speed of super-sonic aircraft is

- A. below speed of sound
- B. equal to speed of sound
- C. more than speed of sound
- D. equal to speed of light.

Answer: C



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7. A vibrator generates the waves of the speed 330 m/s and wavelength 0.8 m. Then the frequency and time period are

- A. 264 Hz, 0.0037 sec
- B. 412.5 Hz, 0.0024 sec
- C. 412.5 Hz, 1.250 sec
- D. 264 Hz, 0.0030 sec

Answer: B



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8. If the velocity of a wave is 400 m/sec and frequency is 100 Hz, then the wavelength of the wave is _____

A. 6 m

B. 2.8 m

C. 3 m

D. 4 m

Answer: D



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9. Which of the following is carried by waves from one place to another?

A. Mass

B. Velocity

C. Wavelength

D. Energy

Answer: D



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10. The vibrations are amplified several times in the middle ear to the bones known as

A. anvil

B. stirrup

C. hammer

D. all of the above.

Answer: D



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11. A sound wave has a frequency of 2 kHz and wavelength 35 cm. How much distance it will travel in 2 seconds?

A. 0.14 m

B. 14 m

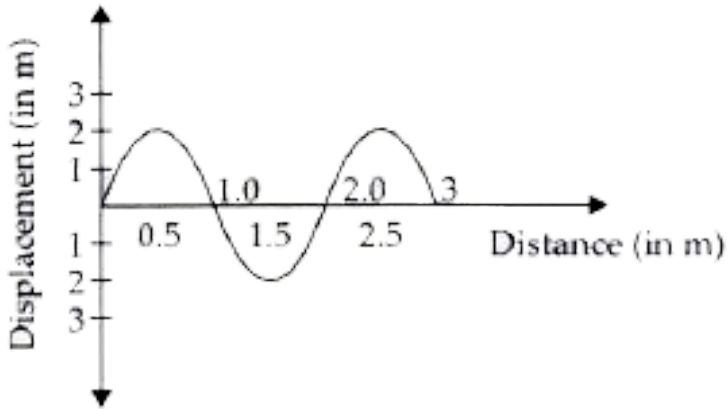
C. 140 m

D. 1400 m

Answer: D



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12.

This diagram represents displacement distance graph of wave travelling in a straight line. The amplitude and wavelength of this wave respectively are

- A. 2 meter and 1 meter
- B. 1 meter and 2 meter
- C. 1 meter and 1 meter

D. 2 meter and 2 meter

Answer: D



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13. An investigator team transmit an ultrasound signal to the sea bed. The signal is received back in 12 second. If the speed of sound in water is 1000 m/s, then the depth of sea is

A. 5 km

B. 6 km

C. 600 m

D. 4000 m

Answer: B



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14. A sound wave of frequency 1 kHz takes $(10/3)$ seconds to travel a distance of 1 km. Then its wavelength would be _____

A. 20 cm

B. 200 cm

C. 300 cm

D. 30 cm

Answer: D



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15. A stone is dropped from the top of a tower 500m high into a pond of water at the base of the tower. When is the splash heard at the top

? Given, $g = 10m/s^2$ and speed of sound
 $= 340m/s$.

A. 10 s

B. 14.70 s

C. 11.47 s

D. None of these

Answer: C



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