PHYSICS

BOOKS - FULL MARKS PHYSICS (TAMIL ENGLISH)

WAVES

In Textual Solved Example

1. Which of the following has longer wavelength ?

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2. Three waves are shown in the figure below :

Write down :

(a) the frequency of in ascending order (b) the

wavelenth in ascending order

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3. The average range of frequencies at which human beings can hear sound waves varies from 20 Hz to 20 kHz. Calculate the wavelength of the sound wave in these limits . (Assume the speed of sound to be $340 ms^{-1}$

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4. A man saw a toy duck on a wave in an ocean . He noticed that the duck moved up and down 15 times per second . He roughly measured the

wavelength of the ocean wave as 1.2 m . Calculate the time taken by the toy duck for going one time up and down and also the velocity of the ocean wave.

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5. Consider a string whose end is attached to a wall . Then compute the following in both situatiions given in figure (assume waves crosses the distance in one second)

(a) Wavelength (b) Frequency and (c) Velocity

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6. Calculate the velocity of the travelling pulse as shown in the figure below . The linear mass density of pulse is $0.25 kgm^{-1}$. Further , compute the time taken by the travelling pulse to cover a distance of 30 cm on the string .

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7. Calculate the speed of sound in a steel rod whose Young's modulus $Y = 2 \times 10^{11} Nm^{-2}$ and $\rho = 7800 kgm^{-3}$

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8. An increase in pressure of 100 kPa causes a certain volume of water to decrease by 0.005% of its original volume .

(a) Calculate the bulk modulus of water ?

(b) Compute the speed of sound (compressional waves) in water ?

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9. The ratio of the densities of oxygen and nitrogen is $16:14$. Calculate the temperature when the speed of sound in nitrogen gas at $17^{\circ}C$ is equal to the speed of sound in oxygen gas .

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10. Suppose a man stands at a distance from a cliff and claps his hands . He receives an echo from the cliff after 4 second . Calculate the distance between the man and the cliff . Assume the speed of sound to be $343ms^{-1}$

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11. Sketch y = x - a for different values of a .

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12. How does the wave y = sin (x -a) for a = 0 , $a = \frac{\pi}{4}, a = \frac{\pi}{2}, a = \frac{3\pi}{2}$ and $a = \pi$ look like ?

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13. Check the dimensional of the wave y = sin (x - vt) . If it is dimensionally wrong , write the above equation in the correct form .

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14. The wavelength of two sine waves are $\lambda_1 = 1m$ and $\lambda_2 = 6$ m . Calculate the corresponding wave numbers .

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15. A mobile phone tower transmits a wave signal of frequency 900 MHz. Calculate the length of the wave transmitted from the mobile phone tower .

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16. Consider two sources A and B as shown in the figure below . Let the two sources emit simple harmonic waves of same frequency but of different amplitudes , and both are in phase (same phase) . Let O be any point equidistant from A and B as shown in the figure . Calculate the intensity at points O , Y and X . (X and Y are not equidistant from A & B)

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17. Two speakers C and E are placed 5 m apart and are driven by the same source . Let a man stand at A which is 10 m away from the mid point O of C and E . The man walks towards the point O which is at 1 m (parallel to OC) as shown in the figure . He receives the first minimum in sound intensity at B . Then calculate the frequency of the source . (Assume speed of sound = $343 ms^{-1}$)

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18. Consider two sound waves with wavelengths 5 m and 6 m . If these two waves propagate in a gas with velocity $330ms^{-1}$. Calculate the number of beats per second .

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19. Two vibrating tuning forks produce waves whose equation is given by $y_1 = 5\sin(240\pi t)$ and $y_2 = 4\sin(244\pi t)$. Compute the number of beats per second .

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20. Compute the distance between anti-node and neighbouring node .

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21. Let f be the fundamental frequency of the string . If the string is divided into three segments l_1, l_2 and l_3 such that the fundamental frequencies of each segments be

f_1, f_2 and f_3 , respectively . Show that $\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2} + \frac{1}{f_3}$

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22. Consider a string in a guitar whose length is 80 cm and a mass of 0.32 g with tension 80 N is plucked . Compute the first four lowest frequencies produced when it is plucked .

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23. A baby cries on seeing a dog and the cry is detected at a distance of 3.0 m such that the intensity of sound at this distance is $10^{-2}Wm^{-2}$. Calculate the intensity of the baby's cry at a distance 6.0 m

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24. The sound level from a musical instrument playing 50 dB . If three identical musical instruments are played together then

compute the total intensity . The intensity of sound from each instrument is $10^{-12} Wm^{-2}$

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25. If a flute sounds a note with 450 Hz , what are the frequencies of the second , third , and fourth harmonics of this pitch ? If the clarinet sounds with a same note as 450 Hz , then what are the frequencies of the lowest three harmonics produced ?

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26. If the third harmonics of a closed organ pipe is equal to the fundamental frequency of an open organ pipe , compute the length of the open organ pipe if the length of the closed organ pipe is 30 cm

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27. A frequency generator with fixed frequency of 343 Hz is allowed to vibrate above a 1.0 m high tube . A pump is switched on to fill the

water slowly in the tube . In order to get resonance , what must be the minimum height of the water ? (Speed of sound in air is $343 ms^{-1}$) .

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28. In the experiment for the determination of the speed of sound in air using the resonance column method, the length of the air column that resonates in the fundamental mode, with a tunig for is 0.1, when this length is changed

to 3.5m the same tuning fork resonates with the first overtone. Calculate the end correction :

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29. Consider a tuning fork which is used to produce resonance in an air column. A resonance air column is a glass tube whose length can be adjusted by a variable piston. At room temperature, the two successive resonances observed are at 20 cm and 85 cm

of the column length. If the frequency of the length is 256 Hz, compute the velocity of the sound in air at room temperature.

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30. A sound of frequency 1500 Hz is emitted by a source which moves away from an observer and moves towards a cliff at a speed of 6 ms^{-1}

(a) Calculate the frequency of the sound which is coming directly from the source.

(b) Compute the frequency ofsound heard by the observer reflected off the cliff. Assume the speed of sound in air is 330 ms^{-1}

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31. An observer observes two moving trains, one reaching the station and other leaving the station with equal speeds of $8ms^{-1}$. If each train sounds its whistles with frequency 240 Hz, then calculate the number of beats heard by the observer.

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Textual Evaluation Solved Multiple Choice Questions

1. A student tunes his guitar by striking a 120 Hertz with a tuning fork, and simultaneously plays the 4^{th} string on his guitar. By keen observation, he hears the amplitude of the combined sound oscillating thrice per second. Which of the following frequency is the most

likely the frequency of the 4^{th} string on his guitar ?

A. 130

B. 117

C. 110

D. 120

Answer: B

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2. A transverse wave moves from a medium A to a medium B. In medium A, the velocity of the transverse wave is 500 ms^{-1} and the wavelength is 5 m. The frequency and the wavelength of the wave in medium B when its velocity is $600ms^{-1}$, respectively are

A. 120 Hz and 5 m

B. 100 Hz and 5 m

C. 120 Hz and 6 m

D. 100 Hz and 6 m

Answer: D

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3. For a particular tube, among six harmonic frequencies below 1000 Hz, only four harmonic frequencies are given: 300 Hz, 600 Hz, 750 Hz and 900 Hz. What are the two other frequencies missing from this list?

A. 100 Hz, 150 Hz

B. 150 Hz, 450 Hz

C. 450 Hz, 700 Hz

D. 700 Hz, 800 Hz

Answer: B

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4. Which of the following options is correct ?

Options for (1), (2) and (3), respectively are

A. (B), (C) and (A)

B. (C), (A) and (B)

C. (A), (B) and (C)

D. (B), (A) and (C)

Answer: A

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5. Compare the velocities of the wave forms given below, and choose the correct option.

where V_A, V_B, V_C and V_D are velocities given in (A), (B), (C) and (D), respectively.

A. $V_A > V_B > V_C$

B. $V_A < V_B < V_C$

C. $V_A = V_B = V_D = V_C$

D. $V_A > V_B = V_D > V_C$

Answer: C

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6. A sound wave whose frequency is 5000 Hz travels in air and then hits the water surface. The ratio of its wavelength in water and air is

A. 4.30

B. 0.23

C. 5.30

D. 1.23

Answer: A

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7. A person standing between two parallel hills fires a gun and hears the first echo after t_1 sec and the second echo after t_2 sec. The distance between the two hills is

A. $\frac{v(t_1 - t_2)}{2}$

B. $\frac{v(t_1 t_2)}{2(t_1 + t_2)}$

C. $v(t_1 + t_2)$

D. $\frac{v(t_1 + t_2)}{2}$

Answer: D

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8. An air column in a pipe which is closed at one end, will be in response with the vibrating body of frequency 83 Hz. Then the length of the air column is

A. 1.5 m

B. 0.5 m

C. 1.0 m

D. 2.0 m

Answer: C

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9. The displacement y of a wave travelling in the x direction is given by $y = \left(2 \times 10^{-3}\right)\sin\left(300t - 2x + \frac{\pi}{4}\right)$, where x and y are measured in metres and t in second. The speed of the wave is

A. $150ms^{-1}$

B. $300ms^{-1}$

C. $450ms^{-1}$

D. $600ms^{-1}$

Answer: A

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10. Consider two uniform wires vibrating simultaneously in their fundamental notes. The tension, densities, lengths and diameter of the two wires are in the ratio 8:1, 1:2, x:y and 4:1 respectively. If the note of the higher pitch

has a frequency of 360 Hz and the number of beats produced per second is 10, then the value of x:y is

A. $36:35$

B. $35:36$

C. $1:1$

D. $1:2$

Answer: A

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11. Which of the following represents a wave?

A. $(x - vt)^3$

B. $x(x + vt)$

C. $\dfrac{1}{(x + vt)}$

D. $\sin(x + vt)$

Answer: D

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12. A man sitting on a swing which is moving to an angle of 60° from the vertical is blowing a whistle which has frequency of 2.0 KHZ. The whistle is 2.0 m from the fixed support point of the swing. A sound detector which detects the whistle sound is kept in front of the swing. The maximum frequency the sound detector detected is :

A. 2.027 kHz

B. 1.974 kHz

C. 9.74 kHz

D. 1.011 kHz

Answer: A

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13. Let $y = \frac{1}{1+x^2}$ at t=0 s be the amplitude of the wave propogating in the positive x-direction. At t=2 s, the amplitude of the wave propogating becomes $y = \frac{1}{1+(x-2)^2}$. Assume that the shape of the wave does not

change during propogation. The velocity of the wave is

A. $0.5ms^{-1}$

B. $1.0ms^{-1}$

C. $1.5ms^{-1}$

D. $2.0ms^{-1}$

Answer: B

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14. A uniform rope having mass m hangs vertically from a rigid support. A tranverse wave pulse is produced at the lower end. Which of the following plots shows the correct variation of speed v with height h from the lower end ?

A. 

B. 

C. 

D. 

Answer: D

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15. An organ pipe A closed at one ends is allowed to vibrate in its first harmonic and another pipe B open at both ends is allowed to vibrate in its third harmonic. Both A and B are in resonance with a given tuning fork. The ratio of the length of A and B is

A. $\frac{8}{3}$

B. $\frac{3}{8}$

C. $\frac{1}{6}$

D. $\frac{1}{3}$

Answer: C

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Textual Evaluation Solved Short Answer Questions

1. What is meant by waves?

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2. Write down the types of waves.

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3. What are transverse waves? Give one exmaple.

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4. What are longitudinal waves? Give one example.

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5. Define wavelength.

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6. Write down the relation between frequency, wavelength and velocity of a wave.

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7. What is meant by interference of waves?

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8. Explain the beat phenomenon.

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9. Define intensity of sound and loudness of sound.

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10. Explain Doppler effect.

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11. Explain red shift and blue shift in Doppler effect.

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12. What is meant by end correction in resonance air column apparatus?

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13. Sketch the function $y = x + a$. Explain your sketch.

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14. Write down the factors affecting velocity of sound in gases.

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15. What is meant by aan echo ? Explain.

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Textual Evaluation Solved Long Answer Questions

1. Discuss how ripples are formed in still water.

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2. Briefly explain the difference between travelling waves and standing waves.

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3. Show that the velocity of travelling wave produced in a string is $v = \sqrt{\frac{T}{\mu}}$

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4. Describe Newton's formula for velocity of sound waves in air.

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5. Write short notes on reflection of sound waves from plane and curved surfaces. Reflection of sound through the plane surface

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6. Briefly explain the concept of super position principle.

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7. What is meant by interference of waves?

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8. Describe the formation of beats.

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9. What are stationary waves? write down the characteristics of stationary waves.

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10. Discuss the laws of transverse vibration in stretched strings.

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11. Explain the concepts of fundamental frequency, harmonics and overtones in detail.

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12. What is a sonometer? Give its construction and working. Explain how to determine the frequency of tuning fork using sonometer.

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13. Write short notes on intensity and loudness .

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14. Explain how overtones are produced in a:

(a) Closed organ pipe (b) Open organ pipe

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15. How will you determine the velocity of sound using resonance air column apparatus ?

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16. What is meant by Doppler effect ? Discuss the following cases

(1) Source in motion and Observer at rest

(b) Source moves away from the observer

(2) Observer in motion and Source at rest .

(a) Observer moves towards Source

(b) Observer resides away from the Source

(3) Both are in motion

(a) Source and Observer approach each other

(b) Sources and Observer resides from each other

(c) Source chases Observer

(d) Observer chases Source

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Textual Evaluation Solved Numerical Problems

1. The speed of a wave in a certain medium is 900 m/s. If 3000 waves passes over a certain point of the medium in 2 minutes, then compute its wavelength.

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2. Consider a mixture of 2 mole helium and 4 mole of oxygen. Compute the speed of sound in this gas mixture at 300 K.

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3. A ship in a sea sends SONAR waves straight down into the seawater from the bottom of the ship. The signal reflects from the deep bottom bed rock and returns to the ship after 3.5 s. After the ship moves to 100 Km it sends another signal which returns back after 2s. Calculate the depth of the sea in each case and also compute the difference in height between two cases.

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4. A sound wave is transmitted into a tube as shown in figure. The sound wave splits into two waves at the point A which recombine at point B. Let R be the radius of the semicircle which is varied until the first minimu. Calculate the radius of the semi-circle if the wavelenght of the sound is $50.0m$

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5. N tuning forks are arranged in order of increasing frequency and any two successive tuning forks give n beats per second when sounded together. If the last fork gives double the frequency of the first (called as octave), Show that the frequency of the first tuning fork is $f = (N-1)n$.

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6. Let the source propagate a sound waves whose intensity at a point (initially) be I. suppose we consider a case when the amplitude of the sound wave is doubled and the frequency is reduced to one-fourth. Calculate now the new intensity of sound at the same point ?

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7. Consider two organ pipes of same length in which are organ is closed and another organ pipe is open. If the fundamental frequency of closed pipe is 250 Hz. Calculate the fundamental frquency of the open pipe.

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8. A police in a siren car moving with a velocity $20ms^{-1}$ chases a thief who is moving in a car with a velocity v_0ms^{-1}.The police car sounds

at frequency 300 Hz, and both of them move towards a stationary siren of frequency 400 Hz. Calculate the speed in which thief is moving.

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9. Consider the following functon,

(a) $y = x^2 + 2\alpha, tx$

(b) $y = (x + vt)^2$

Which among the above function can be characterized as a wave ?

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Textual Evaluation Solved Conceptual Questions

1. Why is it that transverse waves cannot be produced in a gas? Can the transverse waves be produced in solids and liquids?

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2. Why is the roar of our national animal different from the sound of a mosquito?

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3. A sound source and listener are both stationary and a strong wind is blowing. Is there a Doppler effect?

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4. In an empty room why is it that a tone sounds louder than in the room having things like furniture etc.

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5. How do animals sense impending danger of hurricane?

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6. Is it possible to realize whether a vessel kept under the tap is about to fill with water ?

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Additional Questions Solved

1. Explain the types of mechanical wave.

A. are longitudinal only

B. are transverse only

C. can be both longitudinal and transverse.

D. are neither longitudinal for transverse waves.

Answer: C

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2. Sound whose frequency is 50 Hz?

A. has a relatively short wavelength.

B. has a relatively long wavelength.

C. is very loud

D. is very intense

Answer: A

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3. Why does sound travel faster in solids than in gases?

A. Steel

B. air

C. water

D. vacuum

Answer: A

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4. A boat at anchor is rocked by waves of velocity 25m/s, having crests 100 m apart. The boat bounches up once in every ..... .

A. 4.0 s

B. 2500 s

C. 0.25 s

D. 75 s

Answer: A

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5. Choose the correct statement

A. sound waves are transverse waves

B. sound travels fastest through vacuum.

C. sound travels faster in solids than in gases.

D. sound travels faster in gases than in liquids.

Answer: C

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6. transverse waves:

A. both in a gas and in a metal

B. in a gas but not in a metal

C. not in a gas but in a metal

D. neither in a gas nor in a metal

Answer: A

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7. The speed of the wave represented by y =A sin $(\omega t - kx)$ is ..... .

A. k/ω

B. ω/k

C. ωk

D. $1/\omega k$

Answer: B

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8. The equation of a wave travelling in a string can be written as y = $3\cos\{\pi(100t - x)\}$ where y and x are in cm and t is in seconds . Then the value of wavelength is ..... .

A. 100 cm

B. 2 cm

C. 50 cm

D. 4 cm

Answer: B

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9. A wave of frequency 500 Hz has a velocity 300 m/s. The distance between two nearest points which are 60° out of phase , is ..... .

A. 0.2 m

B. 0.1 m

C. 0.4 m

D. 0.5 m

Answer: A

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10. The equation of a wave travelling on a string is $y = 4\sin\left\{\frac{\pi}{2}\left(8t - \frac{x}{8}\right)\right\}$, where x , y are in cm and t in seconds . The velocity of the waves is ..... .

A. 64 cm/s in - x direction

B. 32 cm/s in - x direction

C. 32 cm/s in + x direction

D. 64 cm/s in + x direction

Answer: D

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11. The equation of a wave travelling on a string is $y = 4\sin\left\{\frac{\pi}{2}\left(8t - \frac{x}{8}\right)\right\}$, where x , y are in cm and t in seconds . The velocity of the waves is ..... .

A. 4 cm, 32 cm, 16 cm/s, 0.5 Hz

B. 8 cm, 16 cm, 32 cm/s, 1.0 Hz

C. 4 cm, 32 cm, 32 cm/s, 0.5 Hz

D. 8 cm, 16 cm, 16 cm/s, 1.0 Hz

Answer: A

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12. The diagram shows the profile of a wave, which of the following pairs of points are in phase?

A. A , B

B. B , C

C. B , D

D. B , E

Answer: D

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13. Ultrasonic waves are those waves which .....

A. human beings cannot hear

B. human beings can hear

C. have high velocity

D. have large amplitude

Answer: A

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14. A transverse wave of amplitude 0.5m, wavelength 1m and frequency 2Hz is propagating in a string in the negative x direction. The equation of this wave is .....

.

A. y = 0.5 sin $(2\pi x - 4\pi t)$

B. $y = 0.5\sin(2\pi x + 4\pi t)$

C. $y = 0.5\sin(\pi x - 2\pi t)$

D. $y = 0.5\cos(kx - 2\pi t)$

Answer: B

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15. With the rise of temperature, the speed of sound in a gas .....

A. increases

B. decreases

C. remain the same

D. may increase or decrease depending on the corresponding change in pressure.

Answer: A

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16. Speed of sound in a gas in proportional to .....

A. square root of isothermal elasticity

B. square root adiabatic elasticity

C. isothermal elasticity

D. adiabatic elasticity

Answer: B

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17. Velocity of sound in air is .....

A. atmospheric pressure

B. moisture content of air

C. temperature of air

D. composition of air

Answer: A

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18. A longitudinal wave is described by the equation $y = y_0 \sin 2\pi(ft - x/\lambda)$. The maximum particle velocity is equal to four times the wave velocity if ..... .

A. $\lambda = \pi y_0 / 4$

B. $\lambda = \pi y_0 / 2$

C. $\lambda = 4\pi y_0$

D. $\lambda = 2\pi y_0$

Answer: B

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19. If y_0 and v denote the sound velocity and the rms velocity of the molecules in a gas, then .....

A. $v_0 = v(3/\gamma)^{1/2}$

B. $v_0 = 0$

C. $v_0 = v(\gamma/3)^{1/2}$

D. v_0 and v are not related

Answer: C

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20. With propogation of longitudinal waves through a medium the quantity transmitted is

A. energy , momentum and mass

B. energy and momentum

C. energy and mass

D. energy

Answer: B

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21. If the amplitude of sound is doubled and the frequency reduced to one-fourth, the intensity will .....

A. increases by a factor of 2

B. decrease by a factor of 2

C. decrease by a factor of 4

D. remain unchanged

Answer: C

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22. When a source of sound is in motion towards a stationary observer, the effect observed is .....

A. increase in the velocity of sound only

B. decrease in the velocity of sound only

C. increase in frequency of sound only

D. increase in both the velocity and the frequency of sound

Answer: C

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23. The apparent wavelength of the light from a star, moving away from the earth, is 0.01% more than its real wave length. The speed of the star with respect to the earth is ..... .

A. 10 km/s

B. 15 km/s

C. 30 km/s

D. 60 km/s

Answer: C

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24. The frequency of a radar is 780 MHz. When it is reflected from an approaching aeroplane the opponent frequency is more than the actual frequency by 2.6 kHz. The speed of the aeroplane is ..... .

A. 0.25 km/ s

B. 0.5 km/s

C. 1.0 km/s

D. 2.0 km/s

Answer: B

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25. The temperature at which the speed of sound in air becomes double its value at $27^{\circ}C$ is ..... .

A. $54^\circ C$

B. $327^\circ C$

C. $927^\circ C$

D. $-123^\circ C$

Answer: C

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26. The equation of a transverse wave is given by y = 10 $\sin\{\pi(0.01x - 2t)\}$ where y and x are in cm and t is in seconds. Its frequency is .....

A. $10s^{-1}$

B. $2s^{-1}$

C. $1s^{-1}$

D. $0.01s^{-1}$

Answer: C

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27. When sound waves travel from air to water, which of the following remains constant?

A. velocity

B. frequency

C. wave length

D. all of these

Answer: B

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28. The speed of sound in oxygen is 332 m/s at STP. The speed of sound in hydrogen at STP will be .....

A. 53/2 m/s

B. 2546 m/s

C. 1328 m/s

D. 664 m/s

Answer: C

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29. If v_a, v_b and v_m are the speed of sound in air , hydrogen and a metal at the same temperature , then ..... .

A. $v_b > v_a > v_m$

B. $v_m > v_b > v_a$

C. $v_b > v_m > v_a$

D. $v_a > v_b > v_m$

Answer: B

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30. Ultrasonic waves can be detected by ..... .

A. telephone

B. Hebb's method

C. Kundt's tube

D. Quincke's tube

Answer: C

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31. The velocity of sound in a gas depends on ..... .

A. Wavelength only

B. density and elasticity of gas

C. intensity only

D. amplitude and frequency

Answer: B

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32. When sound waves travel from air to water, which of the following remains constant?

A. velocity

B. wavelength

C. frequency

D. all the above

Answer: C

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33. When a wave goes from one medium to another , there is a change in ..... .

A. velocity

B. amplitude

C. wavelength

D. all the above

Answer: D

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34. The equation of a sound wave is $y = 0.0015 \sin(62.8x + 316t)$. Find the wavelength of the above ..... .

A. 0.2 units

B. 0.3 units

C. 0.1 units

D. 0.15 units

Answer: C

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35. Red shift is an illustration of ..... .

A. low temperature emission

B. high frequency absorption

C. Doppler effect

D. Same unknown Phenomenon.

Answer: C

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36. The ratio of the velocity of sound in a monatomic gas to that in a triatomic gas having same molar mass , under similar

conditions of temperature and pressure , is .....

A. 1.12

B. 1.25

C. 1.50

D. 1.6

Answer: A

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37. Doppler shift in frequency does not depend upon .....

A. the actual frequency of the wave

B. the distance between source from the listener .

C. the velocity of the source .

D. the velocity of the observer.

Answer: B

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38. If the density of oxygen is 16 times that of hydrogen , what will be the ratio of the velocities of sound in them ?

A. $1:4$

B. $4:1$

C. $2:1$

D. $1:16$

Answer: A

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39. Pitch of sound depends on ..... .

A. frequency

B. wavelength

C. amplitude

D. speed

Answer: A

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40. The path difference between the two waves $y_1 = a_1 \sin\left(\omega t - \frac{2\pi x}{\lambda}\right)$ and $y_2 = a_2 \cos\left(\omega t - \frac{2\pi x}{\lambda} + \phi\right)$ is .....

A. $\frac{\lambda}{2\pi}\phi$

B. $\frac{\lambda}{2\pi}\left(\phi + \frac{\pi}{2}\right)$

C. $\frac{2\pi}{\lambda}\left(\phi + \frac{\pi}{2}\right)$

D. $\frac{2\pi}{\lambda}\phi$

Answer: B

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41. Which of the following equations represents a wave?

A. $y = A\sin(\omega t - kx)$

B. $y = A\sin\omega t$

C. $y = A\cos kx$

D. $y = A\sin(at - bx + c)$

Answer: D

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42. A wave travels in a medium according to the equation of displacement given by y (x , t) = 0.03 sin $\{\pi(2t - 0.01x)\}$ where y and x are in metres and t in seconds . The wavelength of the wave is ..... .

A. 200 m

B. 100 m

C. 20 m

D. 10 m

Answer: A

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43. The equation of a wave moving on string $y = 8\sin\{\pi(0.002x - 4t)\}$ where x , y are in centimeter and t in seconds . The velocity of the wave is ..... .

A. 100 cm/s

B. 0.2π cm/s

C. 4π cm/s

D. 200 cm/s

Answer: D

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44. If the velocity of sound in air is $340ms^{-1}$, a person singing a note of frequency 250 cps is producing sound waves with a wavelength of ..... .

A. 0.7

B. 1.36 cm

C. 1.36 m

D. 85 k m

Answer: C

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45. As a transverse wave strikes against a fixed end .....

A. its phase changes by 180° , but velocity does not change

B. its phase does not change, but velocity changes

C. its velocity changes and phase too changes by 180°

D. nothing can be predicted about changes in its velocity and phase.

Answer: A

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46. A source of sound is travelling with a velocity 40 km/h towards an observer and emits a sound of frequency 2000 Hz. If the velocity of sound is 1220 km/h, then the apparent frequency heard by the observer is. .....

A. 2068 Hz

B. 2180 Hz

C. 2000 Hz

D. 1980 Hz

Answer: A

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47. A vehicle with a horn of frequency n is moving with a velocity of 30m/s in a direction perpendicular to the straight line joining the observer and the vehicle. The observer perceives the sound to have a frequency $n + n_1$. Then (if the sound velocity in air is 300 m/s)..... .

A. $n_1 = 10$n

B. $n_1 = 0$

C. $n_1 = -0.1n$

D. $n_1 = 0.1$ n

Answer: B

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48. The Doppler effect is applicable for .....

A. light waves

B. sound waves

C. space waves

D. both (a) and (b)

Answer: D

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49. The speed of a wave in medium is $760ms^{-1}$. If 3600 waves cross a point in the medium in 2 minutes, then the wavelength of the wave is :

A. 13.8 m

B. 25.3 m

C. 41.5 m

D. 57.2 m

Answer: B

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50. If a sound wave travels from air to water, the quantity that remain unchanged is .....

A. velocity

B. wavelength

C. frequency

D. amplitude

Answer: C

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51. As a spherical wave propagates, ...

A. the wave intensity remains constant

B. the wave intensity decrease as the inverse of the distance from the source

C. the wave intensity decreases as the inverse square of the distance from the source.

D. The wave intensity decreases as the inverse cube of the distance from the source.

Answer: C

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52. A source of sound and a listener are approaching each other with a speed of $40ms^{-1}$ The apparent frequency of a note produced by the source is 400 Hz. Then its true frequency is (velocity of sound in air = $360ms^{-1}$)

A. 320 Hz

B. 400 Hz

C. 360 Hz

D. 420 Hz

Answer: A

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53. Sound waves of wavelength greater than that of audible sound are called .....

A. infrasonic waves

B. ultrasonic waves

C. sonic waves

D. seismic waves

Answer: A

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54. The frequency of a sound wave is f and its velocity is v. If the frequency is increased to 4 f , the velocity of the wave will be:

A. v

B. 2v

C. 4 v

D. v/4

Answer: A

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55. Which of the following statement is untrue? The velocity of sound in a gas .....

A. is independent of pressure

B. decreases with increase in temperature

C. is dependent on molecular weight

D. is greater in dry air than in moist air

Answer: D

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56. When a stone is dropped on the surface of still water, the waves produced are .....

A. transverse

B. longitudinal

C. Stationary

D. partly longitudinal and partly transverse

Answer: D

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57. The equation of a wave is y = 0.1 sin $(100\pi t - kx)$ where x , y are in metres and t in seconds . If the velocity of the wave is 100 m/s , then the value of k is

A. $1m^{-1}$

B. $2m^{-1}$

C. πm^{-1}

D. $2\pi m^{-1}$

Answer: C

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58. A transverse wave propagating on a stretched string of linear density $3 \times 10^{-4} kgm^{-1}$ is represented by the

equation $y = 0.2\sin(1.5x + 60t)$

Where x is in metres and t is in seconds . The tension in the string (in newtons) is :

A. 0.24

B. 0.48

C. 1.20

D. 1.80

Answer: A

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59. A transvrs wave propagating along x-axis is represented by

y(x,t) $= 80. . \sin\left(0.5\pi x - 4\pi t - \frac{\pi}{4}\right)$. Where x is in metress and t is seconds. The speed of the wave is :

A. $0.5\pi m / s$

B. $\frac{\pi}{4} m / s$

C. 8 m/s

D. $4\pi m / s$

Answer: C

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60. Two waves represented by the following equation are travelling in the same medium $y_1 = 5\sin 2\pi(75t - 0.25x)$ and $y_2 = 10\sin 2\pi(150 - 0.25x)$

The intensity ratio of the two waves is .....

A. $1:2$

B. $1:4$

C. $1:8$

D. $1:16$

Answer: B

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61. A point source emits sound equally in all direction is a non-absorbing medium. Two points p and Q are at distances of 2m and 3m, respectively, from the source. The ratio of the intensities of the waves at P and Q is

A. $3:2$

B. $4:9$

C. $2:3$

D. $9:4$

Answer: D

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62. The waves produced by a motor boat sailing in water are ..... .

A. transverse

B. longitudinal

C. longitudinal and transverse

D. stationary

Answer: C

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63. Doppler effect in sound is due to .....

A. motion of source

B. motion of observer

C. relative motion of source and observer

D. none of the above

Answer: C

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64. The velocity of sound in air at a particular temperature is $330ms^{-1}$. What will be its value when temperature is doubled and the pressure is halved?

A. 165 m/s

B. 330 m/s

C. $330/\sqrt{2}$

D. $300/\sqrt{2}$ m/s

Answer: C

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65. Sound waves travel at 350 m/s through warm air and at 3500 m/s through brass. The wavelength of a 700 Hz acoustic wave as it enters brass from warm air

A. increases by a factor of 20

B. increases by a factor 10

C. decreases by a factor 20

D. decreases by a factor 10

Answer: B

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66. A train moving at a speed of 220 m/s towards a stationary object , emits a sound of frequency 1000 Hz . Some of the sound

reaching the object gets reflected back to the train as echo . The frequency of the echo as detected by the driver of the train is

A. 3000 Hz

B. 3500 Hz

C. 4000 Hz

D. 5000 Hz

Answer: D

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67. A sound of frequency 1500 Hz is emitted by a source which moves away from an observer and moves towards a cliff at a speed of 6 ms^{-1}

(a) Calculate the frequency of the sound which is coming directly from the source.

(b) Compute the frequency ofsound heard by the observer reflected off the cliff. Assume the speed of sound in air is 330 ms^{-1}

A. 97 Hz

B. 100 Hz

C. 103 Hz

D. 106 Hz

Answer: C

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68. Beats occur because of

A. interference

B. reflection

C. refraction

D. Doppler effect

Answer: A

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69. A vibrating stretched string resonates with a tuning fork of frequency 512 Hz when the length of the string is 0.5 m . The length of the string required to vibrate resonantly with a tuning fork of frequency 256 Hz would be ..... .

A. 0.25 m

B. 0.75 m

C. 1.0 m

D. 2.0 m

Answer: C

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70. A cylindrical tube, open at both ends has a fundamental frequency f in air. The tube is dipped vertically in water so that half of it is in

water. The fundamental frequency of the air column is now ..... .

A. f/2

B. 4

C. 3f/4

D. 2f

Answer: A

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71. With the increase in temperature , the frequency of the found from an organ pipe

A. decrease

B. increase

C. remain unchanged

D. changes erractically

Answer: B

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72. Two waves of the same frequency and amplitude super impose to produce a resultant disturbance of the same amplitude. The phase difference between the waves is.

A. zero

B. $\pi / 3$

C. $\pi / 4$

D. $2\pi / 3$

Answer: D

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73. A sonometer wire is vibrating in the second overtone. In the wire there are ..... .

A. two nodes and two antinodes

B. one node and two antinodes

C. four nodes and three antinodes

D. three nodes and three antinodes

Answer: C

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74. If a resonance tube is sounded with a tuning fork of frequency 256 Hz, resonance occurs at 35 cm and 105 cm. The velocity of sound is about

A. 358 m/ s

B. 512 m/s

C. 524 m/s

D. none of these

Answer: A

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75. A wave of frequency 100 Hz s sent along a string towards a fixed unit. When this wave travels back after reflection a node is formed at a distance of 10 cm from the fixed end of the string.The speeds of incident (or reflected) waves are :

A. 40 m/s

B. 20 m/s

C. 10 m/s

D. 5 m/s

Answer: B

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76. A standing wave is represented by y=A sin (100t) cos (0.01x) where y and A are in millimetres. t in seconds and x in metres. The velocity of the wave is ..... .

A. 10^4 m/s

B. 1 m/ s

C. 10^{-4} m/s

D. not derivable from the above information

Answer: A

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77. Two waves of the same frequency and intensity superimpose with each other in

opposite phases . Then after superposition the

..... .

A. intensity increases to four times

B. intensity increase to two times

C. frequency increases to four times

D. none of the above

Answer: D

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78. Two open organ pipes of lengths 50 cm and 50.5 cm produce 3 beats/s. Then the velocity of sound is .

A. 300 m/s

B. 30 m/s

C. 303 m/s

D. 30.3 m/s

Answer: C

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79. If the ratio of the amplitudes of two waves is $4:3$ then the ratio of maximum and minimum intensities is ..... .

A. $16:9$

B. $49:16$

C. $7:1$

D. $49:1$

Answer: D

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80. An air column in a pipe, which is closed at one end, will be in resonance with a vibrating tuning fork of frequency 256 Hz, if the length of the column in centimeter is (velocity of sound in air 340 m/s)

A. 21.25

B. 125

C. 62.50

D. 33.2

Answer: D

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81. Two sound waves with wavelengths 5.0 cm and 5.5 cm, respectively each propagate in a gas with velocity 330 m/s. The number of beats per second will be .....

A. 0

B. 1

C. 6

D. 12

Answer: C

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82. Two vibrating tuning forks produce progressive waves given be $y_1 = 4\sin 500\pi t$ and $y_2 = 2\sin 506\pi t$ where t is in seconds number of beats produced per minute is .....

A. 60

B. 3

C. 369

D. 180

Answer: D

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83. The ratio of intensities of two waves is $16:9$. If they produce interference , then the ratio of maximum and minimum intensities will be ..... .

A. $4:3$

B. $49:1$

C. $64:27$

D. $81:49$

Answer: B

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84. A closes organ pipe of length 20 cm is sounded with a tuning fork in resonance. What is the frequency of the tuning fork? (v = 332 m/s)

A. 300 Hz

B. 350 Hz

C. 375 Hz

D. 415 Hz

Answer: D

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85. In a resonance tube, the first resonance is obtained at 40 cm length, using a tuning fork

of frequency 450 Hz. Ignoring end correction, the velocity of sound in air is

A. 620 m/s

B. 720 m/s

C. 820 m/s

D. 1020 m/s

Answer: B

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86. If we study the vibration of a pipe open at both ends, then which of the following statement is not true?

A. open end will be antinode

B. odd harmonics of the fundamental frequency will be generated

C. all harmonics of the fundamental

D. pressure change will be maximum at both ends

Answer: D

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87. The fundamental frequency of a closes organ pipe of length 20 cm is equal to the second overtone of an organ pipe open at both the ends. The length of the organ pipe open at both the ends is ..... .

A. 80 cm

B. 100 cm

C. 120 cm

D. 140 cm

Answer: C

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Additional Questions Solved 2 Mark Questions

1. Define the term wave motion?

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2. What is progressive wave ?

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3. What is progressive wave ?

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4. What do you mean by phase of a wave ?

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5. Define wave velocity.

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6. What are stationary waves? write down the characteristics of stationary waves.

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7. What is meant by threshold of hearing ?

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8. What is meant by reverberation time?

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9. What is musical scale ?

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10. What is meant by reverberation time?

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Additional Questions Solved Numerical Problems

1. The fundamental frequency of a closed organ pipe is equal to the first overtone of an open organ pipe. If the length of the open pipe is 60 cm, What is the length of the closed pipe?

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2. Two cars moving in opposite directions approach each other with speed of $22m/s$ and $16.5m/s$ respectively.The driver of the first car blows a horn having a frequency 400Hz.The frequency heard by the driver of the second car is [velocity of sound $340m/s$]

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3. The fundamental frequency of a closed organ pipe is equal to the first overtone of an

open organ pipe. If the length of the open pipe is 60 cm, What is the length of the closed pipe?

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4. A steel wire 0.72 m long has a mass of $5.0 \times 10^{-3} kg$. If the wire is under a tension of 60 N. What is the speed of transverse waves on the wire ?

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5. Estimate the speed of sound in air at standard temperature and pressure. Athe mass of 1 mole of air is $29.0 \times 10^{-3} kg$.

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6. An observer moves towards a stationary source of sound with a velocity one-fifth of the velocity of sound. Calculate the percentage increase in the apparent frequency?

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7. Tube A has both ends open, while B has on end closed otherwise the two tubes are identical. What is the ratio of fundamental frequency of the tubes A and B ?

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8. A train moves towards a stationary observer with speed 34 m/s. The train sounds a whistle and its frequency registered by the observe is f_1. If the train'sspeed is reduced to 17 m/s, the

frequency registered is f_2 If the speed of sound is 340 m/s, then find the ratio f_1 / f_2 .

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9. A police car with a siren of frequency 8 kHz is moving with uniform velocity 36 km/h towards a tall building which reflect the sound waves. The speed of sound in air is 320 m/s. What is the frequency of the siren heard by the car driver ?

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10. The displacement y of a wave travelling in the x- direaction is given by $y = 10^{-4}\sin(600t - 2x + \pi/3)$

Where x is expreseend in metres and t is seconds. What is the speed of the wave motion (in ms^{-1}) ?

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