PHYSICS

BOOKS - SURA PHYSICS (TAMIL ENGLISH)

WAVES

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 an echo? Explain.

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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. Explain the formula of stationary waves.

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10. Discuss the law 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) Sources in motion and Observer at rest

(a) Source moves towards observer

(a) Source moves towards observer

(b) Source moves away from the observer

(2) Observer in motion and Source at rest.

(a) Observer moves towards Source.

(b) Observer recedes away from the Source.

(3) Both are in motion

(a) Source and observer approach each other

(b) Source and Observer resides from each other

(c) Source chases Observer

(d) Observer chases Source.

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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 mol of helium and 4 mol 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 s 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 semi-cicle which is varied until the first minimum. Calculate the radius of the semi-circle. If the wavelength of the sound is 50.0 m.

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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. (Assume the thief does not observe any beat).

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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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10. Audible frequencies have a range of 20 Hz to 20×10^3 Hz. Express 't' is range in tems of (i) period T, (ii) wavelength air at, (iii) angular frequency w. (Given velocity of sound in $0^\circ C = 331 m / s$).

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11. A fruit dropped from the top of a tree of height 200 m high splashes into the water of a pond near the base of the tree. When is the splash heard at the top given that the speed of sound in air is $340 ms^{-1}$.

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12. For the travelling harmonic wave $y(x, t) = 2.0 \cos 2\pi[8t - 0.0060x + 0.27]$, where x and y are in cm and t in s. Calculate the phase difference between oscillatory

motion of two points separated by a distance of,

(a) 300 cm,

(b) 0.75 m,

(c) $\frac{\lambda}{4}$

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13. A transverse harmonic wave on a string is described by y(x,t) $= 5.0 \sin\left(48t + 0.0264x + \frac{\pi}{6}\right)$, where x and y are in cm and t in sec. The positive direction

of x is from left to right.

(a) What are its amplitude and frequency?

(b) What is the least distance between two success in crests in the wave?

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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.

5. How do animals sense impending danger of hurricane?

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

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Multiple Choice Questions 1 Mark

1. Sound waves of wavelength travelling in a medium with a speed of vm/s enter into the medium where its speed is 2vm/s, wavelength of sound waves in the second medium is?

A. λ

B. $\frac{\lambda}{2}$

C. 2λ

D. 4λ

Answer: C

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2. Speed of sound wave in air .

A. Independent of temp

B. Increase with pressure

C. Increase with increase in humidity

D. Decrease with increase in humidity.

Answer: C

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3. Change in temperature of the medium changes

A. frequencies of sound waves

B. amplitude of sound waves

C. wavelength of sound waves

D. loudness of sound waves

Answer: C

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

A. matter

B. energy

C. energy and matter

D. energy, matter and momentum

Answer: B

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5. During propogation of a plane progressive mechanical wave

A. amplitude of all particulars is equal

B. particles of the medium execute S.H.M.

C. wave velocity depends upon the nature of the medium

D. all the above

Answer: D

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6. Speed of sound wave in air .

A. independent of temperature

B. increase witih pressure

C. Increase with increase in humidity

D. Decrease with increase in humidity.

Answer: C

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7. Which of the following statement are true for a stationary wave?

A. Every particle has a forced amplitude which is different from the amplitude of its nearest particle.

B. All the particle cross their mean position at the same time.

C. There is no transfer of energy across any plane.

D. All the above

Answer: D

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8. The displacement y of a wave travelling in the x direction is given by $y = \left(2 \times 10^{-3}\right)\sin\left(600t - 2x + \frac{\pi}{3}\right)$, where x and y are measured in metres and t in second. The speed of the wave is

A. 300

B. 600

C. 1200

D. 200

Answer: A

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9. A wave travelling along the x-axis described by the equation y(x,t) = 0.005 cos $(\alpha x - \beta t)$. Of the wavelength and time period of the wave are 0.08 and 2.0s then and in appropriate units are

A. $\alpha = 12.50\pi, \beta = \frac{\pi}{2.0}$

B. $\alpha = 25.00\pi, \beta = \bar{\pi}$

C. $\alpha = \frac{0.08}{\pi}, \beta = \frac{2.0}{\pi}$

D. $\alpha = \frac{0.04}{\pi}, \beta = \frac{4.0}{\pi}$

Answer: B

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10. The speed of sound in oxygen (O_2) at a certain temp is $460ms^{-1}$ the speed of sound in helium at the same temperature will be

A. $460ms^{-1}$

B. $500ms^{-1}$

C. $650ms^{-1}$

D. $1420ms^{-1}$

Answer: D

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11. Length of a string tied to two rigid supports is 40 cm maximum length of a stationary wave produced on it is

A. 20

B. 80

C. 40

D. 120

Answer: B

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12. Tube A has both ends open, while tube B has one and closed, otherwise they are

identical the ratio of fundamental frequency of tubes A and B is

A. $1:2$

B. $1:4$

C. $2:1$

D. $4:1$

Answer: C

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13. When temperature increases, the frequency of a tuning of fork

A. increases

B. decreases

C. increases or-decreases depending

D. remains the same

Answer: B

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14. An observer moves towards a stationary source of sound with a velocity on fifth of the velocity of sound, what is the percentage increase in the apparent frequency?

A. Zero

B. $0.5\ \%$

C. $5\ \%$

D. $20\ \%$

Answer: D

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15. A sound absorber attenuates the sound level by 20dB the intensity decreases by a factor of

A. 100

B. 1000

C. 10000

D. 10

Answer: A

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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. 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. 4.3

B. 0.23

C. 5.3

D. 1.23

Answer: A

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5. 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. $\left(v\frac{t_1 - t_2}{2}\right)$

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

C. $v(t_1 t_2)$

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

Answer: D

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6. 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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7. 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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8. 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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9. Which of the following represents a wave?

A. $(x - vt)^3$

B. $x(x + vt)$

C. $\frac{1}{x + vt}$

D. sin(x+vt)

Answer: D

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10. 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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11. 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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12. 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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13. 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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14. The disc of a siren containing 60 holes rotates at a constant speed of 360 rpm. The emitted sound is in uniso with a tuning fork of frequency.

A. 10 Hz

B. 360 Hz

C. 216 Hz

D. 60 Hz

Answer: B

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15. The equation of a simple harmonic wave is given $y = 5\sin\left(\frac{\pi}{2}(100t - x)\right)$, where x and y

are in meter and time is in seconds. The period of the wave in second will be

A. 0.04

B. 0.01

C. 1

D. 5

Answer: A

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16. If wave $y = A\cos(\omega t + kx)$ moving alongs x-axis the shapes of pulse at t=0 and t=2s.

A. are different

B. are same

C. may not be same

D. none of these

Answer: B

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17.

$y_1 = 4\sin(\omega t + kx), y_2 = -4\cos(\omega t + kx),$

the phase difference is

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

B. $\frac{3\pi}{2}$

C. π

D. Zero

Answer: B

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18. A wave equation is y=0.01 sin $(100\pi t - kx)$ of wave velocity is 100 m/s, its number is equal to

A. $1m^{-1}$

B. $2m^{-1}$

C. πm^{-1}

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

Answer: C

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19. A particle on the tough of a wave art any instant will come to the mean position after a time (7= time period)

A. $\frac{T}{2}$

B. $\frac{T}{4}$

C. T

D. 2T

Answer: B

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20. An organ pipe of length l vibrates in the fundamental mode,the pressure variation is maximum

A. at the 2 ends

B. at the distance $l/2$ inside the ends

C. at the distance $l/4$ inside the ends

D. at the distance $l/6$ inside the ends.

Answer: B

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21. In an experiment with sonometer, a tuning fork of frequency 256 Hz resonates with a length of 25 cm and another tuning fork resonates with a length of 16 cm. Tension of the string remaining constant, the frequency of the second tuning fork is –

A. 163.84 Hz

B. 400 Hz

C. 320 Hz

D. 204.8 Hz

Answer: B

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22. An organ pipe open at one end is vibrating in first overtone and is in resonance with another pipe open at both ends and vibrating in thrid harmonic. The ratio of length of 2 pipes is

A. $1:2$

B. $4:1$

C. $8:3$

D. $3:8$

Answer: A

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23. The fractional change in wavelength of light coming from a star is $0.014\,\%$. What is the velocity?

A. $4.2 \times 10^3 m/s$

B. $3.8 \times 10^8 m/s$

C. $3.5 \times 10^3 m/s$

D. $4.2 \times 10^4 m/s$

Answer: D

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

A. transverse

B. longitudinal

C. stationary

D. longitudinal and transverse

Answer: D

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Fill In The Blanks

1. Wave number is given by k= _____

A. $\frac{1}{\lambda}$

B. $\frac{2\pi}{T}$

C. $\frac{2\pi}{\lambda}$

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

Answer: c

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2. The waves which requires medium for their propagation are known as _____

A. Non-mechanical waves

B. Mechanical waves

C. Electro magnetic waves

D. Tidal waves

Answer: b

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3. The waves which requires medium for their propagation are known as _____

A. Non-mechanical waves

B. Mechanical waves

C. Electro magnetic waves

D. Tidal waves

Answer: b

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4. If the vibration of particles in a medium is perpendicular to the direction of propagation of the wave, then it is _____

A. longitudinal wave

B. transverse wave

C. mechanical wave

D. non-mechanical wave

Answer: b

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5. _____ is a source dependent

A. Wave velocity

B. wave length

C. Frequency

D. Time

Answer: c

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6. _____ is a medium dependent

A. Wave velocity

B. wave length

C. Frequency

D. Time

Answer: a

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7. Velocity of a wave is

A. λf

B. f / λ

C. λ / f

D. $\lambda + f$

Answer: a

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8. The wave which do not require medium for their propagation are known as

A. mechanical waves

B. electrical waves

C. sea waves

D. Non-mechanical waves

Answer: d

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9. The distance between two consecutive crests or troughs is known as_____

A. Wave velocity

B. wavelength

C. frequency

D. Time period

Answer: b

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10. Number of cycles per second is called _____

A. Wavelength

B. Frequency

C. Wave velocity

D. Angular velocity

Answer: b

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Choose The Odd One Out

1. Choose the odd one out:

A. Transverse wave

B. Light wave

C. Microwave

D. Sound wave

Answer: D

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2. Choose the odd one out:

A. intensity of a wave

B. frequency of a wave

C. wavelength of a wave

D. density of a wave

Answer: D

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3. Choose the odd one out:

A. node

B. antinode

C. harmonics

D. end correction

Answer: D

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Choose The Correct Pair

1. Choose the Correct pair:

A. Beats - Waxing and wanning of sound

B. Wave number -Number of cycles per second

C. Intensity - Inversely proportional to frequency

D. loudness - Independent on sensitivity of the ear.

Answer: A

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2. Choose the Correct pair:

A. Frequency - medium dependent

B. echo - 17.2 m

C. end correction - $\frac{L_2 - 2L_1}{3}$

D. Law of g mass - $\frac{B}{\mu}$

Answer: B

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Choose The Incorrect Pair

1. Choose the Incorrect pair:

A. Loudness - Intensity

B. Doppler Effect - Apparent frequency

C. Organ pipes- Vibration of air columns

D. Resonance Air Column Apparatus - Speed of sound in water

Answer: D

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2. Choose the Incorrect pair:

A. Closed organ pipe - $(f_n = nf_1)$

B. Open Organ pipe - 1:2:3:4

C. Constructive Interference - $(A_1 + A_2)^2$

D. Intensity - Square of Amplitude

Answer: A

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Assertion Reason

1. Assertion: The frequencies of harmonics are in the ratio 1:3:5:7, in the case of open organ pipe.

Reason: The second harmonic for an open organ pipe is $2f_1$.

A. Assertion and Reason are correct and Reason is the correct explanation of Assertion

B. Assertion and Reason are true but Reason is the false explanation of the

Assertion.

C. Assertion is true but Reason is false

D. Assertion is false but Reason is true

Answer: D

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2. Assertion: If the observer the source, then the apparent frquency is $f' = \left[\frac{\gamma + \gamma_0}{\gamma + \gamma_s}\right] f$

Reason: Doppler effect in sound is

asymmetrical whereas Doppler effect in light is symmetrical.

A. Assertion and Reason are correct and Reason is the correct explanation of Assertion

B. Assertion and Reason are true but Reason is the false explanation of the Assertion.

C. Assertion is true but Reason is false

D. Assertion is false but Reason is true

Answer: B

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Choose The Incorrect Or Correct Statements

1. (I) Repetition of sound produced by the reflection of sound waves from a wall is echo.

(II) In a closed room, the sound is repeatedly reflected from the walls and it is heard even after the sound source is ceased, it is called

reverberation?

Which one is correct?

A. I only

B. II only

C. both are correct

D. None

Answer: C

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2. (I) Time taken by a particle to complete one full cycle is called time period.

(II) For propagation of waves, the medium should possess elasticity alone.

Which one is incorrect?

A. 1 only

B. II only

C. Both are correct

D. None

Answer: B

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3. (I) The number of waves per unit second is called Wave number.

(II) $\frac{\text{Phase difference}}{\text{Path difference}} = \frac{2\pi}{\lambda}$

Which one is Incorrect?

A. 1 only

B. II only

C. Both are correct

D. None

Answer: A

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4. (I) Longitudinal waves are possible in all types of media (solid, liquid and gas).

(II) Transverse waves are also possible in all types of media.

Which one is correct?

A. 1 only

B. II only

C. Both are correct

D. None

Answer: A

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Very Short Answers Questions

1. Discuss about the formation of waves on stretched string?

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2. Mention the important properties which medium should posses for propogation of waves.

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3. Define frequency and time period.

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4. Give the relation between velocity v, angular frequency ω and wave number λ?

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5. Define amplitude of the wave.

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6. What is the effect of pressure on velocity of sound in gas?

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7. What is Echo?

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8. What is persistences of hearing?

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9. What is Reverberation?

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10. What is meant by reverberation time?

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11. Define particle velocity.

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12. Write the relation between path difference and phase difference?

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Short Answer Questions 3 Marks

1. Write about the formation of waves in a tuning fork.

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2. What are the characteristics of a wave motion ?

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3. Distinguish between transverse and longitudinal waves.

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4. Define angular frequency, wave number and wave vector.

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5. What is the relation between the velocity and temperature?

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6. Write the application of reflection of sound though the be curved surface.

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7. Write a note about Stethoscope.

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8. How are sound waves classified?

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9. What is progressive wave ?

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10. Derive the relation between Intensity and loudness.

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Long Answer Questions 5 Marks

1. Write the relation for velocity of longitudinal waves in,

(i) One dimensional rod

(ii) Three dimensional rod

(iii) Liquid medium

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2. Discuss the effect of (i) Density (ii) humidity on the velocity of sound in gases?

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3. Write the application of reflection of sound though the be curved surface.

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4. Write Characteristics of progressive waves.

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5. Explain the Graphical representation of the wave.

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Creative Questions Hots

1. How can we distinguish experimentally between longitudinal and transverse waves?

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2. Two astronauts on the surface of the moon cannot talk to each other why?

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3. How does the frequency of a tunning fork change, when the temperature is increased?

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4. The beats are not heard if the difference in frequencies of the two sounding notes is more than 10. Why?

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5. Explain why we cannot here an echo in a small room?

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

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7. Tube A has both ends open, while tube B has one end closed, otherwise they are identical the ratio of fundamental frequency of tubes A & B?

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Value Based Questions

1. (i) What is the science (physics concept) behind a stethoscope? What is the principle?

(ii) How will you make a child to understand the, Intensity of light or sound From Density without using formulae.

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2. Rekesh asked his granpda, (who was once a scientist) that whether the planets orbitting around the sun are regular shaped i.e. properly spherical in shape. His Grandpa answered No, they are not at all. All are irregularly shaped. Then Rakesh asked him

again, how to find that they are irregular in shape. What is his grandpa's explanation?

(i) How does a RADAR and SONAR Work?

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