

India's Number 1 Education App

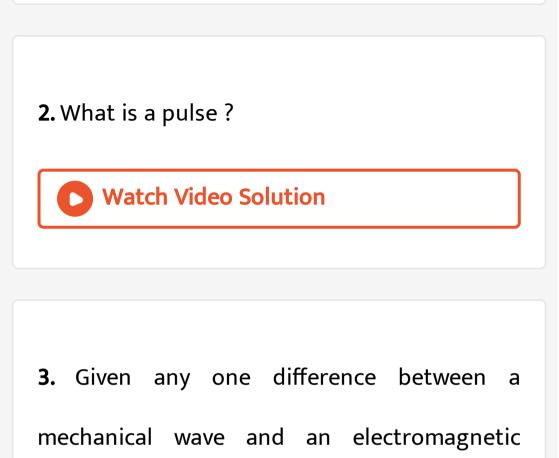
PHYSICS

BOOKS - JEEVITH PUBLICATIONS PHYSICS (KANNADA ENGLISH)

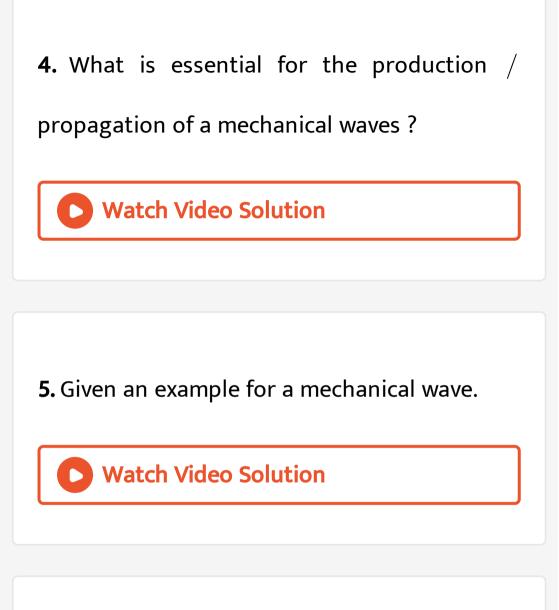
WAVES

One Mark Questions And Answers

1. What is a wave ?

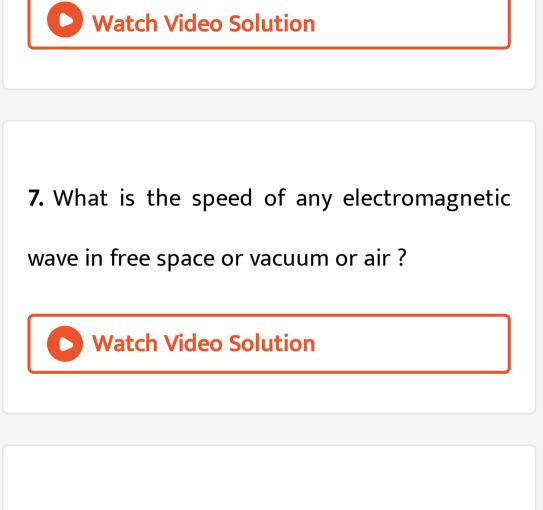


wave.



6. Given an example for a non-mechanical

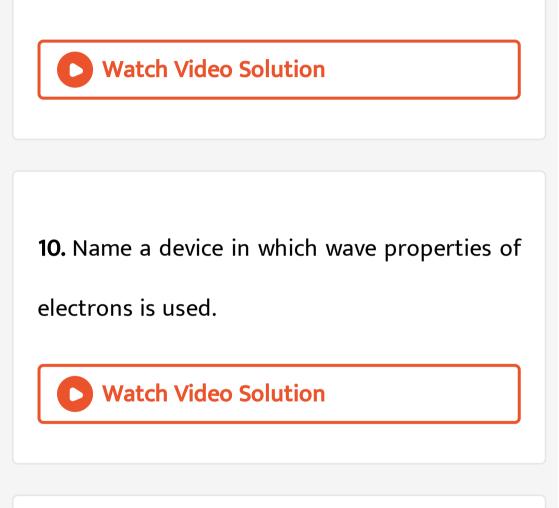
wave.



8. Give an example for a matter wave.

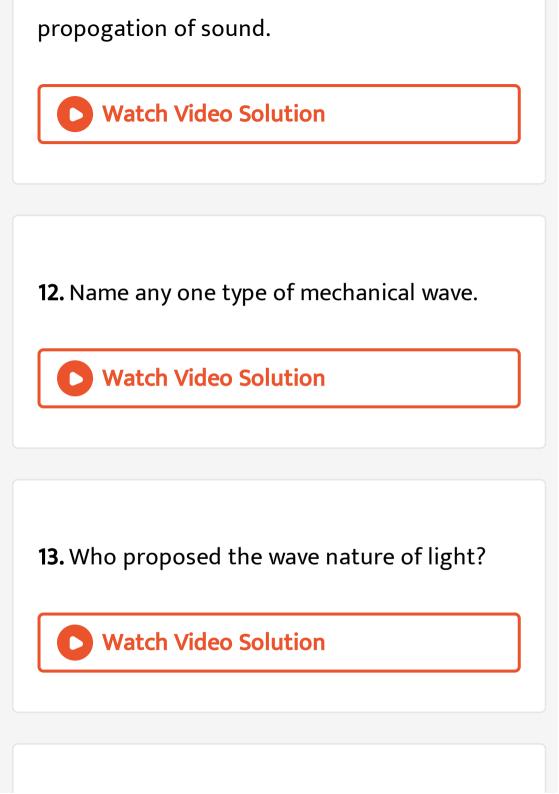


9. What are matter waves ?



11. Name any one mechanical property which

helps a mechanical medium for the



14. What is the direction of particle vibration with respect to the direction of the disturbance ?

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15. In which mode of vibration does the density of the medium vary ?

16. In which mode of vibration does the density of the medium remains the same ?Watch Video Solution

17. Give any one characteristic of longitudinal

wave motion.



18. Give any one characteristic of transverse

wave motion.

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19. Given reason why mechanical transverse

waves are not possible in fluids and gases.

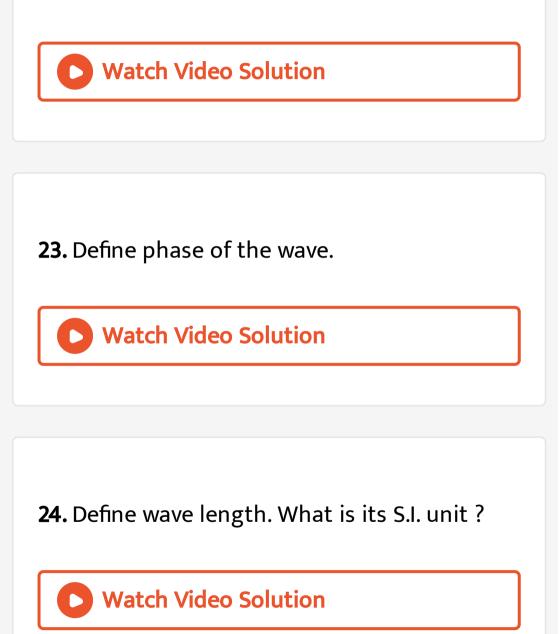
20. Represent instantaneous displacement of

a wave motion.

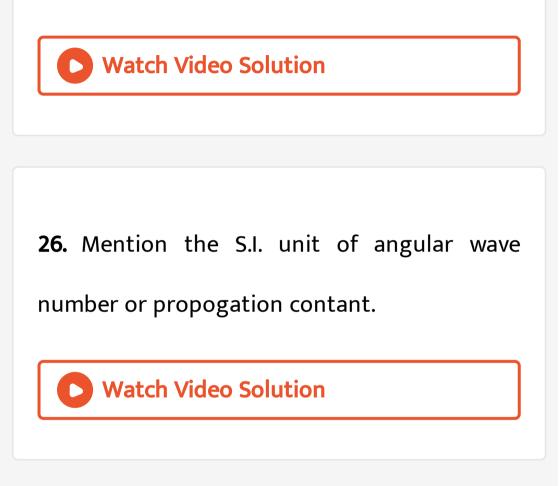
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21. In the equation y (x, t) = A $\sin(\omega t - kx + \phi)$, what does the terms $(\omega t - kt + \phi)$ represent ?

22. Define amplitude of a wave



25. Define frequency of wave motion.



27. Relate angular and linear frequencies of the wave motion.



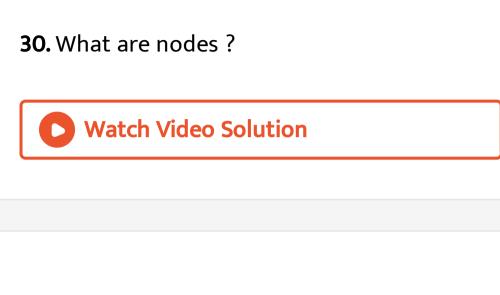
28. Why is the velocity of longitude wave (sound) in solids and liquids is greater than in gases ?

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29. What are stationary (localised or standing)

waves ?





31. Where are antinodes ?



32. What is the distance between any two

consecutive nodes or antinodes ?





33. What is the distance between a node and a

consecutive antinode ?



34. What is meant by a fundamental frequency

(mode) or first harmonic or vibration of a

system?

35. Give the expression for nth harmonic or (n-

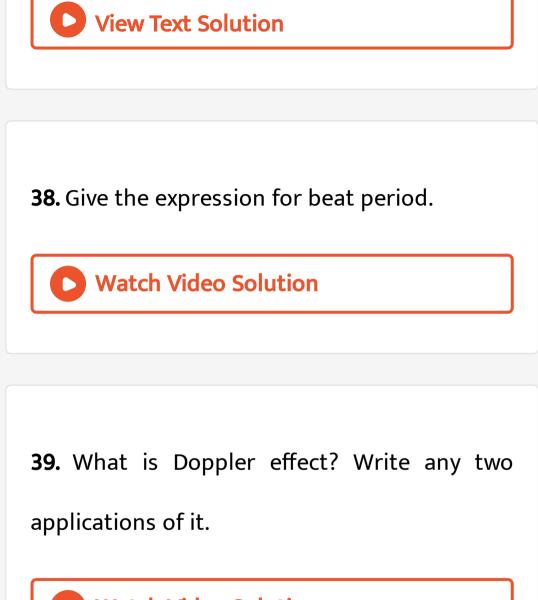
1)th overtone in the case of a closed pipe system.



36. Write the expression for beat frequency.



37. What are audible beats?



40. What will be the wavelength of sound when the source of sound is moving towards the stationary observer ?



41. What happens to the wavelength of sound

when the source of sound is at rest and the

observer moving towards it ?

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42. Write the expression for apparent frequency of sound for source and listener moving in the same direction in a still air.

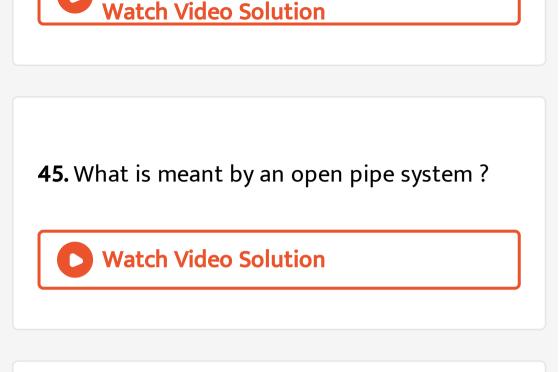
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43. What are overtones ?

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44. What is meant by a closed pipe system ?





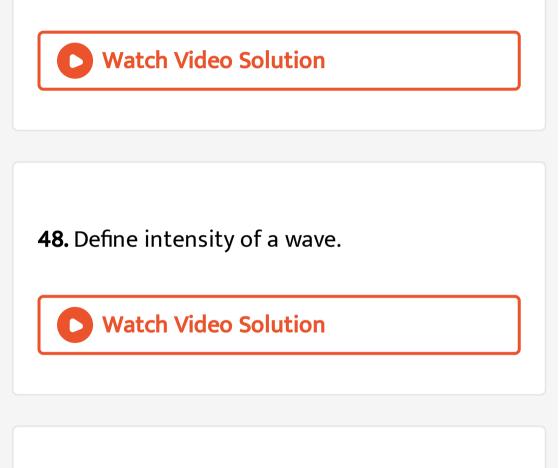
46. Write the first three harmonics in the case

of a closed pipe system.



47. The harmonics in a pipe system are 1028

Hz, 2056Hz, 3084Hz.Name the pipe system.



49. Mention the S.I unit of intensity of wave.

Two Marks Questions With Answers

1. Why does wave velocity remain a constant

whereas particle velocity does not ?



2. Define velocity of wave motion. Give the

expression wave velocity.

3. Write an equation for a progressive wave travelling along the positive x -direction with an epoch zero.

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4. Give the expression for the speed of the transverse wave on a stretched string along with the meanings of the symbols used.

5. Give the expression for the frequency of vibration on a stretched string in a transverse mode of vibration along with the meanings of the symbols used.



6. Give the expression for the velocity of longitudinal wave in an elastic medium along with the meaning of the symbols used.



7. Give the expression for the velocity of sound in air / gaseous media along with the meanings of the symbols used.

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8. Give Newton's for velocity of sound in air or

gases along with the meanings of the symbols

used.

9. What is Laplace correction for velocity of sound in a gaseous medium to the Newton's formula.Give the meanings of the symbols used.

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10. Write the instantaneous displacement of a

combined wave that represent the stationary

wave.



11. Give the expression for resultant displacement of two waves producing beats.

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12. Write the expression for apparent frequency for source of sound moving towards

a stationary observer.

13. Write the expression for apparent frequency of sound for observer moving towards a stationary source of sound.

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14. Write the expression for apparent frequency of sound as heard by a driver of a source of sound moving towards the hill or wall.



15. Give the expression for the fundamental frequency in the case of a closed a pipe system **Watch Video Solution**

16. Give the expression for the fundamental

frequency in the case of an open pipe system.

17. What will be the speed of infrasonics and

ultrasonics in air at $0^{\circ}C$?

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Three Marks Questions With Answers

 Distinguish between mechanical and nonmechanical waves with an example for each type.



2. Name any one type of mechanical wave.



3. Comment on Laplace correction to Newton's

formula for velocity of sound in air.

4. Show that Laplace correction for elasticity of gaseous medium is $E = \gamma p$, where ' γ ' is the ratio of specific heates.



5. Obtain an expression for the instantaneous

displacement of a stationary wave.



Five Marks Questions With Answers

1. Show that the distance between any two consecutive nodes or antinodes in a stationary wave is $\lambda/2$.

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2. if two progressive waves travelling in the same direction interfere, then obtain the instaneous displacement of the combined wave.





expression for beta frequency.

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4. Show that only odd harmonics are present

in the closed pipe system.

5. Show that both odd and even harmonics are

present in an open pipe system.

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6. Show that all harmonics are present in a streteched string under a tranverse mode of vibration.

7. Obtain an expression for the apparent frequency of sound for a source moving away and towards a stationary observer.

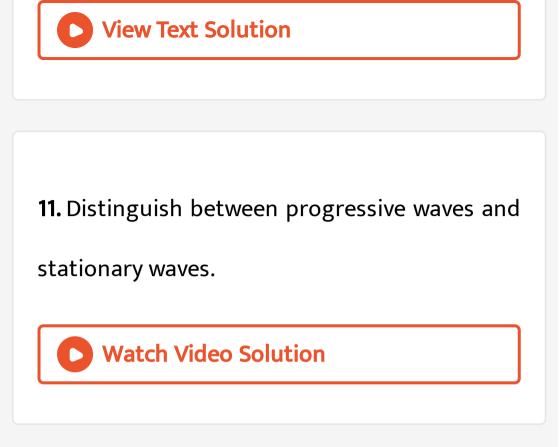


8. Obtain an expression for the apparent frequency of sound for an observer moving towards / away from a stationary source of sound.

9. Obtain an expression for the aparent frequency of sound when the source of sound and the listener are moving away from each other

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10. Obtain an expression for the aparent frequency of sound when the source of sound and the listener are moving towards each other.



Numericals With Solutions

1. A string of mass 2.50kg is under a tension of 200N.The length of the stretched string is 20.0

m. If a transverse jerk is struck at one end of

the string, how long does the disturbance take

to reach the other end ?

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2. A stone dropped from the tope of a tower of height 300m high splashes into the water of a pond near the base of the tower. When is the splash heard at the top, given that the speed of sound in air is $340ms^{-1}$? ($g = 9.8ms^{-2}$)



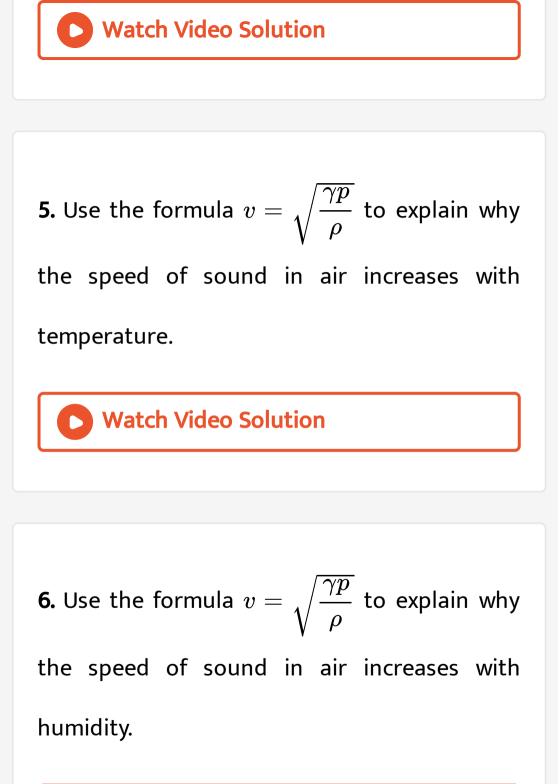
3. A steel has a length of 12.0m and a mass of 2.10kg . What should be the tension in the wire so that speedof a transverse wave on the wire equals the speed of sound in dry airat $20^{\circ}C$ equals $343ms^{-1}$?

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4. Use the formula $v = \sqrt{rac{\gamma p}{
ho}}$ to explain why

the speed of sound in air is independent of

pressure





7. A bat emits ultrasound waves of frequency 1000kHz in air. If the sound meets a water surface, what is the wavelength of the reflected sound. Speed of sound in air is $340ms^{-1}$ and in water $1486ms^{-1}$

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8. A bat emits ultrasound waves of frequency 1000kHz in air. If the sound meets a water surface, what is the wavelength of the transmitted sound in water? Speed of sound in air is $340ms^{-1}$ and in water $1486ms^{-1}$



9. A hospital uses an ultrasonic scanner to locate tumours in a tissue.What is the wavelength of sound in the tissue in which the

speed of sound is $1.7 km s^{-1}$? The operating

frequency of the scanner is 4.2 MHz.



10. A transverse harmonic wave on a string is described by $y(x,t) = 30 \sin \left(36t + 0.018x + \frac{\pi}{4}\right)$ where x and y are in cm and t is in s.The positive direction of x is from left to right.

Is this a travelling wave or a stationary wave ?

If it is travelling, what are the speed and

direction of its propagation ?

11. A transverse harmonic wave on a string is described by $y(x,t) = 30 \sin \left(36t + 0.018x + \frac{\pi}{4}\right)$ where x and y are in cm and t is in s.The positive direction of x is from left to right.

What are its amplitude and frequency?

12. A transverse harmonic wave on a string is described by $y(x,t) = 30 \sin \left(36t + 0.018x + \frac{\pi}{4} \right)$ where x and y are in cm and t is in s.The positive direction of x is from left to right.

What is the initial phase at the origin ?

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13. A transverse harmonic wave on a string is

described

 $y(x, t) = 30 \sin\left(36t + 0.018 + \frac{\pi}{4}\right)$ where x and y are in cm and t is in s. The positive direction of x is from left to right. What is the least distance between two successive crests in the wave ? Watch Video Solution

14. For the travelling harmonic wave $y(x,t) = 20\cos 2\pi(10t - 0.0080x + 0.35)$ where x, y are in cm and t isin s.Calculate the phase difference between oscillary motion of

two points separated by a distance of

4m



15. For the travelling harmonic wave $y(x, t) = 20 \cos 2\pi (10t - 0.0080x + 0.35)$ where x, y are in cm and t isin s.Calculate the phase difference between oscillary motion of two points separated by a distance of 0.5m 16. For the travelling harmonic wave $y(x,t) = 20 \cos 2\pi (10t - 0.0080x + 0.35)$ where x, y are in cm and t isin s.Calculate the phase difference between oscillary motion of two points separated by a distance of $\left(\frac{\lambda}{2}\right)$ Watch Video Solution

17. For the travelling harmonic wave $y(x,t)=20\cos 2\pi(10t-0.0080x+0.35)$

where x, y are in cm and t isin s.Calculate the

phase difference between oscillary motion of

two points separated by a distance of

$$\left(\frac{3\lambda}{4}\right)$$



18. The transverse displacement of a string is

given by

$$y(x,t)=0.06\siniggl(rac{2\pi}{3}iggr)x\cos(120\pi t)$$
 where
'x' & 'y' are 'm' and 't' is s. The length of the
string is 1.5m and its mass is $3.0 imes10^{-2}kg$.

Does the function represent a travelling wave

or stationary wave?

19. The transverse displacement of a string is

$$y(x,t) = 0.06 \sin\left(rac{2\pi}{3}
ight) x \cos(120\pi t)$$
 where

'x' & 'y' are 'm' and 't' is s. The length of the

string is 1.5m and its mass is $3.0 imes 10^{-2} kg$.

Interpret the wave as a superposition of two waves travelling in opposite direction. What is the wavelength, frequency and speed of each

wave?



20. The transverse displacement of a string is given by $y(x,t) = 0.06 \sin\left(\frac{2\pi}{3}\right) x \cos(120\pi t)$ where 'x' & 'y' are 'm' and 't' is s. The length of the string is 1.5m and its mass is $3.0 \times 10^{-2} kg$. Determine the tension in the string.

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21. A wire stretched between two rigid supports vibraes in its fundamental mode with a frequency of 45 Hz. The mass of the wire is $3.5 \times 10^{-2} kg$ and its linear mass density is $4.0 \times 10^{-2} kgm^{-1}$. What is (a) the speed of transverse wave on the string and (b) the tension in the string ?



22. A metre long tube open at one end with a movable piston at the other end, shows resonance with a fixed frequency source (a tuning fork of frequency 340Hz) when the tube length is 0.255m or 0.793m. Estimate the speed of sound in air at the temperature of the experiment. The edge effects may be neglected.

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23. A steel rod 1m long is clamped at its middle. The fundamental frequency of longitudinal vibrations of the rod are given to be 2.53 KHz. What is the speed of sound in steel ?

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24. A pipe 0.20m long is closed at one end. Which harmonic mode of the pipe is resonantly excited by a 430 Hz source ? Will the same source be resonance with the pipe if

both ends are open ? (Speed of sound in air is

 $340 m s^{-1}$)

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25. Two sitar stings A and B playing the note 'ga' are slightly out of tune and produce beats of frequency 6Hz. The tension in the string A is slightly reduced and the beat frequency is found to reduce to by 3Hz. If the original frequency of a is 324 Hz, then what is the

frequency of B?



26. A train standing a the outer signal of a railway station blows a whistle of frequency 400Hz in still air .

What is the frequency of the whistle for a platform observer when the train (i) approaches the platform with a speed of $10ms^{-1}$? (ii) recedes from the platform with a speed of

 $10 m s^{-1}$?



27. A train standing a the outer signal of a railway station blows a whistle of frequency 400Hz in still air . when the train (i) approaches the platform with a speed of $10ms^{-1}$? (ii) recedes from the platform with a speed of

 $10 m s^{-1}$?

What is the speed of sound in each case ? The speed of sound in still air can be taken as $340ms^{-1}$

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28. A train standing in a station yard, blows a whistle of frequency 400 Hz in still air. The wind starts blowing in the direction from the yard to the station with a s speed of $10ms^{-1}$. What are the frequency , wavelength and speed of sound for an observer standing on

the station's platform? Is the situation exactly identical to the case when the air is still and the observer runs towards the yard at a speed of $10ms^{-1}$? The speed of sound in still can be taken as $340ms^{-1}$

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29. A travelling harmonic wave on a string is described by $y(x,t) = 7.5 \sin \Bigl(0.0050 x + 12t + rac{\pi}{4} \Bigr)$

(a) What are the displacement and velocity of

oscillation of a point at x = 1 cm, t = 1s ? Is this velocity equal to the velocity of propagation ? (b) Locate the points of the string which have the same transverse displacements and velocity as the x = 1cm point at t = 2s, 5s and 11s

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30. One end of a long string of linear mass density $8.0 \times 10^{-3} kgm^{-1}$ is connected to an electrically driven tuning fork of frequency 256 Hz. The other passes over a pulley and is tied to a pan containing a mass of 90 kg. The pulley end absorbs all the incoming energy so that reflected waves at this end have negligible amplitude . At t=0, the left end (fork end) of the string x = 0 has zero transverse displacement (y = 0) and is moving along positive y - direction. The amplitude of the wave is 5.0 cm. Write down the transverse displacement y as a function of x and t that describe the wave on the string.

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



32. Earthquakes generate sound waves inside the Earth. Unlike gases, the Earth can

experience both transverse and longitudinal 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 waves arrives 4 min before the first S wave. Assuming the waves traveling straight line, at what distanc does the earthquake occur?



33. A bat is flitting about in a cave, navigating via ultrasonic beeps. Assume that the sound emission frequency of the bat is 40kHz. During the fast swoop directly toward a flat wall surface, the bat is moving at 0.03 times the speed of sound in air. What frequency does the bat hear reflected off the wall?

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34. A progressive wave is represented by an equation $y = 5\sin(80\pi t - 0.5\pi x)$, where x, y are in 'm' and 't' in 's'. Find (a) amplitude (b)wavelength (c) frequency (d) velocity of the wave.

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35. The speed of sound in Hydrogen $1270ms^{-1}$. What will be the speed in a

mixture of oxygen and hydrogen mixed by

volume ratio 1:4?



36. A wave travelling along a string is described by $Y(x, t) = 0.005 \sin(80x - 3t)$ in which the numerical constants are in SI units. Calculate amplitude.

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37. A wave travelling along a string is described by $Y(x, t) = 0.005 \sin(80x - 3t)$ in which the numerical constants are in SI units. Calculate wavelength



38. A wave travelling along a string is described by $Y(x,t) = 0.005 \sin(80x - 3t)$ in which the numerical constants are in SI units.

Calculate (i) amplitude (ii) the wavelength and

(iii) the period and frequency of the wave.



39. A wave travelling along a string is described by $Y(x, t) = 0.005 \sin(80x - 3t)$ in which the numerical constants are in SI units. Calculate (i) amplitude (ii) the wavelength and (iii) the period and frequency of the wave.



40. A progressive wave is represented by an equation $y = 5\sin(80\pi t - 0.5\pi x)$, where x, y are in 'm' and 't' in 's'. Find (a) amplitude (b)wavelength (c) frequency (d) velocity of the wave.

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41. A progressive wave is represented by equation $y = 5\sin(80\pi t - 0.5\pi x)$ where x,y are in metre and t is in second. Find Wavelength

42. A progressive wave is represented by an equation $y = 5\sin(80\pi t - 0.5\pi x)$, where x, y are in 'm' and 't' in 's'. Find (a) amplitude (b)wavelength (c) frequency (d) velocity of the wave.



43. A progressive wave is represented by equation $y = 5\sin(80\pi t - 0.5\pi x)$ where x,y are in metre and t is in second. Find Velocity



44. A train producing a siren with a frequency of 1500 Hz approaches a stationary observr with a speed of 72 kmph. What is apparent frequency of sound heard by him when it crossing him ?(Given velocity of sound

$$v=340ms^{-1}$$
)

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45. A wave travelling along a string is described by $Y(x, t) = 0.005 \sin(80x - 3t)$ in which the numerical constants are in SI units. Calculate (i) amplitude (ii) the wavelength and (iii) the period and frequency of the wave.



46. The transverse wave in a string is represented by $y(x,t) = 7.5 \sin(12\pi t - 0.005x)$ where 'x' and 'y' in cm and 't' in second. Determine (a) Amplitude (b) frequency (c) wavelength and (d) velocity of the wave.

