PHYSICS

BOOKS - BINA LIBRARY PHYSICS (ASSAMESE ENGLISH)

WAVES

Example

1. The equation of a wave is given by $y = 10\cos\pi(2.0t - 0.01x)$,where y and x are in cm and t in sec.Find (i)amplitude,(ii)frequency,(iii)wavelength and (iv)wave velocity.

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2. The displacement of a wave is represented by $y = 0.25 \times 10^{-3}\sin(500t - 0.025x)$,where y,t and x are represented in

cm, sec and cm respectively. Calculate (i)amplitude,(ii)time period, (iii)angular frequency and (iv)wave length.

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3. A tuning fork A of frequency 384 Hz gives 6 beats per second when sounded with another tunig fork B.On loading B with a littile wax,the number of beats per second becomes 4.What is the frequency of B?

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4. Show that when two progressive waves travelling in the same direction superimpose,the resultant was is also a progressive wave.

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5. The velocity of transverse wave passing through a string of length 3m is 16 m/sec.If the mass of the string is 0.15 kg,find (i)the tension of the

string,(ii)the frequency of its fundamental and (iii)the wavelength.

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6. The fundamental frequency of stretched wire of length 50 cm is in unision with the frequency of a tuning fork.If the length is increased by 0.5 cm.4 beats per second are formed.Find the frequency of the tuning fork.

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7. A tuning fork has got a frequency equal to the fundamental frequency of 25 cm length of a sonometer wire.Without change the load,if the legth of the wire is increased to 25.5 cm then 3 beats are heard per secondwhen the fork and wire are made to vibrate together.Calculate frequency of the tuning fork.

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8. A wire is under tension of 32N and the length between the two bridges is 1 metre.A 10 metre length of the sample has a mass of 2g.Deduce the speed of transverse waves on the wire and the frequency of the fundamental.

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9. A copper wire is held at two ends by rigid supports.At 30^0C the wire is just taut,with negligble tension.Find the speed of transverse wave in the wire at 10^0C[$\alpha = 1.7 \times \frac{(10)^{-5}}{\hat{}} 0C, \gamma = 1.3 \times (10)^{11} \frac{N}{(m)^2}$, $\rho = 9 \times (10)^3 k \frac{g}{(m)^3}$]

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10. A uniform rope of length 12 m amd mass 6 kg hangs vertically from a rigid support.A block of mass 2 kg is attached to the free end of the rope.A transverse pulse of wave length 0.06m is produced at the lower

end of the rope.What is the wavelength of the pulse when it reaches the top of the rope?

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11. If the tension in a sonometer wire is increased by 2.5 N,its frequency increases in the ratio 3:2.What was the original tension?

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12. A wire with mass per unit length 0.05 $gcm^{-1}$is stretched between two rigid supports with tension of $4.5 \times (10)^7$ dynes.it is observed that the wire resonates at a frequency of 420 Hz.The next frequency at which the wire resonates is 492 Hz.Find the length of the wire.

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13. A sonometer wire emits a note of frequency 150 Hz.What will be the frequency of the note emitted by it if its tension increaeed in the ratio 9:16 and the length is doubled?

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14. A sonometer wire is under tension of 40 N and the length between the two bridges is 60 cm.A one metre long wire of the sonometer has a mass of 1.0 g.Deduce the speed of transverse waves and the frequency of the second harmonic.

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15. You are asked to prepare open organ pipe having fundamental frequency 240.What should be the length of the pipe?[velocity of sound in air =330 m/sec)

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16. The length of a cylindrical glass tube is 30 cm.the velocity of sound in air is 330 $m(s)^{-1}$.What is the fundamental frequency of vibration of the air coloumn if

(i)both ends of the tube are open and (ii)open end is closed and flat?

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17. A string 25 cm long and having a mass of 2.5 g is under tension.When the string is vibrating in its first overtone and air in a 40 cm long closed pipe in its fundamental frequency 8 beats per second are heard.it is observed that decreasing the tension in the string decreases the beat frequency.Find the tension in the string.[Velocity of sound is 320 m/s]

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18. Two open pipes of different lengths are producing their fundamental tones simultaneously and the number of beats per second is 5.if the

shorter pipe has fundamental frequency 250 Hz,what is the length of the longer pipe?(velocity of sound = 340m/s)

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19. A train moving with speed 72 Km/hr blows its whistle of 200 Hz.What frequency is heard by a stationary observer?[velocity of sound in air = 330 $m(s)^{-1}$]

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20. A train approaching a station at 36 km/hr blows its whistle of 320 Hz.What frequency is heard (i)in the station and (ii)by a stationary observer behind the train?

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21. A frequency of the horn of a car drops from 280 Hz to 240 hz as the car passes a stationary observer.What is the speed of the car?[velocity of the sound in the air is 330 `m(s)^-1].

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22. At each of the stations A and B a siren its surrounding with a constant of frequency pf 250 Hz.A cyclist from A proceeds towards B with a velocity 12km/hr and hears 5 beats per second.Calculate the velocity of sound.

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23. Two aeroplane A and B are approaching each other and their velocities are 108 km/hr and 144 km/hr respectively.The frequency of a note emitted by Aas heard by the passenger in B is 1170 Hz.Calculate the frequency of the note heard by the passenger in A.[velocity of sound 350 $m(s)^{-1}$].

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24. The frequency of horn of a car drops by 10% as the car passes a stationary observer.What is the speed of the car?[velocity of sound = 330 m/s]

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25. A source of sound of frequency 256 Hz is moving rapidly towards a wall with a velocity of 5 $m(s)^{-1}$.How nmany beats per second will be heard if sound travel at a speed of 330 $m(s)^{-1}$ and the observer is behind the source.

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26. A source of sound is movig with a speed 220 $m(s)^{-1}$ towards a stationary target.While moving,it emits a wave of frequency 1000 Hz.Some of the sound reaching the target get reflected back to the source as

echo.Calculate the (i)frequency of sound as detected by the target and (ii)the frequency of echo as detected by the source?

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Exercise

1. What is a wave motion?

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2. What do you mean by wave length?

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3. How are velocity,wave length and frequency related?

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4. Define frequency.What is its unit?

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5. What is the fundamental difference between a longitudinal and a transverse wave?

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6. How are velocity,wave length and frequency related?

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7. What is the basic difference between a sound wave and a light wave?

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8. Why sound wave cannot travel through vaccum?

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9. What is the physical difference between a sine wave and cosine wave?

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10. Why sound waves can not be polarized?

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11. What are stationary waves?

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12. State the difference between a node and an antinode.

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13. How are stationary waves formed?

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14. State the factors on which the fundamental frequency of a string depends.

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15. What is the relation between the fundamental frequency and overtones in a closed pipe?

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16. Why is there a node at the closed end and an antinode at the open end?

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17. What are fundamental nodes and overtones?

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18. What are harmonics?

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19. What are stationary waves?

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20. What is the fundamental difference between a longitudinal and a transverse wave?

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21. Why does sound travels faster in iron than in air?

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22. State the effects of pressure on the speed of sound.

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23. Explain the difference between progressive and stationary waves.

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24. State the laws of vibrations of stretched strings.

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25. Write down Newton's formula for velocity of sound and state the laplace's correction.

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26. Write down the expression for the velocity of longitudinal waves through gaseous medium.hence decuce Laplace's expression for the velocity of sound waves in air.

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27. How does the velocity of sound depend upon pressure and temperature of the medium.

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28. Establish by dimensional analysis that $v = \sqrt{\frac{T}{m}}$ where v is the velocuty of wave along the stretched wire.T is tension applied and m is mass per unit length of the wire.

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29. Dudecue an expression for apparent frequency of sound,when the listener moves towards a stationary source.

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30. Deduce an equation for a progressive wave.

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31. Show that when two progressive waves travelling in the same direction superimpose,the resultant was is also a progressive wave.

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32. What are beats?Show analytically how they are produced due to superposition of two sound waves.

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33. What are stationary waves?

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34. What are stationary waves?

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35. Show analytically how stationary wave are they formed due to superposition of two waves.

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36. Give two differences between stationary and progressive waves.

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37. State the factors on which the fundamental frequency of a string depends.

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38. State the laws of vibrations of stretched strings.

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39. Find an expression for its fundamental frequency.

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40. Show by two neat diagrams that the frequency of the first overtone of vibrating air coloumn in a organ pipe open at one end is three times the frequency of its fundamental vibration.

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41. Show that the fundamental frequency for the open pipe is twice that for the closed pipe of the same length.

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42. How are the harmonics produced related with the fundamentals in the case of an open organ pipe?

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43. What is Doppler effect?

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44. Find expression for Doppler effect in case of a moving source when the observer is at rest and there is no wind.

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45. What is Doppler effect?

Watch Video Solution

46. Find expression for Doppler effect in case of a moving source when the observer is at rest and there is no wind.

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47. Is oscillation a wave?

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48. transverse waves are possible in solids, but not in fluid,why?

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49. When two waves interfere,does one alter the progress of the other?

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50. When two waves interfere,is there a loss of energy?

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51. Does a wave transfer momentum?

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52. Will two waves differing in amplitude only and propagating in opposite direction through a medium produce standing waves?

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53. The length between two bridges of a sonometer wire is L, tension is T and the fundamental frequency is N, if the length between the bridges and tension both are doubled, explain if there is any change in fundamental frequency.

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54. Explain why strings of musical instruments are mounted on hollow wooden box.

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55. Where does a man hear a louder sound at the node or antinode?

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56. How does particle velocity differ from wave velocity?

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57. Why are the holes kept at different positions of flute?

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58. Sometimes it is difficult to recognize a voice over telephone,why?

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59. If an explosion takes place at the bottom of a lake,what will be the nature of shock wave produced in water?

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60. In everyday life Doppler effect is observed readily in sound but rarely in light,why?

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61. Calculate the frequency of fundamental note of a string 1 m long and wighing 2 g when stretched by a weight of 400 kg.

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62. What is the frequency of fundamental note of 0.2 metre long open pipe.Velocity of sound in air is 322 m/s

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63. Two organ pipes one open at both ends,and the other open at one end only give their fundamental noteswhose frequencies differ by 25 vibration per second.The length of the open pipre is 96 cm.Calculate the length of the closed pipe if the velocity of sound in air is 330 $m(s)^{-1}$.

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64. A fork of frequency 256 is held over a tube and the resonance is obtained when the coloumns are 32 cm and 100 cm long.Find the end correction.

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65. Two tuning forks when sounded together give 4 beats per second.if one of them is in unison with 96 cm length of a monochord under constant tension and the other with 97 cm length of the same string,find the frequencies of the fork.

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66. Two waves of wave length 100 and 101 cm produce 20 beats in 6 seconds in air.Find the velocity of sound in air.

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67. Two tuning forks produce 4 beats per second when sounded together.On loading one of them the number of beats become 2 per second.Find the frequency of the loaded fork if that of the other is 510 Hz.

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68. When two tuning forks when sounded together,20 beats were produced in 8 seconds .After loading one of the forks with a littile wax,they produce 32 beats in 8 seconds.If the unloaded fork had a frequency of512 Hz,calculate the frequency of the other.

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69. An ambulance blowing a siren of frequency 700 Hz is travelling towards a wall with a speed 2 $m(s)^{-1}$. $Calcatethevmberofbeatsheard \in o \neq \sec ondbythedriverofthea$ m(s)^-1`)

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70. A train approaching a hill at a speed of 1 Km a minute blows a whistle of frequency 480 Hz.Calculate the frequency which will be recorded byan instrument on the top of the hill.[Velocity of sound = 330 m/s]

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71. A train whistling while approaching a railway platform with a speed of 90 $km(s)^{-1}$.The frequency of sound of the whistle is 600 Hz.If the velocity of sound in air is 325 $m(s)^{-1}$,calculate the apparent frequency of the sound of the whistle as heard by an observer standing on the platform.

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72. A transverse wave is represented by equation $y = y_0 \sin\left(\frac{2\pi}{\lambda}\right)(vt - x)$.

For what value of λ is the maximum particle velocity to two times of the wave velocity?

A. $2\pi y_0$

B. $\frac{\pi y_0}{3}$

C. $\frac{\pi y_0}{2}$

D. πy_0

Answer: D

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73. In a sinusoidal wave,the time required for a particular point to move from maxiumum displacement to zero displacement is 0.170 s.The frequency of the wave is

A. 1.47 Hz

B. 0.36 Hz

C. 0.73 Hz

D. 2.94 Hz

Answer: A

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74. If two waves of same amplitude produce a resultant wave of same amplitude a phase difference between the two is

A. 60^0

B. 90^0

C. 120^0

D. 180^0

Answer: C

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75. A whistle giving out 450 Hz approaches a stationary observer at a speed of 33 m/s.The frequency heard by the observer in Hz is (velocity of sound = 333m/s)

A. 409

B. 429

C. 517

D. 500

Answer: D

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76. A source of sound of frequency 500 Hz is moving towards an observer with velocity 30 m/s.The speed of the sound id 330 m/s.The frequency heard by the observer is

A. 545 Hz

B. 58z Hz

C. 458 Hz

D. 550 Hz

Answer: D

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77. A stationary sound wave has a frequency 165 Hz.Distance between two consecutive nodes is(speed of the sound in air = 330 m/s)

A. 2 m

B. 1 m

C. 5 m

D. 4 m

Answer: B

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78. The equation of a stationary wave is $y = 10\sin\left(\frac{\pi x}{4}\right)\cos 20\pi t$ .Distance between two consecutive nodes is

A. 4

B. 2

C. 1

D. 8

Answer: A

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79. The length of a string tied to supports is 40 cm.Maximum wave length of the stationary wave produced is

A. 20 cm

B. 40 cm

C. 120 cm

D. 80 cm

Answer: D

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80. The tension and diameter of a sonometer wire of fundamental frequency n are doubled and density is halved.Its fundamental frequency will be

A. $\frac{n}{4}$

B. `sqrt(2)n

C. n

D. $\frac{n}{\sqrt{2}}$

Answer: C

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81. The cylindrical tube open at both ends has 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 coloumn is now

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

B. $\frac{3n}{4}$

C. n

D. $2n$

Answer: C

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82. A progressive wave is represented by

A. $a \sin \omega t$

B. $a \sin(\omega t) \cos(kt)$

C. $a \sin(\omega t - kx)$

D. $a \cos kx$

Answer: C

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83. A sine wave travelling to right is represented by the equation $y = a\sin(kx - \omega t)$.The velocity of the wave is given by

A. $\frac{k}{\omega}$

B. ωt

C. $\frac{\omega}{k}$

D. kt

Answer: C

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84. A transverse wave is represented by the equation $y = y_0 \sin 2\pi\left(vt - \frac{x}{\lambda}\right)$.The maximum particle velocity is equal to four times the wave velocity if

A. $\lambda = \frac{\lambda y_0}{4}$

B. $\lambda = \frac{\pi y_0}{2}$

C. $\lambda = \pi y_0$

D. $\lambda = 2\pi y_0$

Answer: B

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85. Which of the following remains unchanged,when the wave propagates from air to water?

A. velocity

B. wave length

C. frequency

D. intensity

Answer: C

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86. The equation of a wave is $y = 20\sin(100\pi t - 0.08\pi x)$cm.The frequency of the wave is

A. 50 Hz

B. 25 Hz

C. 0.8 Hz

D. 100 Hz

Answer: A

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87. The equation of a wave is $y = 3\cos\pi(100t - x)$ cm.its wavelength is

A. 3 cm

B. 100 cm

C. 2 cm

D. 5 cm

Answer: C

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88. In a sonometer, the waves produced are

A. progressive longitudinal waves

B. progressive transverse waves

C. stationary longitudinal waves

D. stationary transverse waves

Answer: D

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89. If the tension of the wire is increased four times and its length reduced to half the original length the frequency of vibration

A. remain same

B. doubled

C. halved

D. increased four times

Answer: D

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90. A string when attached by a weight of 4 Kg weight give a note of frequency 256.What will produce an octave of this note?

A. 4 Kg wt

B. 16 Kg wt

C. 2 Kg wt

D. 24 Kg wt

Answer: B

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91. A closed organ pipe and a open organ pipe have their first overtone identical in frequency. Their length are in the ratio

A. $1:2$

B. $2:3$

C. $3:4$

D. $4:5$

Answer: C

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92. The velocity of sound in air is 332 m/s.The frequency of the fundamental node of an open pipe 50 cm long will be

A. 160 Hz

B. 332 Hz

C. 272 Hz

D. 385 hz

Answer: B

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93. Transverse wave of the same frequency are generated in two steel wires A and B.Diameter of A is twice that of B and tension is A is half that of B.The ratio of velocities of waves in A and B is

A. $1:2$

B. $1:\sqrt{2}$

C. $1:2\sqrt{2}$

D. $3:2\sqrt{2}$

Answer: C

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94. If the distance between the source and the observer is doubled,the intensity of sound becomes

A. double

B. quadrupled

C. one fourth

D. one half

Answer: C

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95. Doppler's effect is exhibited by

A. sound waves only

B. light waves only

C. both light and sound waves

D. ultrasonics

Answer: C

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96. Ultrasonic waves are

A. longitudinal

B. transverse

C. vibration of other particles

D. sometimes longitudinal and sometimes transverse

Answer: A

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97. Production of beat is due to

A. interference

B. diffraction

C. polarisation

D. refraction

Answer: A

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