Wave Motion Assignment

1. The equation $y = A\cos^2\left(2\pi nt - 2\pi\frac{x}{\lambda}\right)$ represents a wave with

(a) Amplitude *A*/2, frequency $2n$ and wavelength $\lambda/2$ (b) Amplitude *A*/2, frequency $2n$ and wavelength λ

(c) Amplitude *A*, frequency $2n$ and wavelength 2λ (d) Amplitude *A*, frequency n and wavelength λ

2. v_1 and v_2 are the velocities of sound at the same temperature in two monoatomic gases of densities ρ_1 and ρ_2 respectively. If $\rho_1/\rho_2 = \frac{1}{4}$ then the ratio of velocities v_1 and v_2 will be

(a) 1 : 2 (b) 4 : 1 (c) 2 : 1 (d) 1 : 4

3. The temperature at which the speed of sound in air becomes double of its value at 0^oC is

(a) 273^o *K* (b) 546^o *K* (c) 1092^o *K* (d) 0^o *K*

4. A wave travelling in positive X-direction with $A = 0.2m$ has a velocity of 360 *m/sec*. if $\lambda = 60m$, then correct expression for the wave is

(a) $y = 0.2\sin\left[2\pi\left(6t + \frac{x}{60}\right)\right]$ (b) $y = 0.2\sin\left[\pi\left(6t + \frac{x}{60}\right)\right]$

(c) $y = 0.2\sin\left[2\pi\left(6t - \frac{x}{60}\right)\right]$ (d) $y = 0.2\sin\left[\pi\left(6t - \frac{x}{60}\right)\right]$

5. The equation for spherical progressive wave is

(a) $y = a\sin(\omega t - kx)$ (b) $y = \frac{a}{\sqrt{r}}\sin(\omega t - kx)$ (c) $y = \frac{a}{2}\sin(\omega t - kx)$ (d) $y = \frac{a}{r}\sin(\omega t - kx)$

6. A stone is dropped into a lake from a tower 500 *metre* high. The sound of the splash will be heard by the man approximately after

(a) 11.5 *sec* (b) 21 *sec* (c) 10 *sec* (d) 14 *sec*

7. The equation of a plane progressive wave is given by $y = 0.25\sin(100\,t + 0.25\,x)$. The frequency of this wave would be

(a) $\frac{50}{\pi}Hz$ (b) $\frac{100}{\pi}Hz$ (c) 100 *Hz* (d) 50 *Hz*

8. The equation of a sound wave is

$$y = 0.0015\sin(62.4\,x + 316\,t)$$

The wavelength of this wave is

(a) 0.2 unit (b) 0.1 unit (c) 0.3 unit (d) Cannot be calculated

9. The equation of a travelling wave is

$$y = 60\cos(1800\,t - 6\,x)$$

where *y* is in microns, *t* in seconds and *x* in meters. The ratio of maximum particle velocity to velocity of wave propagation is

(a) 3.6×10^{-11} (b) 3.6×10^{-6} (c) 3.6×10^{-4} (d) 3.6

10. The wave equation is $y = 0.30\sin(314\,t - 1.57\,x)$ where *t, x* and *y* are in second, meter and centimeter respectively. The speed of the wave is

(a) 100 *m/s* (b) 200 *m/s* (c) 300 *m/s* (d) 400 *m/s*

11. Transverse waves can propagate

(a) Both in a gas and 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

12. The sound carried by air from a sitar to a listener is a wave of the following type

(a) Longitudinal stationary (b) Transverse progressive (c) Transverse stationary (d) Longitudinal progressive

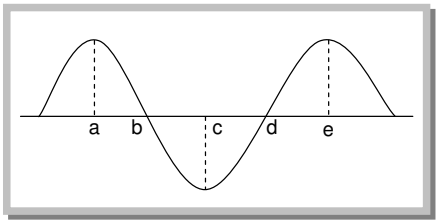
13. A tuning fork produces wave in medium. If the temperature of the medium changes then which of following will change

(a) Time period (b) Wavelength (c) Frequency (d) Amplitude

14. The equation of a longitudinal wave is represented as $y = 20\cos\pi(50\,t - x)$. Its wavelength is

(a) 5 *m* (b) 2 *m* (c) 50 *m* (d) 20 *m*

15. The rope shown at an instant is carrying a wave travelling towards right, created by a source vibrating at a frequency n. Consider the following statements



I. The speed of the wave is $4n \times ab$

II. The medium at a will be in the same phase as d after $\frac{4}{3n}s$

III. The phase difference between b and e is $\frac{3\pi}{2}$

Which of these statements are correct

(a) I, II and III (b) II only (c) I and III (d) III only

16. To increase the frequency from 100 *Hz* to 400 *Hz* the tension in the string has to be changed by

(a) 4 times (b) 16 times (c) 20 times (d) None of these

17. Velocity of sound in air

I. Increases with temperature II. Decreases with temperature

III. Increase with pressure IV. Is independent of pressure

V. Is independent of temperature

Choose the correct answer.

(a) Only I and II are true (b) Only I and III are true (c) Only II and III are true (d) Only I and IV are true

18. At nodes in stationary waves

(a) Change in pressure and density are maximum (b) Change in pressure and density are minimum

(c) Strain is zero (d) Energy is minimum

19. Find the fundamental frequency of a closed pipe, if the length of the air column is 42 *m*. (speed of sound in air = 332 *m/sec*)

(a) 2 *Hz* (b) 4 *Hz* (c) 7 *Hz* (d) 9 *Hz*

20. If *v* is the speed of sound in air then the shortest length of the closed pipe which resonates to a frequency *n*

(a) $\frac{v}{4n}$ (b) $\frac{v}{2n}$ (c) $\frac{2n}{v}$ (d) $\frac{4n}{v}$

21. Two uniform strings *A* and *B* made of steel are made to vibrate under the same tension. if the first overtone of *A* is equal to the second overtone of *B* and if the radius of *A* is twice that of *B*, the ratio of the lengths of the strings is

(a) 1: 2 (b) 1 : 3 (c) 1 : 4 (d) 1 : 6

22. If the length of a stretched string is shortened by 40% and the tension is increased by 44%, then the ratio of the final and initial fundamental frequencies is

(a) 2 : 1 (b) 3 : 2 (c) 3 : 4 (d) 1 : 3

23. Two wires are fixed in a sonometer. Their tensions are in the ratio 8 : 1. The lengths are in the ratio 36 : 35. The diameters are in the ratio 4 : 1. Densities of the materials are in the ratio 1 : 2. If the higher frequency in the setting is 360 *Hz*. the beat frequency when the two wires are sounded together is

(a) 5 (b) 8 (c) 6 (d) 10

24. A metal wire of linear mass density of 9.8 *g/m* is stretched with a tension of 10 *kg* weight between two rigid supports 1 metre apart. The wire passes at its middle point between the poles of a permanent magnet, and it vibrates in resonance when carrying an alternating current of frequency *n*. The frequency n of the alternating source is

(a) 25 *Hz* (b) 50 *Hz* (c) 100 *Hz* (d) 200 *Hz*

25. A tuning fork of known frequency 256 *Hz* makes 5 beats per second with the vibrating string of a piano. The beat frequency decreases to 2 beats per second when the tension in the piano string is slightly increased. The frequency of the piano string before increasing the tension was

(a) 256 + 5 *Hz* (b) 256 + 2*Hz* (c) 256 – 2 *Hz* (d) 256 – 5*Hz*

26. The frequency of fundamental tone in an open organ pipe of length 0.48 *m is* 320 *Hz.* Speed of sound is 320 *m/sec*. Frequency of fundamental tone in closed organ pipe will be

(a) 153.8 *Hz* (b) 160.0 *Hz* (c) 320.0 *Hz* (d) 143.2 *Hz*

27. A sonometer wire resonates with a given tuning fork forming standing waves with five antinodes between the two bridges when a mass of 9 *kg* is suspended from the wire. When this mass is replaced by a mass *M*, the wire resonates with the same tuning fork forming three antinodes for the same positions of the bridges. The value of *M* is

(a) 25 *kg* (b) 5 *kg* (c) 12.5 *kg* (d) 1/25 *kg*

28. The tension of a stretched string is increased by 69%. In order to keep its frequency of vibration constant, its length must be increased by

(a) 20% (b) 30% (c) $\sqrt{69}\%$ (d) 69%

29. Doppler effect is independent of

(a) Distance between source and listener (b) Velocity of source

(c) Velocity of listener (d) None of these

30. A source and an observer approach each other with same velocity 50 *m/s*. If the apparent frequency is 435 s^{-1}, then the real frequency is

(a) 320 s^{-1} (b) 360 s^{-1} (c) 390 s^{-1} (d) 420 s^{-1}

31. A source emits a sound of frequency of 400 *Hz*, but the listener hears it to be 390 *Hz*. Then

(a) The listener is moving towards the source (b) The source is moving towards the listener

(c) The listener is moving away from the source (d) The listener has a defective ear

32. A source and an observer are moving towards each other with a speed equal to $\frac{v}{2}$ where v is the speed of sound. The source is emitting sound of frequency *n*. The frequency heard by the observer will be

(a) Zero (b) n (c) $\frac{n}{3}$ (d) $3n$

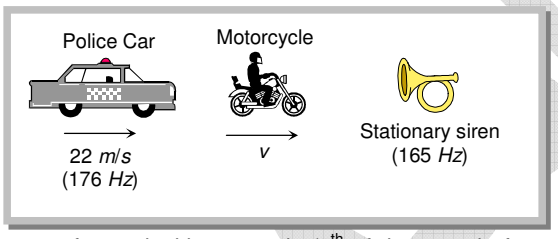
33. A police car moving at 22 *m/s*, chases a motorcyclist. The police man sounds his horn at 176 *Hz*, while both of them move towards a stationary siren of frequency 165 *Hz*. Calculate the speed of the motorcycle, if it is given that he does not observes any beats

(a) 33 *m/s*

(b) 22 *m/s*

(c) Zero

(d) 11 *m/s*



34. An observer moves towards a stationary source of sound with a speed 1/5th of the speed of sound. The wavelength and frequency of the source emitted are λ and f respectively. The apparent frequency and wavelength recorded by the observer are respectively

(a) $1.2f, \lambda$ (b) $f, 1.2\lambda$ (c) $0.8f, 0.8\lambda$ (d) $1.2f, 1.2\lambda$

35. When an engine passes near to a stationary observer then its apparent frequencies occurs in the ratio 5/3. If the velocity of engine is

(a) 540 *m/s* (b) 270 *m/s* (c) 85 *m/s* (d) 52.5 *m/s*

36. A siren placed at a railway platform is emitting sound of frequency 5 *kHz*. *A* passenger sitting in a moving train *A* records a frequency of 5.5 *kHz* while the train approaches the siren. During his return journey in a different train *B* he records a frequency of 6.0 *kHz* while approaching the same siren. The ratio of the velocity of train *B* to that of train *A* is

(a) 242/252 (b) 2 (c) 5/6 (d) 11/6

37. A racing car moving towards a cliff, sounds its horn. The driver observes that the sound reflected from the cliff has a pitch one octave higher than the actual sound of the horn. If v is the velocity of sound, then the velocity of the car is

(a) $v/\sqrt{2}$ (b) $v/2$ (c) $v/3$ (d) $v/4$

38. A person carrying a whistle emitting continuously a note of 272 *Hz* is running towards a reflecting surface with a speed of 18 *km/hour*. The speed of sound in air is 345ms^{-1}. The number of beats heard by him is

(a) 4 (b) 6 (c) 8 (d) 3

39. A bus is moving with a velocity of 5 *m/s* towards a huge wall. the driver sounds a horn of frequency 165 *Hz*. If the speed of sound in air is 355 *m/s*, the number of beats heard per second by a passenger on the bus will be

(a) 6 (b) 5 (c) 3 (d) 4

40. A car sounding a horn of frequency 1000 *Hz* passes an observer. The ratio of frequencies of the horn noted by the observer before and after passing of the car is 11 : 9. If the speed of sound is *v*, the speed of the car is

(a) $\frac{1}{10}v$ (b) $\frac{1}{2}v$ (c) $\frac{1}{5}v$ (d) v

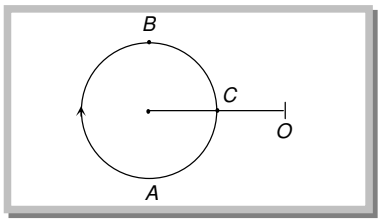
41. What should be the velocity of a sound source moving towards a stationary observer so that apparent frequency is double the actual frequency (Velocity of sound is *v*)

(a) v (b) $2v$ (c) $\frac{v}{2}$ (d) $\frac{v}{4}$

42. Two trains are moving towards each other at speeds of 20 *m/s* and 15 *m/s* relative to the ground. The first train sounds a whistle of frequency 600 *Hz*. the frequency of the whistle heard by a passenger in the second train before the train meets is (the speed of sound in air is 340 *m/s*)

(a) 600 *Hz* (b) 585 *Hz* (c) 645 *Hz* (d) 666 *Hz*

43. A small source of sound moves on a circle as shown in the figure and an observer is sitting on O. Let n_1, n_2 and n_3 be the frequencies heard when the source is at A, B and C respectively. Then



(a) $n_1 > n_2 > n_3$

(b) $n_2 > n_3 > n_1$

(c) $n_1 = n_2 > n_3$

(d) $n_2 > n_1 > n_3$

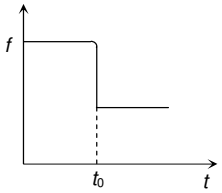
44. Two sirens situated one kilometer apart are producing sound of frequency 330 *Hz*. An observer starts moving from one siren to the other with a speed of 2 *m/s*. If the speed of sound be 330 *m/s*, what will be the beat frequency heard by the observer

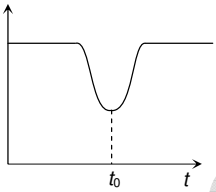
(a) 8 (b) 4 (c) 6 (d) 1

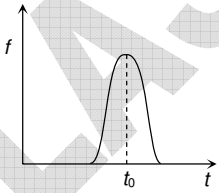
45. Suppose that the speed of sound in air at a given temperature is 400 *m/sec*. An engine blows a whistle at 1200 *Hz* frequency. It is approaching an observer at the speed of 100 *m/sec*. What is the apparent frequency as heard by the observer

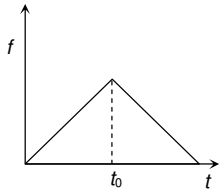
(a) 1600 *Hz* (b) 1500 *Hz* (c) 1200 *Hz* (d) 600 *Hz*

46. A man is standing on a railway platform listening to the whistle of an engine that passes the man at constant speed without stopping. If the engine passes the man at time t_0. How does the frequency f of the whistle as heard by the man changes with time

(a) 

(b) 

(c) 

(d) 

47. A source is moving towards an observer with a speed of 20 *m/s* and having frequency of 240 *Hz*. The observer is now moving towards the source with a speed of 20 *m/s*. Apparent frequency heard by observer, if velocity of sound is 340 *m/s*, is

(a) 240 *Hz* (b) 270 *Hz* (c) 280 *Hz* (d) 360 *Hz*

48. A source and an observer move away from each other with a velocity of 10 *m/s* with respect to ground. If the observer finds the frequency of sound coming from the source as 1950 *Hz*, then actual frequency of the source is (velocity of sound in air = 340 *m/s*)

(a) 1950 *Hz* (b) 2068 *Hz* (c) 2132 *Hz* (d) 2486 *Hz*

49. The phase difference between two waves, represented by

$$y_1 = 10^{-6} \sin[100t + (x/50) + 0.5]m$$

$$y_2 = 10^{-6} \cos[100t + (x/50)]m$$

where *x* is expressed in meters and *t* is expressed in seconds, is approximately

(a) 1.07 radians (b) 2.07 radians (c) 0.5 radians (d) 1.5 radians

50. In forced oscillation of a particle the amplitude is maximum for a frequency ω_1 of the force, while the energy is maximum for a frequency ω_2 of the force, then

(a) $\omega_1 = \omega_2$

(b) $\omega_1 > \omega^2$

(c) $\omega_1 < \omega_2$ when damping is small and $\omega_1 > \omega_2$ when damping is large

(d) $\omega_1 < \omega_2$