Wave and Motion : Vibrations In Strings and Sound Waves– Objective Questions (Typical)

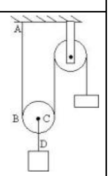
No of Questions:60 **Time Allotted: 6 Hours**

All questions are compulsory

[Note: a. Figures are conceptual only and not to the scale**]**

[b. Solutions may be taken up in Two parts such that Part I: 1 to 30 and Part II: 30 to 60**]**

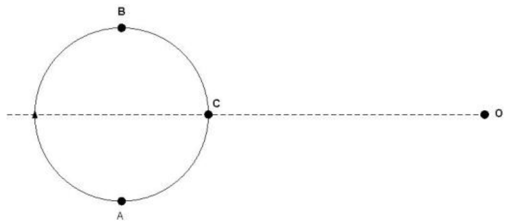
[c. It is advised to attempt question under examination conditions**]**

Q-01	A sine wave is travelling in a medium. The minimum distance between two particles having same speed is – (a) $\frac{\lambda}{4}$ (b) $\frac{\lambda}{34}$ (c) $\frac{\lambda}{2}$ (d) $\frac{\lambda}{4}$
Q-02	A sine wave is travelling in a medium. A particular particle has zero displacement at a certain instant. The particle closest to it having zero displacement is at a distance - (a) $\frac{\lambda}{4}$ (b) $\frac{\lambda}{34}$ (c) $\frac{\lambda}{2}$ (d) $\frac{\lambda}{4}$
Q-03	Which of the following equations represents a sine wave travelling along Y-axis? (a) $x = A\sin(ky - \omega t)$ (b) $x = A\sin(kx - \omega t)$ (c) $x = A\sin ky \cos \omega t$ (d) $x = A\cos ky \sin \omega t$
Q-04	The equation $y = A\sin^2(kx - \omega t)$ represents a wave motion with – (a) Amplitude A, frequency $\frac{\omega}{2\pi}$ (b) Amplitude $\frac{A}{2}$, frequency $\frac{\omega}{\pi}$ (c) Amplitude A, frequency $\frac{\omega}{4\pi}$ (d) Do not represent a wave motion
Q-05	Which of the following is a mechanical wave? (a) Radio wave (b) X-ray (c) Light waves (d) Sound waves
Q-06	A cork floating in a calm pond executes simple harmonic motion if frequency ν when a wave generated by a boat passes by it. The frequency of the wave is – (a) ν(b) $\frac{\nu}{2}$ (c) 2ν (d) $\sqrt{2}\nu$
Q-07	Two strings A and B, made of same material, are stretched by same tension. The radius of string A is double of the radius of the string B. A transverse wave travels on A with speed v_A and on B with speed v_B. The ratio of $\frac{v_A}{v_B}$ is – (a) $\frac{1}{2}$ (b) 2 (c) $\frac{1}{4}$ (d) 4
Q-08	Both the strings, shown in the figure, are made of same material and have same cross-section. The pulleys are light. The wave speed of a transverse wave in the string AB is v_1 and in CD is v_2. Then $\frac{v_1}{v_2}$ is – (a) 1 (b) 2 (c) $\sqrt{2}$ (d) $\frac{1}{\sqrt{2}\nu}$ 

Q-09	Velocity of sound in air is 332 m/s. Its velocity in vacuum will be – (a) >332 m/s (b) =332 m/s (c) <332 m/s (d) meaningless
Q-10	A wave pulse, travelling on a two-piece string, gets partially reflected and partially transmitted at the junction. The reflected wave is inverted in shape as compared to the incident one. If the incident wave has wavelength λ and the transmitted wave λ'- (a) $\lambda' > \lambda$ (b) $\lambda' = \lambda$ (c) $\lambda' < \lambda$ (d) nothing can be said about the relation of λ and λ'.
Q-11	Two waves represented by $y_1 = a\sin(\omega t - kx)$and $y_2 = a\cos(\omega t - kx)$are superimposed. The resultant wave will have an amplitude (a) a (b) $\sqrt{2}a$ (c) $2a$ (d) 0
Q-12	Two wires A and B, having identical geometrical construction, are stretched from their natural length by small but equal amount. The Young's modulus of the wires are Y_A and Y_B whereas the densities are ρ_A and ρ_B. It is given that $Y_A > Y_B$ and $\rho_A > \rho_B$. A transverse signal started at one end takes a time t_1 to reach the other end for A and for t_2 B. (a) $t_1 < t_2$ (b) $t_1 = t_2$ (c) $t_1 > t_2$ (d) The information is insufficient to find the relation between t_1 and t_2
Q-13	Consider two waves passing through the same string. Principle of superimposition for displacement says that the net displacement of a particle on the string is sum of the displacements produced by the two waves individually. Suppose we state similar principles for the net velocity of the particle and the net kinetic energy of the particle. Such a principle will be valid for – (a) Both velocity and the kinetic energy (b) The velocity but not for the kinetic energy (c) The kinetic energy but not for the velocity (d) Neither the velocity nor the kinetic energy.
Q-14	Two wave pulses travel in opposite directions on a string and approach each other. The shape of one pulse is inverted with respect to the other. (a) The pulse will collide with each other and vanish after collision (b) The pulses will reflect from each other i.e. the pulse going towards right will finally move towards left and vice versa (c) The pulses will pass through each other but their shapes will be modified (d) The pulses will pass through each other without any change in their shapes
Q-15	Two periodic waves of amplitudes A_1 and A_2 pass through a region. If $A_1 > A_2$, the difference in the maximum and minimum resultant amplitudes possible is – (a) $2A_1$ (b) $2A_2$ (c) $A_1 + A_2$ (d) $A_1 - A_2$
Q-16	Two waves of equal amplitude A, and equal frequency travel in the same direction in a medium. The amplitudes of the resultant wave is – (a) 0 (b) A (c) $2A$ (d) between 0 and $2A$
Q-17	Two sine waves travel in the same direction in a medium. The amplitude of each wave is A and the phase difference between the two waves is 120^0. The resultant amplitude will be - (a) A (b) $2A$ (c) $4A$ (d) $\sqrt{2}A$
Q-18	The fundamental frequency of a string is proportional to – (a) Inverse of its length (b) The diameter (c) The tension (d) The density
Q-19	A tuning fork of frequency 480 Hz is used to vibrate a sonometer wire having a 240 Hz. The wire will vibrate with a frequency of – (a) 240 Hz (b) 480 Hz (c) 720 Hz (d) Will not vibrate

Q-20	A tuning fork of frequency 480 Hz is used to vibrate a sonometer wire having a natural frequency 410 Hz. The wire will vibrate with a frequency – (a) 410 Hz (b) 480 Hz (c) 820 Hz (d) 960 Hz
Q-21	A sonometer wire of length l vibrates in fundamental mode when excited by a tuning fork of frequency 416 Hz. If length is doubled keeping other things same, the string will – (a) Vibrate with a frequency of 416 Hz. (b) Vibrate with a frequency of 208 Hz (c) Vibrate with a frequency if 832 Hz (d) Stop vibrating.
Q-22	A sonometer wire supports a 4 kg load and vibrates in a fundamental mode with a tuning fork of frequency 416 Hz. The length of the wire between the bridges is now doubled. In order to maintain fundamental mode the load should be changed to – (a) 1 kg (b) 2 kg (c) 8 kg (d) 16 kg
Q-23	A mechanical wave propagates in a medium along the X-axis. The particles of the medium (a) Must move on the X-axis (b) Must move on the Y-axis (c) May move the X-axis (d) May move on the Y-axis
Q-24	A transverse wave travels along the Z-axis. The particles of the medium must move – (a) Along the Z-axis (b) Along the X-axis (c) Along the Y-axis (d) in the X-Y plane
Q-25	Longitudinal waves cannot – (a) Have a unique wavelength (b) Transmit energy (c) Have a unique wave velocity (d) Be polarized
Q-26	A wave going in a solid (a) Must be longitudinal (b) May be longitudinal (c) Must be transverse (d) May be transverse
Q-27	A wave moving in a gas (a) Must be longitudinal (b) May be longitudinal (c) Must be transverse (d) May be transverse
Q-28	Two particles A and B have a phase difference of π when a sine wave passes through a region. (a) A oscillates at half the frequency of B (b) A and B moves in opposite directions (c) A and B must be separated by half of the wavelength. (d) The displacements of A and B have equal magnitudes
Q-29	A wave is represented by an equation: $y = 0.001\text{mm}\sin[(50\text{s}^{-1})t + (2.0\text{m}^{-1})x]$ (a) The wave velocity is 100 m/s (b) The wavelength is 2.0 m (c) The frequency is $\frac{25}{\pi}$ Hz (d) The amplitude is 0.001 mm
Q-30	A standing wave is produced on a string clamped at one end and free at the other. The length of the string (a) Must be an integral multiple of $\frac{\lambda}{4}$ (b) Must be an integral multiple of $\frac{\lambda}{2}$ (c) Must be an integral multiple of λ (d) May be an integral multiple of λ

Q-31	Mark out the correct options – (a) The energy of any small part of a string remains constant in travelling waves (b) The energy of any small part of a string remains constant in standing waves (c) The energies of all the small parts of equal length are equal in travelling waves (d) The energies of all the small parts of equal length are equal in standing waves
Q-32	In stationary wave (a) All the particles of the medium vibrate in phase (b) All the antinodes vibrate in phase (c) The alternate antinodes vibrate in phase (d) All the particles between consecutive nodes vibrate in phase
Q-33	Consider the following statements about sound passing through a gas- (A) The pressure of the gas at a point oscillates in time (B) The position of a small layer of the gas oscillates in time (a) Both A and B are correct (b) A is correct but B is wrong (c) B is correct but A is wrong (d) Both A and B are wrong
Q-34	When we clap our hands, the sound produced is best described by – (a) $p = p_0 \sin(kx - \omega t)$ (b) $p = p_0 \sin kx \cos \omega t$ (c) $p = p_0 \cos kx \sin \omega t$ (d) $p = p_{0n} \sin(k_n x - \omega_n t)$ Here, p denotes the change in pressure from the equilibrium value.
Q-35	The bulk modulus and density of water are greater than those air. With this much of information, we can say that velocity of sound in air – (a) Is larger than its value in water (b) Is smaller than its value in water (c) Is equal to its value in water (d) Cannot be compared with its value in water
Q-36	A tuning fork sends sound waves in air. If the temperature of the air increases, which of the following parameters will change? (a) Displacement amplitude (b) Frequency (c) Wave velocity (d) Time Period
Q-37	When sound wave is refracted from air to water, which of the following will remain unchanged? (a) Wave number (b) Wavelength (c) Wave velocity (d) Frequency
Q-38	The speed of sound in a medium depends on – (a) The elastic property but not on the inertia property (b) The inertia property but not on the elastic property (c) The elastic property as well as inertia property (d) Neither the elastic property nor the inertia property
Q-39	Two sound waves in the same direction in the same medium. The pressure amplitudes of the waves are equal but the wavelength of the first wave is double the second. Let the average power transmitted across a cross-section by the first wave be P_1 and that by the second wave be P_2 . Then – (a) $P_1 = P_2$ (b) $P_1 = 4P_2$ (c) $P_2 = 2P_1$ (d) $P_2 = 4P_1$
Q-40	When two waves with same frequency and constant phase difference interfere, (a) There is a gain of energy (b) There is loss of energy (c) The energy is redistributed and the distribution changes with time (d) The energy is redistributed and the distribution remains constant with time

Q-41	An open organ pipe of length L vibrates in the fundamental mode. The pressure variation is maximum – (a) At two ends (b) At the middle of the pipe (c) At distance $\frac{L}{4}$ inside the ends (d) At distance $\frac{L}{8}$ inside the ends
Q-42	An organ pipe, opens at both ends, contains – (a) Longitudinal stationary waves (b) Longitudinal travelling waves (c) Transverse stationary waves (b) Transverse travelling waves
Q-43	A cylindrical tube, opens at both ends, has a fundamental frequency ν. The tube is dipped vertically in water such that half of its length is inside the water. The new fundamental frequency is – (a) $\frac{\nu}{4}$ (b) $\frac{\nu}{2}$ (c) ν (d) 2ν
Q-44	The phenomenon of beats can take place – (a) For longitudinal waves only (b) For transverse waves only (c) For longitudinal and transverse waves only (d) For sound waves only
Q-45	The tuning fork of frequency 512Hz is vibrated with a sonometer wire and 6 beats per second are heard. The beat frequency reduces if the tension on string is slightly increased. The original frequency vibration of the string is – (a) 506 Hz (b) 512 Hz (c) 518 Hz (d) 524 Hz
Q-46	The engine of a train sounds a whistle at frequency ν. The frequency heard by a passenger is – (a) $> \nu$ (b) $< \nu$ (c) $= \frac{1}{\nu}$ (d) $= \nu$
Q-47	The change on frequency due to Doppler effect does not depend on – (a) The speed of the source (b) The speed of the observer (c) The frequency of the source (d) Separation between the source and the observer
Q-48	A small source of sound moves on a circle as shown in the figure and an observer is sitting at O. Let υ_1, υ_2 and υ_3 be the frequencies heard when the source is at A , B and C respectively. Then (a) $\upsilon_1 > \upsilon_2 > \upsilon_3$ (b) $\upsilon_1 = \upsilon_2 > \upsilon_3$ (c) $\upsilon_2 > \upsilon_3 > \upsilon_1$ (d) $\upsilon_1 > \upsilon_3 > \upsilon_2$ 
Q-49	When you speak to your friend which of the following parameters have a unique value in the sound produced? (a) Frequency (b) Wavelength (c) Amplitude (d) Wave velocity
Q-50	An electrically maintained tuning fork vibrates with constant frequency and constant amplitude. If the temperature of the surrounding air increases but pressure remains constant, the sound produced will have – (a) Larger wavelength (b) Larger Frequency (c) Larger velocity (d) Larger time period
Q-51	The fundamental frequency of a vibrating organ pipe is 200 Hz. (a) The first overtone is 400 Hz (b) The first overtone may be 400 Hz (c) The first overtone may be 600 Hz (d) 600 Hz is an overtone
Q-52	A source of sound moves towards an observer. (a) The frequency of the source is increased (b) The velocity of the sound in the medium is increased

	(c) The wavelength of sound in the medium towards the observer is decreased. (d) The amplitude of vibration of the particle is increased
Q-53	A listener is at rest with respect to the source of sound. A wind starts blowing along the line joining the source and the observer. Which of the following quantities do not change? (a) Frequency (b) Velocity of sound (c) Wavelength (d) Time period
Q-54	A wave represented by an equation $y = a\cos(kx - \omega t)$ is superimposed with another wave to form a stationary wave such that point $x = 0$ is a node. The equation of the other wave is (a) $a\sin(kx + \omega t)$ (b) $-a\cos(kx - \omega t)$ (c) $-a\cos(kx + \omega t)$ (d) $-a\cos(kx - \omega t)$
Q-55	The displacement y of a particle executing periodic is given by $y = 4\cos^2\left(\frac{1}{2}t\right)\sin 1000t$. This expression may be considered to be a result if superimposition of ………. Independent harmonic motions (a) Two (b) Three (c) Four (d) Five
Q-56	An object of specific gravity ρ is hung from a thin steel wire. The fundamental frequency for transverse standing waves in the wire is 300 Hz. The object is immersed in water so that half of its volume is submerged. The new fundamental frequency in Hz is (a) $300\left(\frac{2\rho-1}{2\rho}\right)^{\frac{1}{2}}$ (b) $300\left(\frac{2\rho}{2\rho-1}\right)^{\frac{1}{2}}$ (c) $300\left(\frac{2\rho}{2\rho-1}\right)$ (d) $300\left(\frac{2\rho-1}{2\rho}\right)$
Q-57	The extension in a string, obeying Hooke's Law, is . The speed of transverse wave in the stretched string is v. If extension in the string is increased to $1.5x$ the speed pf transverse wave will be (a) $1.22\,v$ (b) $0.61\,v$ (c) $1.50\,v$ (d) $0.75\,v$
Q-58	A train moves towards a stationary observer with speed 34 m.s^{-1}. The train sounds a whistle and its frequency registered by the observer is f_1. If the train's speed is reduced to 17 m.s^{-1} the frequency registered is f_2. If speed of sound is 340 m.s^{-1} then ratio $\frac{f_1}{f_2}$ is (a) $\frac{18}{19}$ (b) $\frac{1}{2}$ (c) 2 (d) $\frac{19}{18}$
Q-59	A source of sound of frequency 600 Hz is placed inside water. The speed of sound is 1500 m/s and in air it is 300 m/s. The frequency of sound recorded by an observer who is standing in air is (a) 200 Hz (b) 3000 Hz (c) 120 Hz (d) 600 Hz
Q-60	An open pipe is in resonance in 2nd harmonic with frequency f_1. Now one end of the tube is closed and frequency is increased to f_2 such that resonance again occurs in nth harmonic. Choose correct option (a) $n = 3,\ f_2 = \frac{3}{4}f_1$ (b) $n = 3,\ f_2 = \frac{5}{4}f_1$ (c) $n = 5,\ f_2 = \frac{5}{4}f_1$ (d) $n = 5,\ f_2 = \frac{3}{4}f_1$

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