



LifeX Merchant Navy

IMU CET Coaching & Merchant Navy Sponsorship Training

CLASS 11 PHYSICS · NCERT CHAPTER 14 · IMU CET PRACTICE

Waves

Call/WhatsApp: +91 91401 91138

Web: www.lifexmerchantnavy.com

Questions: 45 MCQs

Each question has exactly one correct option. Attempt all questions first, then check the Answer Key and Solutions at the end.

- 1 Sound waves in air are
(A) longitudinal (B) transverse
(C) both longitudinal and transverse (D) electromagnetic
- 2 Transverse waves can propagate through
(A) solids and on the surface of liquids (B) gases only
(C) liquids and gases in bulk (D) vacuum only
- 3 The speed of a wave of frequency 500 Hz and wavelength 0.66 m is
(A) 760 m/s (B) 3300 m/s
(C) 330 m/s (D) 33 m/s
- 4 The equation of a wave is $y = 0.02 \sin(2\pi(100t - 2x))$ (SI). The wavelength is
(A) 0.25 m (B) 2 m
(C) 1 m (D) 0.5 m
- 5 For $y = 0.02 \sin(2\pi(100t - 2x))$ (SI), the speed of the wave is
(A) 200 m/s (B) 50 m/s
(C) 100 m/s (D) 25 m/s
- 6 The speed of a transverse wave on a stretched string of tension T and linear mass density μ is
(A) $\sqrt{(\mu/T)}$ (B) $\sqrt{(T\mu)}$
(C) T/μ (D) $\sqrt{(T/\mu)}$
- 7 If the tension in a string is increased four times, the speed of transverse waves becomes
(A) half (B) unchanged
(C) double (D) four times
- 8 Newton's formula for speed of sound in a gas is $v = \sqrt{P/\rho}$. Laplace's correction changes it to
(A) $\sqrt{(2P/\rho)}$ (B) $\sqrt{(\gamma P/\rho)}$
(C) $\sqrt{(P/\gamma\rho)}$ (D) $\sqrt{(\gamma P/\rho)}$
- 9 The speed of sound in a gas is proportional to
(A) $1/\sqrt{T}$ (B) T^2
(C) $\sqrt{T}$ (D) T



- 10 The speed of sound in air at 0°C is 332 m/s. At 273°C it will be about
(A) 470 m/s (B) 664 m/s
(C) 332 m/s (D) 166 m/s
- 11 The speed of sound in air is independent of
(A) temperature (B) molecular mass of the gas
(C) pressure (at constant temperature) (D) humidity
- 12 Speed of sound is maximum in
(A) air (B) steel
(C) water (D) vacuum
- 13 When a wave is reflected from a rigid boundary, it undergoes a phase change of
(A) π (B) 2π
(C) $\pi/2$ (D) 0
- 14 In a stationary wave, the distance between two consecutive nodes is
(A) λ (B) $\lambda/2$
(C) $\lambda/4$ (D) 2λ
- 15 The distance between a node and the adjacent antinode is
(A) λ (B) $\lambda/2$
(C) $\lambda/4$ (D) $3\lambda/4$
- 16 The fundamental frequency of a string of length L fixed at both ends is
(A) $2v/L$ (B) v/L
(C) $v/4L$ (D) $v/2L$
- 17 A string fixed at both ends vibrates in its third harmonic. The number of nodes (including ends) is
(A) 5 (B) 4
(C) 3 (D) 2
- 18 A closed organ pipe (closed at one end) produces
(A) only odd harmonics (B) all harmonics
(C) no harmonics (D) only even harmonics
- 19 An open organ pipe produces
(A) only the fundamental (B) all harmonics
(C) only even harmonics (D) only odd harmonics
- 20 The fundamental frequency of a closed pipe of length 33 cm ($v = 330$ m/s) is
(A) 125 Hz (B) 1000 Hz
(C) 500 Hz (D) 250 Hz
- 21 The fundamental frequency of an open pipe is f . If one end is closed, the fundamental frequency becomes
(A) $2f$ (B) f
(C) $f/2$ (D) $f/4$



- 22 Two tuning forks of frequencies 256 Hz and 260 Hz are sounded together. The beat frequency is
(A) 516 Hz (B) 4 Hz
(C) 2 Hz (D) 258 Hz
- 23 A tuning fork A produces 5 beats/s with fork B of 512 Hz. On loading A with wax, beats become 3 per second. The original frequency of A is
(A) 507 Hz (B) 517 Hz
(C) 509 Hz (D) 515 Hz
- 24 The phenomenon of beats is due to
(A) reflection
(B) polarisation
(C) diffraction
(D) superposition of two waves of slightly different frequencies
- 25 The apparent change in frequency due to relative motion between source and observer is called
(A) resonance (B) echo
(C) beats (D) Doppler effect
- 26 A source of sound of frequency 500 Hz moves towards a stationary observer at 30 m/s. If $v = 330$ m/s, the apparent frequency is
(A) 500 Hz (B) 550 Hz
(C) 530 Hz (D) 458 Hz
- 27 An observer moves towards a stationary source of frequency 400 Hz at 33 m/s ($v = 330$ m/s). The apparent frequency is
(A) 444 Hz (B) 400 Hz
(C) 440 Hz (D) 360 Hz
- 28 Sound cannot travel through vacuum because
(A) it is a mechanical wave requiring a material medium
(B) vacuum absorbs it
(C) it is an electromagnetic wave
(D) its speed is too low
- 29 The quantity that remains unchanged when sound passes from air into water is
(A) speed (B) frequency
(C) amplitude (D) wavelength
- 30 The wave equation $y = A \sin(\omega t + kx)$ represents a wave travelling
(A) stationary (B) in the negative x-direction
(C) along y-axis (D) in the positive x-direction
- 31 Stationary waves are formed by superposition of two waves of the same frequency and amplitude travelling in
(A) opposite directions (B) perpendicular directions
(C) any direction (D) the same direction



- 32** In a stationary wave, energy
(A) is maximum at nodes
(C) is not transported along the medium
(B) travels with the speed of sound
(D) travels from node to node
- 33** The second overtone of an open pipe is the
(A) second harmonic
(C) fourth harmonic
(B) third harmonic
(D) fifth harmonic
- 34** The first overtone of a closed pipe is the
(A) fourth harmonic
(C) fifth harmonic
(B) second harmonic
(D) third harmonic
- 35** A wire under tension vibrates with fundamental frequency 200 Hz. If its length is halved keeping tension constant, the fundamental frequency becomes
(A) 400 Hz
(C) 200 Hz
(B) 100 Hz
(D) 800 Hz
- 36** Echo is heard if the reflecting surface is at least about ___ away ($v = 340$ m/s, persistence of hearing 0.1 s).
(A) 17 m
(C) 34 m
(B) 10 m
(D) 170 m
- 37** The intensity of a wave is proportional to
(A) square root of amplitude
(C) cube of amplitude
(B) amplitude
(D) square of amplitude
- 38** The equation $y = 4 \sin(\pi x/15) \cos(96\pi t)$ (SI) represents
(A) a progressive wave along $-x$
(C) a stationary wave
(B) a progressive wave along $+x$
(D) a pulse
- 39** In a closed organ pipe resonating with its fundamental, there is
(A) nodes at both ends
(B) antinodes at both ends
(C) an antinode at the closed end
(D) a node at the closed end and an antinode at the open end
- 40** A sonometer wire resonates with a tuning fork. If the length is increased by 10% at constant tension, the frequency changes by about
(A) +10%
(C) -9%
(B) +9%
(D) -10% exactly
- 41** The speed of sound in hydrogen compared to oxygen at the same temperature is
(A) 1/4 times
(C) 4 times
(B) equal
(D) 16 times
- 42** The audible frequency range for humans is about
(A) 20 Hz to 20 kHz
(C) 20 kHz to 200 kHz
(B) 0 to 20 Hz
(D) 2 Hz to 2 kHz



- 43** Ultrasonic waves are used in SONAR on ships because they
- (A) are electromagnetic waves
 - (B) travel faster than ordinary sound
 - (C) cannot be reflected
 - (D) have short wavelength and can be directed as a narrow beam
-
- 44** A pipe open at both ends has its fundamental at 300 Hz. The frequency of the next higher harmonic is
- | | |
|------------|------------|
| (A) 600 Hz | (B) 450 Hz |
| (C) 150 Hz | (D) 900 Hz |
-
- 45** A closed pipe has fundamental at 200 Hz. The next higher resonant frequency is
- | | |
|------------|------------|
| (A) 600 Hz | (B) 300 Hz |
| (C) 400 Hz | (D) 800 Hz |
-

Answer Key

1	2	3	4	5	6	7	8	9	10
A	A	C	D	B	D	C	D	C	A
11	12	13	14	15	16	17	18	19	20
C	B	A	B	C	D	B	A	B	D
21	22	23	24	25	26	27	28	29	30
C	B	B	D	D	B	C	A	B	B
31	32	33	34	35	36	37	38	39	40
A	C	B	D	A	A	D	C	D	C
41	42	43	44	45					
C	A	D	A	A					

Hints & Solutions

- (A)** Air supports only compressions and rarefactions, so sound in air is longitudinal.
- (A)** Transverse mechanical waves need shear rigidity, available in solids (and surface waves on liquids).
- (C)** $v = f\lambda = 500 \times 0.66 = 330 \text{ m/s}$.
- (D)** $k = 2\pi \times 2 = 4\pi \rightarrow \lambda = 2\pi/k = 0.5 \text{ m}$.
- (B)** $v = \omega/k = (200\pi)/(4\pi) = 50 \text{ m/s}$.
- (D)** $v = \sqrt{T/\mu}$.
- (C)** $v \propto \sqrt{T} \rightarrow 2v$.
- (D)** Sound propagation is adiabatic, so the adiabatic bulk modulus γP replaces P .
- (C)** $v = \sqrt{(\gamma RT/M)} \propto \sqrt{T}$.
- (A)** $v \propto \sqrt{T} \rightarrow 332 \times \sqrt{(546/273)} = 332 \times 1.414 \approx 470 \text{ m/s}$.
- (C)** At constant T , P/ρ is constant, so changing pressure alone does not change v .
- (B)** Solids have very high elastic moduli; $v_{\text{steel}} \approx 5000 \text{ m/s}$.
- (A)** At a fixed end, the reflected pulse is inverted (phase change π).
- (B)** Nodes are separated by half a wavelength.
- (C)** Node to antinode $= \lambda/4$.
- (D)** $L = \lambda/2 \rightarrow f_1 = v/2L$.
- (B)** Third harmonic has 3 loops $\rightarrow$ 4 nodes, 3 antinodes.
- (A)** $f = (2n - 1)v/4L$ — only odd multiples of the fundamental.
- (B)** $f = nv/2L$, $n = 1, 2, 3, \dots$
- (D)** $f = v/4L = 330/(4 \times 0.33) = 250 \text{ Hz}$.
- (C)** Open: $v/2L$; closed: $v/4L = f/2$.
- (B)** Beat frequency $= |f_1 - f_2| = 4 \text{ Hz}$.
- (B)** $A = 512 \pm 5$. Loading lowers A's frequency; beats decrease only if A was above B. So $A = 517 \text{ Hz}$.

24. (D) Interference in time of two close frequencies produces periodic waxing and waning.
25. (D) Definition of the Doppler effect.
26. (B) $f' = f_v/(v - v_s) = 500 \times 330/300 = 550 \text{ Hz}$.
27. (C) $f' = f(v + v_o)/v = 400 \times 363/330 = 440 \text{ Hz}$.
28. (A) Mechanical waves need particles of a medium to propagate.
29. (B) Frequency is set by the source; speed and wavelength change in the new medium.
30. (B) $(\omega t + kx) \rightarrow$ phase constant as x decreases with t , so the wave moves along $-x$.
31. (A) Two counter-propagating identical waves create a standing wave.
32. (C) There is no net energy flow; energy oscillates locally between KE and PE.
33. (B) Open pipe: fundamental = 1st harmonic, 1st overtone = 2nd harmonic, 2nd overtone = 3rd harmonic.
34. (D) Closed pipe has only odd harmonics: overtones are 3rd, 5th, ...
35. (A) $f \propto 1/L \rightarrow 400 \text{ Hz}$.
36. (A) $2d = vt \rightarrow d = 340 \times 0.1/2 = 17 \text{ m}$.
37. (D) $I \propto A^2\omega^2$.
38. (C) The product of a space-only function and a time-only function represents a standing wave.
39. (D) Air cannot move at the closed end (displacement node); it moves freely at the open end (antinode).
40. (C) $f \propto 1/L \rightarrow f' = f/1.1 = 0.909f$, a decrease of about 9%.
41. (C) $v \propto 1/\sqrt{M}$ (same γ for both diatomic gases) $\rightarrow \sqrt{(32/2)} = 4$.
42. (A) Below 20 Hz is infrasonic and above 20 kHz is ultrasonic.
43. (D) High frequency means small wavelength, low diffraction and good directionality for detecting underwater objects.
44. (A) Open pipe: $f, 2f, 3f \dots \rightarrow 600 \text{ Hz}$.
45. (A) Closed pipe: $f, 3f, 5f \dots \rightarrow 600 \text{ Hz}$.

Preparing for IMU CET & Merchant Navy Sponsorship?

Join LifeX Merchant Navy — IPP (offline), AIM (online), Interview Intensive, PSP/ASP sponsorship guidance & Test Series.

Call/WhatsApp: +91 91401 91138 | www.lifexmerchantnavy.com