SAMPLE CONTENT

MHT-CET

TRIUMPH

PHYSICS

PART 1

BASED ON THE LATEST SYLLABUS OF MHT-CET

2193 MCQs

In skiing, skiers when making a carving turn bring their center of mass to the inside of the turn to balance the centripetal force and avoid tumbling.

Std. XI

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Target Publications® Pvt. Ltd.

Written in accordance with the latest MHT-CET Paper Pattern prescribed by State Common Entrance Test Cell, Maharashtra State

MHT-CET TRIUMPH

PHYSICS

2193 MCQs

Based on the latest Syllabus of MHT-CET

PART 1 Std. XI

Salient Features

- Includes relevant chapters of Std. XI as per the latest MHT-CET Syllabus
- Includes '2193' MCQs
- Quick Review and exhaustive subtopic wise coverage of MCQs
- Compilation of all 'Important Formulae' & 'Fundamental Constants' in relevant chapters
- Solved Previous Years' MHT-CET questions till 2023
- Evaluation Test for each chapter
- Includes **Smart Keys** (Key Notes For Good Practice, Shortcuts, Mindbenders, Caution, Thinking Hatke)
- 'Real-world applications' in each chapter
- Special inclusion: 'The physics of ….' to engage students in scientific enquiry.
- Video/pdf links via QR codes for boosting conceptual retention
- Answer keys for all the chapters and Evaluation Tests at the end of book
- *Solutions to MCQs and Evaluation Test can be accessed through Q.R. code given at the end of each chapter*

Printed at: **Print to Print,** Mumbai

Balbharati Registration No.: 2018MH0022 P.O. No. 9998

TEID: 3247

PREFACE

"Don't follow your dreams; chase them!" A quote by Richard Dumbrill is perhaps the most pertinent for one who is aiming to crack entrance examinations held after Std. XII. We are aware of the aggressive competition a student appearing for such career-defining examinations experiences and hence wanted to create books that develop the necessary knowledge, tools, and skills required to excel in these examinations.

For the syllabus of **MHT-CET**, 80% of the weightage is given to the syllabus for XIIth standard while only 20% is given to the syllabus for XIth standard (with inclusion of only selected topics).

We believe that although the syllabus for Std. XII and XI and MHT-CET is aligned, the outlook for studying the subject should be altered based on the nature of the examination. To score well in the MHT-CET, a student has to be not just good with the concepts but also quick to complete the test successfully. Such ingenuity can be developed through sincere learning and dedicated practice.

As a first step to MCQ solving, students should start with elementary questions. Once momentum is gained, complex MCQs with a higher level of difficulty should be practised. Such holistic preparation is the key to succeeding in the examination!

Target's **Triumph MHT-CET Physics Standard XI** book which covers relevant chapters of Std. XI has been designed to achieve the above objectives. Beginning with basic MCQs, the book proceeds to develop competence to solve complex MCQs. It offers ample practice of recent questions from MHT-CET examinations. It also includes solutions (via QR codes) that provide explanations to help students learn how to solve the MCQs.

The sections of **Quick Review, Formulae, Fundamental Constants** and **MCQs (Classical, Critical, Concept Fusion, Previous Years' MHT-CET Questions, Evaluation Test)** form the backbone of every chapter and ensure adequate revision.

To optimise learning efficiency, multiple study techniques are included in every chapter in the form of **Smart Keys** *(Key Notes For Good Practice, Shortcuts, Mindbenders, Caution, Thinking Hatke)*.

All the features of this book pave the way for a student to excel in the examination. The features are designed keeping the following elements in mind: Time management, easy memorization or revision, and non-conventional yet simple methods for MCQ solving. The features of the book presented on the next page will explain more about them!

We hope the book benefits the learner as we have envisioned.

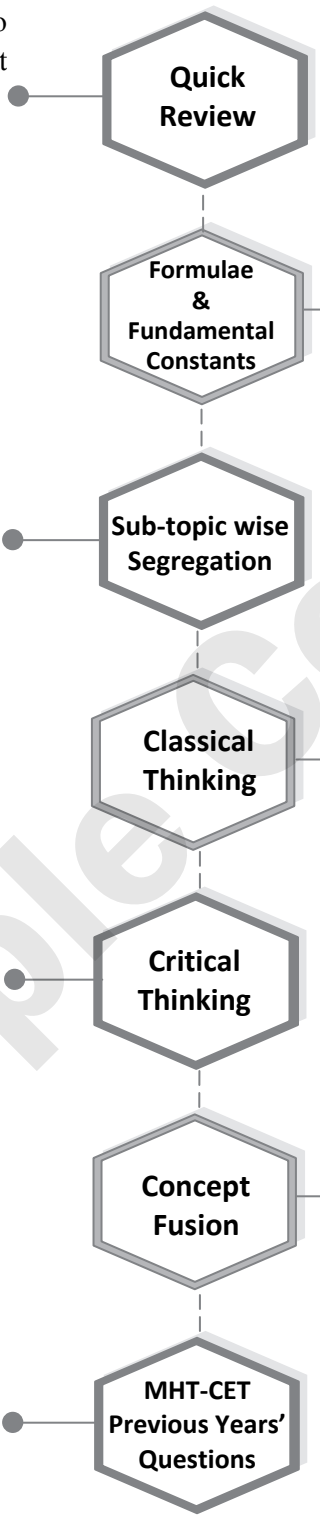
Publisher
Edition: Second

The journey to create a complete book is strewn with triumphs, failures and near misses. If you think we've nearly missed something or want to applaud us for our triumphs, we'd love to hear from you.

Please write to us on: mail@targetpublications.org

FEATURES

Quick Review includes tables/charts to summarize the key points of important concepts in the chapter.
This is our attempt to help students to reinforce key concepts.



Formulae & Fundamental Constants cover all of the key formulae and constants in the chapter.
This is our attempt to make tools of formulae and constants accessible for students while solving problems and revising at last minute at a glance.

Every section is **segregated sub-topic wise.**
This is our attempt to cater to individualistic pace and preferences of studying a chapter in students and enable easy assimilation of questions based on the specific concept.

Classical Thinking section encompasses straight forward questions including knowledge based questions.
This is our attempt to revise chapter in its basic form and warm up students to deal with complex MCQs.

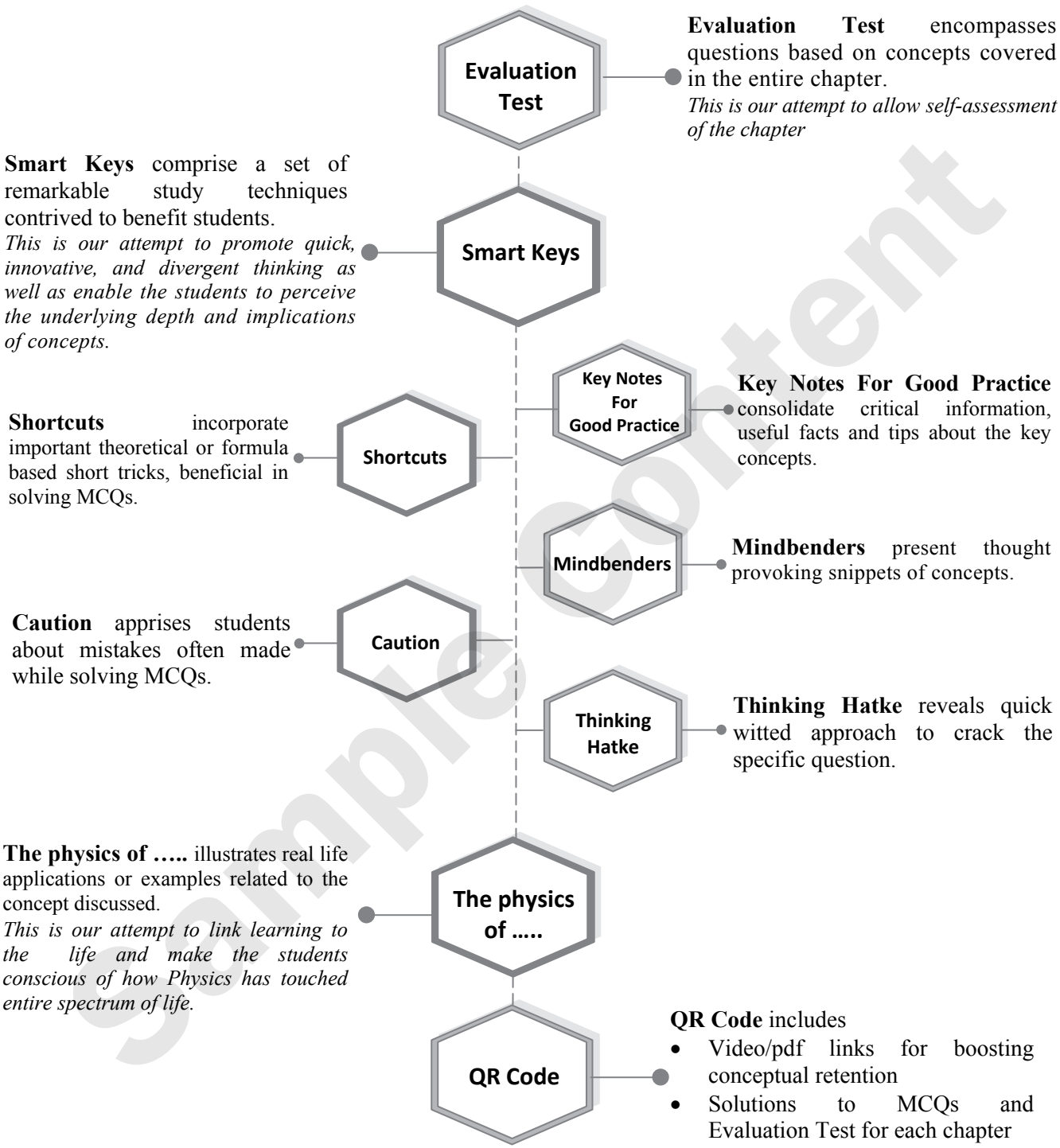
Critical Thinking section encompasses challenging questions which test understanding, rational thinking and application skills of students.
This is our attempt to take students from beginner to proficient level in smooth steps.

Concept Fusion section encompasses questions whose solutions require knowledge of concepts covered in different sub-topics of same chapter or from different chapters.
This is our attempt to develop cognitive thinking in the students essential to solve questions involving fusion of multiple key concepts.

MHT-CET Previous Years' Questions section encompasses questions from MHT-CET examinations.
This is our attempt to give students practice of MHT-CET questions and advance them to acquire knack essential to solve such questions.

Continued…

FEATURES



MHT-CET PAPER PATTERN

- There will be three papers of Multiple Choice Questions (MCQs) in 'Mathematics', 'Physics and Chemistry' and 'Biology' of 100 marks each.
- Duration of each paper will be 90 minutes.
- Questions will be based on the syllabus prescribed by Maharashtra State Board of Secondary and Higher Secondary Education with approximately 20% weightage given to Std. XI and 80% weightage will be given to Std. XII curriculum.
- Difficulty level of questions will be at par with JEE (Main) for Mathematics, Physics, Chemistry and at par with NEET for Biology.
- There will be no negative marking.
- Questions will be mainly application based.
- Details of the papers are as given below:

Paper	Subject	Approximate No. of Multiple Choice Questions (MCQs) based on		Mark(s) Per Question	Total Marks
		Std. XI	Std. XII		
Paper I	Mathematics	10	40	2	100
Paper II	Physics	10	40	1	100
	Chemistry	10	40		
Paper III	Biology	20	80	1	100

- Questions will be set on
  i. the entire syllabus of Std. XII of Physics, Chemistry, Mathematics and Biology subjects prescribed by Maharashtra Bureau of Textbook Production and curriculum Research, Pune, and
  ii. chapters / units from Std. XI curriculum as mentioned below:

Sr. No.	Subject	Chapters / Units of Std. XI
1	Physics	Motion in a plane, Laws of motion, Gravitation, Thermal properties of matter, Sound, Optics, Electrostatics, Semiconductors
2	Chemistry	Some Basic Concepts of Chemistry, Structure of Atom, Chemical Bonding, Redox Reactions, Elements of Group 1 and Group 2, States of Matter: Gaseous and Liquid States, Basic Principles of Organic Chemistry, Adsorption and Colloids, Hydrocarbons
3	Mathematics	Trigonometry - II, Straight Line, Circle, Measures of Dispersion, Probability, Complex Numbers, Permutations and Combinations, Functions, Limits, Continuity
4	Biology	Biomolecules, Respiration and Energy Transfer, Human Nutrition, Excretion and osmoregulation

CONTENTS

Chapter

8
Sound

The Whispering Gallery

The unique acoustic specialty of Gol Gumbaz is the whispering gallery, a circular gallery located at the base of the dome.
When a sound is produced in the whispering gallery, it gets reflected multiple times around the circular gallery before it reaches the opposite end, which is over 37 metres away. Due to the unique shape and acoustics of the gallery, even a faint whisper at one end can be heard clearly at the other end, despite the vast distance between them.

Chapter Outline

Key Notes For Good Practice

- *In stationary waves, there is no transportation of energy. All the points vibrate with the same period but amplitude changes from 0 to max.*
- *Sound travels faster in humid air (rainy season) than in dry air (summer) at the same temperature because* $\left(\rho_{\text{moist air}} < \rho_{\text{dry air}}\right)$
- *All other factors like phase, loudness, pitch, quality etc. have practically no effect on velocity of sound.*
- *The amplitude normally does not affect the velocity of sound. However, if the amplitude is too large, the velocity of sound increases slightly.*
- *Intensity of sound in* CO_2 *is greater than that in air, because density of carbon dioxide is greater than density of air.*
- *The length of a musical instrument reflects the range of frequencies over which the instrument is designed to function. Smaller lengths imply higher frequencies.*
- *In any instrument producing musical sound, the fundamental note and one or more of the higher harmonics are usually generated simultaneously. We hear them superposed as a net wave. As different instruments produce different net waves they sound different to us even when they are played at the same fundamental frequency.*
- *The term "beats frequency" refers to a phenomenon that occurs when two sound waves with slightly different frequencies are played simultaneously. When these waves interact, they produce a periodic variation in the loudness or intensity of resulting sound. This variation is known as "beats". The beats frequency equal to the absolute value of the difference between the frequencies of two original sound waves.*
- *When an object moves with a velocity greater than that of sound, it is termed as supersonic. When such a supersonic body travels in air, it produces energetic disturbances which moves in backward direction and diverges in the form of a cone. Such a disturbance is called shock wave.*

Quick Review

➢ **Types of Waves:**

Waves

- **Mechanical Waves**: They require a medium to propagate. Example: Sound wave.
- **Electro–magnetic Waves**: The waves generated due to periodic oscillation of mutually perpendicular electric and magnetic fields.
- **Progressive Wave**: Waves in which a disturbance created at one place travels to distant points and keeps travelling unless stopped by an external force are known as travelling or progressive waves.
- **Matter Waves**: The waves associated with a moving particle are called matter wave.
- **Stationary Waves**

Types

- **Transverse waves**: Particles of the medium vibrate in a direction perpendicular to the direction of propagation of the wave. **Example:** Light waves
- **Longitudinal wave**: A wave in which particles of medium vibrate in a direction parallel to the direction of propagation of the wave is called longitudinal wave. **Example:** Sound Waves

Characteristics of Waves

Phase	The state of oscillation of a particle is called its phase.
Double periodicity	Wave is periodic in time and space.
Frequency (n)	The number of vibrations performed by a particle per second
Wavelength (λ)	The distance between two successive particles which are in the same state of vibration
Period (T)	The time taken by the particle of a medium to complete one vibration.
Velocity (v)	The distance covered by a wave per unit time.
Amplitude (A)	The largest displacement of a particle of a medium through which the wave is propagating, from its rest position

➢ **Factors affecting velocity of sound:**

Factors affecting velcoity of sound

1. **Pressure** — Independent of pressure if temperature is constant
2. **Humidity** — Speed increases with moistness of air.
3. **Temperatuer** — $v \propto \sqrt{T}$; As T ↑, v ↑

➢ **Common characteristics of a medium transmitting sound wave:**

CHARACTERISTICS

- **Inertia:** This helps particles to store energy and oscillate about their mean position.
- **Uniform density:** This helps waves to have a unifom velocity.
- **Elasticity:** This helps particles to return to their mean position after being displaced.
- **Less friction:** This helps particles not to lose energy.

➢ **Phenomena based on sound:**

Phenomena based on sound

1. **Ecbo** (Repetition of sound due to reflection)
2. **Reverberation** (Multiple reflections of sound)
3. **Doppler effect** (Apparent change in frequency of sound heard by listener due to relative motion between source and listener)

➢ **Qualities of sound:**

Qualities of sound

- **Pitch** (high frequency, high pitch)
- **Timbre** (quality of sound)
- **Loundness** (measure of intensity of sound)

Formulae

1. Relation between v, n and λ:

i. $v = n\lambda$ ii. $v = \frac{\lambda}{T}$

2. Wavelength:

i. $\lambda = \frac{v}{n}$ ii. $\lambda = vt$

3. Velocity of sound wave:

i. Newton's formula: $v = \sqrt{\frac{E}{\rho}}$

ii. Laplace's formula:

$v = \sqrt{\frac{\gamma P}{\rho}}$ (In gases) where $\gamma = \frac{c_P}{c_V}$

iii. $v = \sqrt{\frac{\gamma PV}{M}} = \sqrt{\frac{\gamma nRT}{M}}$

4. Factors affecting velocity of sound:

i. Density: $v \propto \frac{1}{\sqrt{\rho}}$ i.e., $\frac{v_1}{v_2} = \sqrt{\frac{\rho_2}{\rho_1}}$

ii. Temperature: $v \propto \sqrt{T}$

i.e., $\frac{v_1}{v_2} = \sqrt{\frac{T_1}{T_2}} = \sqrt{\frac{273 + t_1}{273 + t_2}}$

5. Velocity of sound at t °C:

$v_t = v_0 \sqrt{\left(1 + \frac{t}{273}\right)}$

6. Loudness of sound:

$$L_{bel} = \log_{10}\left(\frac{I}{I_0}\right)$$

7. Doppler formula for apparent frequency:

i. Source approaching a stationary Listener, $n = n_0\left(\frac{v}{v - v_S}\right)$

ii. Source receding from a stationary observer, $n = n_0\left(\frac{v}{v + v_s}\right)$

iii. Listener approaching a stationary source, $n = n_0\left(\frac{v + v_L}{v}\right)$

iv. Listener receding from a stationary source, $n = n_0\left(\frac{v - v_L}{v}\right)$

v. Both source and Listener approaching each other, $n = n_0\left(\frac{v + v_L}{v - v_s}\right)$

vi. Both source and Listener receding from each other, $n = n_0\left(\frac{v - v_L}{v + v_s}\right)$

Fundamental Constant in This Chapter

1.	Velocity of sound in air at N. T. P. (v)	332 m/s

Shortcuts

1. To find the velocity of sound at any temperature t °C use the formula, $v = v_0 + (0.61)t$

2. When listener or source moves towards other, there is a **shift up** in frequency and whenever they move away from other , there is a **shift down** in frequency.

Mindbenders

1. A mechanical wave shall be transverse or longitudinal depending on the

i. nature of the medium ii. mode of excitation of vibration

For example, in solids, both transverse and longitudinal waves can propagate. This is because solids can sustain both, the shearing strain as well as compressional strain. On strings, mechanical waves are always transverse. Gases can sustain only compressional strain and not the shearing strain. Therefore, only longitudinal waves can pass through air and other gases.

2. Ripple is neither transverse wave nor longitudinal wave but occurs due to combination of these two waves.

3. If two or more persons are speaking simultaneously, we hear each of them due to an important property that "when two or more waves cross each other they are not affected in any way."

4. If two sounds of equal frequency are sounded together we hear a loud sound of constant frequency.

5. Sound produced in air is not heard by the diver inside the water because majority of sound energy is reflected from the water surface.

6. For sound waves $v_w > v_a$. Therefore, in travelling from air to water, a beam of sound bends away from normal, whereas a beam of light bends towards the normal.

7. The formula for velocity of sound does not involve frequency or wavelength. Hence sound of any frequency or wavelength travels through a given medium with the same velocity.

8. Although the densities of solids and liquids are higher than gases, speed of sound in solids > speed of sound in liquids > speed of sound in gases. This is because liquids and solids are less compressible than gases, i.e., liquids and solids have much greater bulk modulus than that of gases.

9. Doppler shift is a little greater when the source is approaching to the listener than when the listener is approaching to the source with the same speed.

Classical Thinking

8.1 Introduction

1. Oscillator transfers _____.
(A) energy (B) particles
(C) electric effect (D) magnetic effect

2. Which of the following is NOT correct condition for the propagation of mechanical wave through a medium?
(A) medium should be elastic.
(B) medium should possess inertia.
(C) medium should possess negligible frictional resistance.
(D) medium should be perfectly plastic.

3. Which of the following is not an example of mechanical waves?
(A) Radio waves
(B) Sound waves
(C) Waves on stretched string
(D) Waves on the water surface

4. Which of the following waves do not require material medium for propagation?
(A) wave of string (B) light waves
(C) sound waves (D) sea waves

5. Sound is a form of energy for which
(A) medium is necessary for its propagation.
(B) medium is not necessary for its propagation.
(C) source of sound is not necessary for its propagation.
(D) vacuum is necessary for its propagation.

6. For propagation of sound waves medium should be _____.
(A) elastic
(B) plastic
(C) denser
(D) chemically ionized

8.2 Common Properties of All Waves

1. The maximum displacement of vibrating particle from its mean position is called as _____.
(A) displacement
(B) amplitude
(C) distance covered
(D) path length

2. Each particle of the medium vibrates with _____ amplitude.
(A) same (B) decreasing
(C) increasing (D) unequal

3. The distance covered by the disturbance (wave) per second is called _____.
(A) velocity of wave
(B) velocity of particle
(C) velocity of medium
(D) speed of medium

4. When wave changes the medium, the _____ does not change.
(A) speed (B) wavelength
(C) frequency (D) amplitude

5. Wave motion is periodic in _____.
(A) space only
(B) time only
(C) both space and time
(D) direction

6. Progressive waves in a vibrating medium have same _____.
(A) amplitude
(B) period
(C) frequency
(D) distribution of particles

7. **Assertion:** Speed of wave = $\frac{\text{Wavelength}}{\text{Time period}}$

Reason: Wavelength is the distance between two nearest particles in phase.
(A) Assertion is True, Reason is True; Reason is a correct explanation for Assertion
(B) Assertion is True, Reason is True; Reason is not a correct explanation for Assertion
(C) Assertion is True, Reason is False
(D) Assertion is False, Reason is False.

8. The radio station broadcasts is at wavelength of 200 m. The speed of the radio waves is 3×10^8 m/s. The frequency for tuning radio station is
(A) 1.5×10^8 Hz (B) 1.5×10^6 Hz
(C) 6×10^6 Hz (D) 0.7×10^{-6} Hz

9. The audible frequency range of human ear is 20 Hz and 20 kHz. The corresponding wavelength range is
[speed of sound in air = 340 m/s]
(A) 17×10^{-3} m to 17 m
(B) 17×10^{-2} m to 1.7 m
(C) 0.17 m to 17 m
(D) 17 m to 17×10^{-3} m

10. A bat emits ultrasonic sound of frequency 100 kHz. If this sound meets a water surface what is the wavelength of the transmitted sound in air and water respectively?
[speed of sound in air = 340 m s^{-1} and in water = 1,486 m s^{-1}]
(A) 1.486×10^{-2} m, 3.40×10^{-3} m
(B) 3.40×10^{-3} m, 1.486×10^{-2} m
(C) 1.486 m, 3.4 m
(D) 3.4 m, 1.486 m

11. A hospital uses an ultrasonic scanner to locate tumours in a tissue. The operating frequency of the scanner is 4.2 MHz. The speed of sound in a tissue is 1.7 km s^{-1}. The wavelength of the sound in the tissue is close to
(A) 4×10^{-4} m (B) 8×10^{-4} m
(C) 4×10^{-3} m (D) 8×10^{-3} m

12. A source of frequency 500 Hz produces waves. If wavelength is 0.1 m, the waves travel distance of 300 m in
(A) 7.2 s (B) 6 s
(C) 3.6 s (D) 0.6 s

8.3 Transverse Waves and Longitudinal Waves

1. The transverse sound waves are produced in
(A) both gases and solids.
(B) neither in the gases nor in the solids.
(C) the gases but not in solids.
(D) the solids but not in gases.

2. In transverse waves, particles of the medium vibrate
(A) perpendicular to the direction of propagation of waves.
(B) parallel to the direction of propagation of waves.
(C) at 30° with the direction of propagation of waves.
(D) at 45° with the direction of propagation of waves.

3. The convex part of the transverse wave is
(A) trough (B) crest
(C) half distance (D) half wave length

4. In longitudinal waves, the region where particles are less crowded are known as
(A) compression (B) condensation
(C) extension (D) propagation

5. In the formation of longitudinal wave 1st particle communicate disturbance to next particle in terms of time T (periodic time) is
(A) $\frac{T}{2}$ (B) $\frac{3T}{4}$ (C) $\frac{T}{4}$ (D) $\frac{T}{8}$

6. In the formation of transverse wave, 1st particle will transfer the disturbance to 6th particle in terms of time T (periodic time)
(A) $\frac{T}{8}$ (B) $\frac{3T}{8}$
(C) $\frac{5T}{8}$ (D) $\frac{7T}{8}$

7. Longitudinal wave creates _____.
(A) crests and troughs
(B) crests and compressions
(C) troughs and rarefactions
(D) compressions and rarefactions

8. Transverse wave has following directions to observe, identify CORRECT one.
(A) Wave travels along z-axis, particles of the medium travel in x-y plane
(B) Wave travels along x-axis, particles of medium travel in x-z plane
(C) Wave travels along z-axis, particles of the medium travel in y-z plane
(D) Wave travels along x-axis, particles of the medium travel in x-y plane

9. When transverse waves advance through a medium
(A) there is change of pressure and density at any point of the medium.
(B) there is no change of pressure and density at any point of the medium.
(C) there is only change of pressure but not density at any point of the medium.
(D) there is only change in density but not pressure.

10. The transverse wave can travel through _____.
(A) gases (B) liquids
(C) fluids (D) solids

11. Compression is the region where particles of the medium are _____.
(A) far apart (B) crowded
(C) equispaced (D) few

12. Distance between any two successive compression or rarefaction in longitudinal wave is _____.
(A) wave number (B) wave velocity
(C) waveform (D) wavelength

13. When longitudinal wave advances through a medium
(A) there is uniformity in pressure and density along the path of wave.
(B) there is variation in pressure and density along the path of wave.
(C) pressure varies but density remains uniform.
(D) density varies but pressure remains uniform.

14. Longitudinal waves cannot be polarised because
(A) direction of vibration of particles and direction of propagation of wave is same.
(B) direction of vibration of particles and direction of propagation of wave is different.
(C) direction of vibrations of particles remains same whereas propagation of waves is different.
(D) direction of vibration of particles and direction of propagation of wave is opposite.

15. When a longitudinal wave travels in a medium then the quantity/ies propagating in the direction of propagation is/are _____.
(A) energy
(B) energy and mass
(C) mass and momentum
(D) momentum and energy

16. Vibrating tuning fork explains compression and rarefaction as below. Choose incorrect statement.
(A) Prongs of fork produce vibrations.
(B) Vibrations bring prongs toward each other thereby creating rarefaction.
(C) When prongs are outwards there is compression.
(D) The waves generated are transverse.

17. The property that distinguishes longitudinal waves from transverse waves is that
(A) longitudinal waves carry energy.
(B) particles of longitudinal waves oscillate.
(C) longitudinal waves cannot be polarised.
(D) longitudinal waves pass through solids.

18. To propagate both longitudinal and transverse waves, a material must have
(A) Bulk and shear moduli
(B) Only bulk modulus
(C) Only shear modulus
(D) Young's and Bulk modulus

8.4 Mathematical expression of a wave

1. A transverse wave of amplitude 0.5 m and wavelength 1 m and frequency 2 Hz is propagating in a string in the negative x-direction. The expression for this wave is
(A) $y(x, t) = 0.5 \sin(2\pi x - 4\pi t)$
(B) $y(x, t) = 0.5 \cos(2\pi x + 4\pi t)$
(C) $y(x, t) = 0.5 \sin(\pi x - 2\pi t)$
(D) $y(x, t) = 0.5 \cos(2\pi x + 2\pi t)$

2. The equation of a sound wave is $y = 0.0015 \sin (62.4x + 316 t)$. The wavelength of this wave is
(A) 0.2 unit
(B) 0.1 unit
(C) 0.3 unit
(D) Cannot be calculated

3. A wave equation which gives the displacement along y-direction is given by $y = 0.001 \sin (100t + x)$ where x and y are in metre and t is time in second. This represented a wave
(A) Of frequency $100/\pi$ Hz
(B) Of wavelength one metre
(C) Travelling with a velocity of $50/\pi$ ms^{-1} in the positive X-direction.
(D) Travelling with a velocity of 100 ms^{-1} in the negative X-direction.

4. A wave travelling in positive X-direction with A = 0.2 m has a velocity of 360 m/sec. If $\lambda = 60$ m, 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 of the propagating wave is $y = 25\sin(20t + 5x)$, where y is displacement. Which of the following statements is not true?
(A) The amplitude of the wave is 25 units
(B) The wave is propagating in positive x-direction.
(C) The velocity of the wave is 4 units.
(D) The maximum velocity of the particles is 500 units.

8.5 The Speed of Travelling Waves

1. Sound wave propagation is NOT possible through _____.
(A) solids (B) liquids
(C) gases (D) vacuum

2. Newton assumed that changes taking place in a medium, when sound waves propagating through medium, are _____.
(A) isothermal (B) adiabatic
(C) isobaric (D) isomeric

3. Velocity of sound in any gas depends upon
(A) wavelength of sound only.
(B) density and elasticity of gas.
(C) intensity of sound waves only.
(D) amplitude and frequency of sound.

4. The _____ is developed during compression.
(A) sound (B) light
(C) heat (D) cooling

5. According to Newton's assumption, the temperature of the gaseous medium _____ when sound waves travel through medium.
(A) decreases
(B) remains constant
(C) increases
(D) depends on wind velocity

6. In the expression for velocity of sound, according to Newton, the modulus of elasticity is
(A) isothermal bulk modulus and is equal to m^2 the atmospheric pressure.
(B) adiabatic rigidity modulus.
(C) isothermal rigidity modulus and is not equal to atmospheric pressure.
(D) force required for the motion of sound waves.

7. The error in the value of velocity of sound in air by Newton's formula and as determined by experiment at 0 °C is
(A) nearly 5% (B) nearly 6%
(C) nearly 16% (D) nearly 22%

8. Laplace's correction in the formula for the speed of sound given by Newton was required because sound waves
(A) are longitudinal waves.
(B) are mechanical waves.
(C) propagate isothermally.
(D) propagate adiabatically.

9. The ratio of specific heat of air at constant pressure (c_p) to specific heat of air at constant volume (c_v) is
(A) γ (B) ρ (C) β (D) α

10. The value of λ for air is
(A) 1.31 (B) 1.41 (C) 1.51 (D) 1.61

11. The correct equation for velocity of sound in a medium given by Laplace is
(A) $v = \sqrt{\frac{\gamma P}{\rho}}$ (B) $v = \sqrt{\frac{P}{\gamma\rho}}$
(C) $v = \sqrt{\frac{\rho}{\gamma P}}$ (D) $v = \sqrt{\frac{\rho P}{\gamma}}$

12. According to Laplace, modulus of elasticity is the adiabatic modulus of elasticity of air medium and it is given by
(A) $E = \gamma P$ (B) $E = \frac{P}{\gamma}$
(C) $E = \frac{\gamma}{P}$ (D) $P = \gamma E$

13. Which of the following relation is correct for velocity of longitudinal waves?
(A) $v = \sqrt{\frac{E}{\rho}}$ (B) $v = \sqrt{\frac{\rho}{E}}$
(C) $v = \sqrt{\rho E}$ (D) $v = \sqrt{\rho - E}$

14. Velocity of transverse wave travelling through a string having tension 25 N and linear density 1 kg/m is
(A) 5 m/s (B) 25 m/s
(C) 125 m/s (D) 100 m/s

15. If the velocity of sound wave in a medium of density 2200 kg/m^3 is 4 km/s. The modulus of elasticity of the medium is
(A) 5.5×10^8 N/m^2 (B) 8.8×10^{10} N/m^2
(C) 3.52×10^{10} N/m^2 (D) 6.25×10^{10} N/m^2

16. At NTP, velocity of sound in air at 0 °C by Newton's formula is
(A) 269.9 m/s (B) 279.9 m/s
(C) 289.9 m/s (D) 299.9 m/s

17. The velocity of sound in air at 0 °C is
[ρ = 1.29 kg m^{-3}, γ = 1.36, density of mercury = 13000 kg/m^3, g = 9.8 m/s^2]
(A) 336.8 m/s (B) 319.5 m/s
(C) 316.8 m/s (D) 306.8 m/s

18. The velocity of sound in air is 332 m/s at pressure 10^5 Pa. What will be its velocity when pressure is 2×10^5 Pa? [Keeping temperature constant]
(A) 0.25×332 m/s (B) 0.50×332 m/s
(C) 332 m/s (D) 2×332 m/s

19. With the rise of temperature, the speed of sound in a gas
(A) may increase or decrease depending upon pressure.
(B) decreases only.
(C) remains constant.
(D) increases only.

20. The velocity of sound at 0 °C is v_0. What will be its velocity at 27 °C?
(A) $1.05v_0$ (B) $2.05v_0$
(C) $3.05v_0$ (D) $4.05v_0$

21. The speed of sound is NOT affected by
(A) temperature of medium.
(B) pressure of medium.
(C) moisture of medium.
(D) density of medium.

22. The speed of sound in air increases by _____ when, the temperature of medium is increased by 10 °C.
(A) 610 m/s (B) 6.1 m/s
(C) 61 m/s (D) 0.61 m/s

23. v_m and v_d are the velocities of sound in humid air and dry air respectively. The relation between them is
(A) $v_m > v_d$ (B) $v_m < v_d$
(C) $v_m = v_d$ (D) $v_m = \frac{v_d}{2}$

24. Under similar conditions of temperature and pressure, in which of the gases the speed of sound will be the greatest?
(A) Carbon dioxide (B) Oxygen
(C) Helium (D) Hydrogen

25. The temperature at which the velocity of sound in air will be 1.5 times its velocity at 0 °C is
(A) 614.2 °C (B) 514.4 °C
(C) 341.2 °C (D) 241.4 °C

26. The velocity of sound is greatest in
(A) steel (B) ammonia
(C) air (D) water

8.6 Principle of superposition of waves

1. The superposition is the characteristic of
(A) wave motion.
(B) particle motion.
(C) wave and particle motion.
(D) neither wave nor particle motion.

2. The energy in the superposition of waves
(A) is lost.
(B) increases.
(C) remains same, only redistribution occurs.
(D) may increase or decrease depending upon the medium.

8.7 Echo, Reverberation and Acoustics

1. To hear an echo, the total distance covered by sound from the point of generation to the reflecting surface and back should be atleast _____.
(A) 36 m (B) 17.2 m
(C) 34.4 m (D) 19 m

8.8 Qualities of sound

1. A note is _____.
(A) pure sine vibration
(B) pure tan vibration
(C) straight motion
(D) irregular disturbance

2. Loudness of the sound depends upon
(A) square of the amplitude.
(B) amplitude.
(C) reciprocal of the amplitude.
(D) square root of the amplitude.

3. Loudness can be increased by
(A) increasing distance.
(B) resonance.
(C) decreasing intensity.
(D) decreasing amplitude.

4. Every musical sound can be regarded as combination of _____.
(A) nodes (B) antinodes
(C) notes (D) noises

5. Quality of a musical note depends on
(A) harmonics present.
(B) length of the wave.
(C) velocity of sound in the medium.
(D) fundamental frequency.

6. Pitch of a note depends upon _____.
(A) fundamental frequency
(B) harmonics
(C) source
(D) amplitude

7. Loudness of the sound does not depend upon _____.
(A) density of air
(B) velocity and direction of wind
(C) temperature of surrounding
(D) distance

8. It is possible to recognize a person by hearing his voice even if he is hidden behind a solid wall. This is due to the fact that his voice
(A) has definite pitch.
(B) has a definite quality.
(C) has a definite capacity.
(D) can penetrate the wall.

8.9 Doppler Effect

1. The apparent change in frequency of a sounding source and observer in relative motion is
(A) phenomenon of beats.
(B) Doppler effect.
(C) stationary waves.
(D) resonance.

2. Doppler effect is not applicable
(A) when the source and observer both are at rest.
(B) when there is relative motion between source and observer.
(C) when source is at rest and observer is moving.
(D) when source is moving and observer is at rest.

3. If the distance between the observer and source decreases with time, then it shows that
(A) apparent frequency will be less than actual frequency.
(B) apparent frequency will be greater than actual frequency.
(C) apparent frequency will be equal to the actual frequency.
(D) apparent frequencies cannot be noticed.

4. A boy moves away from a steady source of sound at a constant speed. The sound he hears will
(A) decrease in frequency and intensity.
(B) increase in frequency and intensity.
(C) decrease in frequency and increase in intensity.
(D) increase in frequency and decrease in intensity.

5. **Assertion:** The whistle of an approaching engine appears to be shriller than that of a receding engine.
Reason: This is due to Doppler effect, which states that if a source of sound approaches the observer, the frequency of sound increases and if the source recedes the observer, the frequency of sound decreases.
(A) Assertion is True, Reason is True; Reason is a correct explanation for Assertion
(B) Assertion is True, Reason is True; Reason is not a correct explanation for Assertion
(C) Assertion is True, Reason is False
(D) Assertion is False but, Reason is True.

6. **Assertion:** There will be no Doppler effect, when both the source and listener are at rest and wind alone is blowing.
Reason: The blowing wind does not change the distance between the source and listener, which is a must for Doppler effect.
(A) Assertion is True, Reason is True; Reason is a correct explanation for Assertion
(B) Assertion is True, Reason is True; Reason is not a correct explanation for Assertion
(C) Assertion is True, Reason is False
(D) Assertion is False but, Reason is True.

7. A passenger is sitting in a fast moving train. The engine of the train blows a whistle of frequency 'n'. If the apparent frequency of sound heard by the passenger is n′, then
(A) $n' < n$ (B) $n' > n$
(C) $n' = n$ (D) $n' \geq n$

8. Doppler's effect for light differs from Doppler's effect for sound, because
(A) The velocity addition is valid for the sound waves but same is not true for the light waves.
(B) Velocity of light is greater whereas it is lesser for sound.
(C) Light can travel in vacuum while sound cannot.
(D) The shift in frequency for light is lesser than that for sound.

9. A source of sound when moves towards a stationary observer, then frequency of the sound heard by listener is more than actual frequency because the
(A) velocity of sound increases.
(B) apparent wavelength of sound decreases.
(C) velocity and apparent wavelength of sound increases.
(D) apparent wavelength of sound increases.

10. An observer is standing on a railway platform. He hears the whistle of a railway engine moving towards him and then passing. He feels that
(A) the frequency appears to increase and then decrease.
(B) the frequency appears to decrease continuously.
(C) the frequency appears to increase continuously.
(D) the pitch does not change.

11. A source of sound and a listener are both moving in the same direction, the source following the listener. If the respective velocities of sound, source and listener are v, v_S and v_l, then the ratio of the actual frequency of the source and the apparent frequency as received by the listener is
(A) $\frac{v - v_l}{v - v_s}$ (B) $\frac{v - v_s}{v - v_l}$
(C) $\frac{v + v_l}{v + v_s}$ (D) $\frac{v + v_s}{v + v_l}$

12. A source of sound is moving with a velocity of 50 ms^{-1} towards a stationary observer. The observer measures the frequency of sound as 500 Hz. The apparent frequency of sound as heard by the observer when source is moving away from him with the same speed is (Speed of sound at room temperature 350 ms^{-1})
(A) 400 Hz (B) 666 Hz
(C) 375 Hz (D) 177.5 Hz

Critical Thinking

8.1 Introduction

1. In oscillatory motion, particles of the medium perform _____.
(A) rotational motion
(B) translational motion
(C) vibratory motion
(D) irregular motion

2. For a wave which of the following statement is true?
(A) Energy is transferred and not the matter.
(B) Energy is not transferred, but matter is transferred.
(C) Energy and matter both are transferred.
(D) Neither energy nor matter is transferred.

8.2 Common Properties of All Waves

1. In case of sound waves, amplitude means
(A) maximum displacement from mean position.
(B) minimum displacement from mean position.
(C) sound distribution.
(D) distance covered in unit time.

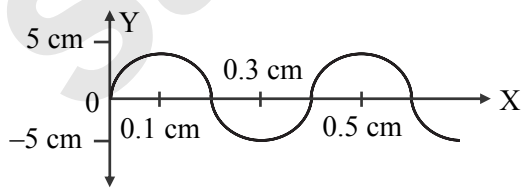
2. Which of the following is NOT the characteristic of the progressive wave?
(A) All the vibrating particles of medium have different amplitudes and frequency.
(B) State of oscillation changes from particle to particle.
(C) For its propagation, medium should have elasticity and inertia.
(D) The form of wave repeats itself at equal intervals.

3. A tuning fork produces waves in a medium. If the temperature of the medium changes, then which of the following will change?
(A) Amplitude (B) Frequency
(C) Wavelength (D) Time-period

4. In a sinusoidal wave, the time required for a particular point to move from maximum displacement to zero displacement is 0.14 second. The frequency of the wave is
(A) 0.42 Hz (B) 2.75 Hz
(C) 1.79 Hz (D) 0.56 Hz

5. An observer standing at the sea-coast, observes 48 waves reaching the coast per minute. If the wavelength of each wave is 10 m, then the velocity of the wave is
(A) 5 m/s (B) 8 m/s
(C) 10 m/s (D) 16 m/s

6. The following figure shows the shape of part of a long string in which transverse waves are produced by attaching one end of the string to tuning fork of frequency 250 Hz. The velocity of the waves is



(A) 1.0 m s^{-1} (B) 1.5 m s^{-1}
(C) 2.0 m s^{-1} (D) 2.5 m s^{-1}

7. The distance between a crest and its nearest trough is 2.5 cm. If 4 complete waves pass through any point per second, then the velocity of wave, in cm/s, will be
(A) 20 (B) 35 (C) 50 (D) 25

8. The tuning forks of frequencies 320 Hz and 340 Hz produce sound waves of wavelength differing by 6 cm in air. The velocity of sound in air is
(A) 426.4 m/s (B) 326.4 m/s
(C) 300 m/s (D) 250 m/s

9. Choose the WRONG statement.
(A) Waves are called progressive wave, if they travel in same straight line.
(B) Waves are called progressive wave, if they travel without change of form.
(C) Waves are called progressive wave, if they travel in positive direction.
(D) Waves are called progressive wave, if they are not transverse or longitudinal.

10. Progressive wave with doubly periodic means
(A) the wave which repeats itself at equal distance in equal interval of time.
(B) repetition at equal distance.
(C) repetition after equal interval of time.
(D) repetition in medium without inertia.

11. A tuning fork makes 256 vibrations per second in air. When velocity of sound is 330 m/s, then wavelength of the tone emitted is
(A) 0.56 m (B) 0.89 m
(C) 1.11 m (D) 1.29 m

12. The minimum audible wavelength at room temperature is about
(A) 0.2 Å (B) 5 Å
(C) 5 cm to 2 metre (D) 20 mm

13. Find the frequency of minimum distance between compression and rarefaction of a wire. If the length of the wire is 1m and velocity of sound in air is 360 m/s
(A) 90 s^{-1} (B) 180 s^{-1}
(C) 120 s^{-1} (D) 360 s^{-1}

14. A man sets his watch by a whistle that is 2 km away. How much will his watch be in error (speed of sound in air 330 m/s) ?
(A) 3 seconds fast (B) 3 seconds slow
(C) 6 seconds fast (D) 6 seconds slow

15. The frequency of a tuning fork is 384 per second and velocity of sound in air is 352 m/s. How far the sound has traversed while fork completes 36 vibration?
(A) 3 m (B) 13 m
(C) 23 m (D) 33 m

16. The number of waves contained in unit length of the medium is called
(A) elastic wave.
(B) wave number.
(C) wave pulse.
(D) electromagnetic wave.

17. An observer standing at the sea coast observes 54 waves reaching the coast every minute. If the wave number is 0.10/metre, the wave velocity is
(A) 11.1 m/s (B) 10 m/s
(C) 9 m/s (D) 6 m/s

18. The distance between two consecutive crests in a wave train produced in a string is 5 cm. If 2 complete waves pass through any point per second, the velocity of sound is
(A) 2.5 cm s^{-1} (B) 5 cm s^{-1}
(C) 10 cm s^{-1} (D) 15 cm s^{-1}

19. Wavelength of the transverse wave is 30 cm. If the particle at some instant has displacement 2 cm, find the displacement of the particle 15 cm away at the same instant.
(A) 2 cm (B) 17 cm
(C) –2 cm (D) –17 cm

20. A tuning fork has frequency 512 Hz. The number of vibrations of the fork in the time during which the sound from the tuning fork reaches 332 m in air are
(velocity of sound in air is 332 m/s.)
(A) 100 (B) 200
(C) 332 (D) 512

21. Sound waves of wavelength λ and velocity v in medium-1 enter medium-2. If their velocity in medium-2 is 4v, the wavelength in medium-2 is
(A) 4λ (B) λ
(C) $\frac{\lambda}{4}$ (D) 16λ

8.3 Transverse Waves and Longitudinal Waves

1. When a stone is dropped on the surface of the still water, the waves produced are _____.
(A) transverse (B) longitudinal
(C) stationary (D) none of these

2. Transverse waves cannot propagate through liquids and gases because
(A) liquids and gases have low density.
(B) gases can flow.
(C) gases are compressible.
(D) liquids and gases do not have modulus of rigidity of shape.

3. For a transverse wave, the distance between two successive crests is 2 m. If 4 troughs cross a given point along the direction of travel in 20 s, the distance between a crest and trough is
(A) 0.2 m (B) 1 m
(C) 8 m (D) 10 m

4. A medium can carry a longitudinal wave because it has the property of _____.
(A) compressibility (B) elasticity
(C) mass (D) density

5. The propagation of sound waves is not possible in space because
(A) the frequency of sound is more in space.
(B) there is vacuum in space.
(C) the astronomical bodies block the sound in space.
(D) the sound is not reflected in space.

6. Water waves produced by a motor boat sailing in water are
(A) neither longitudinal nor transverse.
(B) both, longitudinal and transverse.
(C) only longitudinal.
(D) only transverse.

7. If velocity of sound in a gas is 360 m/s and the distance between a compression and the nearest rarefaction is 1 m, then the frequency of sound is
(A) 90 Hz (B) 180 Hz
(C) 360 Hz (D) 720 Hz

8.4 Mathematical expression of a wave

1. A wave travelling along the x-axis is described by the equation $y(x, t) = 0.005 \cos(\alpha x - \beta t)$. If the wavelength and the time period of the wave are 0.08 m and 2.0 s, respectively, then α and β in appropriate units are
(A) $\alpha = \frac{0.08}{\pi}, \beta = \frac{2.0}{\pi}$
(B) $\alpha = \frac{0.04}{\pi}, \beta = \frac{1.0}{\pi}$
(C) $\alpha = 12.50\ \pi, \beta = \frac{\pi}{2.0}$
(D) $\alpha = 25.00\ \pi, \beta = \pi$

2. A wave travels in a medium according to the equation of displacement given by $y(x, t) = 0.03 \sin \pi$, where y and x are in metres and t in seconds. The wavelength of the wave is
(A) 200 m (B) 100 m
(C) 20 m (D) 10 m

3. Which of the following represents a wave?
(A) $Y = A(\omega t - kx)$
(B) $Y = A \sin \omega t$
(C) $Y = A \cos kx$
(D) $Y = A \sin(\alpha t + bx + c)$

4. A wave of frequency 512 Hz has a velocity of 320 m s^{-1}. The distance between the particles differing in phase by π is
(A) 125 cm (B) 31.5 cm
(C) 62.5 cm (D) 31.25 cm

5. A wave travelling in the +ve x-direction having displacement along y-direction as 1 m, wavelength 2π m and frequency of $\frac{1}{\pi}$ Hz is represented by
(A) $y = \sin(x - 2t)$
(B) $y = \sin(2\pi x - 2\pi t)$
(C) $y = \sin(10\pi x - 20\pi t)$
(D) $y = \sin(2\pi x + 2\pi t)$

6. A transverse wave is represented by $x = A \sin(kx - \omega t)$. The velocity of the wave is given by _____
(A) kx (B) k/ω
(C) ωt (D) ω/k

7. A sound wave $y = A_0 \sin(\omega t - kx)$ is reflected from a rigid wall with 64% of its amplitude. The equation of the reflected wave is
(A) $y = \frac{64}{100} A_0 \sin(\omega t + kx)$
(B) $y = -\frac{64}{100} A_0 \sin(\omega t + kx)$
(C) $y = \frac{64}{100} A_0 \sin(\omega t + kx)$
(D) $y = \frac{64}{100} A_0 \cos(\omega t - kx)$

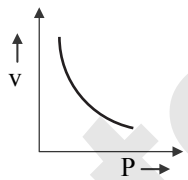
8. A transverse wave is described by the equation $Y = Y_0 \sin 2\pi\left(ft - \frac{x}{\lambda}\right)$. The maximum particle velocity is four times the wave velocity if
(A) $\lambda = \frac{\pi Y_0}{4}$ (B) $\lambda = \frac{\pi Y_0}{2}$
(C) $\lambda = \pi Y_0$ (D) $\lambda = 2\pi Y_0$

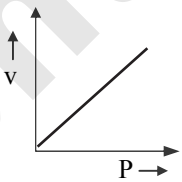
9. The displacement y of wave travelling in the x-direction is given by $y = 10^{-4} \sin\left(600t - 2x + \frac{\pi}{3}\right)$ metres, where x is expressed in metres and t in seconds. The speed of the wave-motion, in ms^{-1}, is
(A) 200 (B) 300
(C) 600 (D) 1200

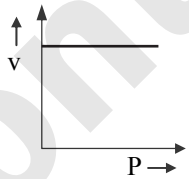
10. When a wave travels in a medium, the particle displacement is given by the equation $y = \alpha \sin 2\pi(bt - cx)$ where a, b and c are constants. The maximum particle velocity will be twice the wave velocity if
(A) $c = \frac{1}{\pi a}$ (B) $c = \pi a$
(C) $b = ac$ (D) $b = \frac{1}{ac}$

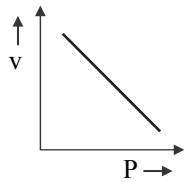
8.5 The Speed of Travelling Waves

1. Which of the following is NOT the correct formula representing velocity of sound?
(A) $v = \sqrt{\frac{\gamma P}{\rho}}$ (B) $v = \sqrt{\frac{\gamma RT}{M}}$
(C) $v = \sqrt{\frac{\gamma PV}{M}}$ (D) $v = \sqrt{\frac{\gamma P}{M}}$

2. At constant temperature the graph between pressure P of the gas and the speed of sound v in a gas will be
(A) 

(B) 

(C) 

(D) 

3. **Assertion:** The basic of Laplace correction was that, exchange of heat between the region of compression and rarefaction in air is not possible.
Reason: Air is a bad conductor of heat and velocity of sound in air is large.
(A) Assertion is True, Reason is True; Reason is a correct explanation for Assertion
(B) Assertion is True, Reason is True; Reason is not a correct explanation for Assertion
(C) Assertion is True, Reason is False
(D) Assertion is False, Reason is False.

4. **Assertion:** The change in air pressure affects the speed of sound.
Reason: The speed of sound in gases is proportional to the square of pressure.
(A) Assertion is True, Reason is True; Reason is a correct explanation for Assertion
(B) Assertion is True, Reason is True; Reason is not a correct explanation for Assertion
(C) Assertion is True, Reason is False
(D) Assertion is False, Reason is False.

5. At a given temperature, the ratio of the velocity of sound in helium gas to that in nitrogen gas is
(A) $\left(\frac{\sqrt{21}}{5}\right):1$ (B) $\left(\frac{5}{\sqrt{21}}\right):1$
(C) $\sqrt{7}:1$ (D) $\sqrt{8}:1$

6. The ratio of the speed of sound in hydrogen gas $\left(\gamma = \frac{7}{5}\right)$ to helium gas $\left(\gamma = \frac{5}{3}\right)$ at same temperature is

(A) $\frac{\sqrt{34}}{5}$ (B) $\frac{\sqrt{7}}{5}$

(C) $\frac{\sqrt{42}}{5}$ (D) $\frac{\sqrt{21}}{5}$

7. The temperature at which the speed of sound in air becomes double of its value at 27 °C is

(A) –123 °C (B) 54 °C

(C) 327 °C (D) 927 °C

8. The velocity of sound is v_s in air. If the density of air is increased to 4 times, then the new velocity of sound will be

(A) $\frac{v_s}{2}$ (B) $\frac{v_s}{12}$

(C) $12v_s$ (D) $\frac{3}{2}v_s^2$

9. The temperature at which the speed of sound in air becomes double of its value at 0° C is

(A) 273 K (B) 546 K

(C) 1092 K (D) 0 K

10. When the temperature of an ideal gas is increased by 600 K, the velocity of sound in the gas becomes $\sqrt{3}$ times the initial velocity in it. The initial temperature of the gas is

(A) –73 °C (B) 27 °C

(C) 127 °C (D) 327 °C

11. The ratio of densities of nitrogen and oxygen is 14:16. The temperature at which the speed of sound in nitrogen will be same as that in oxygen at 55 °C is

(A) 35 °C (B) 48 °C

(C) 65 °C (D) 14 °C

12. Velocity of sound measured in hydrogen and oxygen gas at a given temperature will be in the ratio

(A) 1 : 4 (B) 4 : 1 (C) 2 : 1 (D) 1 : 1

13. It takes 2.0 seconds for a sound wave to travel between two fixed points when the day temperature is 10 °C. If the temperature rises to 30 °C, the sound wave travels between the same fixed parts in

(A) 1.9 s (B) 2.0 s (C) 2.1 s (D) 2.2 s

14. A source of sound of frequency 512 Hz is placed inside water. The speed of sound in water is 1482 m s^{-1} and in air it is 320 m s^{-1}. The frequency of sound recorded by an observer who is standing in air is

(A) 206 Hz (B) 3000 Hz

(C) 120 Hz (D) 512 Hz

15. If the bulk modulus of water is 2100 MPa, what is the speed of sound in water ?

(A) 1450 m/s (B) 2100 m/s

(C) 0.21 m/s (D) 21 m/s

16. If pressure of air gets doubled then velocity of sound in air _____.

(A) gets doubled

(B) remains unchanged

(C) $\sqrt{2}$ times initial velocity

(D) becomes half

17. At which temperature the speed of sound in hydrogen will be same as that of speed of sound in oxygen at 100 °C?

(A) – 148 °C (B) – 212.5 °C

(C) – 317.5 °C (D) – 249.7 °C

8.7 Echo, Reverberation and Acoustics

1. When an aeroplane attains a speed higher than the velocity of sound in air, a loud bang is heard. This is because

(A) it explodes.

(B) it produces a shock wave which is received as the bang.

(C) its wings vibrate so violently that the bang is heard.

(D) the normal engine noises undergo a Doppler shift to generate the bang.

2. A man standing between two cliffs claps his hands and starts hearing series of echoes at interval of one second. Since the speed of sound in air is 340 m/s, the distance between cliffs must be

(A) 1020 m (B) 680 m

(C) 170 m (D) 34 m

3. A man is standing between two parallel cliffs and fires a gun. If he hears first and second echoes after 1.2 s and 3.6 s respectively, the distance between the cliffs is (velocity of sound in air = 340 m s^{-1})

(A) 1190 m (B) 850 m

(C) 595 m (D) 816 m

8.8 Qualities of sound

1. Two waves of same amplitude superimpose to produce two beats per second. What is the ratio of minimum loudness to that of one of the waves?

(A) ∞ (B) 0 (C) 1 (D) –1

2. A stringed instrument is provided with hollow boxes. This helps to increase loudness of sound by _____.

(A) setting string into natural vibrations

(B) setting string into forced vibrations

(C) setting hollow boxes into natural vibrations along with the strings

(D) setting hollow boxes into forced vibrations along with the strings

3. The loudness and pitch of a sound depends on
(A) intensity and velocity.
(B) frequency and velocity.
(C) intensity and frequency.
(D) frequency and number of harmonics.

4. Each of the properties of sound listed in column A primarily depends on one of the quantities in column B. Choose the matching pairs from two columns

Column A	Column B
Pitch	Waveform
Quality	Frequency
Loudness	Intensity

(A) Pitch-waveform, Quality-frequency, Loudness-intensity
(B) Pitch-frequency, Quality-waveform, Loudness-intensity
(C) Pitch-intensity, Quality-waveform, Loudness- frequency
(D) Pitch-waveform, Quality-intensity, Loudness-frequency

5. Two identical sounds A and B reach a point in the same phase. The resultant sound is C. The loudness of C is n dB higher than the loudness of A. The value of n is
(A) 2 (B) 3 (C) 4 (D) 6

6. The ratio of intensities between two coherent sound sources is 4 : 1. The difference of loudness in decibles (dB) between maximum and minimum intensities, on their interference in space is
(A) 20 log 2 (B) 10 log 2
(C) 20 log 3 (D) 10 log 3

7. In an orchestra, the musical sounds of different instruments are distinguished from one another by which of the following characteristics?
(A) Pitch (B) Loudness
(C) Quality (D) Overtones

8. When we hear a sound, we can identify its source from _____.
(A) amplitude of sound
(B) intensity of sound
(C) wavelength of sound
(D) overtones present in the sound

9. The smallest change in sound intensity that can be detected by the human ear is
(A) 0.51 dB (B) 0.1 dB
(C) 1 dB (D) 2 dB

10. If the pulse rate is 1 after every 20 s, (that is the whistle is blown for a split of second after every 20 s), the frequency of the note produced by the whistle is
(A) 1/20 Hz (B) 0.5 Hz
(C) 1 Hz (D) unknown

8.9 Doppler Effect

1. A person is standing on a railway platform. An engine blowing a whistle of frequency 640 Hz approaches him with a speed of 72 km/hr. The frequency of the note heard by the person is (velocity of sound is 340 m/s)
(A) 650 Hz (B) 660 Hz
(C) 675 Hz (D) 680 Hz

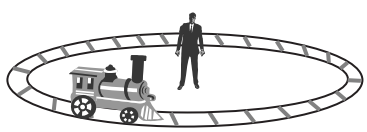
2. An engine blowing a whistle of frequency 133 Hz moves with a velocity of 60 ms^{-1} towards a hill from which an echo is heard. The frequency of the echo heard by the driver (Velocity of sound in air = 340 ms^{-1})
(A) 190 Hz (B) 161 Hz
(C) 133 Hz (D) 113 Hz

3. If a stationary observer notes a change of 25% in the frequency of a whistle of an engine coming towards him, then the velocity of the engine is (velocity of sound = 332 m/s)
(A) 66.4 m/s (B) 64 m/s
(C) 60 km/hr (D) 32 km/hr

4. A train A is travelling at a speed of 108 km hr^{-1}. The train approaches another train B standing on the platform. The engine of the train B blows its horn. The frequency of the horn as observed by the driver in train A is 504 Hz. The frequency of the horn of train B is (speed of sound = 330 ms^{-1})
(A) 504 Hz (B) 462 Hz
(C) 550 Hz (D) 407 Hz

5. Two cars are approaching each other with same speed of 20 m/s. A man in car A fires bullets at regular intervals of 10 seconds. What will be the time interval noted by a man in car B between 2 bullets?
(velocity of sound = 340 m/s)
(A) 11.1 s (B) 10 s
(C) 8.9 s (D) 12 s

6. An engine is moving on a circular track with a constant speed. It is blowing a whistle of frequency 500 Hz. The frequency received by an observer standing stationary at the centre of the track is



(A) 500 Hz
(B) more than 500 Hz
(C) less than 500 Hz
(D) more or less than 500 Hz depending on the actual speed of the engine

7. An engine driver moving towards a wall with a velocity of 60 m/s emits a note of 1400 Hz. Speed of sound in air is 340 m/s. The frequency of the note after reflection from the wall as heard by the engine driver is
(A) 1600 Hz (B) 1200 Hz
(C) 1000 Hz (D) 2000 Hz

8. An object producing a pitch of 600 Hz approaches a stationary person in a straight line with a velocity of 200 m/s. Velocity of sound is 300 m/s. The person will note a change in frequency, as the object flies past him, equal to
(A) 1440 Hz (B) 240 Hz
(C) 1200 Hz (D) 960 Hz

9. When both source and listener approach each other with a velocity equal to half the velocity of sound, the change in frequency of the sound as detected by the listener is
(A) 300% (B) 100%
(C) 150% (D) 200%

10. The difference between the apparent frequency of a source of sound as perceived by the observer during its approach and recession is 2% of the frequency of the source. If the speed of sound in air is 300 ms^{-1}, then the velocity of the source is
(A) 1.5 ms^{-1} (B) 12 ms^{-1}
(C) 6 ms^{-1} (D) 3 ms^{-1}

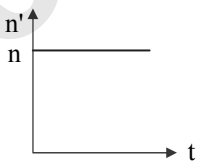
11. If sound velocity is v, velocity of observer is v_0 and velocity of source is v_s, then necessary condition for Doppler's effect to be observed is
(A) $v_s \geq v, v_0 \geq v$ (B) $v_s > v, v_0 > v$
(C) $v_s < v, v_0 \geq v$ (D) $v_s < v, v_0 < v$

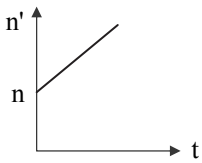
12. Consider a source of sound S and an observer P. The frequency of sound source is n_0. The frequency heard by P is found to be
(1) n_1 if P approaches S at speed v and S is stationary.
(2) n_2 if S approaches P at speed v and P is stationary.
(3) n_3 if each of P and S have speed v/2 towards one another.
Now,
(A) $n_1 = n_2 = n_3$
(B) $n_1 > n_2$
(C) $n_3 < n_0$
(D) n_3 lies between n_1 and n_2

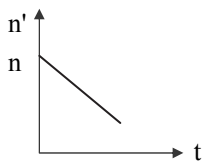
13. What should be the velocity of sound from a source w.r.t. an observer, so that the frequency listened by the observer becomes half of the initial frequency?
(A) v/2 (B) 2v
(C) v/4 (D) v

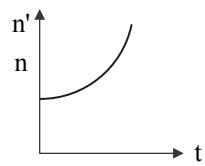
14. The frequency of a whistle of the engine of an express train moving with 20 m/s appears as 500 Hz to a car driver moving with the velocity 15 m/s. The velocity of the sound in air is 335 m/s. If the train and car are moving in opposite directions towards each other, then the frequency of the whistle is
(A) 557.9 Hz (B) 563.4 Hz
(C) 450 Hz (D) 443.6 Hz

15. Two cars are moving on two perpendicular roads towards a crossing with uniform speeds of 72 km/hr and 36 km/hr. If first car blows horn of frequency 280 Hz, then the frequency of horn heard by the driver of second car when line joining the cars make 45° angle with the roads will be
(A) 321 Hz (B) 298 Hz
(C) 289 Hz (D) 280 Hz

16. An observer starts moving with uniform acceleration 'a' towards a stationary sound source emitting a whistle of frequency 'n'. As the observer approaches source, the apparent frequency heard by the observer varies with time as
(A) 

(B) 

(C) 

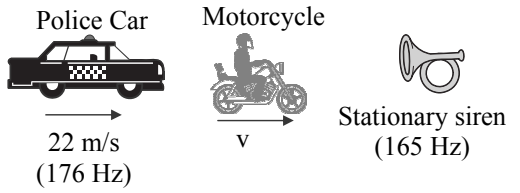
(D) 

17. The frequency of a note emitted by a source changes by 20% as it approaches the observer. As it recedes away from him, the apparent frequency will be different from the actual frequency by
(A) 20%. (B) 17.4%.
(C) 16.67%. (D) 14.3%.

18. A source of sound is travelling towards a stationary observer. The frequency of sound heard by the observer is of three times the original frequency. The velocity of sound is v m/s. The speed of source will be
(A) $\frac{2}{3}v$ (B) v (C) $\frac{3}{2}v$ (D) 3v

19. A man is watching two trains, one leaving and the other coming in with equal speeds of 4 m/s. If they sound their whistles, each of frequency 240 Hz, the number of beats heard by the man (velocity of sound in air = 320 m/s) will be equal to
(A) 6 (B) 3 (C) 0 (D) 12

20. 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 observe any beats.



(A) 33 m/s (B) 22 m/s
(C) Zero (D) 11 m/s

21. An observer moves towards a stationary source of sound with a speed $1/5^{th}$ 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) 1.2 f, λ (B) f, 1.2 λ
(C) 0.8 f, 0.8 λ (D) 1.2 f, 1.2 λ

22. An observer is moving towards a stationary source of sound of frequency n with a speed equal to half the speed of sound in air. The frequency of the sound heard by him will be
(A) $\frac{1}{3}$n (B) $\frac{2}{3}$n
(C) n (D) $\frac{3}{2}$n

23. A source of sound S is moving with a velocity 50 m/s towards a stationary observer. The observer measures the frequency of the source as 1000 Hz. What will be the apparent frequency of the source when it is moving away from the observer after crossing him? The velocity of sound in the medium is 350 m/s
(A) 750 Hz (B) 857 Hz
(C) 1143 Hz (D) 1333 Hz

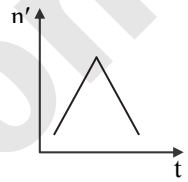
24. A train is moving on a straight track with speed 20 ms^{-1}. It is blowing its whistle at the frequency of 1000 Hz. The percentage change in the frequency heard by a person standing near the track as the train passes him is (speed of sound = 320 ms^{-1}) close to
(A) 6% (B) 12% (C) 18% (D) 24%

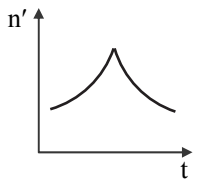
25. A motor car blowing a horn of frequency 124 vib/s moves with a velocity 72 km/hr towards a tall wall. The frequency of the reflected sound heard by the driver will be (velocity of sound in air is 330 m/s)
(A) 109 vib/s (B) 132 vib/s
(C) 140 vib/s (D) 248 vib/s

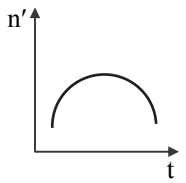
26. A car with a horn of frequency 620 Hz travels towards a large wall with a speed of 20 m/s. velocity of sound is 330 m/s. The frequency of echo of sound of horn as heard by the driver is
(A) 700 Hz (B) 660 Hz
(C) 620 Hz (D) 550 Hz

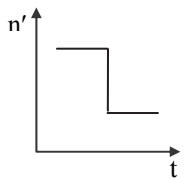
27. A police car with a siren of frequency 8 kHz is moving with uniform velocity 36 km/hr towards a tall building which reflects the sound waves. The speed of sound in air is 320 m/s. The frequency of the siren heard by the car driver is
(A) 8.50 kHz (B) 8.25 kHz
(C) 7.75 kHz (D) 7.50 kHz

28. A railway engine whistling at a constant frequency moves with a constant speed and it goes past a stationary observer standing beside the railway track. Then the frequency of (n′) of the sound heard by the observer with respect to time (t) can be best represented by which of the following curve?

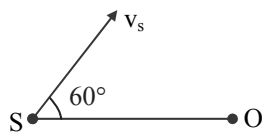
(A) 

(B) 

(C) 

(D) 

29. A source of sound S emitting waves of frequency 100 Hz and an observer O are located at some distance from each other. The source is moving with a speed of 19.4 ms^{-1} at an angle of 60° with the source observer line as shown in the figure. The observer is at rest. The apparent frequency observed by the observer (velocity of sound in air 330 ms^{-1}), is:
(A) 97 Hz
(B) 100 Hz
(C) 103 Hz
(D) 106 Hz



30. A drone fitted with siren is flying directly away from the drone operator and towards a distant building at a speed of 15 m/s. The siren produces sound of frequency 780 Hz. What is the frequency that the operator hears in the echo reflected from the building (Speed of sound is 340 m/s)
(A) 766 Hz (B) 800 Hz
(C) 816 Hz (D) 840 Hz

31. Two trains A and B are approaching a platform from opposite directions. The siren in the station is making a sound at a frequency 4 kHz. The passengers in trains A and B hear siren at frequencies 4.5 and 5 kHz respectively. Then the velocities of the trains A and B are (velocity of sound in air = 340 m/s)
(A) 42.5 m/s , 85 m/s
(B) 75 m/s , 55 m/s
(C) 85 m/s, 8.5 m/s
(D) 42.5 m/s, 62.5 m/s

32. A car is moving with a speed of 72 km-hour^{-1} towards a roadside source that emits sound at a frequency of 850 Hz. The car driver listens to the sound while approaching the source and again while moving away from the source after crossing it. If the velocity of sound is 340 ms^{-1}, the difference of the two frequencies the driver hears is
(A) 50 Hz (B) 85 Hz
(C) 100 Hz (D) 150 Hz

Concept Fusion

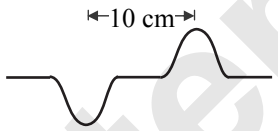
1. Consider the following
I. Waves created on the surfaces of a water pond by a vibrating source.
II. Wave created by an oscillating electric field in air.
III. Sound waves travelling under water.
Which of these can be polarized?
(A) I and II (B) II only
(C) II and III (D) I, II and III

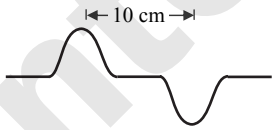
2. It is possible to distinguish between the transverse and longitudinal waves by studying the property of
(A) Interference (B) Diffraction
(C) Reflection (D) Polarisation

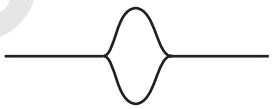
3. **Assertion:** The water waves in the ocean are always normal to the shore.
Reason: Waves on the surface of water are transverse in nature.
(A) Assertion is True, Reason is True; Reason is a correct explanation for Assertion
(B) Assertion is True, Reason is True; Reason is not a correct explanation for Assertion
(C) Assertion is True, Reason is False
(D) Assertion is False, Reason is False.

4. **Assertion:** A tuning fork is made of an alloy of steel, nickel and chromium.
Reason: The alloy of steel, nickel and chromium is called elinvar.
(A) Assertion is True, Reason is True; Reason is a correct explanation for Assertion
(B) Assertion is True, Reason is True; Reason is not a correct explanation for Assertion
(C) Assertion is True, Reason is False
(D) Assertion is False, Reason is False.

5. Two pulses travel in mutually opposite directions in a string with a speed of 2.5 cm/s as shown in the figure. Initially the pulses are 10 cm apart. What will be the state of the string after two seconds ?

(A) 

(B) 

(C)
(D) 

6. A tuning fork vibrates and produces concentric transverse waves on the surface of water. If distance between 10 crests is 9.0 m and velocity of wave on the surface of water is 450 m/s, then frequency of the tuning fork is
(A) 500 Hz (B) 450 Hz
(C) 250 Hz (D) 2250Hz

7. A light pointer fixed to one prong of a tuning fork touches a vertical plate. The fork is set vibrating and the plate is allowed to fall freely. If eight oscillations are counted when the plate falls through 10 cm, the frequency of the tuning fork is
(A) 360 Hz (B) 280 Hz
(C) 560 Hz (D) 56 Hz

8. 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 seconds (B) 21 seconds
(C) 10 seconds (D) 14 seconds

9. If the splash is heard 4.23 s after a stone is dropped into a pit in which water level is 78.4 m deep, the velocity of sound is
(A) 360.9 m/s (B) 350.9 m/s
(C) 340.9 m/s (D) 330.9 m/s

10. Helium has density of 0.179 kg/m^3 at S.T.P. Considering helium gas as an ideal gas, the speed of sound waves in helium is nearly
(A) 752 m/s (B) 810 m/s
(C) 972 m/s (D) 1030 m/s

11 Oxygen is 16 times heavier than hydrogen. Equal volumes of hydrogen and oxygen are mixed. The ratio of speed of sound in the mixture to that in hydrogen is
(A) $\sqrt{\frac{1}{8}}$ (B) $\sqrt{\frac{32}{17}}$ (C) $\sqrt{8}$ (D) $\sqrt{\frac{2}{17}}$

12. An earthquake generates both transverse (S) and longitudinal (P) sound waves in the earth. The speed of S waves is about 4.5 km/s and that of P waves is about 8.0 km/s. A seismograph records P and S waves from an earthquake. The first P wave arrives 4.0 min before the first S wave. The epicenter of the earthquake is located at distance about
(A) 25 km (B) 250 km
(C) 2500 km (D) 5000 km

13. Two boys stand close to a long straight metal pipe, at some distance from each other. One boy fires a gun and the other hears two explosions with a time interval of 1 s between them. If the velocity of sound in metal is 3630 m/s and in air is 330 m/s, then the distance between the two boys is
(A) 36.3 m (B) 363 m
(C) 72.6 m (D) 726 m

14. A man is watching two trains, one leaving and the other coming in with equal speeds of 4 m/s. If they sound their whistles each of frequency 240 Hz, the number of beats heard by the man (velocity of sound in air = 320 m/s) will be equal to
(A) 6 (B) 12 (C) 18 (D) 24

15. A granite rod of 60 cm length is clamped at its middle point and is set into longitudinal vibrations. The density of granite is 2.7×10^3 kg/m^3 and its Young's modulus is 9.27×10^{10} Pa. What will be the fundamental frequency of the longitudinal vibrations?
(A) 10 kHz (B) 7.5 kHz
(C) 5 kHz (D) 2.5 kHz

MHT-CET Previous Years' Questions

1. A source is moving towards observer with speed of 20 ms^{-1} and having frequency 240 Hz and observer is moving towards source with a velocity of 20 ms^{-1}. What is the apparent frequency heard by observer, if velocity of sound is 340 ms^{-1} ? **[2004]**
(A) 270 Hz (B) 240 Hz
(C) 268 Hz (D) 360 Hz

2. If a source emitting waves of frequency f moves towards an observer with a velocity $\frac{v}{4}$ and the observer moves away from the source with a velocity v/6, the apparent frequency as heard by the observer will be (where, v = velocity of sound) **[2007]**
(A) $\frac{14}{15}$f (B) $\frac{14}{9}$f (C) $\frac{10}{9}$f (D) $\frac{2}{3}$f

3. Which of the following requires a medium for their propagation? **[2013]**
(A) Light wave
(B) Electromagnetic wave
(C) Microwave
(D) Sound wave

4. The pitch of the whistle of an engine appears to drop to $\left(\frac{5}{6}\right)^{th}$ of original value when it passes a stationary observer. If the speed of sound in air is 350 m/s then the speed of engine is **[2015]**
(A) 35 m/s
(B) 70 m/s
(C) 105 m/s
(D) 140 m/s

5. The equation of the progressive wave is $Y = 3 \sin\left[\pi\left(\frac{t}{3} - \frac{x}{5}\right) + \frac{\pi}{4}\right]$ where x and Y are in metre and time in second. Which of the following is correct? **[2017]**
(A) velocity, v = 1.5 m/s
(B) amplitude, A = 3 cm
(C) frequency, f = 0.2 Hz
(D) wavelength, λ = 10 m

6. The observer is moving with velocity 'v_0' towards the stationary source of sound and then after crossing moves away from the source with velocity 'v_0'. Assume that the medium through which the sound waves travel is at rest. If 'v' is the velocity of sound and 'n' is the frequency emitted by the source then the difference between apparent frequencies heard by the observer is **[2017]**
(A) $\frac{2n v_0}{v}$ (B) $\frac{n v_0}{v}$
(C) $\frac{v}{2n v_0}$ (D) $\frac{v}{n v_0}$

7. When source of sound moves towards a stationary observer, the wavelength of sound received by him **[2018]**
(A) decreases while frequency increases
(B) remains the same whereas frequency increases
(C) increases and frequency also increases
(D) decreases while frequency remains the same

8. An observer moves towards a stationary source of sound, with a velocity one-fifth of the velocity of sound. What is the percentage increase in the apparent frequency? **[2019, 2008]**
(A) Zero (B) 0.5%
(C) 5% (D) 20%

9. The equation of wave motion is $y = 6 \sin\left[12\pi t - 0.02\pi x + \frac{\pi}{2}\right]$, where x is in m and t in second. The velocity of the wave is **[2020]**
(A) 400 m/s (B) 200 m/s
(C) 600 m/s (D) 100 m/s

10. The frequency of a tuning fork is 220 Hz and the velocity of sound in air is 330 m/s. When the tuning fork completes 80 vibrations, the distance travelled by the vibrations is **[2020]**
(A) 120 m (B) 60 m
(C) 53 m (D) 100 m

11. A bus is moving with a velocity of 5 m/s towards a wall. The driver blows the horn of frequency 165 Hz. If the speed of sound in air is 335 m/s, then after reflection of sound wave, the number of beats per second heard by the passengers in the bus will be **[2020]**
(A) 5 (B) 6 (C) 2 (D) 4

12. A stone is dropped into a well 80 m deep. The splash of sound is heard 4.25 second after the stone is dropped. The speed of sound in air is $\left(g = 10\frac{m}{s^2}\right)$ **[2020]**
(A) 340 m/s (B) 320 m/s
(C) 300 m/s (D) 330 m/s

13. A sound wave of frequency 160 Hz has a velocity of 320 m/s. When it travels through air, the particles having a phase difference of 90°, are separated by a distance of **[2020]**
(A) 50 cm (B) 1 cm
(C) 25 cm (D) 75 cm

14. Two monoatomic ideal gases A and B of molecular masses m_1 and m_2 respectively are enclosed in separate containers kept at the same temperature. The ratio of the speed of sound in gas A to that in gas B is given by **[2020]**
(A) $\sqrt{\frac{m_1}{m_2}}$ (B) $\frac{m_2}{m_1}$
(C) $\sqrt{\frac{m_2}{m_1}}$ (D) $\frac{m_1}{m_2}$

15. When the observer moves towards the stationary source with velocity, 'V_1', the apparent frequency of emitted note is 'F_1'. When the observer moves away from the source with velocity 'V_1', the apparent frequency is 'F_2'. If 'V' is the velocity of sound in air and $\frac{F_1}{F_2} = 2$ then $\frac{V}{V_1} = ?$ **[2020, 2016]**
(A) 2 (B) 3 (C) 4 (D) 5

16. A police car travels towards a stationary observer at a speed of 20 ms^{-1}. The siren on the car emits a sound of frequency 320 Hz. If the speed of sound is 340 ms^{-1} then frequency recorded by the observer will be **[2021]**
(A) 170 Hz (B) 320 Hz
(C) 340 Hz (D) 640 Hz

17. The ratio of the speed of sound in helium gas to that in nitrogen gas at same temperature is $(\gamma_{He} = \frac{5}{3},\ \gamma_{N_2} = \frac{7}{5},\ M_{He} = 4,\ M_{N_2} = 28)$ **[2022]**
(A) $\frac{5}{\sqrt{3}}$ (B) $\sqrt{\frac{7}{5}}$
(C) $\sqrt{\frac{2}{7}}$ (D) $\sqrt{\frac{5}{3}}$

18. A man standing between two parallel cliffs fires a gun and hears two echoes, first after one second and 2nd after four second. If the velocity of sound is 340 m/s, the distance between the cliffs is **[2022]**
(A) 510 m (B) 1020 m
(C) 1700 m (D) 850 m

19. Consider the Doppler effect in two cases. In the first case, an observer moves towards a stationary source of sound with a speed of 50 m/s. In the second case, the observer is at rest and the source moves towards the observer with the same speed of 50 m/s. Then the frequency heard by the observer will be
[velocity of sound in air = 330 m/s.] **[2023]**
(A) same in both the cases.
(B) more in the second case than in the first case.
(C) less in the second case than in the first case.
(D) less than the actual frequency in both the cases.

20. Two sounding sources send waves at certain temperature in air of wavelength 50 cm and 50.5 cm respectively. The frequency of sources differ by 6 Hz. The velocity of sound in air at same temperature is **[2023]**

(A) 300 m/s (B) 303 m/s
(C) 313 m/s (D) 330 m/s

21. A train is moving towards a stationary observer with speed 34 m/s. A train sounds a whistle of frequency 450 Hz. If the speed of sound in air is 340 m/s, the frequency heard by the observer in Hz is **[2023]**

(A) 440 (B) 480
(C) 500 (D) 540

22. When both source and listener are approaching each other the observed frequency of sound is given by (V_L and V_S is the velocity of listener and source respectively, n_0 = radiated frequency) **[2023]**

(A) $n = n_0\left[\frac{V + V_L}{V - V_S}\right]$ (B) $n = n_0\left[\frac{V - V_L}{V + V_S}\right]$

(C) $n = n_0\left[\frac{V - V_L}{V - V_S}\right]$ (D) $n = n_0\left[\frac{V + V_L}{V + V_S}\right]$

23. Two sources are at finite distance apart. They emit sounds of wavelength 'λ'. An observer situated between them on the line joining them, approaches one source with speed 'u'. Then the number of beats heard per second by the observer will be **[2023]**

(A) $\frac{2u}{\lambda}$ (B) $\frac{u}{\lambda}$

(C) $\frac{u}{2\lambda}$ (D) $\frac{\lambda}{u}$

Evaluation Test

1. A student performs resonance tube experiment and calculates speed of sound at 30 °C as 35078 cm/s. If the actual speed of sound at 0 °C is 33200 cm/s, what is the percentage error in his calculation?

(A) 0.6% (B) 0.9%
(C) 0.01% (D) 0.29%

2. When sound is produced in an aeroplane moving with a velocity of 250 m/s horizontally its echo is heard after 12 seconds. If velocity of sound in air is 300 m s^{-1}, the elevation of aircraft is

(A) 995 m (B) 758 m
(C) 1250 m (D) 2500 m

3. Neon is 20 times heavier than hydrogen. The equal volumes of hydrogen and neon are mixed. The ratio of speed of sound in the mixture to that in hydrogen is

(A) $\sqrt{\frac{2}{21}}$ (B) $\sqrt{\frac{1}{8}}$ (C) $\sqrt{\frac{2}{17}}$ (D) $\sqrt{\frac{32}{17}}$

4. Sound waves in air are always longitudinal, because

(A) density of air is very small.
(B) air is a mixture of several gases.
(C) air does not have a modulus of rigidity.
(D) of the inherent characteristics of sound waves in air.

5. Which of the following doesn't produce a sound wave?

(A) A bell ringing under water.
(B) An explosion in outer space.
(C) A gun fired in a room with no echoes.
(D) A hammer hitting a block of rubber.

6. The ratio of velocity of sound in hydrogen and chlorine at STP is

(A) 6 : 1 (B) 8 : 1
(C) 4 : 1 (D) 2 : 1

7. **Assertion:** For sound waves, air is rarer medium than water.
Reason: For sound waves, the density of water is greater than air.

(A) Assertion is True, Reason is True; Reason is a correct explanation for Assertion.
(B) Assertion is True, Reason is True; Reason is not a correct explanation for Assertion.
(C) Assertion is True, Reason is False.
(D) Assertion is False, Reason is False.

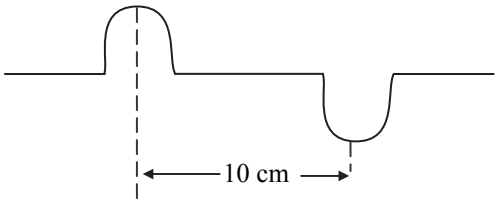
8. Which of the following statements are true for wave motion?

(A) Mechanical transverse waves can propagate through all media.
(B) Longitudinal waves can propagate through solids only.
(C) Mechanical transverse waves can propagate through solids only.
(D) Longitudinal waves can propagate through vacuum.

9. The ratio of the speed of sound in nitrogen gas to that in helium gas, at 300 K is

(A) $\sqrt{2/7}$ (B) $1/\sqrt{7}$
(C) $\sqrt{3}/5$ (D) $\sqrt{6/5}$

10. Two pulses in a stretched string whose centres are initially 10 cm apart are moving towards each other as shown in the figure. The speed of the two pulses are 2 cm/s and 3 cm/s respectively. After 2 seconds, the total energy of the pulses will be



(A) zero.
(B) purely kinetic.
(C) purely potential.
(D) partly kinetic and partly potential.

11. A source of sound of frequency 750 Hz is placed inside water. The speed of sound in water is 1500 m/s and in air is 340 m/s. The frequency of sound recorded by an observer who is standing in air is
(A) 375 Hz (B) 3309 Hz
(C) 170 Hz (D) 750 Hz

12. An observer standing near the seashore observes 42 waves per minute. If the wavelength of the water wave is 12 m then the velocity of water wave is
(A) 540 m s^{-1} (B) 8.4 m s^{-1}
(C) 0.184 m s^{-1} (D) 3.5 m s^{-1}

13. Under similar conditions of temperature and pressure, in which of the following gases the velocity of sound will be largest?
(A) H_2 (B) N_2 (C) He (D) CO_2

14. A train has just completed a U-curve in a track which is a semicircle. The engine is at the forward end of the semi-circular part of the track while the last carriage is at the rear end of the semi-circular track. The driver blows a whistle of frequency 200 Hz. Velocity of sound is 340 m/s. Then the apparent frequency as observed by a passenger in the middle of a train when the speed of the train is 30 m/s is
(A) 219 Hz (B) 188 Hz
(C) 200 Hz (D) 181 Hz

15. Which of the following is the example of transverse wave?
(A) Sound waves
(B) Compressional waves in a spring
(C) Vibration of string
(D) None of these

16. Sound waves travel at 350 m/s through a warm air and at 3500 m/s through brass. The wavelength of a 700 Hz acoustic wave as it enters brass from warm air
(A) decreases by a factor 20.
(B) decreases by a factor 10.
(C) increases by a factor 20.
(D) increases by a factor 10.

17. If at same temperature and pressure, the densities for two diatomic gases are respectively ρ_1 and ρ_2, then the ratio of velocities of sound in these gases will be
(A) $\sqrt{\frac{\rho_2}{\rho_1}}$ (B) $\sqrt{\frac{\rho_1}{\rho_2}}$ (C) $\rho_1\rho_2$ (D) $\sqrt{\rho_1\rho_2}$

18. Two aeroplanes A and B, each moving with a speed of 720 km/hour, are moving directly away from each other. Aeroplane A emits a whistle of frequency 1080 Hz. The apparent frequency heard by a person in plane B will be (velocity of sound in air = 340 m/s)
(A) 200 Hz (B) 260 Hz
(C) 280 Hz (D) 300 Hz

19. A car is travelling with a velocity of 40 m/s towards a source of sound of frequency 1000 Hz. If sound velocity is 330 m/s, then apparent frequency heard by the observer (in Hz) is
(A) 1121 (B) 878
(C) 1400 (D) 1200

20. A siren placed at a railway platform is emitting a sound of frequency 5 kHz. A passenger sitting in a moving train 'A' records the frequency of the siren as 5.5 kHz. During his return journey by train 'B' he records the frequency of the siren as 6 kHz. The ratio of the speed of train B to that of train A is
(A) $\frac{242}{252}$ (B) 2 (C) $\frac{5}{6}$ (D) $\frac{11}{6}$

Answer Key of the chapter: *Sound* & Evaluation Test is given at the end of the book.

Solutions to the relevant questions of this chapter & Evaluation Test can be accessed by scanning the adjacent QR code in ***Quill - The Padhai App.***

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