PHYSICS – CLASS XI

Chapter 14 : Waves

PRACTICE PAPER (Chapter-wise Test)

Time : 1½ Hours **Max. Marks : 35**

General Instructions

(a) All questions are compulsory.

(b) There are 17 questions in total. Section A: Q. 1 to 8 carry 1 mark each. Section B: Q. 9 to 12 carry 2 marks each. Section C: Q. 13 to 15 carry 3 marks each. Section D: Q. 16 and 17 carry 5 marks each.

(c) There is no overall choice. An internal choice is given in one 2-mark question (Q. 11), one 3-mark question (Q. 14) and both 5-mark questions (Q. 16, Q. 17). Attempt only one of the given choices.

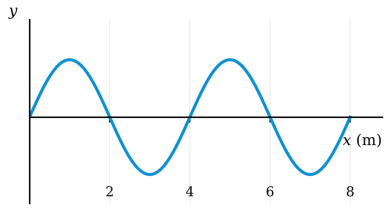
(d) Use of calculators is not permitted. The speed of sound in air is to be taken as given in each question. Angles in trigonometric functions are in radians.

(e) Figures are schematic and not drawn to scale. Write the unit with every numerical answer.

SECTION A

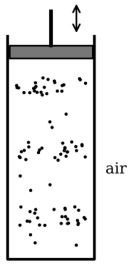
Questions 1 to 8 carry 1 mark each.

1. The figure shows a snapshot of a transverse wave travelling along a string with a speed of 20 m s^{-1}. The frequency of the wave is **(1)**



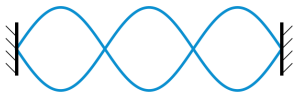
(a) 2 Hz
(b) 5 Hz
(c) 10 Hz
(d) 80 Hz

2. A piston moves up and down in a pipe filled with air and sets up a wave in the air column (figure). The wave produced is **(1)**



(a) transverse
(b) longitudinal
(c) both transverse and longitudinal
(d) neither transverse nor longitudinal

3. The figure shows a stationary wave on a string fixed at both ends. The mode of vibration is the **(1)**



(a) fundamental (first harmonic)
(b) second harmonic
(c) third harmonic
(d) fourth harmonic

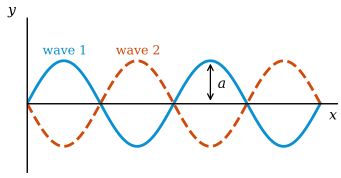
4. **Assertion (A):** Transverse waves cannot propagate through gases. **(1)**
Reason (R): Gases cannot sustain a shearing stress.
(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true but R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.

5. A pulse on a string approaches a rigid wall (figure). State whether the reflected pulse is upright or inverted. **(1)**



6. A wave on a string is described by $y = 0.01 \sin(2x - 10t)$ in SI units. Find the speed of the wave. **(1)**

7. Two waves of equal amplitude a and the same frequency, differing in phase by π, travel along the same string (figure). What is the amplitude of the resultant wave? **(1)**

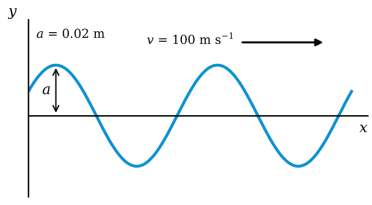


8. A sound wave of wavelength 0.5 m travels in air with a speed of 330 m s^{-1}. Find its frequency. **(1)**

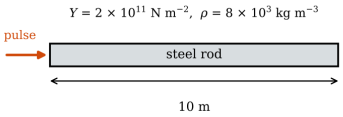
SECTION B

Questions 9 to 12 carry 2 marks each.

9. A progressive wave of amplitude 0.02 m, frequency 50 Hz and speed 100 m s^{-1} travels along the positive x-direction (figure). Find (i) its wavelength and (ii) write its equation in the form $y = a \sin(kx - \omega t)$. **(2)**



10. A pulse is set up at one end of a steel rod of length 10 m, Young's modulus 2×10^{11} N m^{-2} and density 8×10^{3} kg m^{-3} (figure). Find (i) the speed of the longitudinal wave in the rod and (ii) the time taken by the pulse to reach the other end. **(2)**

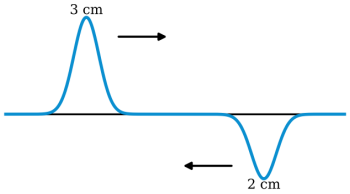


11. A progressive wave is given by $y = a \sin(kx - \omega t)$. By considering a point of constant phase, show that the speed of the wave is $v = \omega/k$. **(2)**

OR

Newton's formula gave the speed of sound in air at STP as 280 m s^{-1} against the measured 331 m s^{-1}. What assumption was wrong, and what is Laplace's corrected formula?

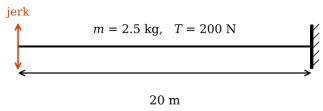
12. Two pulses, one of height 3 cm and one of depth 2 cm, travel in opposite directions along a string and approach each other (figure). (i) State the principle of superposition. (ii) Find the displacement of the string at the instant the pulses overlap exactly. **(2)**



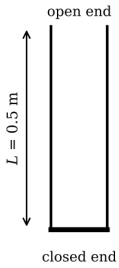
SECTION C

Questions 13 to 15 carry 3 marks each.

13. A string of mass 2.5 kg is under a tension of 200 N. The length of the stretched string is 20 m (figure). A transverse jerk is struck at one end. Find (i) the linear mass density of the string, (ii) the speed of the transverse wave and (iii) the time the disturbance takes to reach the other end. **(3)**

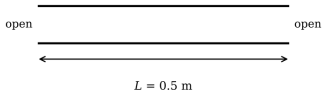


14. A pipe 0.5 m long is closed at one end and open at the other (figure). Take the speed of sound in air as 340 m s^{-1}. Find (i) the fundamental frequency, (ii) the next two frequencies at which the air column can resonate and (iii) whether a source of frequency 340 Hz will produce resonance. **(3)**

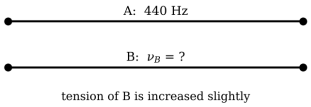


OR

A pipe 0.5 m long is open at both ends (figure). Take the speed of sound in air as 340 m s^{-1}. Find (i) the fundamental frequency, (ii) the next two frequencies at which the air column can resonate and (iii) whether a source of frequency 680 Hz will produce resonance.



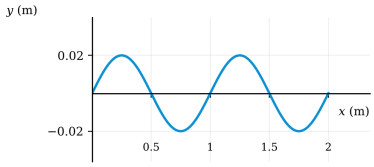
15. Two sitar strings A and B produce beats of frequency 4 Hz. The frequency of A is 440 Hz. When the tension of B is increased slightly, the beat frequency rises to 6 Hz (figure). Find (i) the two possible frequencies of B before tightening, (ii) the original frequency of B, giving reasoning, and (iii) the frequency of B after tightening. **(3)**



SECTION D

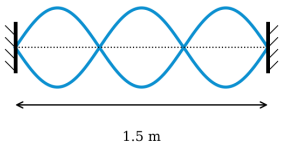
Questions 16 and 17 carry 5 marks each.

16. A travelling wave on a string is described in SI units by $y(x, t) = 0.02 \sin(2\pi x - 100\pi t)$. **(5)**
The figure shows the shape of the string at $t = 0$.
(a) Write the amplitude of the wave. (1)
(b) Find the wavelength. (1)
(c) Find the frequency. (1)
(d) Find the speed of the wave. (1)
(e) Find the displacement at $x = 0.25$ m and $t = 0$. (1)



OR

A stationary wave on a string of length 1.5 m, fixed at both ends, is described in SI units by $y = 0.01 \sin(2\pi x) \cos(100\pi t)$ (figure).
(a) Find the amplitude of each of the two travelling waves that form it. (1)
(b) Find the wavelength. (1)
(c) Find the positions of the nodes. (1)
(d) Find the distance between two consecutive antinodes. (1)
(e) Find the speed of the component waves. (1)



17. A string of length 0.6 m, fixed at both ends, has linear mass density 0.1 kg m^{-1} and is stretched with a tension of 90 N (figure). **(5)**

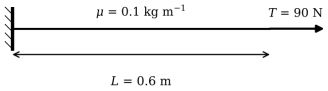
(a) Find the speed of transverse waves on the string. (1)

(b) Find the wavelength of the fundamental mode. (1)

(c) Find the fundamental frequency. (1)

(d) Find the frequency of the fourth harmonic. (1)

(e) Find the fundamental frequency if the tension is made four times. (1)



OR

Two harmonic waves of frequencies 11 Hz and 9 Hz and equal amplitude 1 unit are superposed. The figure shows the resultant displacement of a point of the medium against time.

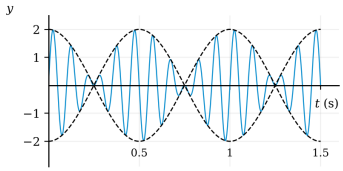
(a) What is this phenomenon called? (1)

(b) Find the beat frequency. (1)

(c) How many beats are heard in 3 s? (1)

(d) Find the frequency of the resultant wave (the average frequency). (1)

(e) What is the maximum amplitude of the resultant? (1)



— END OF QUESTION PAPER —