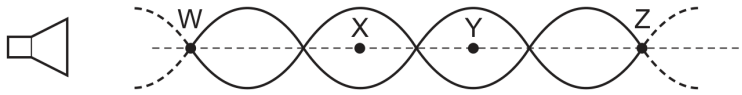
Unit 8: Superposition:

Subunit 8.1: Stationary waves:

Topical Question No: 1

24 The diagram represents the pattern of stationary waves formed by the superposition of sound waves from a loudspeaker and their reflection from a metal sheet (not shown).



W, X, Y and Z are four points on the line through the centre of these waves.

Which statement about these stationary waves is correct?

A An antinode is formed at the surface of the metal sheet.

B A node is a quarter of a wavelength from an adjacent antinode.

C The oscillations at X are in phase with those at Y.

D The air particles oscillate perpendicular to the line WZ.

Topical Question No: 2

25 A musical instrument called a bugle is a long tube with a mouthpiece at one end. The other end is open and flared, as shown.

A musician maintains stationary sound waves with a node at the mouthpiece and an antinode at the other end. The lowest frequency of sound that the bugle can produce is 92 Hz.

Which different frequencies of sound can be produced by the bugle?

A 92 Hz, 138 Hz, 184 Hz, 230 Hz, 276 Hz

B 92 Hz, 184 Hz, 276 Hz, 368 Hz, 460 Hz

C 92 Hz, 276 Hz, 460 Hz, 644 Hz, 828 Hz

D 92 Hz, 276 Hz, 828 Hz, 2484 Hz, 7452 Hz

Topical Question No: 3

27 A progressive wave is incident normally on a flat reflector. The reflected wave overlaps with the incident wave and a stationary wave is formed.

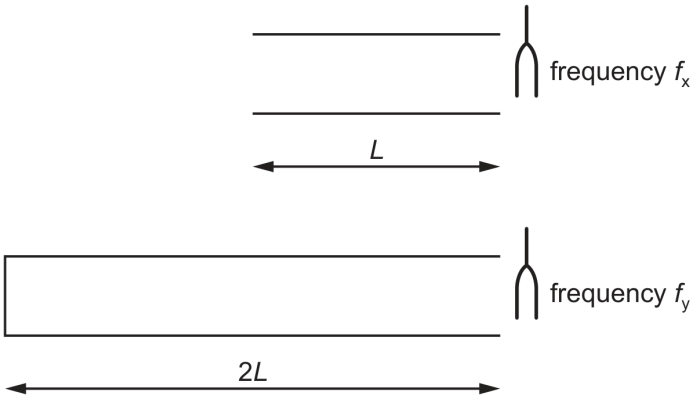
At an antinode, what could be the ratio $\frac{\text{displacement of the incident wave}}{\text{displacement of the reflected wave}}$ at any instant?

A –1 **B** 0 **C** 1 **D** 2

Topical Question No: 4

28 A tube of length L is open at both ends. A stationary wave is set up in this tube when a tuning fork vibrating with frequency f_x is held at one end. This is the lowest frequency of stationary wave that can be formed in this tube.

Another tube of length $2L$ is closed at one end. A stationary wave is set up in this tube when a tuning fork vibrating with frequency f_y is held at the open end. This is the lowest frequency of stationary wave that can be formed in this tube.



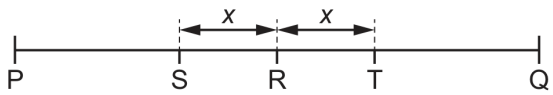
Assume the end correction for each tube is negligible.

Which equation is correct?

A $f_x = \frac{f_y}{4}$ **B** $f_x = \frac{f_y}{2}$ **C** $f_x = 2f_y$ **D** $f_x = 4f_y$

Topical Question No: 5

27 P and Q are fixed points at the end of a string. A transverse stationary wave of constant maximum amplitude is formed on the string.



P, R and Q are the only points on the string where nodes are formed. S and T are two points on the string at a distance x from R.

What is the relationship between points S and T?

A the same amplitude and in phase

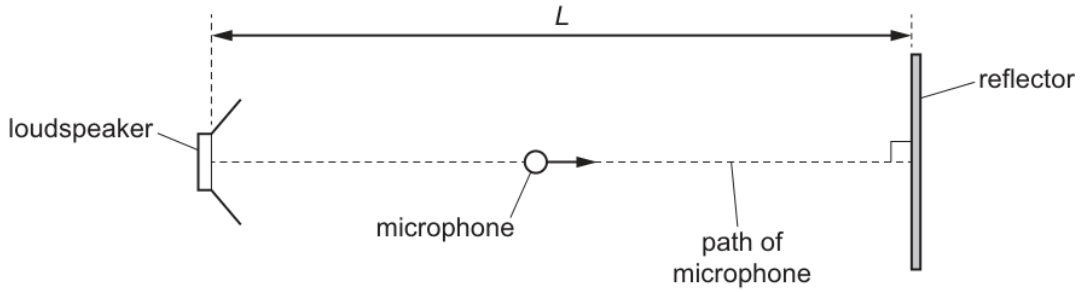
B different amplitudes and in phase

C the same amplitude and a phase difference of 180°

D different amplitudes and a phase difference of 180°

Topical Question No: 6

23 A loudspeaker emitting a sound wave of a single frequency is placed a distance *L* from a reflecting surface, as shown.



A stationary wave is formed with an antinode at the loudspeaker. A microphone is moved from the loudspeaker to the reflector.

Before the microphone reaches the reflector, it detects four points where the sound intensity is a minimum.

What is the wavelength of the sound wave?

A $\frac{2L}{9}$ **B** $\frac{2L}{8}$ **C** $\frac{4L}{9}$ **D** $\frac{4L}{8}$

Topical Question No: 7

25 A musical instrument is made using a long tube with a mouthpiece at one end. The other end is open and flared, as shown.

A musician maintains stationary sound waves with a node at the mouthpiece and an antinode at the other end. The lowest frequency of sound that the instrument can produce is 92 Hz.

Which different frequencies of sound can be produced by the instrument?

A 92 Hz, 138 Hz, 184 Hz, 230 Hz

B 92 Hz, 184 Hz, 276 Hz, 368 Hz

C 92 Hz, 276 Hz, 460 Hz, 644 Hz

D 92 Hz, 276 Hz, 828 Hz, 1288 Hz

Topical Question No: 8

26 Two waves of equal frequency and amplitude are travelling in opposite directions along a stretched string. When they meet, they form a stationary wave with three nodes and two antinodes.

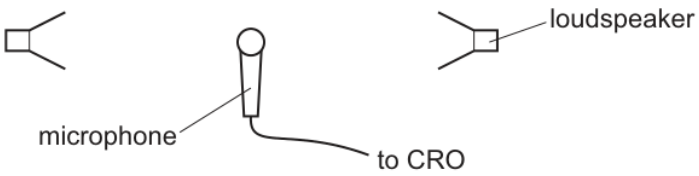
The frequency of both waves is doubled and a new stationary wave is formed.

How many antinodes are there in the new stationary wave?

A 1 **B** 2 **C** 3 **D** 4

Topical Question No: 9

29 Two loudspeakers are connected to the same signal generator. The signal generator produces a single frequency. The loudspeakers face each other so that a stationary sound wave is set up in the region between the loudspeakers.



A microphone is connected to a cathode-ray oscilloscope (CRO) and positioned between the two loudspeakers.

The microphone is moved along a line joining the two loudspeakers.

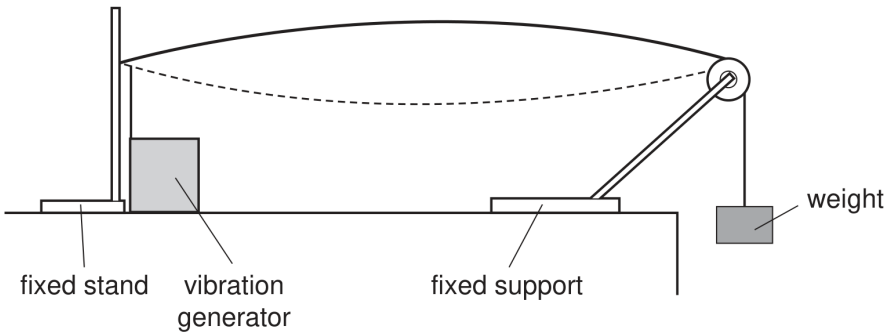
The signal on the CRO shows 5 maximum amplitudes as the microphone moves. The microphone moves a distance of 2.0 m from the position that gives the first maximum to the position that gives the fifth maximum.

What is the wavelength of the sound wave?

A 0.40 m **B** 0.50 m **C** 0.80 m **D** 1.0 m

Topical Question No: 10

22 The diagram shows a steel wire clamped at one end and tensioned at the other by a weight hung over a pulley.



A vibration generator is attached to the wire near the clamped end. A stationary wave with one loop is produced. The frequency of the vibration generator is *f*.

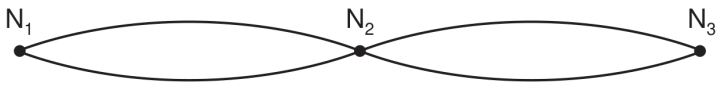
Which frequency should be used to produce a stationary wave with two loops?

A $\frac{f}{4}$ **B** $\frac{f}{2}$ **C** $2f$ **D** $4f$

Space for working

Topical Question No: 11

28 The diagram shows a standing wave on a string. The standing wave has three nodes N_1, N_2 and N_3.



Which statement is correct?

A All points on the string vibrate in phase.

B All points on the string vibrate with the same amplitude.

C Points equidistant from N_2 vibrate with the same frequency and in phase.

D Points equidistant from N_2 vibrate with the same frequency and the same amplitude.

Topical Question No: 12

25 A stationary wave is set up on a stretched string.

The diagram shows the string at two instants of time when it has maximum displacement.

The oscillations of point P on the string have amplitude *A*.

What is the distance moved by P from the position shown in the diagram after half a time period of the wave?

A 0 **B** *A* **C** 2*A* **D** 4*A*

Topical Question No: 13

31 A hollow tube is closed at one end and open at the other.

A stationary sound wave of the lowest possible frequency, 820 Hz, is produced in the tube.

The speed of sound in air is 330 $m\,s^{-1}$.

What is the length of the tube?

A 10 cm **B** 20 cm **C** 40 cm **D** 160 cm

Answer Key

1. N/A
2. N/A
3. N/A
4. N/A
5. N/A
6. C
7. C
8. D
9. D
10. N/A
11. N/A
12. N/A
13. A