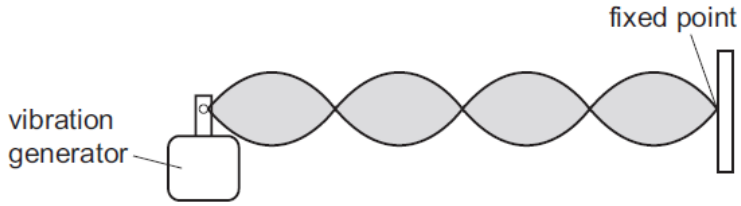
Stationary waves – 2023 June AS Physics 9702

1. June/2023/Paper_ 9702/11/No.26

A string is stretched between a vibration generator and a fixed point.

When the vibration generator is vibrating at a frequency *f*, a stationary wave with five nodes is created on the stretched string, as shown. There is a node at the end of the string that is attached to the vibration generator.



The frequency of vibration of the vibration generator is slowly increased.

What is the next frequency that produces a stationary wave on the string?

A 1.25*f* **B** 1.50*f* **C** 1.75*f* **D** 2.00*f*

2. June/2023/Paper_ 9702/12/No.25

A stationary wave is formed by two progressive waves travelling in opposite directions along the same line of travel.

Which statement about the two progressive waves is **not** correct?

A They must have a constant phase difference.

B They must have the same frequency.

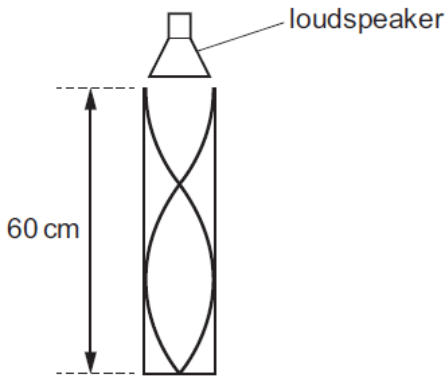
C They must have the same wavelength.

D They must travel at the same speed.

3. June/2023/Paper_ 9702/12/No.26

The sound from a loudspeaker placed above a tube causes resonance of the air in the tube.

A stationary wave is formed with two nodes and two antinodes, as shown.



The tube has height 60 cm.

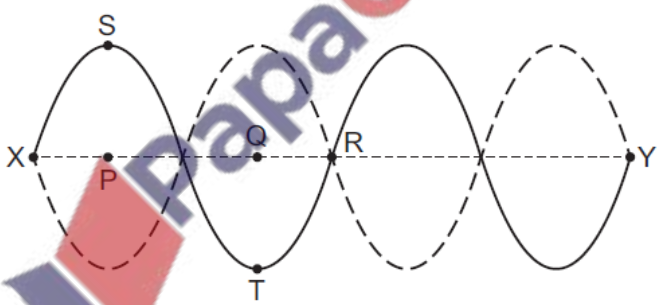
The speed of sound in the air is 340 m s^{-1}.

What is the frequency of the sound?

A 430 Hz **B** 570 Hz **C** 850 Hz **D** 1700 Hz

4. June/2023/Paper_ 9702/13/No.25

The diagram shows a string stretched between fixed points X and Y. There is a stationary wave on the string.



The solid curve shows the string at a position of maximum displacement at time t_0. The dashed curve shows the other position of maximum displacement. The straight central dashed line shows the mean position of the string.

Point S on the string is directly above point P. Point T on the string is directly below point Q.

Which statement is correct?

A A short time after t_0, point R on the string will be displaced.

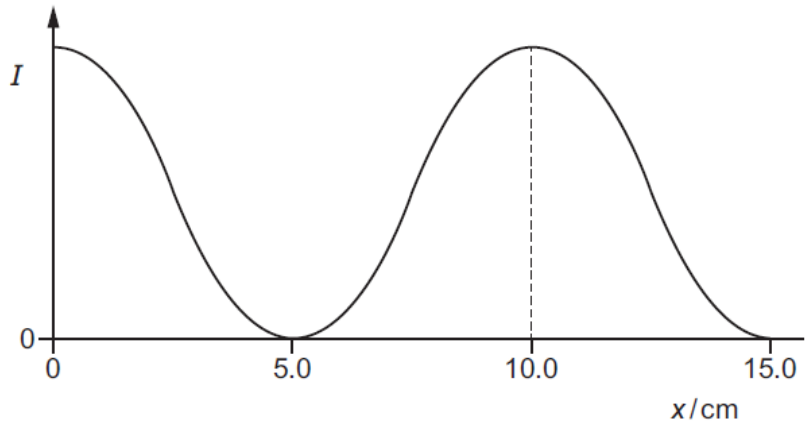
B A short time after t_0, points S and T on the string move in opposite directions.

C The distance between P and Q is one wavelength.

D Two moving points on the string that are equal distances from point R vibrate in phase.

5. June/2023/Paper_ 9702/13/No.26

The variation with distance x of the intensity I along a stationary sound wave in air is shown.



The speed of sound in air is $340\,m\,s^{-1}$.

What is the frequency of the sound wave?

A 1700 Hz **B** 2300 Hz **C** 3400 Hz **D** 6800 Hz

(b) A tube is closed at one end. A loudspeaker is placed near the other end of the tube, as shown in Fig. 5.1.

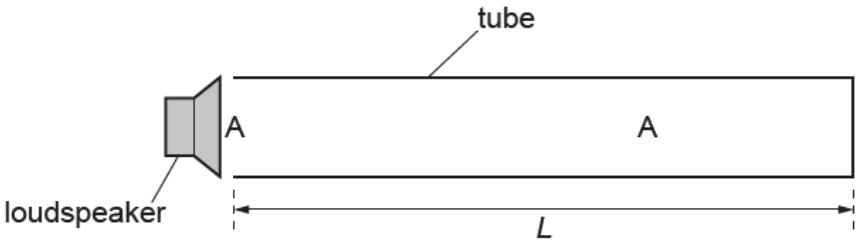


Fig. 5.1 (not to scale)

The loudspeaker emits sound of frequency 1.7 kHz. The speed of sound in the air in the tube is 340 $m s^{-1}$. A stationary wave is formed with an antinode A at the open end of the tube. There is only one other antinode A inside the tube, as shown in Fig. 5.1.

Determine:

(i) the wavelength of the sound

wavelength = ... m [2]

(ii) the length *L* of the tube

L = ... m [1]

(iii) the maximum wavelength of the sound from the loudspeaker that can produce a stationary wave in the tube.

maximum wavelength = ... m [1]

(d) A metal sheet is now placed in front of the loudspeaker in **(b)**, as shown in Fig. 4.3.

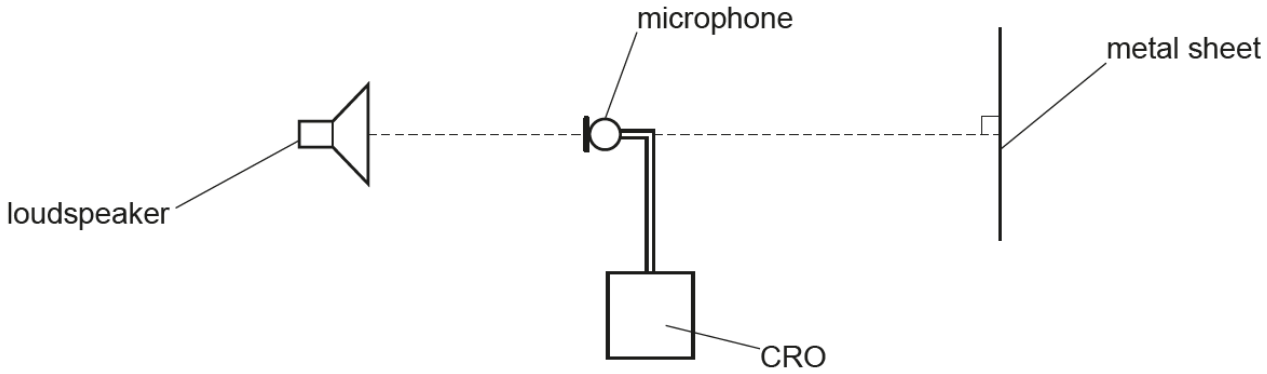


Fig. 4.3

A stationary wave is formed between the loudspeaker and the metal sheet.

(i) State the principle of superposition.

.....

.....

..... [2]

(ii) The initial position of the microphone is such that the trace on the CRO has an amplitude minimum. It is now moved a distance of 1.05 m away from the loudspeaker along the line joining the loudspeaker and metal sheet.

As the microphone moves, it passes through three positions where the trace has an amplitude maximum before ending at a position where the trace has an amplitude minimum.

Determine the wavelength of the sound wave.

wavelength = ... m [2]

(iii) Use your answers in **(b)(i)** and **(d)(ii)** to determine the speed of the sound in the air.

speed = ... $m s^{-1}$ [2]

[Total: 13]