9.1 Stationary Waves

Question Paper

Course	CIE A Level Physics (9702) 2019-2021
Section	9. Superposition
Topic	9.1 Stationary Waves
Difficulty	Hard

Time allowed: **10**

Score: **/10**

Percentage: **/100**

Question 1

A student was investigating the creation of stationary waves. They set up travelling waves with a wavelength of 20 cm in a closed pipe X and an open pipe Y. The lengths of the pipes are shown in the diagram.

In which pipe did the student observe stationary waves?

A X only

B X and Y

C Y only

D neither X or Y

[1 mark]

Question 2

Stationary sound waves can be produced in an organ pipe of length *l* when both ends are open, and this creates a note from an organ.

The speed of sound in the air column is v.

What is the lowest (fundamental) frequency of the note produced in the pipe?

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

[1 mark]

Question 3

A student was investigating the reflection of electromagnetic waves. They set up a transmitter 45 cm from a reflective surface, as shown in the diagram.

The waves had a frequency of 1.00 GHz. A stationary wave was produced with a node at the transmitter and a node at the surface.

How many antinodes are there in the space between the surface and the transmitter?

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

[1 mark]

Question 4

An investigation to sound waves reflected by a wall was carried out. The frequency *f* of the wave was adjusted until a stationary wave is formed with an antinode with a distance *x* closest to the wall.

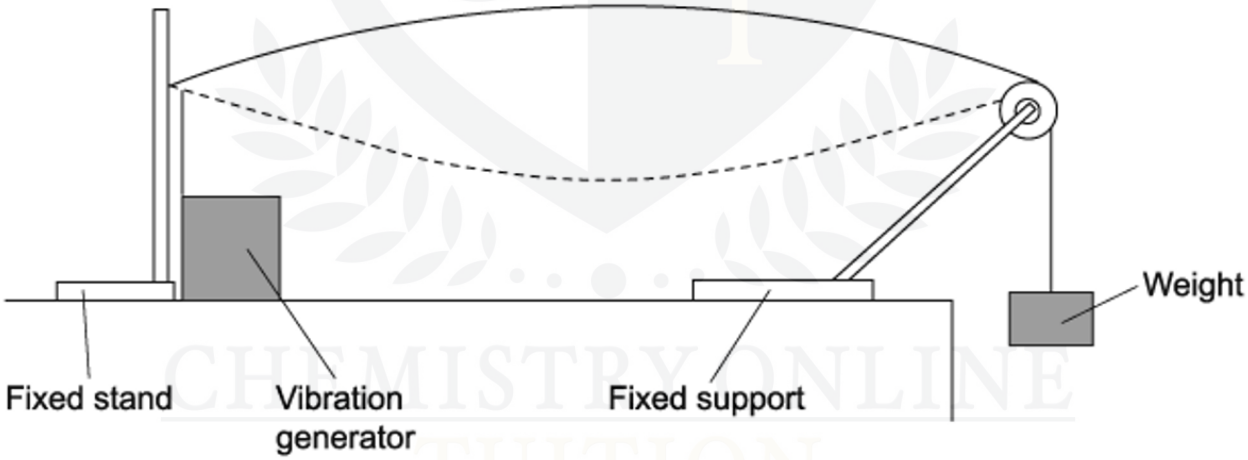
Which expression gives *f* in terms of *x* and the speed of sound *c*?

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

[1 mark]

Question 5

A steel wire was set up clamped at one end and placed under tension by a mass hung over a pully; this is shown in the diagram.



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

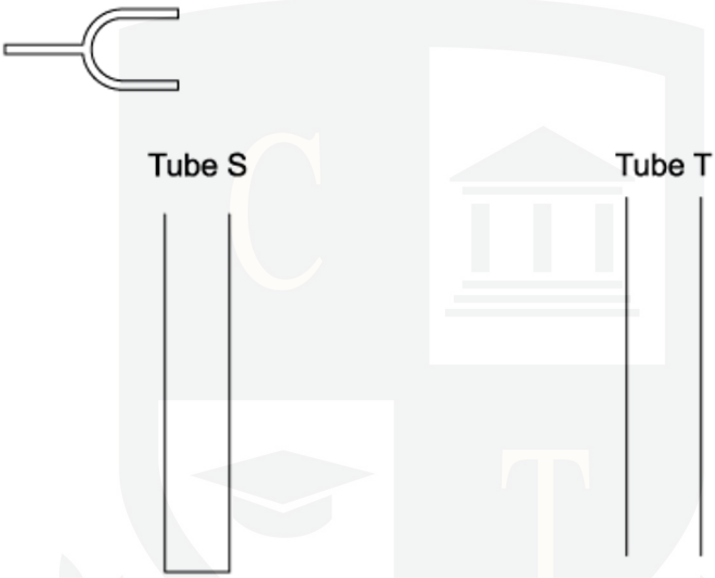
Which frequency should be used to produce two loops?

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

[1 mark]

Question 6

A student was investigating a tuning fork over two tubes. The tube were identical in length and size except tube S is closed at one end, and tube T is open at the lower end.



The tuning fork was placed above tube S and caused a resonance of the air at frequency *f*. No resonance is found at any lower frequency than *f* with tube S.

Which tuning fork will produce resonance when placed above tube T?

A a fork of frequency 2*f*

B a fork of frequency $\frac{3f}{2}$

C a fork of frequency $\frac{2f}{3}$

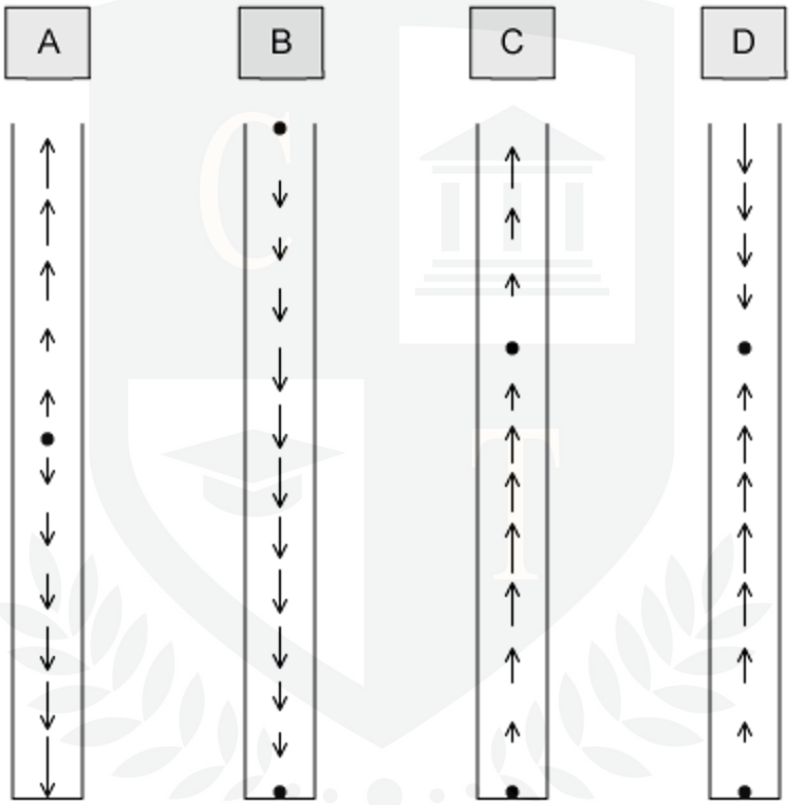
D a fork of frequency $\frac{f}{2}$

[1 mark]

Question 7

A pipe is used to set up a stationary longitudinal wave. The length of each arrow in the diagrams below shows the motion of the air molecules. The arrowheads show the direction of the motion of the particle.

Which diagram shows a stationary wave with two nodes and two antinodes?

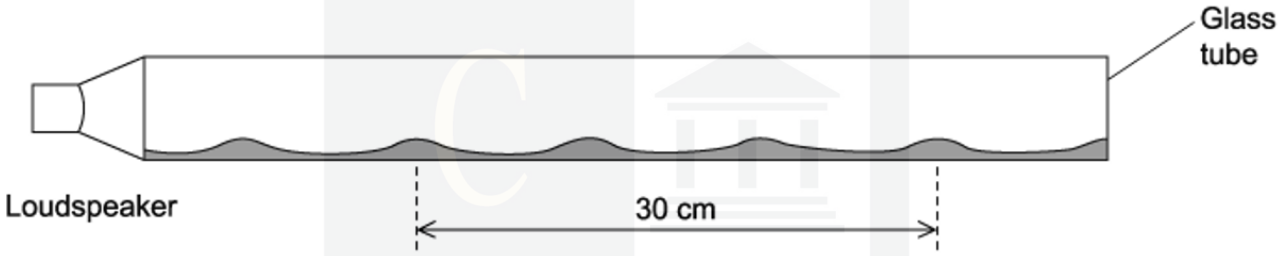


[1 mark]

Question 8

A glass tube closed at one end, with a layer of fine powder laid inside as shown in the diagram, was set up. Sound was emitted from the loudspeaker and placed near the open end of the tube.

The frequency of the sound wave was changed, at one frequency a stationary wave was formed, and the powder formed 4 heaps. The distance between the four heaps of powder was 30 cm.



The speed of sound in the tube is 330 m s^{-1}

What is the frequency of the sound?

A 6600 Hz **B** 1650 Hz **C** 3300 Hz **D** 2200 Hz

[1 mark]

Question 9

When a wind instrument is used to create a note, a stationary wave is produced in the column. An example of this is the horn.

For the range of notes produced by the horn, a node is formed at the mouthpiece and an antinode is formed at the bell. The frequency of the lowest note is 75 Hz.

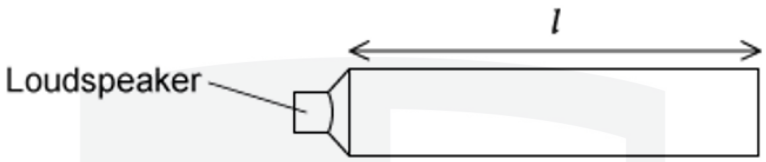
What would be the frequencies of the next two higher notes for this air column?

	first higher note / Hz	second higher note / Hz
A	225	375
B	150	300
C	150	225
D	113	150

[1 mark]

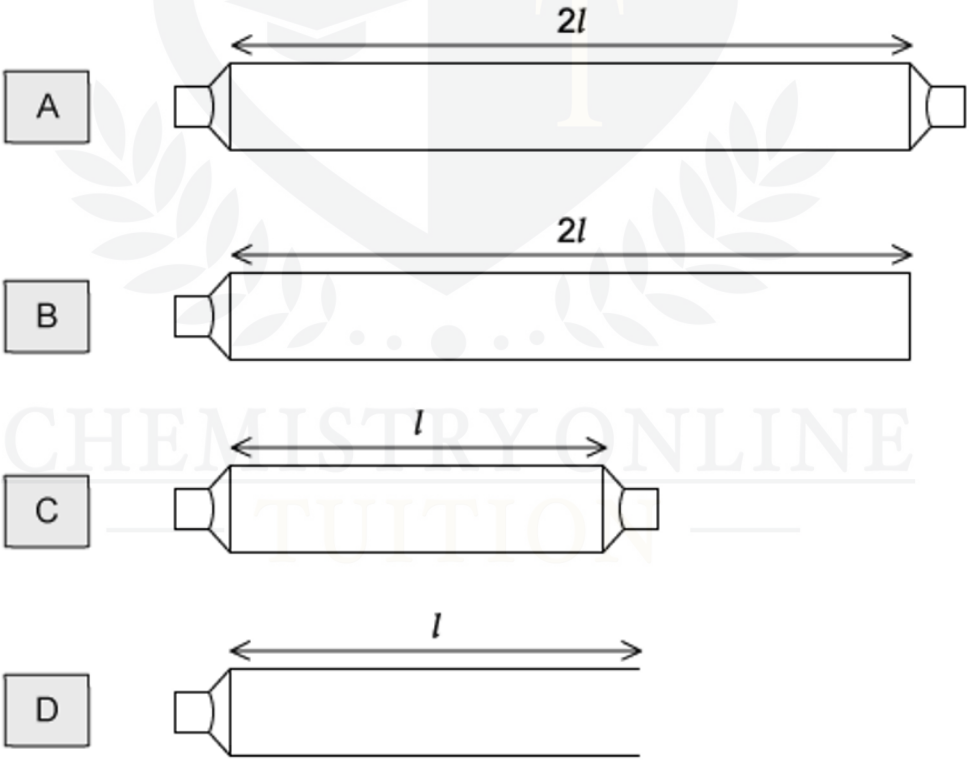
Question 10

A demonstration of a standing wave is set up using a loudspeaker. The loudspeaker is emitting sound with a frequency *f* and is placed at one end of the pipe with length *l*. The pipe is closed at the other end. This is shown in the diagram below.



Different pipes were set up with either one or two loudspeakers of frequency *f*. The pairs of loudspeakers were in phase with each other.

Which pipe would contain a standing wave?



[1 mark]