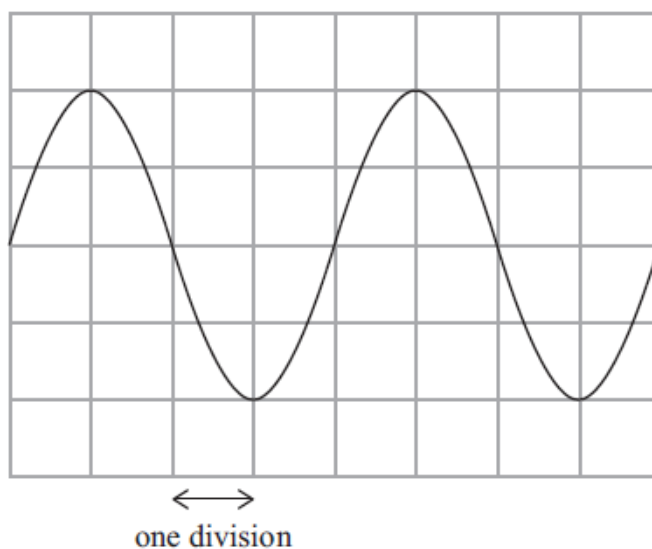


Questions

Q1.

Answer the question with a cross in the box you think is correct (☐). If you change your mind about an answer, put a line through the box (☐) and then mark your new answer with a cross (☐).

The diagram shows the trace of a sound wave on an oscilloscope.



One horizontal division represents a time of 5 ms.

Which of the following expressions gives the frequency of the sound wave in Hz?

☐ A 4×0.005

☐ B 2×0.005

☐ C $\frac{1}{2 \times 0.005}$

☐ D $\frac{1}{4 \times 0.005}$

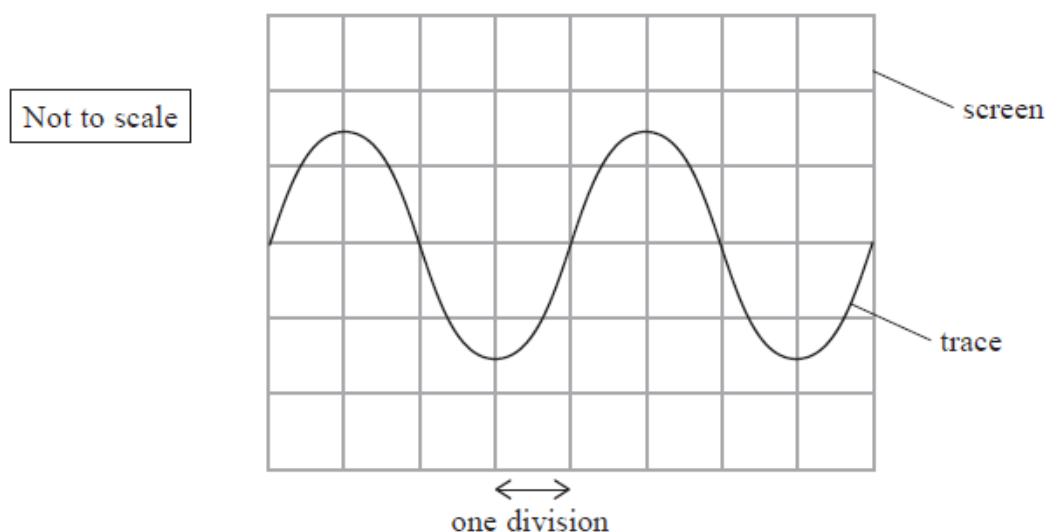
(Total for question = 1 mark)

Q2.

Answer the question with a cross in the box you think is correct ☐. If you change your mind about an answer, put a line through the box ☐ and then mark your new answer with a cross ☐.

A microphone is attached to an oscilloscope. The microphone detects a sound.

The trace displayed on the oscilloscope screen is shown.



One horizontal division represents a time of 0.015 s.

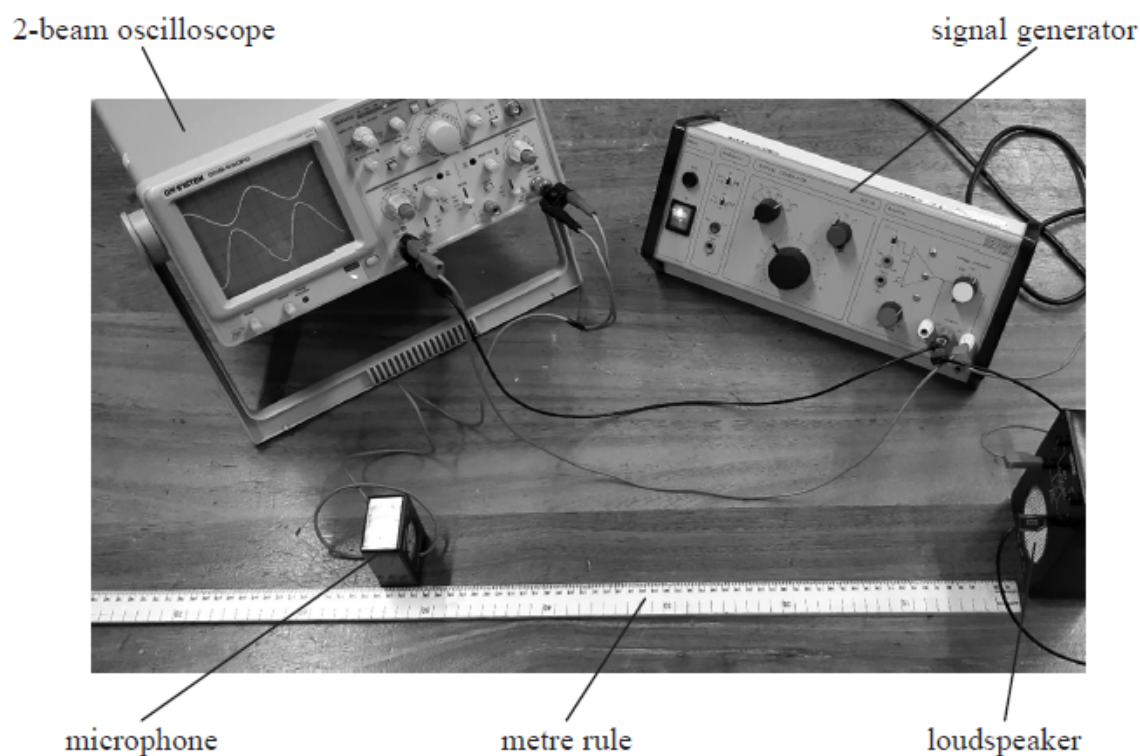
Which of the following expressions gives the frequency of the sound in Hz?

- ☐ A 4×0.015
- ☐ B 2×0.015
- ☐ C $\frac{1}{2 \times 0.015}$
- ☐ D $\frac{1}{4 \times 0.015}$

(Total for question = 1 mark)

Q3.

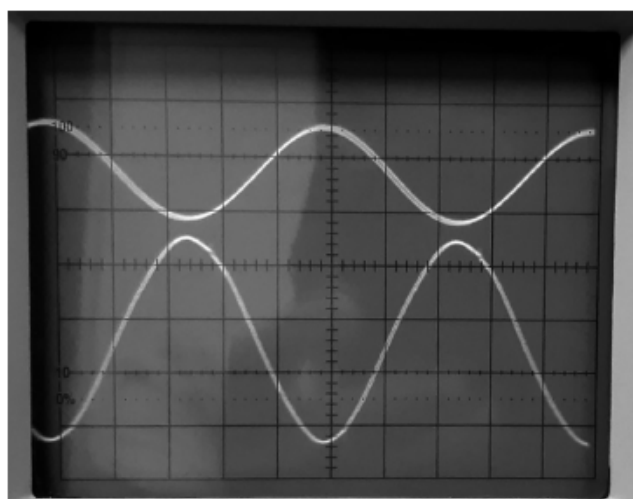
A student used the apparatus shown in Photograph 1 to determine the speed of sound in air.



Photograph 1

The student switched on the signal generator. The oscilloscope showed one trace from the signal generator and another trace from the microphone.

Initially the peaks of one trace were directly above the troughs of the other trace, as shown in Photograph 2.



Photograph 2

The horizontal axis of the oscilloscope screen represents time. The number of milliseconds per division on the horizontal scale is known.

(a) Explain how the apparatus shown in Photograph 1 could be used to determine the speed of sound in air.

(5)

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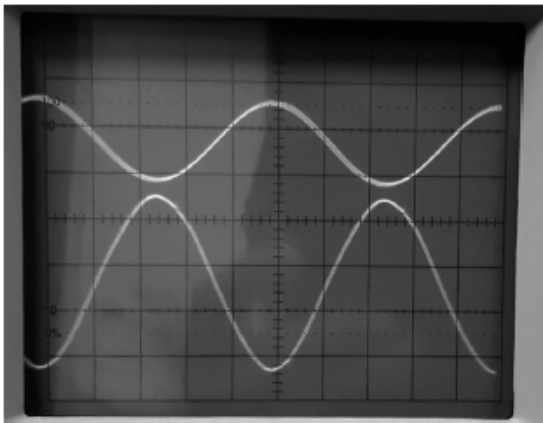
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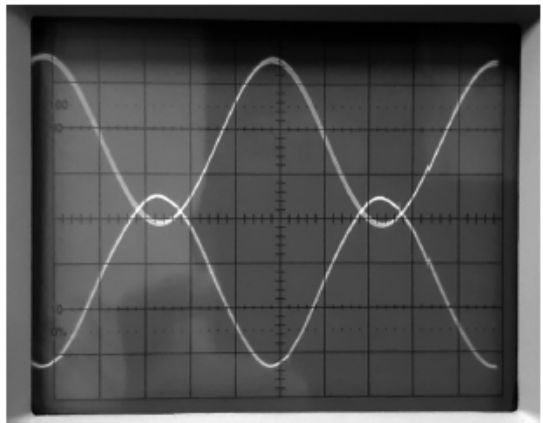
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(b) The student changed the position of the microphone. The traces on the oscilloscope screen before and after changing the position of the microphone are shown in Photograph 2 and Photograph 3.



Photograph 2



Photograph 3

Explain what change the student made to the position of the microphone between Photograph 2 and Photograph 3.

(3)

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(Total for question = 8 marks)

Q4.

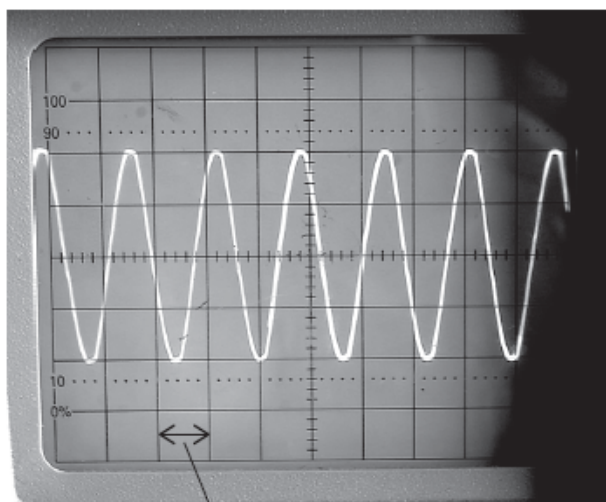
The photograph shows a musical instrument called panpipes.



(Source: © barisonal/Getty Images)

The instrument is made using pipes of different lengths. Blowing air across the top of one of the pipes produces a sound.

(a) A student connected a microphone to an oscilloscope. She then placed the microphone near to one of the pipes. The photograph below shows the oscilloscope screen when the pipe was producing a sound.



1 division

Calculate an accurate value for the frequency of the sound wave.

1 division = 1.5 ms

(3)

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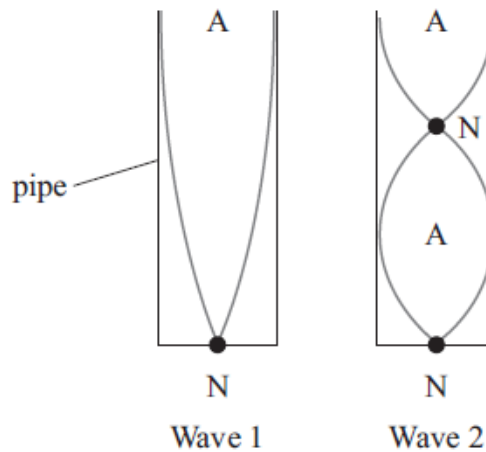
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Frequency =

(b) Each pipe is open at the top and closed at the bottom. When air is blown across the open end, a stationary wave is formed in the pipe.

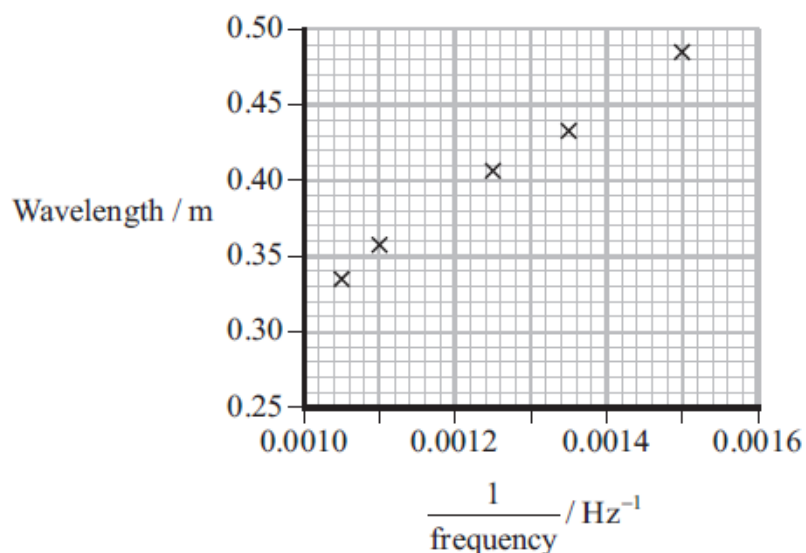
The student was able to produce two sounds from the same pipe. The diagram shows the nodes N and antinodes A in the stationary waves that caused each sound.



Explain how the frequency of wave 1 compares with the frequency of wave 2.

(3)

(c) The student determined the frequency and wavelength of sound waves produced in different pipes and plotted the graph shown.



Determine a value for the speed of sound.

(2)

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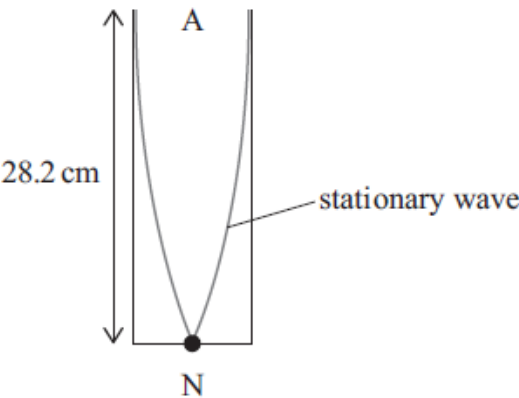
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Speed of sound =

(d) On another day the speed of sound was 340 ms^{-1} . The student produced a stationary wave using the longest pipe. The pipe has a length of 28.2 cm, as shown.



Determine the frequency of this wave.

(3)

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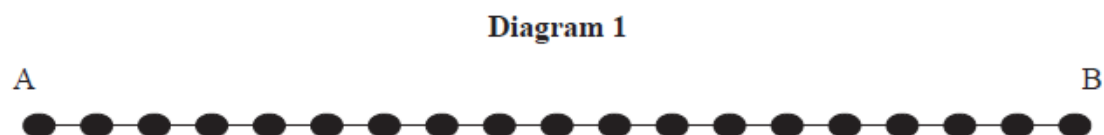
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Frequency =

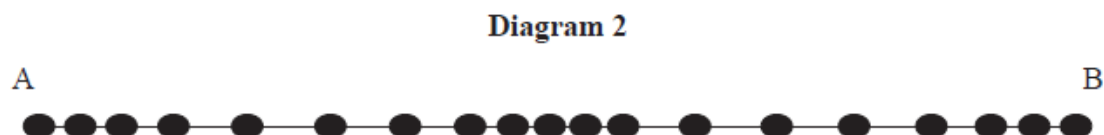
(Total for question = 11 marks)

A loudspeaker produces a sound wave in air.

(a) Diagram 1 shows air molecules before the sound wave passes.



At a particular instant as the sound wave passes, the air molecules are displaced as shown in Diagram 2.



(i) Label a point on Diagram 2 where the pressure of the air is a minimum.

(1)

(ii) Sketch a graph of displacement against distance for the air particles between A and B at this instant on the axes below.

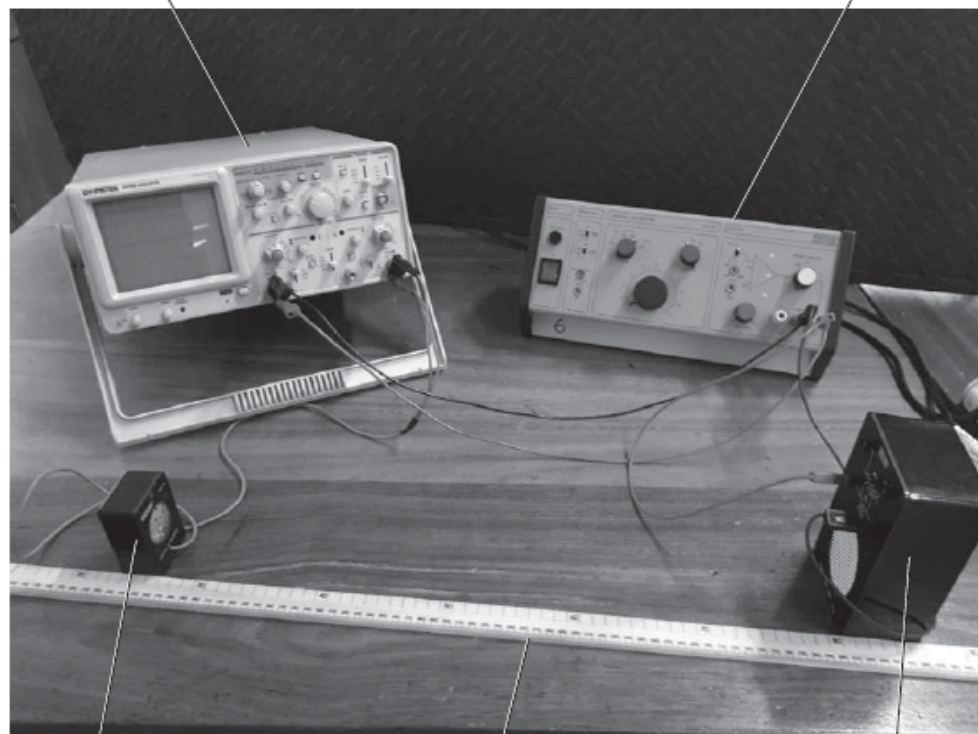


(2)

(b) The speed of sound can be determined using the apparatus shown.

2-beam oscilloscope

signal generator



microphone

metre rule

loudspeaker

When the loudspeaker is switched on, two traces are produced on the oscilloscope, one directly from the signal generator and the other from the microphone.

(i) Describe how a value for the speed of sound in air can be determined.

(5)

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(ii) Describe how the oscilloscope display can be used to demonstrate that the two traces have the same frequency.

(2)

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(iii) A frequency of 15.0 kHz was used. A student suggested that the experiment would give a more accurate result for the speed of sound if a frequency of 4.0 kHz was used.

Evaluate the student's suggestion. You should use a calculation in your answer.

speed of sound in air = 340 m s⁻¹

(3)

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(Total for question = 13 marks)