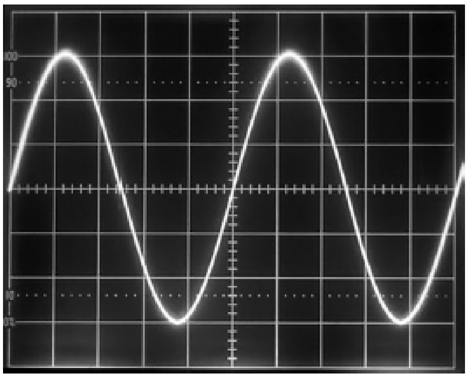
Questions

Q1.

In an investigation to determine the speed of sound in air, a student sets up an oscilloscope to display the waveform of a sound wave as shown.



The timebase is set to 25 μs / division.

The student sets the timebase on the oscilloscope to a lower value per division.

Describe any changes to the appearance of the waveform on the screen.

(1)

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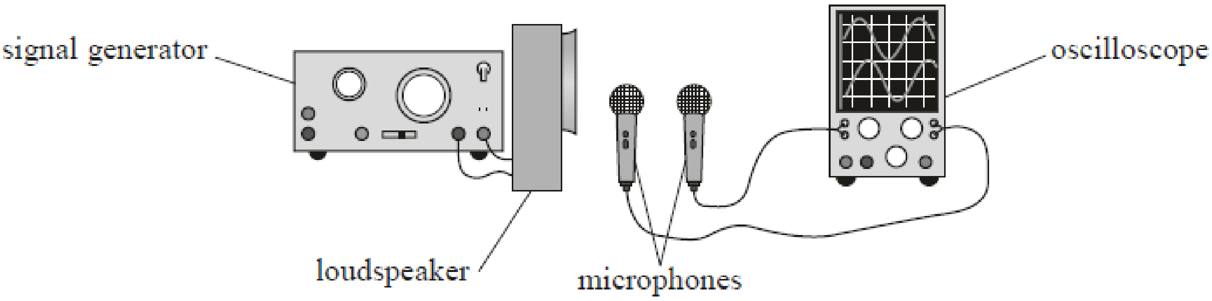
(Total for question = 1 mark)

Q2.

In an experiment to determine the speed of sound in air, a 2-beam oscilloscope is used to display the signals from two microphones. The microphones are placed in front of a loudspeaker that is connected to a signal generator.



The loudspeaker emits a sound of frequency *f*.

The microphones are placed at different distances from the loudspeaker. The time taken for the sound to travel from the first microphone to the second is *t*.

Which of the following expressions gives the phase difference between the two signals?

☒ **A** πtf

☒ **B** $2\pi tf$

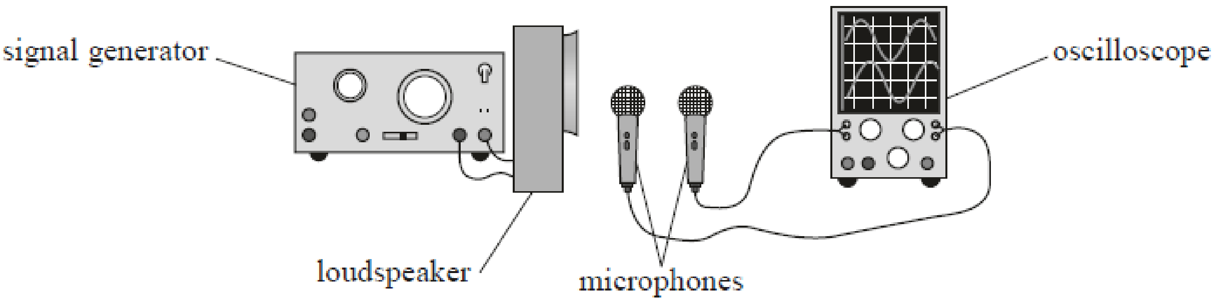
☒ **C** $\frac{\pi f}{t}$

☒ **D** $\frac{2\pi f}{t}$

(Total for question = 1 mark)

Q3.

In an experiment to determine the speed of sound in air, a 2-beam oscilloscope is used to display the signals from two microphones. The microphones are placed in front of a loudspeaker that is connected to a signal generator.



The loudspeaker emits a sound of frequency *f*.

The microphones are placed at equal distances from the loudspeaker. The signals are in phase. One of the microphones is moved further away from the loudspeaker. Initially the signals become out of phase. After moving the microphone a distance *d* the signals are back in phase.

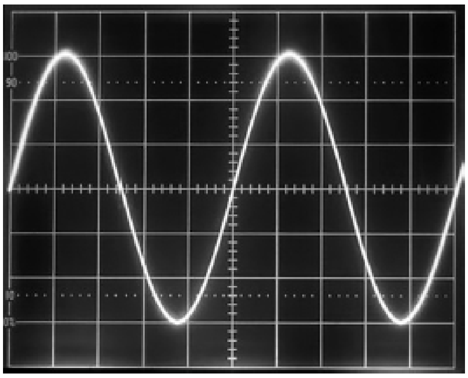
Which of the following expressions gives the speed of sound?

- ☐ **A** $2fd$
- ☐ **B** fd
- ☐ **C** $\frac{2d}{f}$
- ☐ **D** $\frac{d}{f}$

(Total for question = 1 mark)

Q4.

In an investigation to determine the speed of sound in air, a student sets up an oscilloscope to display the waveform of a sound wave as shown.



The timebase is set to 25 μs / division.

Determine the frequency of the sound wave.

(2)

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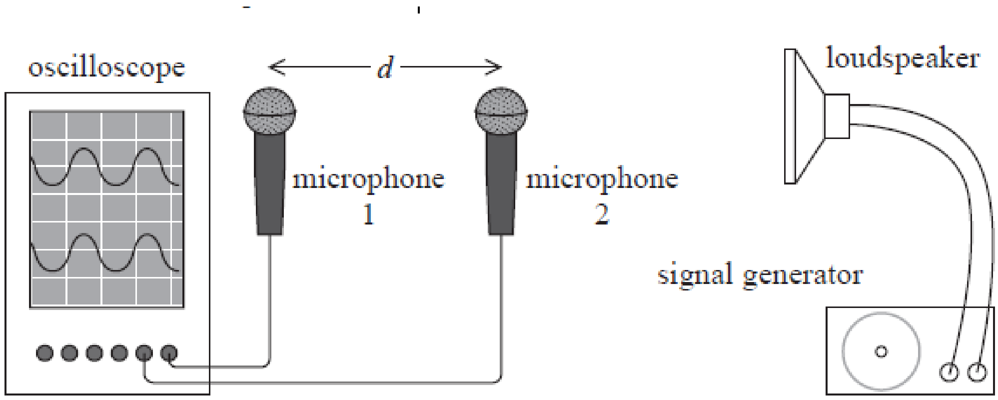
Frequency = ...

(Total for question = 2 marks)

Q5.

In an experiment to determine the speed of sound in air a student connected two microphones to an oscilloscope, as shown.



The microphones detect sound from the loudspeaker, converting it to an electrical signal. The signal is displayed on the oscilloscope screen.

Both microphones were initially positioned the same distance from the loudspeaker. The two signals were in phase on the oscilloscope screen. The student slowly moved microphone 2 towards the loudspeaker, until the two signals on the oscilloscope were in phase again. He then measured the distance d between the microphones to determine the wavelength λ of the sound waves.

d = 20.5cm

Comment on the student's experimental technique to determine λ.

(2)

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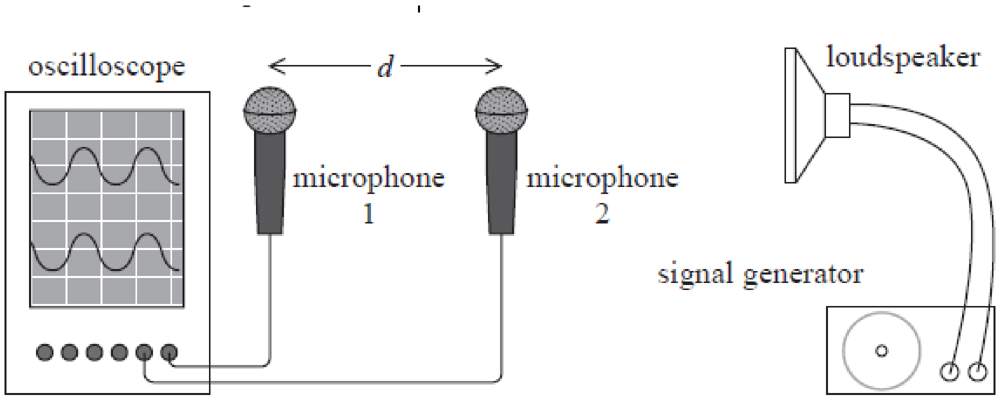
(Total for question = 2 marks)

Q6.

In an experiment to determine the speed of sound in air a student connected two microphones to an oscilloscope, as shown.

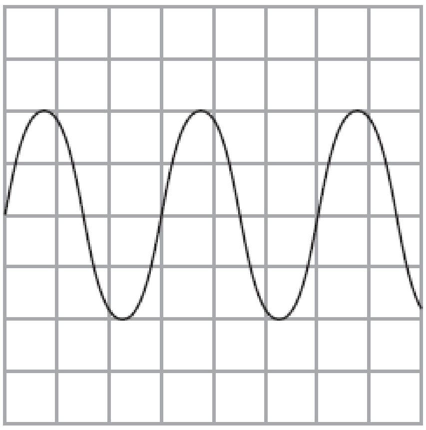


The microphones detect sound from the loudspeaker, converting it to an electrical signal. The signal is displayed on the oscilloscope screen.

Both microphones were initially positioned the same distance from the loudspeaker. The two signals were in phase on the oscilloscope screen. The student slowly moved microphone 2 towards the loudspeaker, until the two signals on the oscilloscope were in phase again. He then measured the distance *d* between the microphones to determine the wavelength λ of the sound waves.

d = 20.5cm

The oscilloscope trace for the signal from microphone 1 is shown below.



The time base of the oscilloscope was set to 0.20 ms div^{-1}.

Determine a value for the speed of sound in air.

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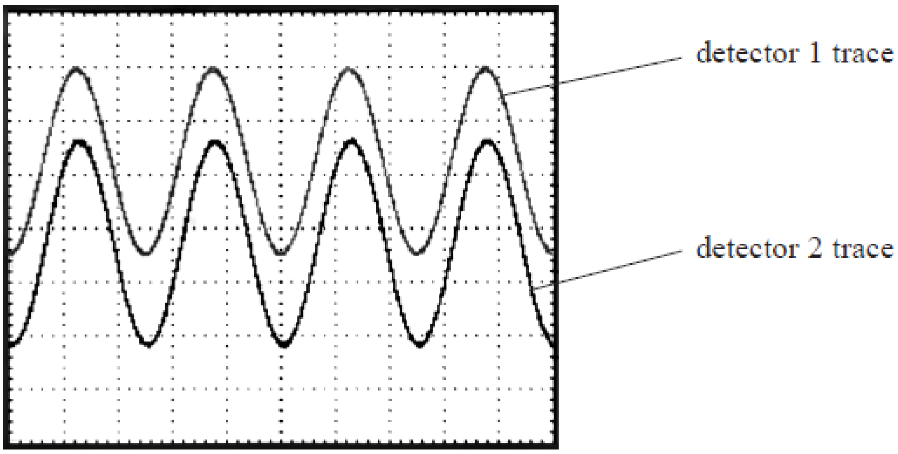
Speed of sound = ...

(Total for question = 5 marks)

Q7.

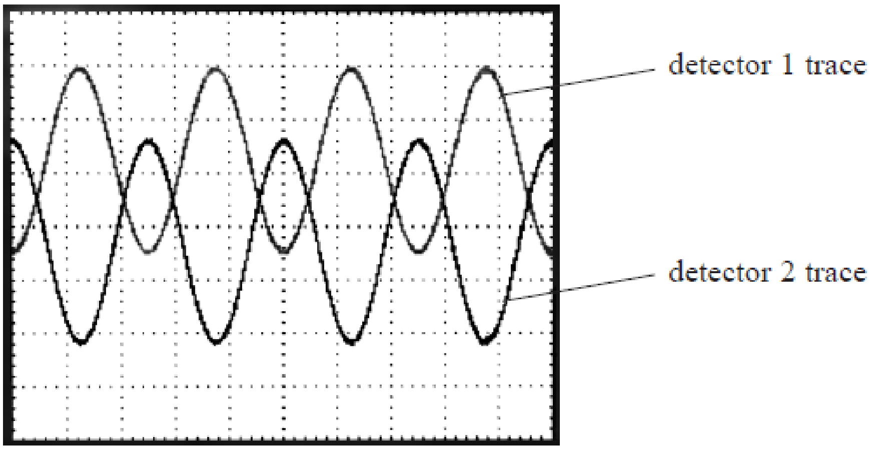
An ultrasound source and two ultrasound detectors are set up as shown.

The detectors are connected to an oscilloscope and photograph 1 shows the traces that are recorded.



photograph 1

Detector 2 is moved slightly further away from the source and photograph 2 shows the traces that are recorded.



photograph 2

(a) Explain the change in the traces between photograph 1 and photograph 2.

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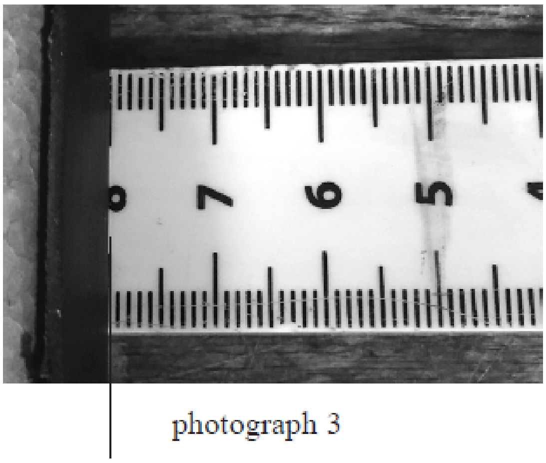
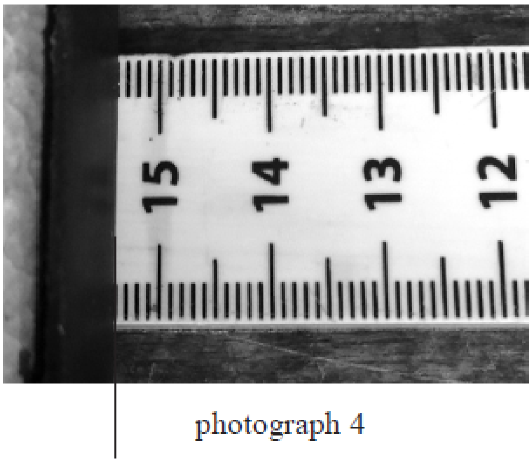
(b) Detector 2 is moved back to its original position, alongside detector 1. Detector 2 is then steadily moved away from the source. This produces the traces seen in photograph 2 then photograph 1 alternately, until nine such cycles have been seen.

The detector moves across a metre rule and the initial and final position of the detector are shown in photograph 3 and photograph 4.



photograph 3



photograph 4

Calculate, using the results of this experiment, the speed of sound in air.

frequency of ultrasound = 40.0 kHz

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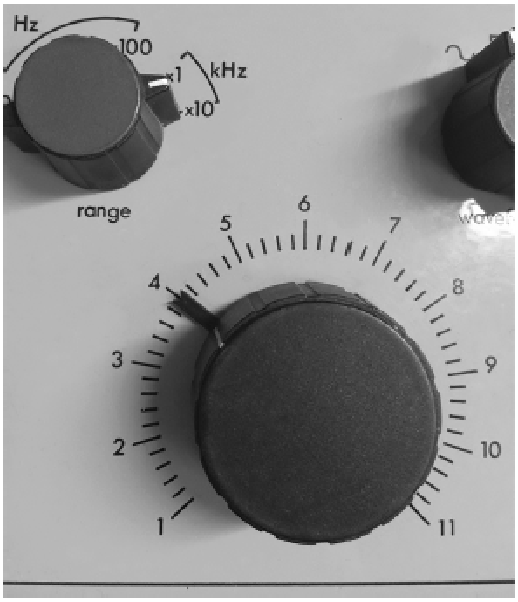
Speed of sound in air = ...

(c) The ultrasound was produced using a signal generator.

The frequency of the ultrasound was measured by reading from the dial of the signal generator as shown.



Explain one limitation of this method of determining the frequency.

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(Total for question = 9 marks)