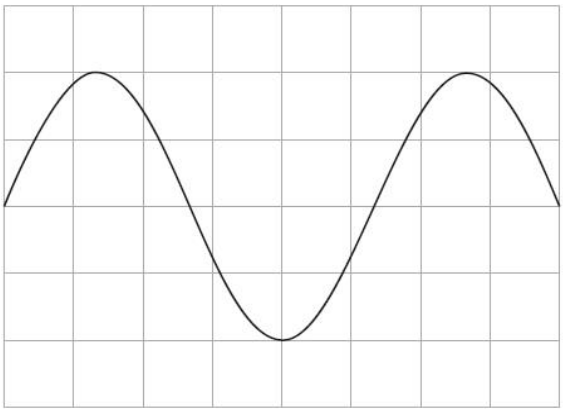
Sound Waves Practical Questions

Practical: Investigate the frequency of a sound wave using an oscilloscope.

Q1.

The diagram shows the screen of an oscilloscope when a sound wave is detected, and the oscilloscope settings.



oscilloscope settings:

y direction: 1 square = 5.0V
x direction: 1 square = 0.0020 s

(a) Give the name of the piece of equipment that is connected to the oscilloscope to detect the sound wave.

(1)

.....

(b) (i) Use the trace on the oscilloscope to determine the time period of the detected sound wave.

(2)

time period = ... s

(ii) Calculate the frequency of the detected sound wave.

(1)

frequency = ... Hz

(Total for question = 4 marks)

Q2.

The photograph shows an oscilloscope.

© dny3d/Shutterstock

An oscilloscope can be used to determine the frequency of a sound wave.

(a) (i) Name the piece of equipment that should be used with an oscilloscope to detect a sound wave.

(1)

.....

(ii) Describe how an oscilloscope can be used to measure the time period of a sound wave.

(2)

.....

.....

.....

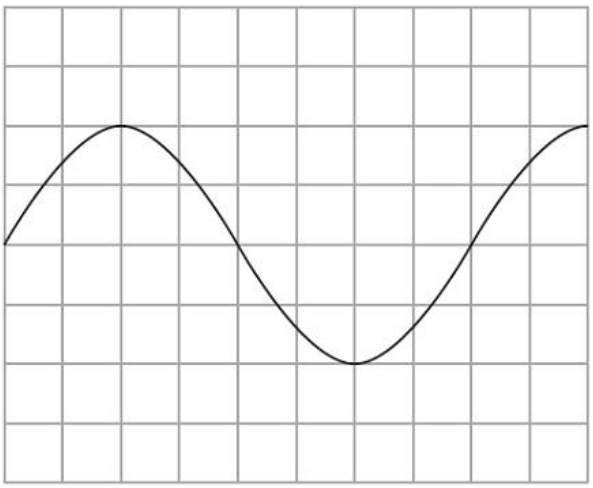
.....

.....

.....

(b) Diagram 1 shows an oscilloscope screen when a sound wave is detected.

It also shows the settings of the oscilloscope.



Oscilloscope settings

y direction: 1 square = 2 V
x direction: 1 square = 5×10^{-6} s

Diagram 1

(i) Determine whether the sound can be heard by humans.
Include a calculation of frequency in your answer.

(4)

.....

.....

(ii) The oscilloscope settings are changed, as shown in Diagram 2.

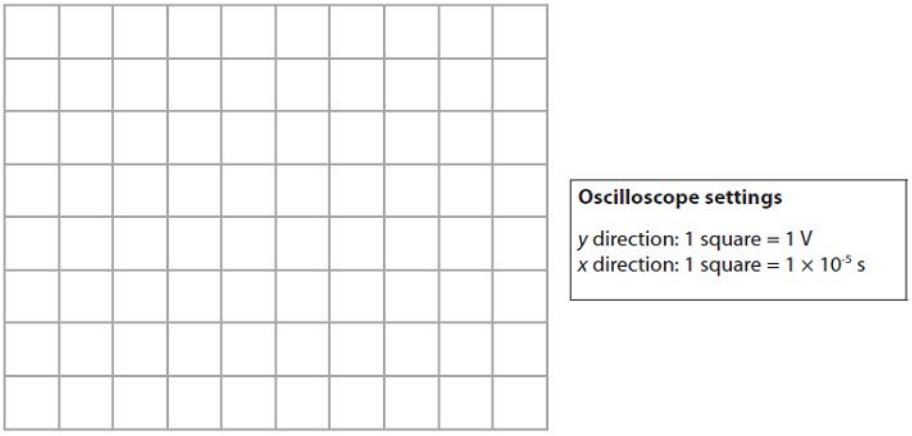


Diagram 2

On Diagram 2, draw the wave that would be displayed on the oscilloscope screen if the same sound wave is detected using these new settings.

(2)

(Total for question = 9 marks)

Q3.

Sound waves with a frequency above the range of human hearing are known as ultrasound.

(a) State the frequency range for human hearing.

(2)

.....

(b) The frequency of ultrasound waves can be determined using an oscilloscope.

(i) Give the name of the piece of apparatus that could be connected to the oscilloscope to detect the ultrasound waves.

(1)

.....

(ii) The time period of the ultrasound waves must be measured to determine their frequency.

Describe how the oscilloscope is used to measure the time period of the ultrasound waves.

(3)

.....

.....

.....

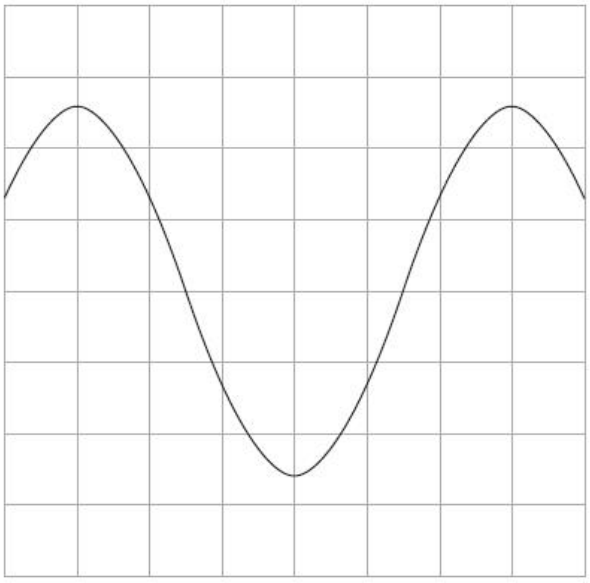
.....

.....

.....

(c) The diagram shows the oscilloscope screen when an ultrasound wave is detected.

The oscilloscope settings are also shown.



oscilloscope settings:

y direction: 1 square = 2V

x direction: 1 square = 5×10^{-6} s

(i) Determine the time period of the ultrasound waves.

(2)

time period = ... s

(ii) Calculate the frequency of the ultrasound waves.

(2)

frequency = ... Hz

(Total for question = 10 marks)

Q4.

A student uses this method to investigate the speed of sound in air.

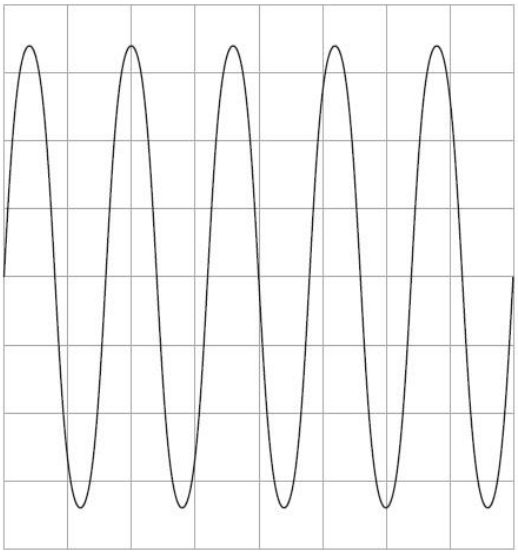
- set up an oscilloscope to detect and display a sound wave
- use a computer and a speaker to produce a sound of known wavelength
- use the oscilloscope to determine the frequency of the sound wave
- use a formula to calculate the speed of sound

(a) Give the name of the equipment that should be connected to the oscilloscope to detect the sound wave.

(1)

.....

(b) The diagram shows the oscilloscope screen and the oscilloscope settings.



Oscilloscope settings

y direction: 1 square = 5 mV

x direction: 1 square = 0.5 ms

(i) Determine the frequency of the sound wave.

(4)

frequency = ... Hz

(ii) The wavelength of the sound wave is 27 cm.
Calculate the speed of sound.

(3)

speed of sound = ... m/s

(iii) Describe how the oscilloscope could be adjusted to show fewer wave cycles on the screen.

(2)

.....

.....

.....

.....

.....

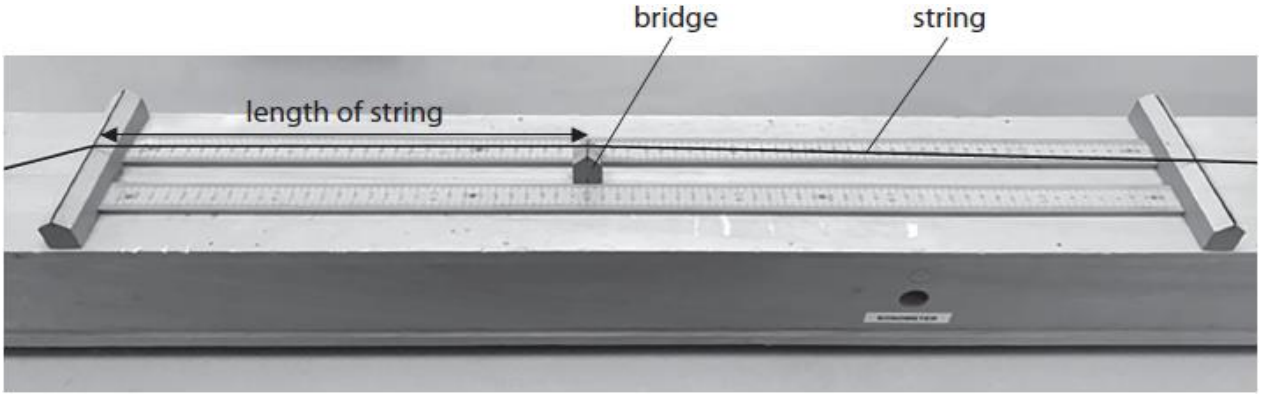
.....

(Total for question = 10 marks)

Q5.

A sonometer is a piece of equipment used to investigate the frequency of waves on a string.

The photograph shows a sonometer.



The string is under tension. When the string is plucked it vibrates to produce a sound wave.

(a) Describe how an oscilloscope should be used to measure the frequency of the sound wave from the sonometer.

(4)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(b) A student investigates how the frequency of sound from the sonometer varies with the length of the string.

This is the student's method.

- apply a constant tension force to the string
- pluck the string and measure the frequency of the sound wave produced
- move the bridge to change the length of the string
- pluck the string and measure the new frequency of the sound wave produced

Repeat the method for different lengths of string.

(i) Give a control variable for the student's investigation.

(1)

.....

(ii) The table shows the student's results.

String length in cm	Frequency in Hz			
	Test 1	Test 2	Test 3	Mean
20	105	104	108	106
40	53	54	52	53
60	36	32	35	
80	25	28	26	26
100	22	20	21	21
120	20	17	18	18
140	15	15	14	15

Calculate the mean frequency for a string length of 60 cm.

(2)

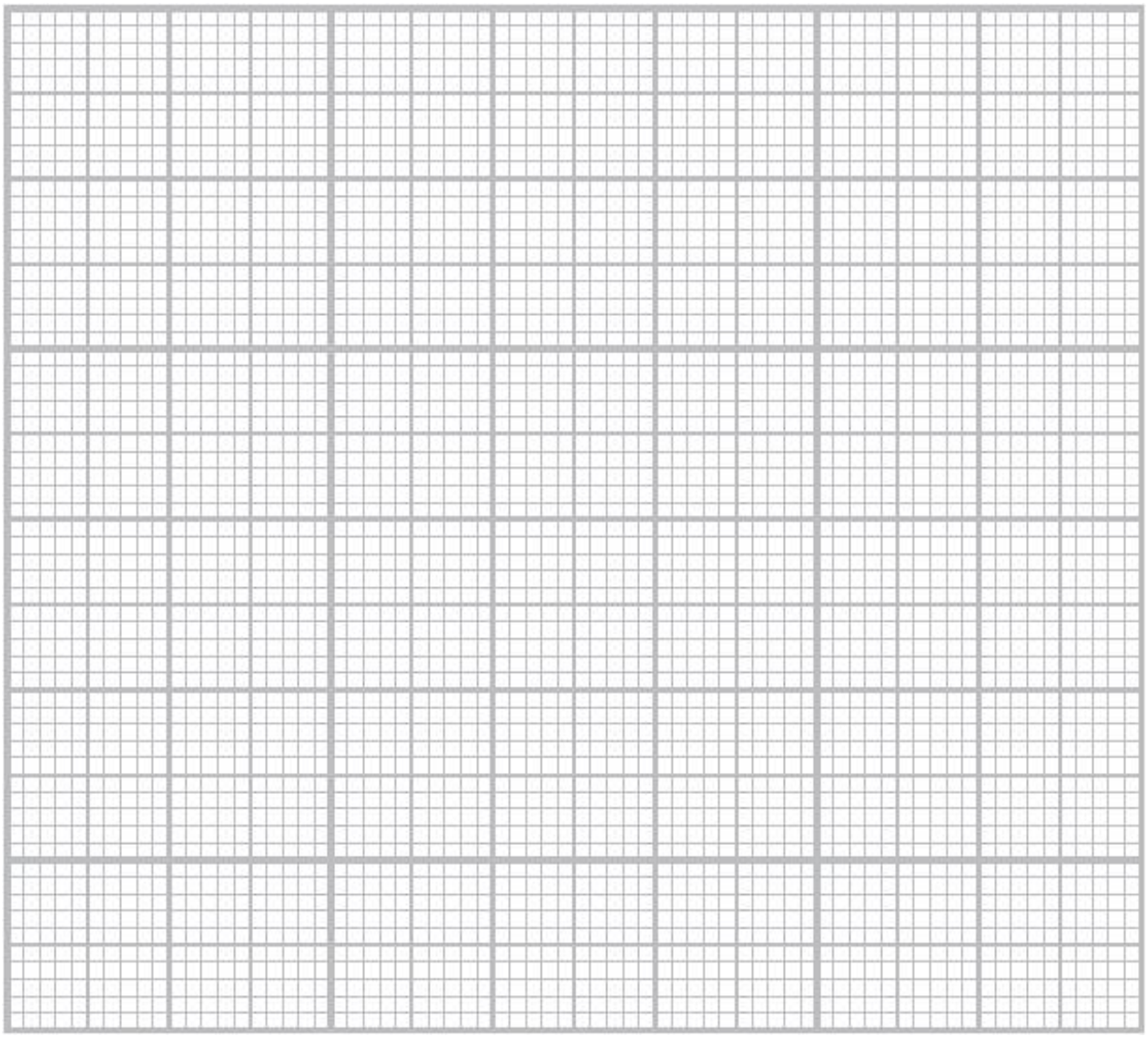
mean frequency = ... Hz

(iii) Plot a graph of the mean frequency and string length data on the grid.

(3)

(iv) Draw the curve of best fit.

(1)



(v) Determine the string length needed to produce a sound wave of frequency 75 Hz.

(1)

string length = ... cm

(vi) The student cannot hear the sound from the sonometer for some of the string lengths tested. Explain which of the string lengths produce sounds that humans cannot hear.

(2)

.....

.....

.....

.....

(Total for question = 14 marks)

Practical: Investigate the speed of sound in air.

Q6.

This question is about sound waves.

(a) Describe an experiment to measure the speed of sound in air.

You may draw a diagram to help your answer.

(5)

.....

.....

.....

.....

.....

.....

.....

.....

.....

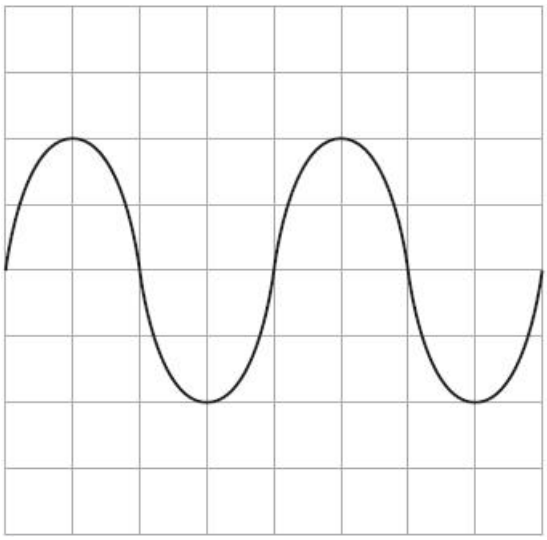
.....

.....

.....

(b) An oscilloscope can be used to determine the frequency of a sound wave.

The diagram shows an oscilloscope trace of a sound wave.



Oscilloscope settings

y direction: 1 square = 1 V

x direction: 1 square = 0.25 ms

(i) Calculate the period of this sound wave.

(3)

period = ... s

(ii) Calculate the frequency of this sound wave.

(2)

frequency = ... Hz

(Total for question = 10 marks)

Q7.

Two students do an experiment to measure the speed of sound in air.

They use two blocks of wood that make a loud noise when hit together.

They do their experiment outside in a wide-open space.

(a) Describe how the students should use their equipment to measure the speed of sound in air.
You may draw a diagram to support your answer.

(5)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(b) The table shows the students' results.

Distance in m	Time in s			
	Trial 1	Trial 2	Trial 3	Mean
50	0.46	0.35	0.49	0.43
100	0.50	0.38	0.62	0.50
150	0.42	0.64	0.57	0.54
200	0.68	0.59	0.60	0.62
250	0.58	0.79	0.75	0.71
300	0.90	0.86	0.84	

(i) Calculate the mean time for the last row in the table.

(2)

mean time = ... s

(ii) The students think that some of their time readings are anomalous.
State how the students should deal with these anomalous readings.

(1)

.....

.....

(iii) Explain which distance in the table is likely to give the most accurate value for the speed of sound in air.

(2)

.....

.....

.....

.....

.....

(Total for question = 10 marks)

Q8.

A student investigates the speed of sound in air.

(a) The student sets up two microphones, A and B, as shown in Diagram 1.

Diagram 1

The microphones are connected to a datalogger.
A sound is made to the left of microphone A.
The datalogger records the time when the sound wave reaches each microphone.
The student uses the data to calculate the time taken for the sound wave to travel from microphone A to microphone B.

(i) Describe how the student could determine the speed of sound in air using his calculated value of time taken.

(3)

.....

.....

.....

.....

.....

.....

(ii) Suggest why the student does not use a stop clock in this investigation.

(1)

.....

.....

.....

(b) The student investigates how the speed of sound in air varies with temperature.

He places several Bunsen burners in the space between the microphones, as shown in diagram 2.

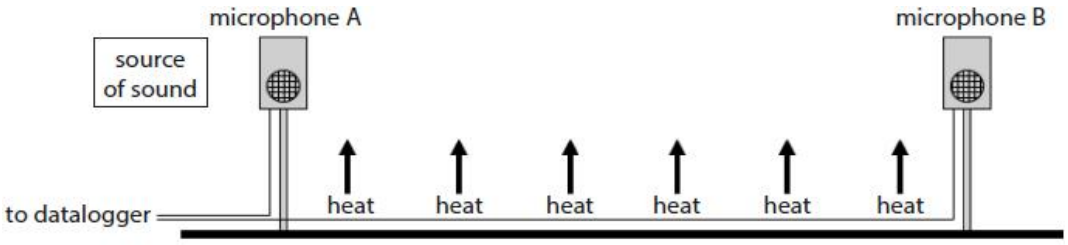


Diagram 2

He uses this method

- light all the Bunsen burners on a low heating flame
- measure the air temperature in three places between the microphones using three temperature sensors
- use the datalogger to record the time taken for a sound wave to travel from microphone A to microphone B
- determine the speed of sound

The student repeats this method as the air temperature increases.

(i) Suggest why it is important for all the Bunsen burners to burn the same amount of gas each second.

(1)

.....

.....

.....

(ii) The table shows the student's results.

Temperature in °C				Time in ms	Speed in m/s
sensor 1	sensor 2	sensor 3	mean		
20.3	20.2	19.9	20.1	4.37	344
29.9	31.3	30.0	30.4	4.29	350
39.7	41.0	39.0	39.9	4.22	358
51.0	50.2	49.3	50.2	4.15	362
59.8	61.5	58.6		4.08	368

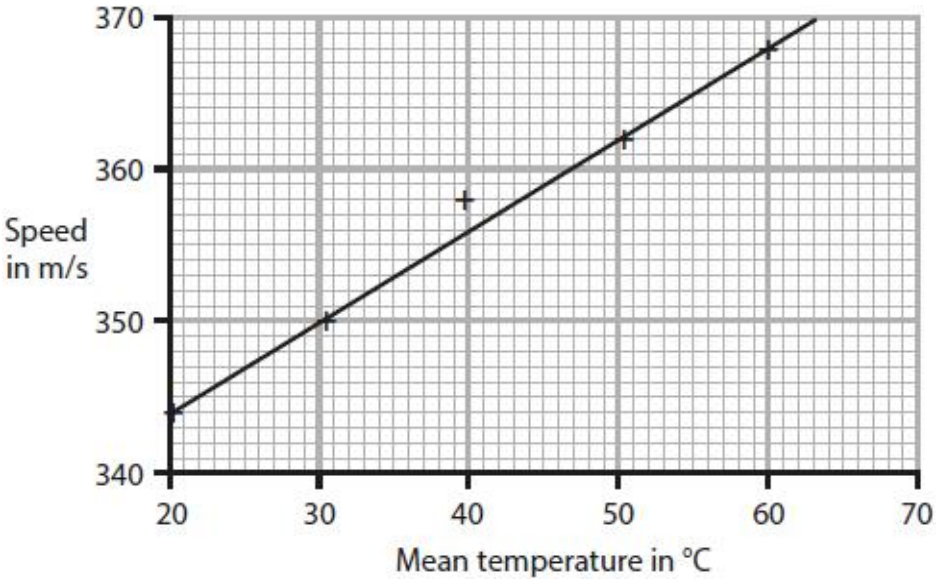
Calculate the mean temperature for the last row in the table.
Give your answer to a suitable number of decimal places.

(2)

mean temperature = ... °C

(iii) The student plots his results and draws the line of best fit.
Draw a circle around the anomalous result.

(1)



(iv) State how the student should deal with the anomalous result.

(1)

.....

.....

(v) Explain why a line graph is the correct type of graph to display these results.

(2)

.....

.....

.....

.....

(vi) Describe the relationship between the speed of sound in air and temperature.

(2)

.....

.....

.....

.....

(Total for question = 13 marks)

Q9.

(a) Describe an investigation to determine the speed of sound.

You may draw a diagram to help your answer.

(5)

.....

.....

.....

.....

.....

.....

.....

.....

.....

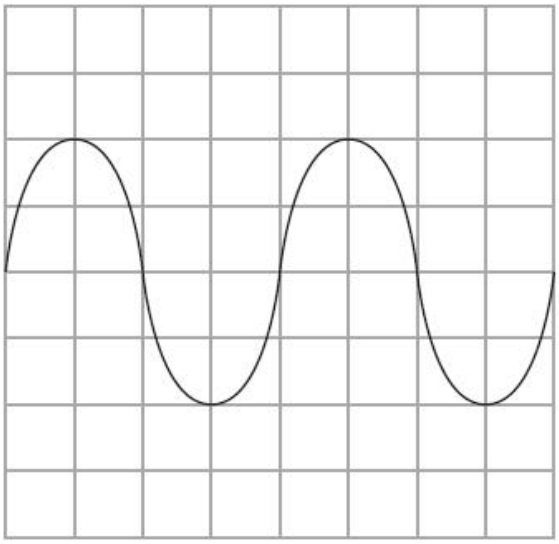
.....

.....

.....

(b) A microphone is connected to an oscilloscope.

A sound is detected by the microphone.
The diagram shows the oscilloscope trace.



Oscilloscope settings

y direction: 1 square = 0.1 V

x direction: 1 square = 5.0 ms

(i) Determine the period of the sound wave.

(3)

period = ... s

(ii) Calculate the frequency of the sound wave.

(2)

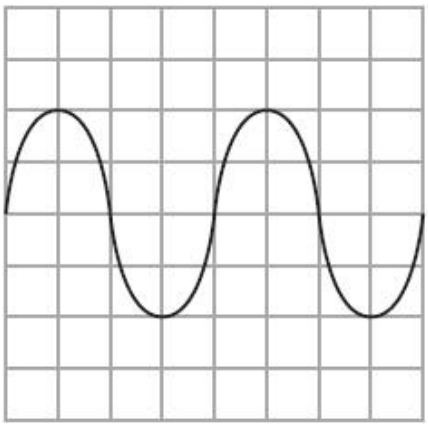
frequency = ... Hz

(Total for question = 10 marks)

Q10.

(a) A student uses an oscilloscope to determine the speed of sound.

The diagram shows the oscilloscope trace produced by the sound wave.



Oscilloscope settings
y direction: 1 square = 1 mV
x direction: 1 square = 1 ms

The student uses two microphones and a ruler to determine the wavelength of the sound wave.
He finds that the wavelength is 1.4 m.

(i) State the formula linking the speed, frequency and wavelength of a wave.

(1)

(ii) Use the oscilloscope trace to calculate the speed of the wave.

(5)

speed = ... m/s

(b) Another student uses this method to determine the speed of sound.

Step 1 The student stands 50 m away from her teacher, measuring the distance with a metre ruler.
Step 2 The teacher makes a loud sound and flashes a light at the same time.
Step 3 The student starts the stopwatch when she sees the flash of light.
Step 4 She stops the stopwatch when she hears the loud sound.

The speed of sound is calculated using the formula

$$\text{speed of sound} = \frac{\text{distance}}{\text{time taken}}$$

Evaluate whether this method could produce an accurate value for the speed of sound in air.

(5)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 11 marks)