1 A remote control emits infrared waves to operate a television.

Source: www.lemon-digital.co.uk

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(a) The television receives infrared waves and radio waves.

It emits light waves and sound waves.

Which type of wave has the highest frequency?

(1)

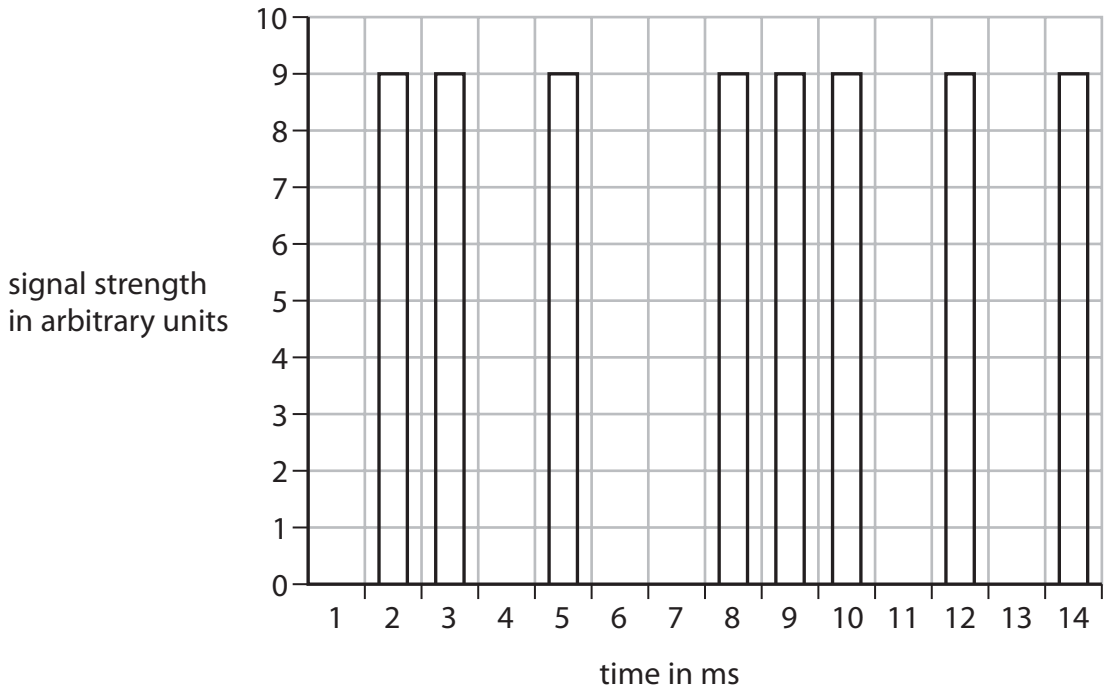
☒ **A** infrared

☒ **B** light

☒ **C** radio

☒ **D** sound

(b) The graph shows how the strength of the infrared signal from the remote control varies with time.



(i) Explain how the graph shows that the infrared signal is digital.

(1)

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.....

(ii) Suggest two ways that this signal could be made to carry more information.

(2)

1 .....

.....

2 .....

.....

(Total for Question 1 = 4 marks)

2 Communicaton signals are often transmitted in digital form.

(a) Sketch a graph to show how a digital signal varies with time.

(2)

(b) Describe the advantages of using digital signals rather than analogue signals.

(2)

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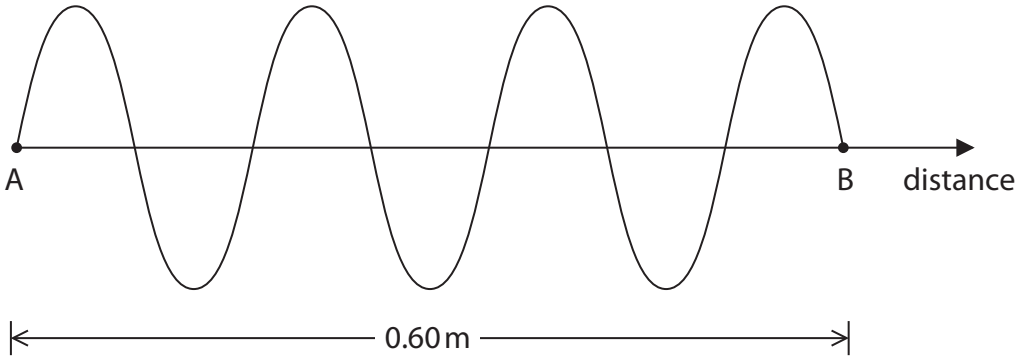
(Total for Question 2 = 4 marks)

3 (a) The diagram represents a microwave travelling in free space from point A to point B.



(i) The distance from A to B is 0.60 m.

Calculate the wavelength of this microwave.

(2)

wavelength = ... m

(ii) State the equation linking wave speed, frequency and wavelength.

(1)

(iii) Calculate the frequency of this microwave.
[speed of microwave in free space = 3.0×10^8 m/s]

(3)

frequency = ... Hz

(b) The diagrams show what happens to radio waves and microwaves as they move past a hill.

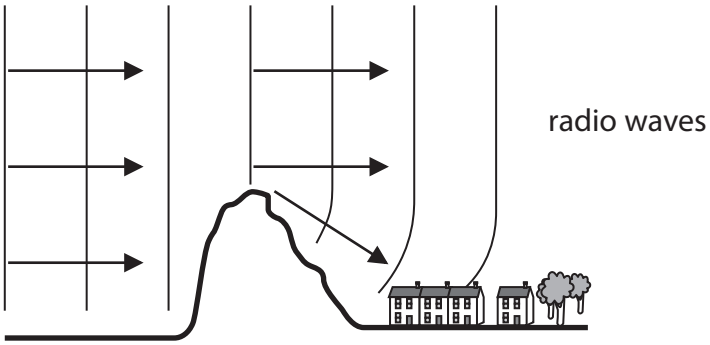


Diagram 1

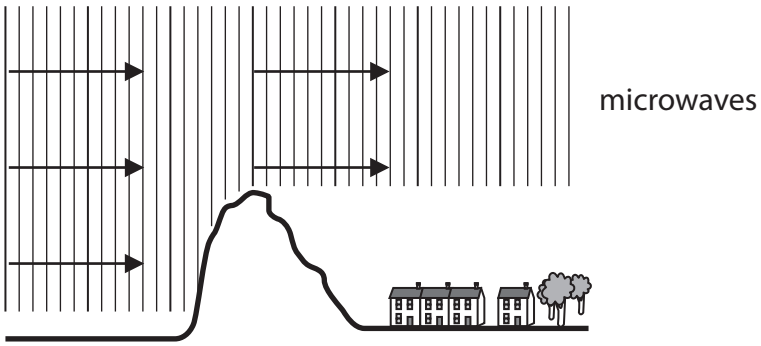


Diagram 2

(i) Name the effect shown by the radio waves in diagram 1.

(1)

.....

(ii) Suggest why this effect is not shown by the microwaves in diagram 2.

(2)

.....

.....

.....

.....

(Total for Question 3 = 9 marks)

4 A signal generator produces sounds from a loudspeaker.

(a) (i) Which property of the sound wave should be increased in order to make the sound louder?

(1)

☒ **A** amplitude

☒ **B** frequency

☒ **C** speed

☒ **D** wavelength

(ii) Which property of the sound wave should be increased in order to make a higher pitched sound?

(1)

☒ **A** amplitude

☒ **B** frequency

☒ **C** speed

☒ **D** wavelength

(b) Sound waves travel as longitudinal waves.

Other waves are transverse.

(i) Give an example of a transverse wave.

(1)

.....

(ii) Describe how the vibrations of longitudinal waves and transverse waves differ.

(2)

.....

.....

.....

.....

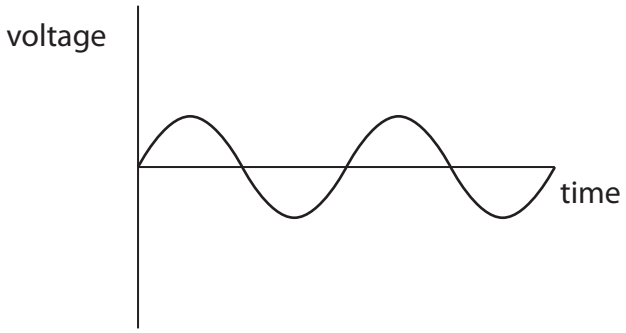
(Total for Question 4 = 5 marks)

5 (a) The graphs show oscilloscope traces produced by four different sounds. The oscilloscope settings are the same for each trace.

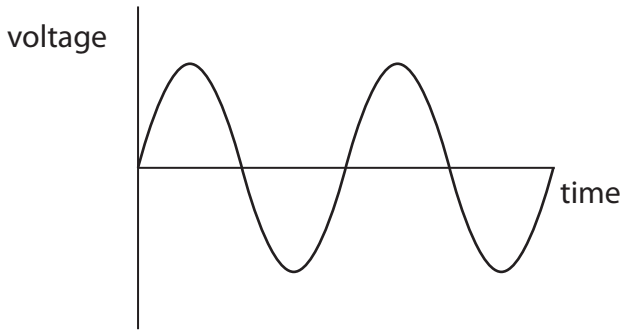
Which graph shows the trace for the loudest sound at the lowest frequency?

(1)

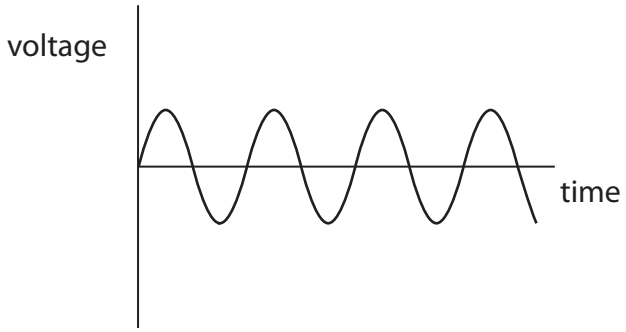
☒ **A**



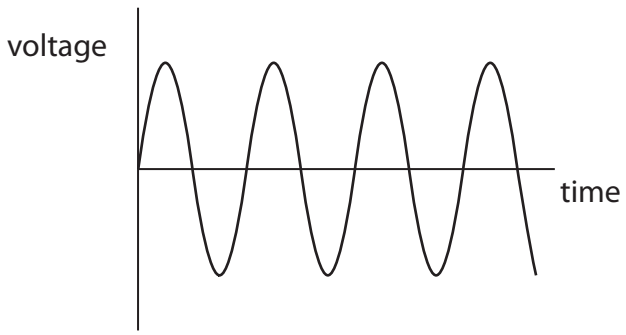
☒ **B**



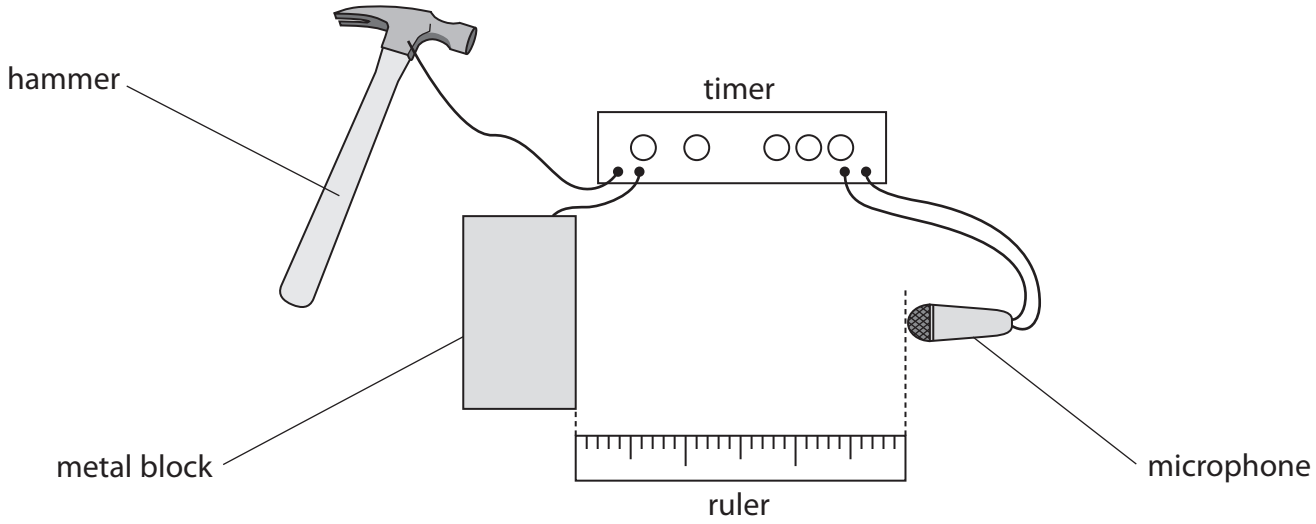
☒ **C**



☒ **D**



(b) The diagram shows the equipment used by a student to measure the speed of sound in air.



The student measures the distance between the front of the metal block and the microphone.

She then uses this method to measure the time taken for sound to travel from the metal block to the microphone.

- start the timer by hitting the metal block with the hammer
- stop the timer when the sound produced reaches the microphone
- record the time taken for sound to reach the microphone in milliseconds

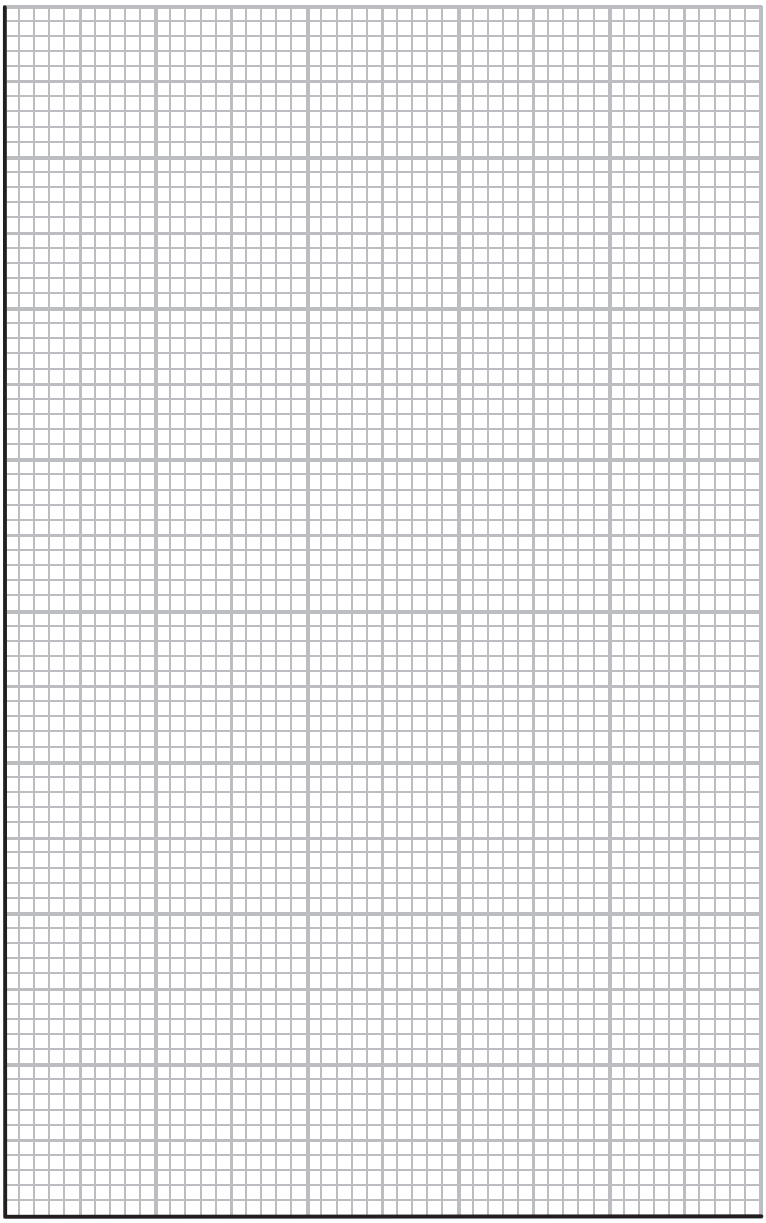
The student repeats the experiment six times, changing the distance between the metal block and the microphone for each experiment.

The table shows her results.

Distance in m	Time in ms
0.62	1.8
0.80	2.4
1.00	3.0
1.20	3.8
1.38	4.2

(i) Use the student's results to plot a graph of distance against time and draw the straight line of best fit.

(5)



(ii) Use your graph to find the speed of sound in air and give the unit.

(3)

speed = ... unit .....

(iii) Suggest how the student could make this experiment valid (a fair test).

(1)

.....

.....

.....

(iv) Suggest two ways that the student could improve the quality of her data.

(2)

1 .....

.....

2 .....

.....

(Total for Question 5 = 12 marks)

6 Somewaves travel across the sea. They all have the same wavelength.

a) What is meant by the term wavelength?

(1)

.....

.....

(b) The waves travel across the sea at 3.0 m/s and have a frequency of 1.5 Hz.

(i) State the equation linking wave speed, frequency and wavelength.

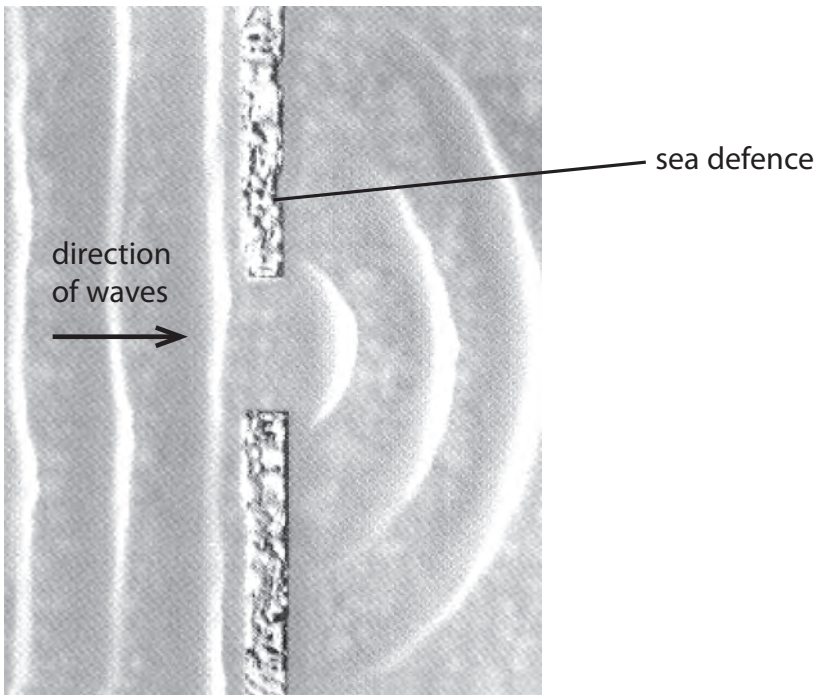
(1)

(ii) Calculate the wavelength of the waves.

wavelength ..... m

(2)

(c) This photograph was taken from an aeroplane. It shows a sea defence, with a gap in the sea wall.



Parallel waves pass through the sea defence at the gap in the sea wall, making the curved pattern shown in the photograph.

(i) Explain how this wave pattern is produced.

(2)

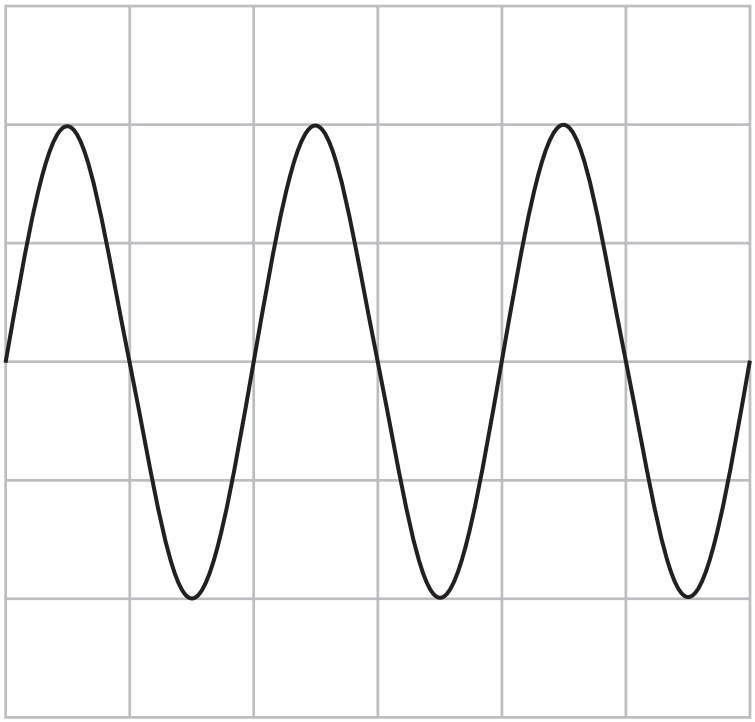
(ii) Explain why light waves do not make a similar pattern as they pass through the same gap.

(2)

(Total for Question 6 = 8 marks)

7 A microphone is connected to an oscilloscope to display a sound wave.

The diagram shows the trace on the oscilloscope screen.



The oscilloscope settings are:

Y direction: 1 square = 1 V

X direction: 1 square = 0.001 s

(a) (i) How many time periods are shown on the trace?

(1)

.....

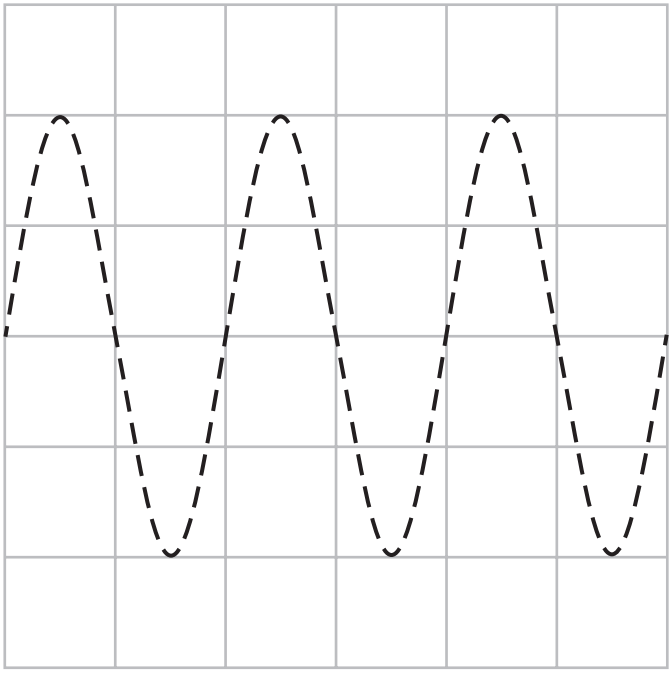
(ii) What is the frequency of the sound wave?

(2)

Frequency = ... Hz

(b) On the grid below, sketch the trace of a sound wave with a smaller amplitude and a higher frequency than the wave shown by the dotted line.

(2)



(Total for Question 7 = 5 marks)

8 A foghorn makes a loud, low-pitched warning sound when a ship is moving in fog.

(a) What is the relationship between the frequency of a sound wave and the pitch of the sound?

(1)

.....

.....

(b) The foghorn emits sound waves with a frequency of 160 Hz.

The speed of sound is 340 m/s.

(i) State the equation linking wave speed, frequency and wavelength.

(1)

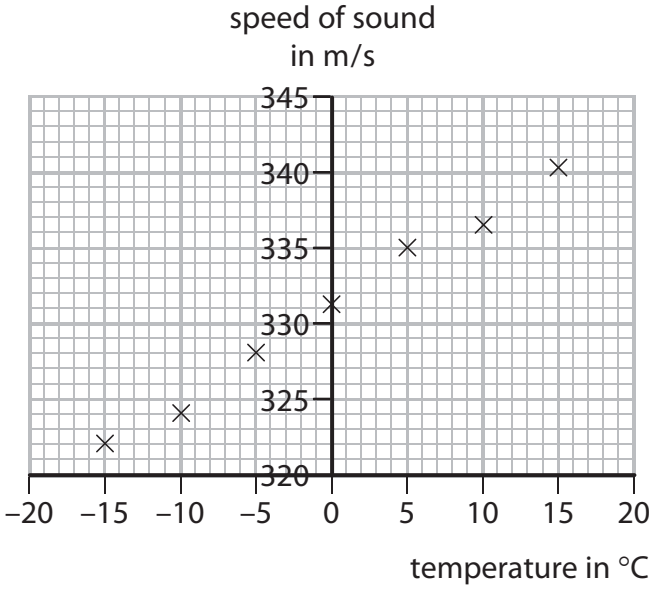
(ii) Calculate the wavelength of these sound waves.

(2)

wavelength = ... m

(c) A student investigates how the speed of sound in air varies with temperature.

The student's results are shown on the graph.



(i) Draw a straight line of best fit on the graph.

(1)

(ii) Use the graph to find the speed of sound when the air temperature is 20 °C.

(2)

speed of sound = ... m/s

(d) The air temperature decreases while the foghorn continues to emit sound waves with a frequency of 160 Hz.

Explain how this decrease in temperature affects the wavelength of the sound waves.

(2)

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.....

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.....

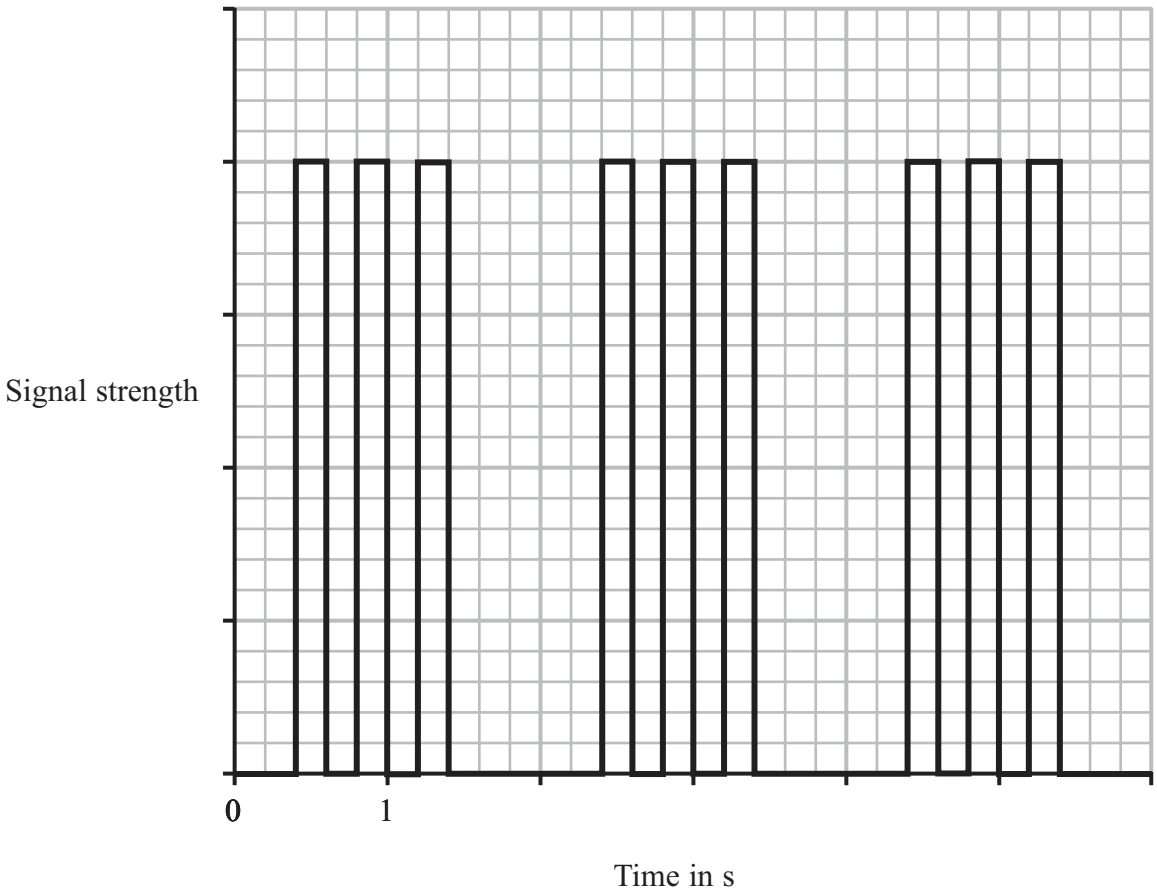
(Total for Question 8 = 9 marks)

9 In 1901, Marconi received the first radio signal across the Atlantic Ocean.

The signal was the letter S in Morse code (three 'dots') sent over and over again.

Each letter S was produced by quickly turning an electric spark on and off three times.

The graph shows how the strength of the signal changed with time.



(a) (i) The graph shows a digital signal.

Explain what is meant by a digital signal.

(2)

.....

.....

.....

.....

(ii) Suggest **two** ways that this signal could be made to carry more information.

(2)

1 .....

.....

2 .....

.....

(b) The frequency of Marconi's radio wave was 820 kHz and the wavelength was 366 m.

(i) State the equation linking wave speed, frequency and wavelength for radio waves.

(1)

(ii) Calculate the speed of the radio waves Marconi received.

(2)

Speed of radio waves ..... m/s

(c) Some people do not believe that Marconi received 820 kHz radio waves.

They think that the frequency was really twice as much: 1640 kHz.

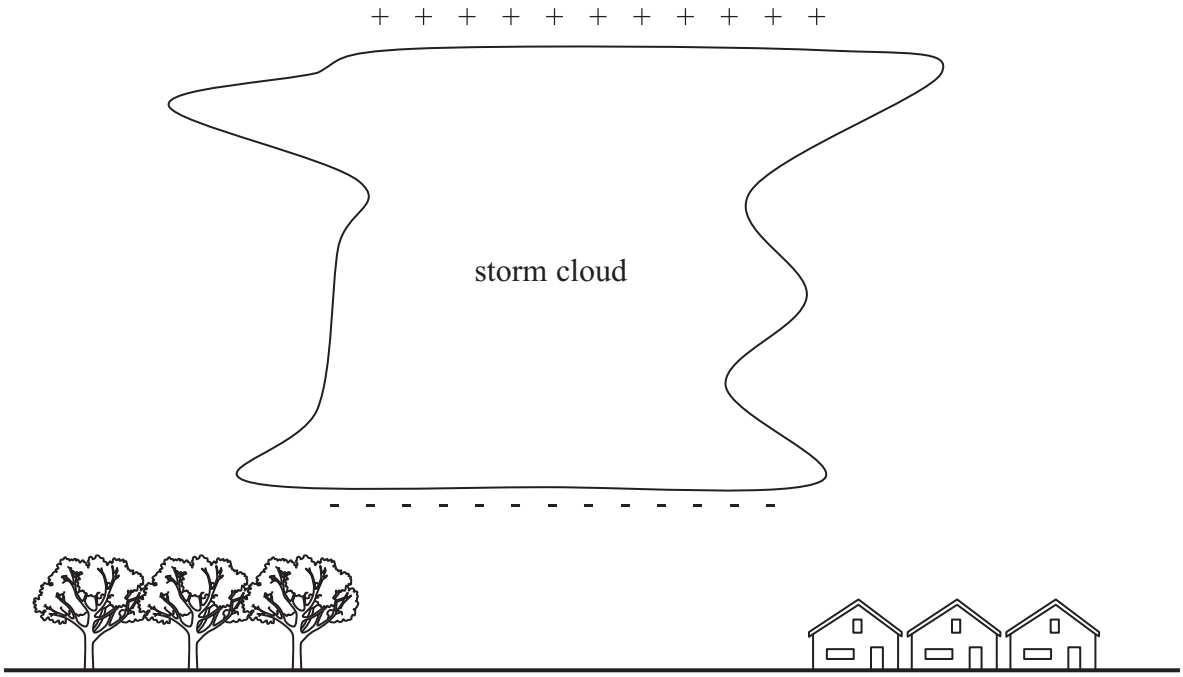
If these people are correct, what wavelength radio waves did Marconi receive?

(1)

Wavelength ..... m

(d) Other people do not think Marconi received a radio signal across the Atlantic Ocean at all.

They think the radio waves he received were really caused by electrostatic discharges from storm clouds.

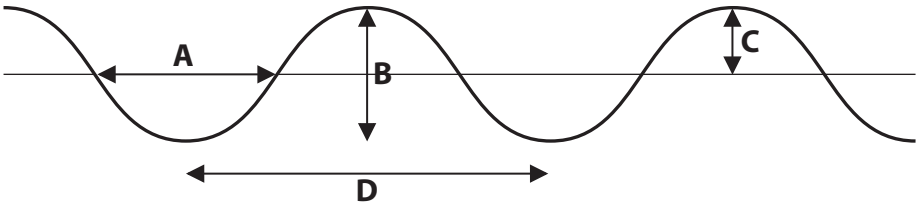


Explain what happens when a storm cloud discharges.

(3)

(Total for Question 9 11 marks)

10 The diagram shows a wave on the sea.



(a) (i) Which letter shows the wavelength of the wave?

(1)

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(ii) Which letter shows the amplitude of the wave?

(1)

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(b) A man watches some waves pass his boat.

He sees the crest of the waves pass him every 5 s.

Calculate the frequency of these waves.

(2)

Frequency = ... Hz

(Total for Question 10 = 4 marks)