AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 6.6.1.2

Properties of waves

Past-paper questions

Tier	**Foundation**
Question groups	**14**
Available paper years	**2018–2025**

Using this booklet

1. Answer the questions in order and show your working.
2. Original question numbers and marks are retained.
3. Print at actual size (100%) for measuring questions.
4. Use the companion answer booklet to check your work.

Name: _____ **Date:** _____

Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

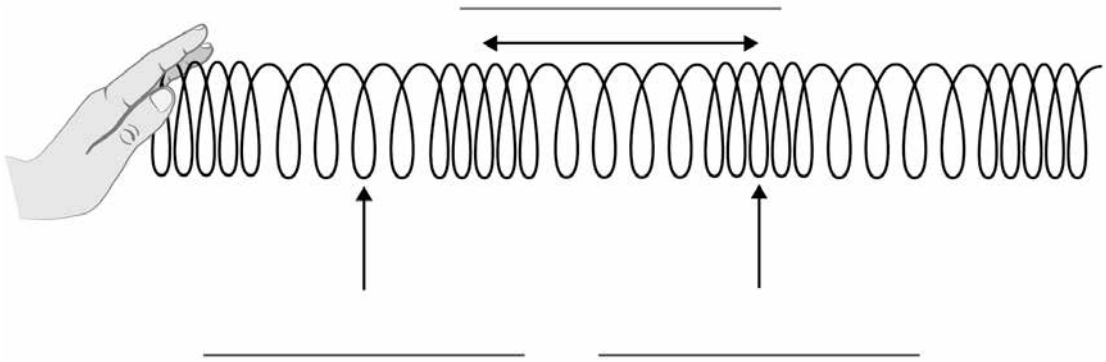
6.6.1.2 Properties of waves

Question 01

June 2018 | 8464/P/2F | Original Q2

0 2 **Figure 2** shows a slinky spring used to model a sound wave.

Figure 2



0 2 . 1 Label the arrows on **Figure 2**

Choose the answers from the box.

[3 marks]

amplitude	**compression**	**frequency**
rarefaction		**wavelength**

0 2 . 2 What type of wave is a sound wave?

[1 mark]

Tick **one** box.

- electromagnetic ☐
- longitudinal ☐
- transverse ☐

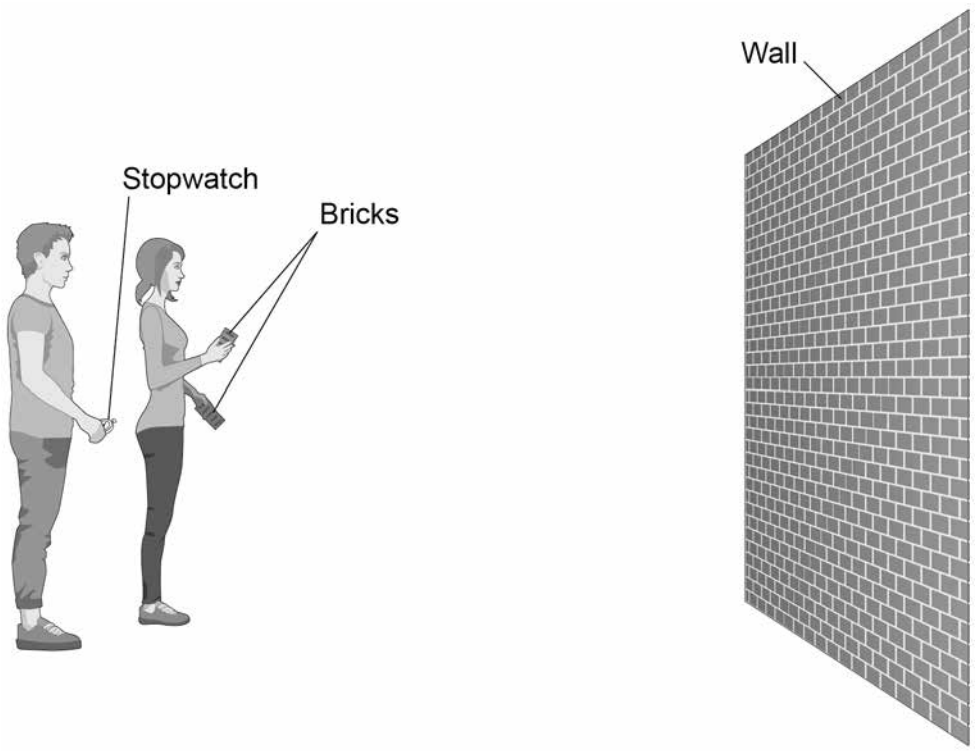
Question 2 continues on the next page

6.6.1.2 Properties of waves

Question 01 · continued

0 2 . 3 **Figure 3** shows two students measuring the speed of sound in air.

Figure 3



One student bangs two bricks together.

The sound wave produced is reflected from the wall and travels back to the students.

Describe how they can determine the speed of sound.

[4 marks]

8

6.6.1.2 Properties of waves

Question 02

June 2019 | 8464/P/2F | Original Q5

0 5 The Sun emits all types of electromagnetic waves.

Figure 7 shows the electromagnetic spectrum.

Figure 7

Radio waves	Microwaves	Infrared	Visible light	Ultraviolet	X-rays	Gamma rays

0 5 . 1 Complete the sentences.

Choose answers from the box.

[3 marks]

frequency	**mass**	**power**
velocity		**wavelength**

In a vacuum, all electromagnetic waves travel at the same _____ .

Gamma waves have the greatest _____ .

Radio waves have the greatest _____ .

0 5 . 2 Explain why it is important that the Earth's atmosphere absorbs gamma rays emitted by the Sun.

[2 marks]

_____

_____

_____

_____

0 5 . 3 Some microwaves are **not** absorbed by the Earth's atmosphere.

Why is this useful?

[1 mark]

_____

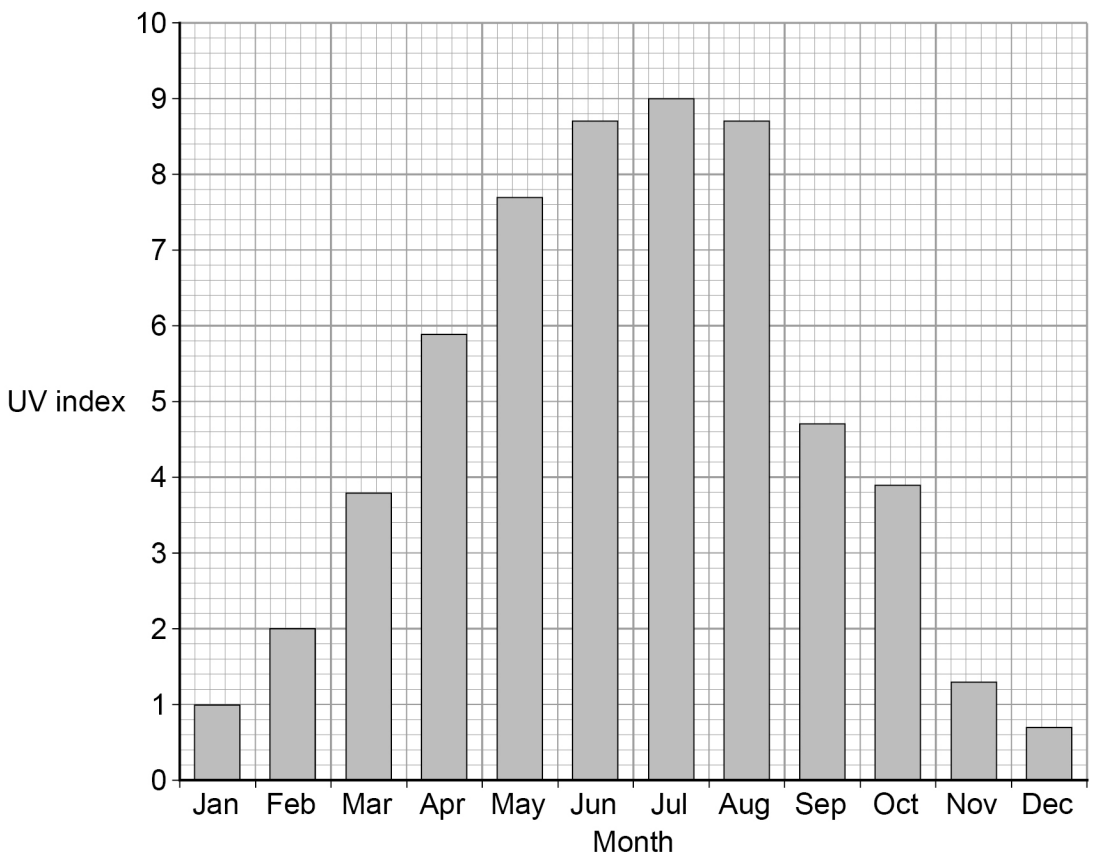
Question 02 · continued

Some ultraviolet (UV) radiation from the Sun passes through the atmosphere and reaches the surface of the Earth.

The amount of UV radiation that reaches the surface of the Earth can be measured on a scale called the UV index.

Figure 8 shows the average midday UV index in the UK for 1 year.

Figure 8



0 5 . 4 Why is exposure to UV radiation harmful to humans?

[1 mark]

6.6.1.2 Properties of waves

Question 02 · continued

0 5 . 5 Compare the risk from UV radiation at different times of year in the UK.

Use data from **Figure 8**.

[2 marks]

9

Turn over for the next question

6.6.1.2 Properties of waves

Question 03

June 2019 | 8464/P/2F | Original Q6

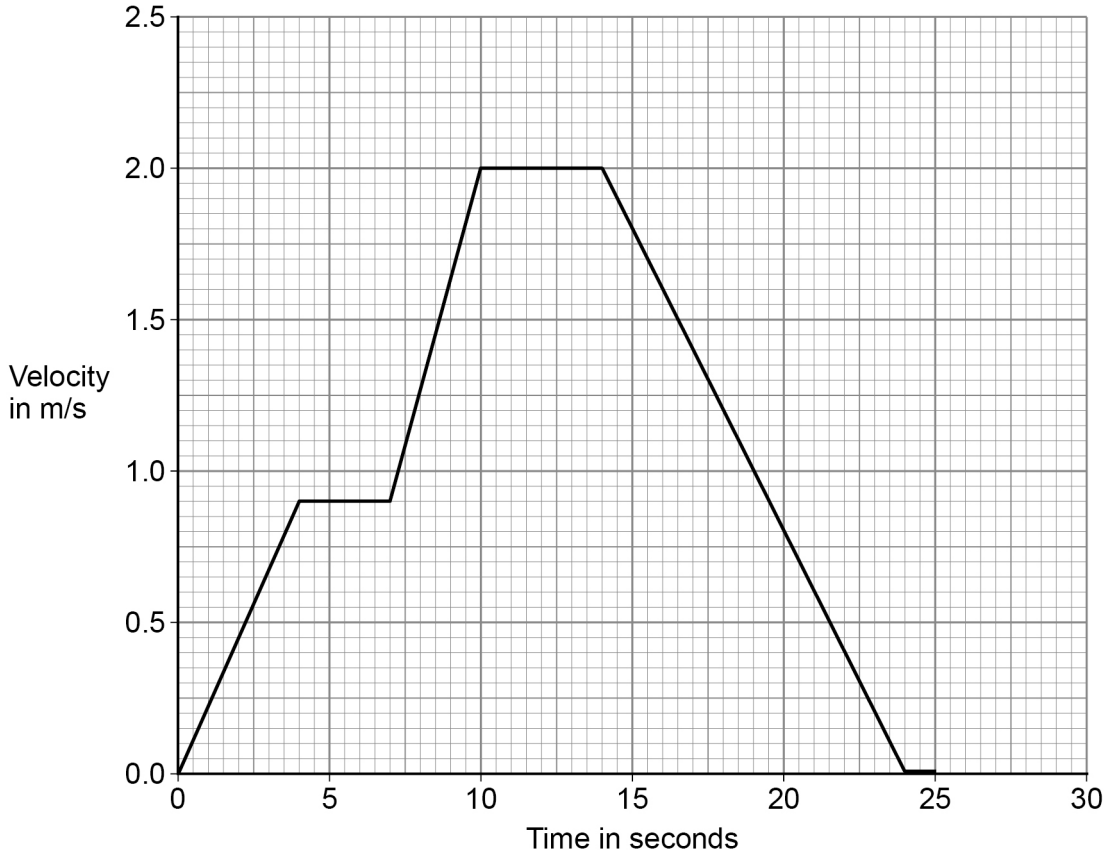
0 6 **Figure 9** shows a runner using a smart watch and a mobile phone to monitor her run.

Figure 9



Figure 10 is a velocity–time graph for part of the runner's warm-up.

Figure 10



6.6.1.2 Properties of waves

Question 03 · continued

0 6 . 1 Determine the total time for which the velocity of the runner was increasing.

[2 marks]

Time = _____ s

0 6 . 2 Determine the deceleration of the runner.

[2 marks]

Deceleration = _____ m/s^2

Question 6 continues on the next page

6.6.1.2 Properties of waves

Question 03 · continued

The smart watch and mobile phone are connected to each other by a system called Bluetooth.

Bluetooth is wireless and uses electromagnetic waves for communication.

0 6 . 3 Suggest why the phone and watch being connected by a wireless system is an advantage when running.

[1 mark]

0 6 . 4 Write down the equation that links frequency, wave speed and wavelength.

[1 mark]

0 6 . 5 The electromagnetic waves have a frequency of 2 400 000 000 Hz

The speed of electromagnetic waves is 300 000 000 m/s

Calculate the wavelength of the electromagnetic waves.

[3 marks]

Wavelength = _____ m

6.6.1.2 Properties of waves

Question 03 · continued

0 6 . 6 **Table 3** shows some information about four types of Bluetooth.

Table 3

Type	Power in milliwatts	Range in metres
1	100	100
2	2.50	10.0
3	1.00	1.00
4	0.50	0.50

Mobile phones use type **2** Bluetooth to communicate with other devices.

Suggest **two** reasons why.

[2 marks]

1 _____

_____

2 _____

_____

11

6.6.1.2 Properties of waves

Question 04

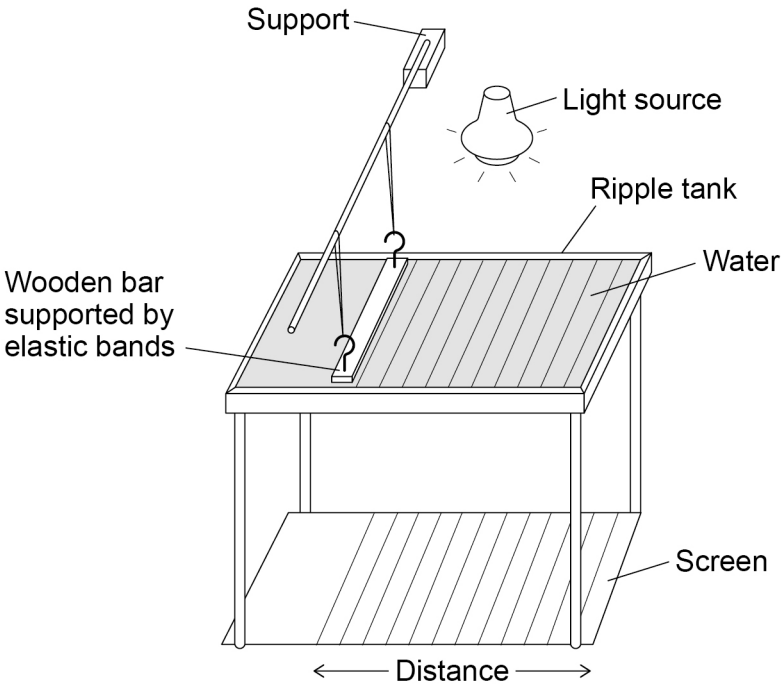
June 2019 | 8464/P/2F | Original Q7

0 7 **Figure 11** shows the equipment a teacher used to determine the speed of a water wave.

The equipment includes:

- a ripple tank filled with water
- a wooden bar that creates ripples on the surface of the water
- a light source which causes a shadow of the ripples on the screen.

Figure 11



0 7 . 1 Describe how equipment in **Figure 11** can be used to measure the wavelength, frequency and speed of a water wave.

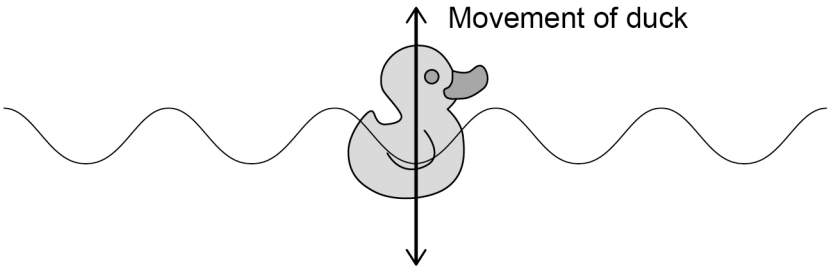
[6 marks]

Question 04 · continued

The teacher put a plastic duck in the ripple tank as shown in **Figure 12**.

The plastic duck moved up and down as the waves in the water passed.

Figure 12



0 7 . 2 How does the movement of the plastic duck in **Figure 12** demonstrate that water waves are transverse?

[1 mark]

Question 7 continues on the next page

6.6.1.2 Properties of waves

Question 04 · continued

0 7 . 3 The teacher measured the maximum height and the minimum height of the plastic duck above the screen as the wave passed.

The teacher repeated his measurements.

Table 4 shows the teacher's measurements.

Table 4

Maximum height in mm	509	513	511
Minimum height in mm	503	498	499

Calculate the mean amplitude of the water wave.

[3 marks]

Mean amplitude = _____ mm

10

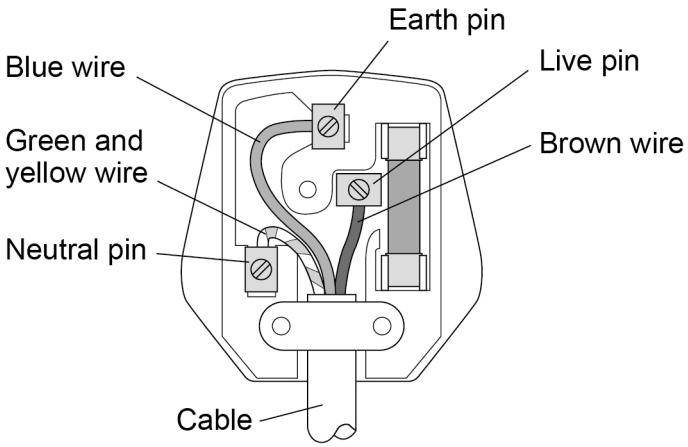
6.6.1.2 Properties of waves

Question 05

November 2020 | 8464/P/1F | Original Q5

0 5 **Figure 5** shows the inside of a plug.

Figure 5



0 5 . 1 The plug is **not** wired correctly.

What should be done to connect the wires in the plug correctly?

[1 mark]

Question 05 · continued

The correctly wired plug and cable connects a washing machine to the mains electricity supply.

0 5 . 2 Give the potential difference and frequency of the mains electricity supply in the UK.

[2 marks]

The potential difference is _____ V

The frequency is _____ Hz

0 5 . 3 The washing machine is switched on.

What is the potential difference between the neutral wire and the earth wire?

[1 mark]

Potential difference = _____ V

0 5 . 4 The plug has a fuse.

Draw the circuit symbol for a fuse in the space below.

[1 mark]

Question 5 continues on the next page

6.6.1.2 Properties of waves

Question 05 · continued

The washing machine has a metal case.

A fault causes the live wire to make an electrical connection with the metal case of the washing machine.

0 5 . 5 The earth wire is **not** connected to the metal case of the washing machine.

Explain why it would not be safe for a person to touch the metal case.

[2 marks]

0 5 . 6 The earth wire is now connected to the metal case of the washing machine.

Explain why it would now be safe for a person to touch the metal case, even if the live wire touches the metal case.

[2 marks]

9

6.6.1.2 Properties of waves

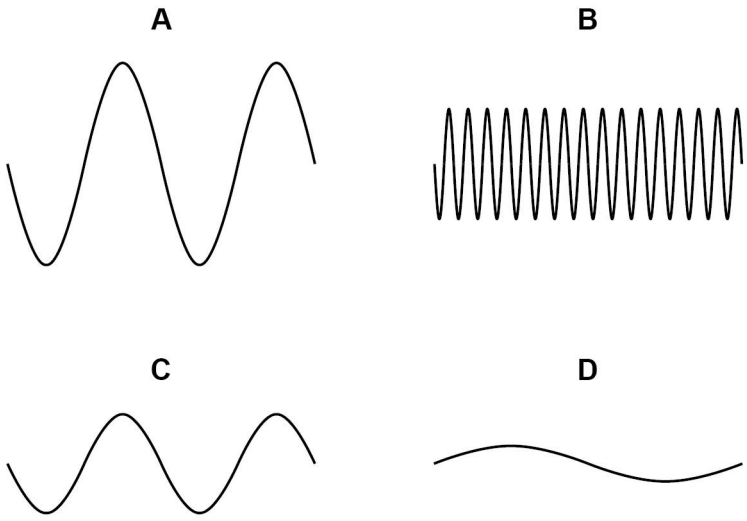
Question 06

November 2020 | 8464/P/2F | Original Q5

0 5 **Figure 6** shows four waves.

The waves are drawn to the same scale.

Figure 6



0 5 . 1 Which wave has the greatest amplitude?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

0 5 . 2 Which wave has the greatest frequency?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

0 5 . 3 Which wave has the greatest wavelength?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

6.6.1.2 Properties of waves

Question 06 · continued

0 5 . 4 A wave has a frequency of 1650 Hz and a wavelength of 0.200 m

Calculate the wave speed.

Use the equation:

wave speed = frequency × wavelength

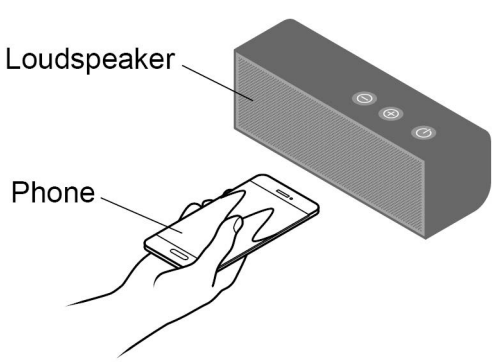
[2 marks]

Wave speed = _____ m/s

A student uses a mobile phone app that displays sound waves.

Figure 7 shows the student holding the mobile phone close to a loudspeaker.

Figure 7

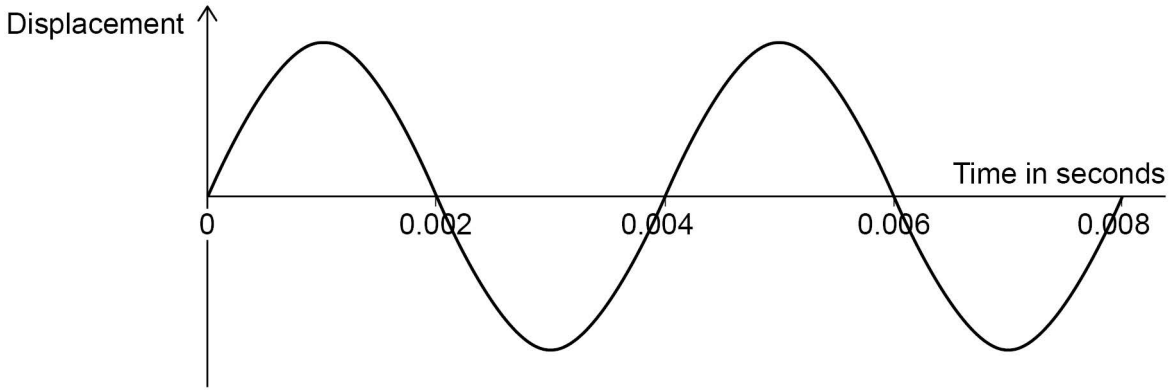


6.6.1.2 Properties of waves

Question 06 · continued

Figure 8 shows the wave pattern seen on the phone screen.

Figure 8



0 5 . 5 What is the period of the wave shown in **Figure 8**?

[1 mark]

Tick (✓) **one** box.

0.002 s ☐ 0.004 s ☐ 0.006 s ☐ 0.008 s ☐

0 5 . 6 Determine the frequency of the wave shown in **Figure 8**.

Use the Physics Equations Sheet.

[3 marks]

Frequency = _____ Hz

9

6.6.1.2 Properties of waves

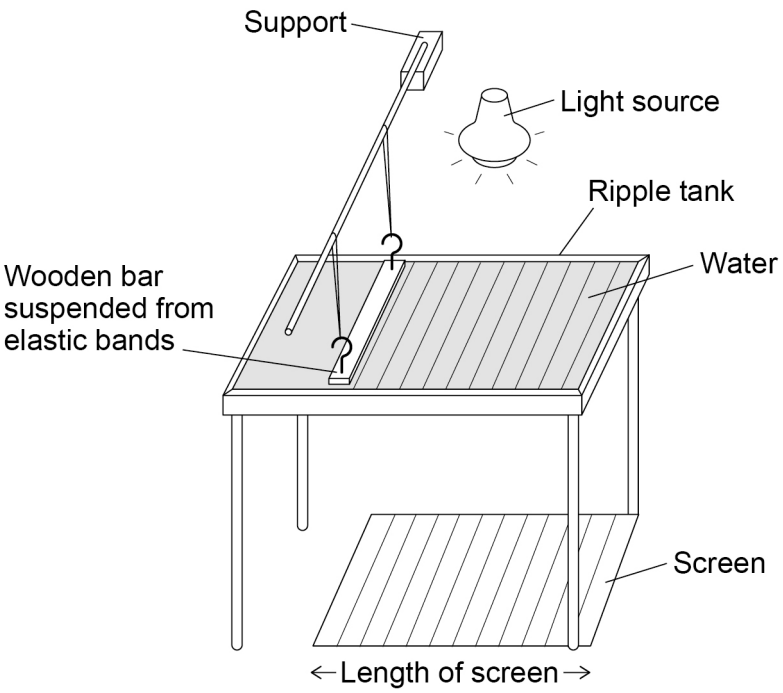
Question 07

0 4 **Figure 7** shows a ripple tank.

The wooden bar vibrates up and down producing waves on the water.

The light source produces shadows of the water waves on the screen.

Figure 7



0 4 . 1 Describe how the student can measure the frequency and wavelength of the waves.

You should refer to any equipment the student needs in your answer.

[4 marks]

6.6.1.2 Properties of waves

Question 07 · continued

A student measured the frequency and wavelength of the waves produced.

Table 1 shows some of the results.

Table 1

Reading	1	2	3	Mean
Frequency in hertz	12.8	12.4	12.3	X

0 4 . 2 Calculate value **X** in **Table 1**.

[1 mark]

X = _____ Hz

0 4 . 3 Why is it a good idea to take repeat readings and then calculate a mean?

[1 mark]

Tick (✓) **one** box.

To reduce the effect of random errors. ☐

To reduce the effect of systematic errors. ☐

To reduce the effect of zero errors. ☐

Question 4 continues on the next page

6.6.1.2 Properties of waves

Question 07 · continued

0 4 . 4 The student changed the frequency of the waves in the ripple tank to 20 Hz.

Calculate the period of the waves.

Use the equation:

$$\text{period} = \frac{1}{\text{frequency}}$$

[2 marks]

Period = _____ s

0 4 . 5 At a frequency of 20 Hz the wavelength of the waves was 0.012 m.

Calculate the wave speed.

Use the equation:

$$\text{wave speed} = \text{frequency} \times \text{wavelength}$$

[2 marks]

Wave speed = _____ m/s

10

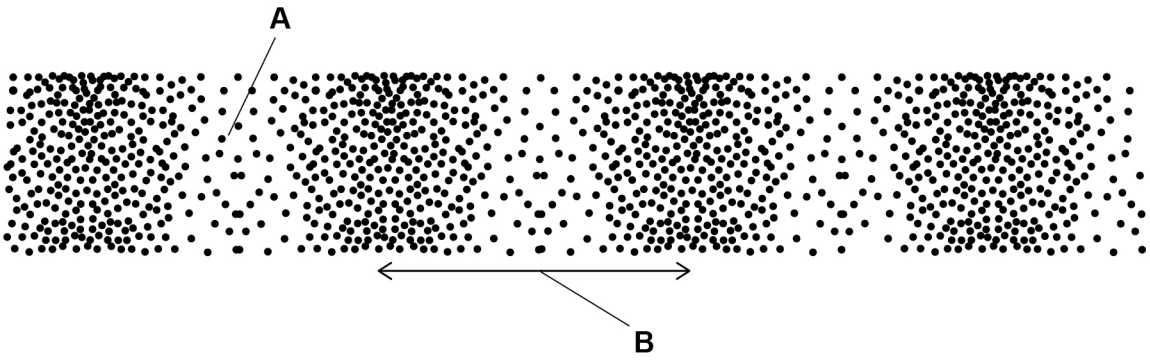
6.6.1.2 Properties of waves

Question 08

June 2022 | 8464/P/2F | Original Q6

0 6 **Figure 8** shows a longitudinal wave.

Figure 8



0 6 . 1 What do the labels **A** and **B** on **Figure 8** represent?

Choose answers from the box.

[2 marks]

amplitude	**frequency**	**rarefaction**	**reflection**	**wavelength**

A _____

B _____

6.6.1.2 Properties of waves

Question 08 · continued

0 6 . 2 The wave shown in **Figure 8** has a frequency of 4.0 kHz

Calculate the period of the wave.

Use the Physics Equations Sheet.

Give the unit.

[4 marks]

Period = _____ Unit _____

Question 6 continues on the next page

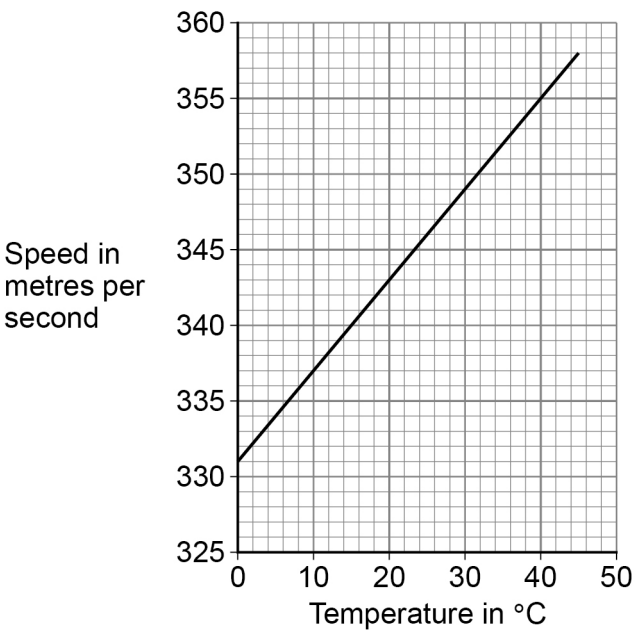
6.6.1.2 Properties of waves

Question 08 · continued

Sound waves are longitudinal.

Figure 9 shows how the speed of sound varies with the temperature of the air.

Figure 9



6.6.1.2 Properties of waves

Question 08 · continued

Use the Physics Equations Sheet to answer questions **06.3** and **06.4**.

0 6 . 3 Write down the equation that links frequency (f), wavelength (λ) and wave speed (v).

[1 mark]

0 6 . 4 A sound wave with a frequency of 300 Hz travels through the air.

The air has a temperature of 28.0 °C

Determine the wavelength of the sound wave.

Use **Figure 9**.

[4 marks]

Wavelength = _____ m

11

6.6.1.2 Properties of waves

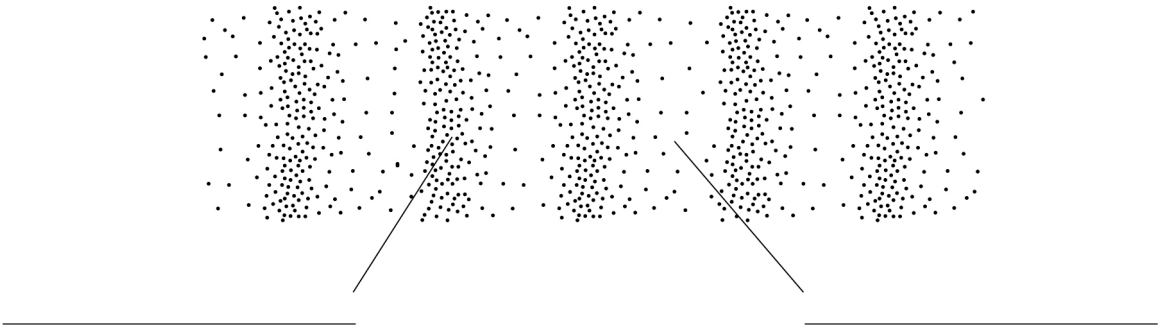
Question 09

June 2023 | 8464/P/2F | Original Q4

0 4 Sound waves are longitudinal waves.

0 4 . 1 **Figure 9** shows a sound wave.

Figure 9



Complete the labels on **Figure 9**.

Choose answers from the box.

[2 marks]

compression	**extension**	**rarefaction**
reflection		**resistance**

6.6.1.2 Properties of waves

Question 09 · continued

0 4 . 2 Which of the following is true for longitudinal waves?

[1 mark]

Tick (✓) **one** box.

Longitudinal waves transfer charge. ☐

Longitudinal waves transfer energy. ☐

Longitudinal waves transfer matter. ☐

Question 4 continues on the next page

6.6.1.2 Properties of waves

Question 09 · continued

Figure 10 shows a device a farmer uses to scare away birds.

Figure 10



The device emits a very loud sound.

The farmer measures the sound emitted by the device at different distances from the device.

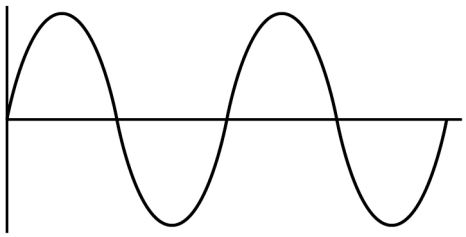
6.6.1.2 Properties of waves

Question 09 · continued

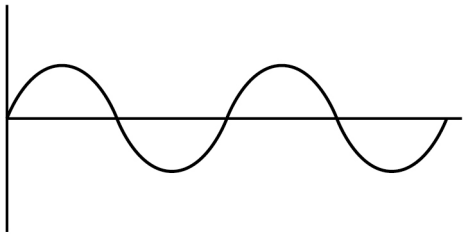
0 4 . 3 **Figure 11** shows a visual display of the sound waves at different distances from the device.

Both waves are drawn to the same scale.

Figure 11



At a distance of 80 m



At a distance of 200 m

Which property of the wave changes between 80 m and 200 m?

[1 mark]

Tick (✓) **one** box.

Amplitude ☐

Frequency ☐

Period ☐

Wavelength ☐

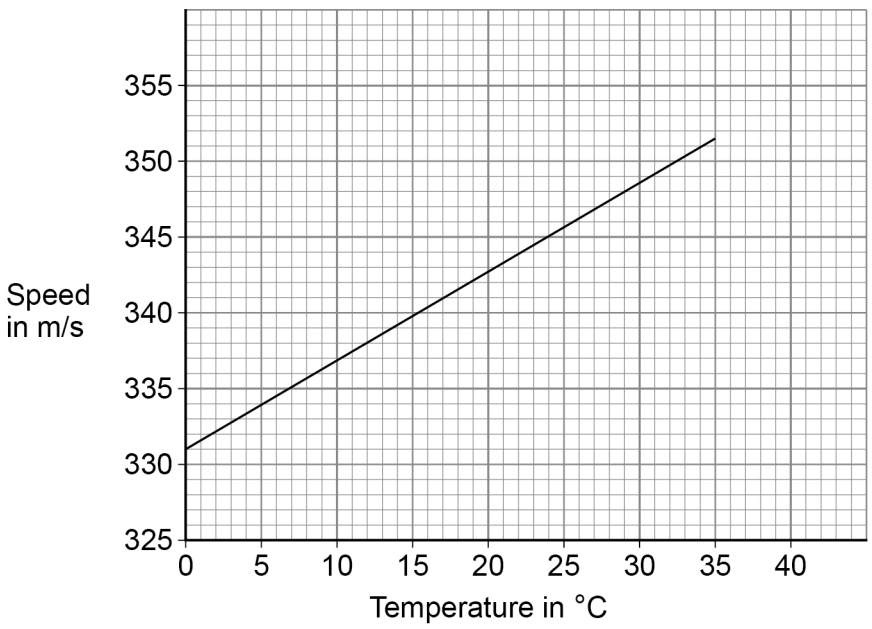
Question 4 continues on the next page

6.6.1.2 Properties of waves

Question 09 · continued

Figure 12 shows how the speed of the sound emitted by the device is affected by the temperature of the air.

Figure 12



0 4 . 4 The farmer tests the device on a day when the temperature of the air is 15 °C.

What is the speed of the sound emitted by the device when the temperature of the air is 15 °C?

[1 mark]

Speed = _____ m/s

6.6.1.2 Properties of waves

Question 09 · continued

0 4 . 5 The farmer stands a safe distance from the device.

It takes a time of 0.20 s for the sound to travel from the device to the farmer.

Calculate the distance between the device and the farmer.

Use your answer to Question **04.4** and the equation:

distance = speed × time

[2 marks]

Distance = _____ m

0 4 . 6 Explain how the time taken for the sound to reach the farmer is affected by the temperature of the air.

Use **Figure 12**.

[2 marks]

9

6.6.1.2 Properties of waves

Question 10

June 2023 | 8464/P/2F | Original Q6

0 6 The Sun emits a continuous spectrum of electromagnetic waves.

Figure 14 names some of the groups of waves in the electromagnetic spectrum.

Figure 14

A	**B**	Infrared	Visible light	Ultraviolet	**C**	Gamma rays

0 6 . 1 Name groups **A**, **B** and **C** in **Figure 14**.

[2 marks]

A _____

B _____

C _____

0 6 . 2 Give **one** similarity and **one** difference between the properties of ultraviolet waves and gamma rays.

[2 marks]

Similarity _____

_____

Difference _____

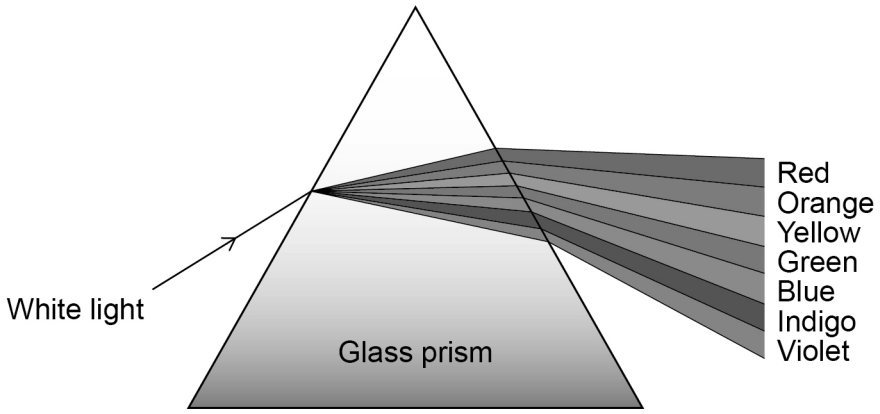
_____

6.6.1.2 Properties of waves

Question 10 · continued

Figure 15 shows white light split into a spectrum of different colours by a glass prism.

Figure 15



0 6 . 3 Light changes direction when it enters the glass prism.

What name is given to this process?

[1 mark]

Question 6 continues on the next page

6.6.1.2 Properties of waves

Question 10 · continued

Use the Physics Equations Sheet to answer questions **06.4** and **06.5**.

0 6 . 4 Write down the equation that links frequency (f), wavelength (λ) and wave speed (v).

[1 mark]

0 6 . 5 The wave in the middle of the spectrum has a wavelength of 5.0×10^{-7} m.

wave speed of light = 3.0×10^{8} m/s

Calculate the frequency of the wave.

[3 marks]

Frequency = _____ Hz

9

6.6.1.2 Properties of waves

Question 11

June 2024 | 8464/P/2F | Original Q3

0 3 **Figure 6** shows an electronic whistle used by a referee in a football match.

Figure 6



When the button is pressed the whistle emits sound waves that travel through the air.

0 3 . 1 What is transferred by the sound waves as they travel through the air?

[1 mark]

Tick (✓) **one** box.

Energy ☐

Mass ☐

Temperature ☐

Question 3 continues on the next page

6.6.1.2 Properties of waves

Question 11 · continued

June 2024 | 8464/P/2F | Original Q3

0 3 . 2 What is a typical value for the speed of sound in air?

[1 mark]

Tick (✓) **one** box.

33 m/s ☐

330 m/s ☐

3300 m/s ☐

33 000 m/s ☐

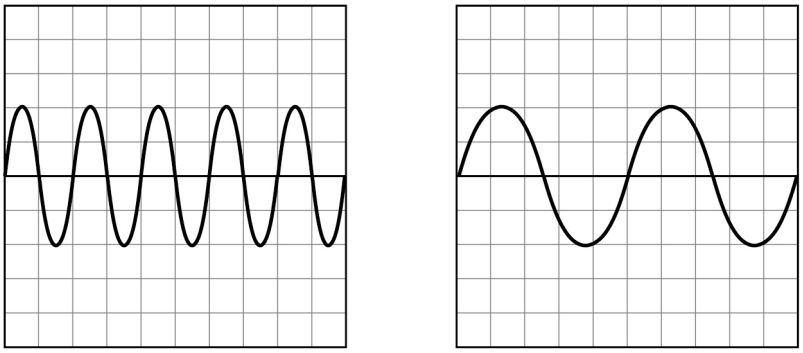
Question 11 · continued

The whistle can emit two different sound waves, **A** and **B**.

Figure 7 shows the two different sound waves as displayed on a screen.

The sound waves are drawn to the same scale.

Figure 7



Wave **A**

Wave **B**

0 3 . 3 Complete the sentences to describe a difference and a similarity between the two waves.

Choose answers from the box.

[2 marks]

amplitude	**frequency**	**wavelength**	**period**

Difference

Wave **A** has a greater _____ than wave **B**.

Similarity

Wave **A** has the same _____ as wave **B**.

Question 3 continues on the next page

6.6.1.2 Properties of waves

Question 11 · continued

0 3 . 4 Wave **A** has a frequency of 4.0 kHz.

Which of the following is the same as 4.0 kHz?

[1 mark]

Tick (✓) **one** box.

4.0 Hz ☐

4000 Hz ☐

4 000 000 Hz ☐

4 000 000 000 Hz ☐

0 3 . 5 Calculate the period of wave **A**.

Use your answer from Question **03.4** and the equation:

$$\text{period} = \frac{1}{\text{frequency}}$$

[2 marks]

Period = _____ s

6.6.1.2 Properties of waves

Question 11 · continued

0 3 . 6 Sound waves in air are longitudinal waves.

Complete the sentence to describe a sound wave.

Choose answers from the box.

[2 marks]

compression	**deflection**	**diffraction**	**rarefaction**	**reflection**

When sound waves travel through air they create areas

of _____ and _____.

9

Turn over for the next question

6.6.1.2 Properties of waves

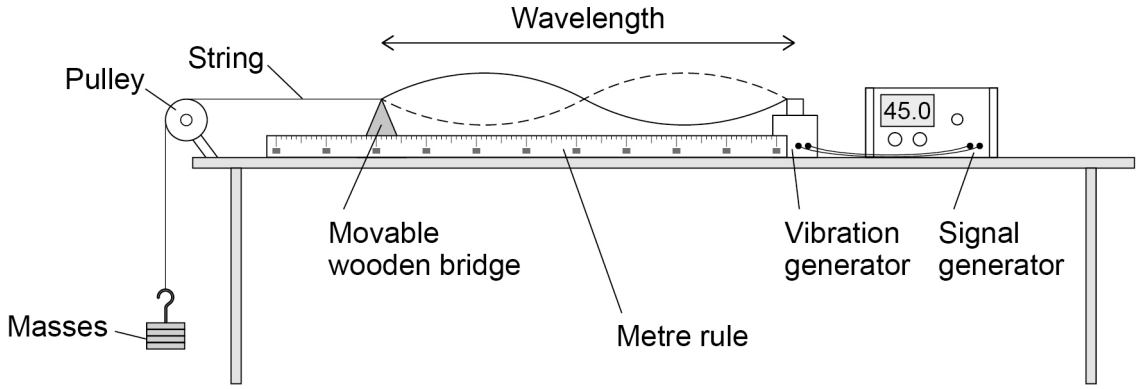
Question 12

June 2024 | 8464/P/2F | Original Q6

0 6 A teacher demonstrated how the frequency of a wave on a string affects the wavelength of the wave.

Figure 11 shows the equipment used.

Figure 11



The frequency of the signal generator is adjusted so that the wave shown in **Figure 11** is seen.

At this frequency the string vibrates between the two positions shown in **Figure 11**.

0 6 . 1 Describe a method the teacher could use to investigate how the frequency of the wave affects the wavelength.

[4 marks]

6.6.1.2 Properties of waves

Question 12 · continued

Use the Physics Equations Sheet to answer questions **06.2** and **06.3**.

06.2 Which equation links frequency (f), wavelength (λ) and wave speed (v)?

[1 mark]

Tick (✓) **one** box.

$f = \lambda \times v$ ☐

$\lambda = f \times v$ ☐

$v = f \times \lambda$ ☐

06.3 The wave on the string has a frequency of 45.0 Hz.

The wave speed is 35.1 m/s.

Calculate the wavelength of the wave.

[3 marks]

Wavelength = _____ m

8

6.6.1.2 Properties of waves

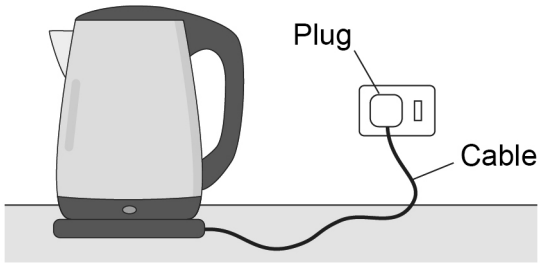
Question 13

June 2025 | 8464/P/1F | Original Q4

0 4 **Figure 5** shows a plastic kettle.

The kettle is connected to the mains electricity supply.

Figure 5



0 4 . 1 What is the frequency of the UK mains electricity supply?

[1 mark]

Tick (✓) **one** box.

25 Hz ☐

50 Hz ☐

75 Hz ☐

100 Hz ☐

Question 4 continues on the next page

6.6.1.2 Properties of waves

Question 13 · continued

0 4 . 2 The cable that connects the kettle to the plug contains two insulated wires.

Draw **one** line from each wire to the colour of the insulation on the wire.

[2 marks]

Wire	Colour of insulation
Live	Blue
Neutral	Brown
	Green and yellow stripes

Use the Physics Equations Sheet to answer questions **04.3** and **04.4**.

0 4 . 3 Write down the equation that links current (I), potential difference (V) and power (P).

[1 mark]

Question 13 · continued

0 4 . 4 The power of the heating element in the kettle is 2100 W.

The potential difference across the heating element is 230 V.

Calculate the current in the heating element.

Give your answer to 2 significant figures.

[4 marks]

Current (2 significant figures) = _____ A

0 4 . 5 The kettle is designed to switch off when the water reaches boiling point.

Before the kettle switches off, 0.0080 kg of water changes state.

The energy transferred to change the state of the water is 18 000 J.

Calculate the specific latent heat of vaporisation of the water.

Use the Physics Equations Sheet.

[3 marks]

Specific latent heat of vaporisation = _____ J/kg

Question 13 · continued

0 4 . 6 A different kettle is used to heat some water.

The useful output energy transferred to the water is 75 600 J.

The total input energy transferred by the kettle is 84 000 J.

Calculate the efficiency of the kettle.

Use the equation:

$$\text{efficiency} = \frac{\text{useful output energy transfer}}{\text{total input energy transfer}}$$

[2 marks]

Efficiency = _____

0 4 . 7 Explain **one** advantage of electrical appliances having a high efficiency.

[2 marks]

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6.6.1.2 Properties of waves

Question 14

June 2025 | 8464/P/2F | Original Q5

0 5 Some homes are connected to the internet using satellites.

Electromagnetic waves are used to transmit data between Earth and the satellites.

0 5 . 1 Which electromagnetic waves are used to transfer data between Earth and satellites?

[1 mark]

Tick (✓) **one** box.

- Gamma rays ☐
- Microwaves ☐
- Ultraviolet ☐
- Visible light ☐

0 5 . 2 Which of the following electromagnetic waves has the greatest frequency?

[1 mark]

Tick (✓) **one** box.

- Gamma rays ☐
- Microwaves ☐
- Ultraviolet ☐
- Visible light ☐

Question 5 continues on the next page

Question 14 · continued

0 5 . 3 What is meant by the 'period of a wave'?

[1 mark]

Tick (✓) **one** box.

The distance travelled by a wave in one second ☐

The number of waves passing a fixed point each second ☐

The time taken for one wave to pass a fixed point ☐

0 5 . 4 Data is transmitted to the satellites by electromagnetic waves with a frequency of 48 GHz.

Calculate the period of waves with a frequency of 48 GHz.

Use the Physics Equations Sheet.

Choose the unit from the box.

[4 marks]

J	N/kg	s

Period = _____ Unit _____

6.6.1.2 Properties of waves

Question 14 · continued

0 5 . 5 The satellites receive and transmit data using electromagnetic waves with different frequencies.

Give **one** property that is the same for electromagnetic waves with different frequencies.

[1 mark]

0 5 . 6 Most homes are connected to the internet using cables.

Suggest **one** reason why homes in some areas of the UK are connected to the internet by satellites.

[1 mark]

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