AQA GCSE Physics | 8463

SPECIFICATION POINT 4.6.1.2

# Properties of waves

## Past-paper questions

| | |
|---|---|
| Tier | **Foundation** |
| Question groups | **107** |
| Available paper years | **2003–2025** |

## 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.

### 4.6.1.2 Properties of waves

**Question 01**

June 2003 | 3451F | Original Q3 | Legacy

**3** (a) In the box are the names of five waves.

| | | | | |
|---|---|---|---|---|
| **infra red** | **microwaves** | **ultrasonic** | **ultraviolet** | **X-rays** |

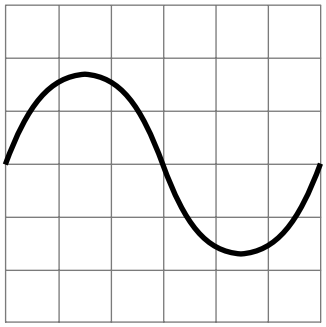
Which wave is used to:

(i) send information to a satellite, .....
*(1 mark)*

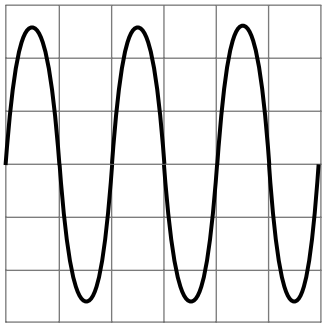
(ii) toast bread, .....
*(1 mark)*

(iii) clean a valuable ring? .....
*(1 mark)*

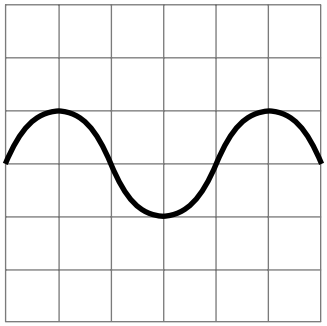
(b) The diagram shows four oscilloscope wave traces. The controls of the oscilloscope were the same for each wave trace.



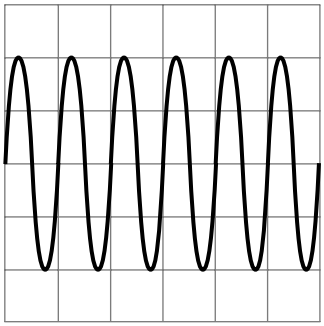
**A**



**B**



**C**



**D**

Which **one** of the waves traces, **A**, **B**, **C** or **D**, has:

(i) the largest amplitude, .....
*(1 mark)*

(ii) the lowest frequency? .....
*(1 mark)*

**4.6.1.2 Properties of waves**

**Question 01 · continued**



5

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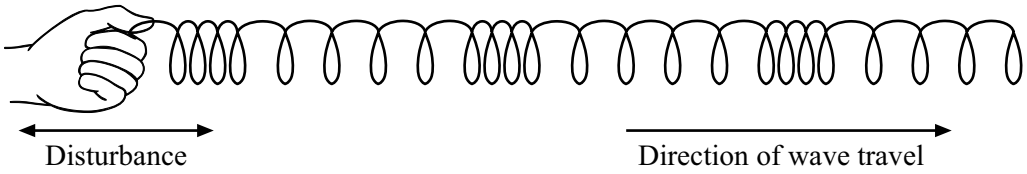
(c) The diagram shows a longitudinal wave in a stretched spring.




Complete the sentence. You should put only **one** word in each space.

A longitudinal wave is one in which the ..... causing the wave is in the same ..... as that in which the wave moves.

*(2 marks)*

(d) Which **one** of the following types of wave is longitudinal? Draw a ring around your answer.

**light wave** **sound wave** **water wave**

*(1 mark)*

8

**4.6.1.2 Properties of waves**

**Question 02**

June 2003 | 3462F3 | Original Q3 | Legacy

**3** (a) In the box are the names of five waves.

| | | | | |
|---|---|---|---|---|
| **infra red** | **microwaves** | **ultrasonic** | **ultraviolet** | **X-rays** |

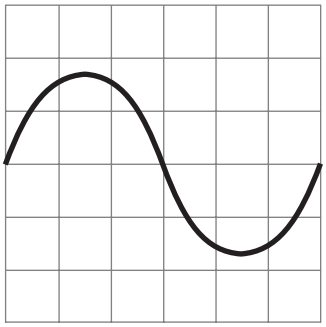
Which wave is used to:

(i) send information to a satellite, .....
*(1 mark)*

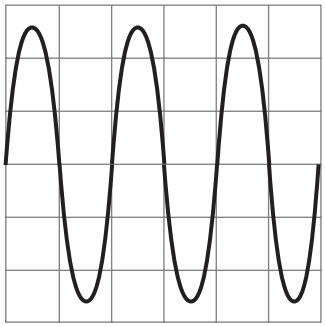
(ii) toast bread, .....
*(1 mark)*

(iii) clean a valuable ring? .....
*(1 mark)*

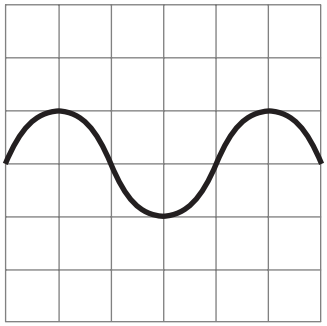
(b) The diagram shows four oscilloscope wave traces. The controls of the oscilloscope were the same for each wave trace.



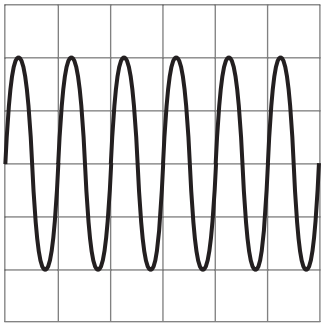
**A**



**B**



**C**



**D**

Which **one** of the waves traces, **A**, **B**, **C** or **D**, has:

(i) the largest amplitude, .....
*(1 mark)*

(ii) the lowest frequency? .....
*(1 mark)*

**4.6.1.2 Properties of waves**

**Question 02 · continued**





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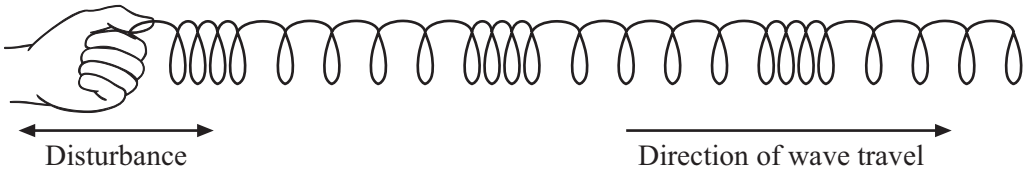
(c) The diagram shows a longitudinal wave in a stretched spring.




Complete the sentence. You should put only **one** word in each space.

A longitudinal wave is one in which the ..... causing the wave is in the same ..... as that in which the wave moves.

*(2 marks)*

(d) Which **one** of the following types of wave is longitudinal? Draw a ring around your answer.

**light wave** **sound wave** **water wave**

*(1 mark)*

8

### 4.6.1.2 Properties of waves

**Question 03**

June 2005 | 3451 | Original Q3 | Legacy

**3** The diagram shows the types of wave that make up the electromagnetic spectrum.

| | | | | | | |
|---|---|---|---|---|---|---|
| **gamma rays** | **X-rays** | **ultraviolet** | **light** | **infra red** | **microwaves** | **radio** |

(a) Which type of wave:

(i) has the longest wavelength and lowest frequency;

.....

*(1 mark)*

(ii) can be used to kill harmful bacteria in food;

.....

*(1 mark)*

(iii) is used in sunbeds to give a sun-tan;

.....

*(1 mark)*

(iv) is used to send information between mobile phones?

.....

*(1 mark)*

(b) Complete the following sentence by crossing out the **two** lines in the box that are wrong.

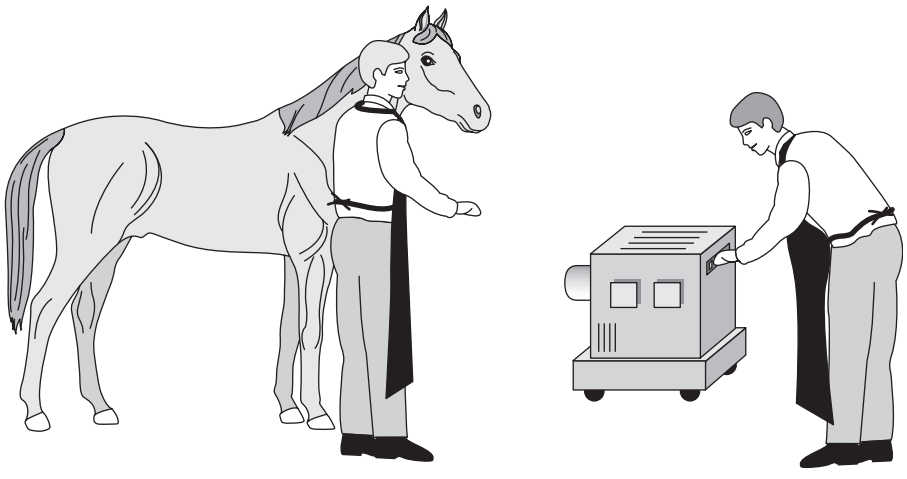
The speed of light rays through space is

| |
|---|
| faster than |
| the same as |
| slower than |

the speed of radio waves through space.

*(1 mark)*

(c) The picture shows a horse being prepared for an X-ray.



The person who will take the X-ray and the person holding the horse are wearing special aprons. These aprons have a lead lining.

Explain why the lead lining is important.

*To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.*

.....

.....

.....

.....

.....

.....

*(3 marks)*

8

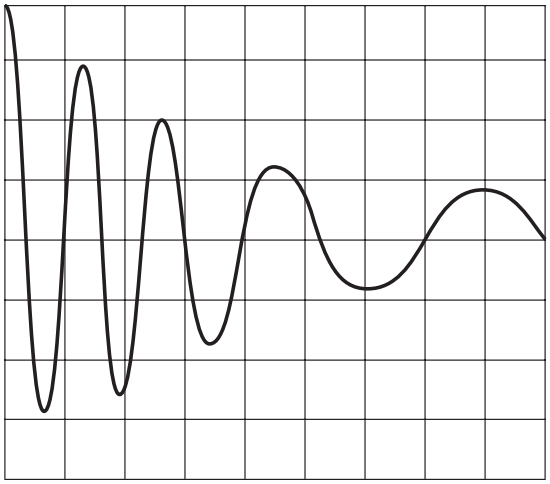
**TURN OVER FOR THE NEXT QUESTION**

### 4.6.1.2 Properties of waves

**Question 04**

June 2005 | 3451 | Original Q17 | Legacy

**17** (a) A microphone connected to an oscilloscope picks up the sound from a siren. The trace produced on the oscilloscope screen is shown below.



Describe how the wave changes as it goes across the screen from left to right (→).

*To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.*

.....

.....

.....

.....

.....

*(3 marks)*

(b) An African bat produces a sound wave with a frequency of 212 kHz and a wavelength of 0.0016 m.

(i) The sound made by the bat is above the limit of human hearing.
What name is given to this type of sound?

.....

*(1 mark)*

(ii) Write down the equation that links frequency, wavelength and wave speed.

.....

*(1 mark)*

(iii) Calculate the speed of this sound wave through the air. Show clearly how you work out your final answer.

.....

.....

Wave speed = ..... m/s

*(3 marks)*

8

### 4.6.1.2 Properties of waves

**Question 05**

June 2005 | 3462 | Original Q3 | Legacy

**3** The diagram shows the types of wave that make up the electromagnetic spectrum.

| | | | | | | |
|---|---|---|---|---|---|---|
| **gamma rays** | **X-rays** | **ultraviolet** | **light** | **infra red** | **microwaves** | **radio** |

(a) Which type of wave:

(i) has the longest wavelength and lowest frequency;

.....

*(1 mark)*

(ii) can be used to kill harmful bacteria in food;

.....

*(1 mark)*

(iii) is used in sunbeds to give a sun-tan;

.....

*(1 mark)*

(iv) is used to send information between mobile phones?

.....

*(1 mark)*

(b) Complete the following sentence by crossing out the **two** lines in the box that are wrong.

The speed of light rays through space is

| |
|---|
| faster than |
| the same as |
| slower than |

the speed of radio waves through space.

*(1 mark)*

**4.6.1.2 Properties of waves**

**Question 05 · continued**





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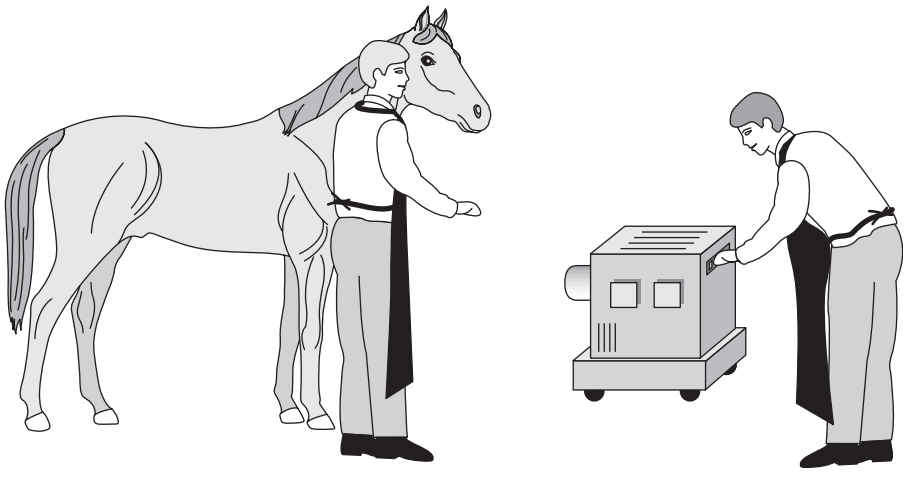
(c) The picture shows a horse being prepared for an X-ray.



The person who will take the X-ray and the person holding the horse are wearing special aprons. These aprons have a lead lining.

Explain why the lead lining is important.

*To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.*

.....

.....

.....

.....

.....

.....

*(3 marks)*

8

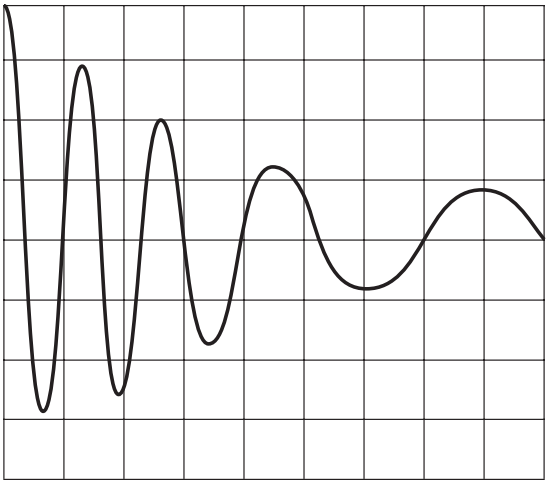
**TURN OVER FOR THE NEXT QUESTION**

**4.6.1.2 Properties of waves**

**Question 06**

June 2005 | 3462 | Original Q13 | Legacy

**13** (a) A microphone connected to an oscilloscope picks up the sound from a siren. The trace produced on the oscilloscope screen is shown below.



Describe how the wave changes as it goes across the screen from left to right (→).

*To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.*

.....

.....

.....

.....

.....

*(3 marks)*

(b) An African bat produces a sound wave with a frequency of 212 kHz and a wavelength of 0.0016 m.

(i) The sound made by the bat is above the limit of human hearing.
What name is given to this type of sound?

.....

*(1 mark)*

(ii) Write down the equation that links frequency, wavelength and wave speed.

.....

*(1 mark)*

(iii) Calculate the speed of this sound wave through the air. Show clearly how you work out your final answer.

.....

.....

Wave speed = ..... m/s

*(3 marks)*

8

**4.6.1.2 Properties of waves**

**Question 07**

June 2006 | 3451 | Original Q13 | Legacy

**13** (a) The diagram shows water waves made by a wave machine in a swimming pool.



In 10 seconds 5 complete waves go past a person standing in the pool.

Calculate the frequency of the water waves and give the unit.

Show how you work out your answer.

.....

Frequency = .....

*(2 marks)*

(b) Water waves are transverse waves.

Give **one** other example of a transverse wave.

.....

*(1 mark)*

(c) How is a transverse wave different from a longitudinal wave? You may draw a diagram to help you with your answer.

.....

.....

.....

.....

*(2 marks)*

**4.6.1.2 Properties of waves**

**Question 07 · continued**



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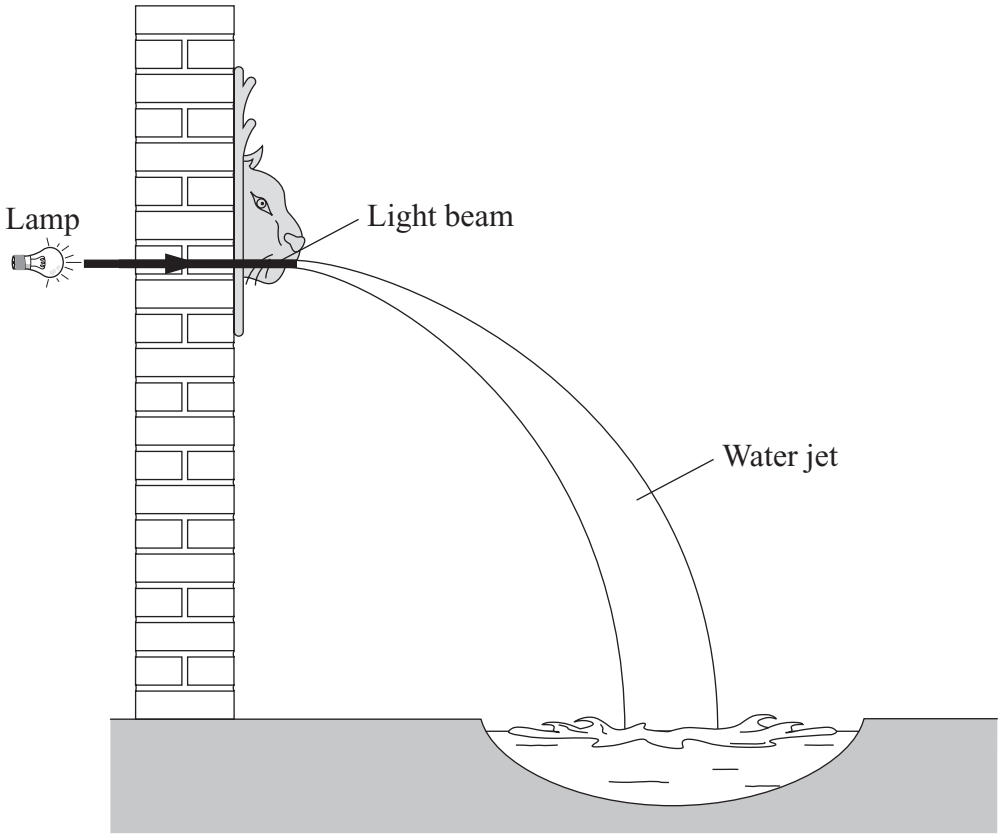
(d) The diagram shows a garden fountain. The fountain features a light beam that is totally internally reflected by the water jet.




(i) Draw the path of the light beam through the water jet. *(1 mark)*

(ii) Complete the following sentence by crossing out the **two** lines in the box that are wrong.

For light to be totally internally reflected the angle between the light ray and the normal must be

| |
|---|
| smaller than |
| equal to |
| bigger than |

the critical angle.

*(1 mark)*

7

**4.6.1.2 Properties of waves**

**Question 08**

June 2006 | 3462 | Original Q11 | Legacy

**11** (a) The diagram shows water waves made by a wave machine in a swimming pool.



In 10 seconds 5 complete waves go past a person standing in the pool.

Calculate the frequency of the water waves and give the unit.

Show how you work out your answer.

.....

Frequency = .....

*(2 marks)*

(b) Water waves are transverse waves.

Give **one** other example of a transverse wave.

.....

*(1 mark)*

(c) How is a transverse wave different from a longitudinal wave? You may draw a diagram to help you with your answer.

.....

.....

.....

.....

*(2 marks)*

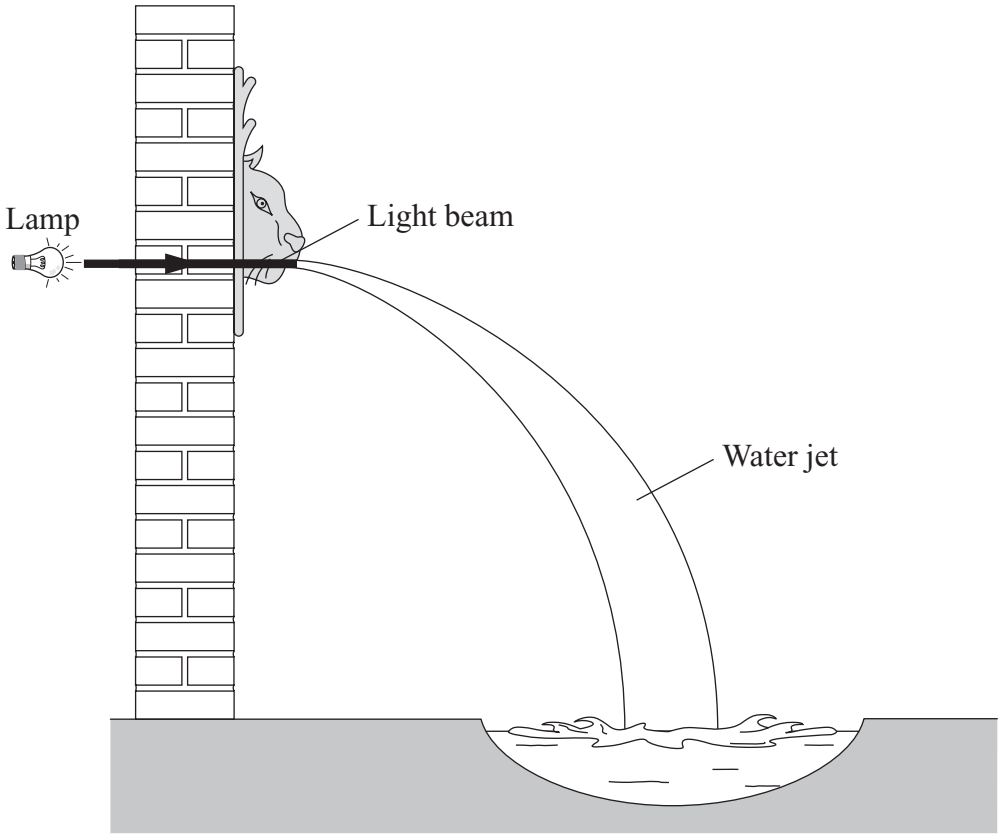
**4.6.1.2 Properties of waves**

**Question 08 · continued**

June 2006 | 3462 | Original Q11 | Legacy

*BLANK*

(d) The diagram shows a garden fountain. The fountain features a light beam that is totally internally reflected by the water jet.




(i) Draw the path of the light beam through the water jet. *(1 mark)*

(ii) Complete the following sentence by crossing out the **two** lines in the box that are wrong.

For light to be totally internally reflected the angle between the light ray and the normal must be

| |
|---|
| smaller than |
| equal to |
| bigger than |

the critical angle.

*(1 mark)*

7

4.6.1.2 Properties of waves

Question 09

November 2006 | PHY1B | Original Q2 | Legacy

## QUESTION TWO

Electromagnetic radiation can be grouped into types, each with a different range of wavelengths.

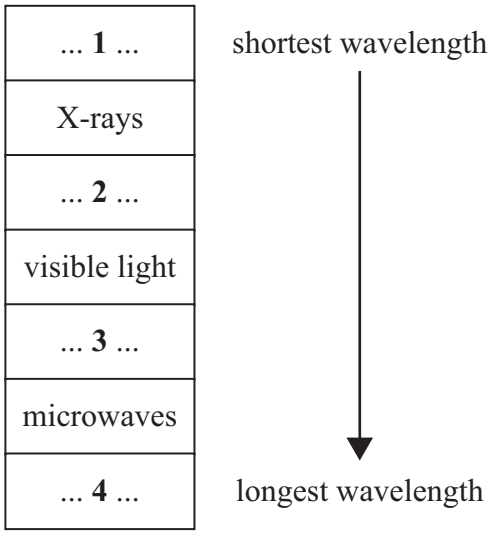
Match types of electromagnetic radiation, **A**, **B**, **C** and **D**, with the numbers **1–4** in the list.

**A** gamma rays

**B** infra red rays

**C** radio waves

**D** ultraviolet waves



4.6.1.2 Properties of waves

Question 10

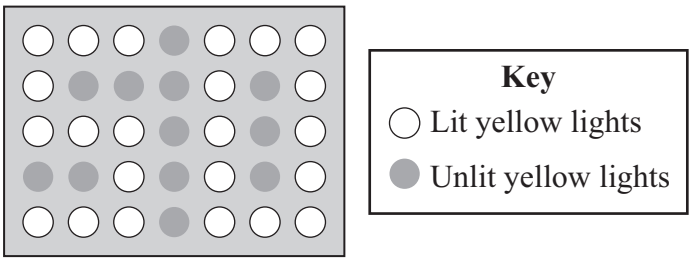
November 2006 | PHY1B | Original Q8 | Legacy

## QUESTION EIGHT

Vehicles on motorways often travel at high speeds. It is important that clear warning signs are used.

Tests were carried out to find the most suitable colour for the lights in the warning sign.

The drawing shows a sign which has yellow lights.




**8A** Suggest why yellow light is used for the sign.

**1** It has a higher frequency than all other colours.

**2** It has a longer wavelength than all other colours.

**3** It is easier to see than all other colours.

**4** It travels faster than all other colours.

**8B** What determines the colour of the light from the display?

**1** its brightness

**2** its frequency

**3** its power

**4** its speed in a vacuum

**8C** The wavelength of red light is 700 nm and the wavelength of violet light is 300 nm.

What is the likely value of the wavelength of the yellow light from the sign?

**1** 250 nm

**2** 350 nm

**3** 600 nm

**4** 750 nm

4.6.1.2 Properties of waves

Question 10 · continued



**8D** The warning sign is switched on by sending a radio signal. The frequency of the signal is 2 000 000 hertz and its wavelength is 150 metres.

Calculate the wave speed of the signal in metres/second.

| wave speed = frequency × wavelength |
|---|

**1** 13 333 m/s

**2** 1 333 333 m/s

**3** 300 000 000 m/s

**4** 3 000 000 000 m/s

**Turn over for the next question**

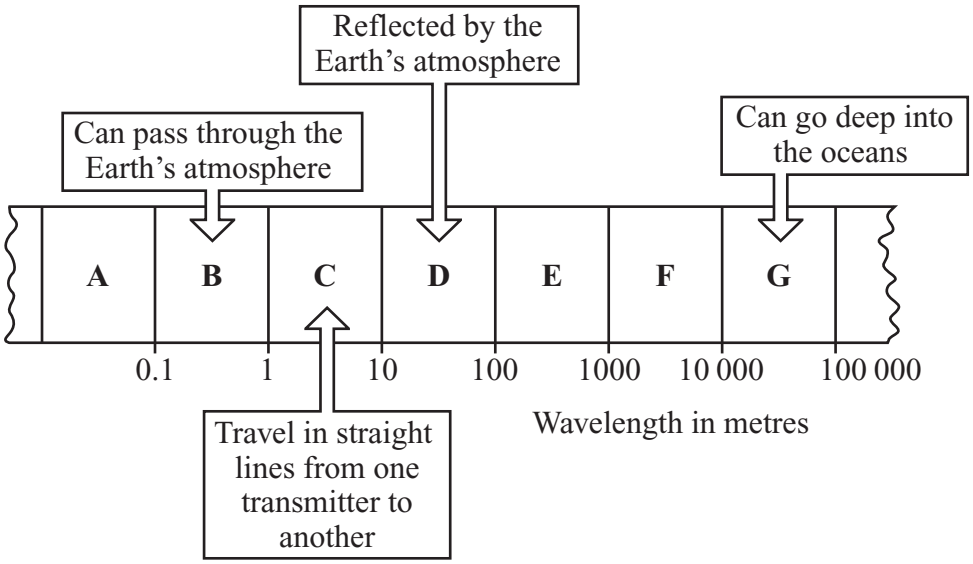
**4.6.1.2 Properties of waves**

**Question 11**

January 2007 | PHY1F | Original Q1 | Legacy

**1** The diagram shows a small part of the electromagnetic spectrum divided into seven sections.

The different properties of the waves in each section make them useful in different ways.




The waves in which section, **A**, **B**, **C**, **D**, **E**, **F** or **G**, are:

(a) used to send a signal to a satellite in space

.....

*(1 mark)*

(b) used to communicate with a submarine under the water

.....

*(1 mark)*

(c) used by a radio station to broadcast programmes around the world

.....

*(1 mark)*

(d) the waves with the shortest wavelength?

.....

*(1 mark)*

**4**

4.6.1.2 Properties of waves

Question 12

March 2007 | PHY1B | Original Q7 | Legacy

**QUESTION SEVEN**

# Electromagnetic radiation fills the Universe

Electromagnetic radiations belong to a spectrum of radiations which have many features in common.

**7A** In the box, the electromagnetic radiations are meant to be in order of increasing wavelength from left to right. Which one is in the wrong position?

| | | | |
|---|---|---|---|
| X-rays | Infra red rays | Radio waves | Gamma rays |
| **1** | **2** | **3** | **4** |

**1** X-rays

**2** infra red rays

**3** radio waves

**4** gamma rays

**7B** Which statement is correct?

**1** All electromagnetic radiation can travel through a vacuum.

**2** All electromagnetic radiation is visible to the human eye.

**3** No electromagnetic radiation can travel through a vacuum.

**4** No electromagnetic radiation is visible to the human eye.

4.6.1.2 Properties of waves

Question 12 · continued



**7C** Which statement about the wavelength of microwaves is correct?

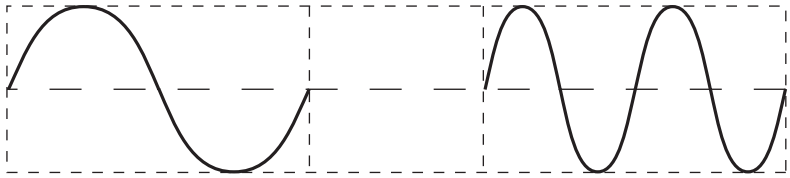
**1** longer than both infra red rays and ultraviolet rays

**2** longer than infra red rays but shorter than ultraviolet rays

**3** shorter than both infra red rays and ultraviolet rays

**4** shorter than infra red rays but longer than ultraviolet rays

**7D** Two electromagnetic waves are shown in the diagrams, which are drawn to the same scale.




Which sentence is correct?

**1** The frequency of wave **X** is double that of wave **Y**.

**2** The frequency of wave **Y** is double that of wave **X**.

**3** The wavelength of wave **Y** is double that of wave **X**.

**4** The wavelength of wave **Y** is four times that of wave **X**.

4.6.1.2 Properties of waves

Question 13

March 2007 | PHY1B | Original Q9 | Legacy

## QUESTION NINE

A student has been learning about the electromagnetic spectrum.

**9A** Which part(s) of the electromagnetic spectrum can be used for communication?

**1** radio waves only

**2** radio waves and microwaves only

**3** radio waves, microwaves and infra red rays only

**4** radio waves, microwaves, infra red rays and visible light

**9B** Waves of the electromagnetic spectrum travel through space.

When they do, which property is the same for all of them?

**1** energy

**2** penetration

**3** power

**4** speed

**9C** The frequency of a radio signal is increased.

Which is correct?

**1** Its speed decreases.

**2** Its speed increases.

**3** Its wavelength decreases.

**4** Its wavelength increases.

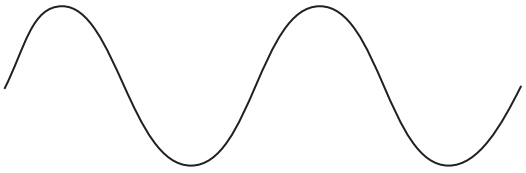
4.6.1.2 Properties of waves

Question 13 · continued



**9D** Communication signals are often digital. The diagrams show four signals.

**E**



**F**



**G**



**H**



Which two could be digital?

**1** **E** and **F**

**2** **F** and **G**

**3** **G** and **H**

**4** **H** and **E**

**END OF TEST**

4.6.1.2 Properties of waves

Question 14

June 2007 | PHY1B | Original Q7 | Legacy

**QUESTION SEVEN**

The solar system is part of the Milky Way galaxy.

**7A** Astronomers measure the wavelengths of light from distant galaxies.

The unit for wavelength is . . .

**1** Hz

**2** m/s

**3** m

**4** °C

**7B** Visible light from distant galaxies shows an increase in . . .

**1** frequency.

**2** intensity.

**3** speed.

**4** wavelength.

**7C** There is a red-shift in light observed from most distant galaxies.

This has led scientists to the belief that . . .

**1** galaxies are moving away from each other.

**2** galaxies are moving towards each other.

**3** galaxies are moving towards the Milky Way.

**4** galaxies are moving towards each other, but some are moving apart.

4.6.1.2 Properties of waves

Question 14 · continued



**7D** Scientists who have studied electromagnetic radiation from distant galaxies support the 'big bang' theory, which states that the Universe began . . .

**1** in many places at the same time.

**2** from a very small point.

**3** as one very big galaxy.

**4** as one very big solar system.

**Turn over for the next question**

**4.6.1.2 Properties of waves**

**Question 15**

June 2007 | PHY1F | Original Q4 | Legacy

**4** (a) Ultraviolet and visible light are both electromagnetic waves.

(i) Name **one** other type of electromagnetic wave.

.....

*(1 mark)*

(ii) Which **one** of the following statements is true for electromagnetic waves travelling through a vacuum?

Put a tick (✓) in the box next to your answer.

All the waves have the same frequency. ☐

All the waves have the same wavelength. ☐

All the waves travel at the same speed. ☐

*(1mark)*

**4.6.1.2 Properties of waves**

**Question 15 · continued**



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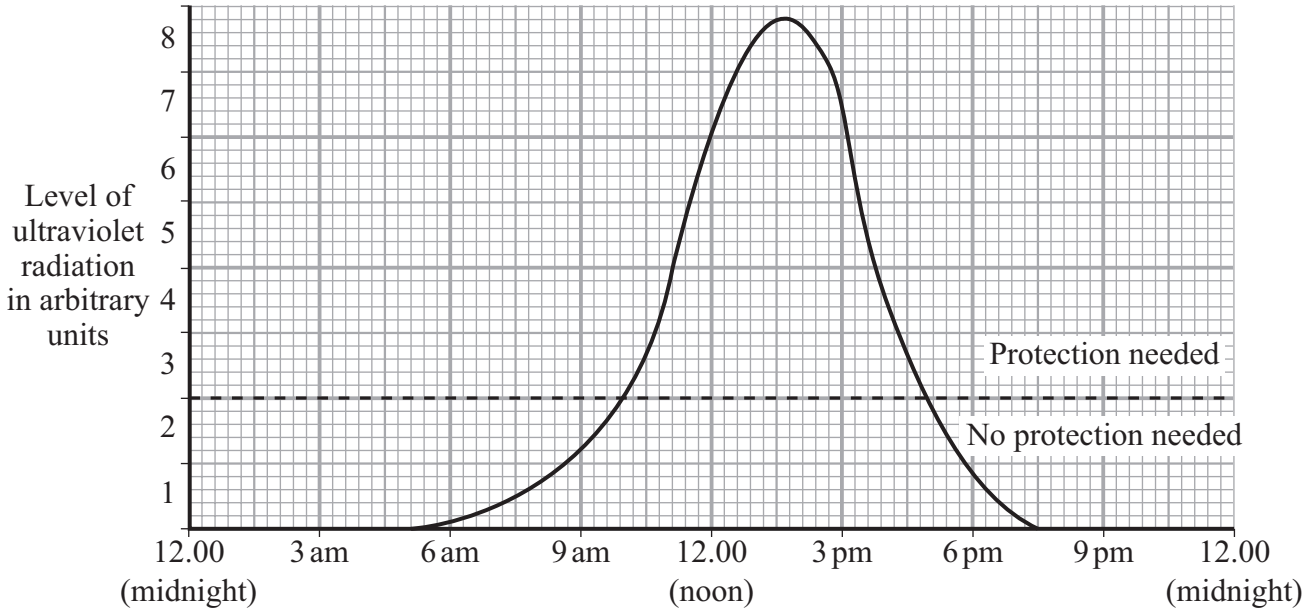
(b) The graph shows how the level of ultraviolet radiation changed during a summer day in England.




(i) What serious health problem can be caused by exposure to the ultraviolet radiation from the Sun?

.....

*(1 mark)*

(ii) Explain why it would be sensible to stay out of the Sun between 10 am and 4 pm in the summer.

.....

.....

.....

.....

*(2 marks)*

**5**

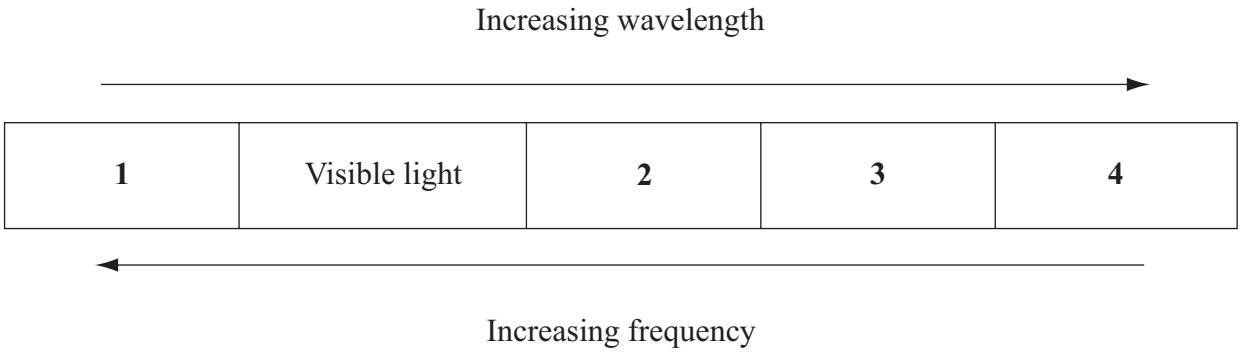
4.6.1.2 Properties of waves

Question 16

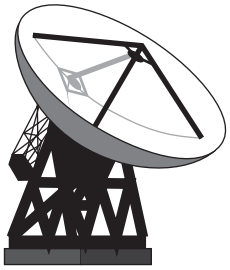
November 2007 | PHY1B | Original Q3 | Legacy

## QUESTION THREE

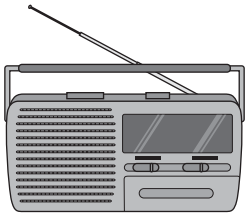
The diagram shows part of the electromagnetic spectrum.



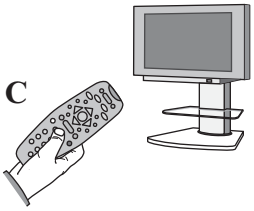

Match devices, **A**, **B**, **C** and **D**, with the types of electromagnetic radiation **1–4** in the spectrum.



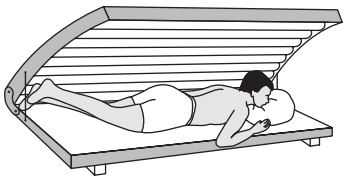
**A**



**B**



**C**



**D**

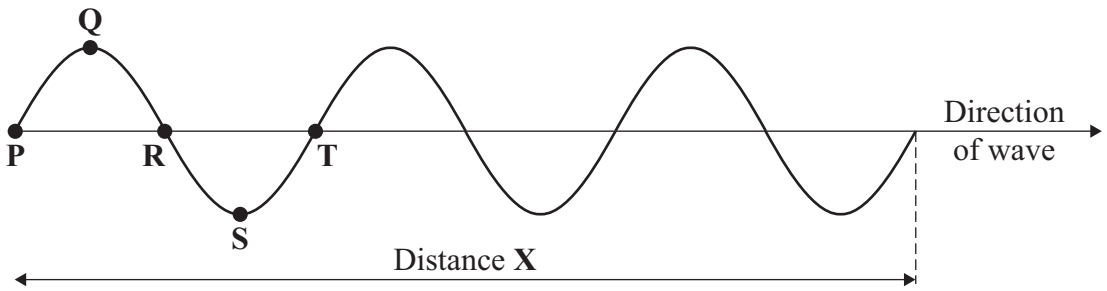
4.6.1.2 Properties of waves

Question 17

November 2007 | PHY1B | Original Q7 | Legacy

## QUESTION SEVEN

The diagram shows part of a wave.




**7A** The wavelength of this wave is . . .

**1** **PR**

**2** **PT**

**3** **RT**

**4** **QS**

**7B** The wave travels distance **X** in 1 second.

The frequency of the wave is . . .

**1** 1 Hz

**2** 2 Hz

**3** 3 Hz

**4** 6 Hz

**4.6.1.2 Properties of waves**

**Question 17 · continued**



**7C** The spectrum of light from a source of white light moving away at high speed shows . . .

**1** a ‘shift’ towards the red end of the spectrum.

**2** an increase in the intensity of the ultraviolet radiation.

**3** that light travels in straight lines.

**4** that red light travels more slowly than blue light in a vacuum.

**7D** Scientists have analysed light from distant galaxies.

Their conclusion is that . . .

**1** our solar system and distant galaxies are moving apart at high speed.

**2** galaxies are moving towards each other at high speed.

**3** galaxies are stationary.

**4** the planets in our solar system are moving away from the Sun at high speed.

**4.6.1.2 Properties of waves**

**Question 18**

January 2008 | PHY1F | Original Q4 | Legacy

**4** Using an optical telescope to look at stars is not always easy because:

- too many street lights often make it too light to see faint stars
- clouds reduce the light getting to the telescope
- atmospheric pollution often distorts the images.

(a) Large optical telescopes are often positioned high up a mountain.

Describe the advantages of positioning a telescope high up a mountain.

.....

.....

.....

.....

.....

.....

*(3 marks)*

(b) A new telescope is going to be built in Chile. It will detect electromagnetic waves with a frequency between infra red and radio waves.

What type of waves will this telescope detect?

.....

*(1 mark)*

(c) Telescopes that detect X-rays are always on satellites in space.

Which statement gives the reason for the telescope to be in space?

Put a tick (✓) in the box next to your choice.

The atmosphere absorbs X-rays. ☐

X-rays can harm people. ☐

X-rays have a shorter wavelength than light. ☐

*(1 mark)*

5

**4.6.1.2 Properties of waves**

**Question 19**

January 2008 | PHY3F | Original Q9 | Legacy

**9** When sound waves reach a material, some of the energy of the sound is reflected and some is transmitted through the material.

(a) Complete the sentence.

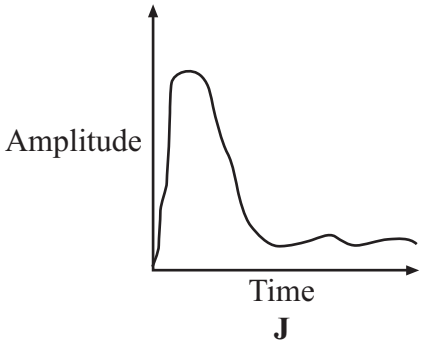
Sound waves are caused by ..... .

*(1 mark)*

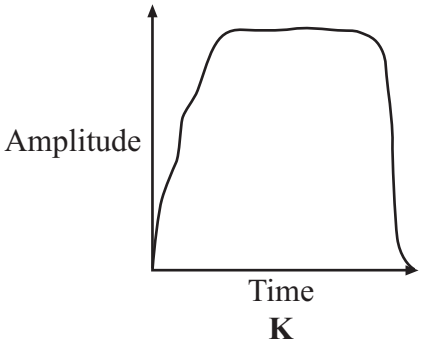
(b) The graphs **J**, **K**, **L** and **M** represent the sound energy reflected from a surface.

The graphs are all drawn to the same scale.

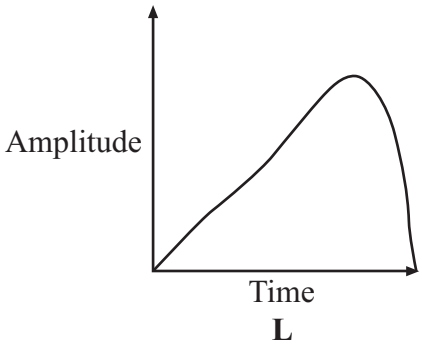
Which graph shows the greatest total sound energy output from the surface?



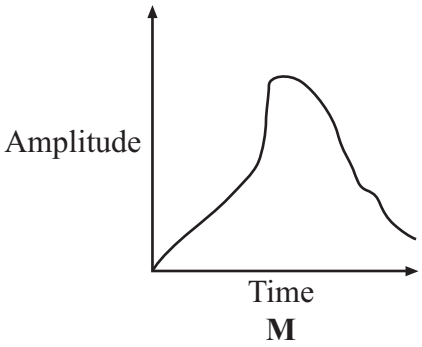

**J**




**K**




**L**




**M**

Graph .....

*(1 mark)*

**Question 9 continues on the next page**

**4.6.1.2 Properties of waves**

**Question 19 · continued**



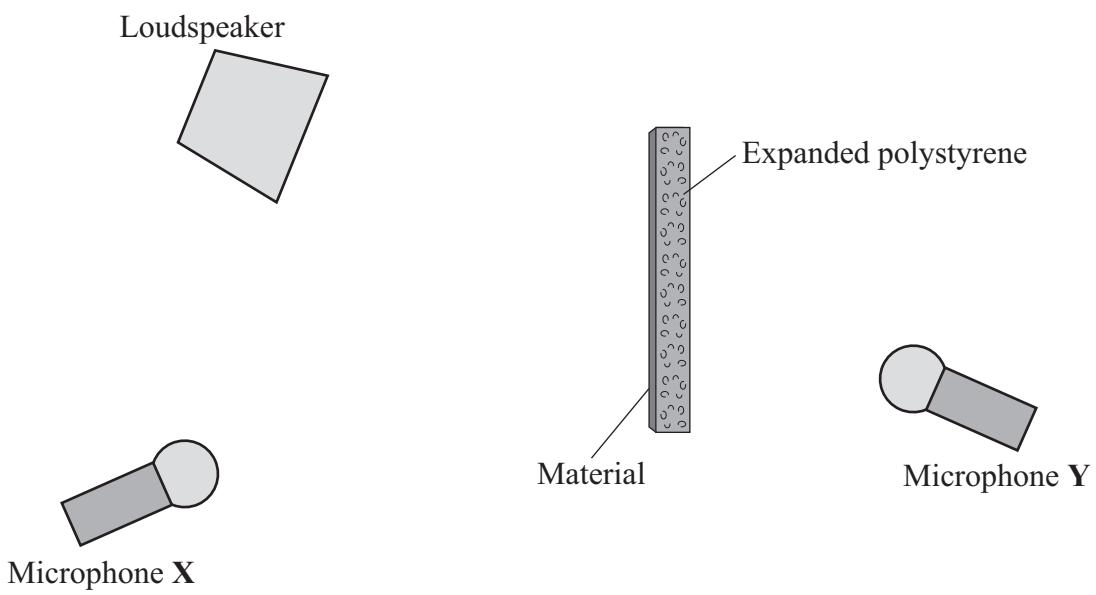
*BLANK*

(c) The proportion of the sound energy which is reflected or transmitted depends on the material which receives the sound.

A student investigates different materials.

The diagram shows how a student sets up her equipment.

(i) Using a pencil and ruler to draw on the diagram, show how microphone **X** receives reflected sound.




*(2 marks)*

(ii) The student tests four materials. Each sheet of material is 1 mm thick. This has been glued onto a block of expanded polystyrene.

Why does the student use the same size of expanded polystyrene block and the same sound level for each test?

.....

.....

*(1 mark)*

4.6.1.2 Properties of waves

Question 19 · continued



BLANK

(iii) The table shows the readings for the sound level transmitted to microphone **Y**.

| Sound level from loudspeaker in arbitrary units | Surface material | Sound level transmitted to microphone Y in arbitrary units |
|---|---|---|
| 60 | paper | 39 |
| 60 | plaster | 18 |
| 60 | cloth | 31 |
| 60 | wood | 15 |

[A] Which surface material transmits the smallest proportion of the sound?

.....

*(1 mark)*

[B] What proportion is this?

.....

*(1 mark)*

(d) People living in a flat have very noisy neighbours who are always playing loud music.

Suggest **one** practical idea to reduce the amount of noise transmitted into the flat through the walls and explain how your idea will work.

.....

.....

.....

.....

.....

.....

*(2 marks)*

9

**4.6.1.2 Properties of waves**

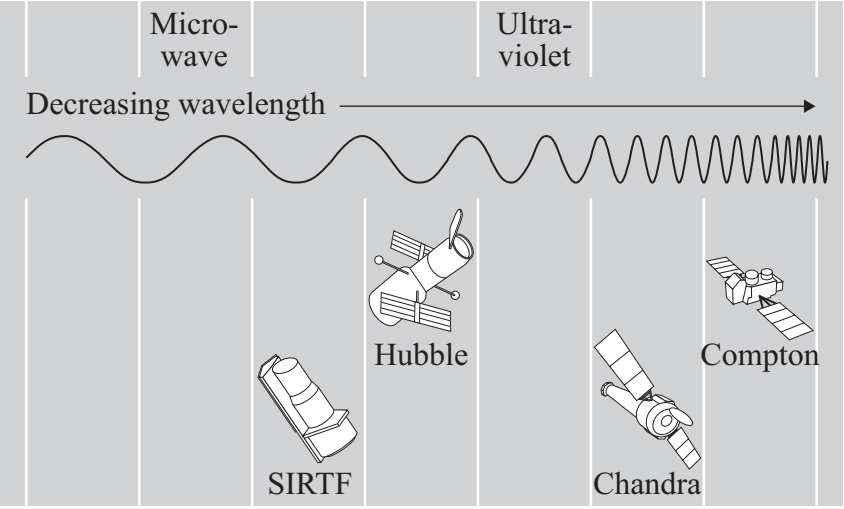
**Question 20**

March 2008 | PHY1BP | Original Q3 | Legacy

## QUESTION THREE

Space telescopes are designed to detect different types of electromagnetic radiation.

The diagram shows part of the electromagnetic spectrum and four different telescopes.




Match telescopes, **A**, **B**, **C** and **D**, with the types of electromagnetic radiation **1–4** in the table that each is designed to detect.

**A** SIRTF

**B** Hubble

**C** Chandra

**D** Compton

| | **Type of electromagnetic radiation** |
|---|---|
| **1** | gamma radiation |
| **2** | infra red radiation |
| **3** | X-rays |
| **4** | visible light |

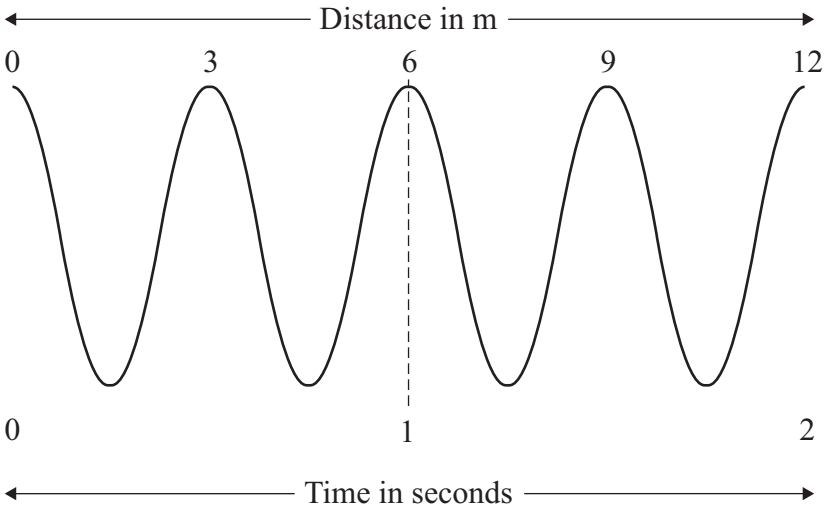
**4.6.1.2 Properties of waves**

**Question 21**

March 2008 | PHY1BP | Original Q6 | Legacy

## QUESTION SIX

The diagram shows a wave.




| wave speed (metre/second, m/s) | = | frequency (hertz, Hz) | × | wavelength (metre, m) |
|---|---|---|---|---|

Match figures, **A**, **B**, **C** and **D**, with the numbers **1–4** in the table.

**A** 2

**B** 3

**C** 4

**D** 6

| | |
|---|---|
| **1** | the number of complete waves shown in the diagram |
| **2** | the wavelength in metres |
| **3** | the frequency in hertz |
| **4** | the speed of the wave in metres per second |

**4.6.1.2 Properties of waves**

**Question 22**

June 2008 | PHY1BP | Original Q4 | Legacy

## QUESTION FOUR

The diagram shows the electromagnetic spectrum.

| | | | | | | |
|---|---|---|---|---|---|---|
| **1** | X-rays | **2** | Visible light | **3** | Micro waves | **4** |

Increasing wavelength ⟶

Match the types of radiation, **A**, **B**, **C** and **D**, with the numbers **1–4** in the electromagnetic spectrum.

**A** gamma

**B** infra red

**C** radio waves

**D** ultraviolet

**Turn over for the next question**

**4.6.1.2 Properties of waves**

**Question 23**

June 2008 | PHY1F | Original Q4 | Legacy

**4** The table gives data about two space telescopes. The Hubble telescope is already in space, but the James Webb telescope is still being built.

| Name of telescope | Mirror diameter in metres | Launch Year | Orbit distance from the Earth in kilometres |
|---|---|---|---|
| Hubble | 2.4 | 1990 | 575 |
| James Webb | 6.5 | 2013 | 1 500 000 |

**4** (a) Give **one** reason why the image from an optical telescope on the Earth may not be as clear as the image produced by a space telescope.

.....

.....

*(1 mark)*

**4** (b) Explain why it is easier for astronauts to service the Hubble telescope than it will be for astronauts to service the James Webb telescope.

.....

.....

.....

.....

*(2 marks)*

**4** (c) The large mirror for the James Webb telescope will be folded, launched into space and then opened out. This will be a complicated process so a working scale model of the mirror system has been built.

Which statement gives a reason for building the scale model?

Put a tick (✓) in the box next to your answer.

To see what the mirror system will look like ☐

To test the design to make sure it will work ☐

To measure the power needed by the telescope ☐

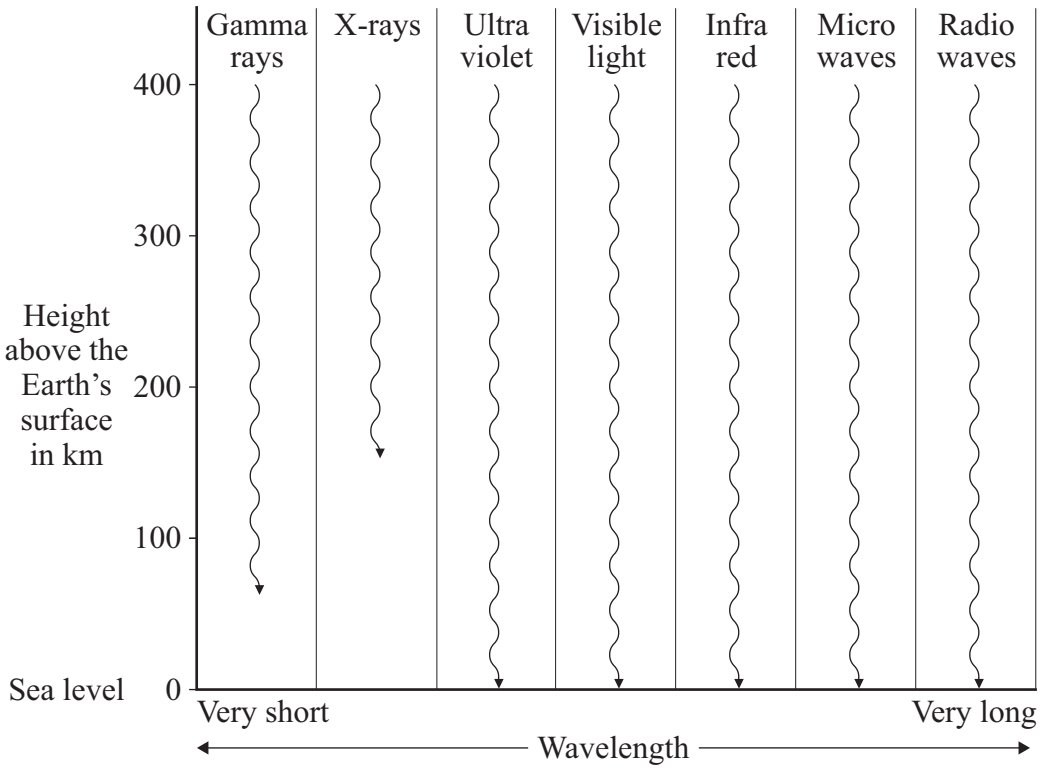
*(1 mark)*

Question 23 · continued



*for mark*

**4** (d) The diagram shows how far different types of electromagnetic wave can travel through the Earth's atmosphere before being absorbed.




Name **two** types of electromagnetic wave that can be detected by a space telescope but cannot be detected by a telescope positioned on Earth.

1 .....

2 .....

*(2 marks)*

**4** (e) Observations of distant galaxies have given evidence to support the theory that the universe began from a very small point.

What name is given to this theory?

.....

*(1 mark)*

7

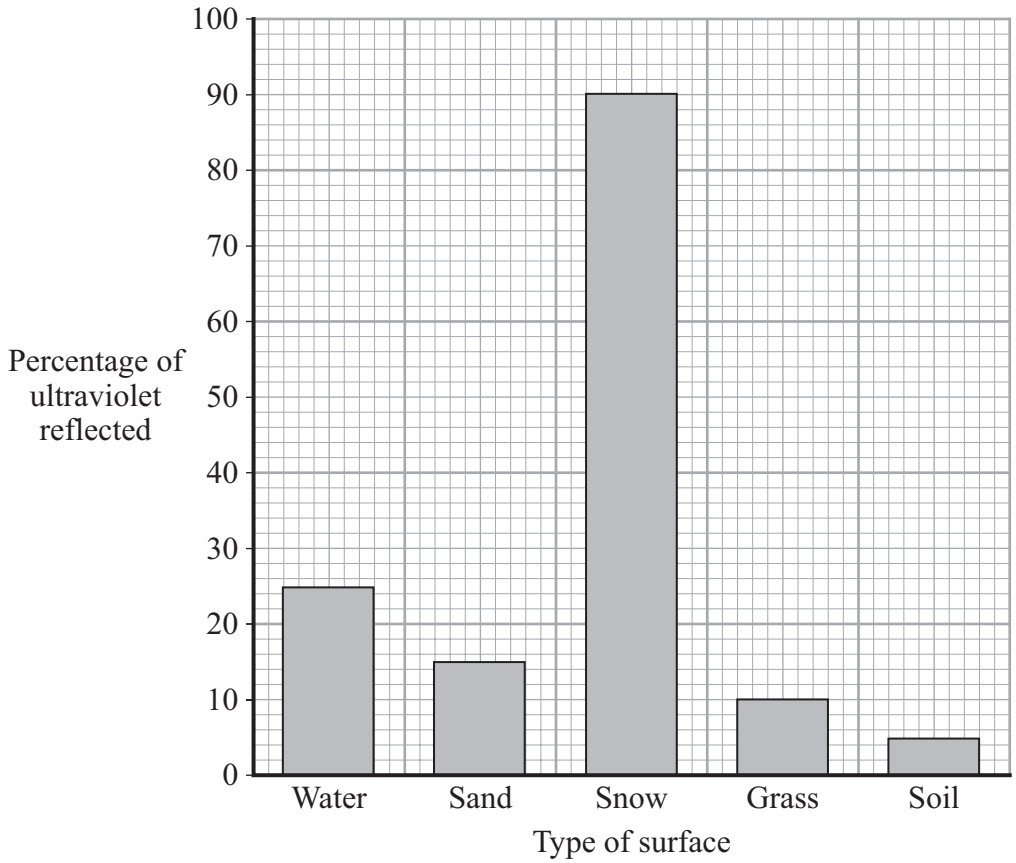
**4.6.1.2 Properties of waves**

**Question 24**

June 2008 | PHY1F | Original Q6 | Legacy

**6** (a) Ultraviolet (UV) radiation can be reflected or absorbed by a surface.

The percentage of ultraviolet radiation reflected by various surfaces is shown in the bar chart.




**6** (a) (i) Which of these surfaces is the best **absorber** of ultraviolet radiation?

.....

*(1 mark)*

**6** (a) (ii) Why has the data been shown as a bar chart rather than a line graph?

.....

.....

*(1 mark)*

**6** (a) (iii) Who is likely to be exposed to more ultraviolet radiation, a skier or a golfer?

Draw a ring around your answer. **skier** **golfer**

Give a reason for your answer.

.....

.....

*(1 mark)*

**Question 6 continues on the next page**

**4.6.1.2 Properties of waves**

**Question 24 · continued**



*for mark*

**6** (a) (iv) State **one** harmful effect that ultraviolet radiation has on skin.

.....

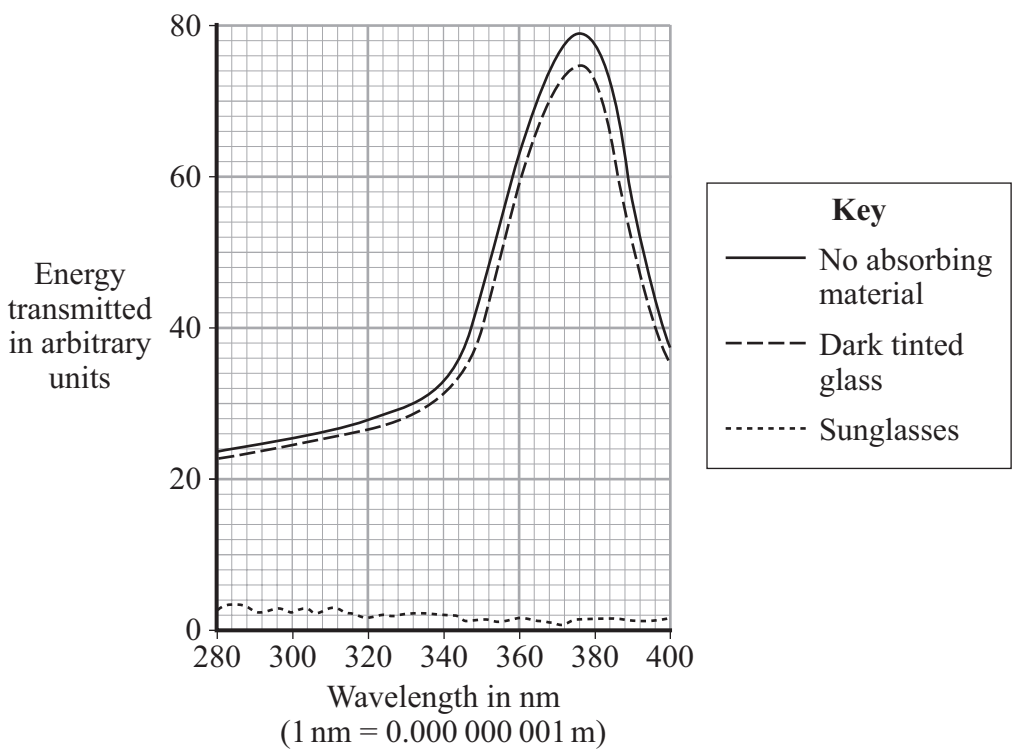
*(1 mark)*

**6** (b) This is a label from a pair of sunglasses.

Sportswear Budget £5

- plastic lenses
- blocks 95% of ultraviolet rays
- UV absorbing up to wavelengths of 400 nm

A student tested the sunglasses by measuring the energy transmitted by the lenses for ultraviolet waves with a range of different wavelengths.
For comparison, the student also measured the transmission of ultraviolet waves through a piece of dark tinted glass.
The results of the tests are shown in the graph.



**4.6.1.2 Properties of waves**

**Question 24 · continued**



*for mark*

**6** (b) (i) Explain how the student's results support the claims made on the label.

.....

.....

.....

.....

*(2 marks)*

**6** (b) (ii) Ultraviolet radiation can cause permanent eye damage.

Why should the lenses for sunglasses **not** be made from the dark tinted glass used in the student's tests?

.....

.....

*(1 mark)*

**6** (c) An eye care charity predicts that within 10 years, everyone, when outside, will wear UV protection sunglasses most of the time. This is because the potential damage from ultraviolet radiation is so serious.

**6** (c) (i) Which **one** of the following statements is the most likely reason for the prediction made by the eye care charity?

Put a tick (✓) in the box next to your answer.

Publicity and education will make people aware of the dangers. ☐

The price of UV blocking sunglasses will fall dramatically. ☐

The level of UV in the atmosphere will increase. ☐

*(1 mark)*

**6** (c) (ii) Several manufacturers of sunglasses have said that the research they have carried out supports the view of the eye care charity.

Suggest why the research conducted by the manufacturers could be biased.

.....

.....

*(1 mark)*

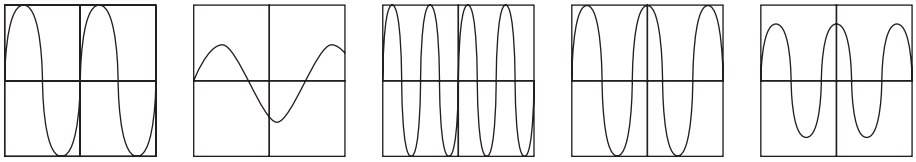
**9**

**4.6.1.2 Properties of waves**

**Question 25**

June 2008 | PHY3F | Original Q3 | Legacy

**3** (a) A student uses a microphone to send different sounds to an oscilloscope. The diagrams show five traces, **A**, **B**, **C**, **D** and **E**, on the oscilloscope. All the traces are drawn to the same scale.



**A** **B** **C** **D** **E**

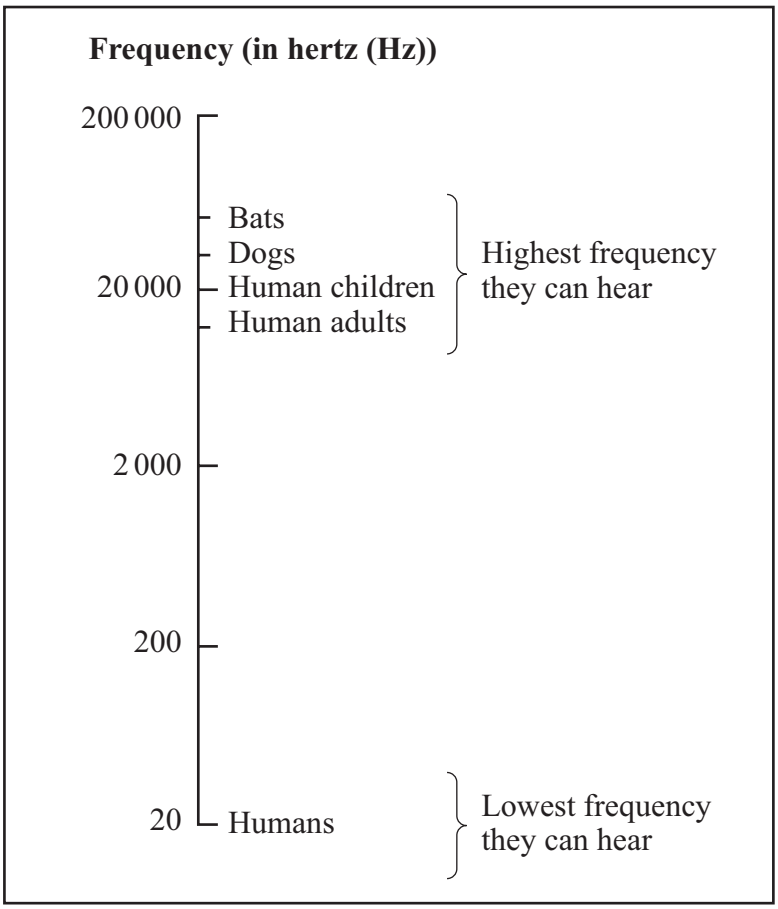
**3** (a) (i) Which **three** diagrams show traces with the same amplitude?

Diagrams ....., ..... and ..... . *(1 mark)*

**3** (a) (ii) Which **two** diagrams show traces with the same frequency?

Diagrams ..... and ..... . *(1 mark)*

**3** (b) The diagram shows the sound frequencies which some living things can hear.



**4.6.1.2 Properties of waves**

**Question 25 · continued**



*for mark*

**3** (b) (i) What is the widest range of frequencies that a human child can hear?

.....

*(1 mark)*

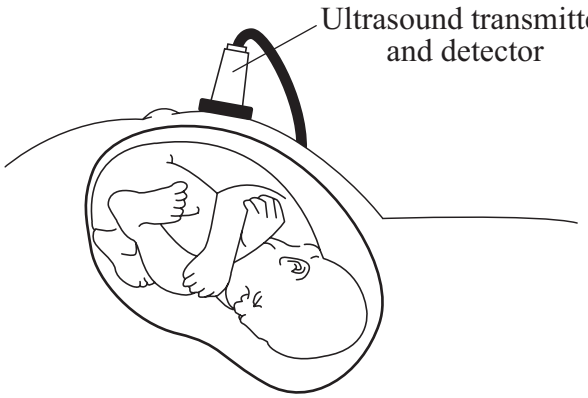
**3** (b) (ii) Why can some dog whistles be heard by dogs but not by humans?

.....

.....

*(1 mark)*

**3** (c) An ultrasound scan can be used to make a picture of a baby in its mother's womb. An ultrasound transmitter and detector are placed above the mother's womb. Ultrasound goes into the body of the mother and into the body of the baby.




Use the correct words from the box to complete the sentences.

| | | | | | |
|---|---|---|---|---|---|
| **detector** | **reflection** | **refraction** | **sound** | **substance** | **transmitter** |

**3** (c) (i) When the ultrasound crosses from one ..... to another, some ultrasound becomes an echo caused by ..... .

**3** (c) (ii) This information is collected by the ultrasound ..... and made into a picture on a screen.

*(3 marks)*

7

**4.6.1.2 Properties of waves**

**Question 26**

November 2008 | PHY1BP | Original Q4 | Legacy

## QUESTION FOUR

The Earth's atmosphere absorbs all electromagnetic waves except those with wavelengths longer than ultraviolet radiation.

Match the electromagnetic radiations, **A**, **B**, **C** and **D**, with the numbers **1–4** in the sentences.

**A** microwaves

**B** radio waves

**C** visible light

**D** X-rays

Three hundred years ago, many objects in the night sky were discovered by looking through hand-held telescopes. These telescopes detect . . . **1** . . . .

In the last century, distant galaxies were discovered by using large dishes and aerials on Earth which detect . . . **2** . . . .

In recent years, many discoveries have been made using telescopes mounted on satellites in space. Unlike telescopes on Earth, these telescopes can detect . . . **3** . . . .

The satellites send images back to Earth using . . . **4** . . . .

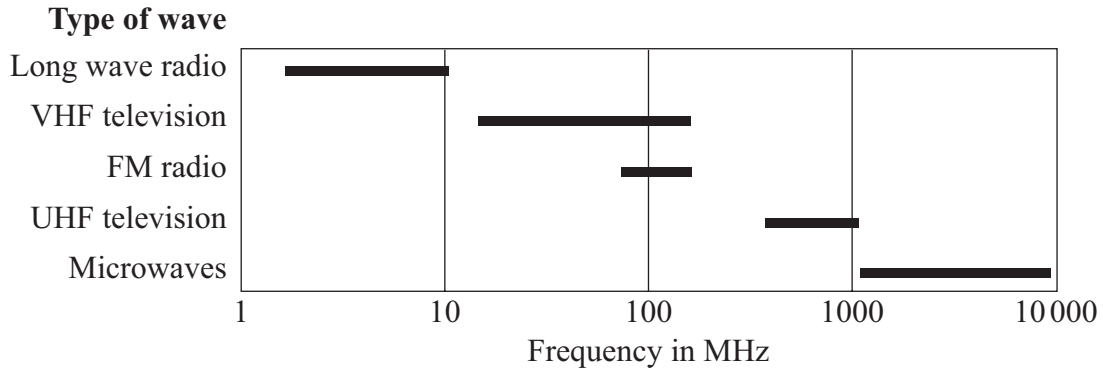
4.6.1.2 Properties of waves

Question 27

November 2008 | PHY1BP | Original Q6 | Legacy

## QUESTION SIX

The diagram shows five types of wave. The bars show the range of frequencies of these waves.




**6A** What kinds of waves are shown in the diagram?

**1** electromagnetic waves

**2** mechanical waves

**3** seismic waves

**4** sound waves

**6B** Which one of the following types of wave has the longest wavelength?

**1** VHF television

**2** FM radio

**3** UHF television

**4** microwaves

4.6.1.2 Properties of waves

Question 27 · continued



**6C** Which of the following can have waves of the same frequency?

**1** long wave radio and VHF television

**2** UHF television and FM radio

**3** VHF television and FM radio

**4** microwaves and long wave radio

**6D** What could microwaves be used for?

**1** examining broken bones

**2** mobile phone networks

**3** skin tanning

**4** treating cancer

**Turn over for the next question**

**4.6.1.2 Properties of waves**

**Question 28**

January 2009 | PHY1F | Original Q1 | Legacy

**1** The table shows the electromagnetic spectrum.
Three types of wave have been missed out.

| | | | | | | |
|---|---|---|---|---|---|---|
| Gamma rays | | Ultraviolet rays | Visible light | | Micro-waves | |

Shortest wavelength ⟷ Longest wavelength

**1** (a) (i) Use words from the box to complete the table.

| | | |
|---|---|---|
| **infra red rays** | **radio waves** | **X-rays** |

*(2 marks)*

**1** (a) (ii) Which **one** of the following gives a use of gamma rays?

Put a tick (✓) in the box next to your choice.

to communicate with satellites ☐

to see objects ☐

to kill cancer cells ☐

*(1 mark)*

**1** (a) (iii) Complete the following sentence by drawing a ring around the correct word in the box.

All electromagnetic waves move [energy / gases / particles] from one place to another.

*(1 mark)*

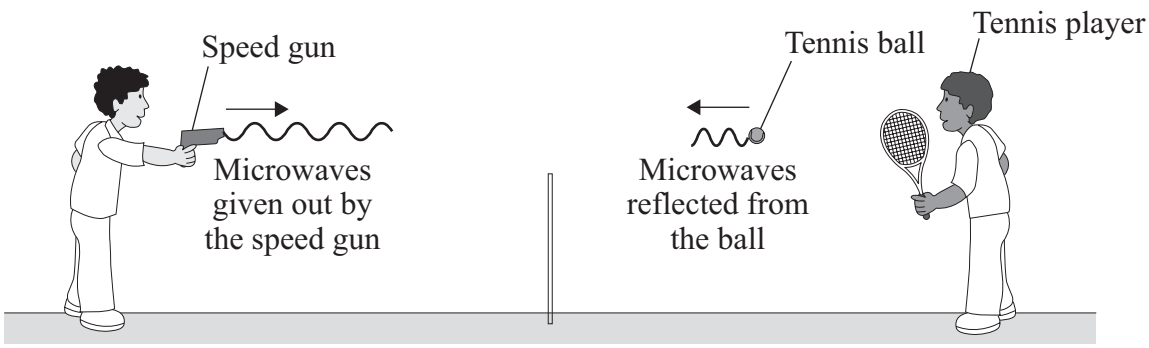
4

**4.6.1.2 Properties of waves**

**Question 29**

January 2009 | PHY1F | Original Q2 | Legacy

**2** (a) The picture shows a speed gun being used to measure how fast a tennis player hits the ball.




Some of the microwaves from the speed gun are absorbed by the ball and some are reflected by the ball.

**2** (a) (i) Complete the following sentence by choosing **one** of the phrases from the box.

| **longer than** | **the same as** | **shorter than** |
|---|---|---|

The wavelength of the microwaves reflected from the ball are

..... the wavelength of the microwaves from the speed gun.

*(1 mark)*

**2** (a) (ii) Complete the following sentence by drawing a ring around the correct line in the box.

When the ball absorbs microwaves, its temperature will

| |
|---|
| decrease slightly |
| not change |
| increase slightly |

.

*(1 mark)*

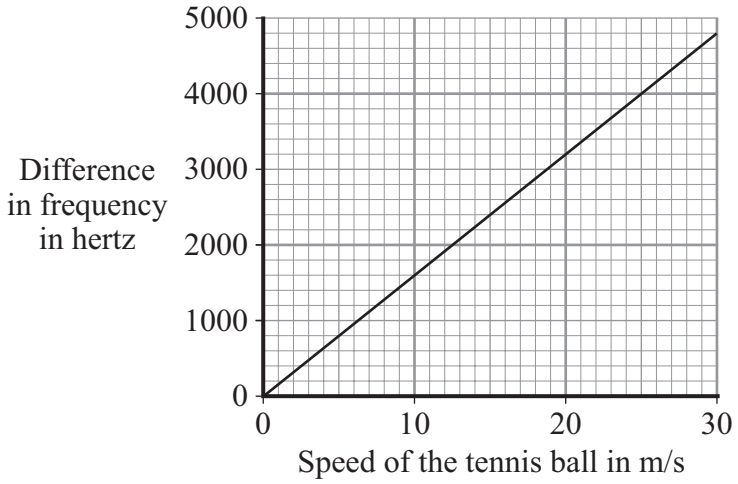
**4.6.1.2 Properties of waves**

**Question 29 · continued**



*for mark*

**2** (b) The microwaves reflected from the ball have a higher frequency than the microwaves from the speed gun.
The graph shows how the difference between the two frequencies depends on the speed of the ball.




**2** (b) (i) Describe the pattern that links the difference between the two frequencies and the speed of the ball.

.....

.....

*(1 mark)*

**2** (b) (ii) The speed gun measures the difference between the two frequencies as 3200 Hz.

Use the graph to find the speed of the tennis ball.
Show clearly on the graph how you obtain your answer.

Speed of the tennis ball = ..... m/s

*(2 marks)*

**2** (b) (iii) Which **one** of the following gives the reason why the data has been shown as a line graph and **not** as a bar chart?

Put a tick (✓) in the box next to your choice.

Frequency and speed are both categoric variables. ☐

Frequency and speed are both continuous variables. ☐

Speed is a continuous variable and frequency is a categoric variable. ☐

*(1 mark)*

**6**

**4.6.1.2 Properties of waves**

**Question 30**

January 2009 | PHY2F | Original Q2 | Legacy

**2** (a) Use numbers given in the box to complete the following sentences.

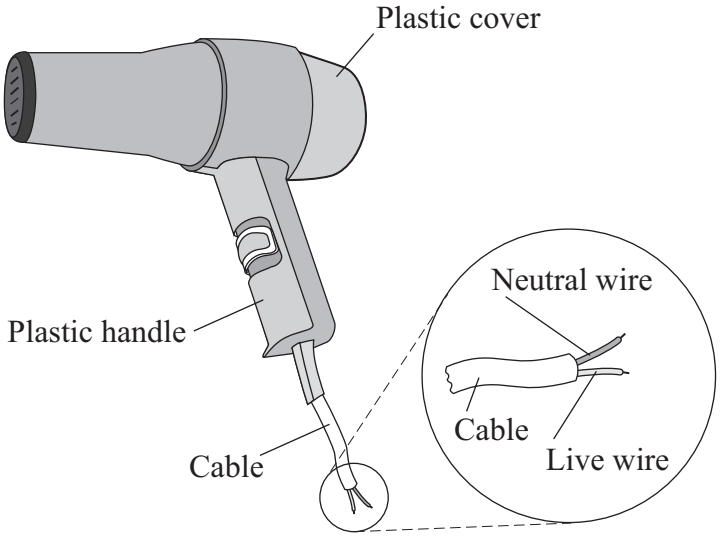
| | | | |
|---|---|---|---|
| **12** | **50** | **110** | **230** |

In the UK, the mains electricity supply is ..... volts.

The frequency of the UK mains electricity supply is ..... hertz.

*(2 marks)*

2 (b) The diagram shows a hairdryer designed to be used with the UK mains supply. The cable connecting the hairdryer to the plug does not have an earth wire.




**2** (b) (i) Why does the hairdryer **not** need a cable with an earth wire?

.....

.....

*(1 mark)*

**2** (b) (ii) Which **one** of the following materials are the two wires inside the cable made from?

Draw a ring around your answer.

**aluminium** **copper** **steel**

*(1 mark)*

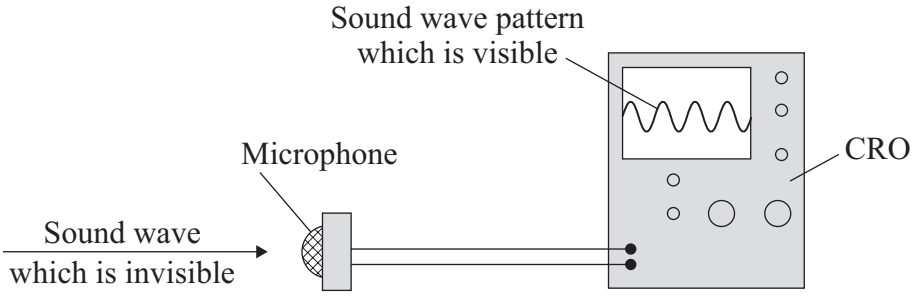
4

**4.6.1.2 Properties of waves**

**Question 31**

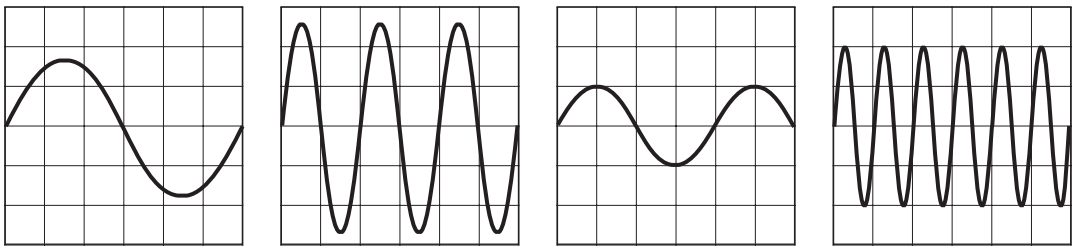


**2** A microphone and a cathode ray oscilloscope (CRO) can be used to show the pattern of a sound wave.




Four sound wave patterns, **A**, **B**, **C** and **D**, are shown.

They are all drawn to the same scale.




**2** (a) Which **one** of the patterns has the smallest amplitude? .....

**2** (b) Which **one** of the patterns has the lowest frequency? .....

*(2 marks)*

**2**

**4.6.1.2 Properties of waves**

**Question 32**

January 2009 | PHY3F | Original Q7 | Legacy

**7** (a) This information is from a science magazine.

> Electronic systems can be used to produce ultrasonic waves.
> These waves have a frequency higher than the upper limit for hearing in humans.

Complete the sentence by choosing the correct number from the box.

| | | | |
|---|---|---|---|
| **20** | **2000** | **20 000** | **200 000** |

The upper limit for hearing in humans is a frequency of ..... Hz.

*(1 mark)*

**7** (b) An electronic system produces ultrasound with a frequency of 500 kHz.

What does the symbol kHz stand for?

.....

*(1 mark)*

**7** (c) (i) State **one** industrial use for ultrasound.

.....

*(1 mark)*

**7** (c) (ii) State **one** medical use for ultrasound.

.....

*(1 mark)*

**4.6.1.2 Properties of waves**

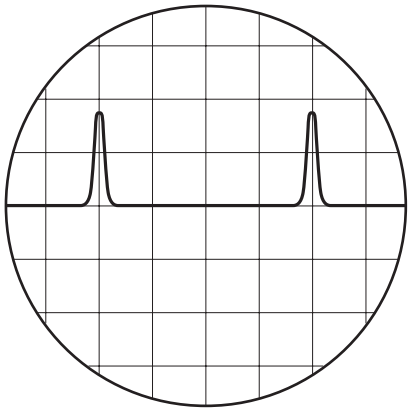
**Question 32 · continued**



*for mark*

**7** (d) An ultrasound detector is connected to an oscilloscope.

The diagram shows centimetre squares on an oscilloscope screen.
Each horizontal division represents 2 microseconds.



Calculate the time, in microseconds, between one peak of one ultrasound pulse and the peak of the next.

.....

Time = ..... microseconds
*(1 mark)*

**7** (e) Ultrasounds are partially reflected when they reach a boundary between two different media.
The time taken for the reflection from the boundary to reach the detector can be seen from the screen.

What can be calculated from this time interval?

.....

.....
*(2 marks)*

**7** (f) Explain what action scientists should take if they find evidence that ultrasonic waves may be harmful to human health.

.....

.....

.....
*(2 marks)*

**9**

**4.6.1.2 Properties of waves**

**Question 33**

March 2009 | PHY1BP | Original Q6 | Legacy

## QUESTION SIX

The table shows part of the electromagnetic spectrum.

| | | | | | |
|---|---|---|---|---|---|
| gamma rays | X-rays | ultraviolet | visible light | infra red | microwaves |

**6A** Which one of the following parts of the electromagnetic spectrum has the longest wavelength?

**1** gamma rays

**2** microwaves

**3** ultraviolet

**4** visible light

**6B** Which one of the following parts of the electromagnetic spectrum has the highest frequency?

**1** gamma rays

**2** microwaves

**3** ultraviolet

**4** visible light

**6C** Which part of the electromagnetic spectrum is used to show up invisible security marking on valuable equipment?

**1** microwaves

**2** ultraviolet

**3** visible light

**4** X-rays

4.6.1.2 Properties of waves

Question 33 · continued



**6D** Which part of the electromagnetic spectrum is emitted by mobile phone transmitters?

**1** microwaves

**2** ultraviolet

**3** visible light

**4** X-rays

**Turn over for the next question**

4.6.1.2 Properties of waves

Question 34

March 2009 | PHY1BP | Original Q7 | Legacy

## QUESTION SEVEN

The radiation from stars produces spectra. By studying these spectra, scientists can learn a lot about the behaviour and history of stars.

Sometimes, lines in a spectrum appear to be shifted towards the longer wavelength end of the spectrum.

**7A** What name is given to the shift towards the longer wavelength end of the spectrum?

**1** blue-shift

**2** green-shift

**3** yellow-shift

**4** red-shift

**7B** What information can this shift give scientists about the star that is producing it?

**1** the diameter of the star

**2** the distance the star is from Earth

**3** the mass of the star

**4** the temperature of the star

**7C** What theory about the universe does observation of this shift support?

**1** the universe is contracting

**2** the universe is expanding

**3** the universe is not changing

**4** the universe is expanding and contracting

**7D** A scientist making measurements with a telescope complains that his observations lack precision.

What type of instrument would give more precision?

**1** one that has been better calibrated

**2** one that has been less well calibrated

**3** one with a larger scale division

**4** one with a smaller scale division

**4.6.1.2 Properties of waves**

**Question 35**

March 2009 | PHY1BP | Original Q9 | Legacy

## QUESTION NINE

This question is about electromagnetic waves.

**9A** Changes may occur in substances when they absorb the energy carried by electromagnetic waves.

Which row in the table is correct?

| | An alternating current is created in the substance | The substance becomes hotter |
|---|---|---|
| **1** | always | never |
| **2** | sometimes | always |
| **3** | sometimes | sometimes |
| **4** | never | sometimes |

**9B** Radio waves travel in straight lines. However, some types of radio waves can be received on the opposite side of the Earth from the transmitter.

This happens because the radio waves are . . .

**1** absorbed by the atmosphere.

**2** interfered with by the atmosphere.

**3** reflected by the atmosphere.

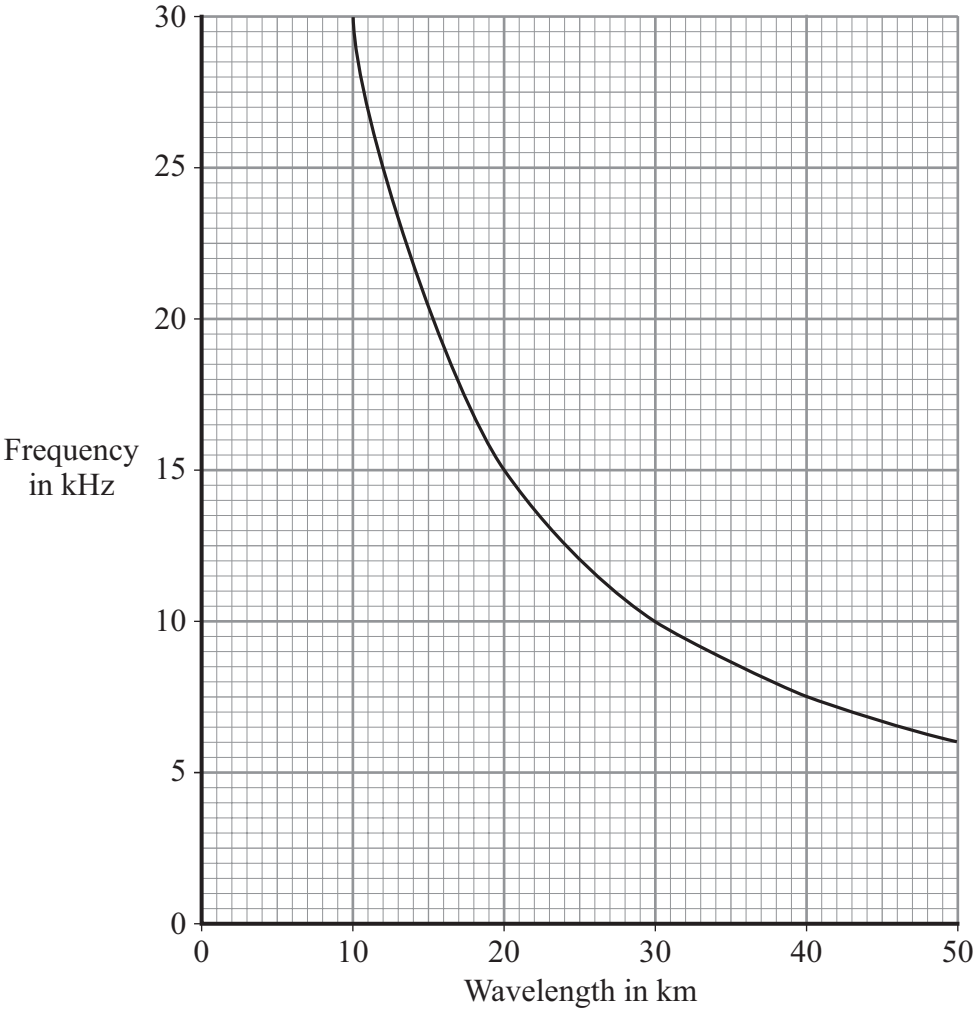
**4** stopped by the atmosphere.

**4.6.1.2 Properties of waves**

**Question 35 · continued**



The graph indicates how the frequency of electromagnetic waves changes with wavelength.




**9C** The graph shows that when the wavelength doubles, the frequency . . .

**1** doubles.

**2** halves.

**3** quadruples.

**4** stays the same.

**9D** What is the frequency of electromagnetic waves of wavelength 25 000 metres?

**1** 1.2 kHz

**2** 1.4 kHz

**3** 12 kHz

**4** 14 kHz

**END OF TEST**

**4.6.1.2 Properties of waves**

**Question 36**

June 2009 | PHY1BP | Original Q5 | Legacy

## QUESTION FIVE

Electromagnetic radiation can be grouped into types. Each type has a different range of wavelengths.

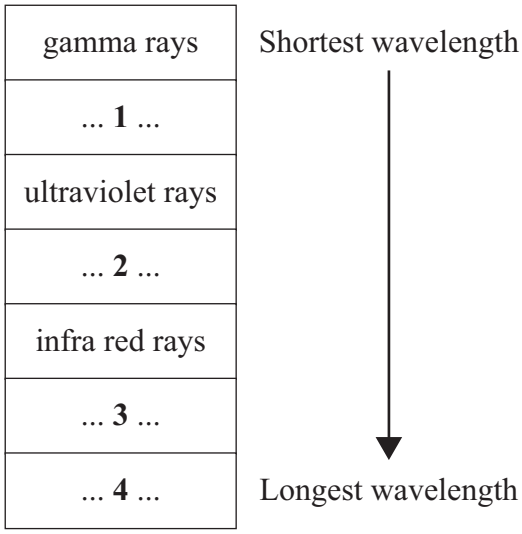
Match types of radiation, **A**, **B**, **C** and **D**, with the numbers **1–4** in the table.

**A** microwaves

**B** X-rays

**C** visible light

**D** radio waves



4.6.1.2 Properties of waves

Question 37

June 2009 | PHY1BP | Original Q7 | Legacy

## QUESTION SEVEN

Scientists studying distant galaxies have noticed that light from them appears to have increased in wavelength.

**7A** What is this apparent increase in wavelength called?

**1** black hole formation

**2** blue-shift

**3** red-shift

**4** the Hubble effect

**7B** What does the apparent increase in wavelength suggest about the universe?

**1** It is expanding.

**2** It is contracting.

**3** It was expanding but is now contracting.

**4** It was contracting but is now expanding.

**7C** What does the apparent increase in wavelength suggest about the origin of the universe?

**1** It all started from one small point.

**2** It was formed by gravity pulling material together.

**3** It was formed by two galaxies colliding.

**4** It had no starting point; it has always existed.

**7D** What name is given to the theory about the origin of the universe that has been developed from these observations?

**1** big bang theory

**2** steady state theory

**3** relativity theory

**4** gravitational theory

**4.6.1.2 Properties of waves**

**Question 38**

June 2009 | PHY1F | Original Q6 | Legacy

**6** (a) The table lists the names of seven telescopes. Each one of the telescopes is designed to detect a different one of the seven types of electromagnetic wave.
The table is incomplete.

| Name of telescope | Type of wave detected |
|---|---|
| HESS | Gamma |
| XMM Newton | X-ray |
| FUSE | Ultraviolet |
| William Herschel | Visible light |
| Spitzer | |
| SPT | Microwave |
| Lovell | Radio |

**6** (a) (i) Which **one** of the telescopes is designed to detect the type of wave with the shortest wavelength?

.....

*(1 mark)*

**6** (a) (ii) What type of wave is the Spitzer telescope designed to detect?

.....

*(1 mark)*

**6** (b) The William Herschel telescope is on the Earth's surface. Another telescope, the Hubble telescope, which also detects visible light, orbits the Earth.

How is the image produced by the Hubble telescope better than the image produced by the William Herschel telescope?

.....

Give a reason for your answer.

.....

.....

*(2 marks)*

**Question 38 · continued**



*for mark*

**6** (c) Some types of electromagnetic wave are absorbed by water.
The SPT telescope is located in the Antarctic, which is a dry environment.

Explain why it is better to have this type of telescope in a dry environment rather than in a wet, humid environment.

.....

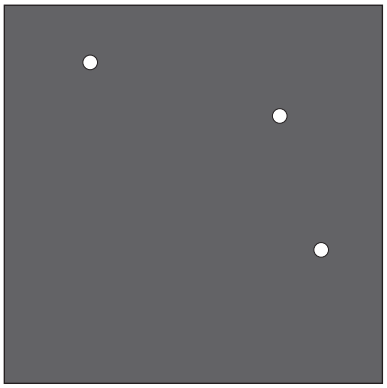
.....

.....

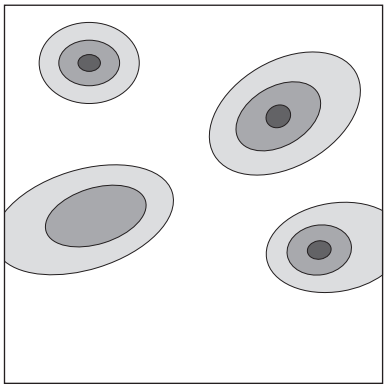
.....

*(2 marks)*

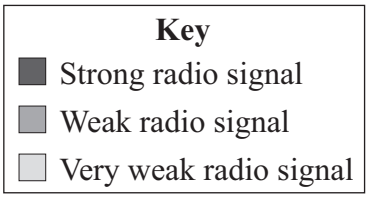
**6** (d) The pictures represent the images produced using a visible light telescope and a radio telescope. Both images are of the same part of the sky. The shading on the radio telescope image represents the strength of the radio signals.



Visible light image



Radio telescope image




Suggest what extra information can be gained from the radio telescope image compared with the visible light image.

.....

.....

*(1 mark)*

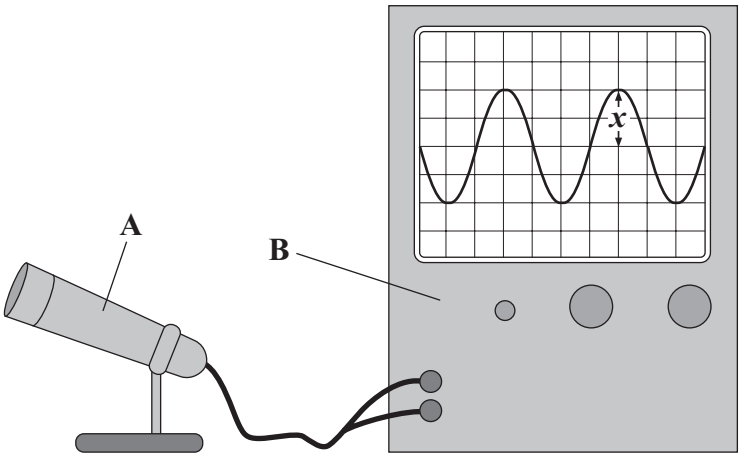
7

**4.6.1.2 Properties of waves**

**Question 39**

June 2009 | PHY3F | Original Q3 | Legacy

**3** (a) A student uses two pieces of equipment, **A** and **B**, to display a sound wave.




**3** (a) (i) Use words from the box to complete the sentence.

| | | | |
|---|---|---|---|
| **a loudspeaker** | **a microphone** | **an oscilloscope** | **a screen** |

**A** is ..... and **B** is ..... .

*(2 marks)*

**3** (a) (ii) Use words from the box to complete the sentence.

| | | | |
|---|---|---|---|
| **the amplitude** | **half the amplitude** | **the frequency** | **half the frequency** |

The distance ***x*** marked on the diagram measures .....of the sound wave.

*(1 mark)*

**3** (a) (iii) Complete the sentence.

The distance ***x*** becomes smaller. This is because the sound has

become ..... .

*(1 mark)*

**4.6.1.2 Properties of waves**

**Question 39 · continued**



*for mark*

**3** (b) There is no air in space.

Astronauts in space cannot hear sounds from outside their spacesuits.

Explain this.

.....

.....

.....

.....

*(2 marks)*

6

**Turn over for the next question**

**4.6.1.2 Properties of waves**

**Question 40**

November 2009 | PHY1BP | Original Q2 | Legacy

## QUESTION TWO

This question is about four types of electromagnetic radiation.

Match words, **A**, **B**, **C** and **D**, with the numbers **1–4** in the sentences.

**A** gamma

**B** infra red

**C** radio

**D** visible light

The type of electromagnetic radiation with the longest wavelength is . . . **1** . . . .

The type of electromagnetic radiation with the highest frequency is . . . **2** . . . .

The type of electromagnetic radiation that is used to cook food is . . . **3** . . . .

The type of electromagnetic radiation that allows us to see is . . . **4** . . . .

4.6.1.2 Properties of waves

Question 41

November 2009 | PHY1BP | Original Q7 | Legacy

## QUESTION SEVEN

Astronomers studying light from distant galaxies notice that the light from them seems to increase in wavelength.

**7A** The increase in wavelength is known as . . .

**1** blue-shift.

**2** contraction.

**3** expansion.

**4** red-shift.

**7B** The increase in wavelength . . .

**1** is smaller the further away the galaxy is.

**2** is larger the further away the galaxy is.

**3** becomes zero for very distant galaxies.

**4** is the same whether galaxies are moving towards us or away from us.

**7C** The unit of wavelength is the . . .

**1** hertz.

**2** metre.

**3** metre per second.

**4** second.

**7D** Most astronomers think that the universe began from a very small initial point.

Since then, the universe has . . .

**1** been contracting.

**2** been contracting then expanding.

**3** been expanding.

**4** stayed unchanged.

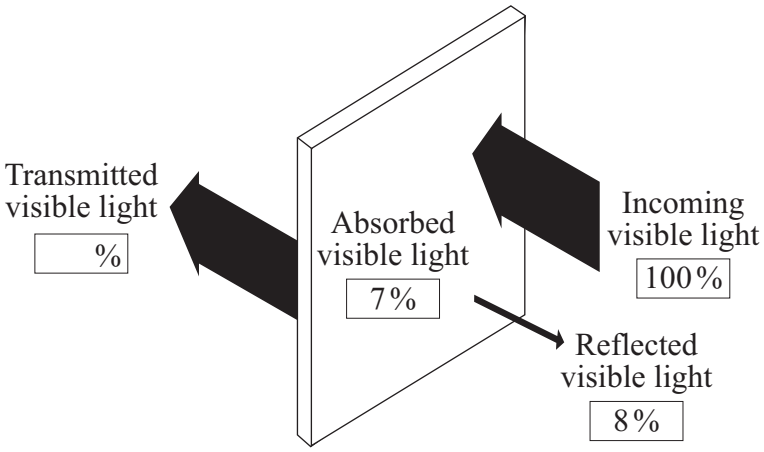
**4.6.1.2 Properties of waves**

**Question 42**



**3** Glass reflects, absorbs and transmits both infra red radiation and visible light.

**3** (a) The diagram shows the percentages of visible light that are reflected and absorbed by one type of glass.

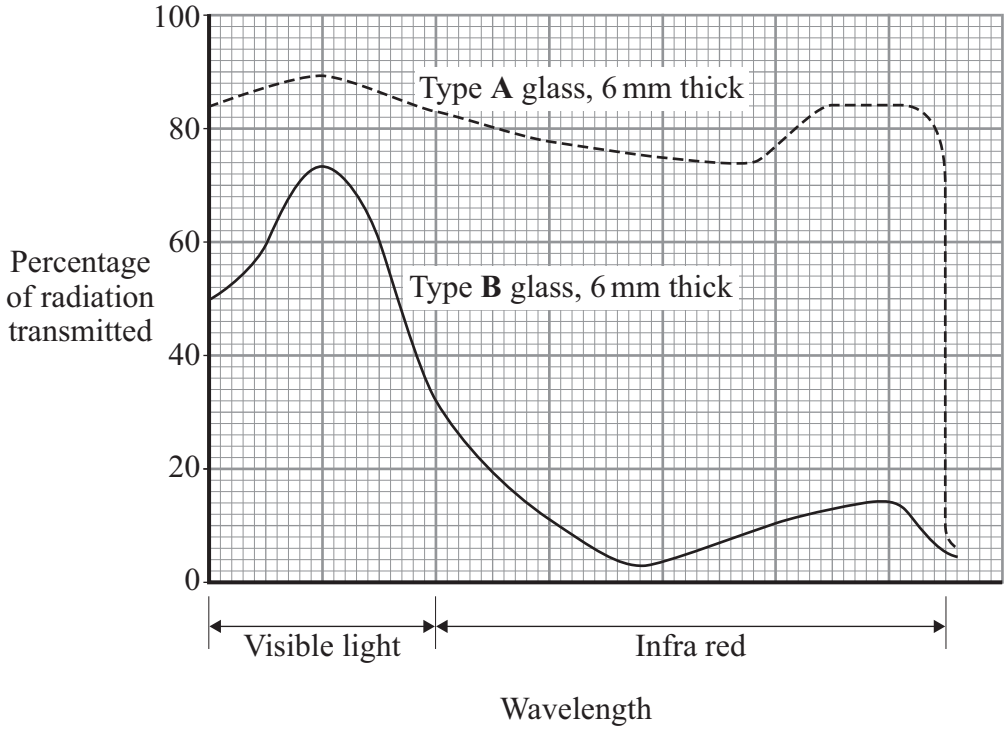



What percentage of visible light is transmitted by this type of glass?

..... %

*(1 mark)*

**3** (b) The amounts of infra red radiation and visible light transmitted by glass depend on the type and thickness of glass. The data obtained from tests on two different types of glass is displayed in the graph below.



**4.6.1.2 Properties of waves**

**Question 42 · continued**



*for mark*

**3** (b) (i) To be able to compare the two types of glass, it was important to control one variable.

What variable was controlled in the tests?

.....

*(1 mark)*

**3** (b) (ii) A homeowner has a glass conservatory built on the back of the house. The homeowner tells the builder that the inside of the conservatory should stay as cool as possible throughout the summer.

Explain why the builder uses 'type **B**' glass for the conservatory.

.....

.....

.....

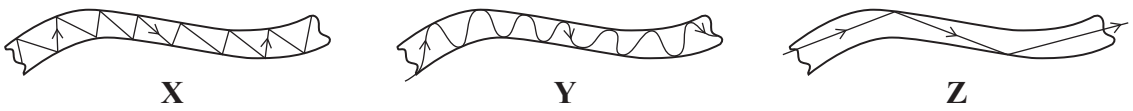
.....

*(2 marks)*

**3** (c) Infra red and visible light can be used to send signals along an optical fibre.

Which **one** of the following diagrams, **X**, **Y** or **Z**, shows the path taken by a signal as it travels along an optical fibre?

Draw a ring around the correct diagram.



**X** **Y** **Z**

*(1 mark)*

**5**

**4.6.1.2 Properties of waves**

**Question 43**

January 2010 | PHY3F | Original Q4 | Legacy

**4** (a) The table gives information about the frequencies in the hearing ranges of six different mammals.

| Name of mammal | Frequencies in hearing range |
|---|---|
| Bat | 20 Hz → 160 kHz |
| Dog | 20 Hz → 30 kHz |
| Dolphin | 40 Hz → 110 kHz |
| Elephant | 5 Hz → 10 kHz |
| Human | 20 Hz → 20 kHz |
| Tiger | 30 Hz → 50 kHz |

**4** (a) (i) Which mammal in the table can hear the highest frequency?

.....

*(1 mark)*

**4** (a) (ii) Which mammal in the table, apart from humans, **cannot** hear ultrasound?

.....

*(1 mark)*

**4** (a) (iii) Give **one** example of a frequency which an elephant can hear but which a tiger **cannot** hear.

Include the unit in your answer.

Frequency .....

*(1 mark)*

**4.6.1.2 Properties of waves**

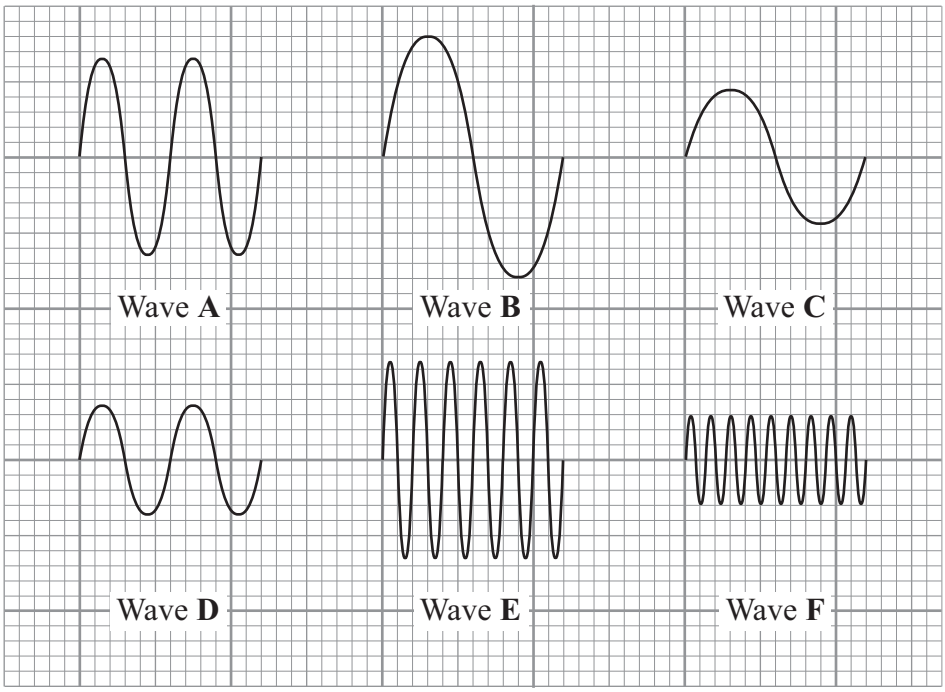
**Question 43 · continued**



*for mark*

**4** (b) The diagrams show six sound waves, **A**, **B**, **C**, **D**, **E** and **F**, represented on an oscilloscope screen.

They are all drawn to the same scale.




**4** (b) (i) Which **one** of the waves has the greatest amplitude?

Wave ..... .

*(1 mark)*

**4** (b) (ii) Which **one** of the waves has the highest frequency?

Wave ..... .

*(1 mark)*

**5**

**4.6.1.2 Properties of waves**

**Question 44**

March 2010 | PHY1BP | Original Q2 | Legacy

## QUESTION TWO

The table shows part of the electromagnetic spectrum.

| | | | | | | |
|---|---|---|---|---|---|---|
| Gamma | | Ultraviolet | | Infra red | | Radio |

Match words, **A**, **B**, **C** and **D**, with the numbers **1–4** in the sentences.

**A** gamma

**B** infra red

**C** radio

**D** ultraviolet

The part of the electromagnetic spectrum with the longest wavelengths is . . . **1** . . . .

Between X-rays and visible light in the electromagnetic spectrum is . . . **2** . . . radiation.

Some radioactive isotopes emit . . . **3** . . . radiation.

Signals can be sent from remote controls to a television by . . . **4** . . . radiation.

4.6.1.2 Properties of waves

Question 45

March 2010 | PHY1BP | Original Q9 | Legacy

## QUESTION NINE

There are two types of communication signal: analogue and digital.

**9A** Which pair of diagrams correctly shows the patterns for digital and analogue signals?

| | Digital signal pattern | Analogue signal pattern |
|---|---|---|
| 1 |  |  |
| 2 |  |  |
| 3 |  |  |
| 4 |  |  |

**9B** One reason for using digital signals rather than analogue signals for communication is that . . .

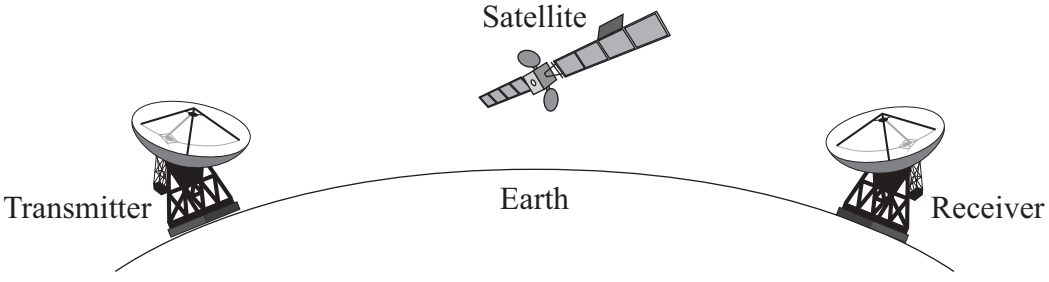
**1** analogue signals are less prone to interference.

**2** analogue signals can have only two values.

**3** digital signals are continuously variable.

**4** digital signals can be easily processed by computers.

**9C** Satellites in orbit around the Earth receive and transmit microwave signals for international telephone communication.




Microwaves are used because . . .

**1** they are the only type of electromagnetic wave that can travel through a vacuum.

**2** they are not absorbed by the Earth's atmosphere.

**3** they follow the curvature of the Earth.

**4** they travel faster than radio waves.

**4.6.1.2 Properties of waves**

**Question 45 · continued**



**9D** Properties of waves are often demonstrated in schools using waves on water.

| wave speed (metre/second, m/s) | = | frequency (hertz, Hz) | × | wavelength (metre, m) |
|---|---|---|---|---|

A wave generator with a frequency of 50 Hz produces water waves with a wavelength of 2 cm.

At what speed do the waves travel?

**1** 1 m/s

**2** 25 m/s

**3** 100 m/s

**4** 2500 m/s

**END OF TEST**

### 4.6.1.2 Properties of waves

**Question 46**

June 2010 | PHY1BP | Original Q1 | Legacy

**QUESTION ONE**

Electromagnetic radiation can be grouped into types. Each type has a different range of wavelengths.

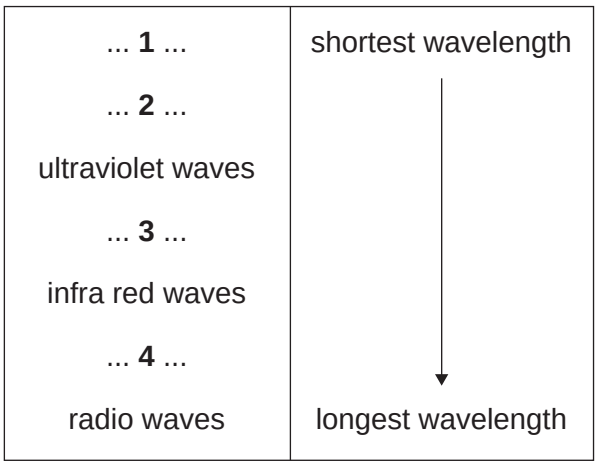
Match types of radiation, **A**, **B**, **C** and **D**, with the numbers **1–4** in the diagram.

**A** gamma rays

**B** microwaves

**C** visible light

**D** X-rays



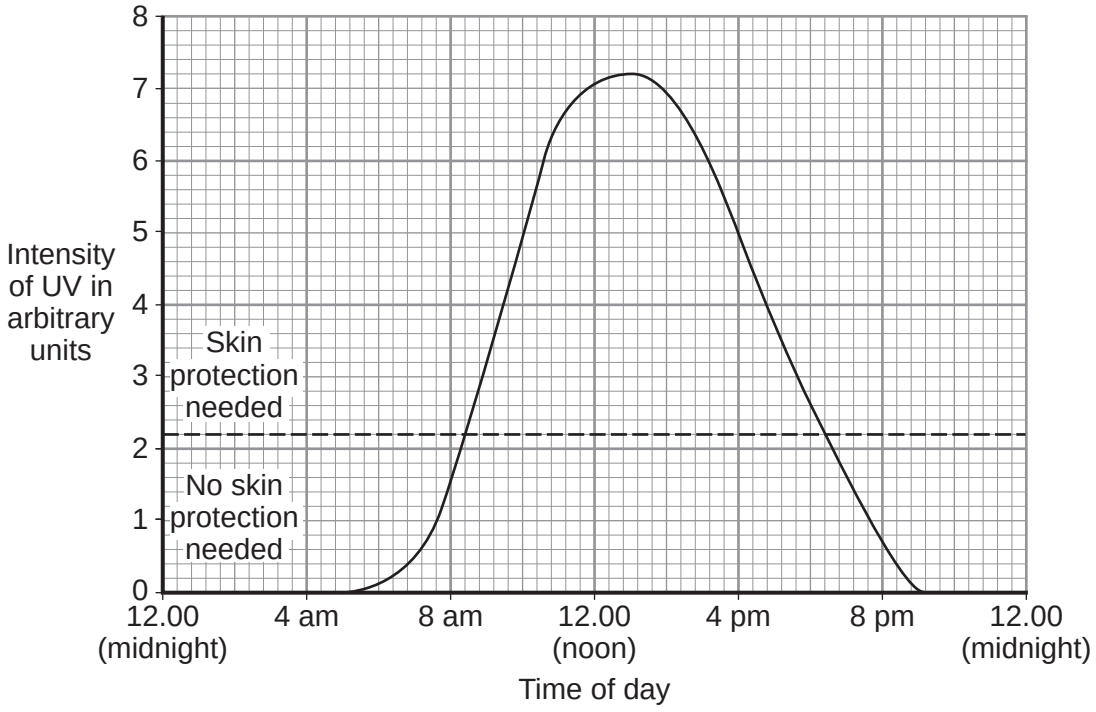
4.6.1.2 Properties of waves

Question 47

June 2010 | PHY1BP | Original Q8 | Legacy

**QUESTION EIGHT**

The graph shows how the intensity of ultraviolet (UV) radiation changes during a typical day in June in the UK.




**8A** The intensity of UV radiation reaches a maximum at . . .

**1** 9.30 am

**2** 12.00 noon

**3** 1.00 pm

**4** 5.00 pm

**8B** The dashed line (– – – –) on the graph shows the intensity above which you should protect your skin from UV radiation by using sunscreen cream.

For approximately how long is the intensity of UV radiation high enough to suggest that protection is needed?

**1** 0 hours

**2** 7 hours

**3** 10 hours

**4** 16 hours

4.6.1.2 Properties of waves

Question 47 · continued



**8C** For a typical day in December in the UK, how would you expect the graph to be different?

| | Peak | Area under the graph |
|---|---|---|
| **1** | higher | the same |
| **2** | lower | the same |
| **3** | higher | bigger |
| **4** | lower | smaller |

**8D** UV radiation travels as an electromagnetic wave.

Which row in the table below correctly shows the speed and frequency of UV compared with the speed and frequency of visible light?

| | Speed of UV compared with visible light | Frequency of UV compared with visible light |
|---|---|---|
| **1** | slower | lower |
| **2** | same | higher |
| **3** | faster | higher |
| **4** | same | lower |

### 4.6.1.2 Properties of waves

**Question 48**

June 2010 | PHY1F | Original Q2 | Legacy

**2** The diagram shows the seven types of wave that make up the electromagnetic spectrum.

| | | | | | | |
|---|---|---|---|---|---|---|
| Gamma rays | X-rays | Ultraviolet rays | Visible light | Infra red rays | Micro-waves | Radio waves |

**2 (a) (i)** Microwaves and visible light can be used for communications.

Name **one** more type of electromagnetic wave that can be used for communications.

.....

*(1 mark)*

**2 (a) (ii)** Name **one** type of electromagnetic wave that has a longer wavelength than microwaves.

.....

*(1 mark)*

**2 (b)** Wi-Fi is a system that joins a laptop computer to the internet without using wires. A 2400 megahertz microwave signal is used to link a computer to a device called a router.

What quantity is measured in hertz?

Draw a ring around your answer.

**frequency** **wavelength** **wave speed**

*(1 mark)*

**2 (c)** A politician commented on the increasing use of Wi-Fi. He said: 'I believe that these systems may be harmful to children.'

**2 (c) (i)** Suggest **one** reason why more scientific research into the safety of Wi-Fi systems is needed.

.....

.....

*(1 mark)*

4.6.1.2 Properties of waves

Question 48 · continued



**2 (c) (ii)** Complete the following sentence by drawing a ring around the correct line in the box.

What the politician said was

| |
|---|
| a fact. |
| an opinion. |
| a prediction. |

*(1 mark)*

5

**Turn over for the next question**

### 4.6.1.2 Properties of waves

**Question 49**

June 2010 | PHY1F | Original Q5 | Legacy

**5 (a)** Scientists use telescopes to observe stars and galaxies.
Some telescopes are on Earth, but some are on satellites in space.

Why do telescopes in space give better images than telescopes on the Earth?

.....

.....

*(1 mark)*

**5 (b)** Scientists have observed that the wavelengths of the light given out from galaxies that are moving away from the Earth are longer than expected.

**5 (b) (i)** What name is given to this observation?

Put a tick (✓) in the box next to your answer.

blue-shift ☐

green-shift ☐

red-shift ☐

*(1 mark)*

**5 (b) (ii)** Complete the following sentence by drawing a ring around the correct line in the box.

This observation gives evidence for the idea that the universe is

shrinking.

not changing.

expanding.

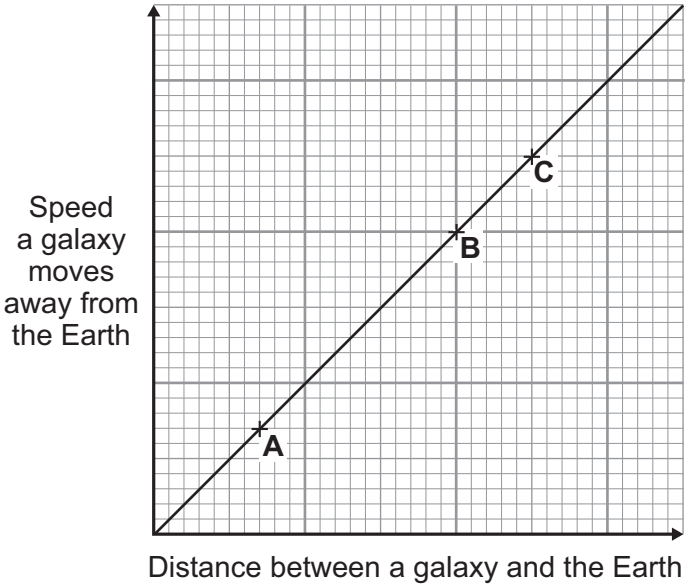
*(1 mark)*

4.6.1.2 Properties of waves

Question 49 · continued



**5 (c)** Use the graph to answer the following questions.




**5 (c) (i)** What is the link between the speed that a galaxy moves away from the Earth and the distance between the galaxy and the Earth?

.....

.....

*(1 mark)*

**5 (c) (ii)** The positions of three galaxies, **A**, **B** and **C**, are marked on the graph.

From which galaxy, **A**, **B** or **C**, would the wavelength of the light reaching the Earth seem to have changed the most?

Galaxy .....

Give a reason for your answer.

.....

.....

.....

.....

*(2 marks)*

6

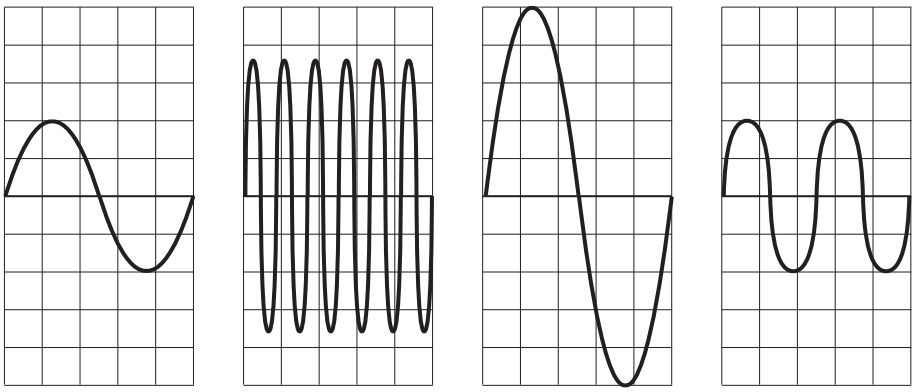
### 4.6.1.2 Properties of waves

**Question 50**

June 2010 | PHY3F | Original Q2 | Legacy

**2 (a) (i)** A sound wave can be represented as a wave on the screen of an oscilloscope.

The diagrams **A**, **B**, **C** and **D** show different screens for the same settings of an oscilloscope.



**A** **B** **C** **D**

Which diagram represents the sound with the highest frequency?

Diagram ☐

*(1 mark)*

**2 (a) (ii)** Complete the sentences using the correct name from the box.

| | | |
|---|---|---|
| **a loudspeaker** | **a microphone** | **an ultrasound transmitter** |

Information is transferred from a sound wave to an oscilloscope by

..... .

*(1 mark)*

4.6.1.2 Properties of waves

Question 50 · continued



**2 (b)** Complete the sentences by drawing a ring around the correct word in the box.

**2 (b) (i)** The pitch of a note increases as the

| |
|---|
| amplitude |
| frequency |
| wavelength |

increases.

*(1 mark)*

**2 (b) (ii)** The loudness of a note decreases as the

| |
|---|
| amplitude |
| frequency |
| wavelength |

decreases.

*(1 mark)*

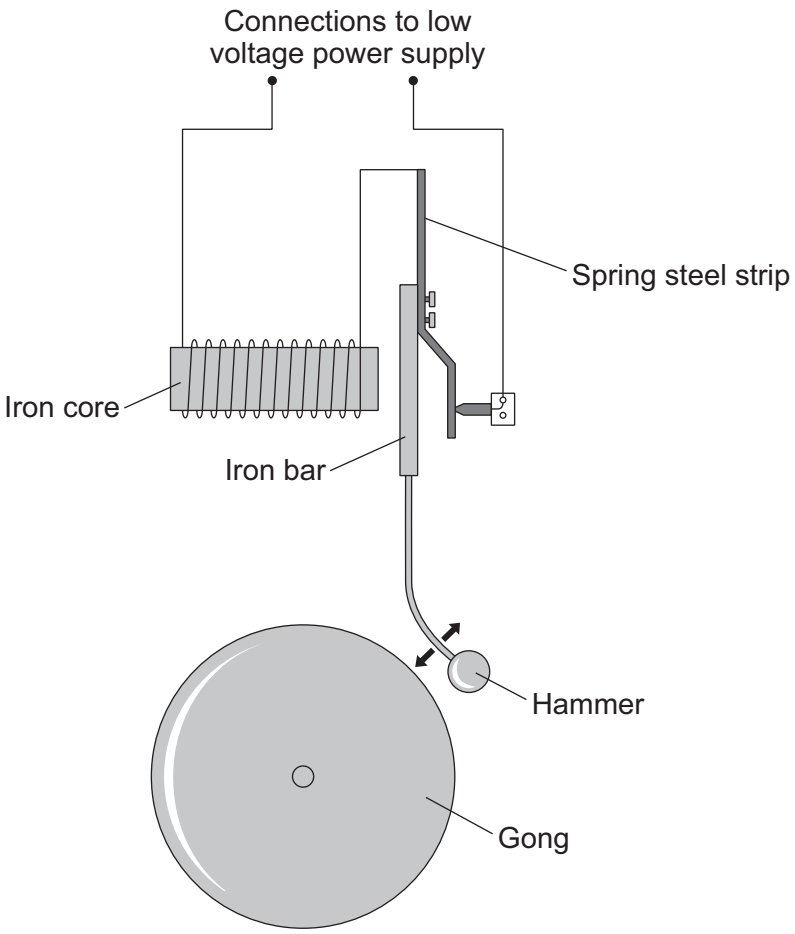
**Question 2 continues on the next page**

4.6.1.2 Properties of waves

Question 50 · continued



**2 (c)** The diagram shows part of the inside of an electric bell.




Name the part of the bell which contains the iron core and attracts the iron bar.

.....

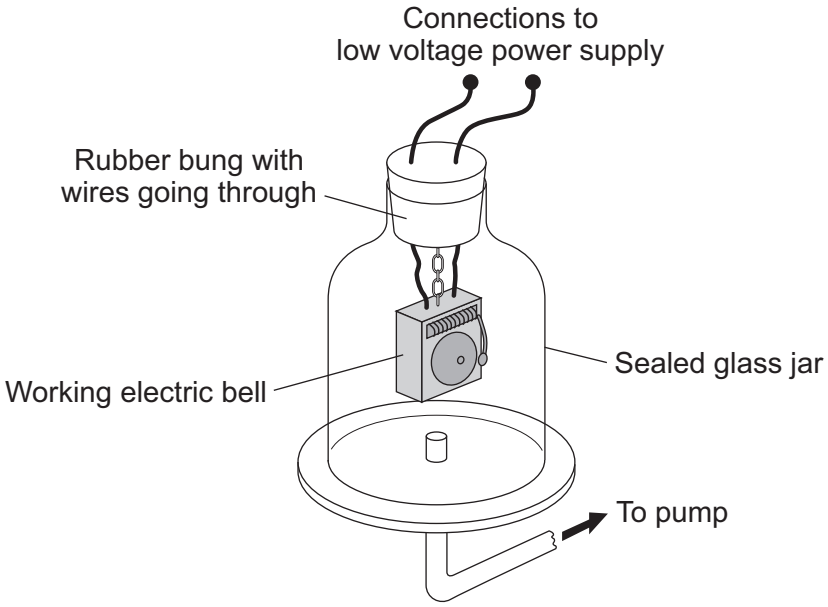
*(1 mark)*

4.6.1.2 Properties of waves

Question 50 · continued



**2 (d)** A group of students use a pump to remove all the air from around a working electric bell in a sealed glass jar.




**2 (d) (i)** What will happen to the sound which they hear from the bell after all the air is removed from the sealed glass jar?

.....

.....

*(1 mark)*

**2 (d) (ii)** Explain your answer to part (d)(i).

.....

.....

*(1 mark)*

7

### 4.6.1.2 Properties of waves

**Question 51**

June 2010 | PHY3F | Original Q7 | Legacy

**7 (a)** Read this passage from a health leaflet.

> Most children can hear the full range of sounds which can be detected by the human ear. But as people get older, they cannot hear the higher frequencies.

**7 (a) (i)** Complete this statement.

Most children can detect sounds in the frequency range

..... Hz to ..... Hz.

*(1 mark)*

**7 (a) (ii)** What word is used to describe sound with a frequency so high that it cannot be heard by humans?

.....

*(1 mark)*

**7 (b)** Read this cutting from a newspaper.

> A shopkeeper has fitted a special loudspeaker outside his store.
> "We used to have gangs of young people out there," he said, "but now, when I switch on the special loudspeaker, they hate the sound and go away."
> Older people are not bothered by the sound because the frequency is too high for them to hear it.

Some people support the use of the special loudspeaker but other people do not.

Give **one** reason against its use.

.....

.....

*(1 mark)*

**7 (c)** Machines are often very noisy. They transfer energy, and some of the energy is transformed into sound.

What is the cause of the sound?

.....

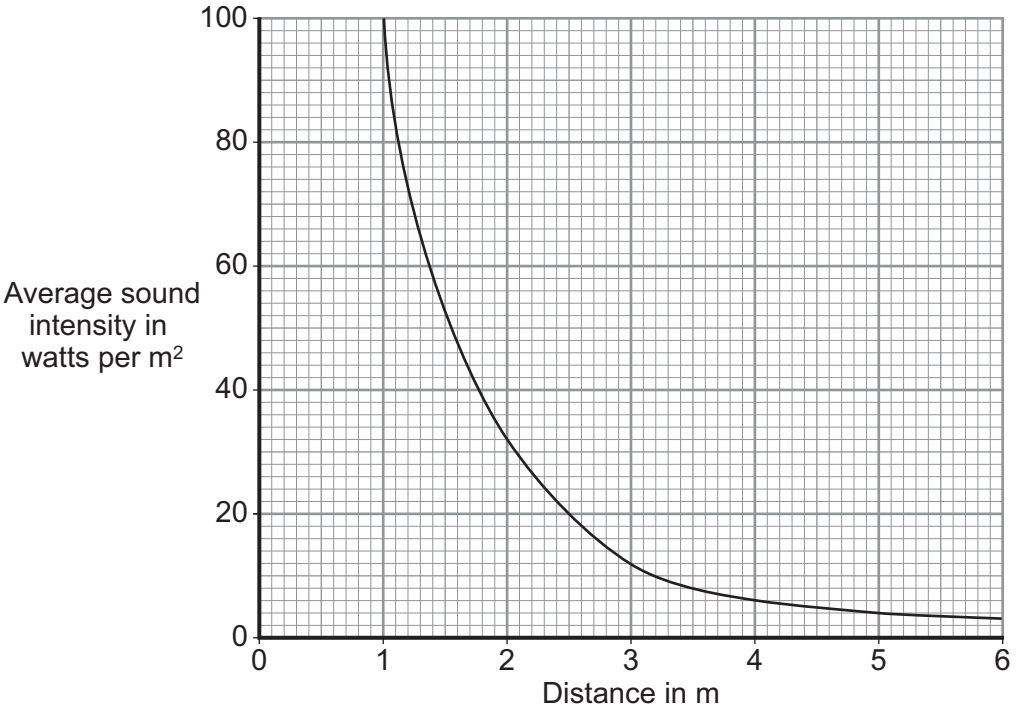
*(1 mark)*

4.6.1.2 Properties of waves

Question 51 · continued



**7 (d)** Sound from a machine may damage the hearing of people who work close by. A safety officer measures the sound intensity at different distances from a noisy machine. The average results are shown on the graph.




**7 (d) (i)** Describe the pattern shown by the graph.

Use one or more examples from the graph to support your description.

.....

.....

.....

.....

*(2 marks)*

**7 (d) (ii)** Average results were plotted.

Explain why taking results several times and then calculating average values is more reliable than taking only a single result.

.....

.....

.....

.....

*(2 marks)*

8

4.6.1.2 Properties of waves

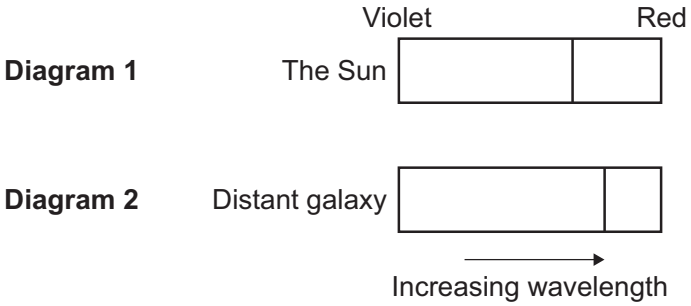
Question 52

November 2010 | PHY1BP | Original Q5 | Legacy

**QUESTION FIVE**

**Diagram 1** shows the spectrum of light from the Sun. There is a black line in the spectrum.

**Diagram 2** shows the spectrum of light from a distant galaxy. This spectrum has the same black line.




Match words, **A**, **B**, **C** and **D**, with the numbers **1**–**4** in the sentences.

**A** decreased

**B** increased

**C** shifted

**D** not changed

Edwin Hubble compared the spectrum of light from this distant galaxy to the spectrum of light from the Sun.

Hubble found that the position of the black line had . . . **1** . . . .

This was because the wavelength of the observed light had . . . **2** . . . .

The frequency of the observed light had . . . **3** . . . .

The speed of the light had . . . **4** . . . .

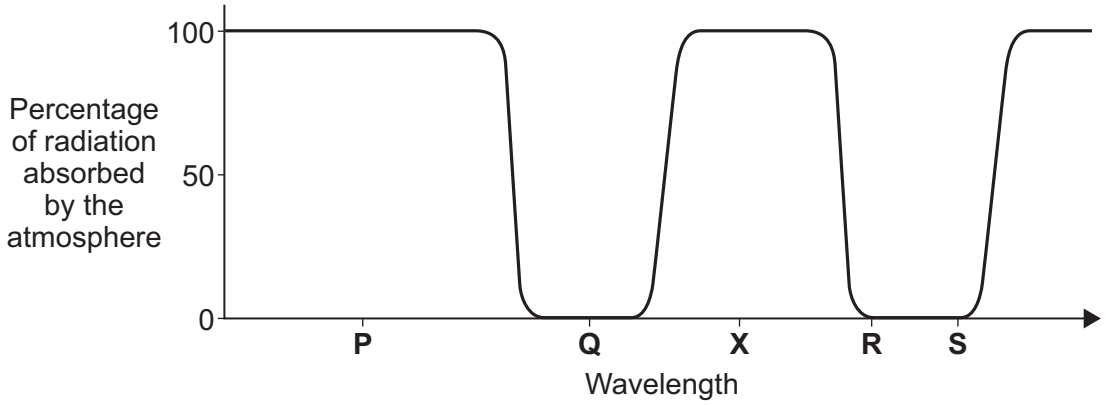
4.6.1.2 Properties of waves

Question 53

November 2010 | PHY1BP | Original Q7 | Legacy

**QUESTION SEVEN**

The graph shows how the Earth's atmosphere absorbs different wavelengths of electromagnetic waves.




**7A** Which wavelength, **P**, **Q**, **R** or **S**, does not reach the Earth's surface?

**1** **P**

**2** **Q**

**3** **R**

**4** **S**

**7B** The wavelength labelled **X** is in the infra red region.

Some objects in space emit infra red radiation.

Where would you put a telescope to collect infra red radiation from objects in space?

**1** above the Earth's atmosphere

**2** on a high mountain

**3** at ground level in a hot desert

**4** at ground level in the Antarctic

4.6.1.2 Properties of waves

Question 53 · continued



- The Hubble Space Telescope (HST) is in orbit around the Earth.
- Astronauts from a space shuttle can repair the HST if it breaks down.
- In 2003, a space shuttle returning to Earth exploded.
- After this explosion it was decided to stop sending astronauts to repair the HST.

**7C** This decision was later changed and in 2009 it was decided to send another space mission to repair the HST.

What is the most likely reason for this?

**1** Space missions are now completely safe.

**2** Astronomers want to keep using the HST.

**3** The HST has never sent data back to Earth.

**4** To give jobs to engineers.

**7D** The HST sends data back to Earth.

Electromagnetic waves labelled **R** on the graph are used to send the data.

The waves labelled **R** are used because the . . .

**1** waves have a shorter wavelength than infra red.

**2** atmosphere absorbs the waves.

**3** atmosphere does not absorb the waves.

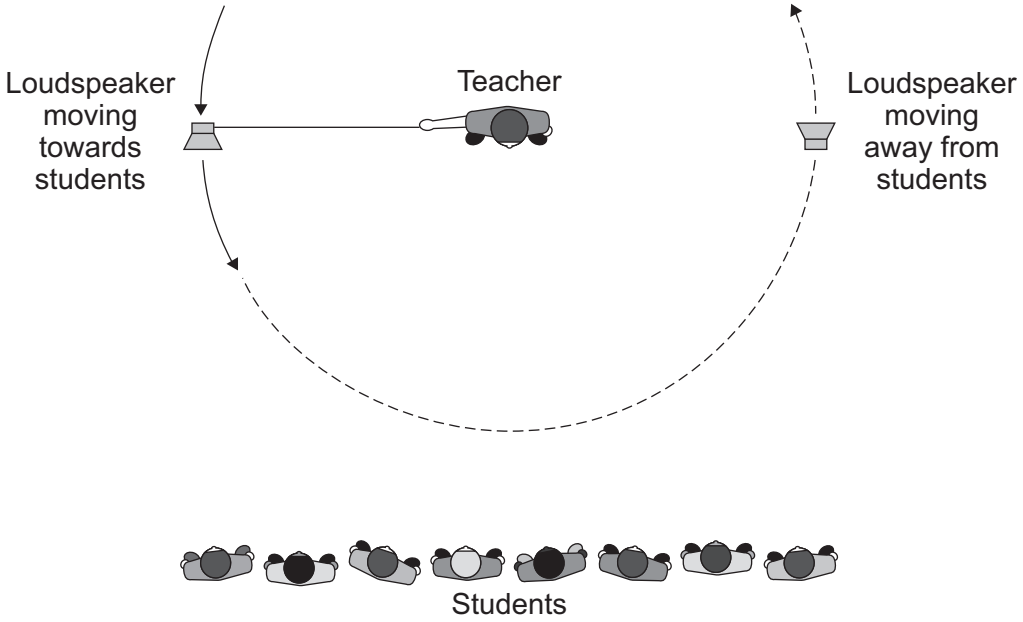
**4** waves are in the visible light region.

### 4.6.1.2 Properties of waves

**Question 54**



**7** The diagram shows a teacher using a loudspeaker to demonstrate an important effect. The loudspeaker, which produces a note of constant frequency, is swung around in a circle.




**7 (a)** As the loudspeaker moves towards the students, the frequency of the note heard by the students increases.

What happens to the note heard by the students as the loudspeaker moves away from them?

.....

.....

*(1 mark)*

4.6.1.2 Properties of waves

Question 54 · continued



**7 (b)** The teacher is using the demonstration to model the red-shift in light that is observed from most distant galaxies.

**7 (b) (i)** Which **one** of the following statements gives the main reason why models are used in science?

Put a tick (✓) in the box next to your answer.

Models can help to explain an effect or theory. ☐

Models can prove that a theory is correct. ☐

Models can help to generate new ideas. ☐

*(1 mark)*

**7 (b) (ii)** Explain how this demonstration can be used as a model for red-shift.

.....

.....

.....

.....

*(2 marks)*

**7 (c)** Red-shift provides evidence to support the theory that the Universe began from a very small initial point.

What name is given to this theory?

.....

*(1 mark)*

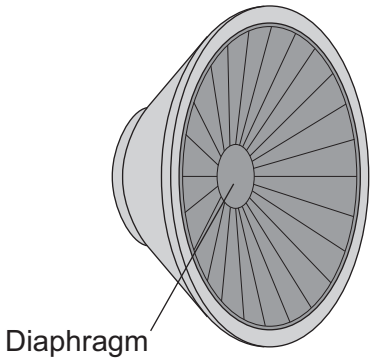
5

**4.6.1.2 Properties of waves**

**Question 55**

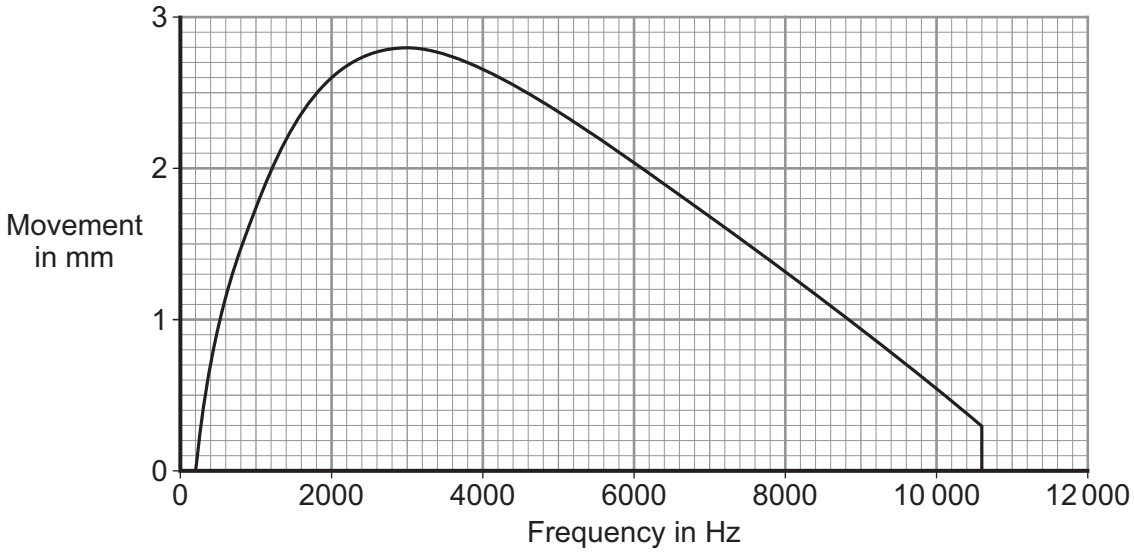


**8** The diaphragm of a loudspeaker moves in and out.




A team of scientists investigated loudspeakers.

The scientists measured the size of the movement of the diaphragm for signals of different frequencies.
They kept all the other variables constant.
The graph shows the average results for a large number of tests on one of the loudspeakers.




**8 (a)** What is the frequency of the highest pitched sound which this loudspeaker produces?

Frequency = ..... Hz

*(1 mark)*

4.6.1.2 Properties of waves

Question 55 · continued



**8 (b)** The greater the movement of the diaphragm, the greater the amplitude of the sound produced.

What is the frequency of the loudest sound which this loudspeaker produces?

Show clearly on the graph how you get to your answer and then complete this answer space.

Frequency = ..... Hz

*(2 marks)*

**8 (c)** Can this loudspeaker produce the full range of sound which most people can hear?

Put a tick (✓) in the box next to your answer.

Yes ☐ No ☐

Explain the reason for your answer.

.....

.....

.....

.....

*(2 marks)*

**8 (d)** Use **one** word to complete the sentence.

Repeating tests a large number of times and taking the average of the results

improves the ..... .

*(1 mark)*

**8 (e)** Why did the scientists keep all the other variables constant?

.....

.....

*(1 mark)*

7

### 4.6.1.2 Properties of waves

**Question 56**

March 2011 | PHY1BP | Original Q4 | Legacy

**QUESTION FOUR**

The waves in the electromagnetic spectrum can be grouped in order of wavelength.

Match types, **A**, **B**, **C** and **D**, with the numbers **1**–**4** in the table.

**A** gamma rays

**B** infra red rays

**C** radio waves

**D** ultraviolet rays

| |
|---|
| . . . **1** . . . |
| X-rays |
| . . . **2** . . . |
| visible light |
| . . . **3** . . . |
| microwaves |
| . . . **4** . . . |

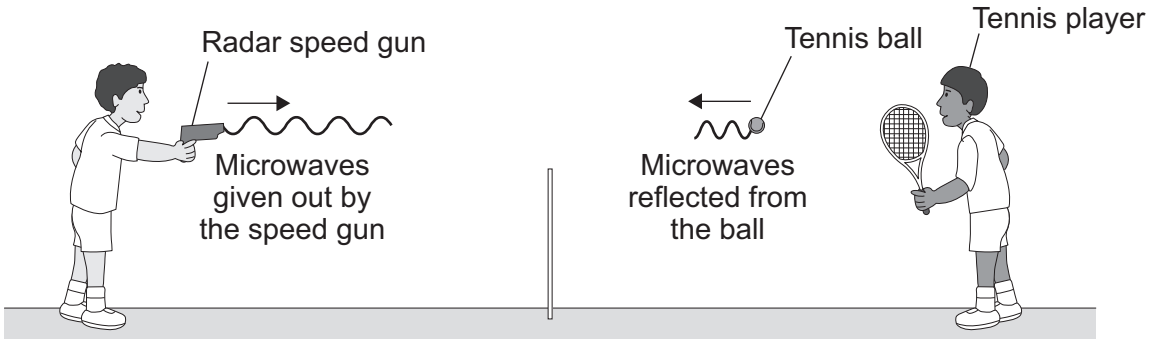
4.6.1.2 Properties of waves

Question 57

March 2011 | PHY1BP | Original Q8 | Legacy

## QUESTION EIGHT

The picture shows a radar speed gun being used to measure how fast a tennis player hits the ball.




Some of the microwaves from the radar speed gun are absorbed by the ball and some are reflected by the ball.

**8A** What effect will the absorbed microwaves have on the ball?

**1** The temperature of the ball will increase slightly.

**2** The ball will go faster.

**3** The temperature of the ball will decrease slightly.

**4** The ball will go slower.

**8B** Which row in the table describes how the frequency and wavelength of the reflected microwaves are different from the microwaves given out by the speed gun?

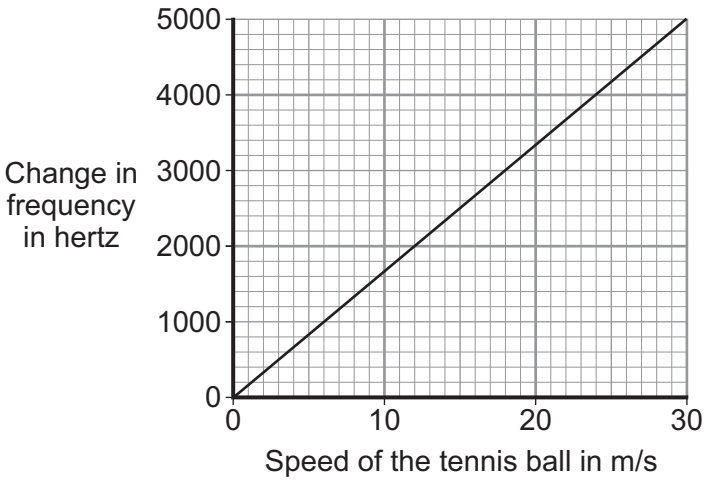
| | Frequency of reflected waves | Wavelength of reflected waves |
|---|---|---|
| **1** | higher | longer |
| **2** | lower | shorter |
| **3** | higher | shorter |
| **4** | lower | longer |

4.6.1.2 Properties of waves

Question 57 · continued



The graph shows how the change in frequency of the microwaves depends on the speed of the ball.




**8C** The data has been drawn as a line graph because . . .

**1** frequency and speed are both categoric variables.

**2** frequency and speed are both continuous variables.

**3** frequency is a categoric variable and speed is a continuous variable.

**4** frequency is a continuous variable and speed is a categoric variable.

**8D** The speed gun measures the change in frequency as 3000 Hz.

What is the speed of the ball?

**1** 18 m/s

**2** 20 m/s

**3** 21 m/s

**4** 22 m/s

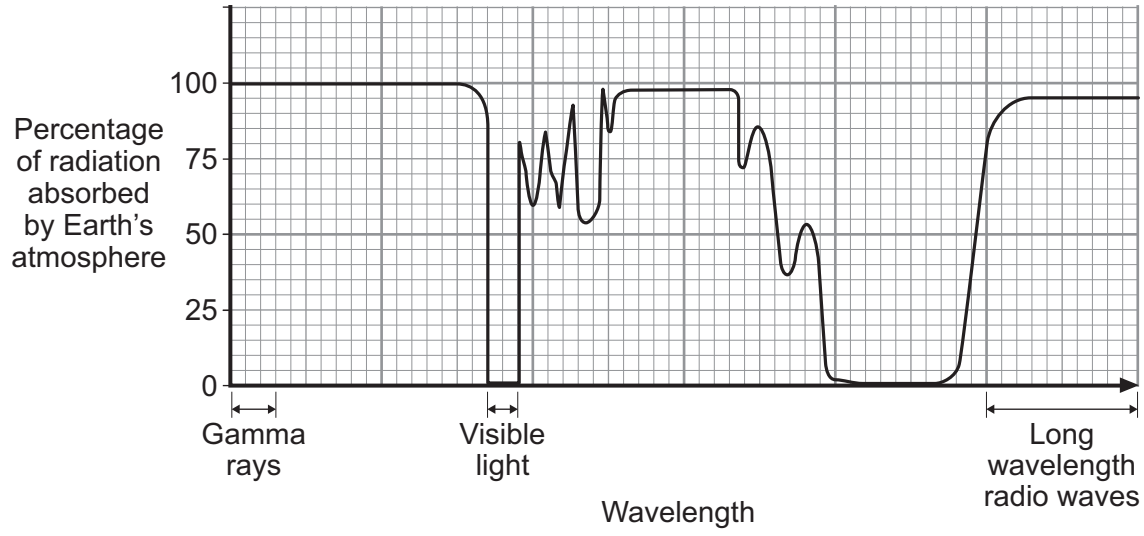
4.6.1.2 Properties of waves

Question 58

March 2011 | PHY1BP | Original Q9 | Legacy

**QUESTION NINE**

The diagram shows the absorption of electromagnetic radiation by the Earth's atmosphere.




**9A** The diagram shows that . . .

**1** all wavelengths of gamma radiation reach the Earth's surface.

**2** all wavelengths of radio waves reach the Earth's surface.

**3** all wavelengths of ultraviolet radiation reach the Earth's surface.

**4** all wavelengths of visible light reach the Earth's surface.

**9B** Some objects in space emit X-rays.

Where would you put a telescope to detect these X-rays?

**1** above the Earth's atmosphere

**2** at the top of a hill

**3** at ground level in a hot desert

**4** at ground level in the Antarctic

4.6.1.2 Properties of waves

Question 58 · continued



The table gives information about some space telescopes.

| Name | Hubble | Compton | Chandra | Spitzer |
|---|---|---|---|---|
| Launched in | 1990 | 1991 | 1999 | 2003 |
| Detects | infra red rays<br>ultraviolet rays<br>visible light | gamma rays | X-rays | infra red rays |

**9C** Which statement about these space telescopes can be deduced from the information in the table?

**1** They all collect data using mirrors.

**2** They all detect electromagnetic radiation.

**3** They are all in space at present.

**4** They were all used to study the Earth.

**9D** From the information in the table, which one of the following emissions could be detected by one of these space telescopes?

**1** alpha particles

**2** nuclear radiation

**3** radio waves

**4** sound waves

**END OF TEST**

### 4.6.1.2 Properties of waves

**Question 59**

June 2011 | PHY1BP | Original Q5 | Legacy

**QUESTION FIVE**

A source of sound waves is moving away from an observer.

Match words, **A**, **B**, **C** and **D**, with the numbers **1**–**4** in the sentences.

**A** frequency

**B** red-shift

**C** wavelength

**D** wave speed

Compared with the sound that the source emits, the observer hears a sound with a bigger . . . **1** . . . and a smaller . . . **2** . . . .

There is no change in the . . . **3** . . . .

A similar effect is seen with the light from a distant galaxy. This is called . . . **4** . . . .

4.6.1.2 Properties of waves

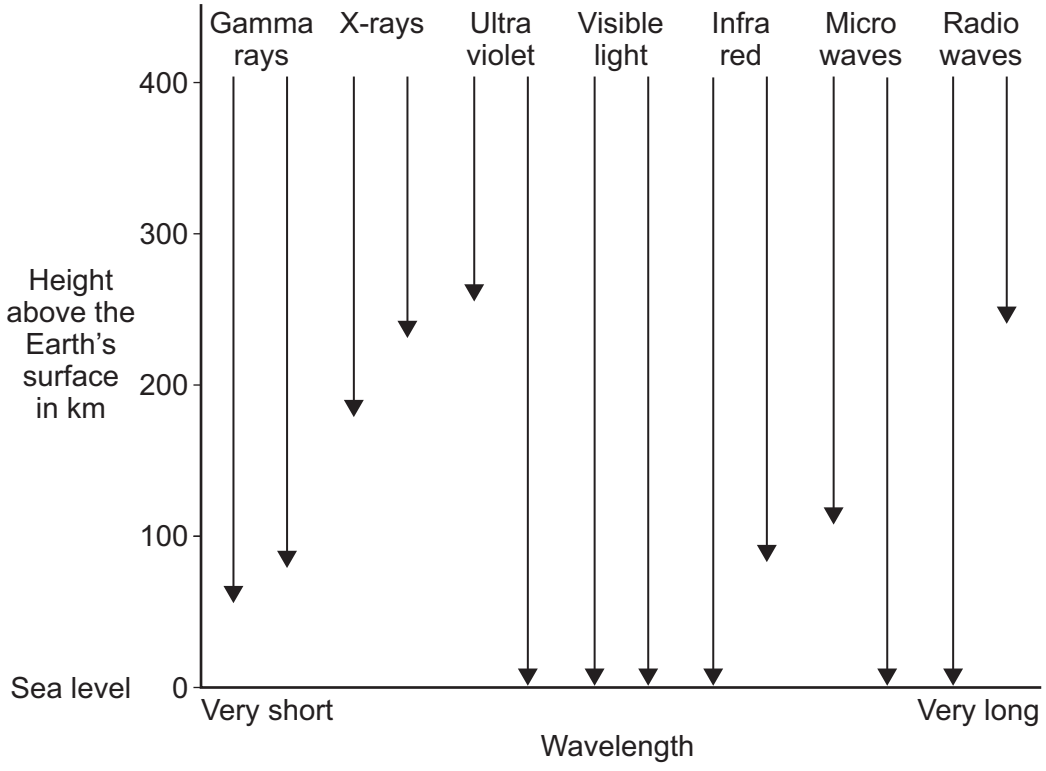
Question 60

June 2011 | PHY1BP | Original Q9 | Legacy

**QUESTION NINE**

Telescopes can be based on the Earth's surface or put into orbit in space.

The diagram shows how far electromagnetic waves penetrate the Earth's atmosphere. For some types of electromagnetic radiation, longer and shorter waves penetrate the atmosphere to different depths.




**9A** Telescopes on Earth detect **all** wavelengths of . . .

**1** radio waves only.

**2** visible light only.

**3** radio waves and visible light.

**4** visible light and X-rays.

**9B** Which of the following statements about the use of telescopes in space is true?

**1** The atmosphere distorts the image produced by the telescope.

**2** The telescopes are affected by light pollution from the Earth.

**3** The telescopes can detect electromagnetic waves that cannot reach the Earth's surface.

**4** The telescopes are easy to repair and maintain.

4.6.1.2 Properties of waves

Question 60 · continued



The table gives information about some space telescopes. Each telescope detects a different type of electromagnetic radiation.

| Telescope | Wavelength detected in nanometres |
|---|---|
| INTEGRAL | less than 0.01 |
| Chandra | 0.01 – 20 |
| FUSE | 20 – 400 |
| Hubble | 400 – 700 |
| Spitzer | 1000 – 1 000 000 |

**9C** The Hubble telescope detects visible light.

Which telescope detects infra red radiation?

**1** Chandra

**2** FUSE

**3** INTEGRAL

**4** Spitzer

**9D** Which telescope detects X-rays?

**1** Chandra

**2** FUSE

**3** INTEGRAL

**4** Spitzer

**END OF TEST**

### 4.6.1.2 Properties of waves

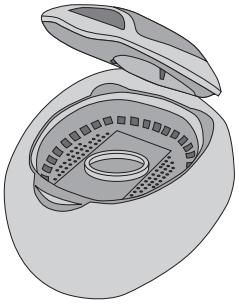
**Question 61**

June 2011 | PHY3F | Original Q3 | Legacy

**3** Ultrasound waves are very high frequency sound waves. They cannot be heard by humans.

**3 (a)** Ultrasound waves can be used to clean jewellery.

The jewellery is put into a container of cleaning fluid.



Complete each sentence to explain how ultrasound can clean jewellery.

The ultrasound generator makes the molecules of the cleaning fluid

..... . The molecules knock particles of .....

from the surface of the jewellery.

*(2 marks)*

**3 (b)** Give a medical use for ultrasound.

.....

*(1 mark)*

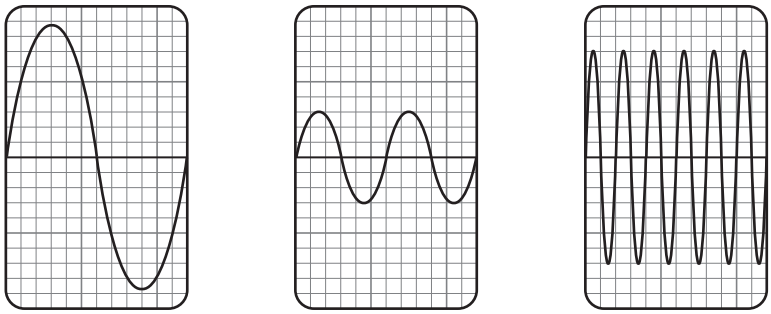
4.6.1.2 Properties of waves

Question 61 · continued



**3 (c)** Ultrasound waves can be represented on the screen of a cathode ray oscilloscope (CRO).

The diagrams show three ultrasound waves.
Each wave is represented on an identical CRO screen, **A**, **B** and **C**.



Screen **A** Screen **B** Screen **C**

**3 (c) (i)** How many complete waves are shown on screen **B**? .....

*(1 mark)*

**3 (c) (ii)** Which screen shows the waves with the highest frequency?

Screen .....

*(1 mark)*

5

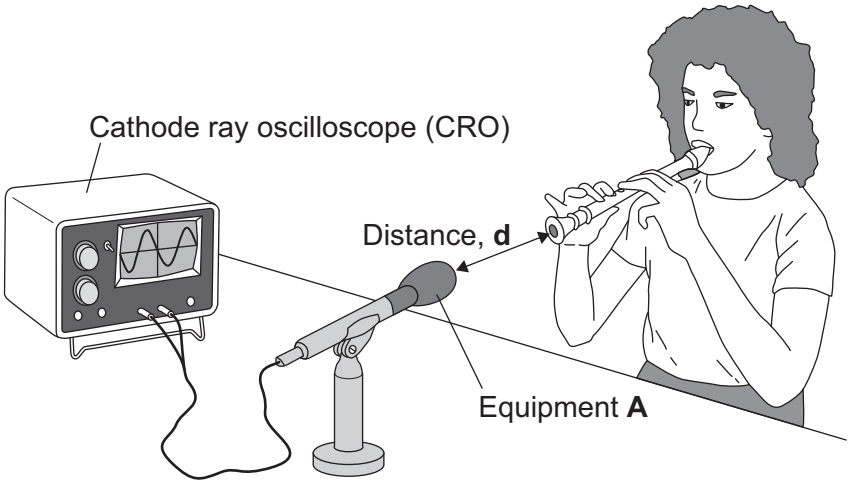
### 4.6.1.2 Properties of waves

**Question 62**

June 2011 | PHY3F | Original Q7 | Legacy

**7** A group of students investigates sound waves.

The diagram shows part of their investigation.




**7 (a)** Identify the equipment labelled **A**.

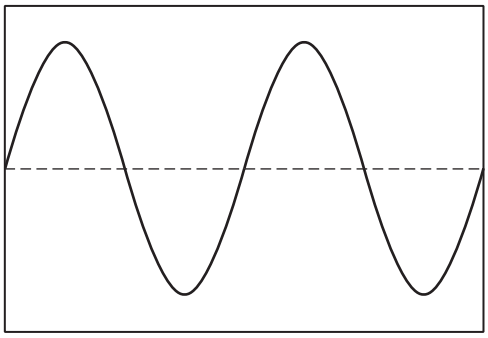
.....

*(1 mark)*

**7 (b)** The student plays the same note in the same way at different distances from equipment **A**.

Another student records the amplitude of the wave shown on the cathode ray oscilloscope (CRO).

**7 (b) (i)** Label this wave to show its amplitude.



*(1 mark)*

**7 (b) (ii)** Complete the sentence.

Increasing the amplitude of a sound wave will increase the .....

of the sound.

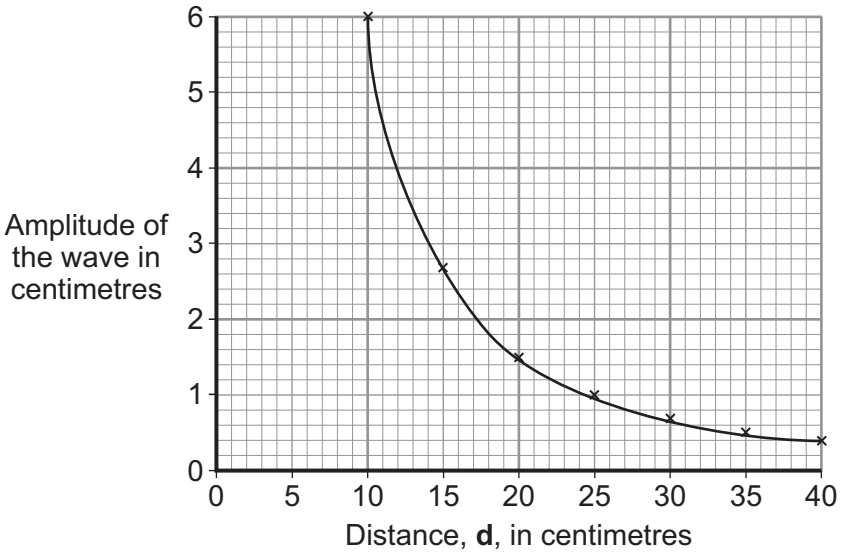
*(1 mark)*

4.6.1.2 Properties of waves

Question 62 · continued



**7 (c)** The graph shows the students' average results from several sets of measurements.




Use the graph to find the distance, **d**, in centimetres, at which the average amplitude is likely to be 2 centimetres.

Distance = ..... cm.

*(1 mark)*

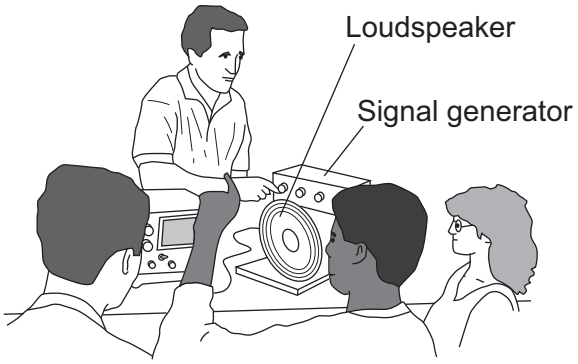
**7 (d)** Write a conclusion for this investigation.

.....

.....

*(1 mark)*

**7 (e)** A physics teacher uses a signal generator and a loudspeaker to demonstrate the range of hearing of a group of students.




What is the range of frequencies most humans can hear?

Most humans can hear from ..... Hz to ..... Hz.

*(2 marks)*

7

4.6.1.2 Properties of waves

Question 63

November 2011 | PHY1BP | Original Q5 | Legacy

**QUESTION FIVE**

The frequencies of the waves in the electromagnetic spectrum can be grouped into types.

Match types, **A**, **B**, **C** and **D**, with the descriptions **1**–**4** in the table.

**A** gamma rays

**B** infra red rays

**C** radio waves

**D** ultraviolet rays

| | |
|---|---|
| **1** | They have a higher frequency than X-rays. |
| **2** | They have a lower frequency than microwaves. |
| **3** | They have a lower frequency than visible light but a higher frequency than microwaves. |
| **4** | They have a lower frequency than X-rays but a higher frequency than visible light. |

### 4.6.1.2 Properties of waves

**Question 64**

June 2012 | PH1FP | Original Q3 | Legacy

**3** A school is near a busy road. A car travels past the school at high speed.



The students notice that the sound of the car engine seems to change as the car travels past the school. A teacher says that this is an example of the Doppler effect. The students decide to study the sound they hear from passing cars.

**3 (a) (i)** Give **one** risk the students should consider when doing their study.

.....

*(1 mark)*

**3 (a) (ii)** As a car travels towards the students, the frequency of the sound the students hear is different to the frequency of the sound they would hear if the car was stationary.

Draw a ring around the correct answer in the box to complete the sentence.

Compared to the sound from the stationary car, the frequency has

| |
|---|
| decreased. |
| increased. |
| become quieter. |

*(1 mark)*

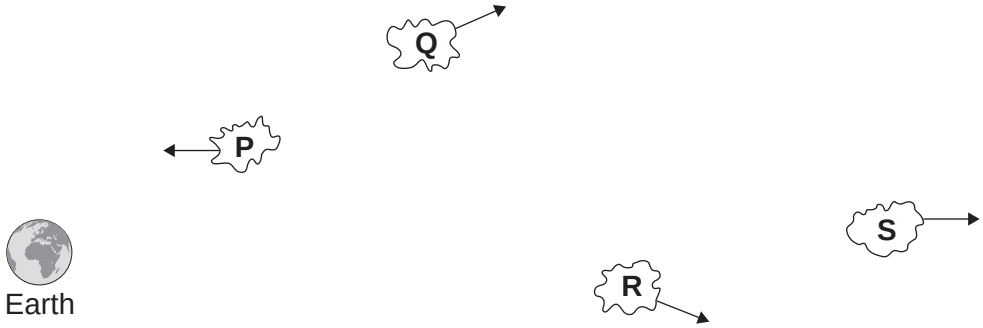
4.6.1.2 Properties of waves

Question 64 · continued



**3 (b)** In the same way as the sound from the car engine changes, the light from most galaxies also seems to have a change in observed frequency. This is called red-shift.

**3 (b) (i)** The diagram shows four galaxies, **P**, **Q**, **R** and **S**. The arrows show the direction the galaxies are moving relative to the Earth.




Which **one** of the galaxies is moving the fastest?

Write the correct answer in the box. ☐

Which **one** of the galaxies will produce the biggest red-shift?

Write the correct answer in the box. ☐

*(2 marks)*

**Question 3 continues on the next page**

4.6.1.2 Properties of waves

Question 64 · continued



**3 (b) (ii)** Most scientists support a theory that the Universe began from a very small initial point. Red-shift can be used as evidence for this theory.

What name is given to the theory that the Universe began from a very small initial point?

.....

*(1 mark)*

**3 (b) (iii)** Cosmic microwave background radiation (CMBR) provides more evidence for this theory. CMBR is detected coming from space.

Where does CMBR come from?

Tick (✓) **one** box.

CMBR only comes from near the Sun. ☐

CMBR comes from all parts of the Universe. ☐

CMBR only comes from the Moon. ☐

*(1 mark)*

**3 (b) (iv)** Which statement gives the reason why most scientists support the theory that the Universe began from a very small initial point?

Tick (✓) **one** box.

The evidence proves it happened. ☐

There is no other way of explaining how the Universe began. ☐

At the moment it is the best way of explaining our scientific knowledge. ☐

*(1 mark)*

7

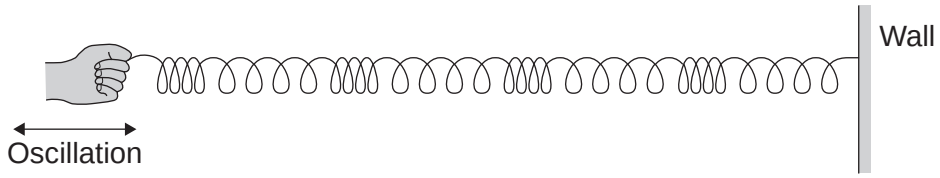
### 4.6.1.2 Properties of waves

**Question 65**

June 2012 | PH1FP | Original Q6 | Legacy

**6** **Diagram 1** shows a longitudinal wave being produced in a stretched spring.

**Diagram 1**



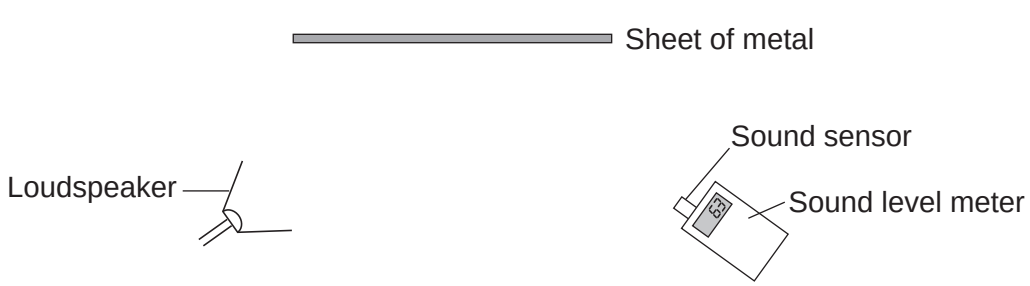

**6 (a)** A longitudinal wave has areas of compression and areas of rarefaction.

Mark with the letter **C**, **one** area of compression shown in **Diagram 1**.

*(1 mark)*

**6 (b)** **Diagram 2** shows the apparatus a teacher uses to demonstrate that sound can be reflected.

**Diagram 2**




**6 (b) (i)** Using a ruler, draw on **Diagram 2** to show how sound from the loudspeaker is reflected by the sheet of metal to the sound sensor.

*(2 marks)*

**6 (b) (ii)** The teacher replaced the sheet of metal with a sheet of glass.

When he did this, the reading on the sound level meter went down.

Suggest why.

.....

.....

*(1 mark)*

4.6.1.2 Properties of waves

Question 65 · continued



**6 (b) (iii)** The teacher changed the output from the loudspeaker to increase the amplitude of the sound wave produced.

What effect, if any, does this increase of amplitude have on the loudness of the sound?

Draw a ring around the correct answer.

| | | |
|---|---|---|
| **makes the sound quieter** | **does not change the loudness of the sound** | **makes the sound louder** |

*(1 mark)*

**6 (b) (iv)** The loudspeaker produces a sound wave at a frequency of 850 Hz. The wavelength of the sound wave is 0.4 m.

Calculate the speed of the sound wave.

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

.....

.....

.....

Speed = ..... m/s

*(2 marks)*

**6 (c)** Music concerts are sometimes performed in sports halls. The concerts can be spoilt because of the sound reflected from the floor and walls.

What word is used to describe a reflected sound?

.....

*(1 mark)*

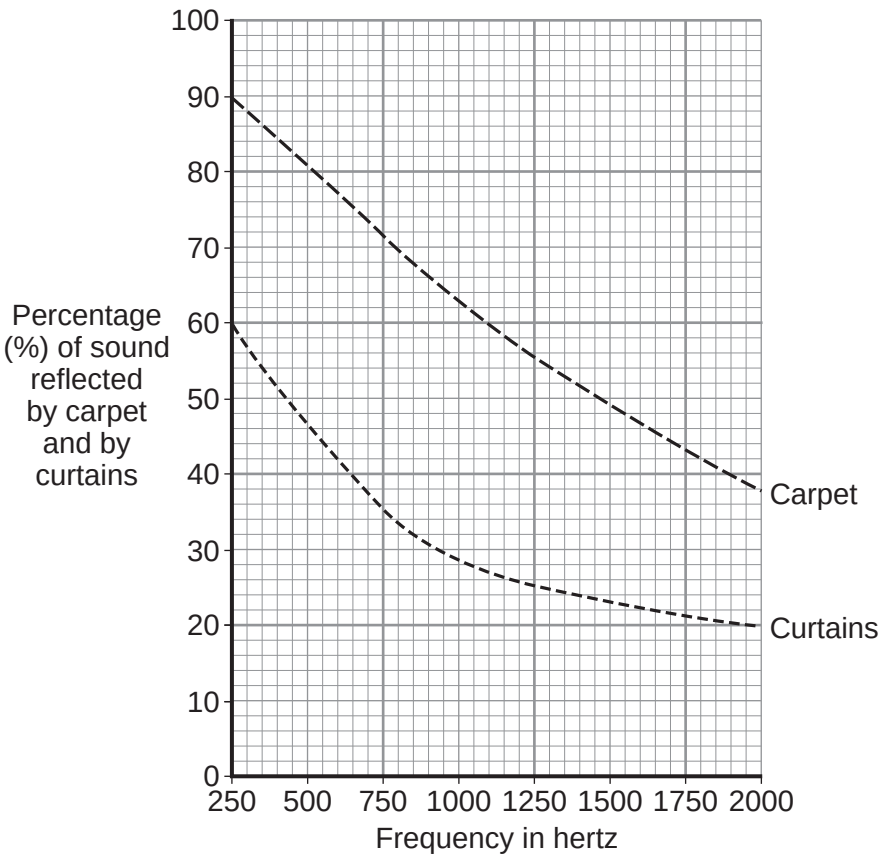
**Question 6 continues on the next page**

4.6.1.2 Properties of waves

Question 65 · continued



**6 (d)** The graph shows how the percentage of sound reflected from the floor and from the walls of a large room can be reduced by carpets and by curtains.




**6 (d) (i)** Over which range of frequencies do curtains reduce the percentage of sound reflected the most?

Tick (✓) **one** box.

from 250 Hz to 750 Hz ☐

from 750 Hz to 1250 Hz ☐

from 1250 Hz to 1750 Hz ☐

*(1 mark)*

4.6.1.2 Properties of waves

Question 65 · continued



**6 (d) (ii)** The manager of a sports hall plans to use the hall for regular music concerts. He has enough money to buy either carpet or curtains, but not both.

To improve the sound an audience hears, it would be better to hang curtains on the walls rather than laying a carpet over the floor.

Use the data in the graph to explain why.

.....

.....

.....

.....

*(2 marks)*

11

**Turn over for the next question**

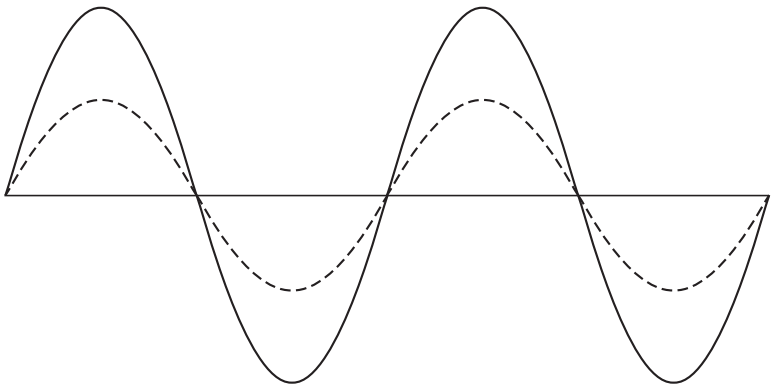
4.6.1.2 Properties of waves

Question 66

January 2013 | PH1FP | Original Q4 | Legacy

**4 (a)** **Diagram 1** shows two waves.

**Diagram 1**



**4 (a) (i)** Name **one** wave quantity that is the same for the two waves.

.....

*(1 mark)*

**4 (a) (ii)** Name **one** wave quantity that is different for the two waves.

.....

*(1 mark)*

**4 (a) (iii)** The waves in **Diagram 1** are transverse.

Which **one** of the following types of wave is **not** a transverse wave?

Draw a ring around the correct answer.

**gamma rays** **sound** **visible light**

*(1 mark)*

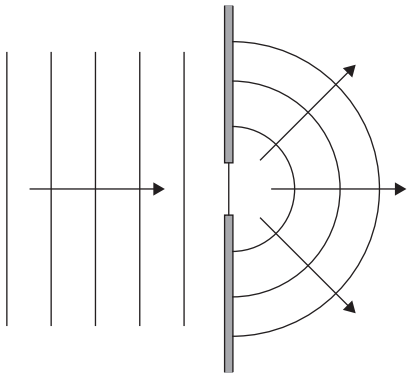
4.6.1.2 Properties of waves

Question 66 · continued



**4 (b)** **Diagram 2** shows water waves in a ripple tank moving towards and passing through a gap in a barrier.

**Diagram 2**



**4 (b) (i)** The water waves spread out after passing through the gap in the barrier.

What name is given to the process causing the waves to spread out?

.....

*(1 mark)*

**4 (b) (ii)** Every second, 8 waves pass through the gap in the barrier. The waves have a wavelength of 0.015 metres.

Calculate the speed of the water waves and give the unit.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

Speed = .....

*(3 marks)*

7

### 4.6.1.2 Properties of waves

**Question 67**

January 2013 | PH1FP | Original Q7 | Legacy

**7 (a)** Scientists have observed that the wavelengths of the light from galaxies moving away from the Earth are longer than expected.

**7 (a) (i)** What name is given to this observation?

.....

*(1 mark)*

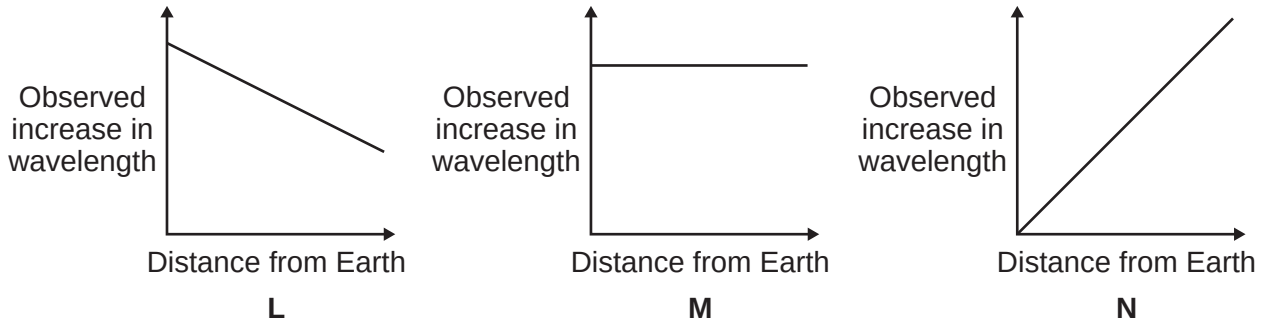
**7 (a) (ii)** Draw a ring around the correct answer in the box to complete the sentence.

This observation gives scientists evidence that

| |
|---|
| light can be stretched. |
| galaxies are changing colour. |
| the Universe is expanding. |

*(1 mark)*

**7 (a) (iii)** There is a pattern linking the size of the observed increase in the wavelengths of light from a galaxy and the distance the galaxy is from the Earth.




Which **one** of the graphs, **L**, **M** or **N**, shows the correct pattern?

Write the correct answer in the box. ☐

*(1 mark)*

4.6.1.2 Properties of waves

Question 67 · continued



**7 (b)** Observations help scientists answer questions about the Universe.

Scientists **cannot** answer every question.

Which **one** of the following questions **cannot** be answered by scientists?

Tick (✓) **one** box.

How old is the Universe? ☐

Why was the Universe created? ☐

How fast does light travel through the Universe? ☐

*(1 mark)*

4

**Turn over for the next question**

### 4.6.1.2 Properties of waves

**Question 68**

January 2013 | PH2FP | Original Q4 | Legacy

**4 (a)** The diagram shows the information plate on an electric kettle. The kettle is plugged into the a.c. mains electricity supply.

| | |
|---|---|
| **230 V** | **2760 W** |
| **50 Hz** | |

Use the information from the plate to answer the following questions.

**4 (a) (i)** What is the frequency of the a.c. mains electricity supply?

.....

*(1 mark)*

**4 (a) (ii)** What is the power of the electric kettle?

.....

*(1 mark)*

**4 (b)** To boil the water in the kettle, 2400 coulombs of charge pass through the heating element in 200 seconds.

Calculate the current flowing through the heating element and give the unit.

Use the correct equation from the Physics Equations Sheet.

Choose the unit from the list below.

**amps** **volts** **watts**

.....

.....

.....

Current = .....

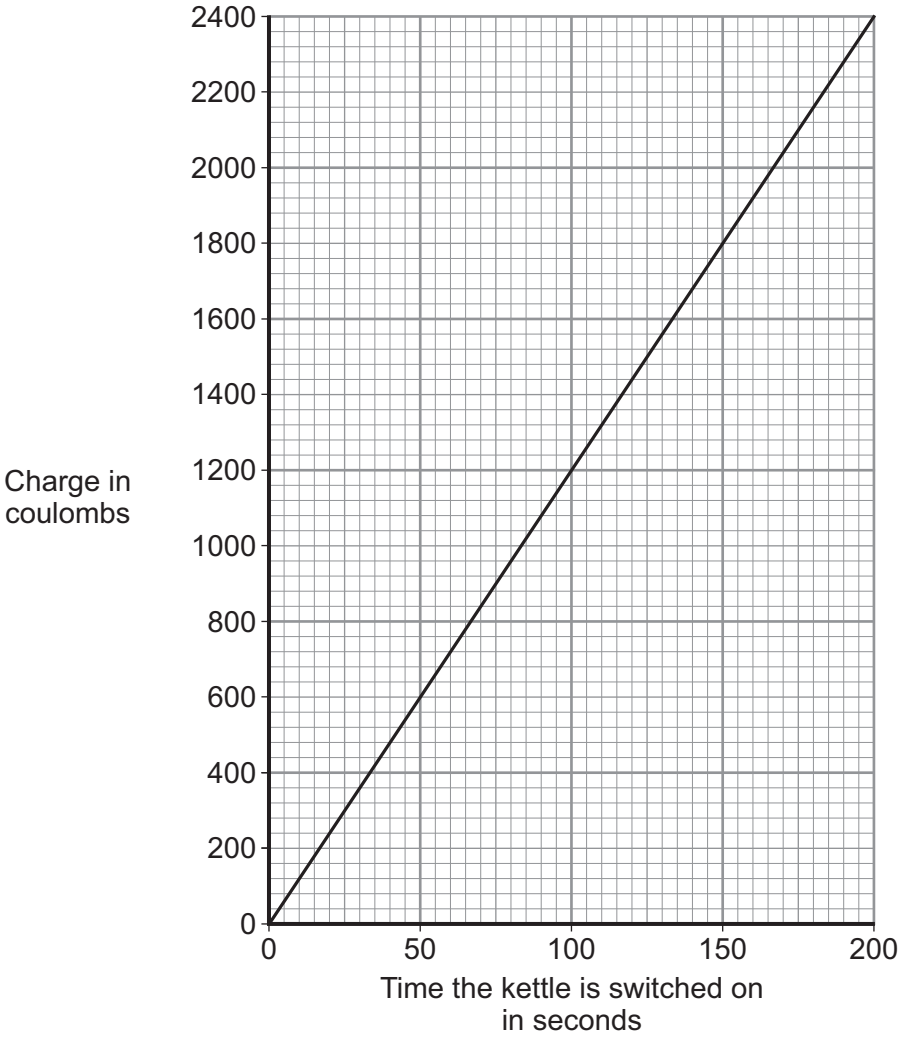
*(3 marks)*

4.6.1.2 Properties of waves

Question 68 · continued



**4 (c)** The amount of charge passing through the heating element of an electric kettle depends on the time the kettle is switched on.




What pattern links the amount of charge passing through the heating element and the time the kettle is switched on?

.....

.....

*(2 marks)*

7

4.6.1.2 Properties of waves

Question 69

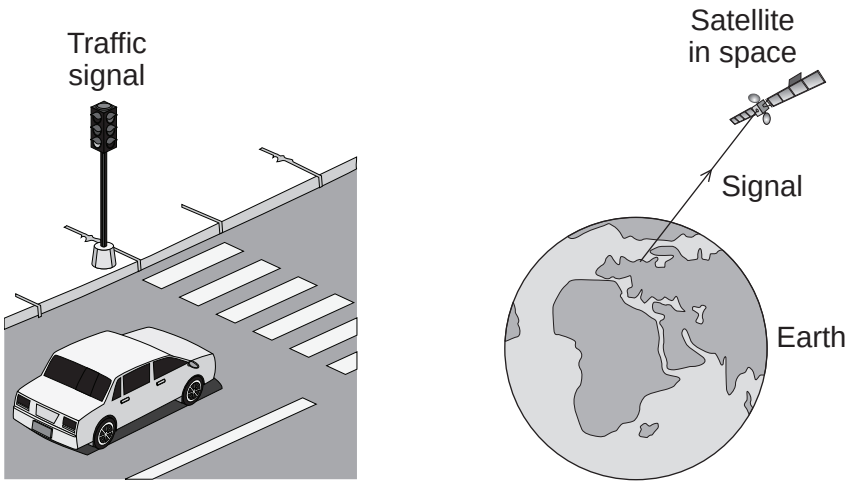
June 2013 | PH1FP | Original Q2 | Legacy

**2** **Diagram 1** shows four of the seven types of wave in the electromagnetic spectrum.

**Diagram 1**

| | | | | | | |
|---|---|---|---|---|---|---|
| **J** | **K** | **L** | Visible light | Infrared | Microwaves | Radio waves |

**2 (a)** The **four** types of electromagnetic wave named in **Diagram 1** above are used for communication.




**2 (a) (i)** Which type of electromagnetic wave is used when a traffic signal communicates with a car driver?

.....

*(1 mark)*

**2 (a) (ii)** Which type of electromagnetic wave is used to communicate with a satellite in space?

.....

*(1 mark)*

**2 (b)** Gamma rays are part of the electromagnetic spectrum.

Which letter, **J**, **K** or **L**, shows the position of gamma rays in the electromagnetic spectrum?

Draw a ring around the correct answer.

**J** **K** **L**

*(1 mark)*

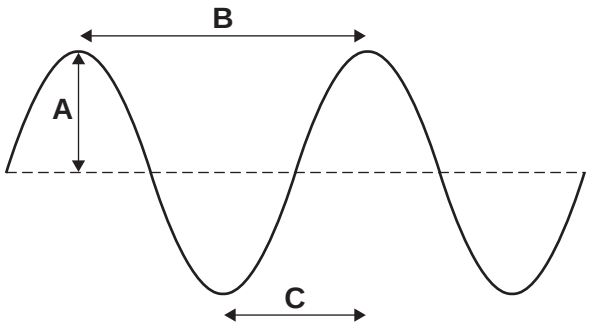
4.6.1.2 Properties of waves

Question 69 · continued



**2 (c)** **Diagram 2** shows an infrared wave.

**Diagram 2**




**2 (c) (i)** Which **one** of the arrows, labelled **A**, **B** or **C**, shows the wavelength of the wave?

Write the correct answer, **A**, **B** or **C**, in the box. ☐

*(1 mark)*

**2 (c) (ii)** Draw a ring around the correct answer to complete the sentence.

The wavelength of infrared waves is [shorter than / the same as / longer than] the wavelength of radio waves.

*(1 mark)*

**Question 2 continues on the next page**

4.6.1.2 Properties of waves

Question 69 · continued



**2 (d)** Mobile phone networks send signals using microwaves. Some people think the energy a person's head absorbs when using a mobile phone may be harmful to health.

**2 (d) (i)** Scientists have compared the health of people who use mobile phones with the health of people who do not use mobile phones.

Which **one** of the following statements gives a reason why scientists have done this?

Tick (✓) **one** box.

To find out if using a mobile phone is harmful to health. ☐

To find out if mobile phones give out radiation. ☐

To find out why some people are healthy. ☐

*(1 mark)*

**2 (d) (ii)** The table gives the specific absorption rate (SAR) value for two different mobile phones.

The SAR value is a measure of the maximum energy a person's head absorbs when a mobile phone is used.

| Mobile Phone | SAR value in W/kg |
|---|---|
| **X** | 0.28 |
| **Y** | 1.35 |

A parent buys mobile phone **X** for her daughter.

Using the information in the table, suggest why buying mobile phone **X** was the best choice.

.....

.....

.....

.....

*(2 marks)*

8

### 4.6.1.2 Properties of waves

**Question 70**

June 2013 | PH1FP | Original Q5 | Legacy

**5 (a)** A lorry has an air horn. The air horn produces sound waves in the air.

**5 (a) (i)** Use **one** word to complete the following sentence.

Sound waves cause air particles to ..... .

*(1 mark)*

**5 (a) (ii)** The air horn produces sound waves at a constant frequency of 420 Hz.
The wavelength of the sound waves is 0.80 m.

Calculate the speed of the sound waves.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

Speed = ..... m/s

*(2 marks)*

**5 (b)** A person standing at the side of the road, as the lorry goes past, hears the sound from the air horn change pitch.

**5 (b) (i)** What determines the pitch of a sound?

Draw a ring around the correct answer.

**amplitude** **frequency** **loudness**

*(1 mark)*

**5 (b) (ii)** As the lorry moves away from the person, the air horn continues to produce sound waves with a wavelength of 0.80 m.

What is the wavelength of the sound waves the person heard?

Draw a ring around the correct answer.

**shorter than 0.8 m** **equal to 0.8 m** **longer than 0.8 m**

*(1 mark)*

4.6.1.2 Properties of waves

Question 70 · continued



**5 (b) (iii)** The sound waves the person heard from the moving air horn are different to the sound waves the air horn produced.

What name is given to this effect?

Draw a ring around the correct answer.

**diffraction** **Doppler** **refraction**

*(1 mark)*

6

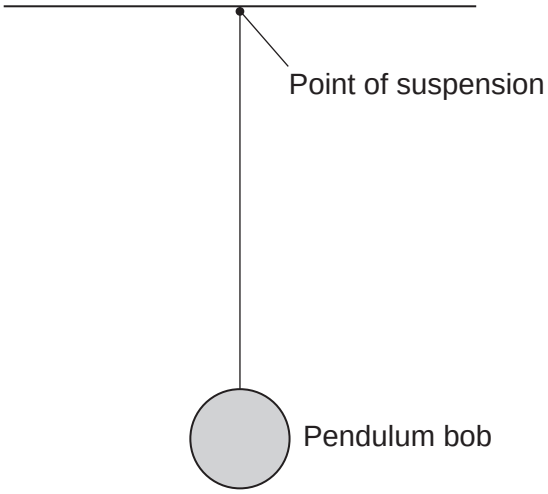
**Turn over for the next question**

### 4.6.1.2 Properties of waves

**Question 71**

June 2013 | PH3FP | Original Q3 | Legacy

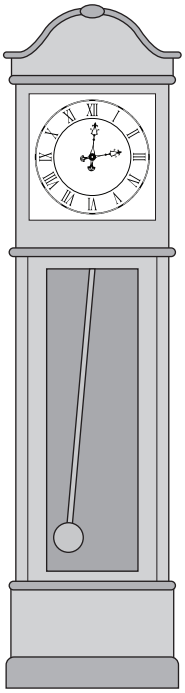
**3 (a)** The diagram shows a pendulum.




**Draw an X** on the diagram above, so that the centre of the **X** marks the centre of mass of the pendulum bob.

*(1 mark)*

**3 (b)** A large clock keeps time using the swing of a pendulum.



4.6.1.2 Properties of waves

Question 71 · continued



**3 (b) (i)** The frequency of the swinging pendulum is 0.5 hertz.

Calculate the periodic time of the pendulum.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

Periodic time = ..... seconds
*(2 marks)*

**3 (b) (ii)** Calculate the number of complete swings the pendulum would make in 60 seconds.

Use your answer from part **(b)(i)** in your calculation.

.....

.....

.....

Number of swings in 60 seconds = .....
*(2 marks)*

**Question 3 continues on the next page**

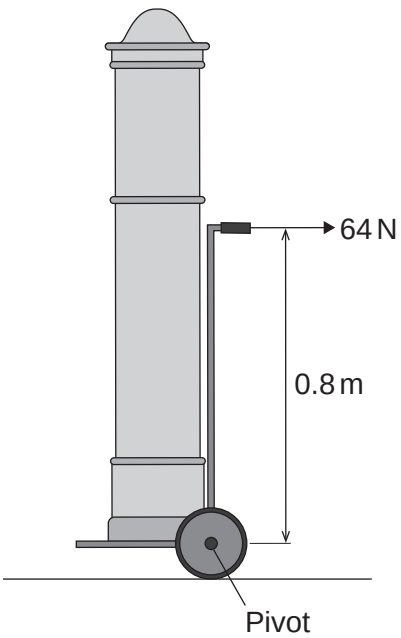
4.6.1.2 Properties of waves

Question 71 · continued



**3 (c)** The diagram shows a clock on a trolley.

The trolley is being used to move the clock.




Calculate the moment of the 64 N force about the pivot.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

Moment of the force = ..... Nm

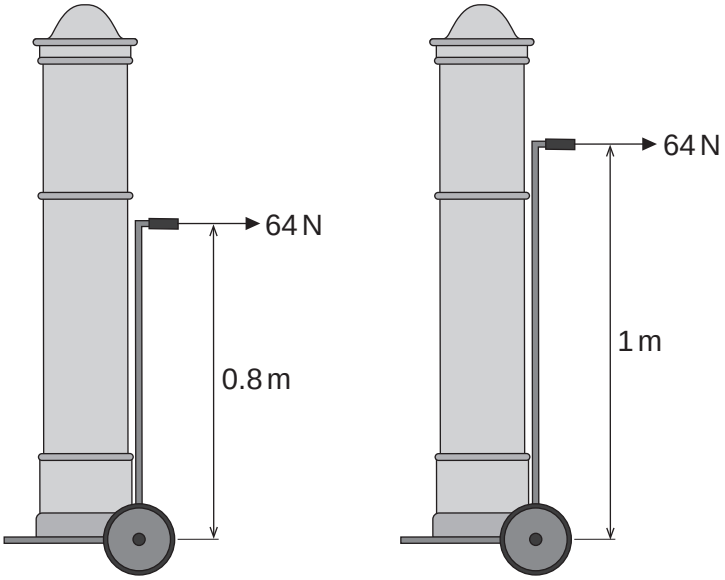
*(2 marks)*

4.6.1.2 Properties of waves

Question 71 · continued



**3 (d)** The design of the trolley is now changed to make it taller.




How does making the trolley taller affect the moment produced by the 64 N force about the pivot?

.....

.....

*(1 mark)*

8

4.6.1.2 Properties of waves

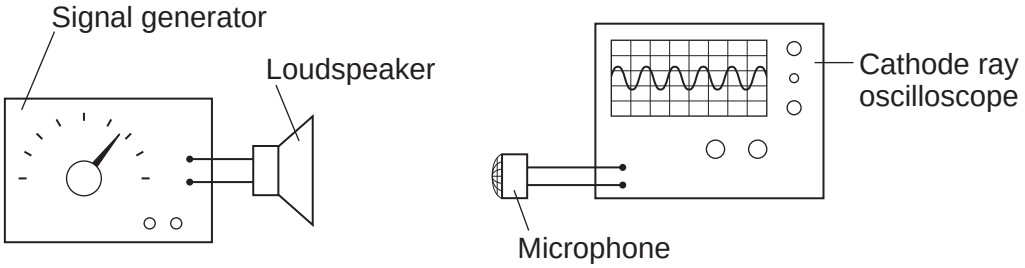
Question 72

June 2014 | PH1FP | Original Q2 | Legacy

**2 (a)** **Figure 2** shows a signal generator connected to a loudspeaker.

The signal generator is adjusted to change the sound wave produced by the loudspeaker.

**Figure 2**

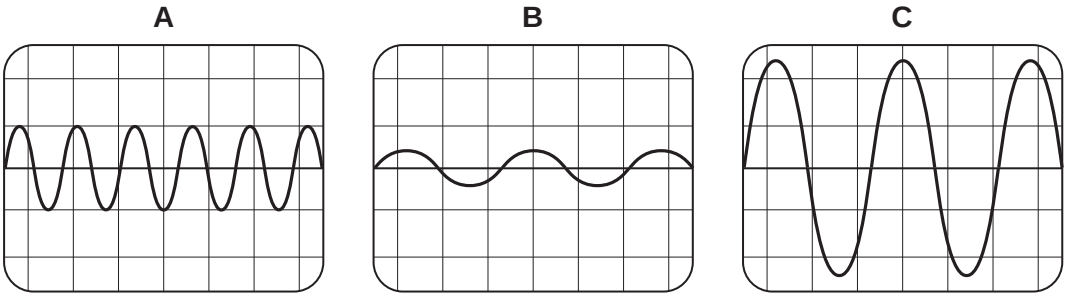



A microphone connected to a cathode ray oscilloscope (CRO) is used to detect the sound waves from the loudspeaker.

**Figure 3** shows the CRO traces, **A**, **B** and **C**, produced by three different sound waves.

The settings on the CRO were the same for each trace.

**Figure 3**




Use the correct letter, **A**, **B** or **C**, to complete each sentence.

**2 (a) (i)** The sound wave with the highest frequency is shown by trace ☐.

**[1 mark]**

**2 (a) (ii)** The sound wave with the smallest amplitude is shown by trace ☐.

**[1 mark]**

4.6.1.2 Properties of waves

Question 72 · continued



**2 (b)** The loudspeaker produces a sound wave with a frequency of 850 hertz and a wavelength of 0.4 metres.

Calculate the speed of this sound wave. Give the unit.

Use the correct equation from the Physics Equations Sheet.

Choose the unit from the list below.

**joules** **metres / second** **watts**

**[3 marks]**

.....

.....

.....

Speed = .....

**2 (c)** A motorbike is driven towards a microphone and CRO which are placed by the side of the road.

The motorbike emits a sound wave of constant frequency.

Draw a ring around the correct answer to complete each sentence.

**[2 marks]**

As the motorbike moves towards the microphone, the frequency of the sound wave detected by the microphone will be [higher than / the same as / lower than] the frequency of the sound wave produced by the motorbike.

The wavelength of the sound wave detected by the microphone will be [longer than / the same as / shorter than] the wavelength of the sound wave from the motorbike.

7

4.6.1.2 Properties of waves

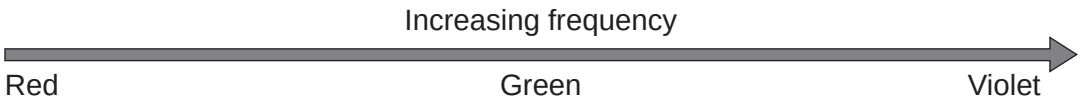
Question 73

June 2014 | PH1FP | Original Q6 | Legacy

**6 (a)** The visible light spectrum has a range of frequencies.

**Figure 8** shows that the frequency increases from red light to violet light.

**Figure 8**




Use the correct answers from the box to complete the sentence.

| | | |
|---|---|---|
| **decreases** | **stays the same** | **increases** |

**[2 marks]**

As the frequency of the light waves increases, the wavelength

of the light waves ..... and

the energy of the light waves ..... .

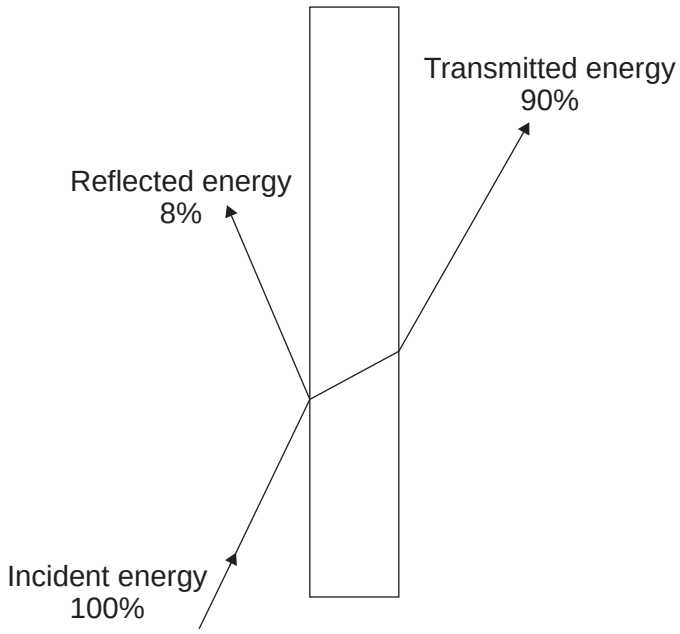
4.6.1.2 Properties of waves

Question 73 · continued



**6 (b)** **Figure 9** shows what happens to the light energy when a ray of light hits a glass block.

**Figure 9**




98% of the incident energy is either reflected or transmitted by the glass block.

What happens to the other 2% of the incident energy?

**[1 mark]**

.....

.....

**Question 6 continues on the next page**

4.6.1.2 Properties of waves

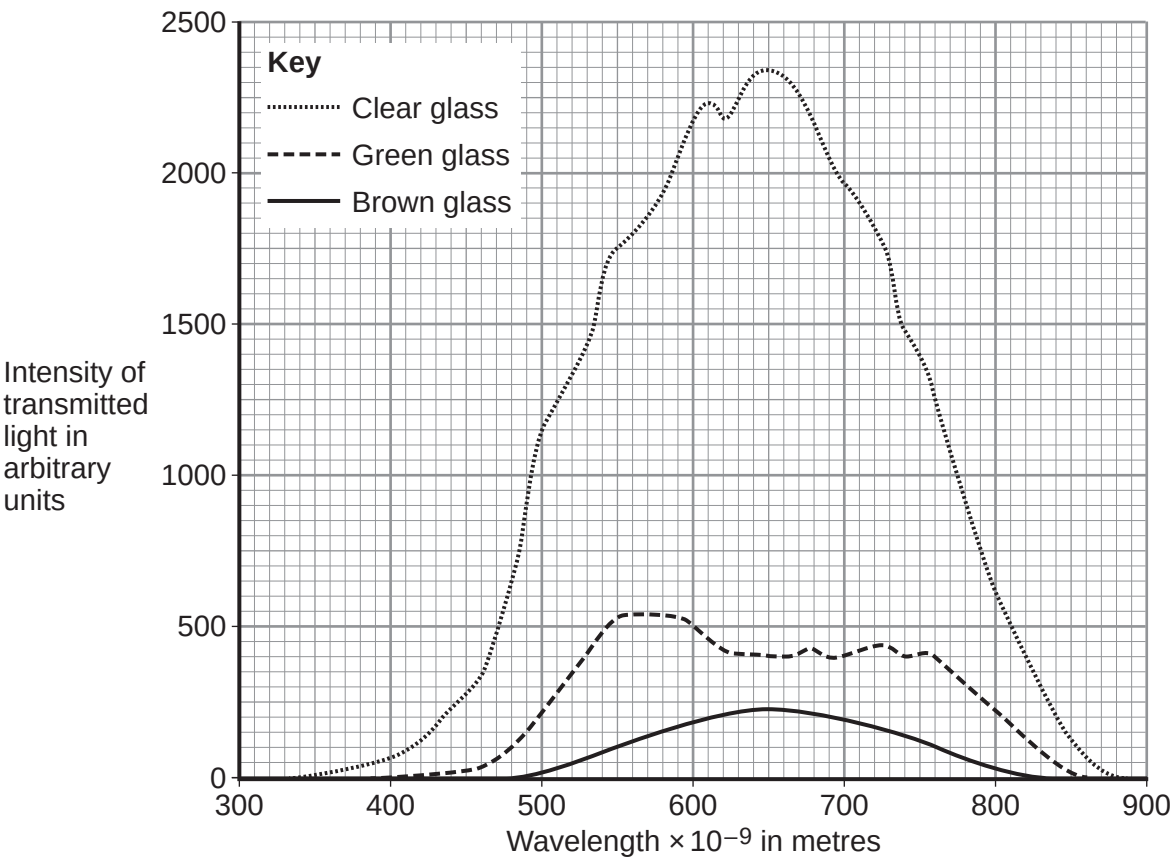
Question 73 · continued



**6 (c)** Bottled beer will spoil if the intensity of the light passing through the glass bottle into the beer is too high.

**Figure 10** shows the intensity of the light that is transmitted through three different pieces of glass.

**Figure 10**




**6 (c) (i)** The pieces of glass all had the same thickness.

Suggest why.

**[1 mark]**

.....

.....

**6 (c) (ii)** Bottles made of brown glass are suitable for storing beer.

Suggest why.

**[1 mark]**

.....

.....

5

4.6.1.2 Properties of waves

Question 74

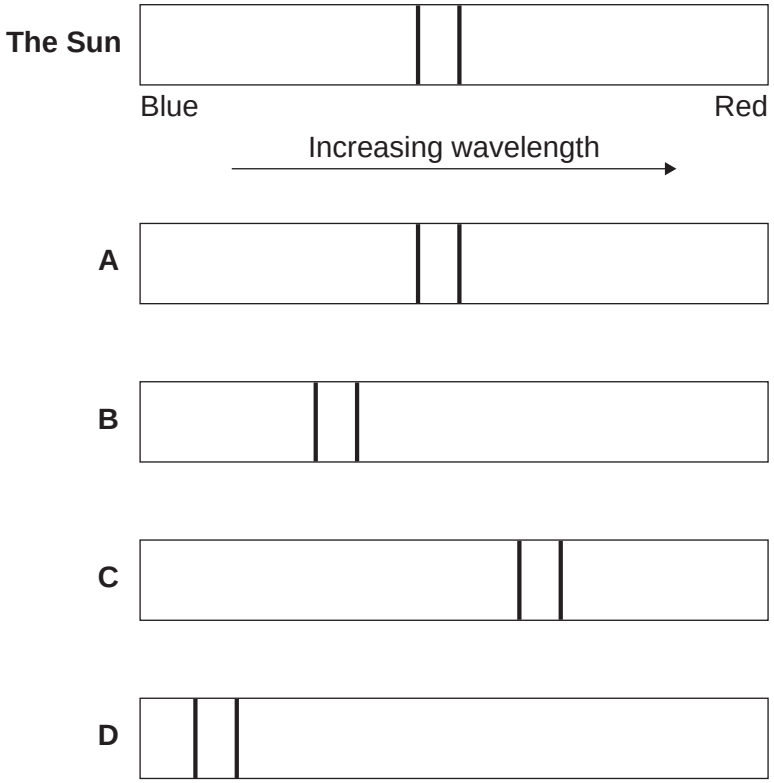
June 2015 | PH1FP | Original Q6 | Legacy

**6** Scientists can use the visible light spectrum from distant stars to determine whether the stars are moving.

The visible light spectrum from stars includes dark lines at specific wavelengths.

**6 (a)** **Figure 9** shows the visible light spectrum from the Sun and from four other stars, **A**, **B**, **C** and **D**.

**Figure 9**




**6 (a) (i)** Which star, **A**, **B**, **C** or **D**, is moving away from the Earth?

**[1 mark]**

4.6.1.2 Properties of waves

Question 74 · continued



**6 (a) (ii)** How does the speed of star **B** compare with the speed of star **D**?

**[1 mark]**

Tick (✓) **one** box.

| | **Tick** (✓) |
|---|---|
| The speed of star **B** is greater than the speed of star **D**. | |
| The speed of star **B** is less than the speed of star **D**. | |
| The speed of star **B** is the same as the speed of star **D**. | |

**6 (b)** A radio wave is emitted by a star.
The radio wave has a wavelength of 1500 m and a frequency of 200 000 Hz.

Calculate the speed of this radio wave.

Use the correct equation from the Physics Equations Sheet.

**[3 marks]**

Choose the correct unit from the list below.

**m** **m/s** **m/s$^2$**

.....

.....

.....

Speed = ..... unit .....

5

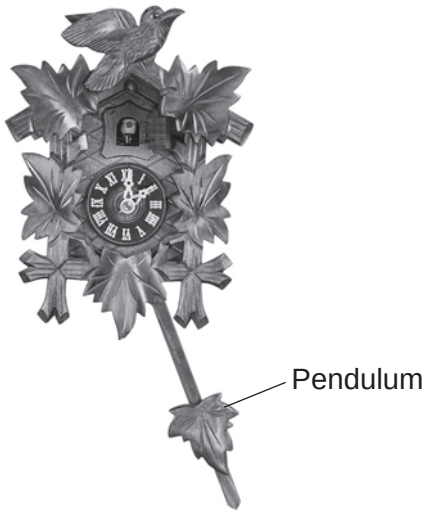
### 4.6.1.2 Properties of waves

**Question 75**

June 2015 | PH3FP | Original Q7 | Legacy

**7** The clock shown in **Figure 13** uses a pendulum to keep time.

**Figure 13**




**7 (a)** The pendulum has a frequency of 0.80 Hz.

Calculate the periodic time of the pendulum.

Use the correct equation from the Physics Equations Sheet.

**[2 marks]**

.....

.....

.....

Periodic time = ..... seconds

**Question 7 continues on the next page**

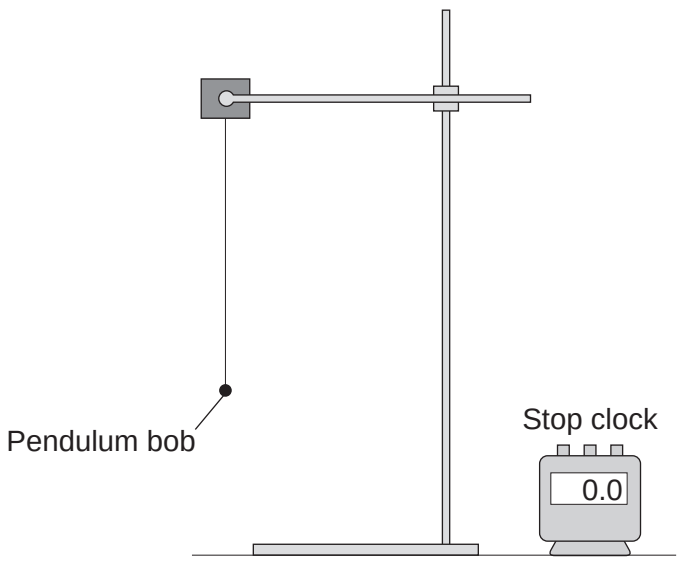
4.6.1.2 Properties of waves

Question 75 · continued



**7 (b)** A student investigated the factors affecting the oscillation of a pendulum. The student set up a pendulum as shown in **Figure 14**.

**Figure 14**




The student investigated how many complete oscillations the pendulum made for different lengths of the pendulum and different masses of the pendulum bob.

The results are shown in **Table 2**.

**Table 2**

| Length of the pendulum in millimetres | Mass of the pendulum bob in grams | Number of complete oscillations made by the pendulum in 20 seconds |
|---|---|---|
| 200 | 100 | 22 |
| 200 | 200 | 22 |
| 400 | 100 | 15 |
| 400 | 200 | 15 |
| 600 | 50 | 13 |
| 600 | 100 | 13 |

4.6.1.2 Properties of waves

Question 75 · continued



**7 (b) (i)** State **two** conclusions that the student should make from the results shown in **Table 2**.
**[2 marks]**

1 .....

.....

2 .....

.....

**7 (b) (ii)** The student wants to be more certain that her conclusions are correct.

Suggest **two** ways in which the investigation could be improved.
**[2 marks]**

1 .....

.....

2 .....

.....

6

### 4.6.1.2 Properties of waves

**Question 76**

June 2015 | PH3FP | Original Q9 | Legacy

**9 (a)** Complete the following sentences.

**[2 marks]**

Ultrasound waves have a minimum frequency

of ..... hertz.

The wavelength of an X-ray is about the same as

the diameter of ..... .

**9 (b)** **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

**Figure 17** shows one medical use of ultrasound and one medical use of X-rays.

**Figure 17**





Compare the medical uses of ultrasound and X-rays.

Your answer should include the risks, if any, and precautions, if any, associated with the use of ultrasound and X-rays.

**[6 marks]**

.....

.....

.....

.....

.....

.....

.....

.....

4.6.1.2 Properties of waves

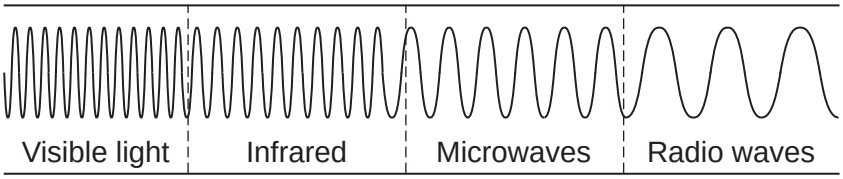
Question 77

June 2016 | PH1FP | Original Q3 | Legacy

**3** Infrared and microwaves are two types of electromagnetic radiation.

**Figure 4** shows the positions of the two types of radiation within part of the electromagnetic spectrum.

**Figure 4**




**3 (a) (i)** Name **one** type of electromagnetic radiation which has more energy than infrared.

**[1 mark]**

_____

**3 (a) (ii)** Use the correct answer from the box to complete each sentence.

Each answer may be used once, more than once or not at all.

**[3 marks]**

| | | |
|---|---|---|
| **greater than** | **less than** | **the same as** |

The wavelength of infrared is _____ the wavelength of microwaves.

The frequency of microwaves is _____ the frequency of infrared.

The speed of microwaves in a vacuum is _____ the speed of infrared in a vacuum.

4.6.1.2 Properties of waves

Question 77 · continued



**3 (b)** Cosmic Microwave Background Radiation (CMBR) is electromagnetic radiation that fills the universe.

Only one theory about the origin of the universe can explain the presence of CMBR.

**3 (b) (i)** Give the name of this theory.

**[1 mark]**

_____

**3 (b) (ii)** Which other piece of evidence supports this theory?

**[1 mark]**

Tick (✓) **one** box.

| | **Tick (✓)** |
|---|---|
| the diffraction of sound waves | |
| the electromagnetic spectrum | |
| the red-shift of light from distant galaxies | |

6

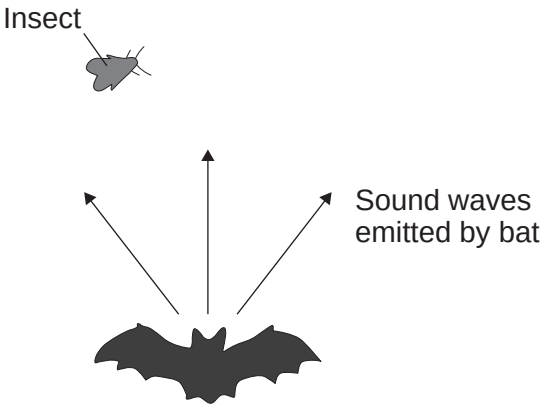
### 4.6.1.2 Properties of waves

**Question 78**

June 2016 | PH1FP | Original Q6 | Legacy

**6** Bats use the reflection of high pitched sound waves to determine the position of objects. **Figure 10** shows a bat and an insect flying in front of the bat.

**Figure 10**




**6 (a)** What determines the pitch of a sound wave?

**[1 mark]**

Tick (✓) **one** box.

| | Tick (✓) |
|---|---|
| amplitude | |
| frequency | |
| speed | |

**6 (b)** State the name given to reflected sound waves.

**[1 mark]**

_____

4.6.1.2 Properties of waves

Question 78 · continued



**6 (c)** The bat emits sound waves with a range of wavelengths.

Some of the sound waves will be diffracted by the insect.

Complete the following sentences to explain why.

**[2 marks]**

Diffraction is caused by the sound waves _____ as they pass the insect.

The most diffraction happens when the wavelength of the sound wave is

_____ the size of the insect.

**6 (d)** The bat emits a sound wave with a frequency of 25.0 kHz and a wavelength of 0.0136 metres.

Calculate the speed of this sound wave.

Use the correct equation from the Physics Equations Sheet.

**[2 marks]**

_____

_____

_____

Speed = _____ m/s

**6 (e)** Sound waves are longitudinal. Describe a longitudinal sound wave.

**[2 marks]**

_____

_____

_____

_____

8

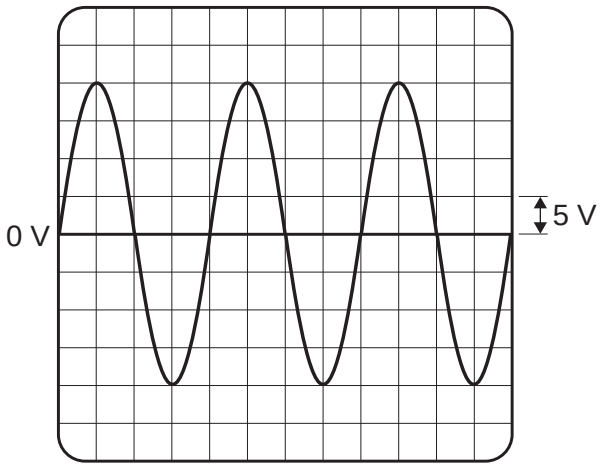
### 4.6.1.2 Properties of waves

**Question 79**

June 2016 | PH2FP | Original Q2 | Legacy

**2 (a)** **Figure 2** shows the oscilloscope trace an alternating current (a.c.) electricity supply produces.

**Figure 2**




One vertical division on the oscilloscope screen represents 5 volts.

Calculate the peak potential difference of the electricity supply.

**[1 mark]**

Peak potential difference = _____ V

**2 (b)** Use the correct answer from the box to complete the sentence.

**[1 mark]**

| | | |
|---|---|---|
| **40** | **50** | **60** |

In the UK, the frequency of the a.c. mains electricity supply is _____ hertz.

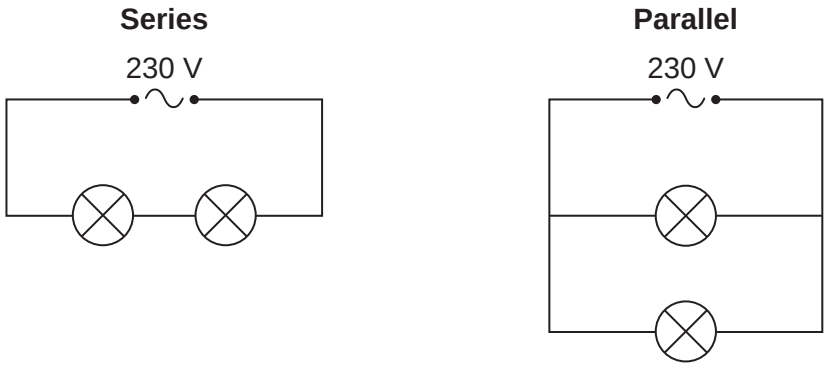
4.6.1.2 Properties of waves

Question 79 · continued



**2 (c)** **Figure 3** shows how two lamps may be connected in series or in parallel to the 230 volt mains electricity supply.

**Figure 3**




**2 (c) (i)** Calculate the potential difference across each lamp when the lamps are connected in **series**.
The lamps are identical.

**[1 mark]**

Potential difference when in series = _____ V

**2 (c) (ii)** What is the potential difference across each lamp when the lamps are connected in **parallel**?

**[1 mark]**

Tick (✓) **one** box.

115 V ☐ 230 V ☐ 460 V ☐

**2 (c) (iii)** Give **one** advantage of connecting the lamps in parallel instead of in series.

**[1 mark]**

**Question 2 continues on the next page**

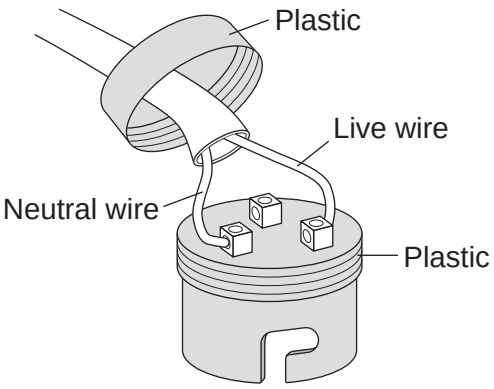
4.6.1.2 Properties of waves

Question 79 · continued



**2 (d)** **Figure 4** shows the light fitting used to connect a filament light bulb to the mains electricity supply.

**Figure 4**




The light fitting does **not** have an earth wire connected.

Explain why the light fitting is safe to use.

**[2 marks]**

**2 (e)** A fuse can be used to protect an electrical circuit.

Name a different device that can also be used to protect an electrical circuit.

**[1 mark]**

8

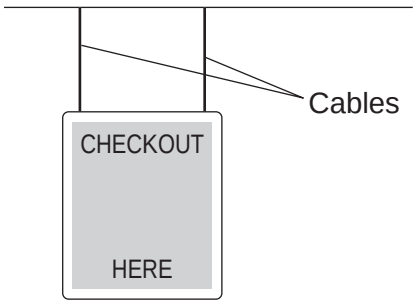
4.6.1.2 Properties of waves

Question 80

June 2016 | PH3FP | Original Q4 | Legacy

**4** A sign hangs from the ceiling using two cables, as shown in **Figure 5**.

**Figure 5**




**4 (a)** On **Figure 5**, mark the centre of mass of the sign using an X.

**[1 mark]**

**4 (b)** Use the correct answer from the box to complete the sentence.

**[1 mark]**

| | | |
|---|---|---|
| **concentrated** | **greatest** | **pivoted** |

The centre of mass of an object is the point where the mass appears

to be _____ .

**4 (c)** A breeze made the sign swing forwards and backwards like a pendulum.
The frequency of oscillations of the sign was 2 hertz.

Calculate the periodic time for the sign.

Use the correct equation from the Physics Equations Sheet.

**[2 marks]**

_____

_____

_____

Periodic time = _____ seconds

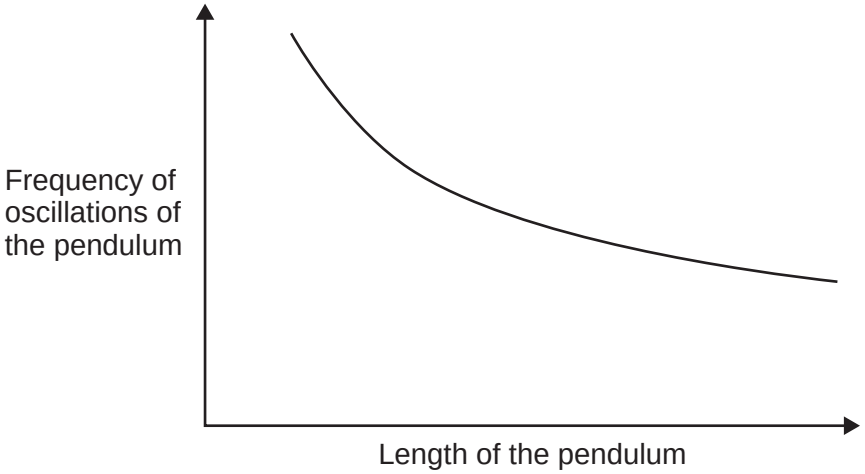
4.6.1.2 Properties of waves

Question 80 · continued



4 (d) **Figure 6** is a sketch graph showing how the frequency of the oscillations of a pendulum changes as the length of the pendulum is increased.

**Figure 6**




Give **one** way the sign could be made to swing with a lower frequency.
Use **only** the information in the sketch graph.

**[1 mark]**

_____

_____

5

4.6.1.2 Properties of waves

Question 81

June 2016 | PH3FP | Original Q5 | Legacy

**5 (a)** Ultrasound is sound above the maximum frequency that humans can hear.

What is the maximum frequency that most humans can hear?

**[1 mark]**

Tick (✓) **one** box.

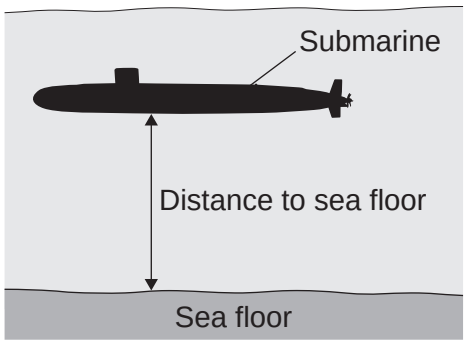
20 Hz ☐

2000 Hz ☐

20 000 Hz ☐

**5 (b)** **Figure 7** shows a submerged submarine.

**Figure 7**




Not to scale

The submarine sends a pulse of ultrasound to the sea floor.
The pulse takes 0.25 seconds to travel from the submarine to the sea floor.

The speed of sound in water is 1600 m/s.

Calculate the distance from the submarine to the sea floor.

Use the correct equation from the Physics Equations Sheet.

**[2 marks]**

Distance = _____ m

4.6.1.2 Properties of waves

Question 81 · continued



**5 (c)** The ultrasound is reflected from the sea floor back to the submarine.
Use the correct answer from the box to complete the sentence.

**[1 mark]**

| half | the same as | twice |
|---|---|---|

The total distance the ultrasound pulse travelled is _____ the distance to the sea floor.

**5 (d)** The submarine moves through the sea and every few seconds sends a pulse of ultrasound to check the distance to the sea floor.

**Table 1** shows the time taken for five ultrasound pulses to travel from the submarine to the sea floor and back to the submarine.

**Table 1**

| Pulse number | Time for pulse to return in seconds |
|---|---|
| 1 | 0.50 |
| 2 | 0.45 |
| 3 | 0.38 |
| 4 | 0.40 |
| 5 | 0.48 |

Describe how the distance from the submarine to the sea floor changed over these five pulses.

**[2 marks]**

_____

_____

_____

_____

6

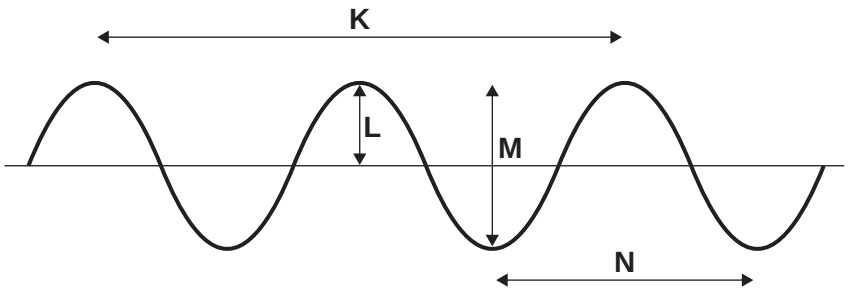
4.6.1.2 Properties of waves

Question 82

June 2017 | PH1FP | Original Q3 | Legacy

**3 (a)** **Figure 4** shows an electromagnetic wave.

**Figure 4**




**3 (a) (i)** Which arrow, **K**, **L**, **M** or **N**, shows the wavelength of the wave?

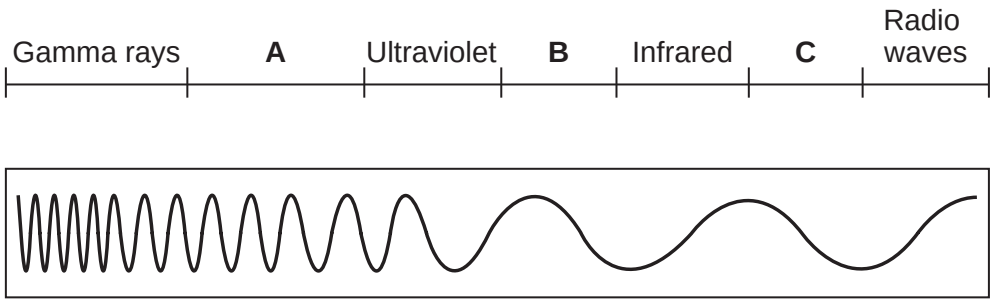
**[1 mark]**

**3 (a) (ii)** Which arrow, **K**, **L**, **M** or **N**, shows the amplitude of the wave?

**[1 mark]**

**3 (b)** **Figure 5** shows the electromagnetic spectrum.

**Figure 5**




A laser emits visible light.

Which letter, **A**, **B** or **C**, on **Figure 5** shows the position of visible light?

**[1 mark]**

4.6.1.2 Properties of waves

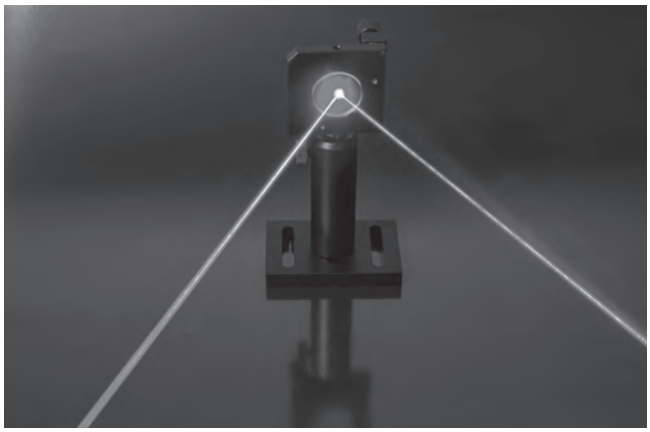
Question 82 · continued



**3 (c)** Laser light is used in some burglar alarms.

**Figure 6** shows laser light being reflected by a mirror. The light then reaches a detector.

**Figure 6**



**3 (c) (i)** How does the size of the angle of incidence compare with the size of the angle of reflection?

**[1 mark]**

_____

_____

**3 (c) (ii)** When a burglar gets in the way of the laser light, the light no longer reaches the detector.

Suggest **one** reason why.

**[1 mark]**

_____

_____

5

4.6.1.2 Properties of waves

Question 83

June 2017 | PH1FP | Original Q6 | Legacy

**6** Starter pistols are used in athletics events to start races. A starter pistol makes a loud bang and produces a puff of smoke.

**Figure 10** shows two people who investigated the speed of sound using a starter pistol and a stopclock.

**Figure 10**

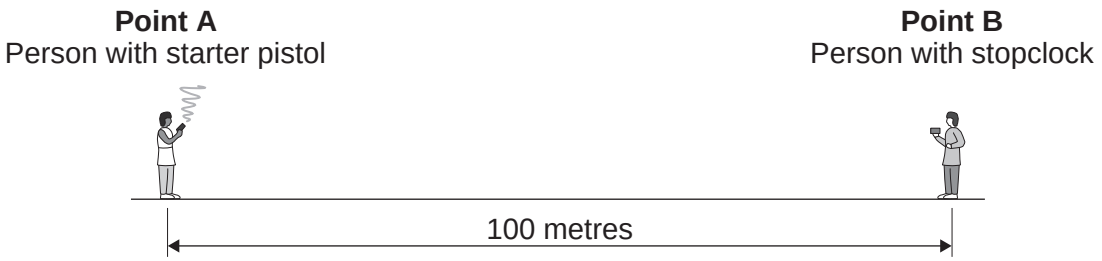



**Figure 10** is not drawn to scale.

**6 (a)** The person at **Point B** sees the puff of smoke before hearing the bang from the starter pistol.

What does this tell you about the speed of sound compared with the speed of light?

**[1 mark]**

**6 (b)** The frequency of the sound wave produced by the pistol was 800 Hz

The wavelength of the sound wave was 0.42 m

Calculate the speed of the sound wave.

Use the correct equation from the Physics Equations Sheet.

Choose the correct unit.

**m/s²** **m/s** **m²/s**

**[3 marks]**

Speed = _____ unit _____

4.6.1.2 Properties of waves

Question 83 · continued



**6 (c)** Complete **Table 1** to show the properties of the sound wave at **Point B** compared with the sound wave at **Point A**.

**[3 marks]**

Tick (✓) **one** box for each property comparison.

**Table 1**

| Properties of the sound wave at Point B compared to Point A | greater than | less than | the same as |
|---|---|---|---|
| amplitude | | | |
| frequency | | | |
| speed | | | |

**6 (d)** A sound wave can be reflected. What name is given to a reflected sound wave?

**[1 mark]**

_____

**6 (e)** Which **two** of these statements are true for sound waves?

**[2 marks]**

Tick (✓) **two** properties.

| | Tick (✓) |
|---|---|
| Sound waves can travel through a vacuum. | |
| Sound waves are transverse waves. | |
| Sound waves are longitudinal waves. | |
| Sound waves transfer energy. | |
| Sound waves are electromagnetic waves. | |

10

4.6.1.2 Properties of waves

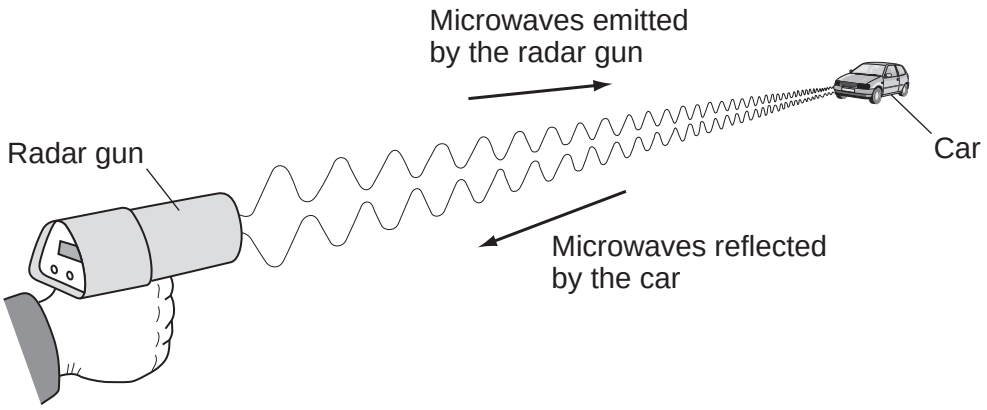
Question 84

June 2017 | PH1FP | Original Q8 | Legacy

**8** A radar gun can be used to measure the speed of a car.

Microwaves are emitted by the radar gun and reflected by the car, as shown in **Figure 13**.

**Figure 13**




**8 (a)** The microwaves reflected by the moving car have a different frequency from the microwaves emitted by the radar gun.

What is the name of the effect causing this change in frequency?

**[1 mark]**

_____

**8 (b)** The data in **Table 3** are measurements taken from three different cars on the same piece of road.

**Table 3**

| Car | Frequency of emitted microwaves in kHz | Frequency of reflected microwaves in kHz |
|---|---|---|
| **A** | 27 000 000 | 27 000 002 |
| **B** | 27 000 000 | 27 000 000 |
| **C** | 27 000 000 | 26 999 997 |

4.6.1.2 Properties of waves

Question 84 · continued



**8 (b) (i)** State which car in **Table 3** is moving towards the radar gun. Give a reason for your answer.

**[2 marks]**

Car _____

Reason _____

_____

**8 (b) (ii)** State which car in **Table 3** is moving the fastest. Give a reason for your answer.

**[2 marks]**

Car _____

Reason _____

_____

5

**Turn over for the next question**

4.6.1.2 Properties of waves

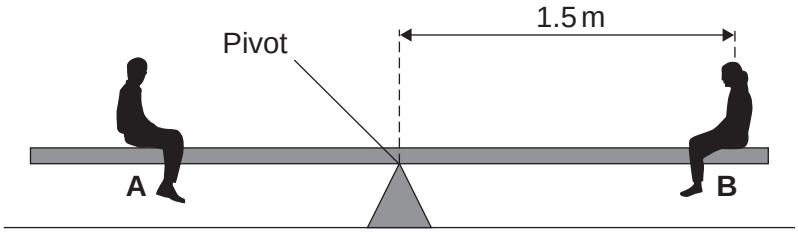
Question 85

June 2017 | PH3FP | Original Q1 | Legacy

**1** Two children visit a playground.

**1 (a)** **Figure 1** shows the two children, **A** and **B**, sitting on a see-saw.

**Figure 1**




**1 (a) (i)** The weight of child **A** and the weight of child **B** each create a moment about the pivot.

What is meant by 'the moment of a force'?

**[1 mark]**

Tick (✓) **one** box.

the direction of the force ☐

the turning effect of the force ☐

the size of the force ☐

**1 (a) (ii)** The see-saw is balanced.

Use the correct answer from the box to complete the sentence.

**[1 mark]**

| **smaller than** | **equal to** | **greater than** |
|---|---|---|

The size of the moment of child **A** is _____ the size of the moment of child **B**.

4.6.1.2 Properties of waves

Question 85 · continued



**1 (a) (iii)** Child **B** has a weight of 400 N and is sitting 1.5 m from the pivot.

Calculate the moment of child **B** about the pivot.

Use the correct equation from the Physics Equations Sheet.

Choose the correct unit.

**[3 marks]**

**kilogram** **newton-metre** **newton per metre**

Moment = _____ unit _____

**Question 1 continues on the next page**

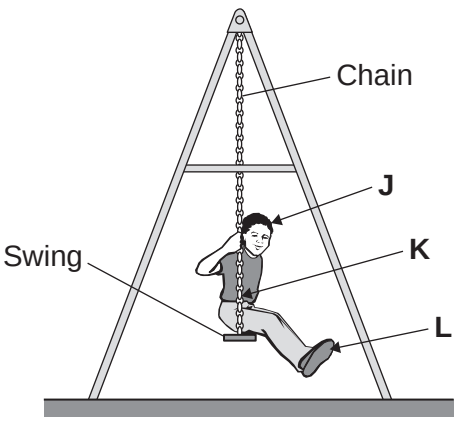
4.6.1.2 Properties of waves

Question 85 · continued



**1 (b)** Child **A** now sits on a swing as shown in **Figure 2**. The swing is not moving.

**Figure 2**




Which arrow, **J**, **K** or **L**, points to the centre of mass of the child?

**[1 mark]**

Tick (✓) **one** box.

**J** ☐

**K** ☐

**L** ☐

**1 (c)** The child on the swing is now moving backwards and forwards like a pendulum. The frequency of the swing is 0.5 hertz.

Calculate the periodic time of the swing.

Use the correct equation from the Physics Equations Sheet.

**[2 marks]**

_____

_____

Periodic time = _____ s

8

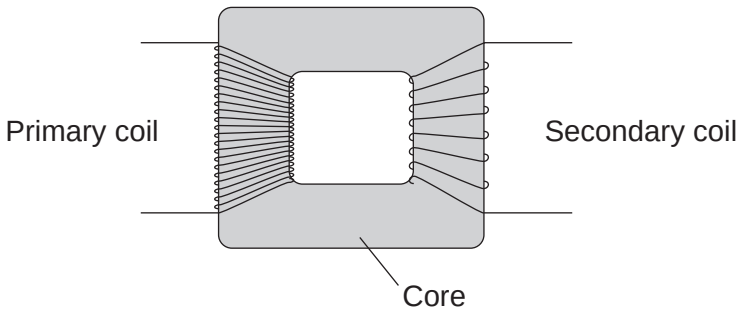
4.6.1.2 Properties of waves

Question 86

June 2017 | PH3FP | Original Q2 | Legacy

**2** **Figure 3** shows a traditional transformer.

**Figure 3**




**2 (a) (i)** Use the correct answer from the box to complete the sentence.

**[1 mark]**

| | | |
|---|---|---|
| **greater than** | **equal to** | **less than** |

The potential difference across the secondary coil is _____

the potential difference across the primary coil.

**2 (a) (ii)** Give a reason for your answer to part **2 (a) (i)**.

**[1 mark]**

_____

_____

**2 (b)** What is the core of the transformer made from?

**[1 mark]**

_____

4.6.1.2 Properties of waves

Question 86 · continued



**2 (c)** What happens as the magnetic field in the core of the transformer changes?

**[1 mark]**

Tick (✓) **one** box.

The mass of the core increases. ☐

A potential difference is induced across the secondary coil. ☐

The temperature of the core decreases. ☐

**2 (d)** The power supply to the transformer is connected to the mains electricity supply.

What is the frequency of the mains electricity supply?

**[1 mark]**

Tick (✓) **one** box.

25 hertz ☐

50 hertz ☐

100 hertz ☐

**2 (e)** The power input of the transformer is 2 W. The transformer is 100% efficient.

State the power output of the transformer.

**[1 mark]**

_____

6

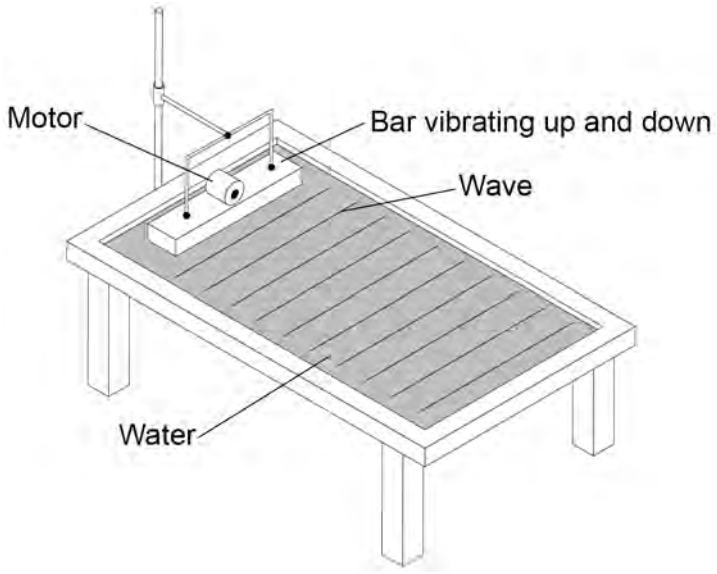
4.6.1.2 Properties of waves

Question 87

June 2018 | 8463/2F | Original Q3

**0 3** **Figure 2** shows a ripple tank that a student used to investigate water waves.

**Figure 2**




**0 3 . 1** The student adjusted the speed of the motor so that the bar hit the water more times each second.

What happened to the frequency of the waves produced?

Tick **one** box.

**[1 mark]**

Decreased ☐

Did not change ☐

Increased ☐

**0 3 . 2** Describe how the frequency of the water waves in the ripple tank can be measured.

**[2 marks]**

4.6.1.2 Properties of waves

Question 87 · continued



**0 3 . 3** The student measured the frequency of the water waves as 5 hertz.

Calculate the period of the water waves.

Use the equation:

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

Choose the unit.

| | | |
|---|---|---|
| **metres** | **metres / second** | **seconds** |

**[3 marks]**

Period = _____ Unit _____

6

4.6.1.2 Properties of waves

Question 88

June 2018 | 8463/2F | Original Q12

**1 2** P-waves and S-waves are two types of seismic wave caused by earthquakes.

**1 2 . 1** Which **one** of the statements about P-waves and S-waves is correct?

Tick **one** box.

**[1 mark]**

P-waves and S-waves are transverse. ☐

P-waves and S-waves are longitudinal. ☐

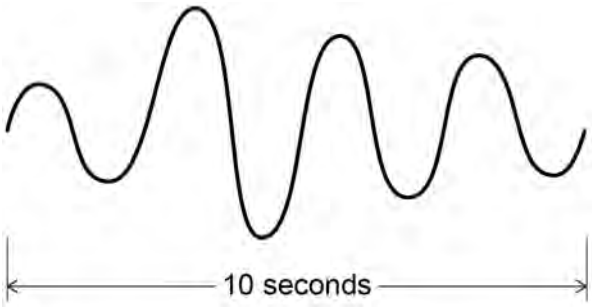
P-waves are transverse and S-waves are longitudinal. ☐

P-waves are longitudinal and S-waves are transverse. ☐

Seismometers on the Earth's surface record the vibrations caused by seismic waves.

**Figure 16** shows the vibration recorded by a seismometer for one P-wave.

**Figure 16**




**1 2 . 2** Calculate the frequency of the P-wave shown in **Figure 16**.

**[1 mark]**

Frequency = _____ Hz

4.6.1.2 Properties of waves

Question 88 · continued

June 2018 | 8463/2F | Original Q12

**12.3** Write down the equation which links frequency, wavelength and wave speed.

**[1 mark]**

**12.4** The P-wave shown in **Figure 16** is travelling at 7200 m/s.

Calculate the wavelength of the P-wave.

**[3 marks]**

Wavelength = _____ m

**12.5** Explain why the study of seismic waves provides evidence for the structure of the Earth's core.

**[2 marks]**

8

4.6.1.2 Properties of waves

Question 89

June 2019 | 8463/2F | Original Q2

**0 2** Most galaxies are moving away from the Earth. Scientists can determine the speed of a galaxy by observing the light from the galaxy.

**0 2 . 1** Complete the sentence.

Choose the answer from the box.

**[1 mark]**

| | | |
|---|---|---|
| **frequency** | **speed** | **wavelength** |

When scientists observe the light from distant galaxies, they observe an increase in the _____ of light from those galaxies.

Question 89 · continued

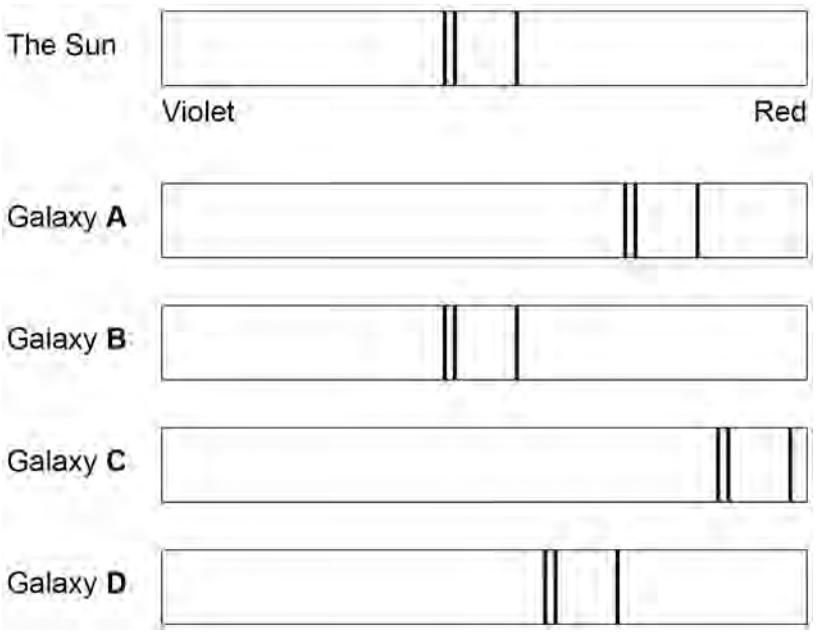


The light spectra from stars and galaxies include dark lines.

The lines have the same pattern.

**Figure 3** shows the light spectrum from the Sun and from four galaxies.

**Figure 3**




**0 2 . 2** Which galaxy is moving the fastest away from the Earth?

**[1 mark]**

Tick (✓) **one** box.

**A** ☐ **B** ☐ **C** ☐ **D** ☐

**0 2 . 3** Which galaxy is the furthest away from the Earth?

**[1 mark]**

Tick (✓) **one** box.

**A** ☐ **B** ☐ **C** ☐ **D** ☐

4.6.1.2 Properties of waves

Question 89 · continued



**0 2 . 4** The Big Bang theory is one way to explain the origin of the universe.

How does the Big Bang theory describe the universe when it began?

**[1 mark]**

Tick (✓) **one** box.

- Very big and very dense ☐
- Very big and extremely hot ☐
- Very dense and extremely hot ☐
- Very small and extremely cold ☐

**0 2 . 5** Which statement about the Big Bang theory is correct?

**[1 mark]**

Tick (✓) **one** box.

- Scientists have proved that the theory is correct. ☐
- Scientific evidence supports the theory. ☐
- There is no other way to explain the origin of the universe. ☐

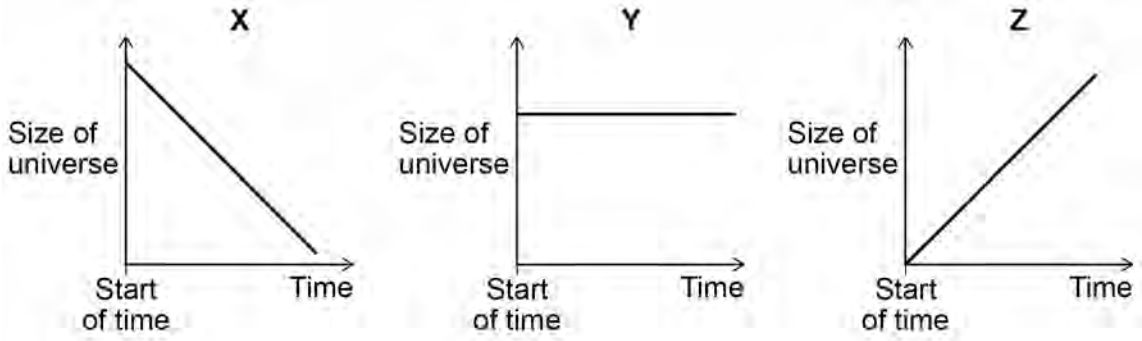
4.6.1.2 Properties of waves

Question 89 · continued



**0 2 . 6** **Figure 4** shows three ways that the size of the universe may have changed with time.

**Figure 4**




Which graph would the Big Bang theory suggest is correct?

**[2 marks]**

Tick (✓) **one** box.

X ☐ Y ☐ Z ☐

Give a reason for your answer.

_____

_____

7

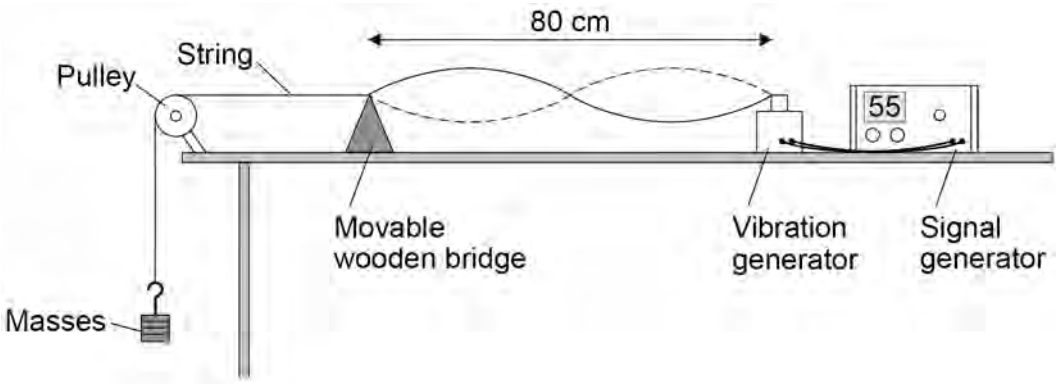
4.6.1.2 Properties of waves

Question 90

June 2019 | 8463/2F | Original Q9

**0 9** **Figure 23** shows the apparatus used to investigate the waves in a stretched string.

**Figure 23**




The frequency of the signal generator is adjusted so that the wave shown in **Figure 23** is seen.

At this frequency the string vibrates between the two positions shown in **Figure 23**.

**0 9 . 1** The wavelength of the wave shown in **Figure 23** was measured as 80 cm

What piece of apparatus would have been suitable for measuring this wavelength?

**[1 mark]**

**0 9 . 2** Write down the equation which links frequency, wavelength and wave speed.

**[1 mark]**

**0 9 . 3** The string in **Figure 23** vibrates at 55 Hz

Calculate the wave speed of the wave shown in **Figure 23**.

Use data given in **Figure 23**.

**[3 marks]**

Wave speed = _____ m/s

4.6.1.2 Properties of waves

Question 90 · continued



**0 9 . 4** The frequency of the signal generator is increased.

This makes the wavelength of the wave change.

The wave speed stays the same.

Describe how the apparatus could be adjusted to show one complete wave without reducing the frequency.

**[2 marks]**

**0 9 . 5** A student wants to investigate how the speed of a wave on a stretched string depends on the tension in the string.

The student uses the apparatus in **Figure 23**.

Describe a method the student could use for this investigation.

**[4 marks]**

11

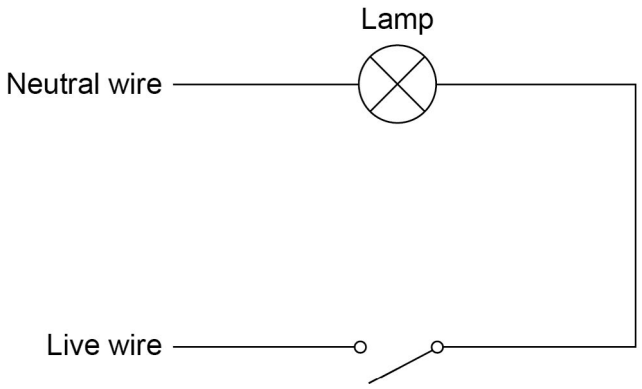
4.6.1.2 Properties of waves

Question 91

November 2020 | 8463/1F | Original Q3

**0 3** **Figure 5** shows part of a lighting circuit in a house.

**Figure 5**




**0 3 . 1** What is the frequency of the ac mains electricity supply in the UK?

**[1 mark]**

Tick (✓) **one** box.

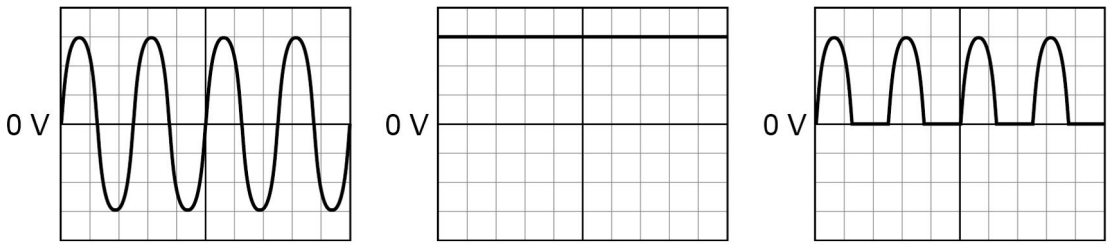
20 Hz ☐ 50 Hz ☐ 60 Hz ☐ 100 Hz ☐

**0 3 . 2** The mains electricity supply has an alternating potential difference.

Which diagram shows an alternating potential difference?

**[1 mark]**

Tick (✓) **one** box.




☐ ☐ ☐

4.6.1.2 Properties of waves

Question 91 · continued



**0 3 . 3** The potential difference across the lamp is 230 V.

The current in the lamp is 0.020 A.

Calculate the power output of the lamp.

Use the equation:

power = potential difference × current

**[2 marks]**

Power = _____ W

**0 3 . 4** The potential difference across the lamp is 230 V.

Calculate the energy transferred by the lamp when 180 C of charge flows through the lamp.

Use the equation:

energy transferred = charge flow × potential difference

**[2 marks]**

Energy transferred = _____ J

**0 3 . 5** An electrician needs to replace the light switch in **Figure 5**.

Describe the possible hazard and the risk to the electrician of changing the light switch.

**[2 marks]**

Hazard _____

Risk _____

8

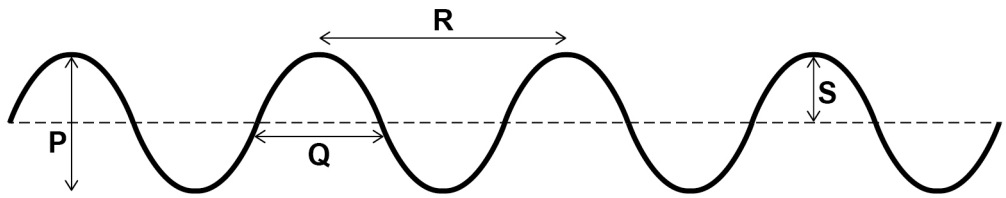
4.6.1.2 Properties of waves

Question 92

November 2020 | 8463/2F | Original Q3

**0 3** **Figure 2** shows some waves.

**Figure 2**




**0 3 . 1** Which arrow represents the wavelength of the waves?

**[1 mark]**

Tick (✓) **one** box.

P ☐

Q ☐

R ☐

S ☐

**0 3 . 2** Which arrow represents the amplitude of the waves?

**[1 mark]**

Tick (✓) **one** box.

P ☐

Q ☐

R ☐

S ☐

4.6.1.2 Properties of waves

Question 92 · continued



**0 3 . 3** The waves have a frequency of 0.20 hertz.

Calculate the period of the waves.

Use the equation:

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

**[2 marks]**

Period = _____ s

**0 3 . 4** The frequency of the waves is increased. The speed of the waves stays the same.

What happens to the wavelength of the waves?

**[1 mark]**

Tick (✓) **one** box.

- The wavelength decreases. ☐
- The wavelength increases. ☐
- The wavelength stays the same. ☐

**Question 3 continues on the next page**

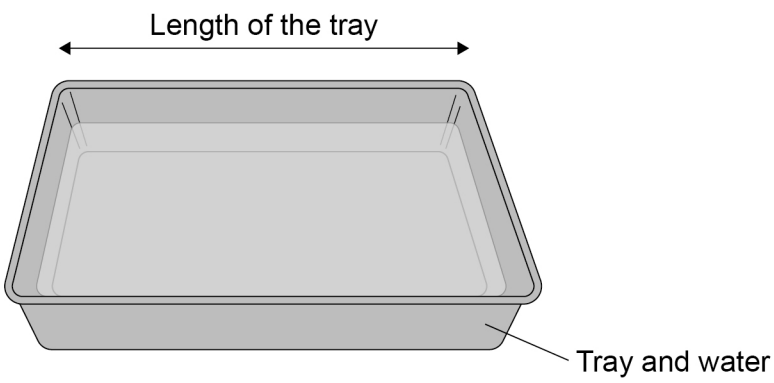
Question 92 · continued



A student investigated how the speed of water waves is affected by the depth of water in a tray.

**Figure 3** shows some water in a rectangular tray.

**Figure 3**




The student lifted one end of the tray and then dropped it.

This made a wave which travelled the length of the tray.

**0 3 . 5** The student measured the length of the tray.

What else should the student measure in order to calculate the speed of the wave?

**[1 mark]**

Tick (✓) **one** box.

- Area of the bottom of the tray ☐
- Depth of water in the tray ☐
- Temperature of the water in the tray ☐
- Time taken by the wave to travel the length of the tray ☐

4.6.1.2 Properties of waves

Question 92 · continued



**0 3 . 6** What was the independent variable in this investigation?

**[1 mark]**

Depth of water ☐

Length of tray ☐

Speed of waves ☐

**Question 3 continues on the next page**

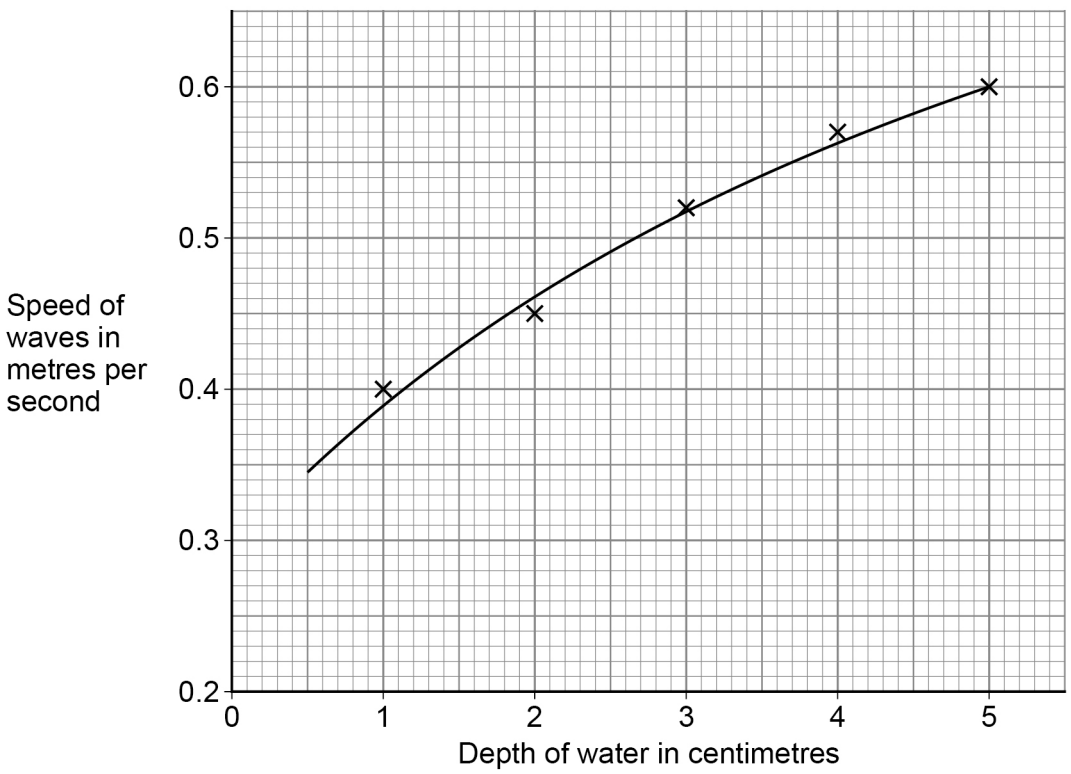
4.6.1.2 Properties of waves

Question 92 · continued



**Figure 4** shows the results.

**Figure 4**




**0 3 . 7** Give **one** conclusion that can be made from **Figure 4**.

**[1 mark]**

**0 3 . 8** What was the speed of a wave when the depth of water was 2.5 cm?

**[1 mark]**

Speed of wave = _____ m/s

9

4.6.1.2 Properties of waves

Question 93

November 2020 | 8463/2F | Original Q9

**0 9 . 1** Complete the sentences.

**[2 marks]**

The Sun is a stable star. This is because the forces pulling inwards caused by _____ are in equilibrium with the forces pushing outwards caused by the energy released by nuclear _____.

**0 9 . 2** Write down the equation that links distance travelled ($s$), speed ($v$) and time ($t$).

**[1 mark]**

_____

**0 9 . 3** The mean distance between the Sun and the Earth is $1.5 \times 10^{11}$ m.

Light travels at a speed of $3.0 \times 10^{8}$ m/s.

Calculate the time taken for light from the Sun to reach the Earth.

**[3 marks]**

_____

_____

_____

_____

_____

Time = _____ s

**Question 9 continues on the next page**

4.6.1.2 Properties of waves

Question 93 · continued



**0 9 . 4** Some stars are much more massive than the Sun.

Describe the life cycle of stars much more massive than the Sun, including the formation of new elements.

**[6 marks]**

4.6.1.2 Properties of waves

Question 93 · continued

November 2020 | 8463/2F | Original Q9

**0 9 . 5** Stars emit radiation with a range of wavelengths.

Which property of a star does the range of wavelengths depend on?

**[1 mark]**

Tick (✓) **one** box.

- Density ☐
- Mass ☐
- Temperature ☐
- Volume ☐

13

4.6.1.2 Properties of waves

Question 94

November 2021 | 8463/2F | Original Q1

**0 1** **Figure 1** shows a water wave.

**Figure 1**




**0 1 . 1** What type of wave is a water wave?

**[1 mark]**

Tick (✓) **one** box.

Electromagnetic ☐

Longitudinal ☐

Transverse ☐

**0 1 . 2** Which statement describes the movement of the water at point **X**?

**[1 mark]**

Tick (✓) **one** box.

The water at point **X** does **not** move. ☐

The water at point **X** moves to the left and right. ☐

The water at point **X** moves up and down. ☐

4.6.1.2 Properties of waves

Question 94 · continued



**0 1 . 3** The wave has a frequency of 2.0 hertz.

The wavelength is 0.032 metres.

Calculate the wave speed.

Use the equation:

wave speed = frequency × wavelength

Choose the unit from the box.

**[3 marks]**

| | | |
|---|---|---|
| **$m^2/s$** | **m/s** | **$s^2$** |

Wave speed = _____ Unit _____

**0 1 . 4** What is transferred by all waves?

**[1 mark]**

Tick (✓) **one** box.

- Energy ☐
- Information ☐
- Water ☐

**Question 1 continues on the next page**

4.6.1.2 Properties of waves

Question 94 · continued

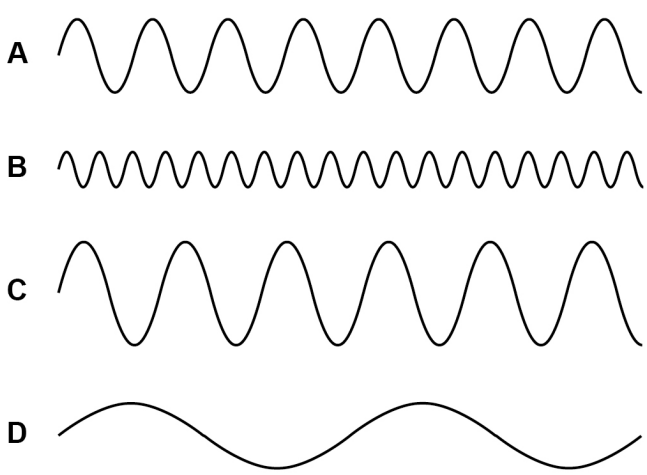


**Figure 2** shows four water waves.

The waves are all drawn to the same scale.

The waves all travel at the same speed.

**Figure 2**




**0 1 . 5** Which wave has the longest wavelength?

**[1 mark]**

Tick (✓) **one** box.

A ☐ B ☐ C ☐ D ☐

**0 1 . 6** Which wave has the highest frequency?

**[1 mark]**

Tick (✓) **one** box.

A ☐ B ☐ C ☐ D ☐

8

4.6.1.2 Properties of waves

Question 95

June 2022 | 8463/2F | Original Q5

**0 5** Ultraviolet and visible light are both parts of the electromagnetic spectrum.

**0 5 . 1** How does the speed of ultraviolet in a vacuum compare to the speed of visible light in a vacuum?

**[1 mark]**

Tick (✓) **one** box.

Ultraviolet travels at a faster speed than visible light. ☐

Ultraviolet travels at a slower speed than visible light. ☐

Ultraviolet travels at the same speed as visible light. ☐

**0 5 . 2** **Figure 9** shows parts of the electromagnetic spectrum.

**Figure 9**

| Radio waves | A | B | C | D | X-rays | Gamma rays |
|---|---|---|---|---|---|---|

Which letters represent the positions of ultraviolet and visible light in the electromagnetic spectrum?

**[2 marks]**

Ultraviolet _____

Visible light _____

4.6.1.2 Properties of waves

Question 95 · continued



**0 5 . 3** **Table 3** shows the range of wavelengths for different types of ultraviolet.

**Table 3**

| Type | Range of wavelength in nanometres |
|---|---|
| Ultraviolet **A** (UVA) | 315–400 |
| Ultraviolet **B** (UVB) | 280–315 |
| Ultraviolet **C** (UVC) | 100–280 |

Determine which type of ultraviolet shown in **Table 3** has the largest range of wavelengths.

To gain full marks you must calculate the range of wavelengths for each type of ultraviolet.

**[3 marks]**

Type of ultraviolet with the largest range of wavelengths _____

**Question 5 continues on the next page**

4.6.1.2 Properties of waves

Question 95 · continued



**Figure 10** shows how different types of ultraviolet are absorbed by the ozone layer in the Earth's atmosphere.

**Table 4** shows the relative ionising power from each type of ultraviolet.

**Figure 10**

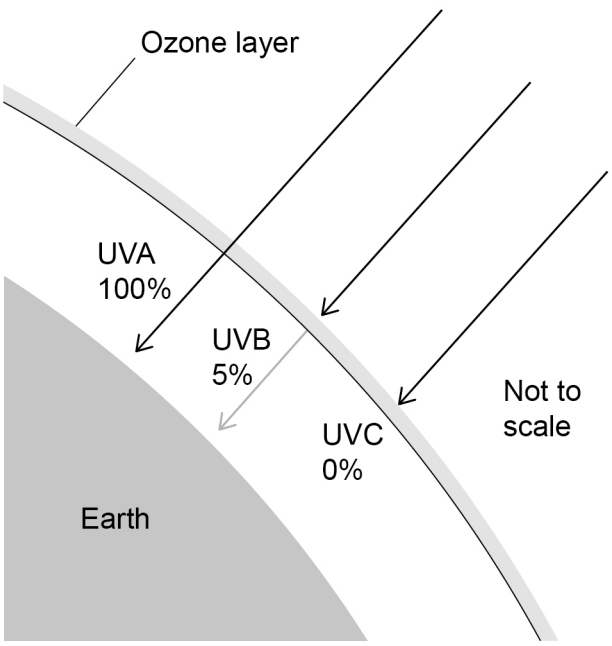



**Table 4**

| Type | Relative ionising power |
|---|---|
| UVA | Low |
| UVB | Medium |
| UVC | High |

**0 5 . 4** Explain the importance of the ozone layer in reducing the risk to people from all types of ultraviolet.

Use **Figure 10** and **Table 4**.

**[4 marks]**

Question 95 · continued



**0 5 . 5** The Sun emits visible light.

A student concludes that visible light is **not** absorbed by the ozone layer.

Give **one** piece of evidence that shows the student's conclusion is correct.

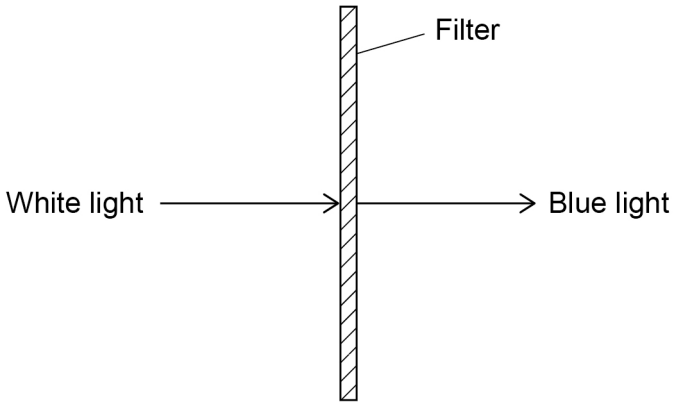
**[1 mark]**

_____

_____

**0 5 . 6** **Figure 11** shows white light incident on a colour filter.

**Figure 11**




Complete the sentence.

Choose the answers from the box.

**[2 marks]**

| | | | | |
|---|---|---|---|---|
| **absorbed** | **radiated** | **reflected** | **refracted** | **transmitted** |

When white light is incident on the filter, only blue light is _____

and all other colours of light are _____ .

13

4.6.1.2 Properties of waves

Question 96

June 2022 | 8463/2F | Original Q7

**0 7** Sound travels as longitudinal waves.

**0 7 . 1** Complete the sentences.

Choose the answers from the box.

**[2 marks]**

| amplitude | frequency | speed | wavelength |
|---|---|---|---|

The distance between the centre of one compression of a sound wave and the centre of the next compression is called the _____ .

The number of waves passing a point each second is called the _____ .

**0 7 . 2** Complete the sentence.

Choose the answer from the box.

**[1 mark]**

| opposite | perpendicular | parallel |
|---|---|---|

In a longitudinal wave, the oscillations are _____ to the direction of energy transfer.

**Question 7 continues on the next page**

4.6.1.2 Properties of waves

Question 96 · continued



**0 7 . 3** A sound wave has a frequency of 8.0 kHz.

Which of the following is the same as 8.0 kHz?

**[1 mark]**

Tick (✓) **one** box.

0.0080 Hz ☐

8.0 Hz ☐

8000 Hz ☐

800 000 Hz ☐

**0 7 . 4** Calculate the period of a sound wave with a frequency of 8.0 kHz.

Use the Physics Equations Sheet.

**[2 marks]**

Period = _____ s

4.6.1.2 Properties of waves

Question 96 · continued



**0 7 . 5** Calculate the wavelength of a sound wave with a frequency of 6600 Hz.

speed of sound = 330 m/s

Use the equation:

$$\text{wavelength} = \frac{\text{speed}}{\text{frequency}}$$

Choose the unit from the box.

**[3 marks]**

| kg | m | N |
|---|---|---|

Wavelength = _____ Unit _____

**Question 7 continues on the next page**

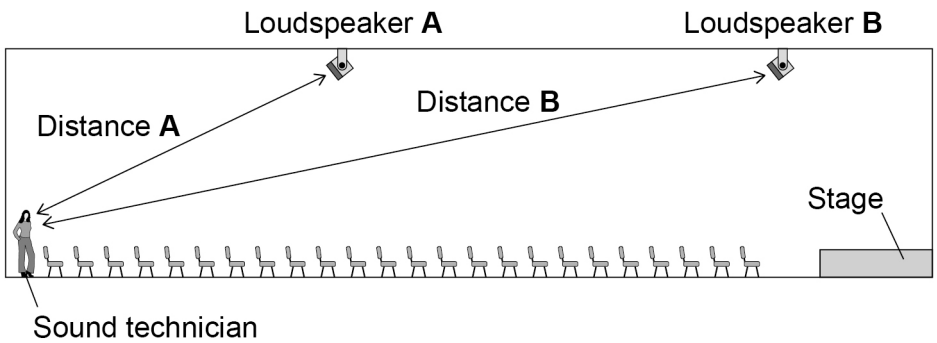
4.6.1.2 Properties of waves

Question 96 · continued



**Figure 14** shows the arrangement of two loudspeakers at a concert venue.

**Figure 14**




The loudspeakers in **Figure 14** are tested by playing the same song through both loudspeakers.

A sound technician listens to the song.

Use the Physics Equations Sheet to answer questions **07.6** and **07.7**.

**0 7 . 6** Write down the equation which links distance (*s*), speed (*v*) and time (*t*).

**[1 mark]**

**0 7 . 7** Distance **A** on **Figure 14** is 13.2 m.

speed of sound = 330 m/s

Calculate the time taken for the sound to travel from loudspeaker **A** to the technician.

**[3 marks]**

Time taken = _____ s

4.6.1.2 Properties of waves

Question 96 · continued



**0 7 . 8** The sound from each loudspeaker travels at the same speed.

For the sound technician to hear the song clearly, the sound from loudspeaker **B** should be emitted slightly before the sound from loudspeaker **A**.

Explain why.

**[3 marks]**

16

**Turn over for the next question**

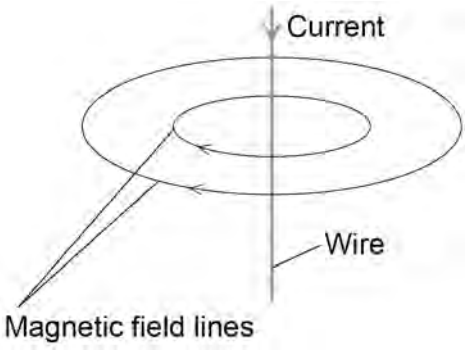
4.6.1.2 Properties of waves

Question 97

June 2023 | 8463/2F | Original Q3

**0 3** **Figure 5** shows the magnetic field pattern produced when there is a current in a wire.

**Figure 5**




**0 3 . 1** What do the arrows on the magnetic field lines represent?

**[1 mark]**

**0 3 . 2** How could the strength of the magnetic field be increased?

**[1 mark]**

Tick (✓) **one** box.

Change the direction of the current in the wire ☐

Increase the current in the wire ☐

Increase the temperature of the wire ☐

4.6.1.2 Properties of waves

Question 97 · continued

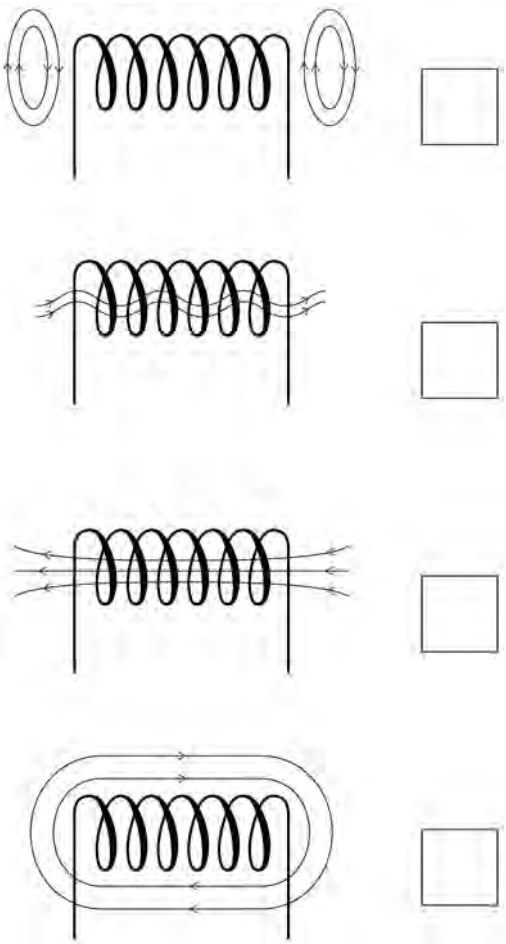


**0 3 . 3** The wire is coiled to make a solenoid.

Which diagram in **Figure 6** shows the magnetic field pattern produced when there is a current in the solenoid?

**[1 mark]**

**Figure 6**



**Question 3 continues on the next page**

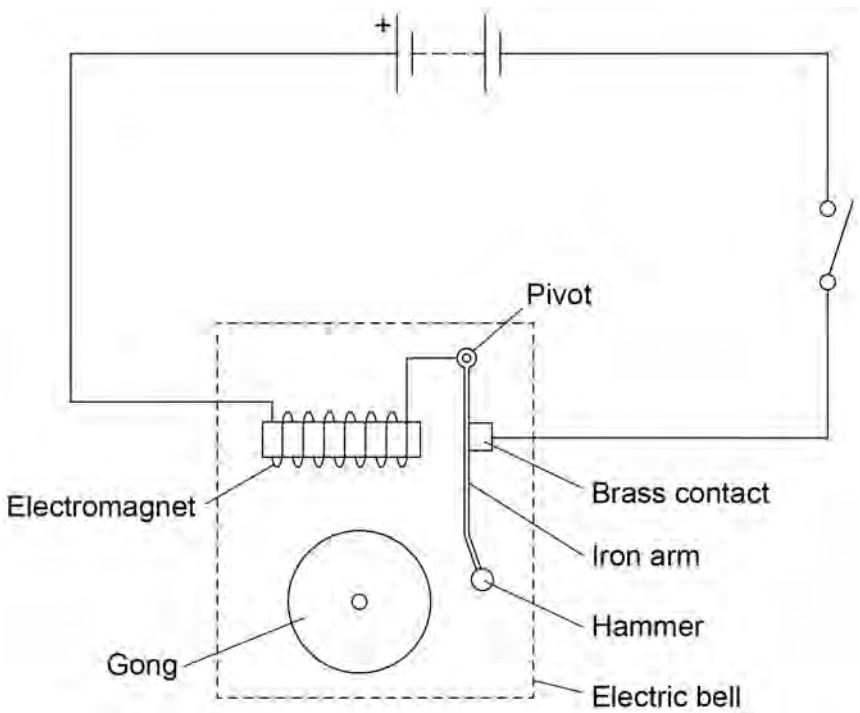
4.6.1.2 Properties of waves

Question 97 · continued



**Figure 7** shows the parts of an electric bell.

**Figure 7**

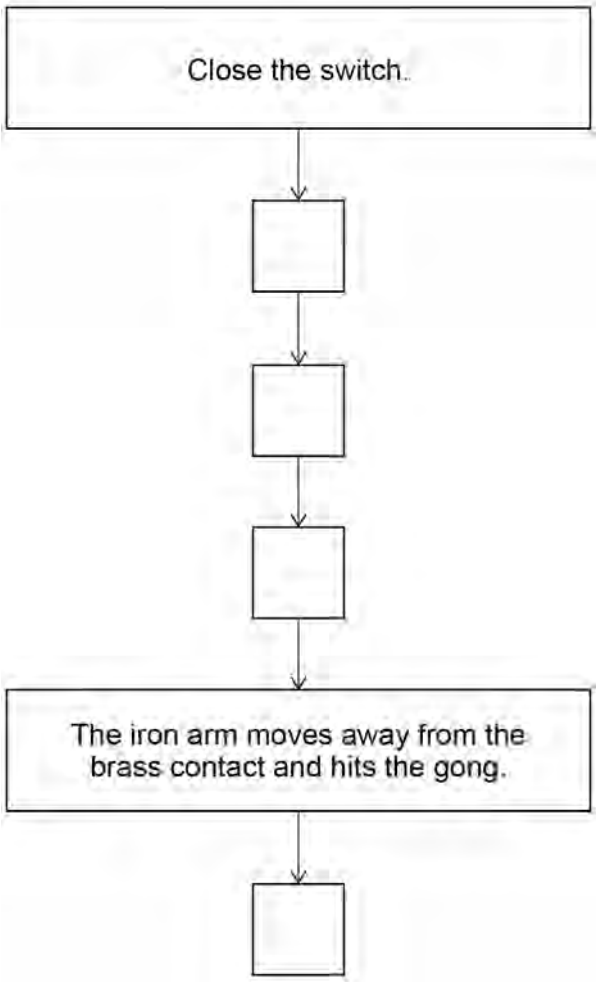


Question 97 · continued



**0 3 . 4** **Figure 8** shows an incomplete sequence of how the bell works.

**Figure 8**




Write **one** letter in each box to show the correct sequence.

Use each letter once.

**[2 marks]**

**A** A magnetic field is created around the electromagnet.

**B** A resultant force acts on the iron arm causing it to move towards the electromagnet.

**C** The iron arm returns to its original position.

**D** There is a current in the circuit.

4.6.1.2 Properties of waves

Question 97 · continued



**0 3 . 5** Which of the following would increase the resultant force on the iron arm?

**[1 mark]**

Tick (✓) **one** box.

Decrease the distance between the electromagnet and the iron arm ☐

Decrease the number of cells in the circuit ☐

Decrease the number of turns on the electromagnet ☐

**0 3 . 6** The iron arm of the bell vibrates with a frequency of 6.25 Hz.

Calculate the period of the iron arm.

Use the equation:

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

**[2 marks]**

Period = _____ s

4.6.1.2 Properties of waves

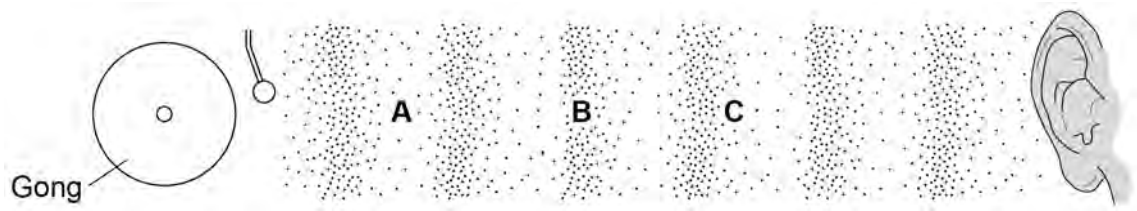
Question 97 · continued



**0 3 . 7** The sound waves produced by the bell are longitudinal waves.

**Figure 9** shows the position of the air particles at one point in time as the sound waves travel through the air.

**Figure 9**




Which letter represents an area of compression?

**[1 mark]**

Tick (✓) **one** box.

**A** ☐ **B** ☐ **C** ☐

9

**Turn over for the next question**

4.6.1.2 Properties of waves

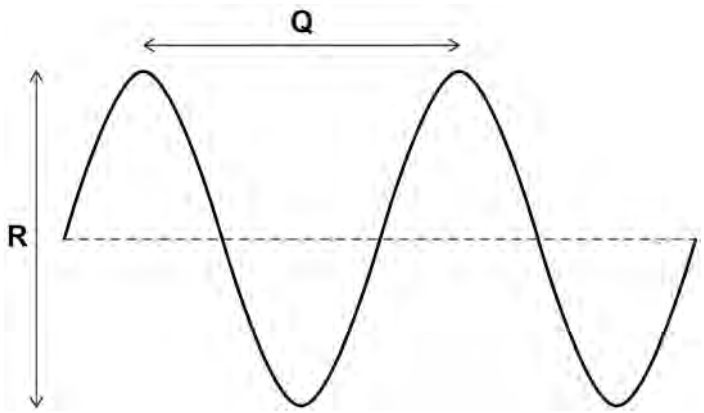
Question 98



**0 5** Electromagnetic waves are transverse.

**Figure 13** represents a transverse wave.

**Figure 13**




**0 5 . 1** Which of the following gives the wavelength of the transverse wave?

**[1 mark]**

Tick (✓) **one** box.

wavelength = $\frac{Q}{2}$ ☐

wavelength = Q ☐

wavelength = 2 Q ☐

**0 5 . 2** Which of the following gives the amplitude of the transverse wave?

**[1 mark]**

Tick (✓) **one** box.

amplitude = $\frac{R}{2}$ ☐

amplitude = R ☐

amplitude = 2 R ☐

4.6.1.2 Properties of waves

Question 98 · continued



**0 5 . 3** Microwaves are electromagnetic waves used for mobile phone communications.

Which other type of electromagnetic wave is also used for communications?

**[1 mark]**

Tick (✓) **one** box.

Radio waves ☐

Ultraviolet ☐

X-rays ☐

**0 5 . 4** Microwaves from a mobile phone take 0.000 009 s to reach a mobile phone mast.

speed of microwaves = 300 000 000 m/s

Calculate the distance between the mobile phone and the mobile phone mast.

Use the equation:

distance = speed × time

**[2 marks]**

Distance = _____ m

**0 5 . 5** Mobile phone communications is only one of the uses for microwaves.

Give **one** other use of microwaves.

**[1 mark]**

6

4.6.1.2 Properties of waves

Question 99

June 2023 | 8463/2F | Original Q6

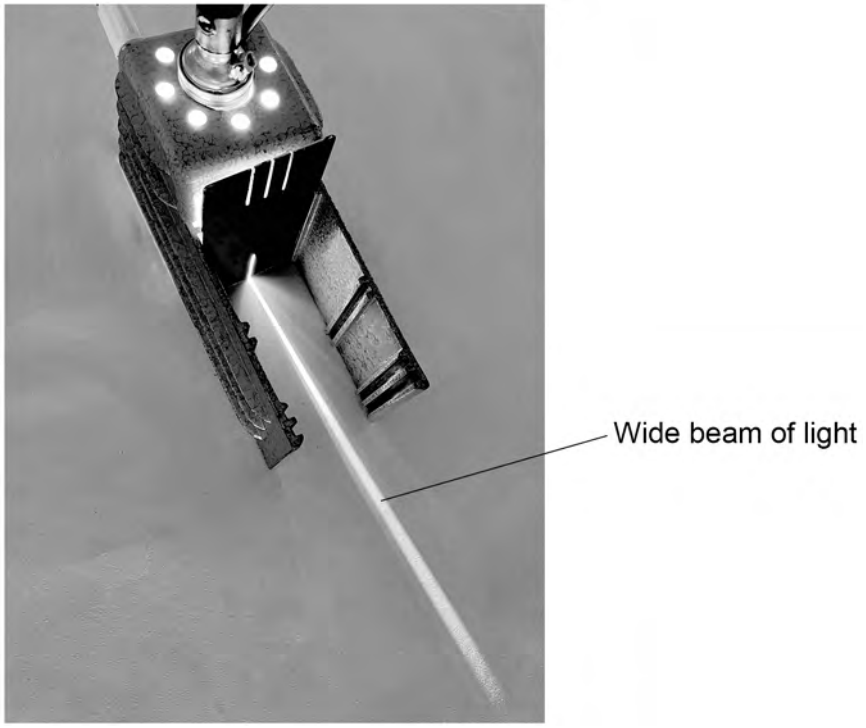
**0 6** A student investigated the refraction of light through a glass block.

**Figure 14** shows the ray box used.

The student aimed the beam of light from the ray box towards a glass block.

The student measured the angle of incidence at the point where the light entered the glass block.

**Figure 14**




**0 6 . 1** Why is using a wide beam of light less likely to give accurate results than using a narrow beam?

**[1 mark]**

Tick (✓) **one** box.

- It will be harder to judge where the centre of the beam is. ☐
- It will cause a smaller uncertainty in the measurements. ☐
- The angle of refraction will be larger than it should be. ☐

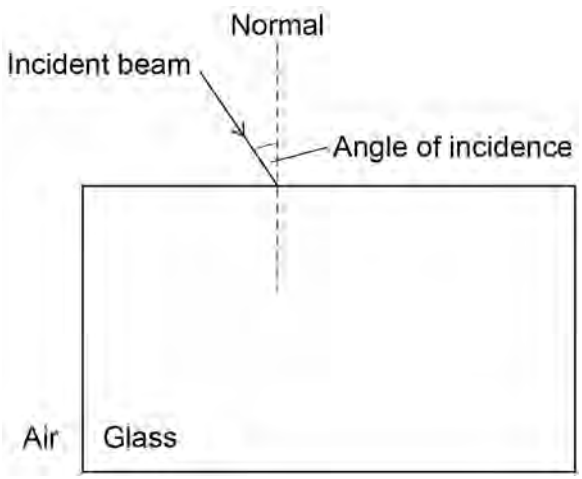
4.6.1.2 Properties of waves

Question 99 · continued



**0 6 . 2** **Figure 15** shows the beam of light incident on the glass block.

**Figure 15**




Complete **Figure 15** to show the path taken by the beam of light through the glass block and back into the air.

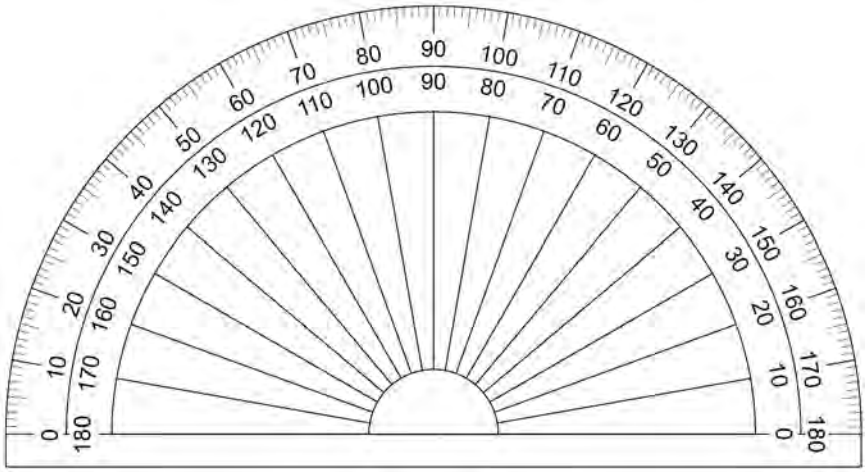
**[3 marks]**

Question 99 · continued



**Figure 16** shows the protractor used by the student.

**Figure 16**



**0 6 . 3** What is the resolution of the protractor?

**[1 mark]**

Tick (✓) **one** box.

1 degree ☐

10 degrees ☐

180 degrees ☐

**0 6 . 4** For one angle of incidence the student measured the angle of refraction three times.

The three measurements were:

35° 31° 33°

Calculate the mean angle of refraction.

**[1 mark]**

Mean angle of refraction = _____ °

4.6.1.2 Properties of waves

Question 99 · continued



The student placed a red filter in front of the white beam of light.

Only red light passes through the filter.

**0 6 . 5** Complete the sentence.

**[1 mark]**

When white light is incident on the red filter, all colours except for red are

_____ by the filter.

Use the Physics Equations Sheet to answer questions **06.6** and **06.7**.

**0 6 . 6** Write down the equation which links frequency ($f$), wave speed ($v$) and wavelength ($\lambda$).

**[1 mark]**

_____

**0 6 . 7** Light has a wave speed of $3.0 \times 10^8$ m/s in air.

The frequency of the red light is $4.0 \times 10^{14}$ Hz.

Calculate the wavelength of the red light in air.

**[3 marks]**

_____

_____

_____

_____

_____

Wavelength = _____ m

11

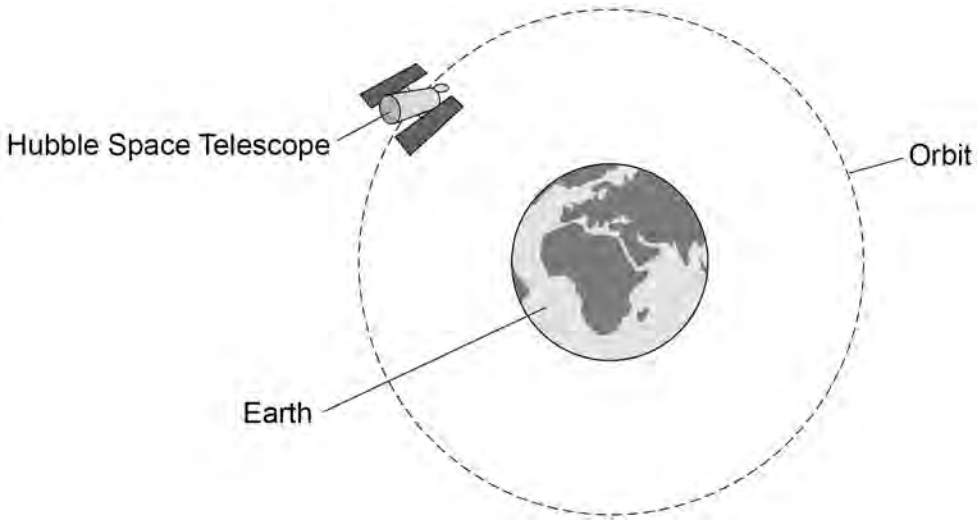
4.6.1.2 Properties of waves

Question 100

June 2023 | 8463/2F | Original Q7

**0 7** **Figure 17** shows the Hubble Space Telescope orbiting the Earth.

**Figure 17**




**0 7 . 1** What name is given to an object that orbits a planet?

**[1 mark]**

Tick (✓) **one** box.

A comet ☐

A satellite ☐

A star ☐

**0 7 . 2** The Earth exerts a gravitational force on the Hubble Space Telescope.

Draw an arrow on **Figure 17** to show the gravitational force.

**[1 mark]**

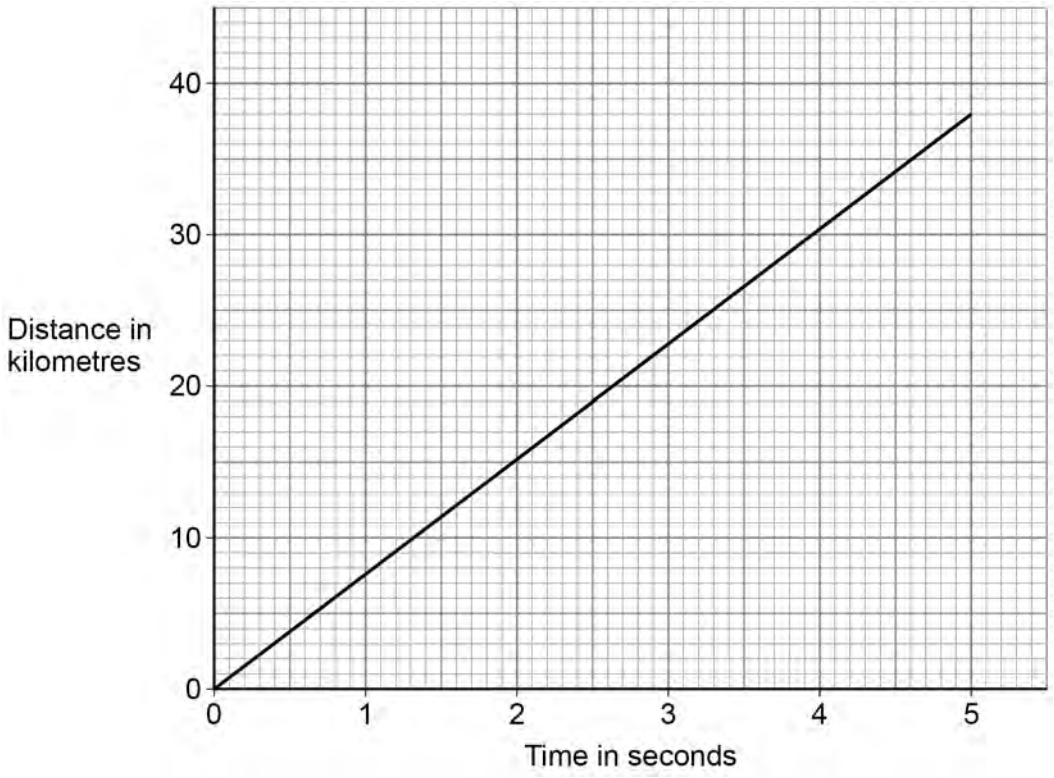
4.6.1.2 Properties of waves

Question 100 · continued



**0 7 . 3** **Figure 18** shows how the distance travelled by the Hubble Space Telescope during its orbit changes with time.

**Figure 18**




The gradient of the line in **Figure 18** gives the speed of the Hubble Space Telescope.

Determine the speed of the Hubble Space Telescope.

Give your answer in km/s.

**[3 marks]**

Speed = _____ km/s

**Question 100 · continued**

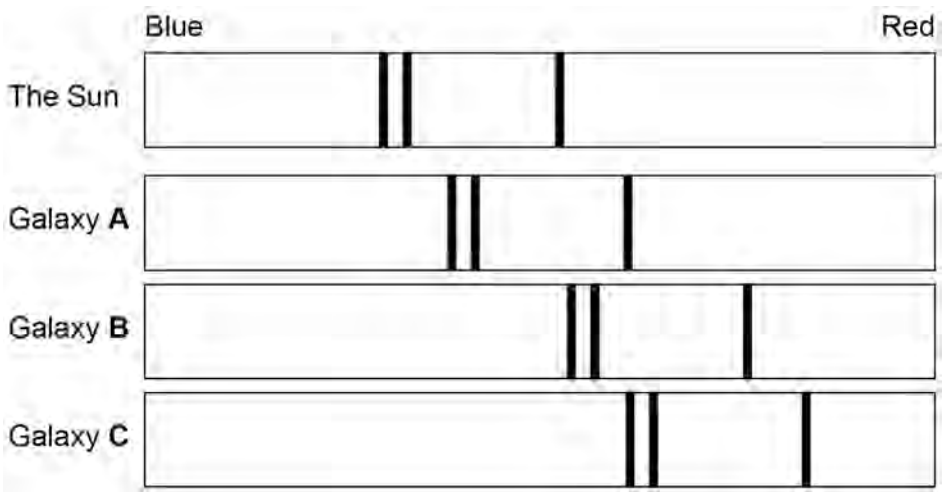


The Hubble Space Telescope can detect the visible light spectra from distant galaxies.

The visible light spectra from stars and galaxies include dark lines at specific wavelengths.

**Figure 19** shows the visible light spectra from the Sun and three galaxies.

**Figure 19**




**0 7 . 4** Which galaxy is moving away from the Earth the fastest?

**[1 mark]**

Tick (✓) **one** box.

Galaxy **A** ☐

Galaxy **B** ☐

Galaxy **C** ☐

4.6.1.2 Properties of waves

Question 100 · continued

June 2023 | 8463/2F | Original Q7

**0 7 . 5** Which galaxy is the furthest away from the Earth?

**[1 mark]**

Tick (✓) **one** box.

Galaxy **A** ☐

Galaxy **B** ☐

Galaxy **C** ☐

**0 7 . 6** New scientific observations indicate that many galaxies rotate too quickly for the known mass of the stars they contain.

Why is it important that new scientific observations are peer reviewed?

**[1 mark]**

Tick (✓) **one** box.

To check the observations are correct ☐

To identify control variables ☐

To provide more proof ☐

8

4.6.1.2 Properties of waves

Question 101

June 2024 | 8463/1F | Original Q2

**0 2** **Figure 4** shows a student putting a coin into a vending machine that sells food.

**Figure 4**




The vending machine is connected to the mains electricity supply.

**0 2 . 1** What is the frequency of the mains electricity supply in the UK?

**[1 mark]**

Tick (✓) **one** box.

50 hertz ☐

60 hertz ☐

100 hertz ☐

4.6.1.2 Properties of waves

Question 101 · continued



**0 2 . 2** What is the potential difference of the mains electricity supply in the UK?

**[1 mark]**

Tick (✓) **one** box.

12 volts ☐

230 volts ☐

20 000 volts ☐

The vending machine identifies the value of the coin by measuring the resistance of the coin.

**0 2 . 3** The machine applies a potential difference of 0.45 V across the coin.

The current in the coin is 0.75 A.

Calculate the resistance of the coin.

Use the equation:

$$\text{resistance} = \frac{\text{potential difference}}{\text{current}}$$

**[2 marks]**

Resistance = _____ Ω

4.6.1.2 Properties of waves

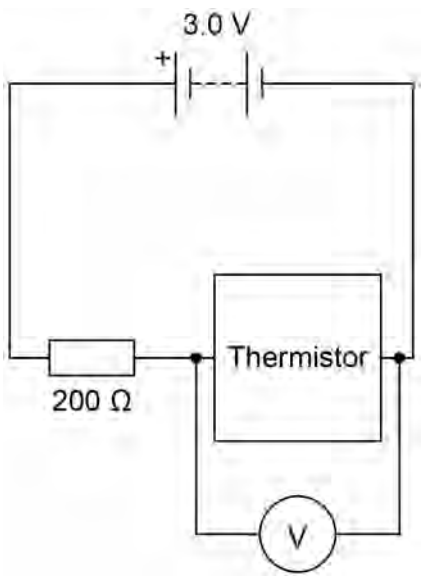
Question 101 · continued



The temperature inside the vending machine is monitored using an electrical circuit.

**Figure 5** shows part of the circuit.

**Figure 5**

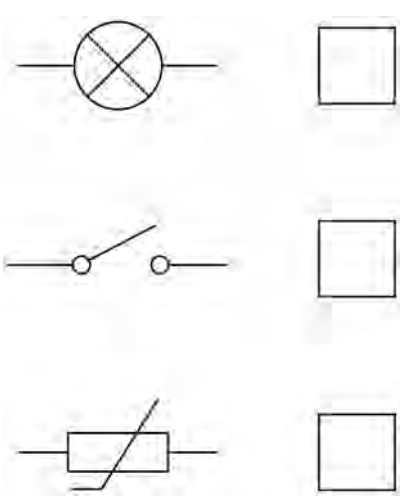



**0 2 . 4** The circuit symbol for the thermistor is wrong.

What is the circuit symbol for a thermistor?

**[1 mark]**

Tick (✓) **one** box.



Question 101 · continued



**0 2 . 5** How could the potential difference (pd) across the resistor be calculated?

**[1 mark]**

Tick (✓) **one** box.

pd across battery – pd across thermistor ☐

pd across battery + pd across thermistor ☐

pd across battery × pd across thermistor ☐

pd across battery ÷ pd across thermistor ☐

**0 2 . 6** At one temperature, the thermistor in **Figure 5** has a resistance of 200 Ω.

What is the potential difference across the thermistor at this temperature?

Give a reason for your answer.

**[2 marks]**

Tick (✓) **one** box.

0.0 V ☐

1.0 V ☐

1.5 V ☐

2.0 V ☐

Reason _____

_____

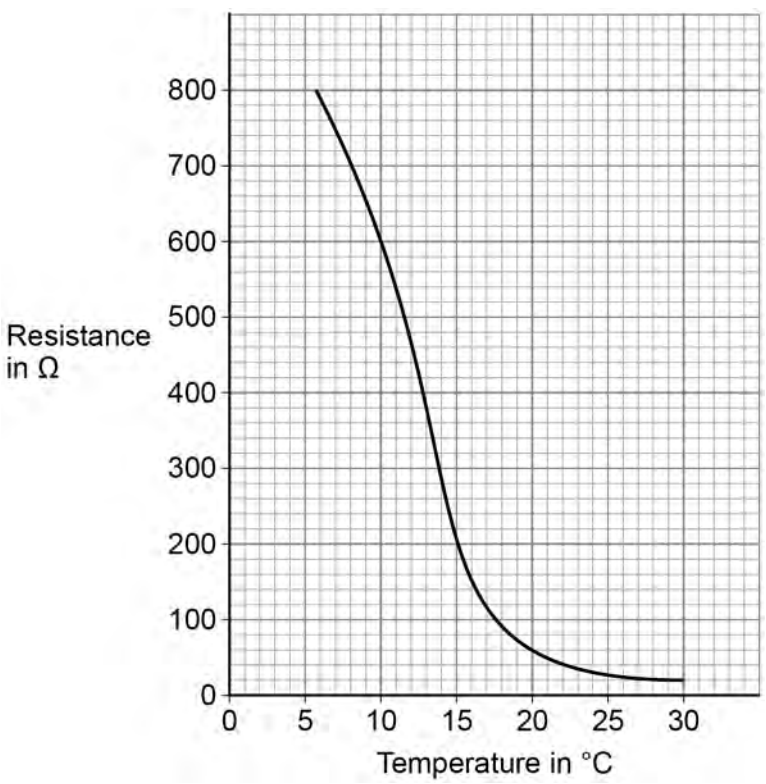
4.6.1.2 Properties of waves

Question 101 · continued



**Figure 6** shows how the resistance of the thermistor varies with temperature.

**Figure 6**




**0 2 . 7** When the temperature of the thermistor is 10 °C, the resistance of the thermistor is 600 Ω.

Calculate the change in resistance when the temperature increased from 10 °C to 15 °C.

**[2 marks]**

Change in resistance = _____ Ω

**10**

4.6.1.2 Properties of waves

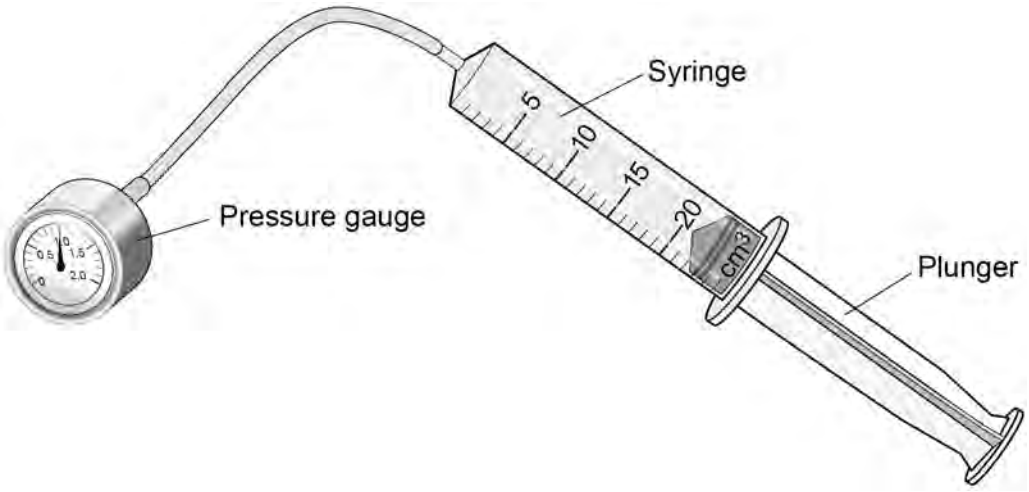
Question 102



**0 5** A student investigated how the pressure in a fixed mass of air varies with the volume of the air.

**Figure 10** shows the equipment used.

**Figure 10**




When the plunger was pushed slowly into the syringe, the temperature of the air stayed the same.

**0 5 . 1** How did pushing the plunger in affect the volume of air in the syringe?

**[1 mark]**

Tick (✓) **one** box.

The volume decreased. ☐

The volume stayed the same. ☐

The volume increased. ☐

4.6.1.2 Properties of waves

Question 102 · continued

June 2024 | 8463/1F | Original Q5

**0 5 . 2** How did pushing the plunger in affect the distance between the air particles in the syringe?

**[1 mark]**

Tick (✓) **one** box.

- The distance decreased. ☐
- The distance stayed the same. ☐
- The distance increased. ☐

**0 5 . 3** How did pushing the plunger in affect the frequency of collisions between the air particles and the syringe walls?

**[1 mark]**

Tick (✓) **one** box.

- The frequency of collisions decreased. ☐
- The frequency of collisions stayed the same. ☐
- The frequency of collisions increased. ☐

**0 5 . 4** How did pushing the plunger in affect the air pressure in the syringe?

**[1 mark]**

Tick (✓) **one** box.

- The air pressure decreased. ☐
- The air pressure stayed the same. ☐
- The air pressure increased. ☐

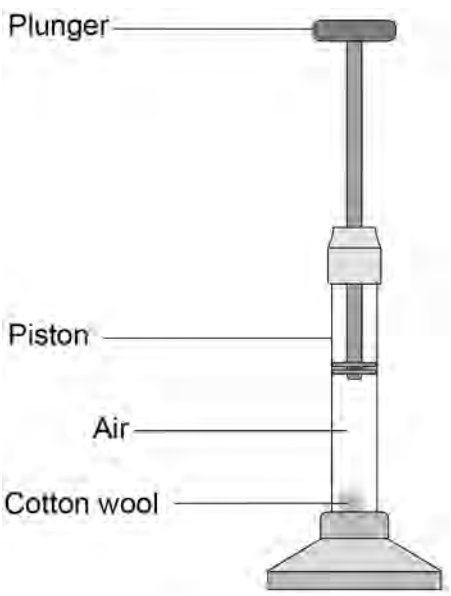
Question 102 · continued



A fire piston is a special type of syringe that can be used to start fires.

**Figure 11** shows a fire piston.

**Figure 11**




The plunger is pushed quickly downwards and compresses the air.

When the air is compressed quickly, the temperature of the air increases.

**0 5 . 5** How does an increase in temperature affect the mean speed of the air particles inside the syringe?

**[1 mark]**

Tick (✓) **one** box.

The mean speed of the particles decreases. ☐

The mean speed of the particles does not change. ☐

The mean speed of the particles increases. ☐

4.6.1.2 Properties of waves

Question 102 · continued



**0 5 . 6** When the air is hot enough, a small piece of cotton wool in the piston catches fire.

The energy transferred to the air in the piston is 0.0130 J.

The mass of air in the piston is $2.60 \times 10^{-8}$ kg.

specific heat capacity of air = 1010 J/kg °C

Calculate the temperature change of the air.

Use the Physics Equations Sheet.

**[3 marks]**

Temperature change = _____ °C

8

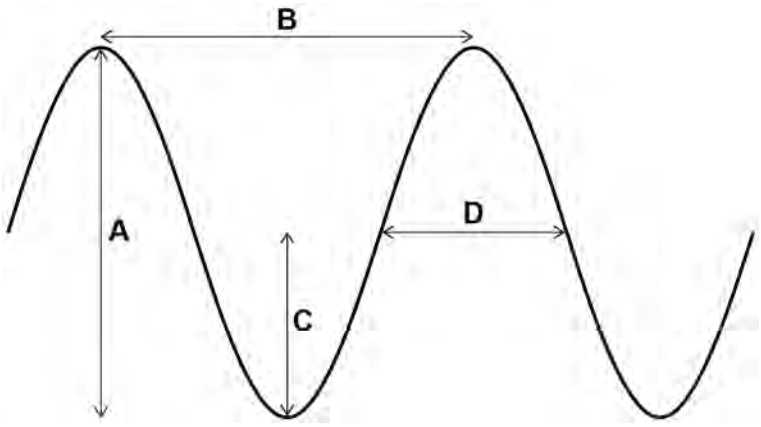
4.6.1.2 Properties of waves

Question 103



**0 4** **Figure 7** represents a transverse wave.

**Figure 7**




**0 4 . 1** Which arrow represents the amplitude of the wave?

**[1 mark]**

Tick (✓) **one** box.

**A** ☐ **B** ☐ **C** ☐ **D** ☐

**0 4 . 2** Which arrow represents the wavelength of the wave?

**[1 mark]**

Tick (✓) **one** box.

**A** ☐ **B** ☐ **C** ☐ **D** ☐

Question 103 · continued



**0 4 . 3** A wave has a frequency of 5000 Hz.

Calculate the period of the wave.

Use the equation:

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

**[2 marks]**

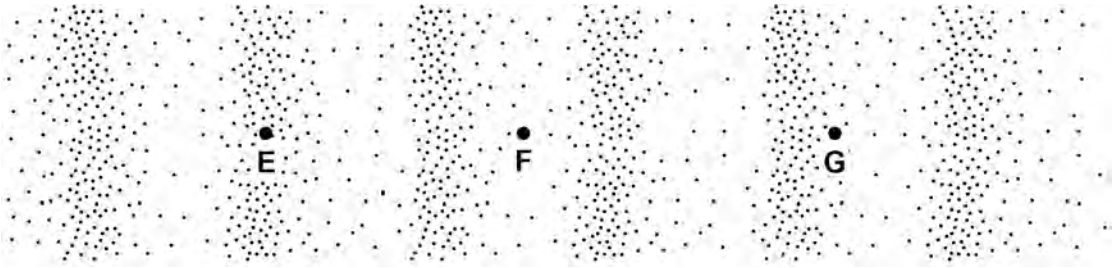
Period = _____ s

**0 4 . 4** Give **one** example of a transverse wave that can travel through a vacuum.

**[1 mark]**

**0 4 . 5** **Figure 8** represents a longitudinal wave.

**Figure 8**




Which point is at the centre of a rarefaction?

**[1 mark]**

Tick (✓) **one** box.

**E** ☐ **F** ☐ **G** ☐

4.6.1.2 Properties of waves

Question 103 · continued



**0 4 . 6** A sound wave has a frequency of 750 Hz.

speed of sound in air = 330 m/s

Calculate the wavelength of the sound wave.

Use the equation:

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

**[2 marks]**

Wavelength = _____ m

**0 4 . 7** Describe a method that could be used to determine the speed of sound in air.

**[4 marks]**

4.6.1.2 Properties of waves

Question 103 · continued



**0 4 . 8** When a sound wave moves from air into water, the speed of the wave increases.

The frequency of the sound wave does **not** change.

Complete the sentence.

Choose the answer from the box.

**[1 mark]**

| | | |
|---|---|---|
| **decreases** | **stays the same** | **increases** |

When a sound wave moves from air into water its

wavelength _____.

13

**Turn over for the next question**

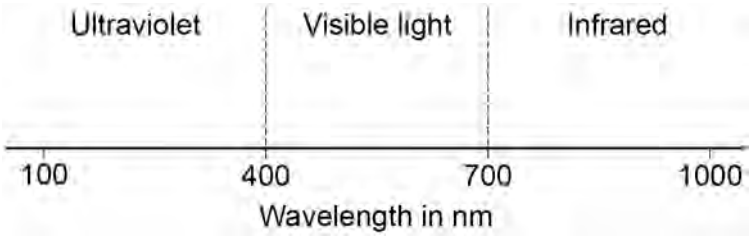
4.6.1.2 Properties of waves

Question 104

June 2024 | 8463/2F | Original Q6

**0 6** **Figure 10** shows the wavelengths of some types of electromagnetic radiation.

**Figure 10**




**0 6 . 1** Suggest **one** piece of equipment that can be used to detect infrared radiation.

**[1 mark]**

**0 6 . 2** Which of the following values is a wavelength of red light?

**[1 mark]**

Tick (✓) **one** box.

320 nm ☐

410 nm ☐

690 nm ☐

750 nm ☐

**Question 6 continues on the next page**

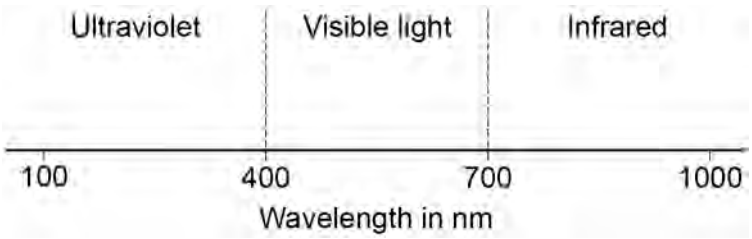
4.6.1.2 Properties of waves

Question 104 · continued



**Figure 10** is repeated below.

**Figure 10**




**0 6 . 3** The eyes of a bee can detect electromagnetic radiation with wavelengths between 300 nm and 600 nm.

Give **two** ways the radiation detected by the eyes of a bee is different from the radiation detected by human eyes.

**[2 marks]**

1 _____

_____

2 _____

_____

**0 6 . 4** Complete the sentences.

Choose the answers from the box.

**[2 marks]**

| | | | |
|---|---|---|---|
| **absorbed** | **emitted** | **reflected** | **refracted** |

When sunlight shines on a red flower, the red light

is _____.

All other colours of light shining on the red flower

are _____.

4.6.1.2 Properties of waves

Question 104 · continued



**0 6 . 5** A gardener looks at a red flower through a green filter.

How does the flower appear to the gardener?

**[1 mark]**

Tick (✓) **one** box.

Black ☐

Green ☐

Red ☐

White ☐

**0 6 . 6** The leaves of the plant reflect light.

The leaves have a rough surface.

What type of reflection happens at the leaf surface?

**[1 mark]**

8

4.6.1.2 Properties of waves

Question 105

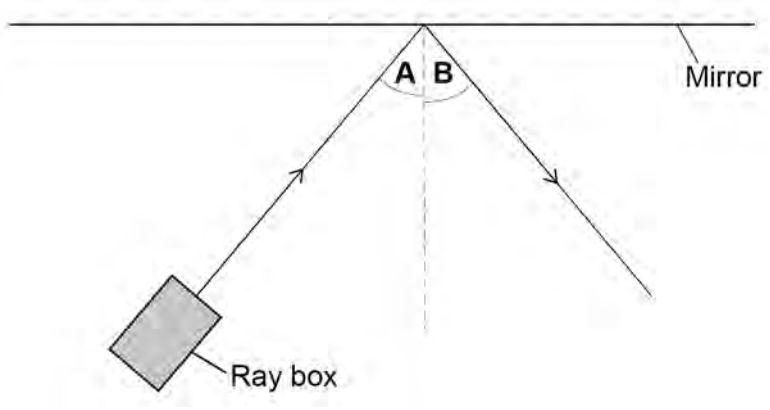
June 2025 | 8463/2F | Original Q1

**0 1** Light waves and water waves can both be reflected.

A student used a ray box and a mirror to investigate the reflection of light.

**Figure 1** shows some of the apparatus used.

**Figure 1**




**0 1 . 1** The student measured angle **A** and angle **B**.

What equipment should the student have used to measure each angle?

**[1 mark]**

**Question 1 continues on the next page**

4.6.1.2 Properties of waves

Question 105 · continued



The student moved the ray box and changed the direction of the ray of light.

The student recorded different pairs of values of angle **A** and angle **B**.

**Table 1** shows the results.

**Table 1**

| Angle A in degrees | Angle B in degrees |
|---|---|
| 0 | 0 |
| 5 | 5 |
| 11 | 11 |
| 20 | 20 |
| 29 | 29 |

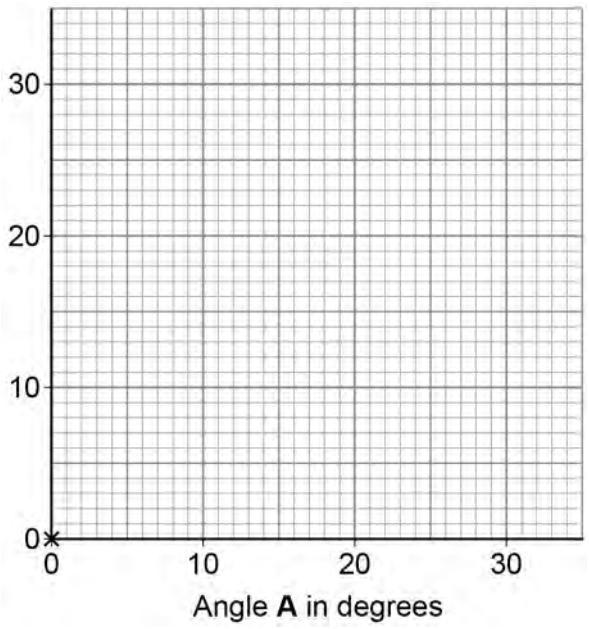
4.6.1.2 Properties of waves

Question 105 · continued



**0 1 . 2** **Figure 2** shows an incomplete graph of the results.

**Figure 2**




Complete **Figure 2**.

You should:

- label the *y*-axis
- plot the remaining data from **Table 1**
- draw a line of best fit.

**[4 marks]**

**0 1 . 3** What is the relationship between angle **A** and angle **B**?

**[1 mark]**

Tick (✓) **one** box.

Angle **A** is directly proportional to angle **B**. ☐

There is a negative correlation between angle **A** and angle **B**. ☐

The relationship between angle **A** and angle **B** is non-linear. ☐

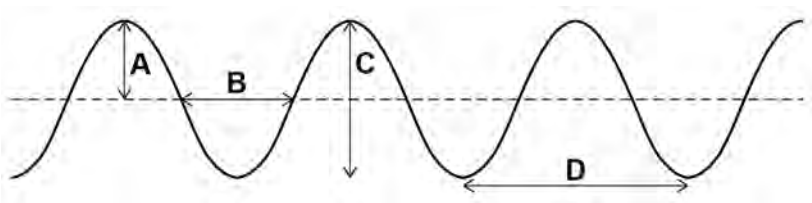
4.6.1.2 Properties of waves

Question 105 · continued



**Figure 3** represents a water wave.

**Figure 3**




**0 1 . 4** Which letter represents the amplitude of the water wave in **Figure 3**?

**[1 mark]**

Tick (✓) **one** box.

**A** ☐ **B** ☐ **C** ☐ **D** ☐

**0 1 . 5** Which letter represents the wavelength of the water wave in **Figure 3**?

**[1 mark]**

Tick (✓) **one** box.

**A** ☐ **B** ☐ **C** ☐ **D** ☐

4.6.1.2 Properties of waves

Question 105 · continued



**0 1 . 6** A water wave in a ripple tank has a wave speed of 0.125 m/s.

The wave has a frequency of 2.5 Hz.

Calculate the wavelength of the wave.

Use the equation:

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

Choose the unit from the box.

**[3 marks]**

| | | |
|---|---|---|
| **m** | **Pa** | **kg / m** |

Wavelength = _____ Unit _____

**0 1 . 7** The wave has a frequency of 2.5 Hz.

Calculate the period of the wave.

Use the equation:

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

**[2 marks]**

Period = _____ s

**13**

4.6.1.2 Properties of waves

Question 106

June 2025 | 8463/2F | Original Q3

**0 3** Telescopes are used to observe distant objects.

**0 3 . 1** Complete the sentences.

Choose answers from the box.

**[2 marks]**

| | | | | |
|---|---|---|---|---|
| **galaxy** | **moon** | **nebula** | **star** | **universe** |

A natural satellite of a planet is called a _____.

A planet orbits a _____.

**0 3 . 2** What is the name of our galaxy?

**[1 mark]**

Tick (✓) **one** box.

- Andromeda ☐
- Centaurus ☐
- Milky Way ☐
- Whirlpool ☐

Question 106 · continued



**0 3 . 3** The Sun is our nearest star.

What will happen to the Sun at the end of its life cycle?

**[1 mark]**

Tick (✓) **one** box.

It will become a black dwarf. ☐

It will become a black hole. ☐

It will become a neutron star. ☐

The James Webb Space Telescope is the most powerful telescope ever launched into space.

**0 3 . 4** Very distant galaxies can be observed using the James Webb Space Telescope.

How does the speed of a very distant galaxy compare to the speed of a much nearer galaxy?

**[1 mark]**

Tick (✓) **one** box.

A very distant galaxy moves faster. ☐

The speeds are the same. ☐

A very distant galaxy moves slower. ☐

**Question 3 continues on the next page**

Question 106 · continued



**0 3 . 5** There is an observed increase in the wavelength of light from most distant galaxies.

What name is given to this increase in the wavelength of light?

**[1 mark]**

Tick (✓) **one** box.

Blue-shift ☐

Green-shift ☐

Red-shift ☐

**0 3 . 6** Observations from the James Webb Space Telescope support the Big Bang theory.

Complete the sentence.

Choose the answer from the box.

**[1 mark]**

| cold | hot | large |
|---|---|---|

The Big Bang theory suggests that the universe began from a region that

was extremely _____.

**0 3 . 7** What does the Big Bang theory suggest is happening to the size of the universe?

**[1 mark]**

Tick (✓) **one** box.

The universe is getting smaller. ☐

The size of the universe is constant. ☐

The universe is getting bigger. ☐

8

### 4.6.1.2 Properties of waves

**Question 107**

June 2025 | 8463/2F | Original Q8

**0 8** In a thunderstorm, lightning produces visible light waves and sound waves.

**0 8 . 1** Describe the similarities and differences between visible light waves and sound waves.

**[6 marks]**

4.6.1.2 Properties of waves

Question 107 · continued



Use the Physics Equations Sheet to answer questions **08.2** and **08.3**.

**0 8 . 2** Which equation links distance (*s*), speed (*v*) and time (*t*)?

**[1 mark]**

Tick (✓) **one** box.

speed = distance × time ☐

speed = $\frac{\text{distance}}{\text{time}}$ ☐

speed = $\frac{\text{time}}{\text{distance}}$ ☐

**0 8 . 3** Lightning strikes the ground 13 200 m from a student.

The speed of sound in air is 330 m/s.

Calculate the time taken for the sound created by the lightning strike to reach the student.

**[3 marks]**

Time = _____ s

10