AQA GCSE Physics | 8463

SPECIFICATION POINT 4.6.1.4

Sound waves (physics only) (HT only)

Past-paper questions

Tier	**Higher**
Question groups	**29**
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:** _____

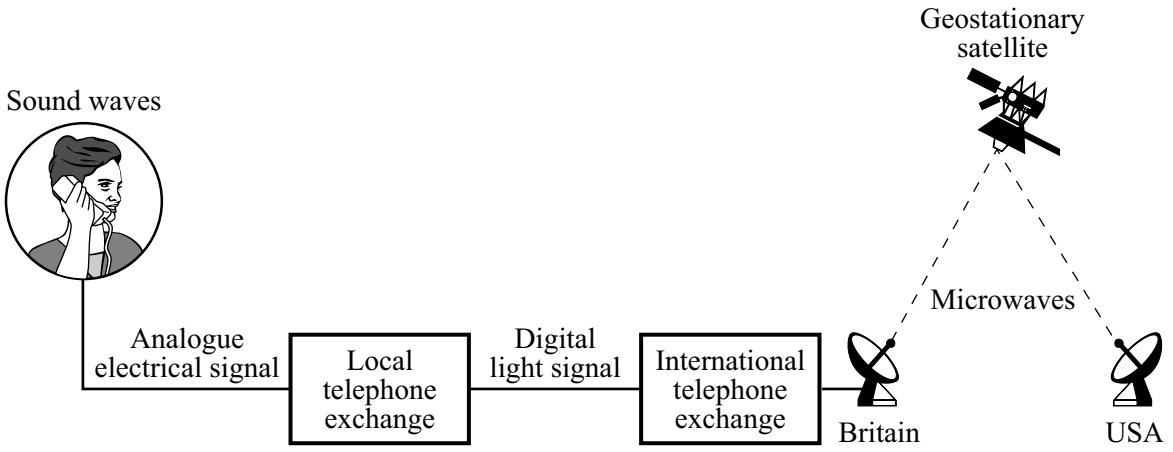
Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

4.6.1.4 Sound waves (physics only) (HT only)

Question 01

June 2003 | 3451H | Original Q9 | Legacy

9 (a) The diagram shows, in a simplified form, how a telephone call can be transmitted from Britain to the USA.



(i) What is the difference between an analogue and a digital signal? You may wish to draw a diagram to help your answer.

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(2 marks)

(ii) Explain why the quality of an analogue signal transmitted over a long distance decreases, but the quality of a digital signal transmitted over the same distance does not change.

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(3 marks)

MARGIN BLANK

(iii) Explain why the satellite used to receive and transmit the microwave signals is placed in a geostationary orbit.

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(2 marks)

(b) The picture shows a pre-natal scan obtained using ultrasonic waves.



(i) Explain how ultrasonic waves are used to produce the image of an unborn baby.

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.....

.....

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(2 marks)

(ii) Give another use for ultrasonic waves.

.....

(1 mark)

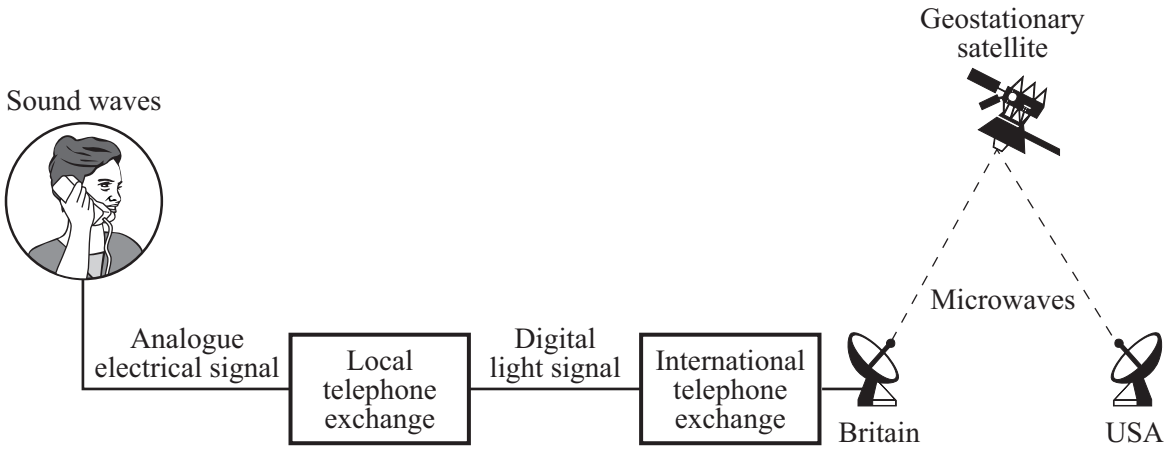
10

4.6.1.4 Sound waves (physics only) (HT only)

Question 02

June 2003 | 3462H3 | Original Q7 | Legacy

7 (a) The diagram shows, in a simplified form, how a telephone call can be transmitted from Britain to the USA.



(i) What is the difference between an analogue and a digital signal? You may wish to draw a diagram to help your answer.

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(2 marks)

(ii) Explain why the quality of an analogue signal transmitted over a long distance decreases, but the quality of a digital signal transmitted over the same distance does not change.

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(3 marks)

4.6.1.4 Sound waves (physics only) (HT only)

Question 02 · continued

MARGIN BLANK

(iii) Explain why the satellite used to receive and transmit the microwave signals is placed in a geostationary orbit.

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(2 marks)

(b) The picture shows a pre-natal scan obtained using ultrasonic waves.



(i) Explain how ultrasonic waves are used to produce the image of an unborn baby.

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.....

.....

.....

(2 marks)

(ii) Give another use for ultrasonic waves.

.....

(1 mark)

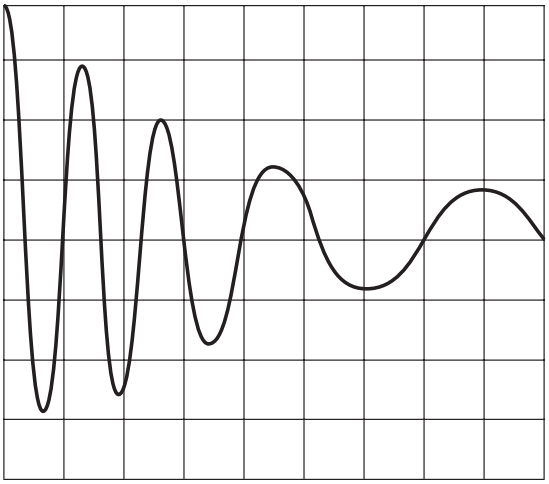
10

4.6.1.4 Sound waves (physics only) (HT only)

Question 03

June 2005 | 3451 | Original Q7 | Legacy

7 (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.

.....

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.....

(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)

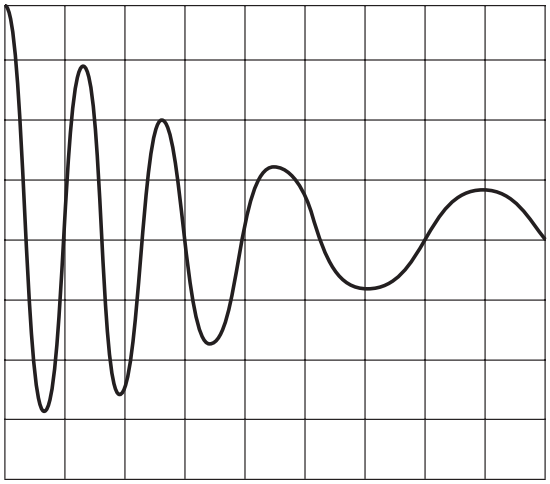
8

4.6.1.4 Sound waves (physics only) (HT only)

Question 04

June 2005 | 3462 | Original Q5 | Legacy

5 (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.

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.....

(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

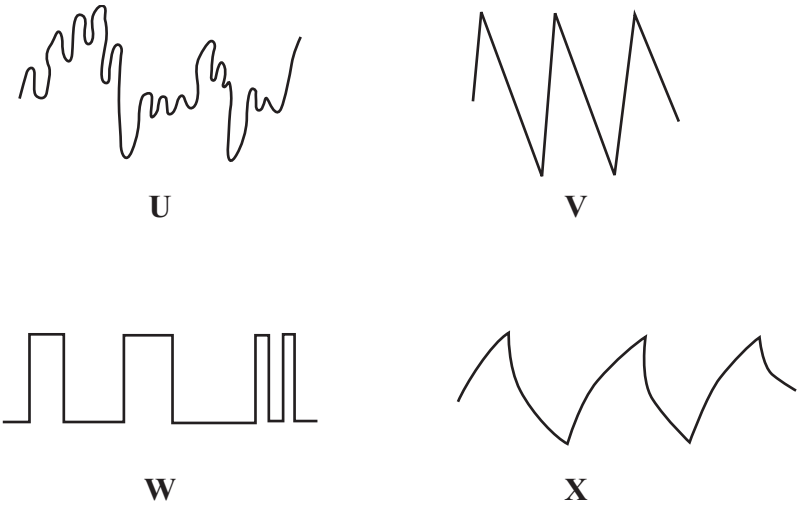
4.6.1.4 Sound waves (physics only) (HT only)

Question 05

June 2006 | 3451 | Original Q3 | Legacy

3 Converting sound waves into electrical signals allows information to be sent over long distances.

The diagram shows three analogue signals and one digital signal.



(a) Which signal, **U**, **V**, **W** or **X**, is the digital signal?

.....

Give a reason for your choice.

.....

.....

(2 marks)

(b) Give **one** advantage of sending information as a digital signal instead of as an analogue signal.

.....

.....

(1 mark)

3

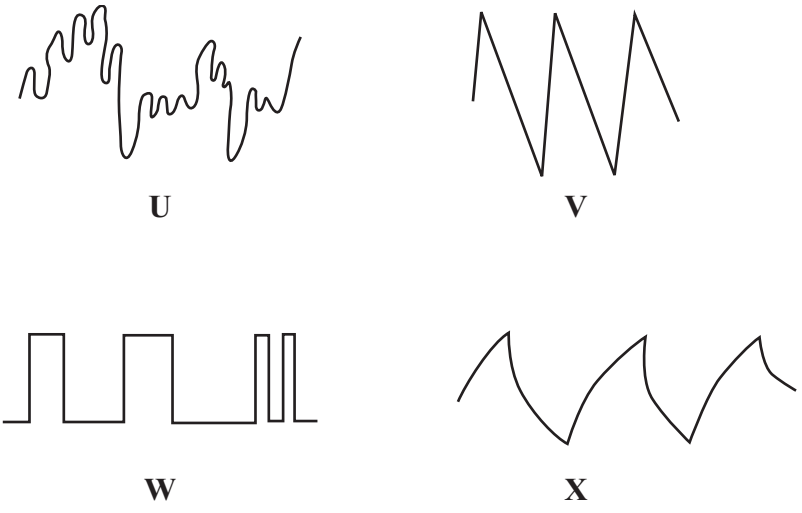
4.6.1.4 Sound waves (physics only) (HT only)

Question 06

June 2006 | 3462 | Original Q3 | Legacy

3 Converting sound waves into electrical signals allows information to be sent over long distances.

The diagram shows three analogue signals and one digital signal.



(a) Which signal, **U**, **V**, **W** or **X**, is the digital signal?

.....

Give a reason for your choice.

.....

.....

(2 marks)

(b) Give **one** advantage of sending information as a digital signal instead of as an analogue signal.

.....

.....

(1 mark)

3

4.6.1.4 Sound waves (physics only) (HT only)

Question 07

March 2007 | PHY1B | Original Q3 | Legacy

QUESTION THREE

What was that again?

A scientist investigated the claim that the use of mobile phones leads to hearing loss.

She investigated two groups of young adults aged 20 to 24 years old. One group said that they used mobile phones frequently. The other group was the control group. They said that they did not use mobile phones.

She found that, on average, the mobile phone users experienced a 5 % hearing loss over a two-year period.

3A What valid conclusion can she come to on the basis of this evidence?

1 that excessive sound levels lead to hearing loss

2 that some members of her group of mobile phone users experienced a hearing loss

3 that microwaves lead to hearing loss

4 that most younger people have better hearing than most older people

3B A criticism of her investigation made by other scientists is likely to be that . . .

1 mobile phones are not significantly different from other phones.

2 she used the wrong age group and should have chosen a younger group.

3 some people in the group had a lower than average hearing loss.

4 we cannot be sure that people have described their mobile phone use correctly.

4.6.1.4 Sound waves (physics only) (HT only)

3C Other scientists said that the two groups would not be well matched.

This is because . . .

1 it is difficult to find people in the 20–24 age group who do not use mobile phones.

2 people objected to being controlled.

3 some people changed their mobile phones during the two-year period.

4 the control group did not get on with the others.

3D Newspapers reported her findings, but most of their readers did not alter their mobile phone use.

The most likely reason was that most people . . .

1 considered all the scientific arguments, both for and against.

2 did not believe that she had measured the hearing loss correctly.

3 experience some hearing loss as they get older.

4 were prepared to take the possible risk.

4.6.1.4 Sound waves (physics only) (HT only)

Question 08

June 2007 | PHY1H | Original Q4 | Legacy

4 (a) A student listens to the sound waves produced by a car siren. When the car is stationary, the student hears a constant frequency sound.

Describe how the wavelength and frequency of the sound waves heard by the student change when the car is driven away from the student.

.....

.....

.....

.....

(2 marks)

(b) Satellites fitted with various telescopes orbit the Earth. These telescopes detect different types of electromagnetic radiation.

Why are telescopes that detect different types of electromagnetic waves used to observe the Universe?

.....

.....

(1 mark)

(c) In 2005 a space telescope detected a star that exploded 13 billion years ago. The light from the star shows the biggest *red-shift* ever measured.

(i) What is *red-shift*?

.....

.....

(1 mark)

(ii) What does the measurement of its red-shift tell scientists about this star?

.....

.....

(1 mark)

4.6.1.4 Sound waves (physics only) (HT only)

Question 08 · continued

BLANK

(d) Red-shift provides evidence for the 'big bang' theory.

(i) Describe the 'big bang' theory.

.....

.....

.....

.....

(2 marks)

(ii) Suggest what scientists should do if new evidence were found that did not support the 'big bang' theory.

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(1 mark)

8

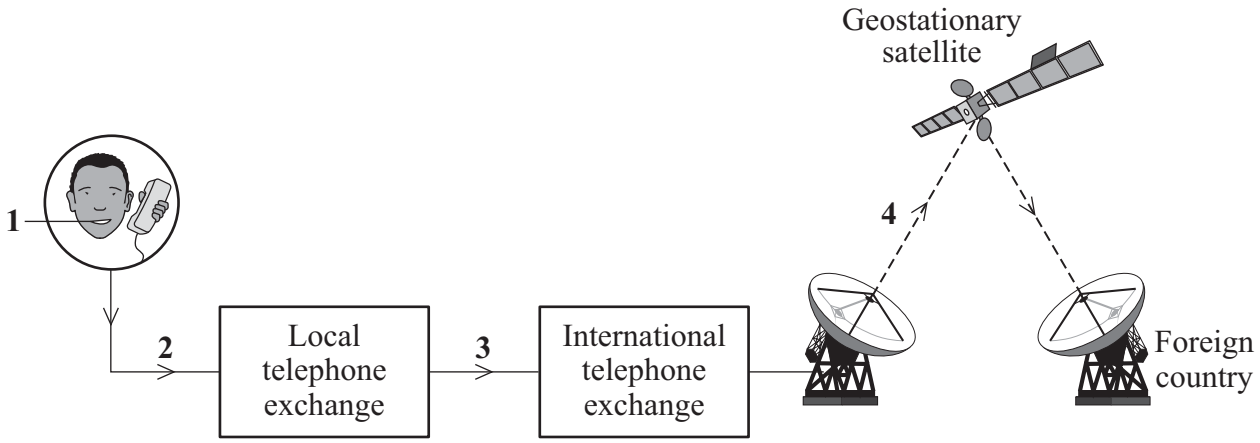
4.6.1.4 Sound waves (physics only) (HT only)

Question 09

November 2007 | PHY1B | Original Q1 | Legacy

QUESTION ONE

The diagram shows how a telephone call can be made to a foreign country.



Match waves and signals, **A**, **B**, **C** and **D**, with the numbers **1–4** on the diagram.

A analogue electrical signal

B digital light signal

C microwaves

D sound waves

4.6.1.4 Sound waves (physics only) (HT only)

Question 10

January 2008 | PHY3H | Original Q2 | Legacy

2 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.

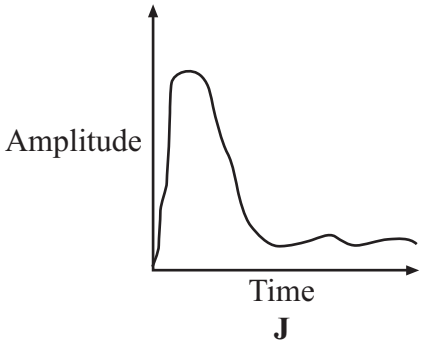
Sound waves are caused by ..... .

(1 mark)

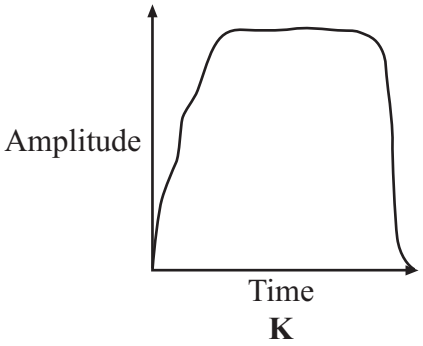
(b) The graphs **J**, **K**, **L** and **M** represent the sound energy reflected from a surface.

The graphs are all drawn to the same scale.

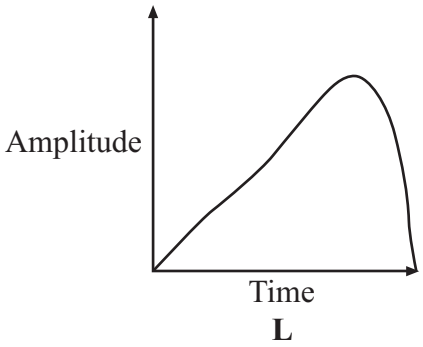
Which graph shows the greatest total sound energy output from the surface?



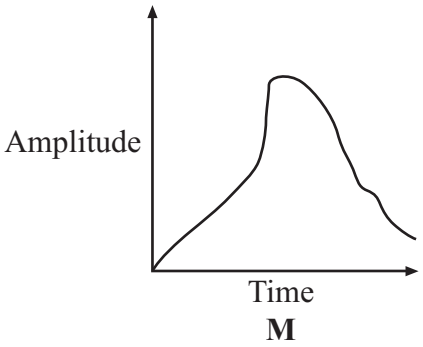
J



K



L



M

Graph .....

(1 mark)

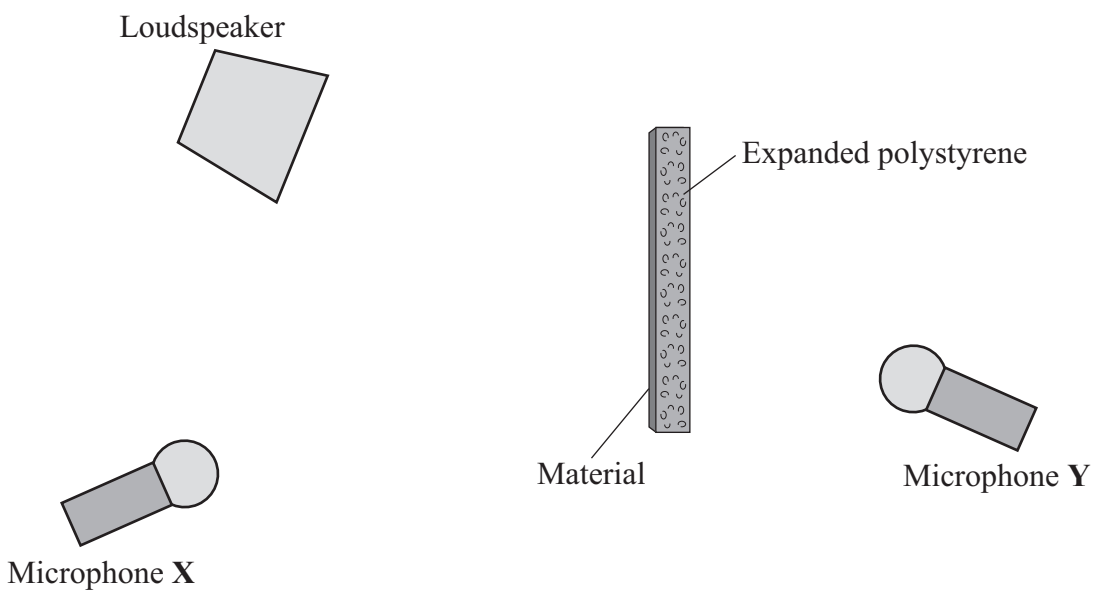
Question 2 continues on the next page

(c) The proportion of the sound energy which is reflected or transmitted or absorbed 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)

Question 10 · 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.

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(2 marks)

9

4.6.1.4 Sound waves (physics only) (HT only)

Question 11

1 (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)

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

What does the symbol kHz stand for?

.....

(1 mark)

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

.....

(1 mark)

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

.....

(1 mark)

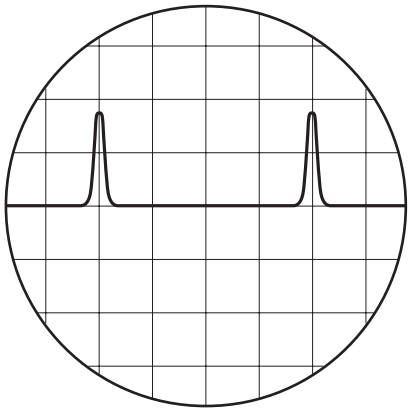
4.6.1.4 Sound waves (physics only) (HT only)

Question 11 · continued

for mark

1 (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)

1 (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?

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.....
(2 marks)

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

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.....
(2 marks)

9

4.6.1.4 Sound waves (physics only) (HT only)

Question 12

March 2009 | PHY1BP | Original Q7 | Legacy

QUESTION SEVEN

This question is about the behaviour of waves as the source of the wave moves, and what this can tell us about the universe.

7A At an air show, an aircraft flies at a steady speed in a straight line over the crowd of spectators.

As the aircraft approaches, how do the wavelength and frequency of the sound wave heard by the spectators differ from the sound emitted by the aircraft?

	Wavelength	Frequency
1	shorter	higher
2	longer	lower
3	longer	the same
4	the same	lower

7B Scientists observing the Andromeda galaxy see that its light is undergoing a blue-shift.

What does this tell them about the wavelength of light arriving on Earth from this galaxy and the movement of Andromeda relative to Earth?

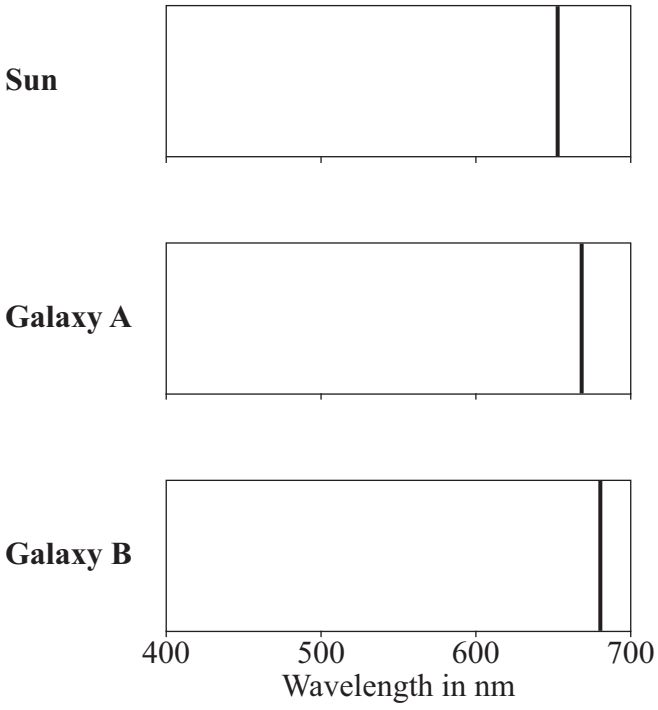
	Wavelength	Movement relative to Earth
1	decreasing	moving away
2	decreasing	moving towards
3	increasing	moving away
4	increasing	moving towards

Question 12 · continued March 2009 | PHY1BP | Original Q7 | Legacy

The visible part of the electromagnetic spectrum from stars includes dark lines. They correspond to chemical elements in the stars and occur at specific wavelengths.

The line in the spectra shown below, from three different sources, represents hydrogen which is found in the Sun's spectrum at a wavelength of 656.3 nm.

1 nanometre, 1 nm = 0.000 000 001 metre



7C What does this indicate about galaxies **A** and **B**?

1 Galaxy **A** is colder than galaxy **B**.

2 Galaxy **A** is further away from Earth than galaxy **B**.

3 Galaxy **B** is colder than galaxy **A**.

4 Galaxy **B** is further away from Earth than galaxy **A**.

7D Which of the following theories about the universe does red-shift information support?

1 The universe began from a small initial point and has been expanding ever since.

2 The universe expanded initially, but is now contracting.

3 The universe has always been the size it is now.

4 The universe will eventually run out of energy and collapse.

4.6.1.4 Sound waves (physics only) (HT only)

Question 13

June 2009 | PHY3H | Original Q5 | Legacy

5 (a) The diagrams show oscilloscope traces for the same musical note played on two different instruments. The oscilloscope settings are not changed.

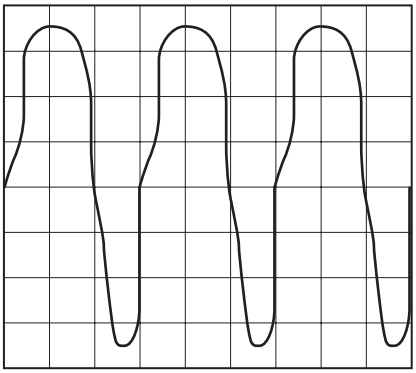


Diagram X

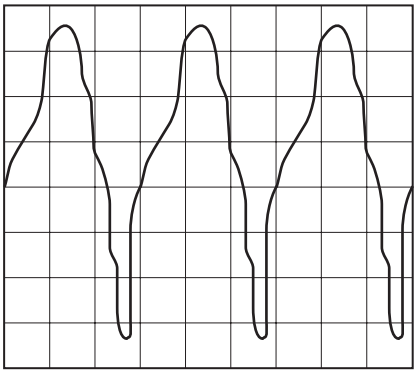


Diagram Y

5 (a) (i) How can you tell, from the diagrams, that it is the same musical note?

.....

.....

(1 mark)

5 (a) (ii) How can you tell, from the diagrams, that the musical note has been played on different instruments?

.....

.....

(1 mark)

4.6.1.4 Sound waves (physics only) (HT only)

Question 13 · continued

for mark

5 (b) This passage is from an electronics magazine.

> *Electronic systems can be used to produce ultrasound waves.*
> *These waves have a higher frequency than the upper limit for hearing in humans.*
> *Ultrasound waves are partially reflected when they meet a boundary between two different media.*

5 (b) (i) Approximately what is the highest frequency that humans can hear?
State the number and the unit.

.....

(1 mark)

5 (b) (ii) What does the word *media* mean when it is used in this passage?

.....

.....

(1 mark)

5 (b) (iii) What happens to the ultrasound which reaches the boundary between two different media and is **not** reflected?

.....

.....

.....

.....

(2 marks)

6

4.6.1.4 Sound waves (physics only) (HT only)

Question 14

3 (a) Explain what an ultrasound wave is.

.....

.....

.....

.....

(2 marks)

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

One method is to put the jewellery in a bath of cleaning fluid which contains an electronic oscillator. The electronic oscillator generates ultrasound waves in the cleaning fluid.

Suggest how these waves clean the jewellery.

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(2 marks)

3 (c) Ultrasound is used for pre-natal scanning. This is much safer than using X-rays. However, doctors were only sure it was safe after experiments on mice.

Explain whether or not you think that these experiments were justified.

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(2 marks)

6

4.6.1.4 Sound waves (physics only) (HT only)

Question 15

June 2010 | PHY3H | Original Q2 | Legacy

2 (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.

2 (a) (i) Complete this statement.

Most children can detect sounds in the frequency range

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

(1 mark)

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

.....

(1 mark)

2 (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)

2 (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?

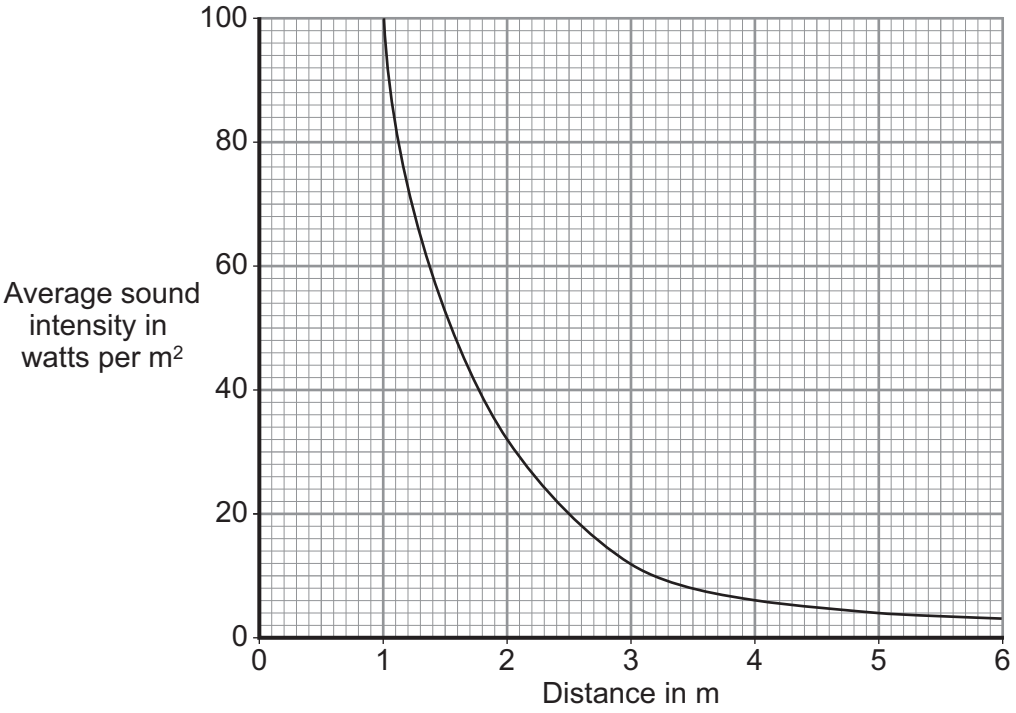
.....

(1 mark)

4.6.1.4 Sound waves (physics only) (HT only)

Question 15 · continued

2 (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.



2 (d) (i) Describe the pattern shown by the graph.

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

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(2 marks)

2 (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.

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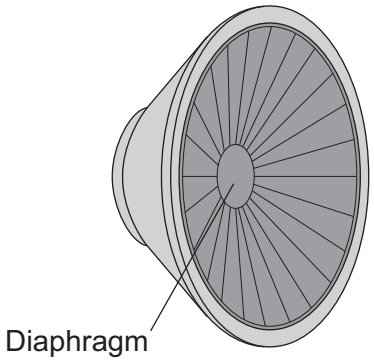
(2 marks)

8

4.6.1.4 Sound waves (physics only) (HT only)

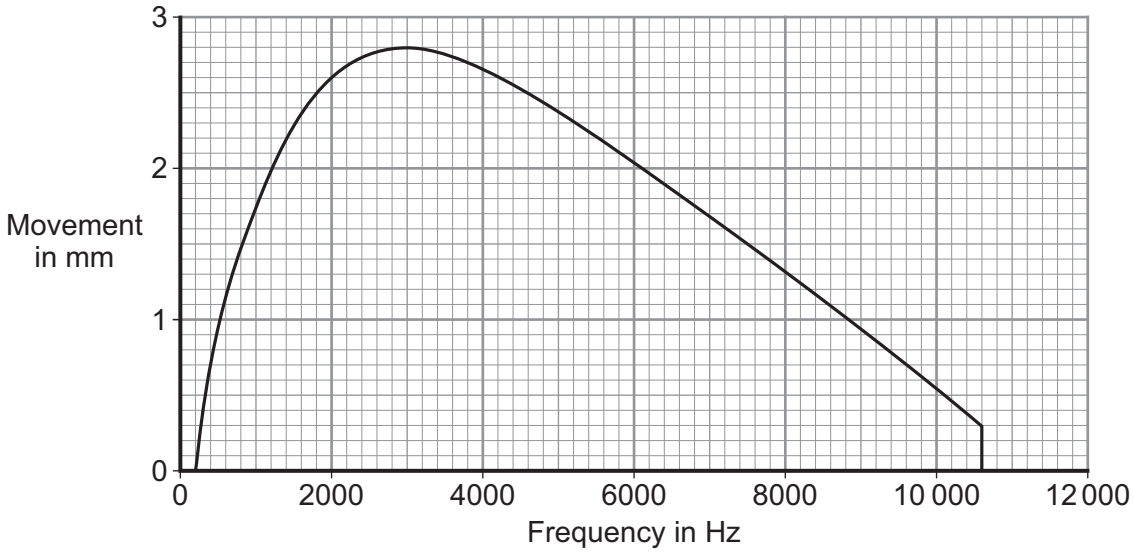
Question 16

2 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.



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

Frequency = ... Hz

(1 mark)

4.6.1.4 Sound waves (physics only) (HT only)

Question 16 · continued

2 (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)

2 (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)

2 (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)

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

.....

.....

(1 mark)

7

4.6.1.4 Sound waves (physics only) (HT only)

Question 17

June 2011 | PHY1BP | Original Q1 | Legacy

QUESTION ONE

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** . . . .

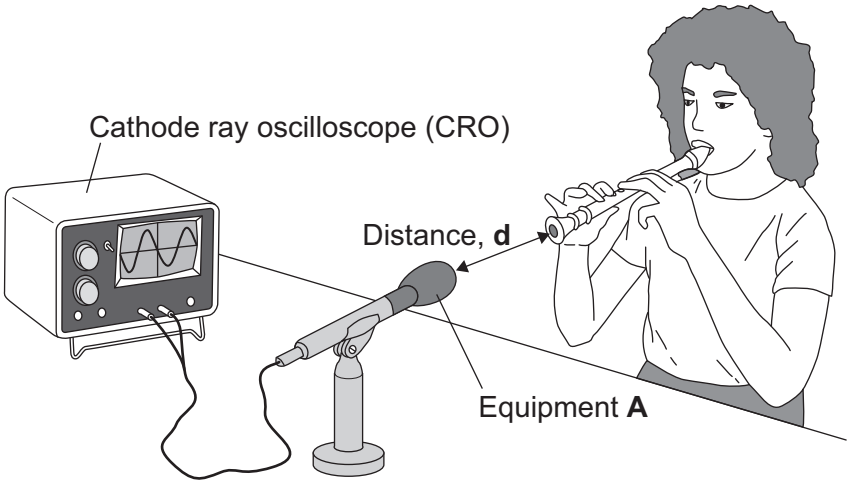
4.6.1.4 Sound waves (physics only) (HT only)

Question 18

June 2011 | PHY3H | Original Q1 | Legacy

1 A group of students investigates sound waves.

The diagram shows part of their investigation.



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

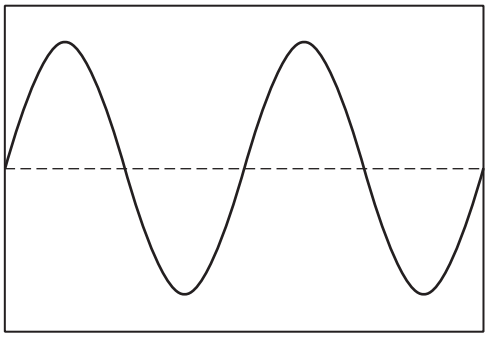
.....

(1 mark)

1 (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).

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



(1 mark)

1 (b) (ii) Complete the sentence.

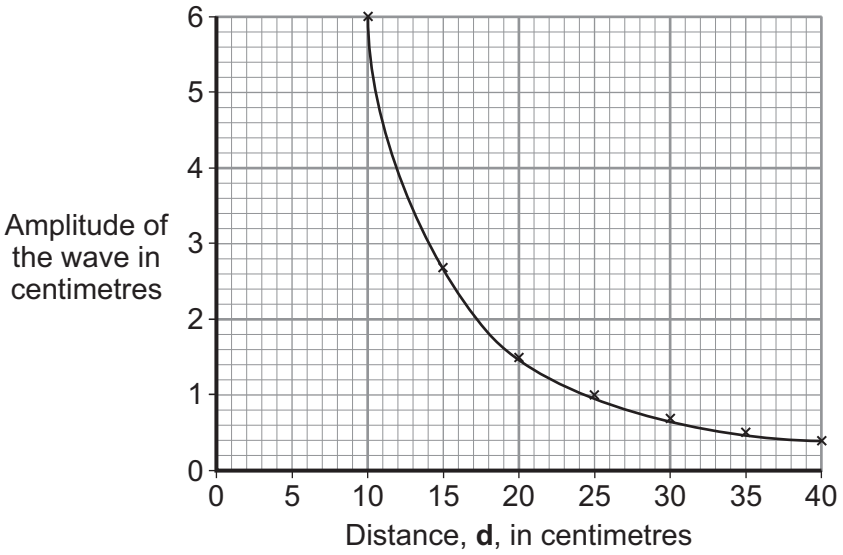
Increasing the amplitude of a sound wave will increase the .....

of the sound. *(1 mark)*

4.6.1.4 Sound waves (physics only) (HT only)

Question 18 · continued

1 (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)

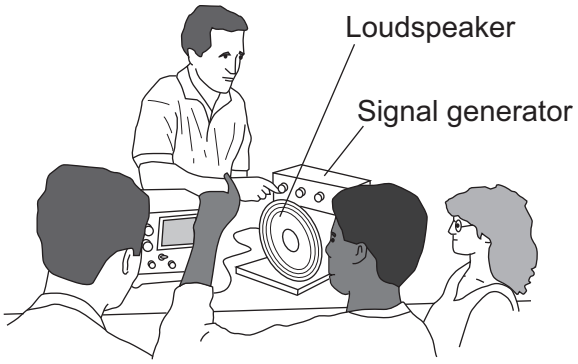
1 (d) Write a conclusion for this investigation.

.....

.....

(1 mark)

1 (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

4.6.1.4 Sound waves (physics only) (HT only)

Question 19

June 2014 | PH1HP | Original Q4 | Legacy

4 A note was played on an electric keyboard.

The frequency of the note was 440 Hz.

4 (a) (i) What does a frequency of 440 Hz mean?

[1 mark]

.....

.....

4 (a) (ii) The sound waves produced by the keyboard travel at a speed of 340 m/s.

Calculate the wavelength of the note.

Use the correct equation from the Physics Equations Sheet.

Give your answer to **three** significant figures.

[3 marks]

.....

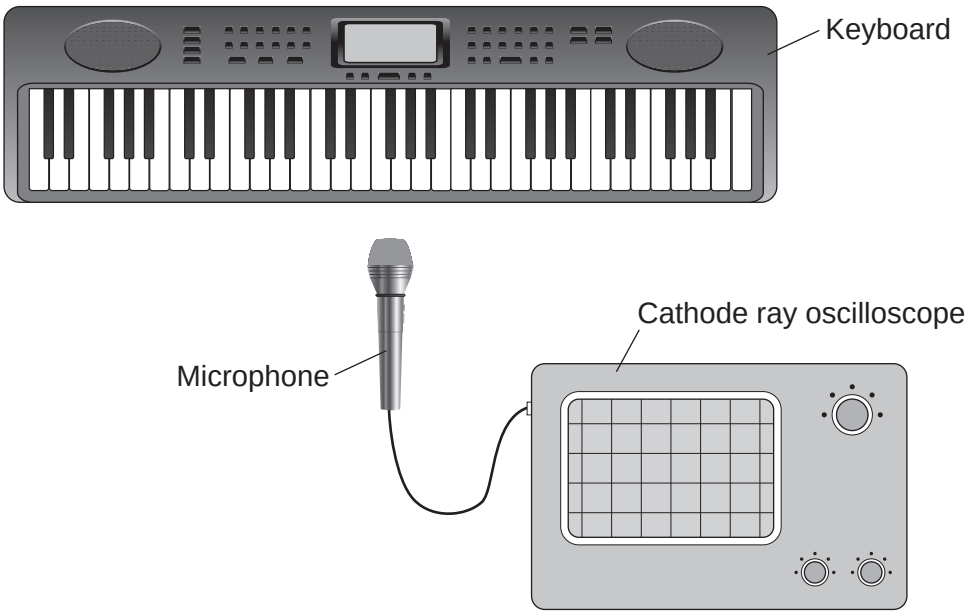
.....

.....

Wavelength = ... metres

4 (b) **Figure 3** shows a microphone connected to a cathode ray oscilloscope (CRO) being used to detect the note produced by the keyboard.

Figure 3

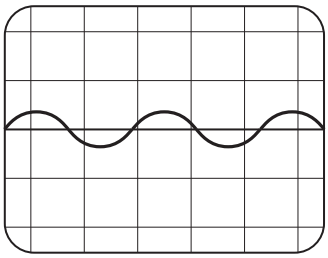


4.6.1.4 Sound waves (physics only) (HT only)

Question 19 · continued

Figure 4 shows the trace produced by the sound wave on the CRO.

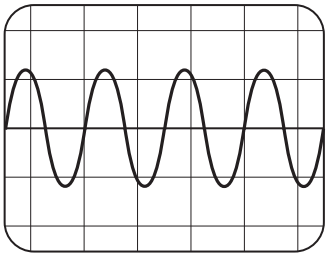
Figure 4



A second note, of different wavelength, was played on the keyboard.

Figure 5 shows the trace produced by the sound wave of the second note on the CRO.

Figure 5



The settings on the CRO were unchanged.

What **two** conclusions should be made about the **second** sound wave produced by the keyboard compared with the **first** sound wave?

Give a reason for each conclusion.

[4 marks]

Conclusion 1 .....

.....

Reason .....

.....

Conclusion 2 .....

.....

Reason .....

.....

8

4.6.1.4 Sound waves (physics only) (HT only)

Question 20

June 2015 | PH3HP | Original Q3 | Legacy

3 (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 ..... .

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

Figure 5 shows one medical use of ultrasound and one medical use of X-rays.

Figure 5





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]

.....

.....

.....

.....

.....

.....

.....

.....

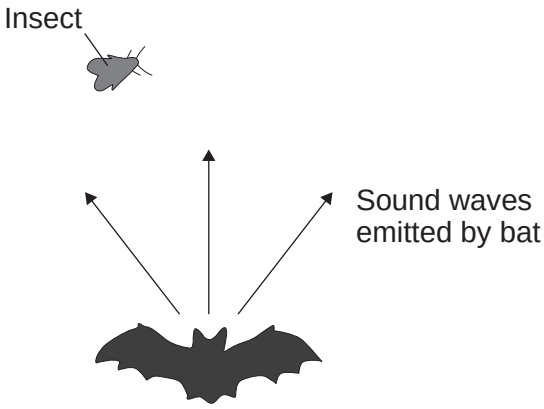
4.6.1.4 Sound waves (physics only) (HT only)

Question 21

June 2016 | PH1HP | Original Q1 | Legacy

1 Bats use the reflection of high pitched sound waves to determine the position of objects. **Figure 1** shows a bat and an insect flying in front of the bat.

Figure 1



1 (a) What determines the pitch of a sound wave?

[1 mark]

Tick (✓) **one** box.

	Tick (✓)
amplitude	
frequency	
speed	

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

[1 mark]

_____

4.6.1.4 Sound waves (physics only) (HT only)

Question 21 · continued

1 (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.

1 (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

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

[2 marks]

_____

_____

_____

_____

8

4.6.1.4 Sound waves (physics only) (HT only)

Question 22

June 2016 | PH3HP | Original Q3 | Legacy

3 X-rays and ultrasound can both be used for scanning internal organs.

3 (a) Ultrasound is used to scan unborn babies but X-rays are **not** used to scan unborn babies.

Explain why.

[3 marks]

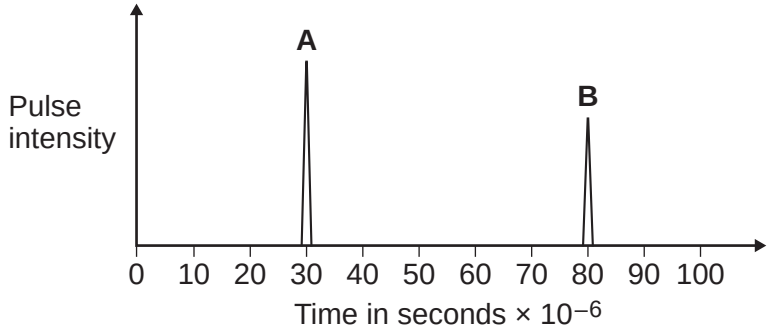
3 (b) The behaviour of ultrasound waves when they meet a boundary between two different materials is used to produce an image.

Describe how.

[2 marks]

3 (c) **Figure 4** shows two pulses from a scan of an unborn baby. The emitted pulse is labelled **A**. The returning pulse picked up by the receiver is labelled **B**.

Figure 4



The closest distance between the unborn baby and the mother's skin is 4.0 cm.
Use information from **Figure 4** to calculate the average speed of the pulse.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

Average speed = _____ m/s

Question 3 continues on the next page

4.6.1.4 Sound waves (physics only) (HT only)

Question 22 · continued

3 (d) **Figure 5** shows an X-ray of an arm with a broken bone.

Figure 5



3 (d) (i) Describe how X-rays are able to produce an image of bones.

[3 marks]

_____

_____

_____

_____

_____

_____

3 (d) (ii) Complete the following sentence.

X-rays are able to produce detailed images because their wavelength

is very _____ .

[1 mark]

12

4.6.1.4 Sound waves (physics only) (HT only)

Question 23

7 Ultrasound has industrial applications as well as medical applications.

One industrial application of ultrasound is testing an aeroplane wing to make sure that there are no cracks.

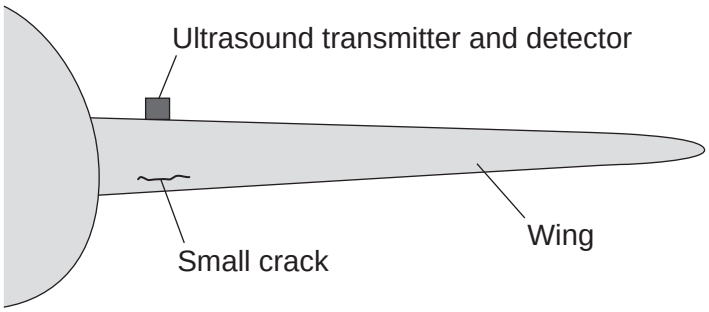
7 (a) State the minimum frequency of an ultrasound wave.

Include the correct unit.

[1 mark]

7 (b) An ultrasound pulse is transmitted from the top of a wing as shown in **Figure 6**.

Figure 6



There is a small crack in the wing. The ultrasound can be used to detect how far the crack is from the surface of the wing.

7 (b) (i) The ultrasound signal on its own does not directly give the distance to the crack.

What measurement is taken to determine the distance to the crack?

[1 mark]

7 (b) (ii) What other information is needed to calculate the distance from the surface of the wing to the crack?

[1 mark]

4.6.1.4 Sound waves (physics only) (HT only)

Question 23 · continued

June 2017 | PH3HP | Original Q7 | Legacy

7 (b) (iii) Describe what happens to the ultrasound pulse when it reaches the small crack.

[2 marks]

7 (c) An aircraft is safe to fly for at least 2000 hours after a crack begins to develop in a wing. The wing is tested after every 500 hours of flying time. If a crack is found the wing is replaced immediately.

If there is a crack in the wing, an ultrasound test will detect the crack 99% of the time.

Suggest why the interval between tests is less than the safe flying time after a crack develops.

[1 mark]

6

4.6.1.4 Sound waves (physics only) (HT only)

Question 24

June 2019 | 8463/2H | Original Q9

0 9 . 1 **Table 3** gives the frequencies in the hearing ranges of five different animals.

Table 3

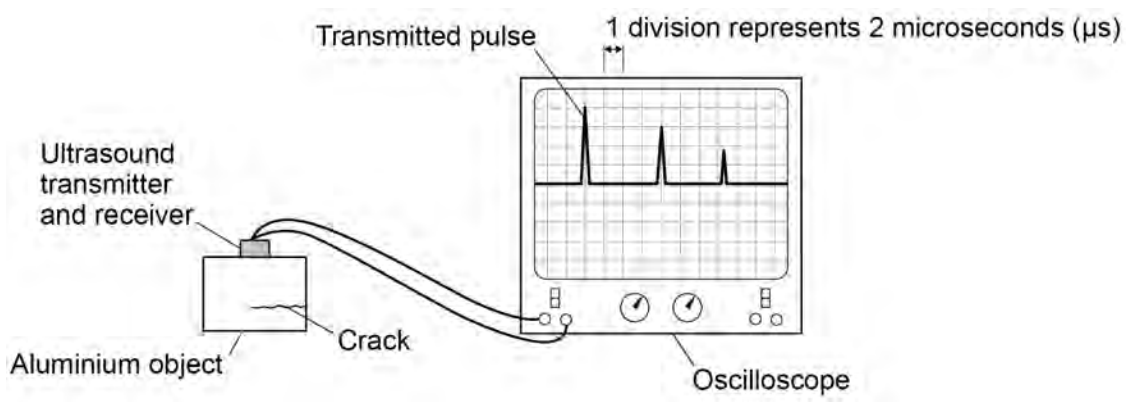
Animal	Frequencies of hearing range
Cat	55 Hz to 77 kHz
Chicken	125 Hz to 2 kHz
Dog	20 Hz to 30 kHz
Gerbil	56 Hz to 60 kHz
Horse	55 Hz to 33 kHz

Which **one** of the animals from **Table 3** would not be able to hear ultrasound?

[1 mark]

Figure 17 shows ultrasound being used to detect a hidden crack in a solid aluminium object. The transmitted and reflected pulses of ultrasound are shown on the screen.

Figure 17



0 9 . 2 Which of the following is the same as 2 microseconds?

[1 mark]

Tick (✓) **one** box.

2×10^{3} s ☐

2×10^{-3} s ☐

2×10^{-6} s ☐

2×10^{-9} s ☐

0 9 . 3 Ultrasound travels at 6300 m/s in aluminium.

Determine the depth of the crack below the top surface of the aluminium.

Use information from **Figure 17**.

Give your answer to **two** significant figures.

[4 marks]

Depth = _____ m

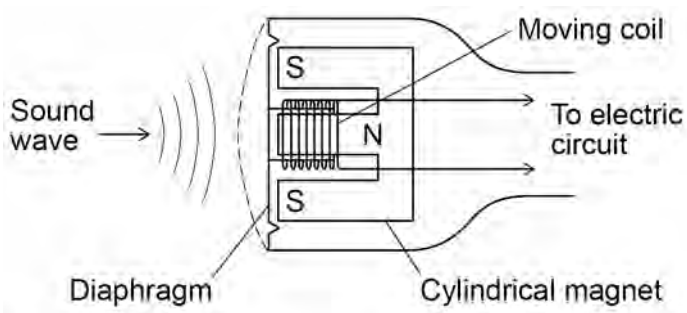
Question 9 continues on the next page

4.6.1.4 Sound waves (physics only) (HT only)

Question 24 · continued

Figure 18 shows the parts of a moving-coil microphone.

Figure 18



0 9 . 4 What is the function of a microphone?

[1 mark]

0 9 . 5 Explain how a moving-coil microphone works.

[4 marks]

11

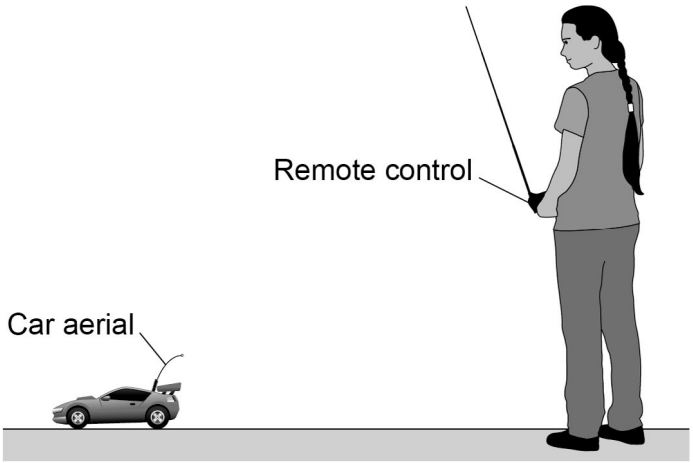
4.6.1.4 Sound waves (physics only) (HT only)

Question 25

November 2020 | 8463/2H | Original Q6

0 6 **Figure 8** shows a student playing with a remote-controlled car.

Figure 8



0 6 . 1 The remote control transmits radio waves to the car aerial.

The transmitted radio waves have a frequency of 320 MHz.

speed of radio waves = 3.0×10^8 m/s

Calculate the wavelength of the radio waves.

Give the unit.

[5 marks]

Wavelength = _____ Unit _____

4.6.1.4 Sound waves (physics only) (HT only)

Question 25 · continued

0 6 . 2 The car aerial is connected to an electrical circuit in the car.

Describe what happens in the electrical circuit when the car aerial absorbs radio waves.

[2 marks]

0 6 . 3 The car produces sound waves.

Give **two** ways in which radio waves are different to sound waves.

[2 marks]

1

2

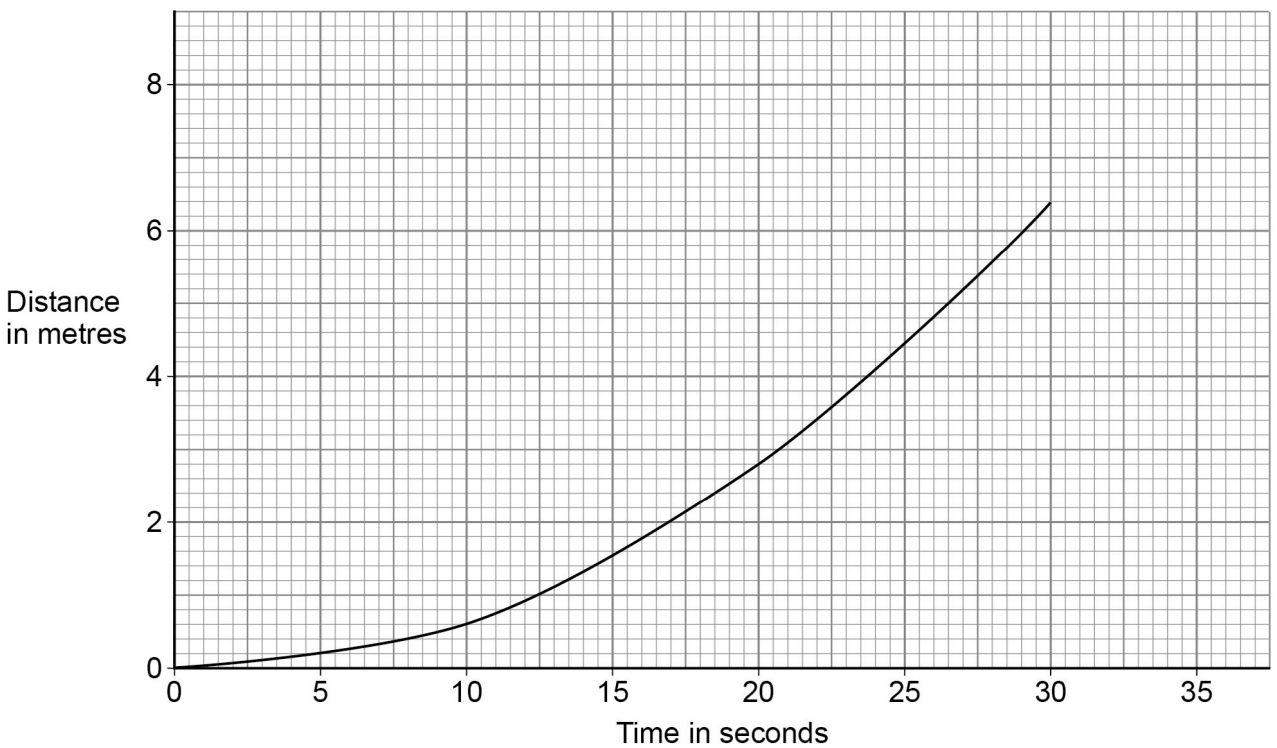
Question 6 continues on the next page

4.6.1.4 Sound waves (physics only) (HT only)

Question 25 · continued

Figure 9 shows the distance-time graph for the first 30 seconds of the car's motion.

Figure 9



0 6 . 4 Describe the motion of the car during the first 30 seconds.

[1 mark]

0 6 . 5 Determine the speed of the car 20 seconds after it started to move.

[4 marks]

Speed = _____ m/s

Question 25 · continued

0 6 . 6 A different car accelerated from 0.12 m/s to 0.52 m/s.

The acceleration of the car was 0.040 m/s^2.

The work done to accelerate the car was 0.48 J.

Calculate the resultant force needed to accelerate the car.

[6 marks]

Resultant force = _____ N

0 6 . 7 Explain why the car has a maximum speed.

[4 marks]

24

4.6.1.4 Sound waves (physics only) (HT only)

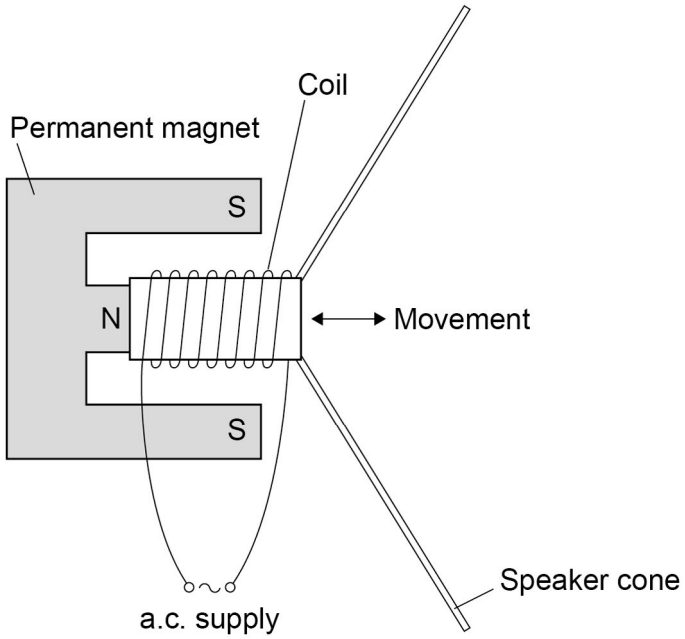
Question 26

November 2021 | 8463/2H | Original Q8

0 8 A student made a moving-coil loudspeaker.

Figure 15 shows a diagram of the loudspeaker.

Figure 15



0 8 . 1 What is the name of the effect used by the moving-coil loudspeaker to produce sound waves?

[1 mark]

4.6.1.4 Sound waves (physics only) (HT only)

Question 26 · continued

0 8 . 2 Explain how a moving-coil loudspeaker produces a sound wave.

[4 marks]

Question 8 continues on the next page

4.6.1.4 Sound waves (physics only) (HT only)

Question 26 · continued

0 8 . 3 A student investigated how the loudness of sound from the loudspeaker depends on:

- the number of turns on the coil
- the frequency of the supply.

Table 2 shows the results.

Table 2

Number of turns	Frequency of supply in Hz	Loudness of sound in arbitrary units
100	200	32
200	400	47
300	600	63

Explain why the results **cannot** be used to make a valid conclusion.

[2 marks]

7

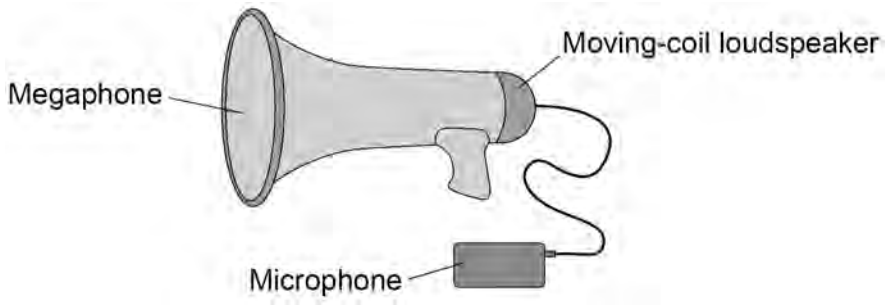
4.6.1.4 Sound waves (physics only) (HT only)

Question 27

0 4 A megaphone uses a loudspeaker to amplify sounds that are detected by a microphone.

Figure 10 shows a megaphone and microphone.

Figure 10



0 4 . 1 Complete the sentence.

[1 mark]

The microphone is used to convert the pressure variations in sound waves into variations in _____ .

0 4 . 2 The loudspeaker contains a permanent magnet.

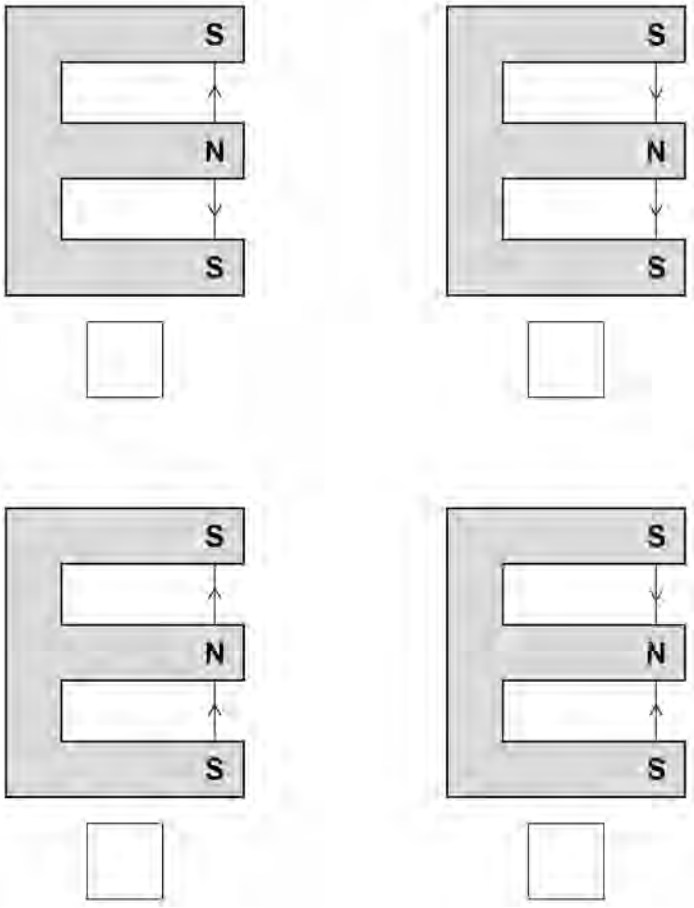
Which diagram in **Figure 11** shows the direction of the magnetic field between the north pole and the south pole of the magnet?

The magnets are shown in cross-section.

[1 mark]

Tick (✓) **one** box.

Figure 11



0 4 . 3 Some magnets are permanent magnets and some are induced magnets.

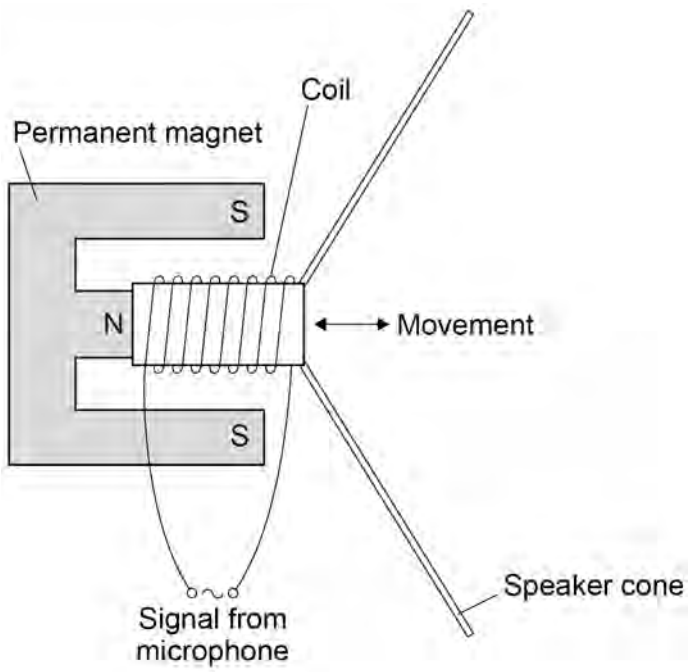
What is an induced magnet?

[1 mark]

Question 27 · continued

Figure 12 shows the parts of the loudspeaker in the megaphone.

Figure 12



A current in the coil of the loudspeaker causes the coil to move.

0 4 . 4 What is the name of the effect that causes the coil to move?

[1 mark]

Tick (✓) **one** box.

- Electromagnet effect ☐
- Induction effect ☐
- Motor effect ☐
- Speaker effect ☐

4.6.1.4 Sound waves (physics only) (HT only)

Question 27 · continued

0 4 . 5 When the current in the coil is 16 mA, the force on the coil is 0.013 N.

The length of the wire that makes up the coil is 6.5 m.

Calculate the magnetic flux density around the coil in the electromagnet.

Use the Physics Equations Sheet.

[4 marks]

Magnetic flux density = _____ T

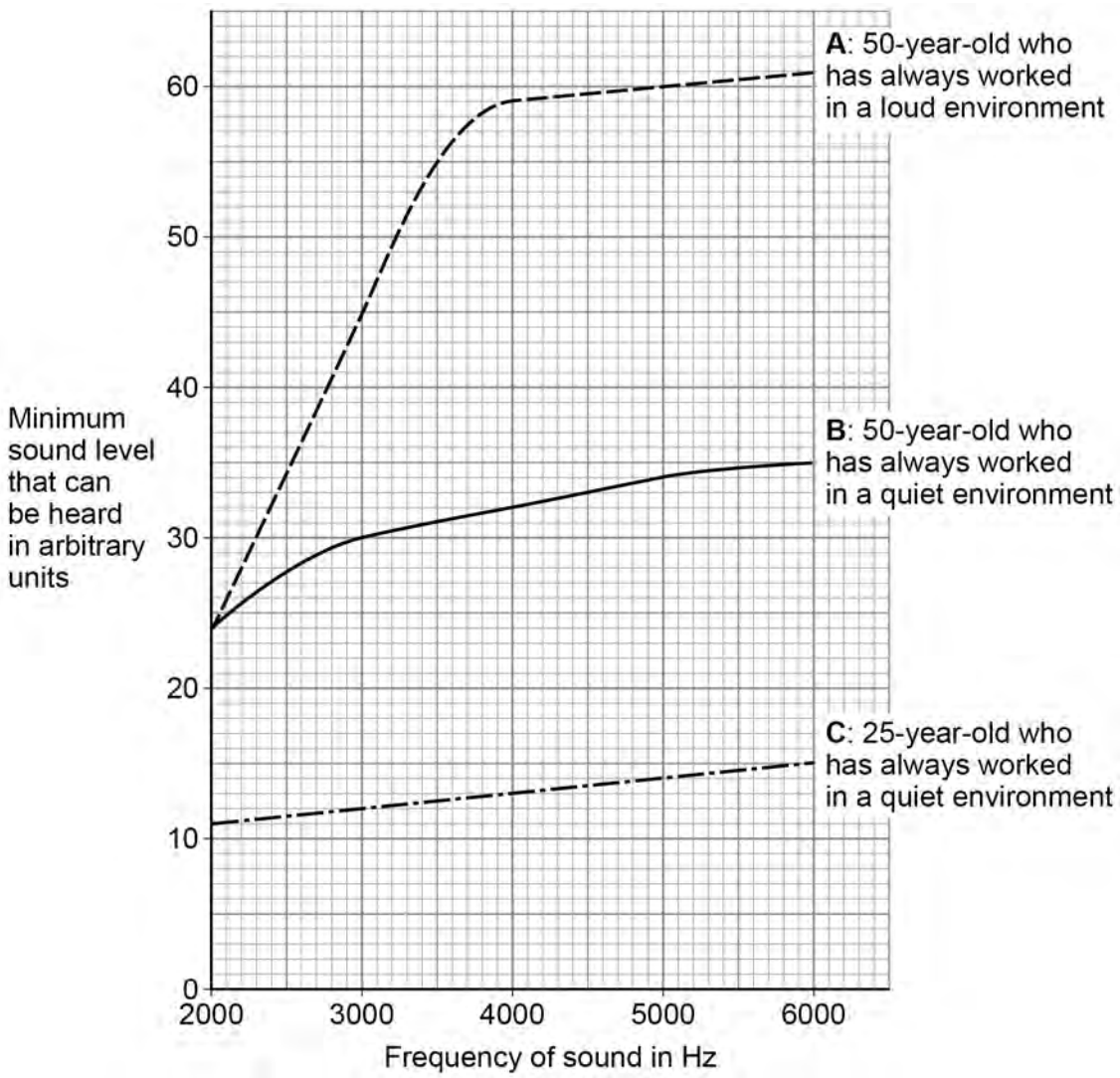
Question 4 continues on the next page

0 4 . 6 Megaphones can produce very loud sounds.

A person's hearing can be affected by age and by working in a loud environment.

Figure 13 shows how frequency affects the minimum sound level that can be heard by three different people, **A**, **B** and **C**.

Figure 13



4.6.1.4 Sound waves (physics only) (HT only)

Question 27 · continued

Compare how different factors affect the minimum sound level that these people can hear.

[4 marks]

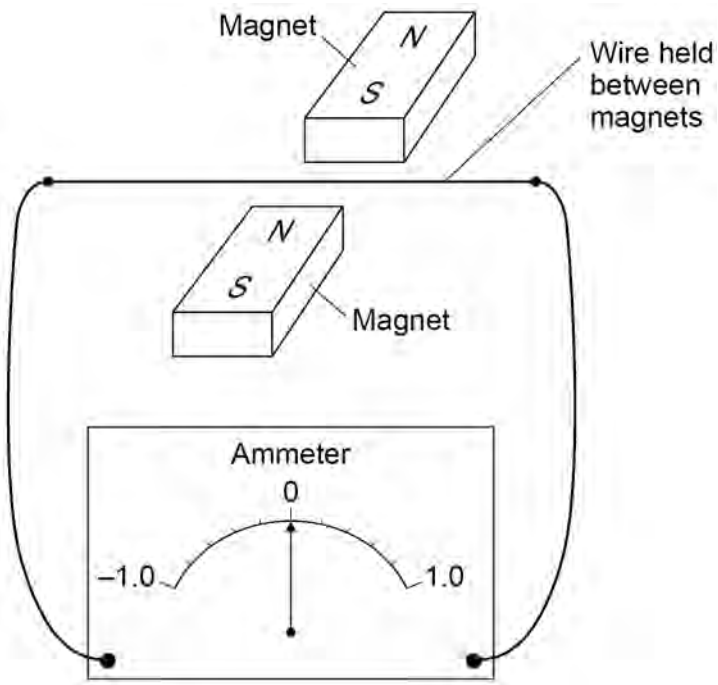
12

4.6.1.4 Sound waves (physics only) (HT only)

Question 28

0 8 **Figure 13** shows some apparatus used by a teacher in a demonstration.

Figure 13



The teacher moved the wire upwards between the magnets.

The needle on the ammeter deflected to a value of +0.4 mA and then returned to zero.

0 8 . 1 What effect did this demonstrate?

[1 mark]

Question 28 · continued

0 8 . 2 Explain why a current was detected when the wire in **Figure 13** was moved upwards.

[3 marks]

0 8 . 3 The teacher reversed the direction of the magnetic field.

The teacher replaced the wire in its original position.

The teacher moved the wire upwards in the same way as before.

What was the deflection of the needle on the ammeter?

[1 mark]

Tick (✓) **one** box.

The needle will deflect to –0.4 mA. ☐

The needle will not move. ☐

The needle will deflect to +0.4 mA. ☐

Question 8 continues on the next page

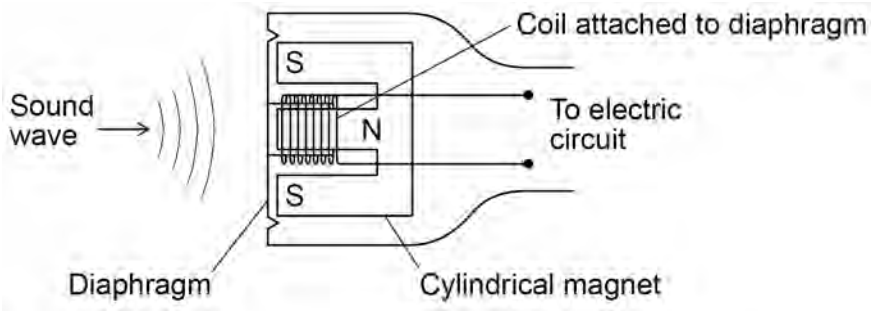
4.6.1.4 Sound waves (physics only) (HT only)

Question 28 · continued

0 8 . 4 **Figure 14** shows a sound wave incident on the diaphragm of a moving-coil microphone.

The inside of the microphone includes a small coil of wire and a magnet.

Figure 14



Explain why the sound waves have an effect on the electric circuit.

[3 marks]

8

4.6.1.4 Sound waves (physics only) (HT only)

Question 29

June 2025 | 8463/2H | Original Q1

0 1 In a thunderstorm, lightning produces visible light waves and sound waves.

0 1 . 1 Describe the similarities and differences between visible light waves and sound waves.

[6 marks]

4.6.1.4 Sound waves (physics only) (HT only)

Question 29 · continued

Use the Physics Equations Sheet to answer questions **01.2** and **01.3**.

0 1 . 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 1 . 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