AQA GCSE Physics | 8463

SPECIFICATION POINT 4.6.1.5

Waves for detection and exploration (physics only) (HT only)

Past-paper questions

Tier	**Higher**
Question groups	**22**
Available paper years	**2003–2024**

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:** _____

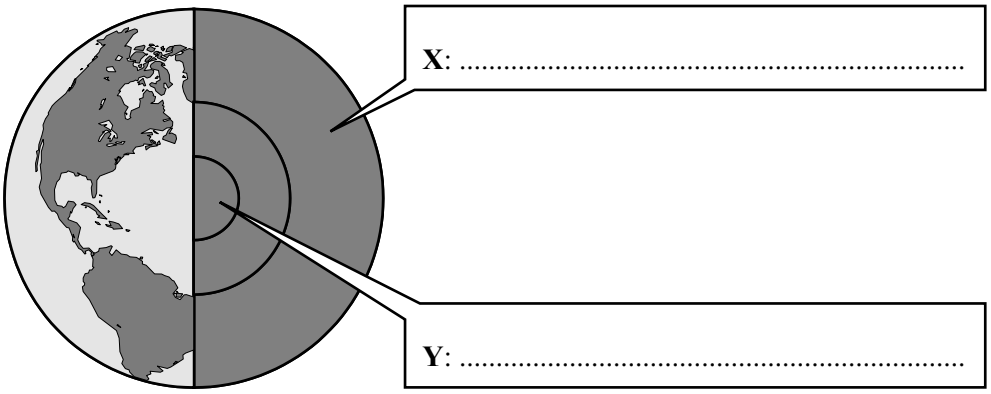
Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Question 01

June 2003 | 3451H | Original Q7 | Legacy

7 (a) The diagram shows the layered structure of the Earth.



(i) Write in the boxes the name of layer **X** and the name of layer **Y**.

(2 marks)

(ii) The overall density of the Earth is about 5500 kg/m^3. The average density of the rocks in the Earth's crust is about 2800 kg/m^3. What does this suggest about the material that makes up the lower layers of the Earth?

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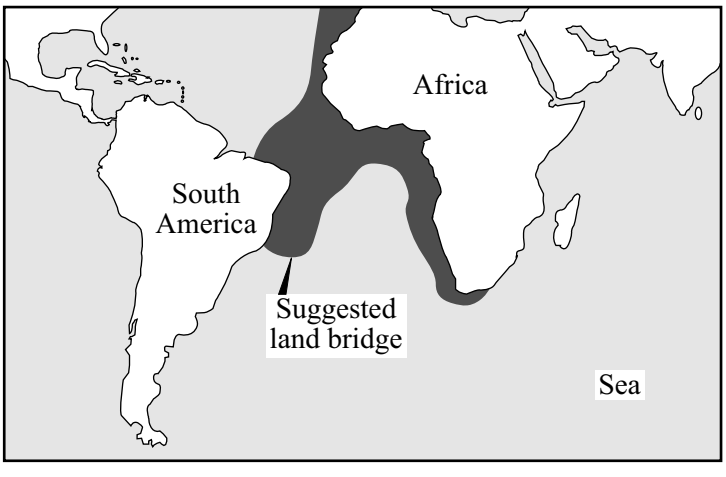
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(2 marks)

(b) In 1915, the scientist Alfred Wegener suggested that Africa and South America had once been joined but had since drifted apart. Evidence for his theory came from the animal fossils found in the two continents. The fossils are almost the same, although animals now living in Africa and South America are different. Other scientists did not agree with Wegener and suggested that a land bridge had once joined the two continents.



How could scientists use the idea of a land bridge to explain the evidence put forward by Wegener?

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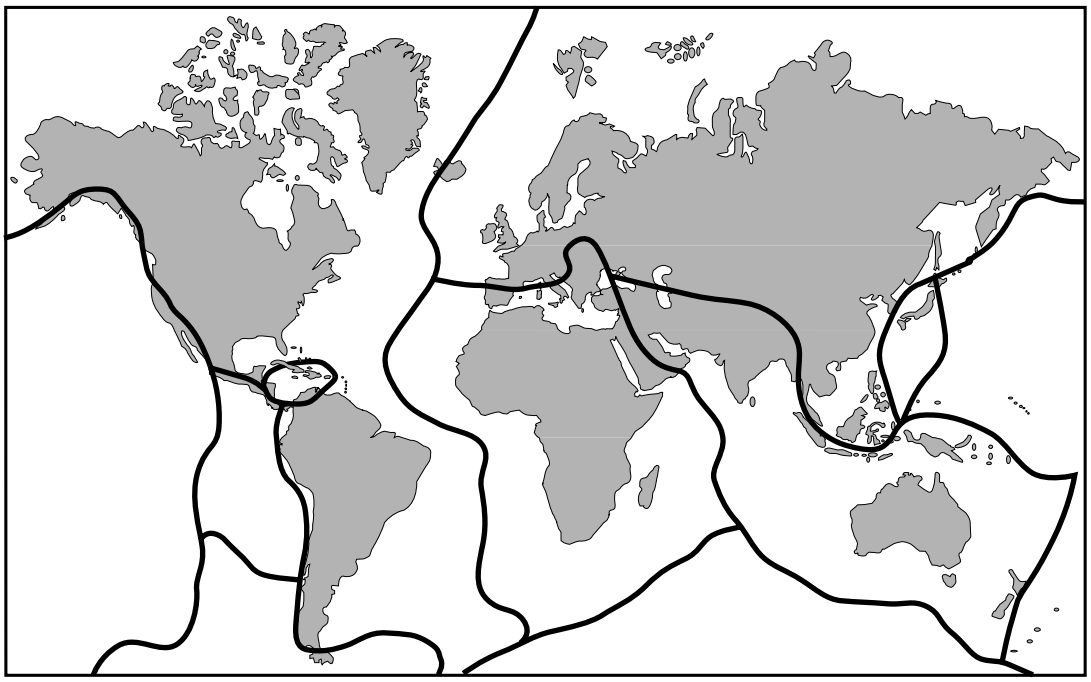
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(2 marks)

QUESTION 7 CONTINUES ON THE NEXT PAGE

(c) Scientists now think that the outer layer of the Earth is cracked into a number of large pieces called tectonic plates. The tectonic plates are moving very slowly. The lines on the diagram show the boundaries between the major tectonic plates.



(i) Explain why there are no major earthquakes in Britain.

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(2 marks)

(ii) What is causing the tectonic plates to move?

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(1 mark)

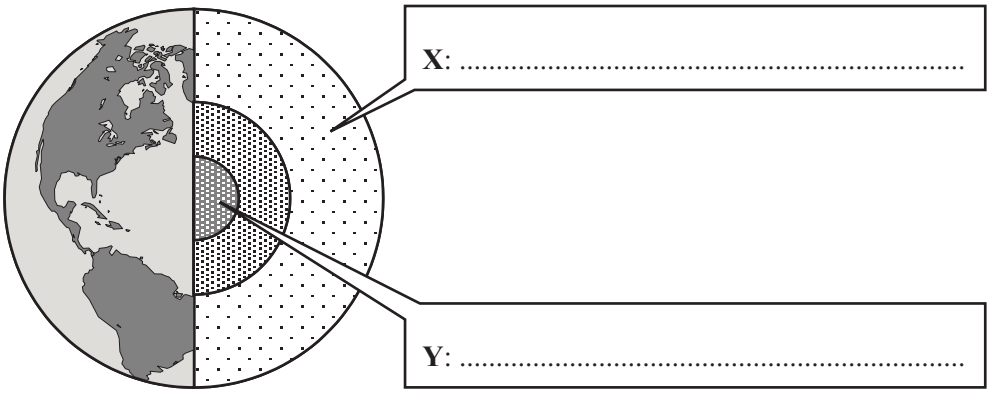
9

4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Question 02

June 2003 | 3462H3 | Original Q5 | Legacy

5 (a) The diagram shows the layered structure of the Earth.



(i) Write in the boxes the name of layer **X** and the name of layer **Y**.

(2 marks)

(ii) The overall density of the Earth is about 5500 kg/m^3. The average density of the rocks in the Earth's crust is about 2800 kg/m^3. What does this suggest about the material that makes up the lower layers of the Earth?

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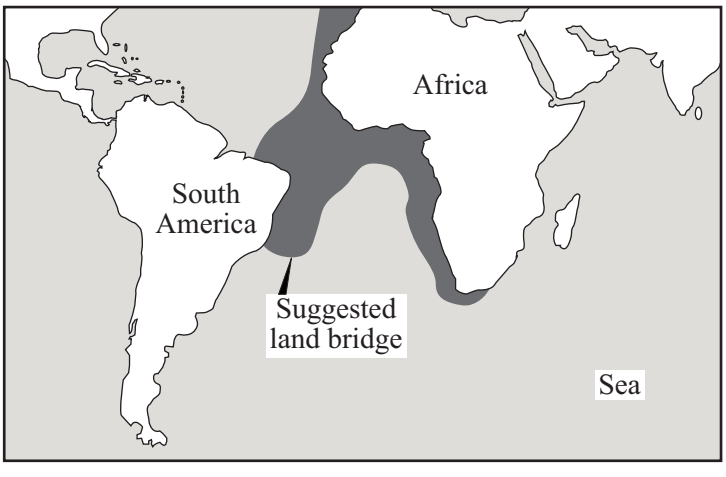
(2 marks)

4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Question 02 · continued

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(b) In 1915, the scientist Alfred Wegener suggested that Africa and South America had once been joined but had since drifted apart. Evidence for his theory came from the animal fossils found in the two continents. The fossils are almost the same, although animals now living in Africa and South America are different. Other scientists did not agree with Wegener and suggested that a land bridge had once joined the two continents.



How could scientists use the idea of a land bridge to explain the evidence put forward by Wegener?

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(2 marks)

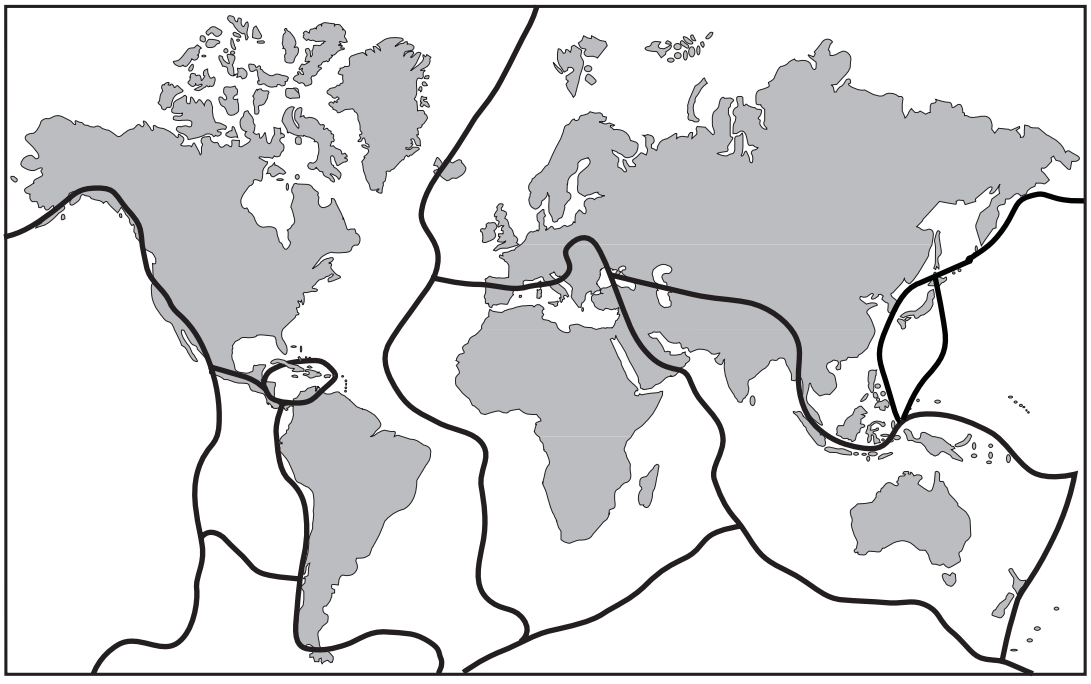
QUESTION 5 CONTINUES ON THE NEXT PAGE

4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Question 02 · continued

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(c) Scientists now think that the outer layer of the Earth is cracked into a number of large pieces called tectonic plates. The tectonic plates are moving very slowly. The lines on the diagram show the boundaries between the major tectonic plates.



(i) Explain why there are no major earthquakes in Britain.

.....

.....

.....

.....

(2 marks)

(ii) What is causing the tectonic plates to move?

.....

.....

(1 mark)

9

4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Question 03

June 2004 | 3451H | Original Q14 | Legacy

14 (a) Use the theory of plate tectonics to explain sea floor spreading.

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(2 marks)

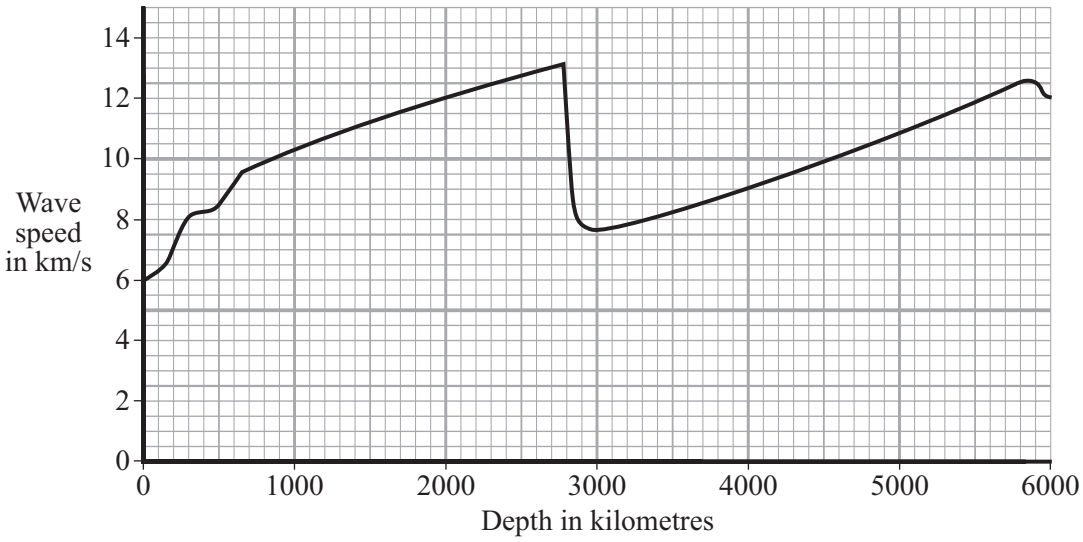
(b) What evidence is there to support the idea of sea floor spreading?

.....

.....

(1 mark)

(c) The diagram shows how the speed of a P-wave produced by an earthquake changes as it travels through the Earth.



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

.....

(1 mark)

(ii) At a depth of 2000 km the P-wave has a wavelength of 24 000 m. Calculate the frequency of the P-wave. Show clearly how you work out your answer.

.....

.....

frequency = ...Hz

(2 marks)

6

4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Question 04

June 2004 | 3462H3 | Original Q12 | Legacy

12 (a) Use the theory of plate tectonics to explain sea floor spreading.

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(2 marks)

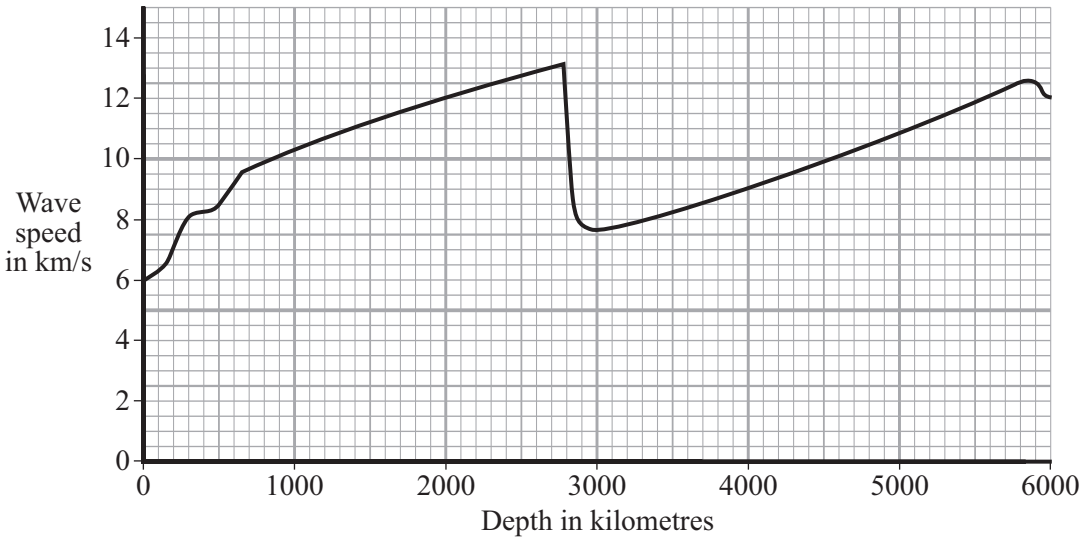
(b) What evidence is there to support the idea of sea floor spreading?

.....

.....

(1 mark)

(c) The diagram shows how the speed of a P-wave produced by an earthquake changes as it travels through the Earth.



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

.....

(1 mark)

(ii) At a depth of 2000 km the P-wave has a wavelength of 24 000 m. Calculate the frequency of the P-wave. Show clearly how you work out your answer.

.....

.....

frequency = ...Hz

(2 marks)

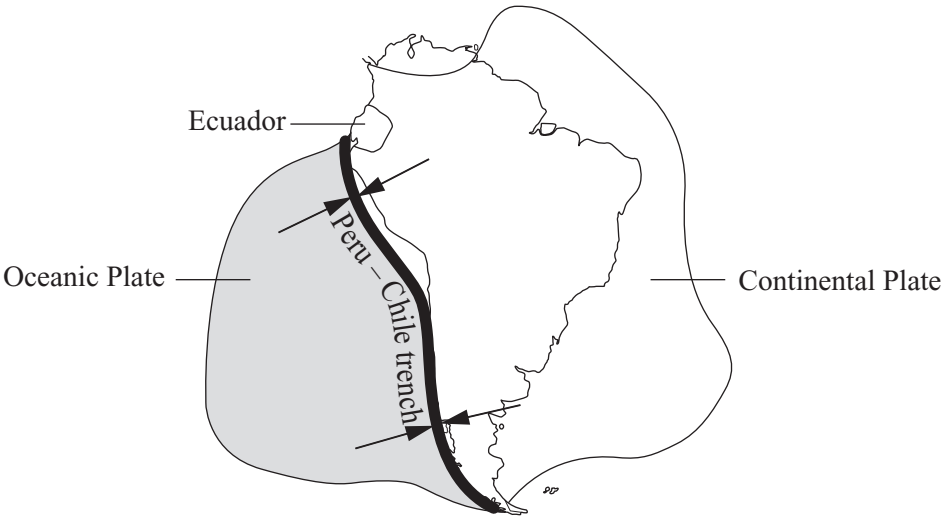
6

4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Question 05

June 2005 | 3451 | Original Q15 | Legacy

15 The Peru–Chile trench runs down the west coast of South America. It is the boundary between two tectonic plates that are slowly moving towards each other.



Source: WITNEY, DROZDOWSKA AND MAILE, *AQA GCSE Physics* (Hodder & Stoughton) 2002. Adapted and reproduced by permission of Hodder & Stoughton.

(a) Explain what causes the tectonic plates to move.

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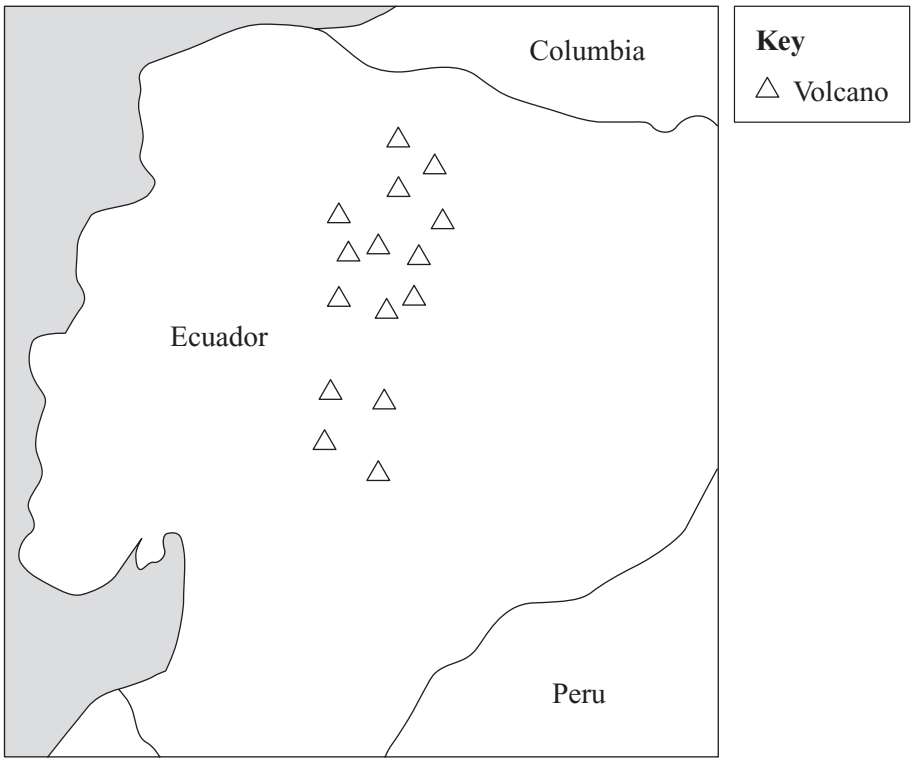
(2 marks)

4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Question 05 · continued

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(b) The map shows the location of some of the volcanoes in Ecuador. The volcanoes are all close to the Peru–Chile trench.



Explain how the volcanoes were formed.

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(3 marks)

(c) The eruption of Mount St Helens in the USA is one of the few volcanic eruptions to have been accurately predicted by scientists. The scientists had been monitoring *seismic activity*, levels of sulphur dioxide and changes to the ground level.

(i) What is meant by *seismic activity*?

.....

(1 mark)

QUESTION 15 CONTINUES ON THE NEXT PAGE

4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Question 05 · continued

MARGIN BLANK

(ii) Suggest why scientists find it difficult to predict accurately when a volcano is going to erupt.

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.....

(2 marks)

(d) The molten rock flowing from an erupting volcano can reach a speed of 8 m/s.

(i) Write down the equation that links kinetic energy, mass and speed.

.....

(1 mark)

(ii) Calculate the kinetic energy of 1 tonne of molten rock flowing at 8 m/s.
(1 tonne = 1000 kg)

.....

.....

Kinetic energy = ... joules
(1 mark)

(e) Read the information in the box and then answer the questions.

> Igneous rocks contain potassium-40. This is a radioactive isotope. It has a half-life of 1300 million years.
>
> Potassium-40 decays into argon-40 which is stable.
>
> Argon escapes from molten rock. Any argon found in an igneous rock must have been produced since the rock solidified.
>
> A sample of an igneous rock has one atom of potassium-40 for every three atoms of argon-40.

(i) What fraction of the potassium-40 has not yet decayed?

.....

(1 mark)

(ii) Calculate the age of the rock.

.....

Age of rock = ... million years
(1 mark)

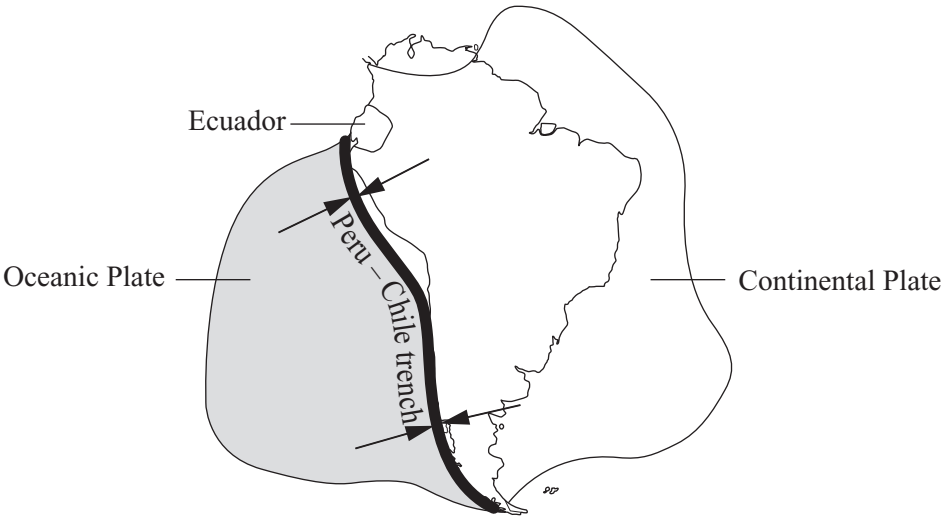
12

4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Question 06

June 2005 | 3462 | Original Q11 | Legacy

11 The Peru–Chile trench runs down the west coast of South America. It is the boundary between two tectonic plates that are slowly moving towards each other.



Source: WITNEY, DROZDOWSKA AND MAILE, *AQA GCSE Physics* (Hodder & Stoughton) 2002. Adapted and reproduced by permission of Hodder & Stoughton.

(a) Explain what causes the tectonic plates to move.

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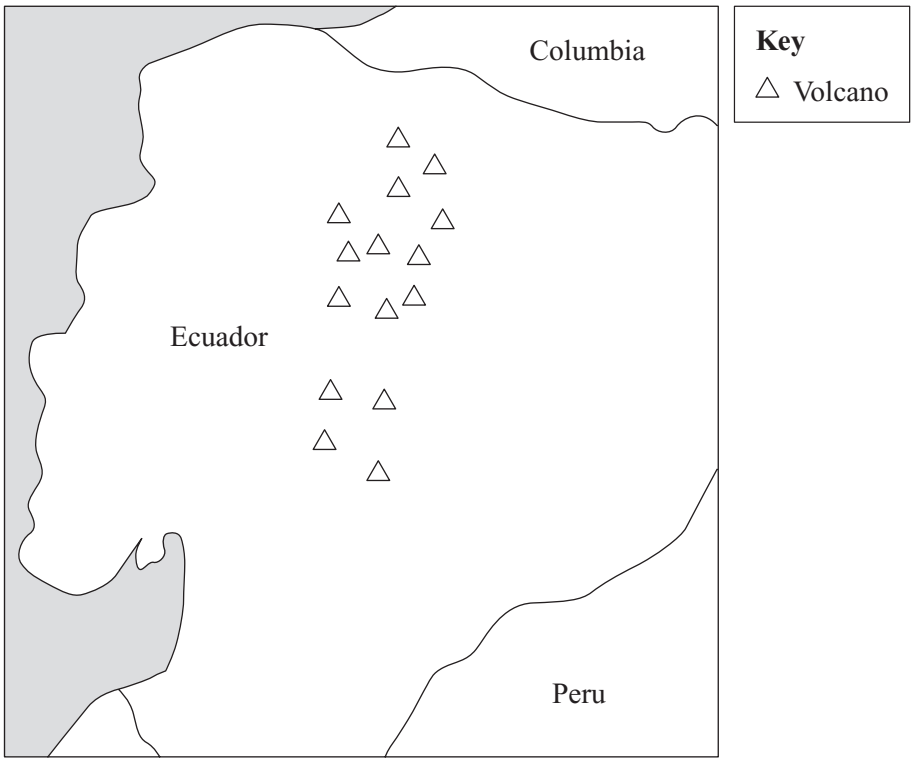
(2 marks)

4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Question 06 · continued

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(b) The map shows the location of some of the volcanoes in Ecuador. The volcanoes are all close to the Peru–Chile trench.



Explain how the volcanoes were formed.

.....

.....

.....

.....

.....

.....

(3 marks)

(c) The eruption of Mount St Helens in the USA is one of the few volcanic eruptions to have been accurately predicted by scientists. The scientists had been monitoring *seismic activity*, levels of sulphur dioxide and changes to the ground level.

(i) What is meant by *seismic activity*?

.....

(1 mark)

QUESTION 11 CONTINUES ON THE NEXT PAGE

4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Question 06 · continued

MARGIN BLANK

(ii) Suggest why scientists find it difficult to predict accurately when a volcano is going to erupt.

.....

.....

.....

.....

(2 marks)

(d) The molten rock flowing from an erupting volcano can reach a speed of 8 m/s.

(i) Write down the equation that links kinetic energy, mass and speed.

.....

(1 mark)

(ii) Calculate the kinetic energy of 1 tonne of molten rock flowing at 8 m/s.
(1 tonne = 1000 kg)

.....

.....

Kinetic energy = ... joules
(1 mark)

(e) Read the information in the box and then answer the questions.

> Igneous rocks contain potassium-40. This is a radioactive isotope. It has a half-life of 1300 million years.
>
> Potassium-40 decays into argon-40 which is stable.
>
> Argon escapes from molten rock. Any argon found in an igneous rock must have been produced since the rock solidified.
>
> A sample of an igneous rock has one atom of potassium-40 for every three atoms of argon-40.

(i) What fraction of the potassium-40 has not yet decayed?

.....

(1 mark)

(ii) Calculate the age of the rock.

.....

Age of rock = ... million years
(1 mark)

12

4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Question 07

June 2008 | PHY3H | Original Q5 | Legacy

5 Ultrasound can be used in industry for detecting internal cracks in metals.

5 (a) State **two** features of ultrasound.

1 .....

2 .....

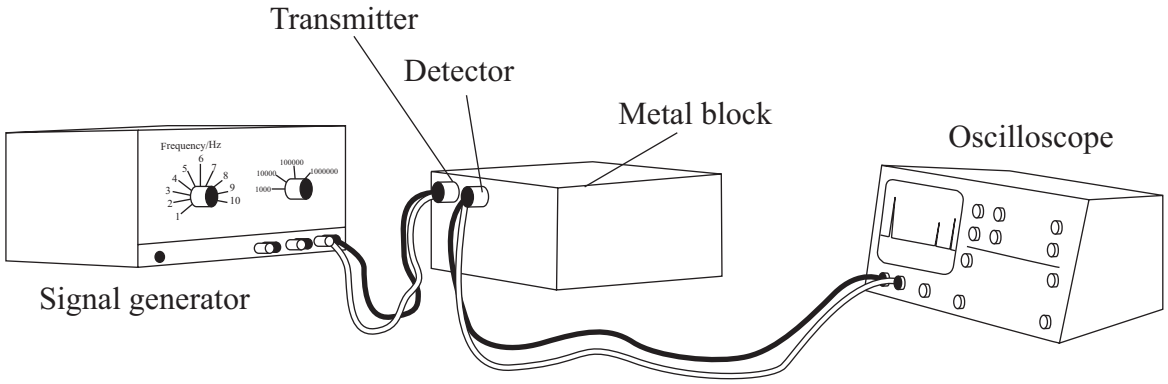
(2 marks)

4.6.1.5 Waves for detection and exploration (physics only) (HT only)

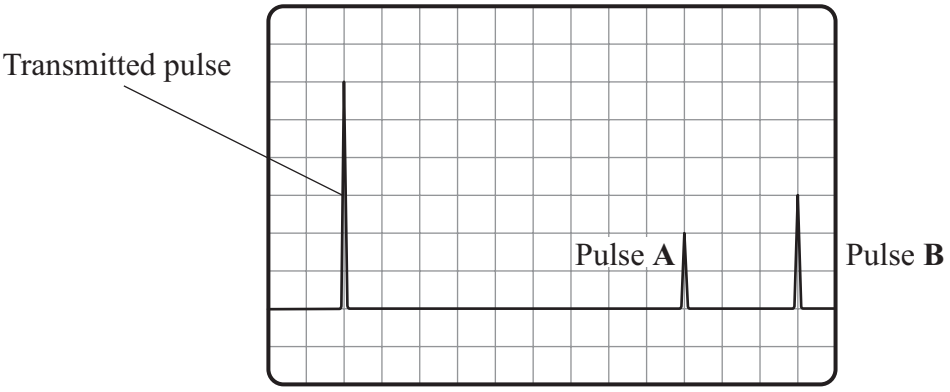
Question 07 · continued

for mark

5 (b) The diagram shows an ultrasound transmitter and detector fixed to the front of a metal block. The block has an internal crack.



The diagram below shows the screen of the oscilloscope connected to the detector.



5 (b) (i) Explain why pulse **A** and pulse **B** occur.

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.....

(2 marks)

5 (b) (ii) The metal block is 120 mm from front to back. What is the distance, in mm, from the front of the block to the internal crack?

Distance = ... mm

(1 mark)

5

4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Question 08

January 2009 | PHY3H | Original Q1 | Legacy

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)

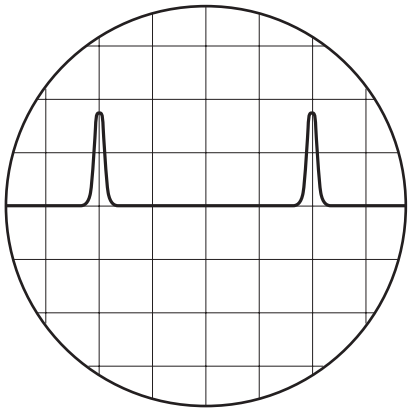
4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Question 08 · 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

4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Question 09

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.

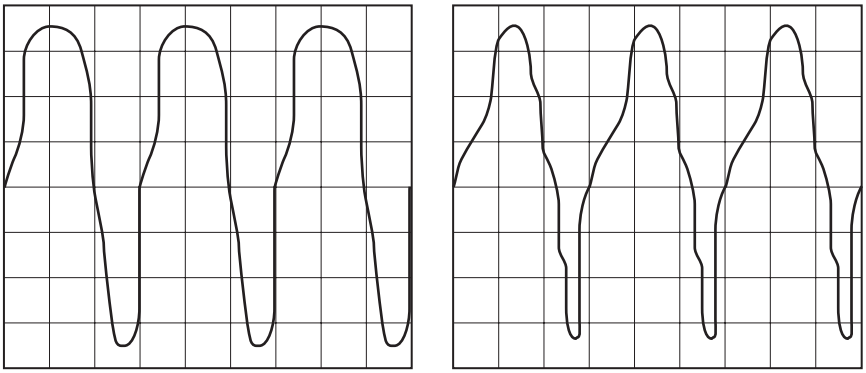


Diagram X **Diagram Y**

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

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.....

(1 mark)

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

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(1 mark)

4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Question 09 · 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?

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(2 marks)

6

4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Question 10

3 (a) Explain what an ultrasound wave is.

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(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

4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Question 11

June 2010 | PHY1BP | Original Q9 | Legacy

QUESTION NINE

Thermal imaging cameras are used by rescue workers to search for people trapped under rubble after an earthquake. Like all warm objects, the living human body emits infra red radiation. The cameras detect this infra red radiation. Electronic circuits in the camera produce a colour image in which different colours correspond to different wavelengths of infra red radiation.

The table shows the image colour, infra red wavelength and the temperature of the object.

Image colour	Infra red wavelength in micrometres	Temperature of object in °C
Red	9.51	32
Red-orange	9.45	34
Orange	9.4	36
Orange-yellow	9.32	38
Yellow	9.26	40
Yellow-white	9.2	42

9A Two of the values of wavelength in the table show a lower . . .

1 calibration.

2 precision.

3 range.

4 reliability.

9B A scientist wanted to display this data as a line graph.

Which row in the table below shows the scales which would best display the data?

	x-axis (wavelength in micrometres)	y-axis (temperature in °C)
1	0 to 10	0 to 50
2	0 to 10	30 to 50
3	9 to 10	0 to 50
4	9 to 10	30 to 50

4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Question 11 · continued

9C A thermal image of a small boy is mainly orange.

Under identical conditions, the thermal image of a much larger man would be . . .

1 mainly yellow because the man's body has a greater mass.

2 mainly red because the man's body has a larger surface area.

3 a mixture of red, orange and yellow because the man's body has a larger mass and a larger surface area.

4 mainly orange because the man and the boy have approximately the same body temperature.

9D At night, police officers use thermal imaging cameras to track criminals running away from crime scenes.

These cameras work better at night than during the day because at night . . .

1 the criminals emit more infra red radiation.

2 the cooler surroundings emit less infra red radiation.

3 the cooler surroundings emit less visible light.

4 the criminals wear black clothes.

END OF TEST

4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Question 12

June 2013 | PH2HP | Original Q5 | Legacy

5 In 2011 an earthquake caused severe damage to a nuclear power station in Japan. The damage led to the release of large amounts of radioactive iodine-131($^{131}_{53}I$) into the atmosphere.

5 (a) The table gives some information about an atom of iodine-131($^{131}_{53}I$).

Complete the table.

mass number	131
number of protons	53
number of neutrons	

(1 mark)

5 (b) Complete the sentence.

The number of protons in an atom is called the proton number or

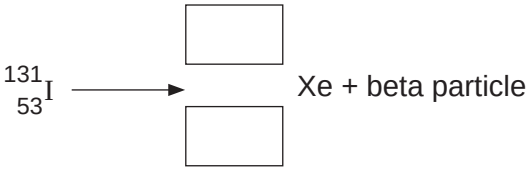
the ..... number.

(1 mark)

5 (c) An atom of iodine-131 decays into an atom of xenon (Xe) by emitting a beta particle.

5 (c) (i) The decay of iodine-131 can be represented by the equation below.

Complete the equation by writing the correct number in each of the **two** boxes.



(2 marks)

Question 5 continues on the next page

5 (c) (ii) A sample of rainwater contaminated with iodine-131 gives a count rate of 1200 counts per second.

Calculate how many days it will take for the count rate from the sample of rainwater to fall to 75 counts per second.

Half-life of iodine-131 = 8 days

Show clearly how you work out your answer.

.....

.....

..... days
(2 marks)

5 (c) (iii) If people drink water contaminated with iodine-131, the iodine-131 builds up in the thyroid gland. This continues until the thyroid is saturated with iodine-131 and cannot absorb any more. The radiation emitted from the iodine-131 could cause cancer of the thyroid.

In Japan, people likely to be drinking water contaminated with iodine-131 were advised to take tablets containing a non-radioactive isotope of iodine.

Suggest why this advice was given.

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(2 marks)

8

4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Question 13

June 2013 | PH3HP | Original Q3 | Legacy

3 Ultrasound and X-rays are waves used in hospitals to create images of the inside of the human body. To produce the images below, the waves must enter the human body.

Ultrasound scan of an unborn child



X-ray of a broken bone



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

Describe the features of ultrasound and X-rays, and what happens to each type of wave after it has entered the human body.

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(6 marks)

4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Question 13 · continued

3 (b) It would **not** be safe to use X-rays to produce an image of an unborn child.

Explain why.

.....

.....

.....

.....

(2 marks)

3 (c) Ultrasound can be used for medical treatments as well as for imaging.

Give **one** use of ultrasound for medical treatment.

.....

.....

(1 mark)

9

4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Question 14

June 2014 | PH3HP | Original Q1 | Legacy

1 (a) What is ultrasound?

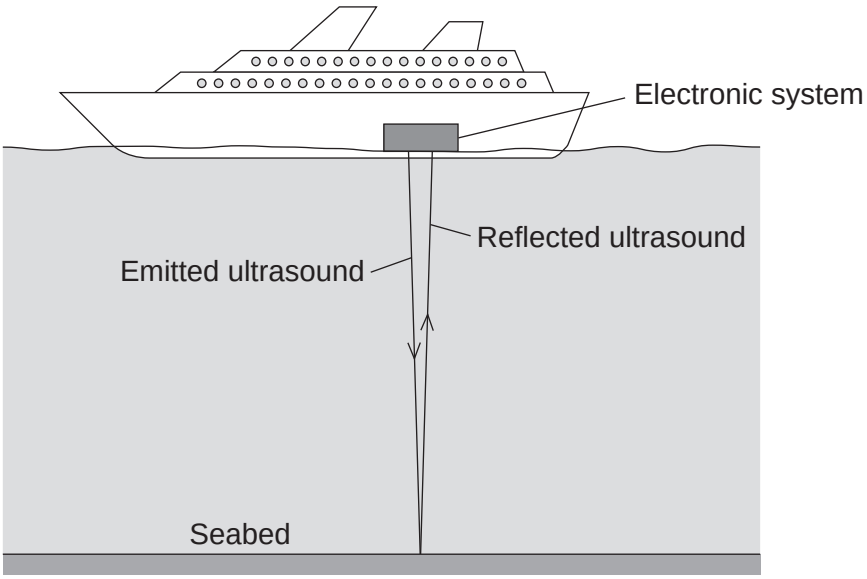
[1 mark]

.....

.....

1 (b) **Figure 1** shows how ultrasound is used to measure the depth of water below a ship.

Figure 1



A pulse of ultrasound is sent out from an electronic system on-board the ship.

It takes 0.80 seconds for the emitted ultrasound to be received back at the ship.

Calculate the depth of the water.

Speed of ultrasound in water = 1600 m/s

Use the correct equation from the Physics Equations Sheet.

[3 marks]

.....

.....

.....

.....

Depth of water = ... metres

4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Question 14 · continued

1 (c) Ultrasound can be used in medicine for scanning.

State **one** medical use of ultrasound scanning.

[1 mark]

.....

1 (d) Images of the inside of the human body can be made using a Computerised Tomography (CT) scanner. The CT scanner in **Figure 2** uses X-rays to produce these images.

Figure 2



State **one** advantage and **one** disadvantage of using a CT scanner, compared with ultrasound scanning, for forming images of the inside of the human body.

[2 marks]

Advantage of CT scanning .....

.....

.....

Disadvantage of CT scanning .....

.....

.....

7

4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Question 15

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]

.....

.....

.....

.....

.....

.....

.....

.....

4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Question 16

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.

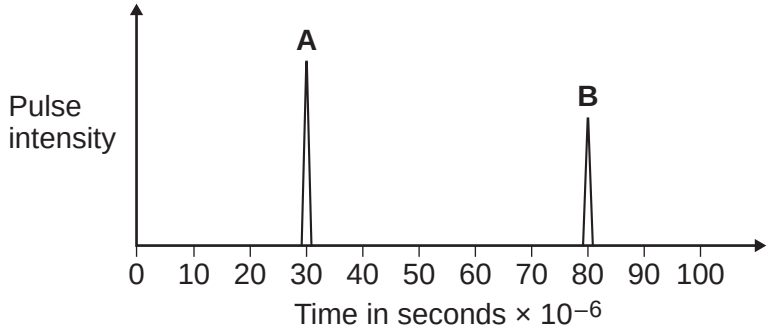
[2 marks]

4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Question 16 · continued

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

4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Question 16 · 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

4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Question 17

June 2017 | PH3HP | Original Q3 | Legacy

3 CT scans are used by doctors to create three-dimensional images of a patient's body.

3 (a) (i) Explain why CT scans can increase the risk of cancer to the patient.

[2 marks]

3 (a) (ii) Although CT scans increase the risk of cancer they are still carried out.

Suggest why.

[1 mark]

3 (b) A child has a CT scan. Her mother stays in the room with her during the scan.

Suggest **one** precaution that the mother should take during the scan.

[1 mark]

3 (c) Ultrasound can also be used to create three-dimensional images of a patient.

State **one** advantage of using CT scans rather than ultrasound scans.

[1 mark]

5

4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Question 18

June 2017 | PH3HP | Original Q7 | Legacy

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.

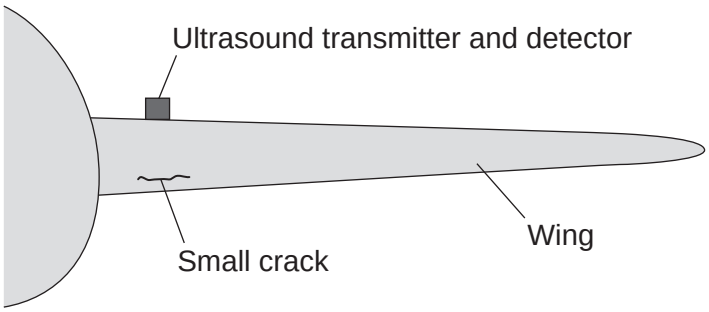
7 (a) State the minimum frequency of an ultrasound wave.

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]

4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Question 18 · continued

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

4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Question 19

June 2018 | 8463/1H | Original Q8

0 8 Nuclear power stations generate electricity through nuclear fission. Electricity can also be generated by burning shale gas.

0 8 . 1 Shale gas is natural gas trapped in rocks. Shale gas can be extracted by a process called fracking. There is some evidence that fracking causes minor earthquakes. Burning shale gas adds carbon dioxide to the atmosphere.

Describe the advantages of nuclear power compared with the use of shale gas to generate electricity.

[3 marks]

0 8 . 2 What is the name of **one** fuel used in nuclear power stations?

[1 mark]

4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Question 19 · continued

0 8 . 3 Describe the process of nuclear fission.

[4 marks]

8

Turn over for the next question

4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Question 20

June 2018 | 8463/2H | Original Q3

0 3 P-waves and S-waves are two types of seismic wave caused by earthquakes.

0 3 . 1 Which **one** of the statements about P-waves and S-waves is correct?

Tick **one** box.

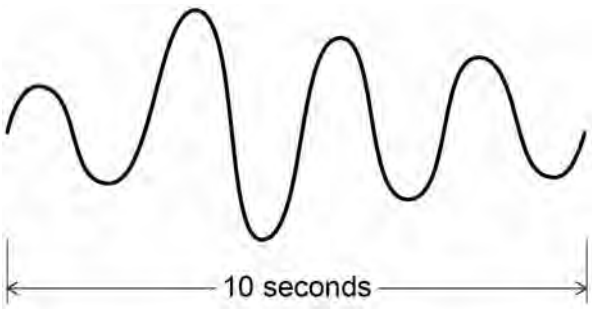
[1 mark]

- 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 3 shows the vibration recorded by a seismometer for one P-wave.

Figure 3



0 3 . 2 Calculate the frequency of the P-wave shown in **Figure 3**.

[1 mark]

Frequency = _____ Hz

Question 20 · continued

0 3 . 3 Write down the equation which links frequency, wavelength and wave speed.

[1 mark]

0 3 . 4 The P-wave shown in **Figure 3** is travelling at 7200 m/s.

Calculate the wavelength of the P-wave.

[3 marks]

Wavelength = _____ m

0 3 . 5 Explain why the study of seismic waves provides evidence for the structure of the Earth's core.

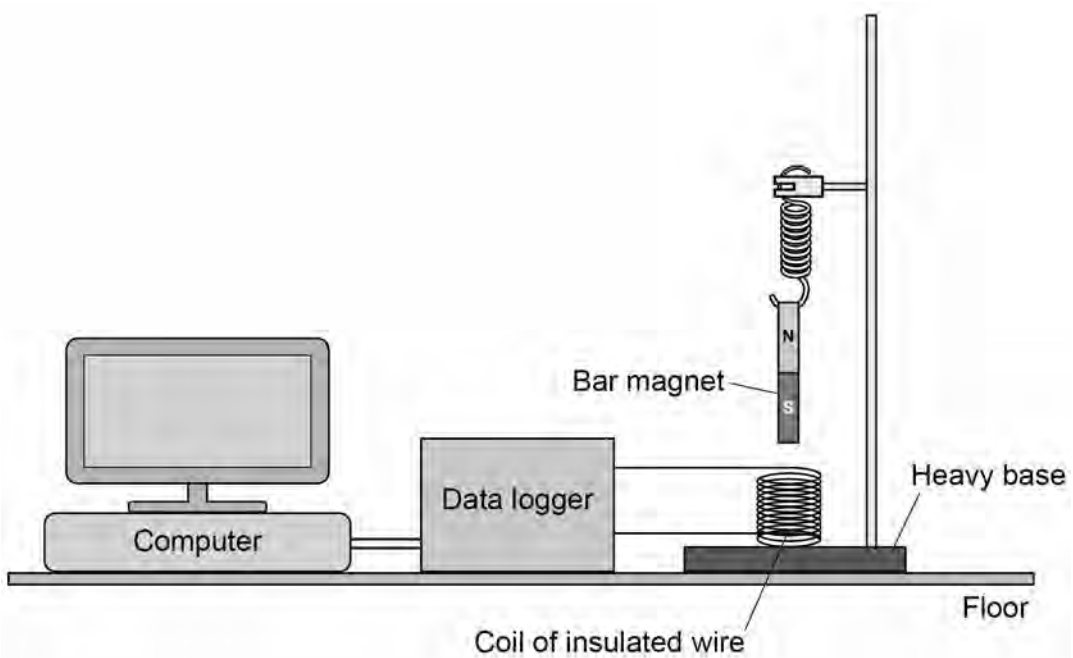
[2 marks]

Question 3 continues on the next page

Question 20 · continued

Figure 4 shows a simple seismometer made by a student.

Figure 4



To test that the seismometer works, the student pushes the bar magnet into the coil and then releases the bar magnet.

0 3 . 6 Why does the movement of the bar magnet induce a potential difference across the coil?

[1 mark]

0 3 . 7 Why is the induced potential difference across the coil alternating?

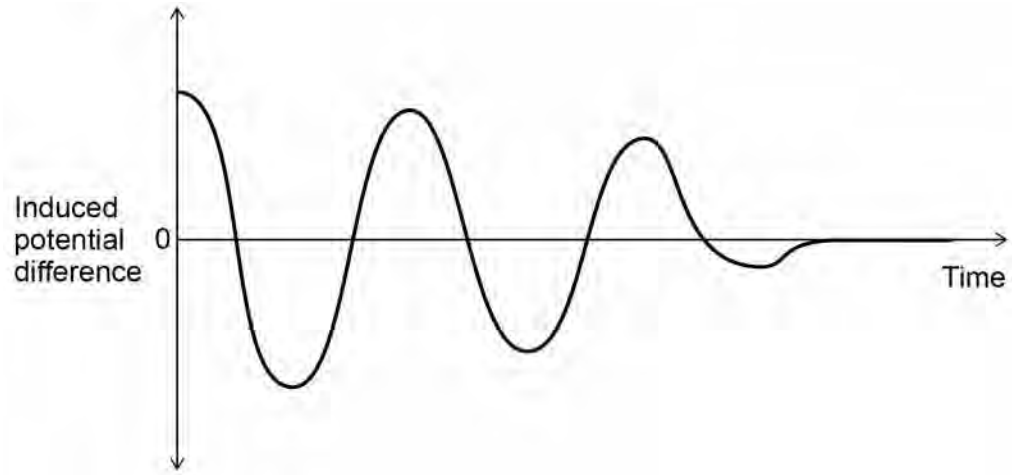
[1 mark]

4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Question 20 · continued

0 3 . 8 **Figure 5** shows how the potential difference induced across the coil varies after the bar magnet has been released.

Figure 5



Which statement describes the movement of the magnet when the induced potential difference is zero?

Tick **one** box.

[1 mark]

Accelerating upwards. ☐

Constant speed upwards. ☐

Decelerating downwards. ☐

Stationary. ☐

0 3 . 9 The seismometer cannot detect small vibrations.

Suggest **two** changes to the design of the seismometer that would make it more sensitive to small vibrations.

[2 marks]

1 _____

_____

2 _____

_____

13

4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Question 21

June 2019 | 8463/2H | Original Q9

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

Table 3

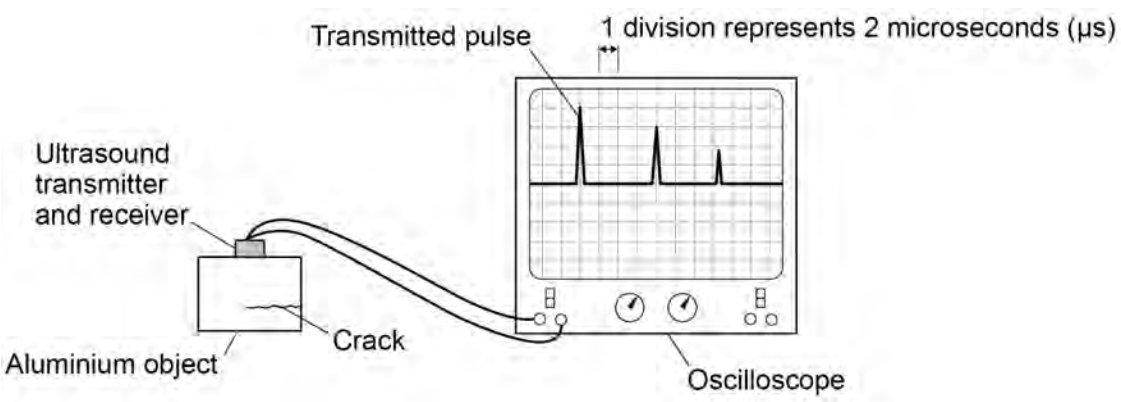
Animal	Frequencies of hearing range
Cat	55 Hz to 77 kHz
Chicken	125 Hz to 2 kHz
Dog	20 Hz to 30 kHz
Gerbil	56 Hz to 60 kHz
Horse	55 Hz to 33 kHz

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



Question 21 · continued

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]

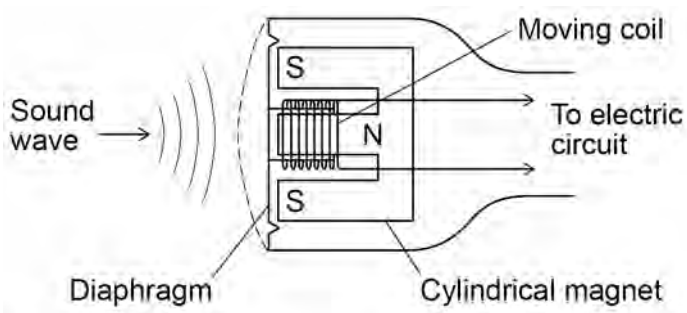
Depth = _____ m

Question 9 continues on the next page

Question 21 · 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

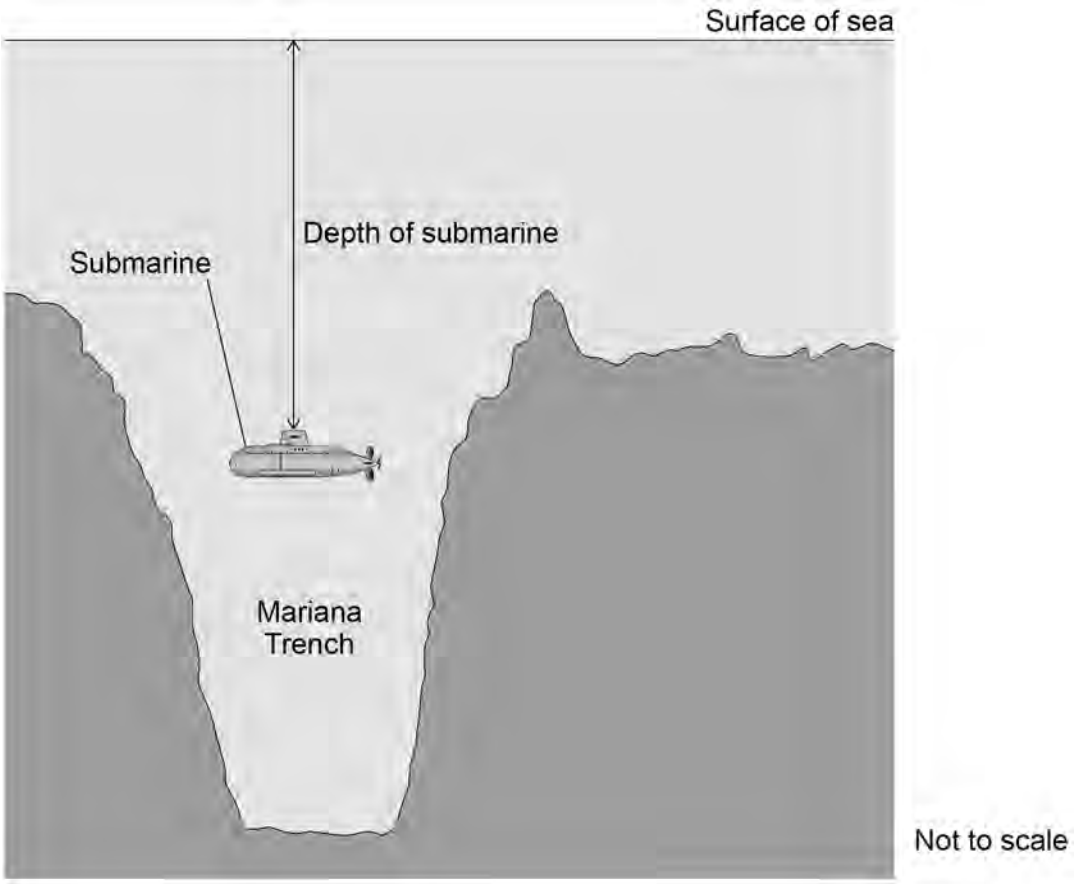
4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Question 22

0 4 The Mariana Trench is the deepest part of the Pacific Ocean.

Figure 8 shows a submarine going to the bottom of the Mariana Trench.

Figure 8



0 4 . 1 The depth of the submarine increases.

Explain what happens to the pressure on the submarine.

[2 marks]

0 4 . 2 The submarine moved from the surface of the water to the bottom of the Mariana Trench.

The change in pressure was 110 000 kPa.

mean density of sea water = 1026 kg/m^3

gravitational field strength = 9.8 N/kg

Calculate the depth of the Mariana Trench.

Use the Physics Equations Sheet.

[4 marks]

Depth = _____ m

Question 4 continues on the next page

Question 22 · continued

Earthquakes often occur at the Mariana Trench.

P-waves and S-waves are produced by earthquakes.

0 4 . 3 Which statement describes P-waves and S-waves?

[1 mark]

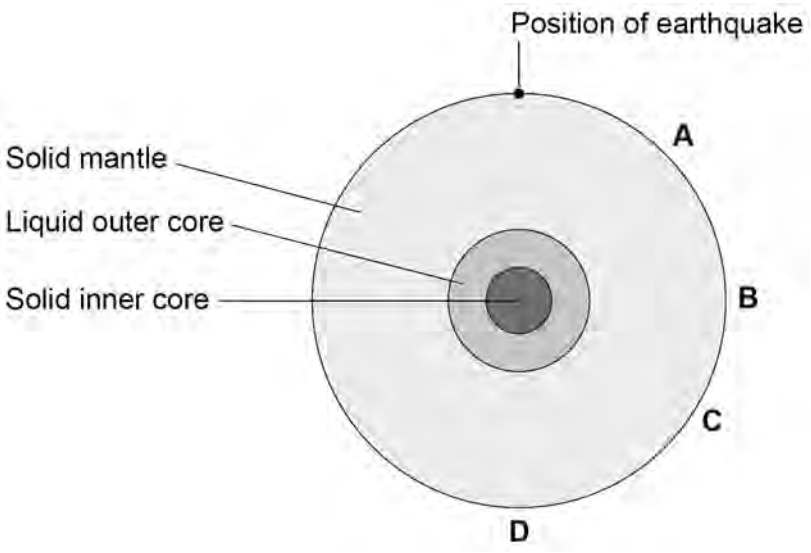
Tick (✓) **one** box.

- Both P-waves and S-waves are longitudinal. ☐
- Both P-waves and S-waves are transverse. ☐
- P-waves are longitudinal and S-waves are transverse. ☐
- P-waves are transverse and S-waves are longitudinal. ☐

0 4 . 4 **Figure 9** shows the layers inside the Earth.

An earthquake occurs at the position shown.

Figure 9



Which letter shows the position where **only** P-waves will be detected?

Give a reason for your answer.

[2 marks]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

Reason _____

_____

Question 4 continues on the next page

4.6.1.5 Waves for detection and exploration (physics only) (HT only)

Question 22 · continued

0 4 . 5 An S-wave has a frequency of 3.6 Hz.

The S-wave has a speed of 4.5 km/s.

Calculate the wavelength of this S-wave.

Use the Physics Equations Sheet.

[3 marks]

Wavelength = _____ m

0 4 . 6 A seismometer is a device that detects earthquakes.

P-waves travel at a known speed between an earthquake and a seismometer.

S-waves travel at a slower speed than P-waves.

A P-wave and an S-wave from the earthquake arrive at the seismometer at different times.

Describe the relationship between the distance from the earthquake to the seismometer and the time between the P-wave and the S-wave arriving.

[2 marks]

14