

# Ultrasound

## Question Paper

Level	GCSE
Subject	Physics
Exam Board	AQA
Unit	P3
Topic	Ultrasound
Difficulty Level	Silver Level
Booklet	Question Paper

**Time Allowed:** 94 minutes

**Score:** /94

**Percentage:** /100

Q1.(a) Complete the following sentences.

Ultrasound waves have a minimum frequency  
of ..... hertz.

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

(2)

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

The images show one medical use of ultrasound and one medical use of X-rays.



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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.

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(6)  
(Total 8 marks)

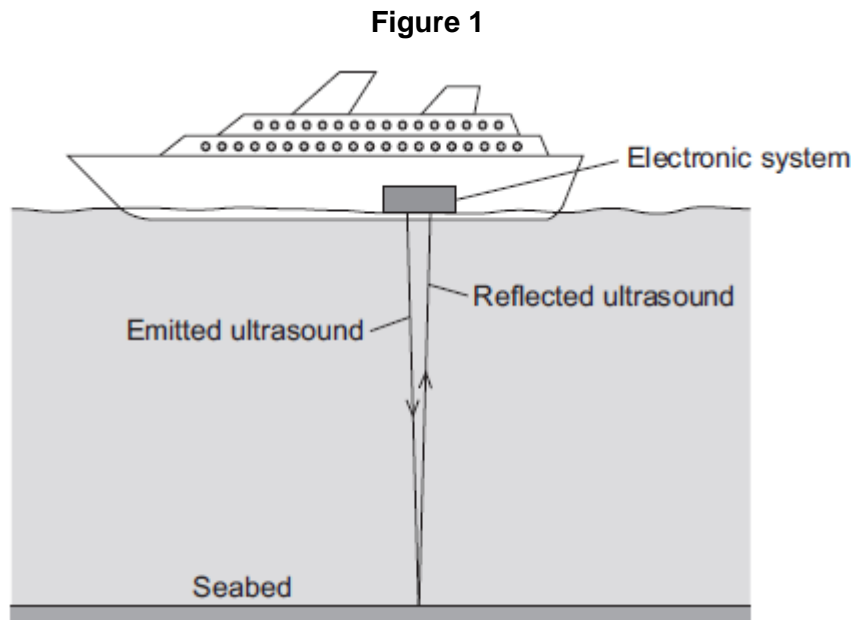
Q2.(a) What is ultrasound?

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(1)

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



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.

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.....  
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Depth of water = ..... metres

(3)

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

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

.....

(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**



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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.

Advantage of CT scanning .....

.....  
.....  
Disadvantage of CT scanning .....

(2)  
(Total 7 marks)

**Q3.** 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  
bone**

**X-ray of a broken  
bone**



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- (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)

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

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(2)

- (c) Ultrasound can be used for medical treatments as well as for imaging.  
Give **one** use of ultrasound for medical treatment.

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(1)

(Total 9 marks)

- Q4.(a) Explain what ultrasound is.

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.....

.....

(2)

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

Do you think the ultrasound experiments on mice were justified?

Explain your answer.

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(2)

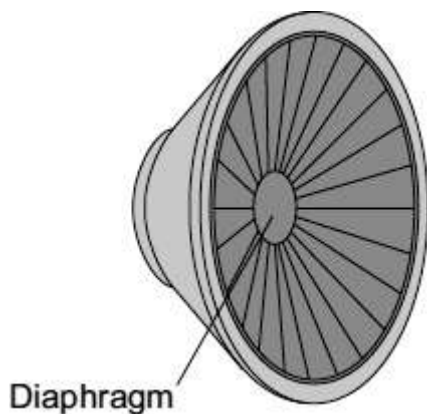
- (c) Explain what scientists should do if they find evidence that ultrasound may be harmful to human health.

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(2)

(Total 6 marks)

**Q5.** The diaphragm of a loudspeaker moves in and out.

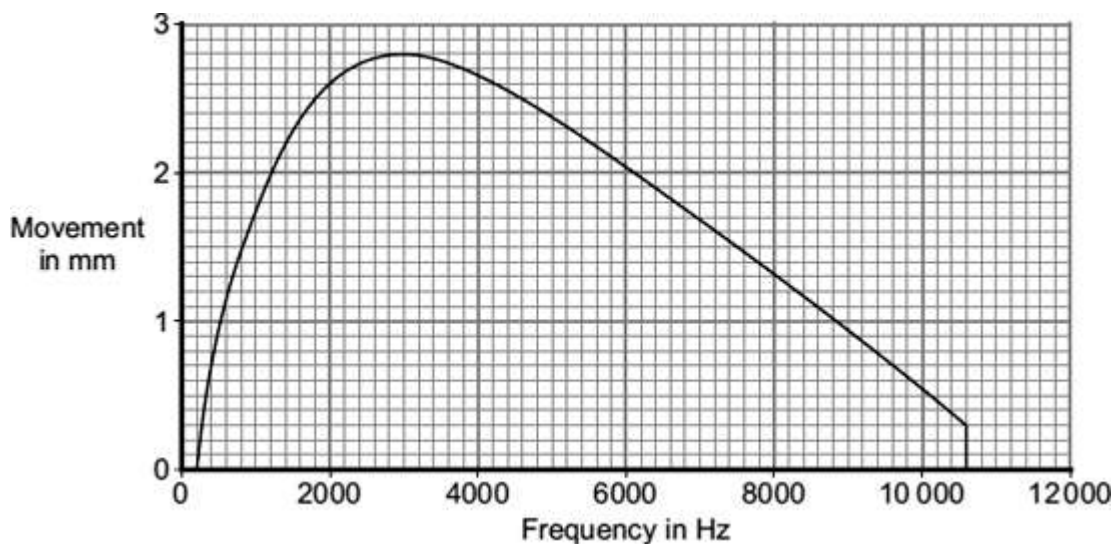


A team of scientists investigated loudspeakers.

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.



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

Frequency = ..... Hz

(1)

- (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)

- (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)**

(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)**

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

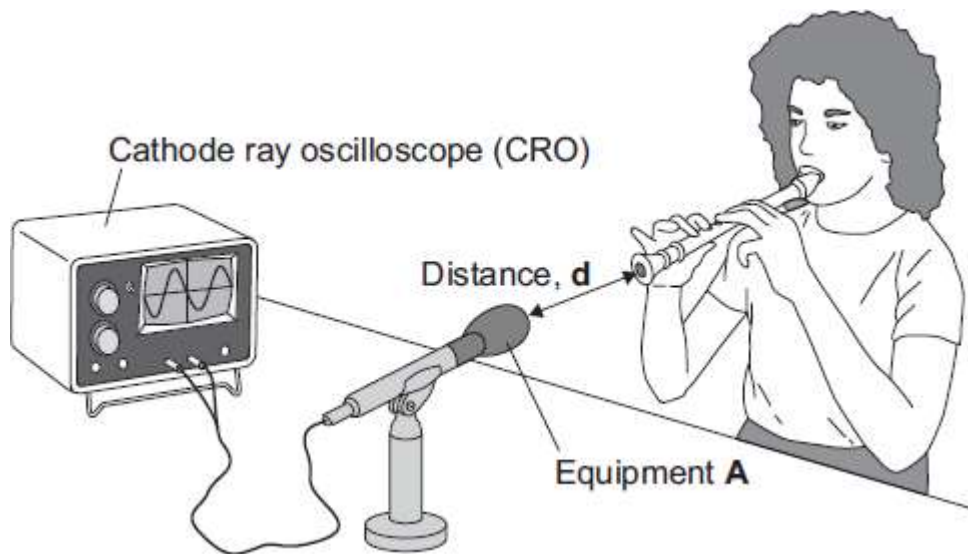
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**(1)**

**(Total 7 marks)**

**Q6.** A group of students investigates sound waves.

The diagram shows part of their investigation.



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

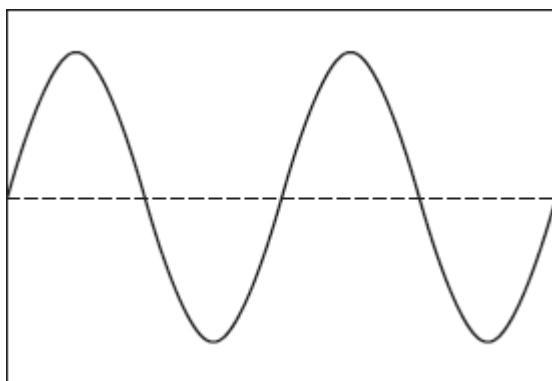
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(1)

- (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).

- (i) Label this wave to show its amplitude.



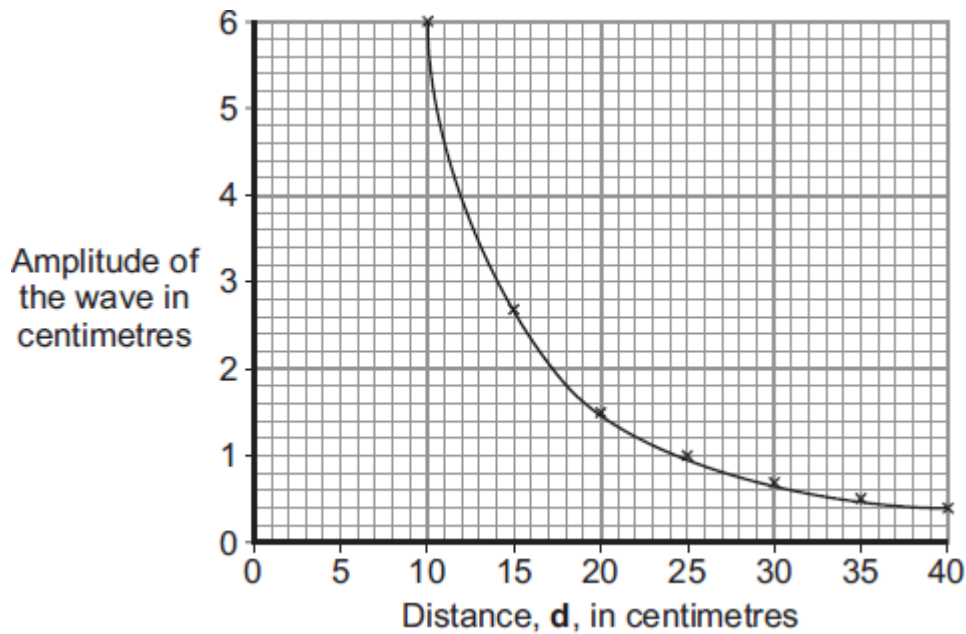
(1)

- (ii) Complete the sentence.

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

(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.

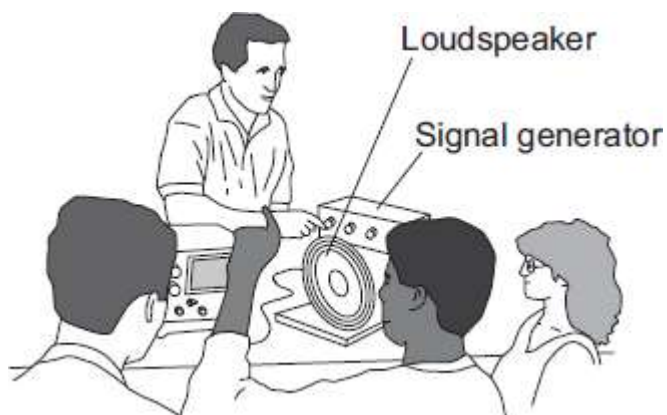
(1)

(d) Write a conclusion for this investigation.

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.....

(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)  
(Total 7 marks)

**Q7.** (a) Explain what an ultrasound wave is.

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.....  
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(2)

(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)

- (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)

(Total 6 marks)

- Q8.** (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
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The upper limit for hearing in humans is a frequency of ..... Hz.

(1)

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

What does the symbol kHz stand for?

..... (1)

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

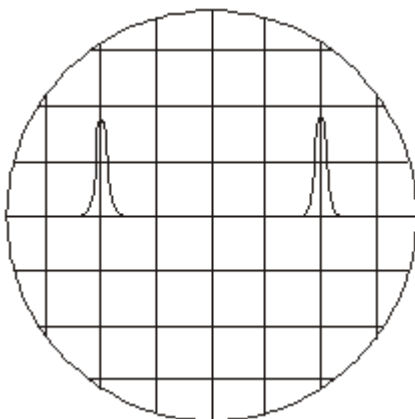
..... (1)

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

..... (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)

- (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)

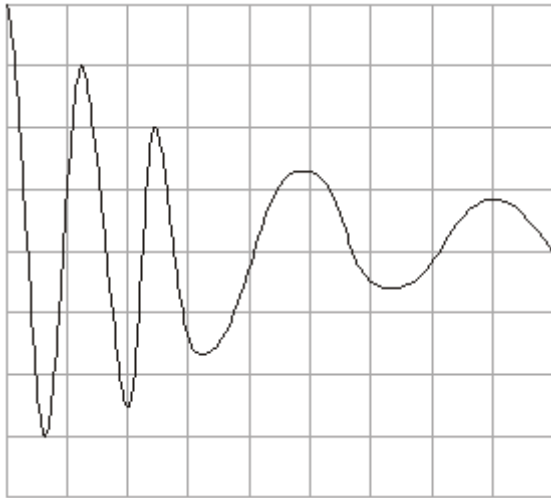
- (f) Explain what action scientists should take if they find evidence that ultrasonic waves may be harmful to human health.

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(2)

(Total 9 marks)

- Q9.** (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)

(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)

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

.....

(1)



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

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Wave speed = ..... m/s

(3)  
(Total 8 marks)

- Q10.** (a) What is ultrasound?

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(1)

- (b) The picture shows a pregnant woman having an ultrasound scan and the image produced by the scan.



To produce the image, a very narrow beam of ultrasound pulses is fired into the mother's body. The reflected pulses are used to build up the image of the unborn baby.

(i) Why is it important to have a very narrow beam of ultrasound waves?

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.....

(1)

(ii) Why is it possible to produce a very narrow beam with ultrasound but not with normal sound waves?

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(1)

(iii) The image produced by ultrasound is not as clear as an image produced by X-rays. Why is ultrasound used for looking at unborn babies rather than X-rays?

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(1)

(iv) Give **two** important pieces of information about an unborn baby which can be gained from the image produced by an ultrasound scan.

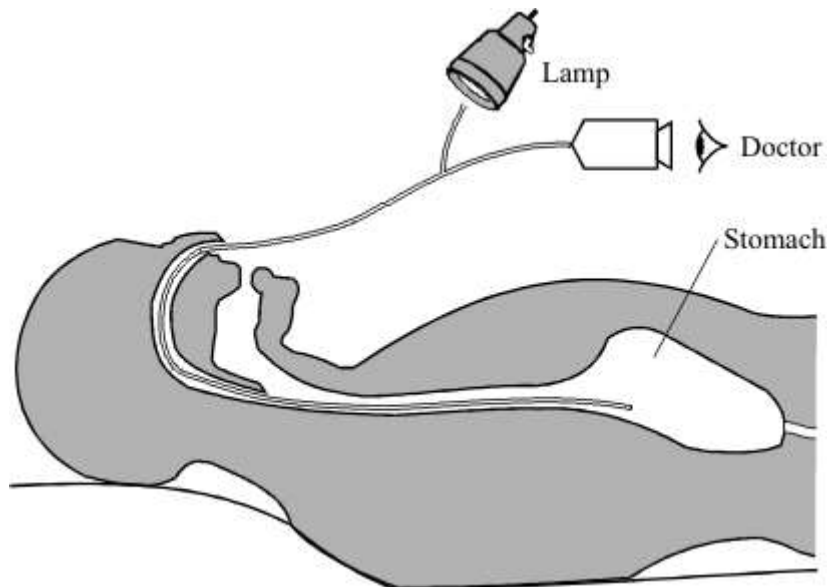
1 .....

2 .....

(2)

(Total 6 marks)

- Q11. (a) An endoscope is an instrument used by doctors for looking inside patients. A bundle of thin optical fibres pass light into the patient's body, a second bundle of fibres carry reflected light back to the doctor.



- (i) Complete the diagram below to show how an optical fibre is able to pass light into a patient's body.



(2)

- (ii) Give **one** advantage of using lots of thin fibres to make the bundles, rather than a few thick fibres.

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(1)

- (iii) Give **one** further example of the practical use of an optical fibre.

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(1)

(b) The diagram shows a wave travelling through a stretched spring.



In what way is this wave the same as a sound wave?

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(1)

(c) Sound waves travel faster in liquids than in gases. Why?

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(1)

(d) A bat uses ultrasound to find its way around. Explain how.

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(2)

(Total 8 marks)

**Q12.** (a) Sound travels through air, water and glass at different speeds. Through which of these materials does sound travel:

the fastest; .....

the slowest? .....

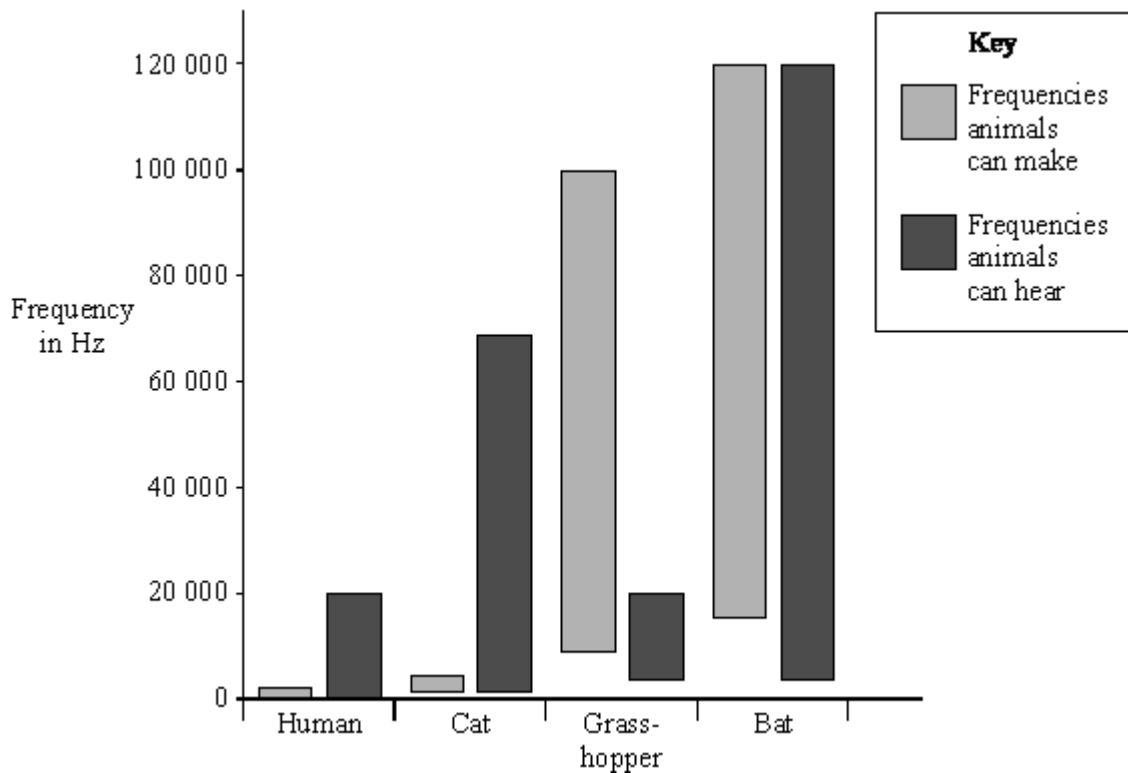
(2)

Give a reason for your choice of answers.

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(1)

- (b) The bar chart shows the frequencies of sound which different animals can make and can hear.



- (i) Which of the animals can make sounds which are beyond their own hearing range?

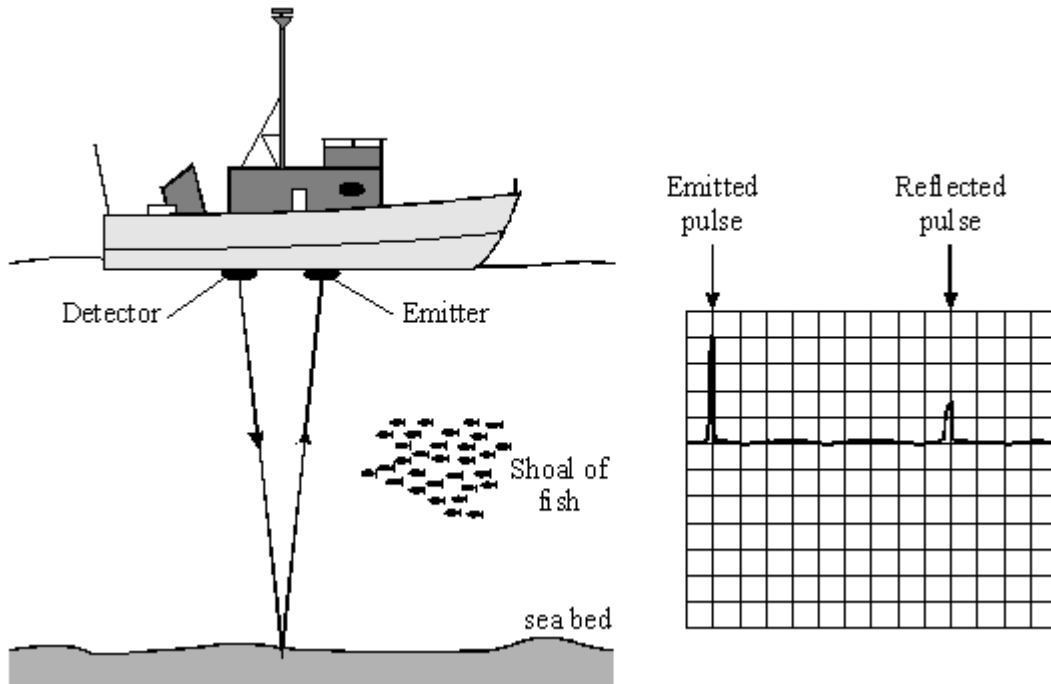
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(1)

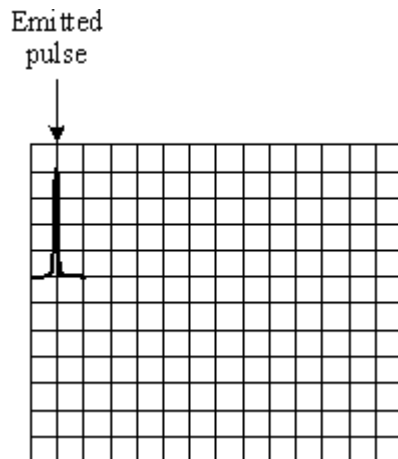
- (ii) What name is given to the sounds which a cat can hear but a human cannot?

(1)

- (c) The diagram shows a trawler searching for a shoal of fish. Pulses of high frequency sound emitted from the trawler are reflected back to the trawler. The pulses are displayed on a cathode ray oscilloscope.

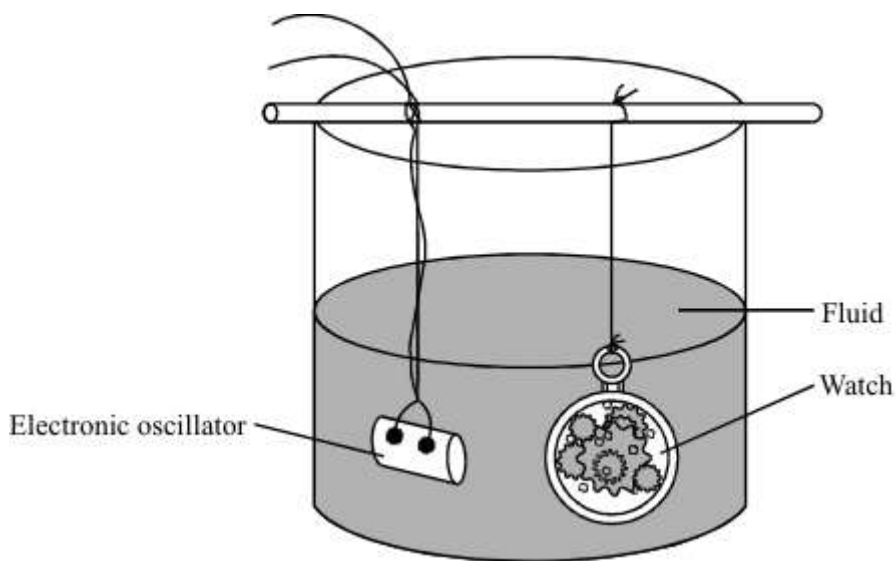


Complete the diagram below to show the pattern seen on the cathode ray oscilloscope as the trawler passes over the shoal of fish.



(2)  
(Total 7 marks)

**Q13.** The diagram shows how ultrasonic waves can be used to clean a watch.



Suggest how this method cleans the watch.

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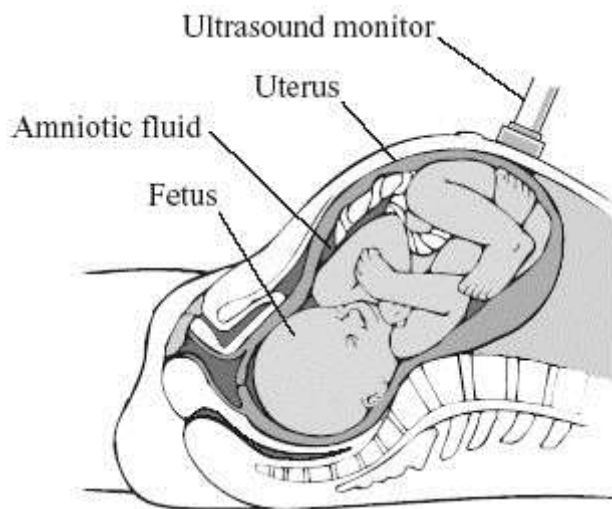
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**(Total 2 marks)**

**Q14.** The diagram shows an ultrasound monitor being used to scan a fetus.



The table shows the velocity of ultrasound waves in different tissues of the fetus.

Tissue	Velocity of ultrasound in m/s
Amniotic fluid (liquid surrounding fetus)	1540
Bone	3080
Kidney	1561
Liver	1549
Muscle	1585

Explain why we are able to see the different parts of the fetus in an ultrasound scan. You may use information from the table in your answer.

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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**(Total 4 marks)**