# Wave Behaviour (H)

**1 (a).** Ultrasound waves can be used to create an image of part of the inside of a body.

Ultrasound waves have a higher frequency than ripples on the surface of water.

Describe **another** difference between ultrasound waves and ripples on the surface of water.

Explain your answer.

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**[2]**

**(b).** The graph in **Fig. 19.1** shows how displacement of an ultrasound wave varies with distance.

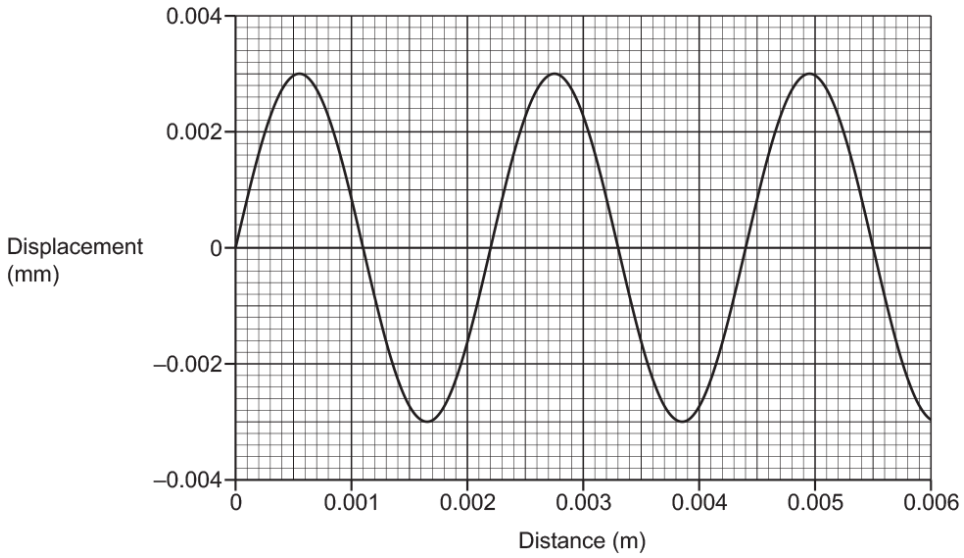


**Fig. 19.1**

**i.** Use the graph in **Fig. 19.1** to determine the wavelength of an ultrasound wave.

Wavelength = ..... m **[1]**

**ii.** The speed of ultrasound waves in **(i)** is 4500 m / s.

Calculate the frequency of the ultrasound wave in **Fig. 19.1**.

Use the equation: wave speed = frequency × wavelength

Give your answer in **standard form** and to **2** significant figures.

Frequency = ..... Hz **[4]**

**(c).** Doctors can use an ultrasound scan to measure the size of a person's kidney.


**Fig. 19.2**

Complete the sentences using the words below.

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

**Increases** **Decreases** **Stays the same**

The ultrasound scanner is made from a solid ceramic material.

As the wave enters the body, the speed ..... .

As the wave enters the body, the frequency ..... .

**[2]**

**(d).**

**i.** Explain what happens to the ultrasound wave when it reaches the kidney.

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**[2]**

**ii. Fig. 19.2** shows the thickness of the kidney, **w**.

Explain how ultrasound waves are used to measure **w**.

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**[2]**

**(e).** A doctor uses an ultrasound scan instead of X-rays to measure the kidneys.

Explain why.

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**[1]**

**2.** The maximum frequency of sound that a person can hear changes as they get older.

Which row in the table explains this change?

| | Maximum frequency of sound a person can hear | What part of the ear is damaged? |
|---|---|---|
| **A** | Decreases with age | Cochlea |
| **B** | Decreases with age | Eardrum |
| **C** | Increases with age | Cochlea |
| **D** | Increases with age | Eardrum |

Your answer ☐ **[1]**

**3.** Six wave peaks hit a wall in one minute.

Determine the frequency of the waves.

**A** 0.1 Hz
**B** 6 Hz
**C** 10 Hz
**D** 360 Hz

Your answer ☐ **[1]**

**4 (a).** Some students try to measure the speed of sound, as shown in **Fig. 24.1**.

One student makes a loud sound by clapping her hands.

The sound of the clap reflects from the gym wall causing an echo.

Another student measures the time between hearing the clap and hearing the echo.

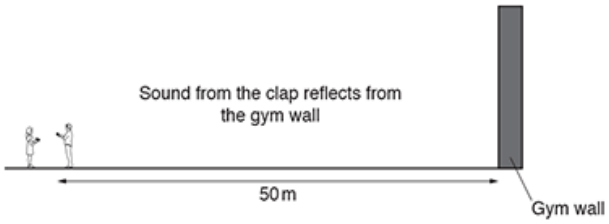


**Fig. 24.1**

They repeat the experiment three times and record their results in the table below.

| Distance to wall (m) | Time 1 (s) | Time 2 (s) | Time 3 (s) | Mean time (s) |
|---|---|---|---|---|
| 50 | 0.28 | 0.32 | 0.54 | |

**i.** The student did not pay attention when recording **time 3**.

Calculate the **mean** time taken for the sound of the clap to return, using suitable values from the table.

Mean time taken = ..... s **[1]**

**ii.** Calculate the speed of sound for the clap.

Use your answer to **(i)** and the equation: distance travelled = speed × time

Give your answer to  significant figures.

Speed of sound = ..... m / s **[4]**

**iii.** Describe **two** ways to improve and develop their method.

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2 ----------

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**[2]**

**(b).** Ultrasound wave pulses are used by vets to scan inner tissues inside animals.

The ultrasound pulses partially reflect from different layers of tissue. These reflected wave pulses (echoes) are collected by the detector as shown in **Fig. 24.2**.

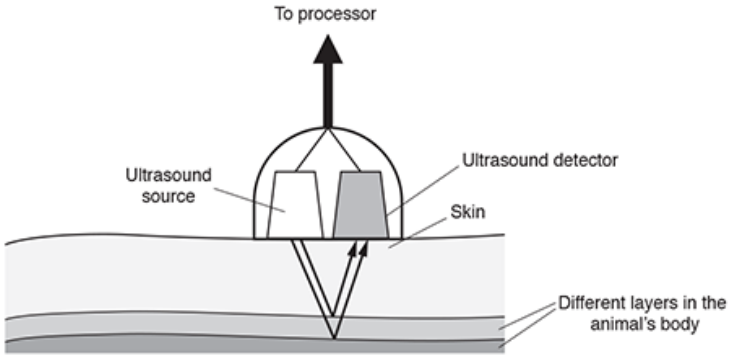


**Fig. 24.2**

In a scan using ultrasound pulses, three layers of tissue are detected, with each layer having a different thickness.

Describe and explain how the results from the detector can show:

- that there are three layers
- that each layer has a different thickness.

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_____ **[3]**

**5 (a).** A student investigates reflection and refraction of light rays.

The student sends a ray of red light into a glass prism.

**Fig. 18.1** shows the light ray as it leaves the glass prism.

On **Fig. 18.1** complete the ray of light as it travels towards **and** through the glass prism.

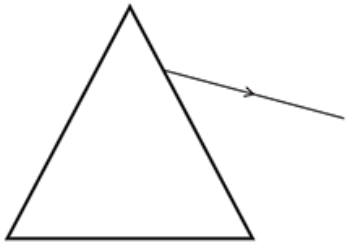


**Fig. 18.1**

**[2]**

**(b). Fig. 18.2** shows two mirrors placed at 90° to each other.

A light ray hits one of the mirrors at 45°.

On **Fig. 18.2** complete the ray of light as it reflects from both mirrors.

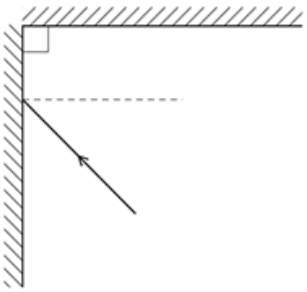


**Fig. 18.2**

**[2]**

**6.** The table contains descriptions of wavelength and frequency.

Which row in the table is correct?

| | Wavelength | Frequency |
|---|---|---|
| **A** | Distance between a peak and its neighbouring trough. | Number of waves that go past a point in a second. |
| **B** | Distance between neighbouring peaks. | Number of waves that go past a point in a second. |
| **C** | Distance between neighbouring troughs. | Time period in seconds. |
| **D** | Height of the wave. | Number of waves produced. |

Your Answer

**[1]**

**7.** A sound wave travels in air and enters water.

What happens to the sound wave as it enters the water?

| | Speed | Frequency | Wavelength |
|---|---|---|---|
| **A** | decreases | decreases | decreases |
| **B** | decreases | stays the same | decreases |
| **C** | increases | increases | increases |
| **D** | increases | stays the same | increases |

Your answer ☐ **[1]**

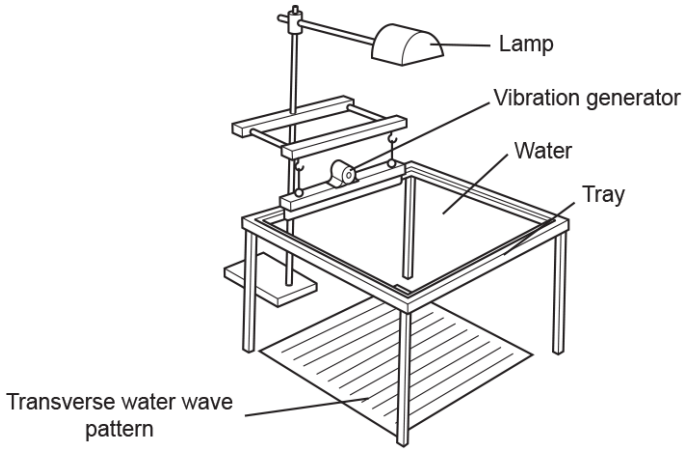
**8.** An electromagnetic wave transfers energy.

Which row in the table is correct?

| | Electromagnetic wave | Energy transfer |
|---|---|---|
| **A** | Infra-red | From a heating element of a toaster to the bread inside |
| **B** | Radio | From a radio to a transmitter |
| **C** | Gamma rays | From a high voltage supply to heating water in food |
| **D** | X-rays | From bones in the body to an X-ray machine |

Your answer ☐ **[1]**

**9 (a).** A teacher uses water waves in a ripple tank to demonstrate **transverse** waves.




She makes measurements of the water waves.

The frequency of the water waves is 0.5 Hz.

**i.** Calculate the number of water waves produced in 5 seconds.

Answer = _____ **[1]**

**ii.** The teacher **increases** the frequency of the water waves.

Describe what happens to the speed **and** the wavelength of the water waves.

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_____ **[2]**

**iii.** A student tries to describe water waves in the sea.

'The water waves move up and down. The water particles move all the way across the surface of the sea. This means that water moves in the direction of the waves.'

Part of his explanation is **incorrect**.

Write an improved and correct description about water waves in the sea.

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_____ **[2]**

**(b).** A student watches a ball game on the school field.

The student sees the ball being hit with a bat but he hears the sound a short time after. This is because the speed of light is much greater than the speed of sound.

Describe an experiment which measures the speed of **sound** in air. In your answer describe the measurements, calculations and procedures needed to gather **accurate** and **reliable** results.

You may draw a diagram as part of your answer.

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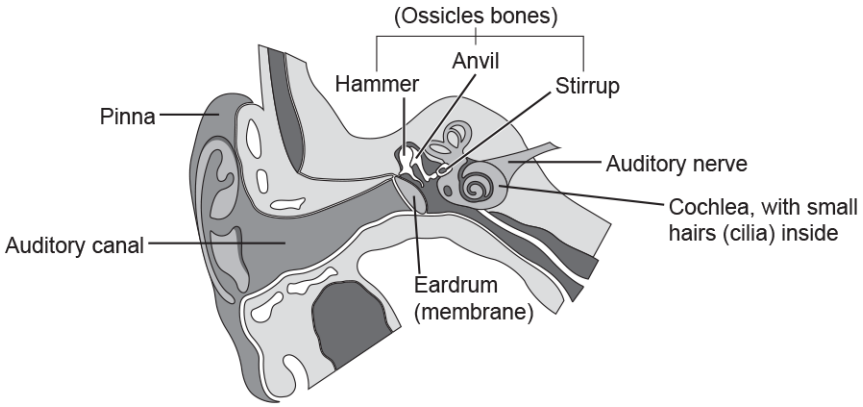
_____ **[5]**

**(c).** Look at the diagram of a human ear.




Sound wave disturbances, outside the ear, transfer energy to the small hairs (cilia) inside the cochlea.

The cochlea then sends nerve impulses along the auditory nerve to the brain.

Explain how sound wave disturbances in the air outside the ear transfer to the small hairs (cilia) inside the cochlea.

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**[3]**

**10.** A student measures the time it takes for the sound from a firework to reach the observer.

She takes 3 measurements of the time taken for four different distances, **A**, **B**, **C** and **D**.

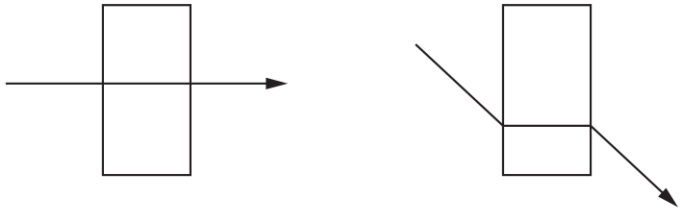
| Distance | Time taken (s) | | |
|---|---|---|---|
| | **1st measurement** | **2nd measurement** | **3rd measurement** |
| **A** | 2.16 | 2.19 | 2.17 |
| **B** | 1.99 | 2.02 | 1.97 |
| **C** | 1.80 | 1.81 | 1.89 |
| **D** | 1.69 | 1.68 | 1.71 |

Which distance **A**, **B**, **C** or **D**, has the largest range of values?

Your Answer ☐

**[1]**

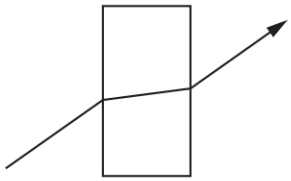
**11.** Look at the diagrams of a light ray as it passes from air through a glass block.



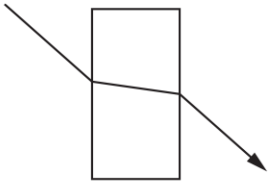
A



B



C



D

Which diagram shows an **incorrect** refraction?

Your answer ☐ **[1]**

**END OF QUESTION PAPER**