

Ultrasound

Name & Set

1 A ship sends out a sonar signal that is reflected from the bottom of the seabed and detected 3 seconds later. If the speed of sound in water is 1500 ms^{-1} , calculate the depth of the seabed.

[3]

2 A 30 kHz sound wave is projected from a helicopter into the sea below it.

- (a) What is this type of sound called? _____ [1]
(b) Can this sound be heard by the human ear? Explain your answer.

[2]

(c) All sound waves bend away from the normal when it enters the sea. What is this phenomenon called?

[1]

(d) Sound waves travel faster in water than they do in air. The frequency of a sound wave remains unchanged when it passes from one medium to another. What happens to each of the following when sound enters water from air?

(i) The speed of sound _____ [1]

(ii) The wavelength of the sound _____ [1]

3 (a) What is ultrasound? _____

[2]

(b) Give two uses for ultrasound.

(i) _____

[1]

(ii) _____

[1]

(c) The speed of sound through water is 1500 m/s. If the frequency of ultrasound used by a particular sonar system is 45 kHz, what is the wavelength of the ultrasound in this case?

[2]

(d) If the time between sending and receiving a pulse of ultrasound is 0.5 seconds, what is the depth of water below the boat?

[2]

4 Ultrasound is used to examine pregnant women and check on the condition of the foetus. To produce an image a narrow beam of ultrasonic pulses is directed into the mother's body. An image of the foetus is built up from the reflected pulses.

(i) Why is it important to have a very narrow beam of ultrasonic pulses?

[3]

(ii) What is it about ultrasound that makes it possible to produce a narrow beam, whereas this can't be done with normal sound waves?

[3]

(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?

[2]

(iv) What **two** important pieces of information about an unborn baby can be gained from the ultrasound investigation.

(i) _____
_____ [1]

(ii) _____
_____ [1]

5 (a) Explain how sonar and radar are used to 'see' objects at a distance.

[3]

(b) Give two ways in which radar & sonar are similar and two ways in which they are different.

(i) Similar _____

_____ [2]

(ii) Different _____

_____ [2]

6 The speed of sound in air is 330 m/s, and in water it is 1500 ms⁻¹. A particular sound wave has a frequency of 30,000Hz.

(a) Is this sound audible to humans? Explain your answer.

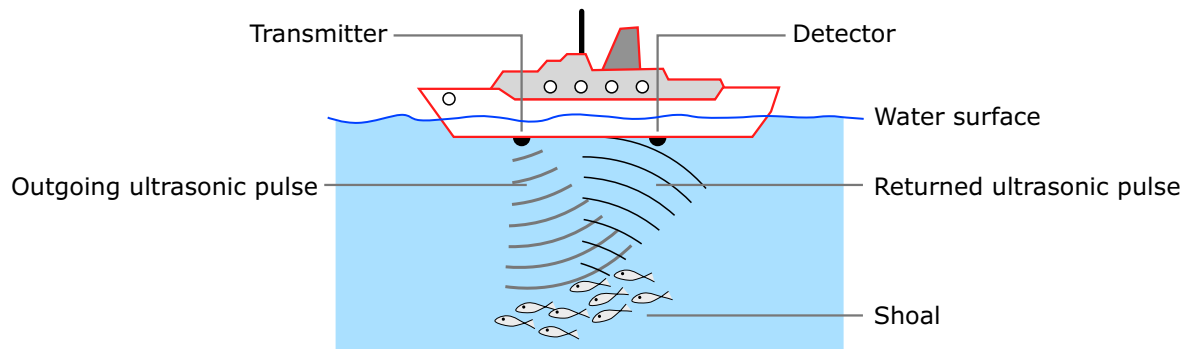
_____ [2]

(b) Calculate the wavelength of a sound that has a frequency of 30 kHz.

(i) in air _____ [2]

(ii) in water _____ [2]

(c) The diagram shows a ship using an echo locator (SoNAR) to find a shoal of fish. A brief pulse of sound is transmitted from the ship is reflected off a fish. The reflected wave is picked up by the receiver.



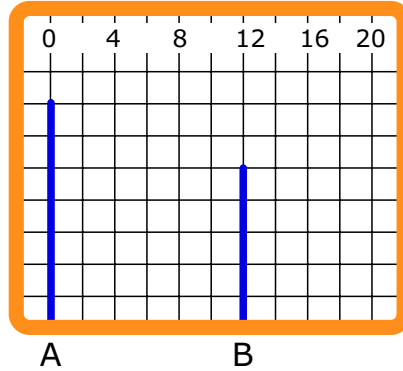
(i) The echo is picked up by the receiver 0.2s after transmission. Calculate how deep the ship has to lower its fishing nets to catch the top of the shoal.

_____ [4]

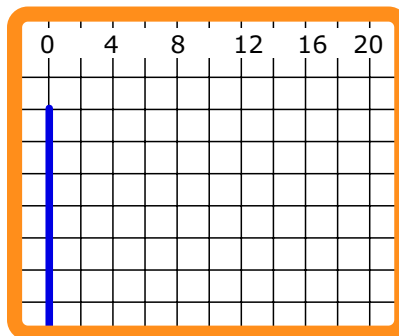
(d) Give one other use of ultrasound (apart from echo-location).

_____ [2]

- 7 The diagram shows a screen used to display sonar signals. The horizontal scale measures time in milliseconds. The vertical scale gives an indication of the strength of the ultrasonic pulse emitted and received by the sonar apparatus.
- The pulse of ultrasound emitted by the apparatus is displayed as A, and the return pulse received by the sonar is displayed as B.
- The speed of ultrasound in water is 1500 m/s



- (a) Calculate the depth of the water
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- [2]
- (b) Why is the strength of the return pulse not the same as the emitted pulse?
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-
- [2]
- (c) On the diagram below draw a line to show the return pulse if the depth of water below the ship is 12 metres. Calculation required.
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-
- [3]



- (d) What is the maximum depth that this particular sonar can measure?
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- [2]