1 **(a)** Two students are measuring the speed of sound.

The students are provided with a starting pistol, a stopwatch and a long measuring tape. The starting pistol, when fired, produces a loud sound and a puff of smoke at the same instant.

Describe how the students use the apparatus and how they calculate the speed. You may draw a diagram.

....

....

....

....

....

....

....

....

....

.... [4]

(b) A device at the bottom of the sea emits a sound wave of frequency 200 Hz.

(i) The speed of sound in sea-water is 1500 m / s.

Calculate the wavelength of the sound in sea-water.

wavelength = ... [2]

(ii) The sound wave passes from the sea-water into the air.

State what happens, if anything, to

- the frequency of the sound, ...

....

- the speed of the sound. ....

....

[2]

[Total: 8]

2 **(a)** Fig. 6.1 represents the waveform of a sound wave. The wave is travelling at constant speed.

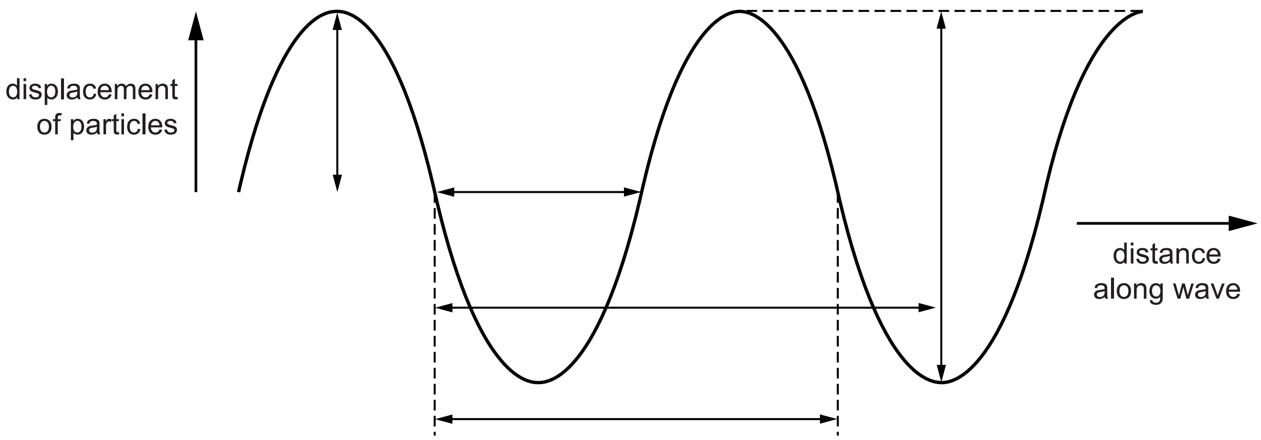

Fig. 6.1

(i) On Fig. 6.1,

1. label with the letter X the marked distance corresponding to the amplitude of the wave, [1]

2. label with the letter Y the marked distance corresponding to the wavelength of the wave. [1]

(ii) State what happens to the amplitude and the wavelength of the wave if

1. the loudness of the sound is increased at constant pitch,

amplitude ....

wavelength ....
[1]

2. the pitch of the sound is increased at constant loudness.

amplitude ....

wavelength ....
[1]

(b) A ship uses pulses of sound to measure the depth of the sea beneath the ship. A sound pulse is transmitted into the sea and the echo from the sea-bed is received after 54 ms. The speed of sound in seawater is 1500 m / s.

Calculate the depth of the sea beneath the ship.

depth = ...[3]

[Total: 7]

3 **(a)** A sound wave in air consists of alternate compressions and rarefactions along its path.

(i) Explain how a compression differs from a rarefaction.

....

....[1]

(ii) Explain, in terms of compressions, what is meant by

1. the wavelength of the sound,

....

....[1]

2. the frequency of the sound.

....

....[1]

(b) At night, bats emit pulses of sound to detect obstacles and prey. The speed of sound in air is 340 m/s.

(i) A bat emits a pulse of sound of wavelength 0.0085 m.

Calculate the frequency of the sound.

frequency = ...[2]

(ii) State why this sound cannot be heard by human beings.

....

....[1]

(iii) The pulse of sound hits a stationary object and is reflected back to the bat. The pulse is received by the bat 0.12 s after it was emitted.

Calculate the distance travelled by the pulse of sound during this time.

distance = ...[2]

[Total: 8]

4 A sound wave, travelling in air, approaches a solid barrier with a gap in the middle. Fig. 6.1 represents the compressions and rarefactions of the sound wave. The compressions are labelled A, B and C.

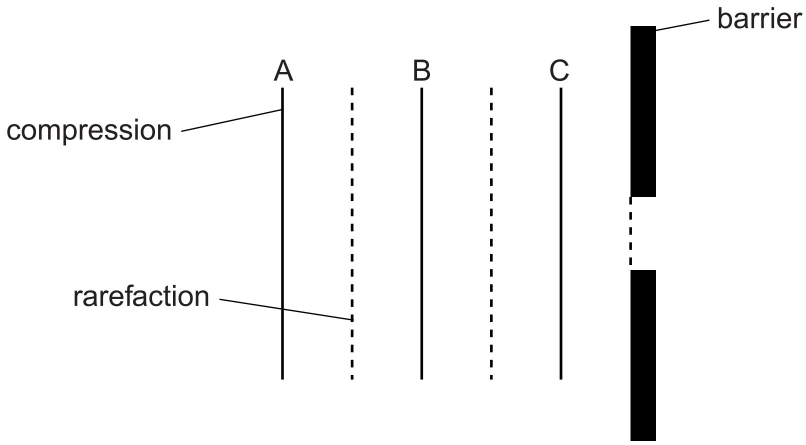

Fig. 6.1

(a) State how a *compression* differs from a *rarefaction*.

....

....[1]

(b) The speed of sound in air is 340 m/s. The frequency of the sound is 850 Hz.

For this wave, determine

(i) the wavelength,

wavelength = ...[2]

(ii) the time that elapses before compression A reaches the barrier.

time = ...[2]

(c) On Fig. 6.1, draw the shape and positions of compressions B and C as compression A reaches the barrier. [2]

(d) Sound waves can also travel in water.

State how the speed of sound in water compares with the speed of sound in air.

....[1]

[Total: 8]

5 A dolphin produces a sound wave in water of frequency 7800 Hz.

Fig. 6.1 represents rarefactions of the sound wave travelling in the water and hitting the side of a wooden ship at an angle.

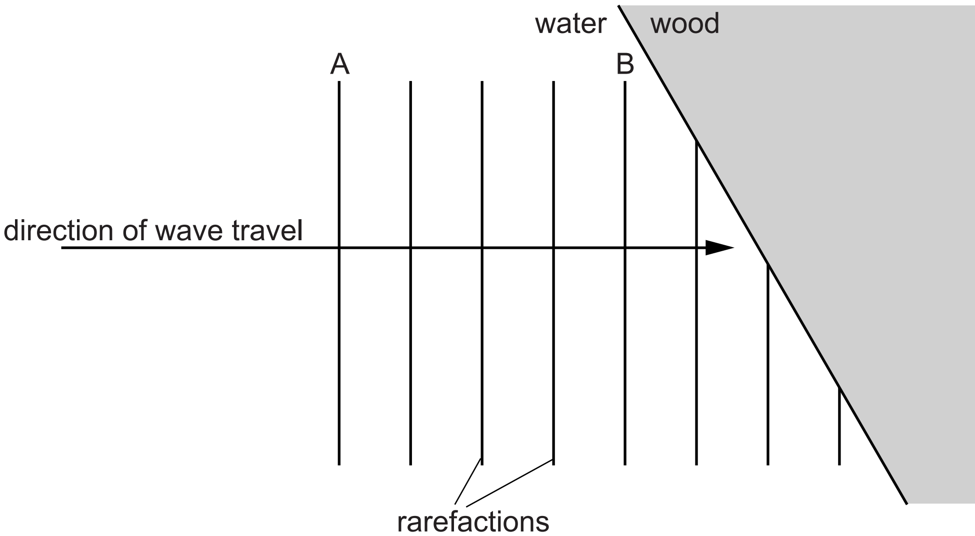

Fig. 6.1

(a) State what is meant by a *rarefaction*.

....

....[1]

(b) On Fig. 6.1, two rarefactions A and B are labelled. The distance between rarefaction A and rarefaction B is 0.76 m.

Determine

(i) the wavelength in water of the sound wave,

wavelength = ...[1]

(ii) the time taken for the rarefaction at A to reach the point where rarefaction B is now positioned.

time = ...[2]

(c) The sound wave passes from the water into the wood where the speed of sound is greater.

State what happens to

(i) the frequency,

....[1]

(ii) the wavelength.

....[1]

(d) On Fig. 6.1, sketch the positions in the wood of the three incomplete rarefactions. [2]

[Total: 8]

6 **(a)** Draw a straight line from each quantity on the left-hand side to a speed on the right-hand side which is typical for that quantity.

	30 m/s
speed of sound in gas	300 m/s
	3000 m/s
speed of sound in solid	30 000 m/s
	300 000 m/s

[2]

(b) Explain why sound waves are described as *longitudinal*.

....

.... [2]

(c) Fig. 8.1 shows how the displacement of air molecules, at an instant of time, varies with distance along the path of a sound wave.

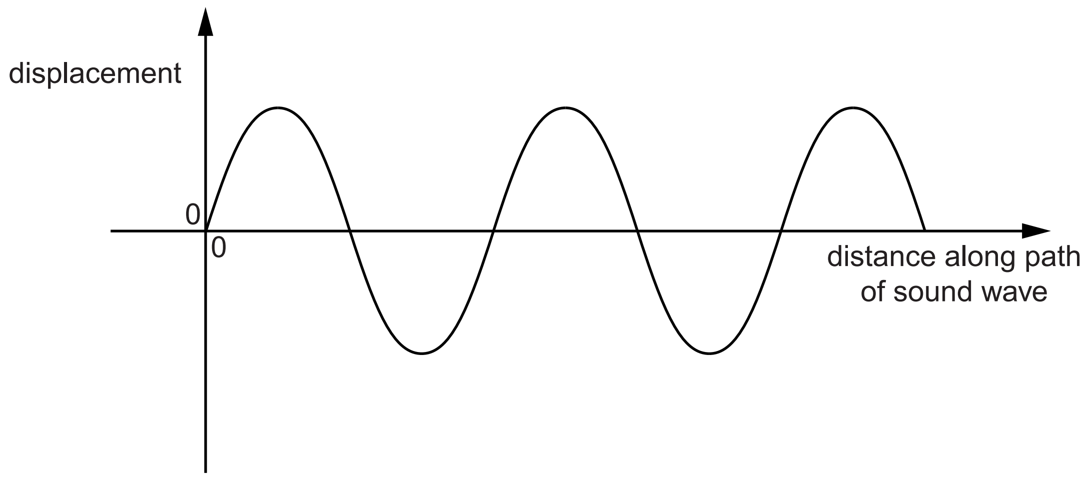

Fig. 8.1

(i) On Fig. 8.1, sketch two cycles of a sound wave that has a shorter wavelength **and** a greater amplitude. [2]

(ii) State **two** changes in the sound heard from this wave compared with the original wave.

1. ....

2. .... [2]

[Total: 8]