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

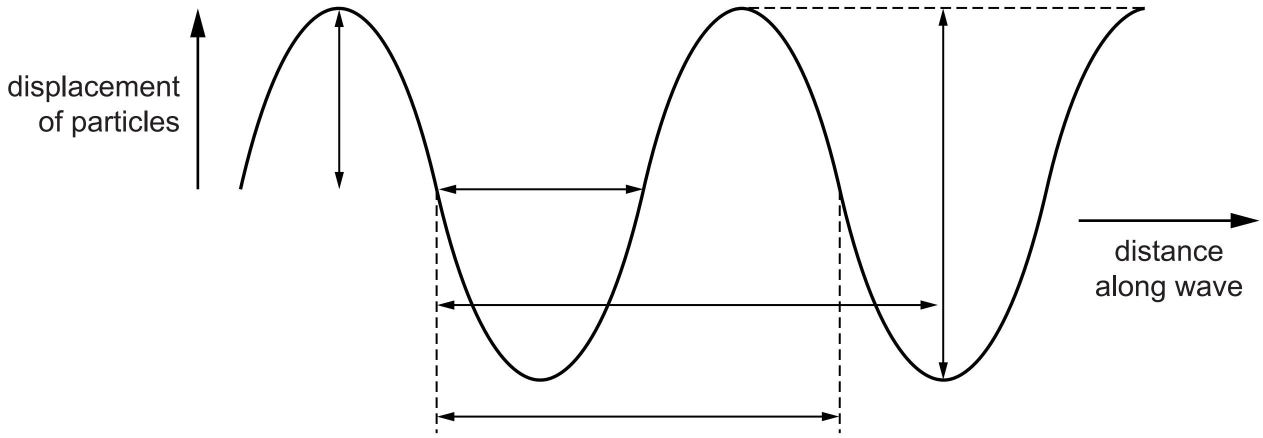

Fig. 6.1

(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]

2 **(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]

3 **(a)** Fig. 6.1 shows an object O placed in front of a plane mirror M. Two rays from the object to 3 mirror are shown.

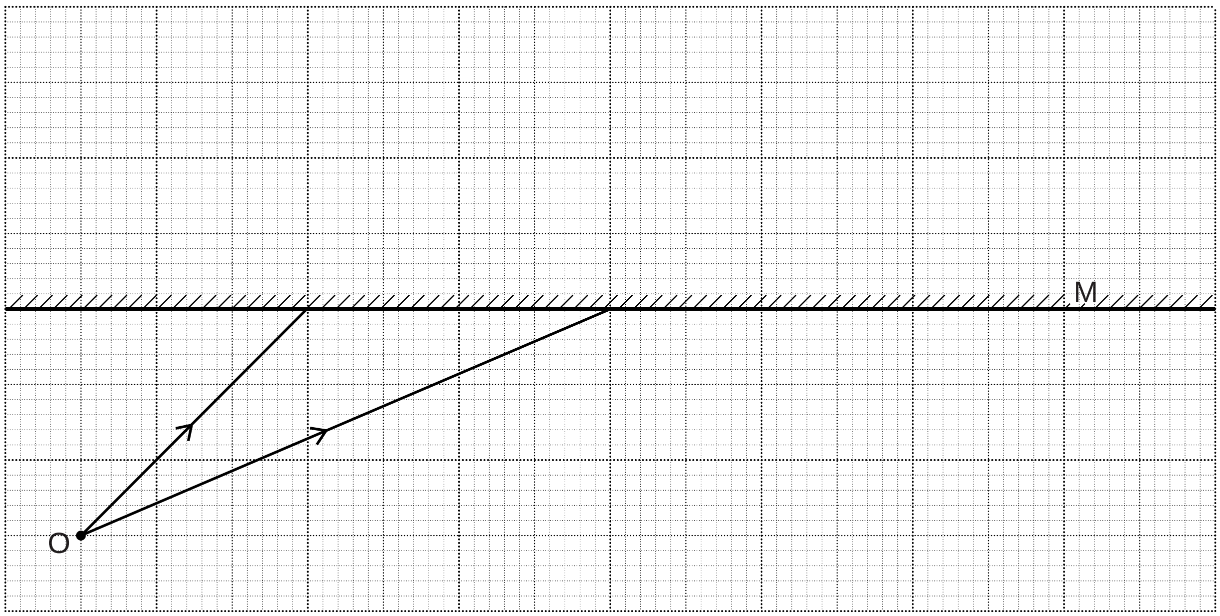

Fig. 6.1

(i) On Fig. 6.1, for **one** of the rays shown,

1. draw the normal to the mirror,

2. mark the angle of incidence. Label this angle X.

[2]

(ii) On Fig. 6.1, draw

1. the reflected rays for both incident rays,

2. construction lines to locate the image of O. Label this image I.

[2]

(b) In Fig. 6.2, circular wavefronts from a point source in a tank of water strike a straight barrier.

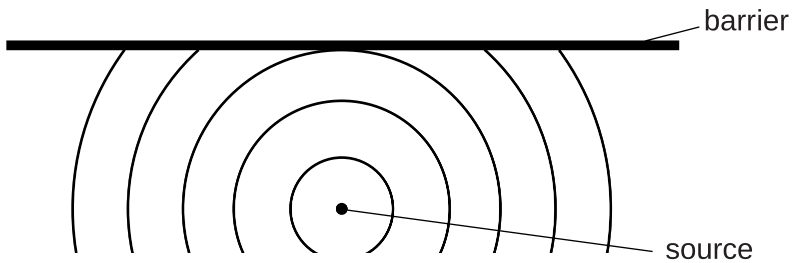

Fig. 6.2

(i) The reflected wavefronts seem to come from a single point.

On Fig. 6.2, mark a dot to show the position of this point. Label this point C. [1]

(ii) Draw, as accurately as you can, the reflected circular wavefronts. [2]

[Total: 7]

4 (a) A police car siren emits sound waves that vary in pitch.

Tick **two** boxes that apply to the sound waves emitted by the siren.

- ☐ electromagnetic
- ☐ longitudinal
- ☐ transverse
- ☐ visible
- ☐ frequency 0.1–10 Hz
- ☐ frequency 100–10 000 Hz
- ☐ frequency 100 000–1 000 000 Hz

[2]

(b) Fig. 7.1 is a top view of one wavefront of a water wave before it strikes a hard boundary.

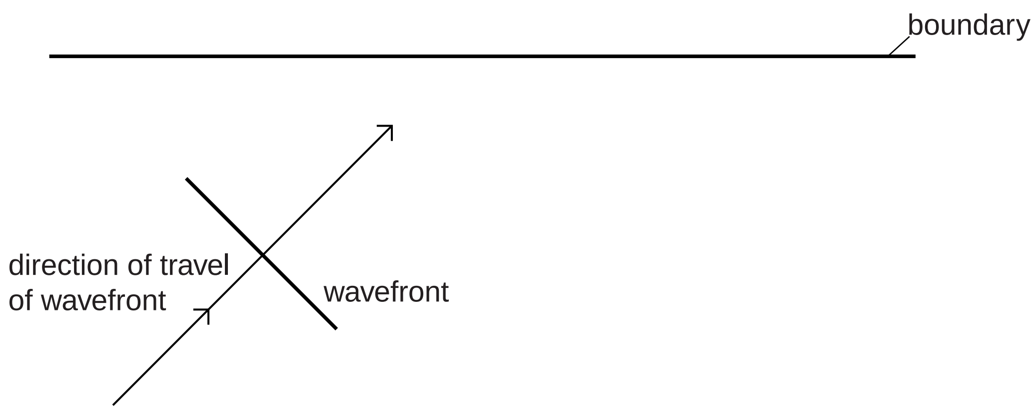

Fig. 7.1

(i) Name the process that occurs as the wavefront strikes the boundary.

.... [1]

(ii) Explain, in terms of wave theory, what occurs as the wavefront strikes the boundary.

....

....

....

....

.... [2]

(iii) State whether there is an increase, a decrease or no change in the wavelength of the wave after it strikes the boundary.

.... [1]

(iv) The speed of the wave is 3.0 m / s and its wavelength 7.0 cm.

Calculate the frequency of the wave.

frequency = ... [2]

[Total: 8]

5 During a thunderstorm, thunder and lightning are produced at the same time.

(a) A person is some distance away from the storm.

Explain why the person sees the lightning before hearing the thunder.

....

....

.... [1]

(b) A scientist in a laboratory made the following measurements during a thunderstorm.

time from start of storm / minutes	0.0	2.0	4.0	6.0	8.0	10.0
time between seeing lightning and hearing thunder / s	3.6	2.4	1.6	2.4	3.5	4.4

Fig. 7.1

(i) How many minutes after the storm started did it reach its closest point to the laboratory?

.... [1]

(ii) How can you tell that the storm was never immediately over the laboratory?

.... [1]

(iii) When the storm started, it was immediately above a village 1200 m from the laboratory.

Using this information and information from Fig. 7.1, calculate the speed of sound.

speed of sound = ... [2]

(iv) State the assumption you made when you calculated your answer to **(b)(iii)**.

.... [1]

(c) Some waves are longitudinal; some waves are transverse.

Some waves are electromagnetic; some waves are mechanical.

Put ticks (✓) in the table below to indicate which of these descriptions apply to the light waves of the lightning and the sound waves of the thunder.

	light waves	sound waves
longitudinal		
transverse		
electromagnetic		
mechanical		

[3]

[Total: 9]