Core 1

A man is watching a thunderstorm which is directly over a village. Some distance behind the village is a mountain.

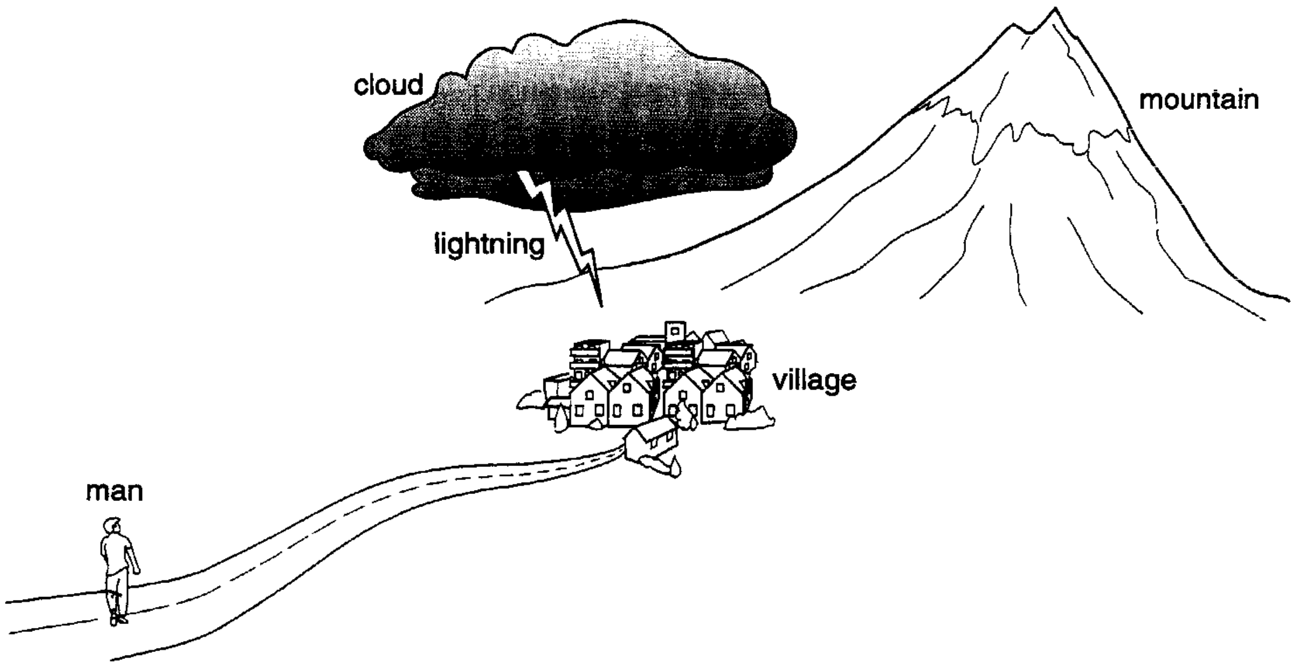

Fig. 1

(a) Thunder is created at the same time as the lightning flash but, after the man sees a lightning flash, he has to wait a short time before he hears the thunder.

Why is there this delay?

....

....

....

....[2]

(b) When he listens carefully, the man realises that, for each lightning flash, he can hear a loud sound of thunder followed by a quieter one.

(i) After studying Fig. 1 , explain why he hears two sounds for each lightning flash.

....

....

(ii) Suggest why the second sound is quieter.

....

....[2]

(c) The man measures the time between seeing a flash of lightning over the village, and hearing the first sound of thunder. The time is 4 s.

The speed of sound in air is 330 m/s.

How far away is the village?

ANSWER: .... m [3]

Core 2

Here is a list of different types of waves.

gamma (γ)
infra-red
radio
sound
ultra-violet
visible
X-rays

(a) Which one of these is the only one which is **not** part of the electromagnetic spectrum?

....[1]

(b) Which one of these makes us feel warm when the Sun shines?

....[1]

(c) Which one of these do doctors use to detect broken bones?

....[1]

(d) (i)

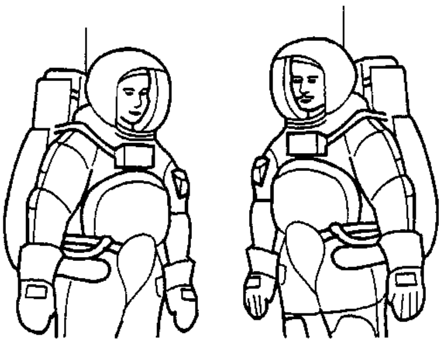

Fig. 2

On the moon, two astronauts cannot hear each other, even when they shout, unless they have their radios switched on.

1. Why cannot they hear each other even when they shout?

....

....

2. Why can they hear each other using their radios?

....

....

(ii) Which type of wave is used to carry messages from the astronauts to mission control on Earth?

....**[4]**

Core 3

(a) Fig. 3 shows a view from above of a person standing at the edge of a pond, dipping the end of a stick up and down in the water.
Some of the wavefronts that spread out are shown.

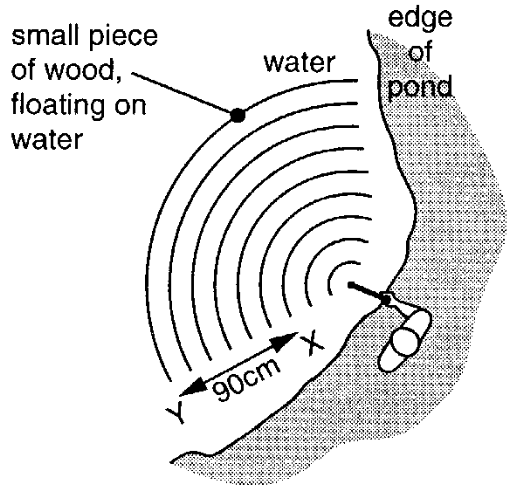

Fig. 3

(i) How many wavelengths are there between X and Y? ....[1]

(ii) The distance from X to Y is 90 cm. Calculate the wavelength of the waves.

wavelength = ... cm [2]

(iii) The speed of the waves is affected by the depth of the water.

1. Describe the shape of the wavefronts, as seen from above.

   ....

2. What does the shape of the wavefronts tell you about the depth of the pond?

   Give a reason for your answer.

   ....

   ....
[3]

(iv) Fig. 4 shows a sideways view of the water surface just before the first wave reaches the floating piece of wood.

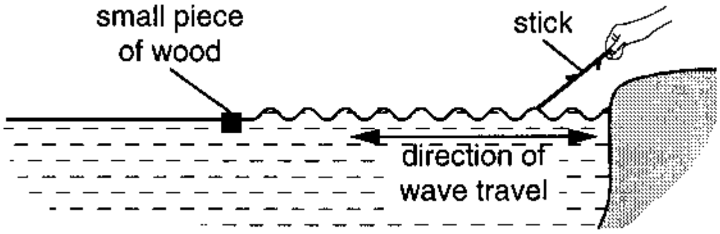

Fig. 4

Describe how the piece of wood moves after the waves reach it.
You may draw on Fig. 4 if it helps you to answer the question.

....

....[2]

(b) An underwater loudspeaker, placed in the pond in part **(a)**, sends out sound waves through the water, as shown in Fig. 5.

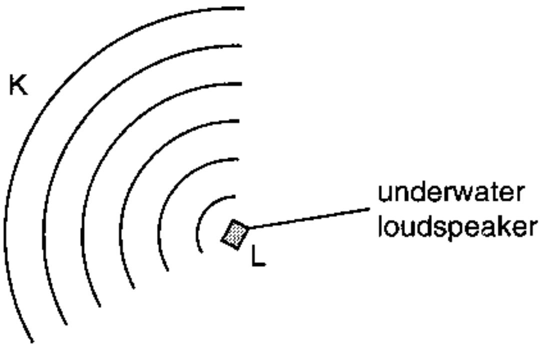

Fig. 5

(i) What is the difference between the nature of these sound waves and the water waves in **(a)**? Write the appropriate words in the gaps in the following sentences.

"Water waves are .... waves."

"Sound waves are .... waves." [2]

(ii) Fig. 6 shows a sideways view along the line KL.

Fig. 6

The dot labelled M represents a water molecule on the line KL.
Describe how the molecule moves when the loudspeaker is working.
You may draw on Fig. 6 if it helps you to answer the question.

....

....[2]

Extension 1

(a) A sound wave in air is made up of compressions and rarefactions.

(i) State what is meant by a *compression*.

....

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

....
[2]

(b) The distance between two consecutive rarefactions in a sound wave is 2.5 m. The speed of sound in air is 330 m/s.

Calculate the frequency of this sound wave.

frequency = ... [2]

(c) A person makes a loud sound and hears the echo of this sound 1.2 s later.

Calculate how far the person is from the object causing the echo. Assume that the speed of sound is 330 m / s.

distance = ... [2]

Extension 2

Fig. 7 shows water wavefronts which are approaching a small gap in a wall which divides two stretches of water of the same depth. The diagram is drawn to scale.

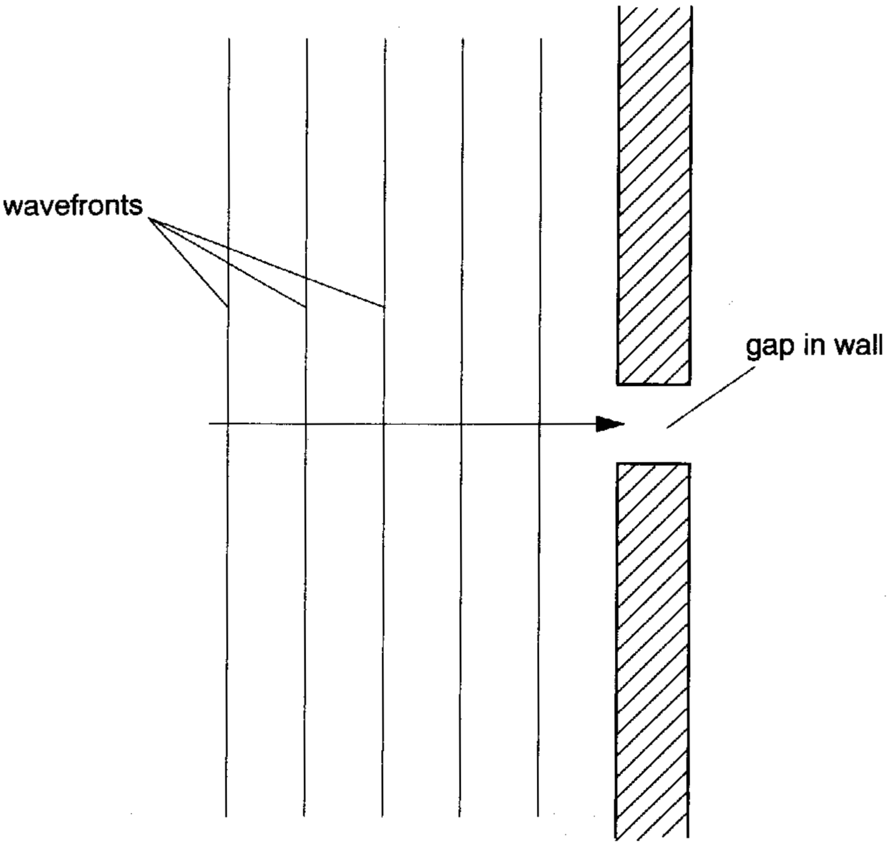

Fig. 7

(a) The waves moving towards the wall have a wavelength of 1.6 m and a frequency of 0.80 Hz.

Calculate the speed of these water waves.

speed of waves = ... [2]

(b) State the wavelength and frequency of the waves after they have passed through the gap in the wall.

wavelength = ...

frequency =... [2]

(c) On Fig. 7 , complete the pattern of wavefronts to the right of the wall. [3]

Core 1

a light travels faster than sound
much faster / very fast so that it appears to arrive instantaneously

b(i) because of the echo

(ii) the absorption of sound / dispersion / diffraction

c speed = distance / time

distance = speed x time

= 330 x 4

= 1320 m

Core 2

a sound

b infra-red

c X-rays

d(i) 1 there is no air on the moon so air can not travel

2 radio waves do not need a medium to travel

(ii) radio / micro waves

Core 3

a(i) 6

(ii) wavelength = 90 / 6

= 15 cm

(iii) 1 arcs of circles

2 the pond has a constant depth
because it travels at the same speed in all directions

(ii) the motion may be described as up and down or in circles

b(i) transverse

longitudinal

(ii) the motion should be described as backwards and forwards / back and forth

Extension 1

a(i) a place of higher pressure / air molecules closer together

(ii) a place of lower pressure / air molecules further apart

b wavelength = 2.5 m speed = 330 m/s

frequency = 330 / 2.5

= 130 Hz

c distance travelled in 1.2 s = 330 x 1.2 = 396 m

distance to object = 396 / 2 = 198 m

Extension 2

a velocity = frequency x wavelength

= 0.8 x 1.6

= 1.3 m/s

b(i) 1.6 m / the same

(ii) 0.8 Hz / the same

c the diagram should show part circles (not semi-circles) centred on the middle of the gap