

Core 1

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

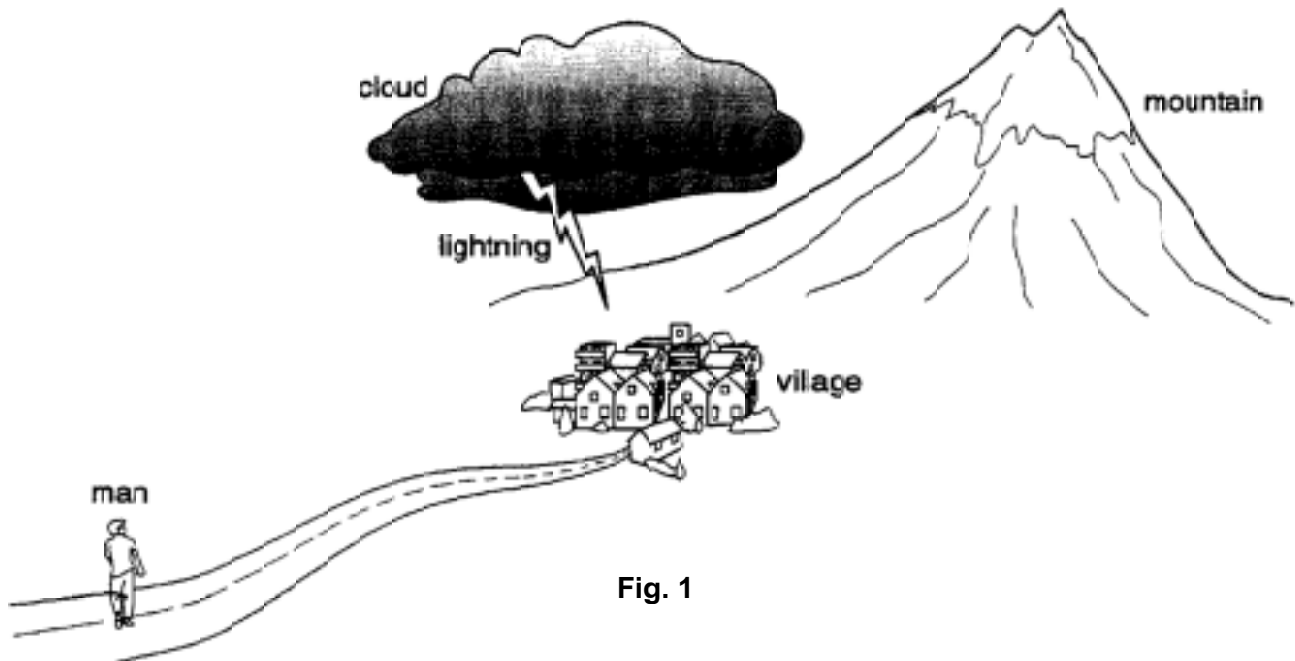


Fig. 1

- (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 4s.

The speed of sound in air is 330m/s

Calculate the distance the man is from the village.

distance = m [3]

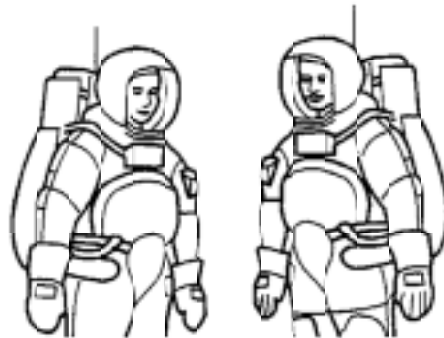
Core 2

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)



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?

Core 3

- (a) Fig. 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.

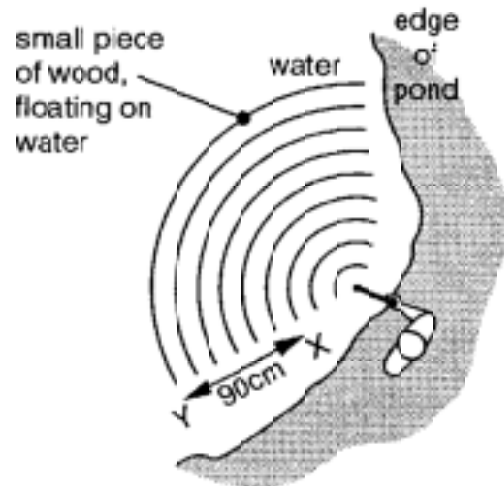


Fig. 2

- (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]

Extension 2

Observations of a distant thunderstorm are made.

- (a) During a lightning flash, the average wavelength of the light emitted is 5×10^{-7} m. This light travels at 3×10^8 m/s.

Calculate the average frequency of this light.

frequency = [2]

- (b) The interval between the lightning flash being seen and the thunder being heard is 3.6 s. The speed of sound in air is 340 m/s.

- (i) Calculate the distance between the thunderstorm and the observer.

distance =

- (ii) Explain why the speed of light is not taken into account in this calculation.

.....
.....

[3]

Answers

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

Extension 2

(a) $f = c / \lambda = 6 \times 10^{14} \text{ Hz}$

(b)(i) $S = v \times t = 340 \times 3.6 = 1.22 \text{ km}$

(ii) Speed of light very much greater than speed of sound so time for light to reach observer is negligible.