



Give the marks for the points in the marking scheme; an answer in other words that says the same is right.

1 Key words

1. energy
2. mechanical
3. longitudinal
4. compressions
5. crests
6. frequency
7. hertz
8. echolocation

K • 4

Each carries 0.5 mark.

2 Label the diagram

- | | |
|-----------------------------|------------------|
| 1. trough | 4. amplitude (A) |
| 2. wavelength (λ) | 5. wave travels |
| 3. crest | 6. mean position |

K • 3

Each carries 0.5 mark.

3 Multiple choice**i. a. sound wave**

K • 1

In sound, the air particles vibrate back and forth along the direction the sound travels. Ripples on water are (nearly) transverse; light and radio waves are electromagnetic, and so transverse.

ii. b. It has a shorter wavelength.

U • 1

In one medium, the speed v stays the same, so from $v = f \times \lambda$, a higher frequency means a **shorter wavelength**. The time period $T = 1 \div f$ gets **shorter**, not longer. Amplitude has nothing to do with frequency: a high note can be soft or loud.

iii. c. ultraviolet ray, violet light, red light, infrared ray

U • 1

From short to long wavelength: X-ray, ultraviolet, violet, (blue, green, yellow, orange,) red, infrared. Only the third group follows this order all the way.

iv. b. CT scan

A • 1

The brain is soft tissue inside the hard skull. An ordinary X-ray shows the skull bone but not the brain behind it; ultrasound can't get through the skull of an adult; echocardiography looks at the heart. A **CT scan** shows slices through the brain, revealing bleeding or swelling.

v. c. One uses a transverse wave, the other a longitudinal wave.

U • 1

X-rays are **electromagnetic** waves, which are **transverse**; ultrasound is a **sound** wave, which is **longitudinal**. The last option is tempting, but it isn't exact: X-rays also show the lungs, teeth and tumors, and ultrasound can show some bone surfaces. Both are reliable for their own jobs, and both use computers today.

4 Very short answers**a. MARKING SCHEME**

K • 1

- ✓ The whole range of electromagnetic waves arranged in order of wavelength (or frequency), from radio waves to gamma rays.

b. MARKING SCHEME

K • 1

- ✓ Sound of frequency above 20,000 Hz (20 kHz), which humans can't hear.



- c. MARKING SCHEME U · 1
✓ The time is for the trip to the sea bed and back (twice the depth).

5 Short answers

- a. MARKING SCHEME U · 2
✓ Any one difference, e.g. in a longitudinal wave the particles vibrate along the direction of travel; in a transverse wave, at right angles to it.
✓ Any second difference, e.g. a longitudinal wave travels as compressions and rarefactions; a transverse wave as crests and troughs.
- b. MARKING SCHEME U · 2
✓ Seismic waves are mechanical waves: the rocks they pass through absorb part of their energy.
✓ The energy also spreads out over a larger and larger area, so less reaches each place far away.
- c. MARKING SCHEME A · 2
✓ A CT scan uses a large dose of X-rays, which can damage the baby's fast-dividing cells.
✓ Ultrasound is a sound wave that does no harm to cells, yet shows the baby's size, position and heartbeat clearly.
- d. MARKING SCHEME K · 2
✓ The use of soft, porous materials (foam, curtains, carpets, perforated panels) on walls, ceilings and floors to absorb unwanted sound, so it isn't reflected.
✓ Any one use, e.g. in cinema halls, auditoriums, music rooms, recording studios or seminar halls, so speech and music sound clear.

6 Long answer

ANSWER

U · 4

Ultrasonography is the technology of examining the organs inside the body with ultrasound.

Procedure: gel is put on the skin and a **transducer** is pressed on it. The transducer sends high-frequency ultrasound into the body; part of it is reflected at each boundary between tissues, and the transducer receives the echoes. A **computer** uses the strength and the time of each echo to build a picture, the **sonogram**, on a screen.

Uses: checking stones in the kidneys and gall bladder; tumors; diseases of the liver, intestines and uterus; the growth, position and heartbeat of a baby in the womb; and the heart and its valves (**echocardiography**). It is safe, as it uses no X-rays.

MARKING SCHEME

- ✓ Ultrasonography is examining the organs inside the body with ultrasound.
- ✓ Gel is put on the skin and a transducer pressed on it sends high-frequency ultrasound into the body.
- ✓ Echoes from the boundaries between tissues return to the transducer, and a computer builds a picture (the sonogram) from their strength and time.
- ✓ Any two uses, e.g. stones in the kidneys or gall bladder, diseases of the liver or uterus, a baby in the womb, the heart (echocardiography).

7 Numerical problems

a. ANSWER

A · 2

- i. $v = f \times \lambda$, so $\lambda = v \div f = 340 \div 500 = 0.68 \text{ m}$.
- ii. $T = 1 \div f = 1 \div 500 = 0.002 \text{ s}$.

MARKING SCHEME

- ✓ $\lambda = 340 \div 500 = 0.68 \text{ m}$.
- ✓ $T = 1 \div 500 = 0.002 \text{ s}$.



b. ANSWER

A • 4

- i. The pulse goes down and back: $2d = v \times t = 1,500 \times 2.4 = 3,600$ m, so $d = 1,800$ m.
- ii. $\lambda = v \div f = 1,500 \div 50,000 = 0.03$ m (3 cm).
- iii. $t = 2d \div v = (2 \times 600) \div 1,500 = 0.8$ s.

MARKING SCHEME

- ✓ $2d = 1,500 \times 2.4 = 3,600$ m (the distance there and back).
- ✓ $d = 1,800$ m.
- ✓ $\lambda = 1,500 \div 50,000 = 0.03$ m.
- ✓ $t = 1,200 \div 1,500 = 0.8$ s.

8 Think**ANSWER**

HA • 2

The hard, smooth tiles reflect almost all the sound and there is nothing soft to absorb it, so the voice bounces around many times; the overlapping reflections make it louder and fuller. Curtains and a carpet absorb sound, as in acoustic protection, so there are few reflections.

MARKING SCHEME

- ✓ The hard, smooth tiles reflect almost all the sound and nothing absorbs it, so the reflections overlap with the voice and make it louder and fuller.
- ✓ Curtains and carpets are soft and porous: they absorb the sound (as in acoustic protection), so there are few reflections.

9 Activity: Two ways to shake a slinky (Activity 10.2)

(not marked)

WHAT STUDENTS SHOULD FIND

In the push-and-pull wave, compressions and rarefactions run along the slinky and the thread moves forwards and backwards along the slinky, the same line the wave travels: a longitudinal wave. In the side-to-side wave, humps run along the slinky and the thread moves from side to side, at right angles to it: a transverse wave. In both, the thread stays about its place; only the wave travels. The velocity is the frequency $\times$ the wavelength.

See it at Science Playground

Exhibits and plants at the center, Bhaktapur, that go with this unit. Book a class visit at science-playground.com/booking.

- **Glowing Wire Sculptures** (exhibit): Under the UV lamp the wire coating glows: it turns invisible UV into visible light.
- **The Echo Tube** (exhibit): Clap into the 38 m tube: the echo returns after about 0.22 s, having gone 76 m.
- **Whisper Dishes — Send a Whisper Across the Garden** (exhibit): Whisper at one dish's ring: the curved dishes reflect and focus it across the garden.

Marks by level	Knowledge	Understanding	Application	Higher ability	Total
Marks	12	12	9	2	35

