

Sound, echoes, ultrasound and hearing

Physics grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · Test answers (mark scheme)

Mark as indicated. Accept equivalent wording and allow follow-through from earlier errors. Penalise a missing unit only once in the whole paper, and do not penalise sensible rounding to 2 or 3 significant figures.

Level: Physics grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · **Curriculum:** IGCSE 3.4

Question 1 Hearing range (2 marks)

- a. About 20 Hz to 20 000 Hz (20 kHz).
- b. Sound with a frequency higher than the upper limit of human hearing, above 20 kHz.

Marking: 1 mark each part.

Question 2 Thunder (3 marks)

$$d = v t = 330 \times 6.0 = 1980 \text{ m} = \mathbf{2.0 \text{ km}} \text{ (1.98 km)}.$$

Marking: equation (1), substitution (1), answer with unit (1).

Question 3 Sonar (3 marks)

$$d = v t / 2 = 1500 \times 0.160 / 2 = \mathbf{120 \text{ m}}.$$

Marking: total distance 240 m (1); halving (1); answer with unit (1).

Question 4 Two sounds (4 marks)

- a. Trace Y (more waves in the same time).
- b. Trace X (larger amplitude).
- c. X has two waves in 10 ms, so $T = 5.0 \text{ ms} = 0.0050 \text{ s}$ and $f = 1 / 0.0050 = \mathbf{200 \text{ Hz}}$.
- d. $\lambda = v / f = 330 / 200 = \mathbf{1.65 \text{ m}}$.

Marking: 1 mark each part.

Question 5 Sound in air (3 marks)

The loudspeaker cone vibrates and pushes on the air particles, creating regions of compression and rarefaction. These pass along as a longitudinal wave, each particle vibrating to and fro in the direction of travel and passing the energy on. The energy reaches the ear, but the particles do not travel.

Marking: vibrating source / compressions and rarefactions (1); longitudinal, parallel vibration

(1); energy transferred, not particles (1).

Question 6 Sound and vacuum (2 marks)

A sound wave is passed from particle to particle. A vacuum has no particles, so there is nothing to carry the vibrations.

Marking: sound needs particles to pass vibrations (1); vacuum has none (1).

Question 7 Medical ultrasound (2 marks)

Pulses of ultrasound are sent into the body and are partly reflected at the boundaries between different tissues. A detector records the time for each echo, and a computer uses the time to calculate the depth and builds up an image.

Marking: reflection at boundaries (1); time of echo gives depth / image built by computer (1).

Question 8 Speed in air (1 mark)

330 m/s (accept values between 330 and 343 m/s).

Marking: 1 mark.