Blast-off : Sound Mark Scheme

Page 5: Features of a Wave

1. Longitudinal waves move (or **oscillate**) in the same direction as the energy they are transferring. They are transferring energy **parallel** to the direction in which the waves oscillate (or **vibrate**).
2. Longitudinal waves can be modeled by pushing a spring **horizontally**. The energy is transferred horizontally along the spring, in the **same** direction the waves move in.
3. **Sound** waves are an example of longitudinal waves.
4. Longitudinal waves contain areas where the particles are closer together than the **average**. These are called **compressions**.
5. Areas where the coils are stretched out model **rarefactions**.

Page 6: Transverse Waves

1. Transverse waves transfer energy at **right** angles to the direction in which the waves **oscillate**. They can be modeled by moving a spring up and down.
2. The waves on the spring move **vertically**, but the energy is being transferred **horizontally**.
3. **Light** waves are an example of transverse waves.
4. The highest point a transverse wave reaches above its resting position is called a **peak**. The lowest point a transverse wave reaches below its resting position is called a **trough**.

Page 7: Wave Keywords

- Amplitude: The distance between the wave's resting position and the furthest point from it.
- Compression: Areas on a longitudinal wave where the particles are closer together than average.
- Frequency: The number of waves passing a point each second.
- Longitudinal wave: Transfer energy parallel to the direction in which the waves oscillate.
- Peak: The highest point a transverse wave reaches above its resting position.
- Rarefaction: Areas on a longitudinal wave where the particles are further apart than average.
- Transverse wave: Transfer energy at right angles to the direction in which the waves oscillate.
- Trough: The lowest point a transverse wave reaches below its resting position.
- Wavelength: The distance from a point on one wave to the equivalent point on an adjacent wave.

Page 11: Questions on Sound Waves

1. (a) Frequency: Number of waves per second; units = **Hertz (Hz)**. (b) Amplitude relates to **loudness**. (c) Wavelength relates to **pitch**.
2. Sound waves are **longitudinal**.
3. Sound travels fastest in solids and slowest in gases because particles in solids are closely packed, enabling vibrations to transfer energy faster.

4. CRO Traces:
    - Loud, low pitch: Large amplitude, long wavelength.
    - Soft, high pitch: Small amplitude, short wavelength.
    - Loud, high pitch fading: Large amplitude, short wavelength decreasing over time.
5. Sound cannot travel in a vacuum because it needs **particles** to transmit energy.

Page 15: Questions on the Ear

- Ear canal: Sound waves pass down this tube.
- Ear drum: A tight sheet of skin; sound waves make it vibrate.
- Ear bone: The 3 small bones pass on the vibrations from the ear drum.
- Cochlea: Coiled tube that picks up vibrations and sends signals along the nerve.
- Nerve: Carries signals to the brain.

Page 17: Questions on Echoes

1. Good absorbers of sound: **duvet, cushions, curtains, carpet**.
2. Soft materials absorb sound waves, reducing echoes and improving sound quality in a cinema by preventing sound from bouncing off hard surfaces.
3. In a sports hall, sound reflects off hard surfaces, creating multiple overlapping echoes, making it difficult to hear clearly.

Page 21: Ultrasound and Sonar

1. Distance of seabed = Speed × Time ÷ 2 = 1500 m/s × 0.8 s ÷ 2 = **600 m**.
2. Matching:
    - Echolocation: Measure distances.
    - Dolphins and whales use ultrasound to: Communicate.
    - Ultrasound is: Sound beyond a human's audible range.
    - Medical use: Scanning unborn babies.
    - Echoes: Reflected sound waves.
    - Soft materials: Reduce echoes.

Page 23: Sound Waves on Oscilloscope

1. (i) A loud sound with a low pitch: P
   (ii) A quiet sound with a high pitch: S
   (iii) A loud sound with a high pitch: R

Page 24: Higher Pitch and More Quietly

2. Correct diagram: B

- Higher pitch: Waves closer together.
- More quiet: Smaller amplitude.

Page 25: Longitudinal Wave and Speed of Sound

3. (a) (i) Arrow at A pointing right (direction of energy flow).

(ii) Particles at X oscillate parallel to the direction of wave energy transfer.

(b) Trend: As temperature increases, the speed of sound increases.

Page 26: Sound Levels and Reflection

(c) Recommended maximum time for 100 dB: 0.25 hours (15 minutes).

(d) (i) Material with the biggest difference in sound reflection: Carpet (76% at 250 Hz to 29% at 2 kHz).
(ii) Worst absorber of sound: Brick (consistently reflects >90%).

Page 27: Transverse Wave
(e) (i) Amplitude of the wave: 1.5 m.
(ii) Wave speed = frequency × wavelength
Wave speed = 30 Hz × 1.5 m = 45 m/s.
Answer: 45 m/s

Page 28: Wave Diagram
4. (i) Amplitude: d
(ii) Wavelength: b

5. (a) (i) Sound above 20 kHz: Ultrasound
   (ii) Method of detection: Echolocation
   (iii) In a longitudinal wave, particles oscillate parallel to the direction of wave travel.

Page 29: Calculating Speed of Sound
(b) Wave speed = frequency × wavelength
Wave speed = 1,000 Hz × 1.5 m = 1,500 m/s.
Answer: 1,500 m/s
(c) Mistake: The student did not divide the time by 2 to account for the round trip of the sound wave.

Page 30: Sound Wave Graph
6. (i) Amplitude: 6 cm
(ii) Wavelength: 12 cm

Page 31: Dolphin Ultrasound
7. Distance = speed × time ÷ 2
Distance = 1,500 m/s × 0.04 s ÷ 2 = 30 m
Answer: 30 m