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IGCSE PHYSICS 0625 · TOPICAL PAST PAPERS

Sound — Paper 1

Worked Answer Key (Multiple Choice)

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Sound — Paper 1 · Worked Answer Key

These are **Megalecture worked answers** for the topical multiple-choice compilation on **Sound (IGCSE Physics 0625, Paper 1)**. Every answer below was solved from first principles by the Megalecture team. Calculations use the standard sound relations — speed = distance / time, the echo rule (the sound travels to the reflector *and back*, so distance = ½ × speed × time), and the wave equation $v = f\lambda$. Useful reference values: the audible range for a healthy human ear is about **20 Hz to 20 000 Hz**; ultrasound is any frequency **above 20 000 Hz**; and sound travels **fastest in solids, slower in liquids, slowest in gases** (and not at all in a vacuum). Use this key to mark your work and to see the one-line reasoning behind each correct letter. The questions are numbered as in the compilation; the exam reference for each is given in the second column.

Part A · Speed of sound, states of matter & the audible range

Q #	Exam reference	Answer	Brief working / reason
1	M/J 11 P11 Q25	**A**	Sound needs particles and travels faster the more closely packed they are: slowest in **air** (gas), fastest in **steel** (solid). → row **A**.
2	M/J 13 P11 Q23	**C**	The audible range of a healthy human ear is approximately **20 Hz → 20 000 Hz** → option **C**.
3	M/J 13 P11 Q24	**D**	Speed of sound: highest in a solid, then liquid, lowest in a gas. Highest→lowest = **solid, liquid, air** → row **D**.
6	M/J 14 P11 Q28	**D**	Sound cannot travel through a vacuum and is fastest where particles are closest together → **sound travels fastest in solids**.
9	M/J 15 P11 Q20	**A**	Sound is a mechanical wave and needs a medium; space is (almost) a vacuum, so sound does **not** travel **from a satellite in space to Earth** → **A**.
13	M/J 18 P11 Q25	**D**	Audible range of a young, healthy ear = **20 Hz to 20 000 Hz only** → **D**.
14	M/J 18 P12 Q32	**C**	The value inside 20 Hz–20 000 Hz is **12 kHz** (= 12 000 Hz). 12 mHz and 12 Hz are too low, 12 MHz far too high → **C**.
17	M/J 19 P12 Q29	**C**	Audible range ≈ **20 Hz to 20 kHz** → **C**.
18	M/J 19 P12 Q30	**C**	Speeds: air (≈330) < water (≈1500) < ice/solid (≈3200). So $c_i > c_w$ is the correct relationship → **C**.
19	M/J 20 P11 Q30	**B**	At fixed speed, $\lambda \propto 1/f$. Longest λ ↔ lowest f (20 Hz); shortest λ ↔ highest f (20 000 Hz). Ratio $\lambda_{max}:\lambda_{min} = f_{high}:f_{low}$ = 20 000:20 = **1000:1** → **B**.
25	M/J 22 P11 Q25	**D**	Fastest in the closest-packed state (**solid**), slowest in the most spread-out state (**gas**) → row **D**.

Q #	Exam reference	Answer	Brief working / reason
39	O/N 16 P12 Q29	**A**	Increasing speed (slowest→fastest) = gas (slowest), then liquid, then solid (fastest) = **gas → liquid → solid** → option **A**.
41	O/N 17 P11 Q24	**A**	Typical speeds: air ≈ 330 m/s, water ≈ 1500 m/s, steel ≈ 6000 m/s → row **A** (330, 1500, 6000).
44	O/N 18 P11 Q22	**C**	Audible range = lowest **20 Hz**, highest **20 kHz** (= 20 000 Hz) → row **C**.
48	O/N 19 P11 Q29	**A**	Speed of sound in air ≈ 330 m/s. Convert each option: A = 3.3×10^4 cm/s = 33 000 cm/s = **330 m/s** ✓. B = 33 000 m/s, C = 330 000 m/s, D = 3.3×10^8 m/s — all far too fast. → **A**.
49	O/N 19 P12 Q27	**D**	Slowest→fastest = air (c_a), liquid (c_L), solid (c_s) → row **D** (c_a, c_L, c_s).
51	O/N 20 P11 Q31	**C**	Sound is fastest where particles are most closely bonded → **in solids** → **C**.

Part B · Pitch, loudness, waveforms & the wave equation

Q #	Exam reference	Answer	Brief working / reason
4	M/J 13 P11 Q25	**D**	Pitch depends on frequency. A higher pitch means a higher frequency → **an increase in the frequency of vibration**.
10	M/J 15 P12 Q30	**B**	Y has greater amplitude → louder; Y has smaller frequency than X → lower pitch. So Y is **louder and lower pitch** → **B**.
11	M/J 16 P11 Q26	**B**	Quieter = smaller amplitude (lower); unchanged pitch = same frequency. So amplitude **lower**, frequency **same** → row **B**.
16	M/J 19 P11 Q27	**D**	Louder = increasing amplitude; lower pitch = decreasing frequency (waves spreading out, growing taller). The trace with growing height and lengthening wavelength is **D**.
27	O/N 11 P11 Q26	**C**	Same note (same frequency) and same loudness setting, but different waveform shapes → the difference is **the quality (timbre)** → **C**.
28	O/N 13 P11 Q23	**B**	A compression is a region of **maximum** air pressure, i.e. the peak of the pressure–time graph → point **B**.
33	O/N 15 P11 Q22	**D**	Same pitch (same frequency) and similar size, but different waveform shape → the sounds differ in **the quality** → **D**.
35	O/N 15 P12 Q25	**B**	Increasing amplitude only makes the sound louder; frequency (50 Hz) is unchanged so pitch is unchanged → **a louder sound of the same pitch** → **B**.
38	O/N 16 P11 Q29	**A**	Loudness is determined by **amplitude**; greater amplitude → louder → **A**.

Q #	Exam reference	Answer	Brief working / reason
42	O/N 17 P11 Q25	D	Crossing into a new medium, the frequency is fixed by the source (**stays constant**); since λ increases and $v = f\lambda$, the speed must **increase** → row **D**.
23	M/J 22 P11 Q20	B	On refraction the frequency is unchanged (set by the source). Only the **speed and wavelength** change → **B**.

Part C · Echoes & speed-of-sound calculations

Q #	Exam reference	Answer	Brief working / reason
8	M/J 14 P12 Q29	C	Echo travels 2 × 200 = 400 m. Mean time = (1.44+1.70+1.58+1.76)/4 = 1.62 s. v = 400 / 1.62 ≈ **247 m/s** → **C**.
12	M/J 17 P11 Q31	A	Depth of sea bed = ½ × 1500 × 1.0 = 750 m. Depth of whale = ½ × 1500 × 0.60 = 450 m. Height above sea bed = 750 − 450 = **300 m** → **A**.
21	M/J 21 P11 Q25	B	Echo path = 2d. d = ½ × v × t = ½ × 320 × 4.0 = **640 m** → **B**.
24	M/J 22 P11 Q24	B	Echo from P travels 2×50 = 100 m; from Q travels 2×200 = 400 m. Extra path = 300 m in 1.0 s → v = 300 / 1.0 = **300 m/s** → **B**.
34	O/N 15 P12 Q21	A	v = fλ → λ = v / f = 1500 / 24 000 = **0.063 m** → **A**.
37	O/N 15 P12 Q27	C	d = ½ × v × t = ½ × 320 × 4.0 = **640 m** → **C**.
40	O/N 16 P12 Q30	B	Echo from P = 2×50 = 100 m; from Q = 2×200 = 400 m. Difference = 300 m heard 1.0 s apart → v = 300 / 1.0 = **300 m/s** → **B**.
43	O/N 18 P11 Q21	C	(speed of light)/(speed of sound) ≈ $(3 \times 10^8)/(330) \approx 9 \times 10^5 \approx \mathbf{10^6}$ → **C**.
46	O/N 18 P12 Q27	D	Each pulse makes a round trip of 2×1200 = 2400 m. 5 pulses in 8.0 s → one round trip every 8.0/5 = 1.6 s. v = 2400 / 1.6 = **1500 m/s** → **D**.
50	O/N 19 P12 Q28	D	Echo is heard halfway between bangs (bangs 1.0 s apart) → echo time = 0.50 s for a round trip of 2×80 = 160 m. v = 160 / 0.50 = **320 m/s** → **D**.
52	O/N 20 P12 Q27	D	Round-trip distance = 2×6000 = 12 000 m → travel time = 12 000/1500 = 8.0 s. The next pulse is sent 2.0 s after the echo returns, so the gap between pulses = 8.0 + 2.0 = **10 s** → **D**.
54	O/N 21 P11 Q25	D	Each clap echo travels 2x. Claps coincide with echoes, so the clap interval = 2x/v. N claps in time t → interval = t/N. Hence 2x/v = t/N → v = **2Nx/t** → **D**.
56	O/N 21 P12 Q28	B	An echo is sound bouncing back off a surface → it is caused by **reflection** → **B**.

Q #	Exam reference	Answer	Brief working / reason
47	O/N 19 P11 Q28	**C**	The echo is the sound wave bouncing back from the cliff face → **reflection** → **C**.

Part D · Ultrasound

Q #	Exam reference	Answer	Brief working / reason
5	M/J 13 P12 Q27	**D**	Ultrasound is above 20 kHz. Of the options only **30 kHz** exceeds 20 kHz → **D**.
7	M/J 14 P12 Q28	**D**	Ultrasound > 20 000 Hz. Only **35 000 Hz** qualifies → **D**.
15	M/J 18 P12 Q33	**A**	A genuine ultrasound use is **cleaning jewellery** (ultrasonic cleaning). The others use light/electromagnetic waves → **A**.
20	M/J 20 P11 Q31	**B**	Another ultrasound use is **pre-natal scanning** (imaging an unborn baby) → **B**.
22	M/J 21 P12 Q29	**B**	P (cleaning jewellery) and R (imaging an unborn baby) are real ultrasound uses; Q (tanning) uses UV light. So **P and R only** → **B**.
26	M/J 22 P11 Q26	**A**	The valid ultrasound use listed is **cleaning jewellery** → **A**.
29	O/N 14 P13 Q24	**C**	Two traces of the same frequency and amplitude but different shape differ in **timbre (quality)** → **C**.
30	O/N 14 P13 Q25	**C**	Light reaches the campers almost instantly; the thunder arrives 5.0 s later. Distance = v × t = 340 × 5.0 = **1700 m** → **C**.
31	O/N 14 P13 Q27	**A**	Echo path = 2d. Mean time = (0.72+0.80+0.71+0.81+0.71)/5 = 0.75 s. d = ½ × v × t = ½ × 320 × 0.75 = **120 m** → **A**.
32	O/N 14 P12 Q19	**B**	A medical ultrasound use is **pre-natal scanning** → **B**.
36	O/N 15 P12 Q26	**C**	An ultrasound scanner builds an image from echoes — ultrasound **reflected by the baby** → **C**.
45	O/N 18 P11 Q23	**D**	Ultrasound is used for cleaning, pre-natal scanning and quality control, but **not** for sterilising medical equipment → **D**.
53	O/N 20 P12 Q28	**B**	Sound (and so ultrasound) is a **longitudinal** wave; ultrasound has a frequency **greater than 20 kHz** → row **B**.
55	O/N 21 P12 Q26	**C**	The scanner forms the image from ultrasound **reflected by the baby** (echoes from boundaries inside the body) → **C**.

Note from Megalecture. Several questions in this compilation repeat across exam sessions — for example the two-buildings echo (Q24 / Q40), the cliff echo (Q21 / Q37), the ultrasound prenatal-scan items and the audible-range items. They are answered consistently above. Remember the two ideas that unlock almost every numerical part: for an **echo** the sound covers *twice* the distance to the reflector (use d = ½ × v × t), and for any wave **v = fλ**. These are original Megalecture worked solutions prepared for revision use.