Question	Answer	Mark
1(a)	Method 1: Long distance / distance in field measured with the tape One student fires pistol at one end (of this distance) Student at other end starts stop-watch on seeing smoke / light from pistol and st / ops stop-watch on hearing sound of pistol speed = (measured) distance / (measured) time Method 2: Distance of 50 m or more from a vertical wall measured with the tape Student 1 fires pistol at this distance from the wall Student 2 standing next to student 1 starts stop-watch on hearing pistol and stops stop-watch on hearing echo speed = 2 × (measured) distance / (measured) time	 **B1** **B1** **B1** **B1** **(B1)** **(B1)** **(B1)** **(B1)**
(b)(i)	v = fλ OR (λ =) v / f OR 1500 / 200 7.5 m	**C1** **A1**
(b)(ii)	1 (frequency) does not change 2 (speed) decreases	**B1** **B1**
		Total: 8

2 **(a) (i) 1.** Mark amplitude with **X** B1
2. Mark wavelength with **Y** B1

(ii) 1. Amplitude increases and wavelength stays the same B1
2. Amplitude stays the same and wavelength decreases B1

(b) v = (total) distance / time OR d / t OR 2d / t in any form C1
d = 1500 × 0.054 / 2 C
40 m OR 41 m A1

[Total: 7]

3 **(a) (i)** (compression is a) region of higher pressure
OR region where air layers/particles/molecules are closer B1

(ii) 1. distance between (two successive / adjacent) compressions B1

2. number of compressions (passing a point) per second / unit time
OR number of compressions emitted per second/unit time B1

(b) (i) (f =) v / λ OR 340 / 0.0085
40 000 Hz OR 40 kHz

(ii) frequency/pitch is above the upper threshold for human hearing / 20 kHz
OR it is ultrasound B1

(iii) (d =) vt in any form: words, symbols, numbers C1
41 m **or** 40.8 m A

[Total: 8]

4 **(a** (in compressions) pressure higher OR molecules / atoms / particles close(r) together / (more) tightly packed B1

(b) $v = f\lambda$ in any form OR (λ =) v / f OR 340 / 850
= 0.40 m A1

(ii) distance (of compression A from barrier) = 2.5×0.40 OR 1.0 m C
time (to reach barrier) = $1/340 = 2.9 \times 10^{-3}$ s OR 2.9 ms

OR T (= 1 / f) = 1 / 850 OR 0.4 / 340 OR 1.2×10^{-3} (C1)
(moves 2.5 wavelengths:) time = 2.5 / 850 = 2.9×10^{-3} s OR 2.9 ms (A

(c) two circular arcs centred on mid-point of gap in barrier <u>by eye</u> B1
along centre line, arcs separated by the same distance as adjacent compressions approaching barrier B1

(d) (speed in water) greater OR numerical value greater than 340 m / s B

[Total: 8]

5 **(a** (region of) low(er) pressure OR where molecules are further apart B1

(b) (i) 0.19 m B1

(ii) $v = f\lambda$ OR $7\,800 \times 0.19$ OR 1 500 / 1 480 / 1 482 (m / s) OR 0.76 / 1 500 OR 1 / 7 800 OR 4 / 7 800 etc. ecf from **(i)** C1
$5.1(28205) \times 10^{4}$ s ecf from **(i)** A1

(c) (i) unchanged / stays the same / constant OR 7 800 Hz

(ii) increases B1

(d) three wavefronts (rarefactions) joined to those below B1
three wavefronts with their upper ends further to the right AND parallel B1

[Total: 8]

6 **(a** speed of sound in gas: 300 m / s B

speed of sound in solid: 3000 m / s B

(b) particles / molecules / atoms oscillate / vibrate
OR pressure variation / compressions / rarefactions / displacements move B1

in the direction of travel (of the wave / sound)

(c) (i) two complete wavelengths / cycles with shorter wavelength B1

wave drawn has greater amplitude B1

(ii) higher frequency / pitch B1

louder / higher volume B1

[Total: 8]