3. Waves

3.4 Sound

Paper 3 and 4

Answer Key

Paper 3

Q1.

Question	Answer	Marks
(a)	(sound is) reflected (from cliff) OR echo (from cliff)	**B1**
(b)	(d =) 440 (m)	**A3**
	(d =) 340 × 1.3	(C2)
	(d =) $s \times t$ OR $s = d \div t$	(C1)

Q2.

Question	Answer	Marks
(a)	oscillating / vibrating/backwards and forwards	**B1**
(b)(i)	stopwatch / (stop)clock	**B1**
(b)(ii)	540 (m)	**A3**
	340 × 1.6	(C1)
	(distance =) speed × time	(C1)
(c)	20 – 20 000	**B1**
	Hz / hertz	**B1**

Q3.

Question	Answer	Marks
(a)(i)	610 (m)	**A3**
	340 = distance ÷ 1.8 **OR** (distance =) 340 × 1.8	(C2)
	speed = distance ÷ time in any form	(C1)
(a)(ii)	an echo **OR** sound (waves) reflecting	**B1**
	from rocks **OR** YZ **OR** Z **OR** bottom of quarry	**B1**
(b)	1200 (Hz)	**A3**
	340 = $f \times 0.28$ **OR** (f =) 340 ÷ 0.28	(C2)
	$v = f\lambda$ in any form **OR** (f =) $v \div \lambda$	(C1)

Q4.

(b)	any **four** from: (student A) bangs two blocks of wood together (student B) starts stopwatch when (sees) blocks or wood collide (student B) stops stopwatch when she hears echo repeat (experiment) AND calculate average (time) uses 240 m as distance travelled by sound owtte use s= d ÷ t	**B4**

Q5.

Question	Answer	Marks
(a)(i)	amplitude	**B1**
(a)(ii)	frequency	**B1**
(b)(i)	160 (m)	**B1**
(b)(ii)	(s =) d ÷ t (speed of sound =) distance ÷ time	**C1**
	160 ÷ 0.56	**C1**
	290 (m / s)	**A1**
(b)(iii)	any **two** from: use something to give sharper sound stand further away from wall no other walls nearby both students stand at 80 (m)/same distance (from wall) repeat (the measurement/experiment) AND average (results)	**B2**

Q6.

Question	Answer	Marks
(a)(i)	(wavelength =) 40 (cm)	**B1**
(a)(ii)	wave drawn with greater amplitude	**B1**
(b)	20 to 20 000	**B1**
	Hz or hertz	**B1**

Q7.

Question	Answer	Marks
(a)	vibrates	**B1**
	reflected	**B1**
	amplitude	**B1**
	frequency	**B1**
	matter	**B1**
(b)	vibrations with higher frequency than sound	**B1**

Q8.

Question	Answer	Marks
(a)(i)	(it is) vibrating	B1
(a)(ii)	longitudinal	B1
(a)(iii)	frequency (of sound) OR 25 kHz	B1
	is above (upper limit of) human hearing range OR is an ultrasound	B1
(b)(i)	horizontal line with arrows at either end	B1
(b)(ii)	(14.4 ÷ 4 =) 3.6 (cm)	B1
(c)	Any **four** from: use of shallow water use of flat lamina or shape below surface / different depths (of water) used waves hit {shallower water / shape} at an angle (other than 90°) waves change direction (due to) change in speed	B4

Q9.

Question	Answer	Marks
(a)(i)	light travels faster than sound **OR** flash / light seen before bang heard	B1
(a)(ii)	speed = distance ÷ time in any form	C1
	500 √ 1.6	C1
	312.5 (m / s)	A1
(a)(iii)	it is windy owtte **OR** reaction times to start / stop watch	B1
(b)	echo	B1
	(sound) reflected from cliffs	B1

Q10.

Question	Answer	Marks
(a)(i)	vibrates	B1
(a)(ii)	Yes	B1
	(as within audible range of) 20 Hz to 20 000 Hz	B1
(b)	line drawn with smaller amplitude	B1
	lower frequency i.e. fewer waves on screen	B1

Q11.

Question	Answer	Marks
(a)	circle around 20 Hz–20 000 Hz	B1
(b)	frequencies (of sound)	B1
	above 20 000 Hz	B1
(c)	Quieter sound **AND** has lower pitch	B1
	(as) smaller amplitude	B1
	(as) frequency is lower	B1

Q12.

Question	Answer	Marks
(a)(i)	tape measure	1
(a)(ii)	reflection (of sound)	1
(b)	time for sound to travel to wall and back = 1.0 s	1
	340 m in 1.0 s	1
	(speed =) 340	1
	m / s	1

Q13.

Question	Answer	Marks
(a)(i)	vibrates	1
(a)(ii)	longitudinal	1
(a)(iii)	vacuum	1
(b)(i)	1000 (Hz)	1
(b)(ii)	frequency in range 10 001 to 30 000 (Hz)	1
(b)(iii)	lowest frequency heard by humans is 20 Hz	1
	(but) elephants can hear frequencies below 20 Hz	1
(b)(iv)	ultrasound	1

Paper 4

Q14.

Question	Answer	Marks
(a)	0.20 m	**B1**
(b)	any value in range from 330 m / s ⩽ value ⩽ 350 m / s	**B1**
(c)(i)	**(b)** ÷ **(a)** evaluated **AND** Hz	**A2**
	$f = v / \lambda$ **OR** ($f =$) v / λ **OR (b)** ÷ **(a)**	C1
(c)(ii)	audible/yes/it is **OR** inaudible / no / it isn't consistent with value in **5(c)(i)** **AND** consistent explanation with reference to 20 (Hz) ⩽ normal range of human hearing ⩽ 20 000 (Hz)	**B1**
(d)	1 (explanation mentions) diffraction	**M1**
	2 Only a little diffraction owtte	**A1**
	3 (because) gap width large (compared to wavelength) owtte	**A1**
	4 Little / no sound heard at J **AND** (some) sound heard at K	**A1**

Q15.

Question	Answer	Marks
(a)	ultrasound	**B1**
(b)	0.029 s	**A3**
	(distance travelled =) 22 × 2 **OR** 44 SEEN	C1
	$v = s / t$ OR ($t =$) s / v OR 44 / 1500	C1
(c)	reflected wave is weaker / has smaller amplitude	**M1**
	fish is small(er) **OR** only small part of wave reflects off fish OR most of sound goes to seabed	**A1**

Q16.

Question	Answer	Marks
(a)(i)	C marked and labelled at a peak of the sine wave	**B1**
	R marked and labelled at a trough of the sine wave	**B1**
(a)(ii)	graph / it does not show (variation with) displacement	**B1**
(a)(iii)	(amplitude) increases **AND** (frequency) decreases	**B1**
(b)	0.12 m	**A3**
	$v = f\lambda$ **OR** (λ =) v / f **OR** (λ) = 1500 / 13 000	C1
	1500 / 13 000 **OR** 1.2×10^{N}	C1
(c)	330 m / s ⩽ speed ⩽ 350 m / s	**B1**

Q17.

Question	Answer	Marks
(a)(i)	C in line with smallest gap between dots	**B1**
(a)(ii)	R in line with largest gap between dots	**B1**
(a)(iii)	arrow corresponds to wavelength	**B1**
(b)	1500 m / s	**B1**
(c)	$v = f\lambda$ in any form OR (f =) v / λ	**C1**
	(f =) 1500 / 0.12	**C1**
	(f =) 13 kHz OR 13 000 Hz	**A1**
(d)	statement consistent with candidate's answer to 6c	**M1**
	ultrasound is above 20 000 Hz	**A1**

Q18.

Question	Answer	Marks
(a)	two points labelled C at the centre of the two compressions	**B1**

Q19.

Question	Answer	Marks
(a)(i)	ultrasound OR sound (frequency) above audible range	**B1**
	frequency > 20 kHz OR 20 000 Hz	**B1**
(a)(ii)	8.7×10^{-4} m	**A3**
	(λ =) v / f OR $v = f\lambda$ in any form	C1
	(λ =) 1.3×10^{3} / 1.5×10^{6} OR 8.7×10^{n}	C1
(b)	basic description of use e.g. X-rays for detecting broken bones	**B1**
	additional detail e.g. X-rays pass through soft tissue AND not through bone	**B1**