01. 0625_s22_ms_42 Q: 5

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 =) $1.3 \times 10^{3} / 1.5 \times 10^{6}$ 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**

02. 0625_s22_ms_43 Q: 6

Question	Answer	Marks
(a)(i)	wavefronts semicircles or part semicircles centred on gap	**B1**
	wavelength of waves to right of barrier same as wavelength of incident wave	**B1**
(a)(ii)	1 wavelength shorter	**B1**
	correct refraction	**B1**
	2 direction of travel perpendicular to wavefronts	**B1**
(b)	any **two** from: • particles (in transverse waves) vibrate perpendicular to the direction of travel (of the wave) OR particles in longitudinal waves vibrate parallel to the direction of travel of the wave • longitudinal waves have compressions and rarefactions • transverse waves have troughs and crests	**B2**
(c)(i)	1000 m / s ⩽ value ⩽ 2000 m / s	**B1**
(c)(ii)	molecules closer together / water has greater density	**B1**

03. 0625_m21_ms_42 Q: 5

	Answer	Marks
(a)	echo	**B1**
(b)	(λ=) 7.5×10^{-4} m	**A3**
	(λ=) v / f OR $v = f\lambda$ in any form	C1
	(λ=) $1.5 \times 10^{3} / 2 \times 10^{6}$	C1
(c)(i),(ii)	labelled wavelength of incident wave	**B1**
	3 part circles to the left of the barrier and centred to right of the barrier	**B1**
	wavelengths of reflected and incident waves same	**B1**

04. 0625_s21_ms_41 Q: 6

	Answer	Mark
(a)	two points labelled C at the centre of the two compressions	**B1**
(b)	6200–6500 Hz	**A3**
	(λ =) value from 0.051 to 0.053 (m) seen anywhere	**C1**
	(f =) v / λ in any form **or** 330 / 0.052 **or** 330 / 5.2 **or** 63	**C1**
(c)	compressions / rarefactions closer **or** more compressions / rarefactions (in same distance)	**B1**
	less diffraction / spreading out	**B1**
	(because of) smaller wavelength **or** ratio wavelength / gap width smaller	**B1**

05. 0625_s21_ms_43 Q: 5

	Answer	Mark
(a)(i)	part of a circle, at least quarter of a circle, centred on centre of gap	**B1**
	waves same wavelength as incident waves	**B1**
(a)(ii)	waves pass through gap remaining straight	**B1**
	less / no diffraction occurs	**B1**
(b)	1.8 m	**A2**
	$\lambda = v/f$ OR 1500/850 in any form	**C1**

06. 0625_w21_ms_42 Q: 6

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

07. 0625_w21_ms_43 Q: 6

Question	Answer	Marks
(a)		B5
	method of producing sound, e.g. clap for echo method or gun for direct measurement, sig gen or loudspeaker, hammer on block	B1
	apparatus used, e.g. stopwatch, long tape, trundle wheel, wall if using echo method, metre rule, microphones and timer or microphones and oscilloscope	B1
	detail of measurement of (long) distance, e.g. measure distance between person and the wall, measure distance between loudspeaker and microphone or measure distance between two microphones	B1
	detail of measurement of time OR appropriate time measured, e.g. at one end start stopwatch when smoke seen from gun and stop it when sound heard, start stopwatch when gun heard / clap heard and stop when echo heard, measure time taken between clap and hearing echo, timer starts when first microphone receives signal and stops when second receives signal OR measurement of wavelength, e.g. move one microphone away until two waves on oscilloscope have moved one wavelength apart	B1
	speed = measured distance / time for direct method OR speed = 2 × distance from student clapping to wall / time for echo method OR distance between microphones = wavelength AND v = f × λ	B1
(b)		B2
	wavelength of light is (much) smaller than width of doorway or wavelength of sound	B1
	wavelength of sound is similar to width of doorway OR λ ≃ width of gap for diffraction to occur OR larger wavelength results in greater diffraction ORA	B1

08. 0625_s20_ms_41 Q: 6

(a)	(λ =) v / f OR 340 / 20 000 OR 340 / 20	C1
	0.017 m AND 17 m	A1
(b)	(longitudinal wave) vibration direction parallel to propagation / energy travel direction	B1
	transverse wave vibration direction perpendicular to propagation / energy travel direction	B1
	consists of rarefactions AND compressions	B1

(c)	diffraction mentioned	**B1**
	wavelength of sound from drum / low frequency sound greater (than wavelength of high frequency sound)	**B1**
	more diffraction of sound from drum OR less diffraction of high frequency sound	**B1**

09. 0625_s20_ms_42 Q: 5

(a)	three wavefronts parallel to each other AND same angles of reflection and incidence both by eye	**B1**
	two wavelengths same as original wavelength by eye	**B1**
	three reflected waves meet incident waves at barrier	**B1**
(b)	$v = f\lambda$ in any form OR $(f =) v/\lambda$	**C1**
	OR (f =) 1.2 / 0.36	**C1**
	(f =) 3.3 Hz	**A1**
(c)	sound OR ultrasound	**B1**
	compressions	**B1**

10. 0625_s20_ms_43 Q: 6

(a)	three wavefronts parallel to each other	**B1**
	two wavelengths same as reflected by eye	**B1**
	three wavefronts at same angle to barrier as original	**B1**
(b)	second, third, fifth and sixth boxes ticked	**B3**
(c)	1500 m / s	**B1**

11. 0625_w20_ms_43 Q: 6

Question	Answer	Marks
(a)	molecules closer together than normal in a compression	**B1**
	molecules further apart than normal in a rarefaction	**B1**
	pressure higher (than normal) in a compression AND pressure lower (than normal) in a rarefaction	**B1**

Question	Answer	Marks
(b)(i)	4400 (Hz) seen	**C1**
	$(\lambda =) v \div f$ in any form OR 340 ÷ 4400 OR 340 ÷ 4.4 OR 77	**C1**
	$(\lambda = v \div f =)$ 0.077 m	**A1**
(b)(ii)	**1** speed stays the same	**B1**
	2 wavelength decreases	**B1**

12. 0625_w20_ms_43 Q: 7

Question	Answer	Marks
(a)	any **two** from: remote controls (infrared) sensors / alarms specific electrical appliances thermal imaging	**B2**
(b)	Any **three** from • shielding of operator behind screen / lead apron / out of room AND to absorb radiation • shielding of other parts of patient with lead / shielding of other parts of patient AND to absorb radiation • distance from source AND reduces intensity / amount of radiation / exposure • limit time of exposure / not too frequent / max number of X-rays per year AND to limit dose • limit strength / intensity of X-ray beam AND to limit dose	**B3**
(c)(i)	**1** 3×10^8 m / s	**B1**
	2 3×10^8 m / s	**B1**
(c)(ii)	> 20 000 Hz	**B1**

13. 0625_s19_ms_42 Q: 6

(a)(i)	refraction	**B1**
(a)(ii)	(waves move) faster (in region B) OR slower in region A	**B1**
(b)	at least one complete cycle with half the amplitude	**B1**
	at least one complete cycle shorter time period	**B1**
(c)(i)	sound travels faster in steel/metal/solid/the rail (than in air)	**B1**
(c)(ii)	$v = f\lambda$ in any form OR (λ =) v/f OR (λ =) 5800/1100	**C1**
	(λ =) 5.3 m	**A1**

14. 0625_s19_ms_43 Q: 3

(a)	(p) = ρgh in any form OR (p=) $1030 \times 10 \times 3.0 \times 10^3$	**C1**
	3.1×10^7 Pa	**A1**
(b)(i)	$v = d/t$ OR $v = 2d/t$ in any form	**C1**
	$1500 = \frac{2d}{0.50}$ OR $2d = 1500 \times 0.50$	**C1**
	380 m	**A1**
(b)(ii)	distance smaller (first box ticked) AND speed of sound lower (in air than liquid)	**B1**

15. 0625_w19_ms_41 Q: 4

(a)	it / cone vibrates any **two** from: alternating current (a.c.) (in coil / wire) **or** alternating magnetic field (neighbouring) air vibrates **or** vibrations passed on (producing) compressions **and** rarefactions / vibrations parallel to energy transfer vibrating at 15 000 Hz	**B1** **B2**
(b)	$\lambda = v / f$ in any form words, symbols or numbers **or** ($\lambda =$) v / f **or** 330 / 15 000 0.022 m	**C1** **A1**
(c)	at least two vertical wavefronts either to left of barrier or in gap at least one wavefront showing some diffraction approximately constant wavelength throughout **and** ~50% of gap width	**B1** **B1** **B1**

16. 0625_w19_ms_42 Q: 5

(a)(i)	(compression region:) particles / they close(r)	**B1**
	(rarefaction region:) particles / they far / further apart	**B1**
(a)(ii)	(longitudinal) oscillations / vibrations parallel to direction of wave (motion) / energy transfer OR medium is required OR cannot be polarised	**B1**
	(transverse) oscillations / vibrations perpendicular to direction of wave (motion) / energy transfer OR medium not required OR can be polarised	**B1**
(b)(i)	$v = f\lambda$ in any form OR ($\lambda =$) v / f	**C1**
	($\lambda =$) 3500 / 120	**C1**
	($\lambda =$) 29 m	**A1**
(b)(ii)	frequency not changed (in different medium)	**B1**
	audible / yes AND audible range 20 Hz – 20 kHz	**B1**

17. 0625_w19_ms_43 Q: 6

(a)(i)	compression	**B1**
(a)(ii)	rarefaction	**B1**
(b)	correct wavelength indicated	**B1**
(c)	closer together at compression and further apart at rarefaction	**B1**
	amplitude changes	**B1**
	loudness does not affect wavelength	**B1**
(d)	more spread out / further apart	**B1**
	Velocity / speed greater in water than air	**B1**
	(so) wavelength greater	**B1**

18. 0625_s18_ms_42 Q: 6

(a)	frequency 35 000 Hz ringed	1
	longitudinal ringed	1
(b)	$v = f\lambda$ **OR** ($\lambda =$) $v \div f$	1
	($\lambda =$) $3 \times 10^8 \div 1.3 \times 10^{17}$	1
	($\lambda =$) 2.3×10^{-9} m	1
(c)	X-rays ionising/harmful/dangerous (to humans)	1
	Any **one** from: patient rarely exposed low total dose on patient meaningful comment about benefit outweighs danger dentist frequently exposed total dose on dentist would be high if stayed in room	1
(d)	microwaves harmful/dangerous (to humans)	1
	microwaves would pass through open door	1

19. 0625_s18_ms_43 Q: 6

(a)	attempt at compressions and rarefactions	**B1**
	at least one compression labelled **and** at least one rarefaction labelled	**B1**
	wavelength **and** labelled λ	**B1**
(b)(i)	(it/frequency remains) constant	**B1**
(b)(ii)	(it/wavelength) decreases	**B1**
(c)	320 to 350 m / s	**B1**

20. 0625_w18_ms_41 Q: 8

(a)	Particles / molecules / water / medium vibrate	**B1**
	Vibration is in the direction travel of the wave	**B1**
	Has compressions and rarefactions	**B1**
(b)(i)	Value in range from 900 m / s to 2000 m / s	**B1**
(b)(ii)	$v = f\lambda$ in any form OR ($\lambda =$) v / f OR answer to **(b)(i)** / 800	**C1**
	correct evaluation with unit (m)	**A1**

21. 0625_w18_ms_42 Q: 6

(a)(i)	C marked within the shortest gap	**B1**
(a)(ii)	R marked within longest gap	**B1**
(a)(iii)	double-headed arrow **across** two wavelengths	**B1**
(b)	(v =) $f\lambda$ in any form	**C1**
	(v = 750 × 0.45 =) 340 m/s	**A1**
(c)	air OR any / a gas AND speed is (typical) of sound in a gas	**B1**
(d)(i)	longitudinal OR vibration parallel to wave travel direction OR transfer energy	**B1**
(d)(ii)	frequency / pitch less OR below 20 000 Hz OR audible (to someone with normal hearing)	**B1**

22. 0625_s17_ms_41 Q: 7

(a)	Number of wavefronts (generated/produced/passing a point) in 1 sec/per sec/in unit time	**B1**
(b)(i)	(Part of wave where) pressure/density is higher OR molecules are closer together	**B1**
(b)(ii)	At least 3 wavefronts shown as part semi-circles	**B1**
	Same separation between wavefronts drawn by candidate as for incident wavefronts	**B1**
(b)(iii)	Less spreading out OR less diffraction	**B1**
(c)(i)	(λ =) v/f OR 340 / 6800	**C1**
	0.050 m	**A1**
(c)(ii)	In range 900 – 2000 m/s	**B1**
	Total:	**8**

23. 0625_s17_ms_43 Q: 7

(a)(i)	(v =)$f\lambda$ **or** 6000 × 0.25	**C1**
	1500 m/s	**A1**
(a)(ii)	300 m/s ⩽ c ⩽ 360 m/s	**B1**
(a)(iii)	less **and** travels less far in same/periodic time	**B1**
(b)	vibration/oscillation	**B1**
	vibration/oscillation parallel to direction of travel OR compressions and rarefactions	**B1**
(c)(i)	inversely related OR the wider the gap, the less the diffraction OR v.v.	**B1**
(c)(ii)	directly related OR greater wavelength, greater diffraction OR v.v.	**B1**
	Total:	**8**

24. 0625_w17_ms_41 Q: 6

(a)	1500 m / s liquid 5000 m / s solid 300 m / s gas	**B2**
(b)(i)	X and Y marked at centres of any two rarefactions	**B1**
(b)(ii)	Area of low pressure or low density (of atoms) or where atoms / molecules far apart	**B1**
(c)	$v = = d / t$ or $2 d / t$ in any form	**C1**
	$d = v t / 2$ OR $3.0 \times 10^8 \times 2.56 / 2$	**C1**
	3.84×10^8 m OR 3.84×10^5 km	**A1**