

- 1 (a) (i) (number of complete) vibrations (of the strip) per second/unit time B1
- (ii) maximum displacement of end of strip from mid-position
OR XY OR ZY OR $XZ \div 2$ B1
- (b) (i) $(t =) d \div v$ OR $2d \div v$ C1
- 0.20 s OR 0.2 s A
- (ii) 0.60 s OR 0.6 s c.a.o. B1
- (c) (i) accept any value between 1.0 and 9.9×10^3 m/s B
- (ii) accept any value between 1.0 and 9.9×10^3 m/s B
- (d) $v = f\lambda$ in any form OR $v \div f$ C1
- correct evaluation from candidate's (c)(i) with unit, expect 0.016 m B
- 2 (a) pressure high/increased OR molecules/particles close(r/st together) B1
- (b) (i) 1.7 m B1
- (ii) $v = f\lambda$ in any form OR $(f =) v/\lambda$ OR $5/0.025$
200 Hz A1
- (c) three compressions at $23^\circ - 33^\circ$ to wall B1
constant and correct wavelength by eye
only scored if at $8^\circ - 48^\circ$ to wall B1
- (d) (wavelength) greater B1
change of speed correctly related to change of wavelength B1

[Total: 8]

- 3 (a) vibrations **OR** compressions **AND** rarefactions M1
 vibrations parallel to direction of travel (of wave energy)
OR compressions move in direction of travel (of wave energy) A1
- (b) (i) $(\lambda =) v/f$ **OR** 6100/7500 **OR** 6100/7.5 C1
 0.81(33333)m **OR** 813(33333)mm A1
- (ii) 1. decreases B1
 2. same answer as 1. B1
- [Total: 6]**

- 4 (a) (i) longitudinal: oscillations/vibration of particles/molecules in direction of travel (of wave) B1
 transverse: oscillation/vibrations of particles/molecules perpendicular to direction of travel (of wave) B1
- (ii) 1. e.g. sound wave / compression wave on a spring B1
 2. e.g. any named electromagnetic wave / ripples / water wave / wave on a stretched rope B1
- (b) use of $v = f\lambda$ in any form **OR** $(\lambda =) v/f$ **OR** 7200/30 **OR** 7.2/30
 240 m / 0.24 km A1
- (c) no sound heard/quieter sound B1
 medium/air required to transmit sound
OR sound does not travel through a vacuum B1
- [Total: 8]**

- 5 (a) (i) diffraction B1
- (ii) waves travel slow(er)/water is shallow(er) B1
- (iii) angular spread of wavefronts increases o.w.t.t.e.
OR amplitude of waves is smaller B1
- (b) (i) oscillation/up and down motion (of rope) is at right angles to the direction of the wave
OR motion of rope/particles is at right angles to the direction of the wave B1
- (ii) $\lambda = 2.4/2 = 1.2$ m C1
 $v = f\lambda$ in any form OR $(f =) v/\lambda$ OR $3.2/1.2$ C1
 2.7 Hz A1
 OR
 $t = 2.4/3.2$ (
 $f = 2 \times 3.2/2.4$ (
 2.7 Hz (A
- [Total: 7]**

- 6 (a) light in air BOX 5 3×10^8 m/s B
 sound in air BOX 2 300 m/s B
 sound in water BOX 3 1500 m/s B [3]
- (b) distance = speed \times time in any form NOT speed = $2d/t$ C1
- $t_{\text{air}} = 120 \div$ value for speed of sound in air C1
- $t_{\text{rail}} (= 120/5000) = 0.024$ s C
- (time difference =) candidate's t_{air} – candidate's t_{rail} correctly evaluated
 (expect $0.400 - 0.024 = 0.376$ s) [4]
- [Total: 7]**

- 7 (a) (i) 1. compressions and/or rarefactions closer together
OR more compressions and/or rarefactions
ignore wavelength shorter B1
2. layers closer together at compressions B1
layers farther apart at rarefactions B1
OR
compressions narrower (B1)
rarefactions wider (B1)
ignore wavelength shorter ignore 'amplitude greater' ignore 'maximum displacement greater'
- (ii) distance between 2 compressions or 2 rarefactions shown with reasonable accuracy
- (b) time taken by sound in air = $200 / 343 = 0.583$ s C
time taken by sound in steel = $0.583 - 0.544 = 0.039$ s C
5128 m/s A1 [7]
- 8 (a) (i) 1. compressions and/or rarefactions closer together
OR more compressions and/or rarefactions B1
ignore wavelength shorter
2. layers closer together at compressions B1
layers farther apart at rarefactions B1
OR
compressions narrower (B1)
rarefactions wider (B1)
ignore wavelength shorter ignore 'amplitude greater' ignore 'maximum displacement greater'
- (ii) distance between 2 compressions or 2 rarefactions shown with reasonable accuracy
- (b) time taken by sound in air = $200 / 343 = 0.583$ s C
time taken by sound in steel = $0.583 - 0.544 = 0.039$ s C
5128 m/s A1 [7]

9	(a)	value 3×10^8 m/s	A1	1
	(b)	speed of light (much) greater than speed of sound or value for sound	A1	1
	(c)	(i) source and receiver arrangement with detail and labels	C1 A1	
		(ii) distance between source and receiver time between flash and bang	B1 B1	
		(iii) speed = distance/time	B1	max 4 [6]