

- 1 (a) longitudinal (2<sup>nd</sup> box) B1  
frequency 100 – 10 000 Hz (6<sup>th</sup> box) B1  
(note: –1 for e.e.o.o)
- (b) (i) reflection B1
- (ii) any two from:  
  - new wave(fronts/lets) generated
  - same speed **OR** frequency
  - angle of incidence = angle of reflection **OR** wavefronts make same angle (with boundary) B2
- (iii) no change B1
- (iv)  $v/\lambda$  **OR**  $v = f\lambda$  in any form C1  
( $f = 3.0/0.07 =$ ) 43 Hz A1
- [Total: 8]**

- 2 (a) 1500 m/s underlined/indicated
- (b) compression: closer together **AND** rarefaction: further apart B1
- compression: particles / molecules / wavefronts closer together / low pressure  
**AND** rarefaction: particles / molecules / wavefronts further apart / high pressure B1
- (c) (i) ( $t =$ )  $d/v$  used **OR**  $t = 2d/v$  **OR** 12 / 1500 **OR** 0.008 (s) C1  
( $t =$ )  $2d/v$  used **OR** 24 / 1500  
0.016 s A1
- (ii) amplitude: decrease B1  
pitch: no change B1
- [Total: 8]**

- 3 (a) 15–25 Hz to 15 000–25 000 Hz / 15–25 kHz B1
- (b) (region) where air layers/molecules/particles are pushed together/moved together/  
closer (than normal)  
OR (region) where (air) pressure raised/air (more) compressed/more dense B1
- (ii) (region) where air layers/molecules are pushed apart/far(ther) apart (than normal)  
OR (region) where (air) pressure reduced/air expanded B1
- (c) (sound is) loud(er) OR volume (of sound is) increased B1
- (ii) sound has a higher frequency/pitch OR higher note (heard) B1
- (d) 3.5 – 1.9 OR 1.6 (s) seen OR  $v = 2d / 1.9$  C1  
250 × 2 OR 500 (m) seen OR  $v = (2d + 500)/3.5$  C1  
(speed = 500 / 1.6 =) 312.5 m/s at least 2 sig. figs A1

[Total 8]

- 4 (a) (i) 320-350 m/s condone 100 – 999 m/s B1
- (ii)  $3 \times 10^8$  m/s condone  $2 - 4 \times 10^8$  m/s [2]
- (b) use of  $v = f\lambda$  C1  
correct evaluation of candidate's (a)(i)/1.2  
(330 m/s gives 275 Hz) [2]
- (c) (i) correct evaluation of candidate's (a)(i) × 4.8  
(330 m/s gives 1584m) B1
- (ii) clear statement that light travels instantaneously o.w.t.t.e.  
OR distance of thunderstorm same as distance travelled by sound  
OR thunder and lightning caused by same event  
OR negligible wind B1 [2]

- 5 (a) compression B1  
rarefaction B1 [2]
- (b) cone moves forward / in direction of travel of wave B1  
OR cone pushes air particles closer o.w.t.t.e.  
cone moves backwards / away from direction of travel of wave B1 [2]  
OR cone causes empty spaces o.w.t.t.e.
- (c) (i) loudness increases AND pitch same B1  
(ii) loudness same AND pitch increases B1 [2]

- 6 (a) idea of light travelling (much) faster than sound B1
- (b) (i) 4.0 (min) B1
- (ii) always a (measurable) time difference / never zero time difference B1  
Ignore time would be less
- (iii) distance/time in any form, symbols, words, numbers OR 1200/3.6 C1  
333.3 m/s to 2 or more sig figs A1
- (iv) idea of light travelling instantaneously OR no wind B1  
OR idea of lightning at ground level OR no obstruction to sound  
Ignore echoes

(c)

	light waves	sound waves
longitudinal		✓
transverse	✓	
electromagnetic	✓	
mechanical		✓

-1 e.e.o.o. i.e. 1 mark subtracted from 3 for each error or omission B3 [9]

- 7 (a) (i) approximately 330 m/s  
(correct order of magnitude) B1
- (ii)  $300 / 5000$  OR  $t = d/v$  NOT  $t = 2d/v$  C1  
0.06 s A1
- (b) sound through air and sound through steel NOT echo B1
- speeds in air and steel are different NOT if faster in air  
accept sound in steel/rail heard first B1 [5]