Wave Behaviours

Questions

Q1.

Figure 8 shows a long metal rod and a hammer.

The rod is hit at one end by the hammer.
This causes a sound wave to travel along the inside of the metal rod.

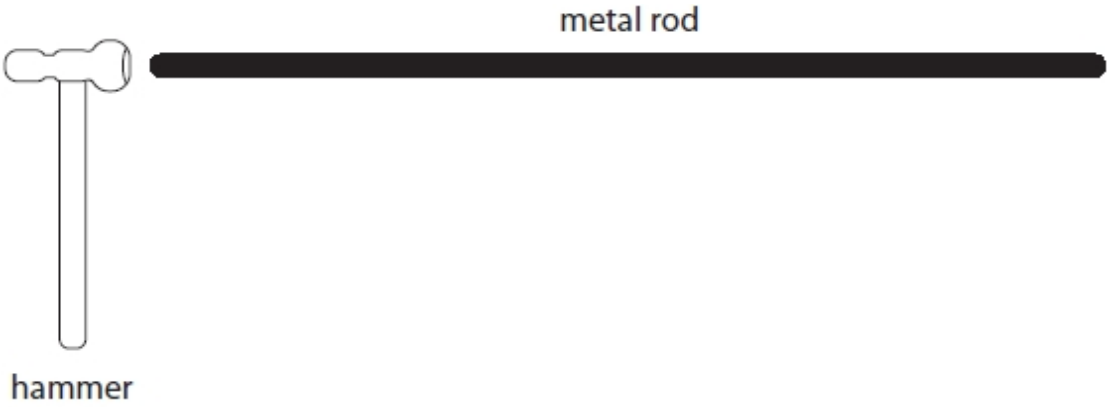


Figure 8

Describe how hitting the rod causes a sound wave to travel along the inside of the rod.

(2)

.....

.....

.....

.....

(Total for question = 2 marks)

Q2.

To investigate refraction in a rectangular glass block a student uses the apparatus shown in Figure 5.

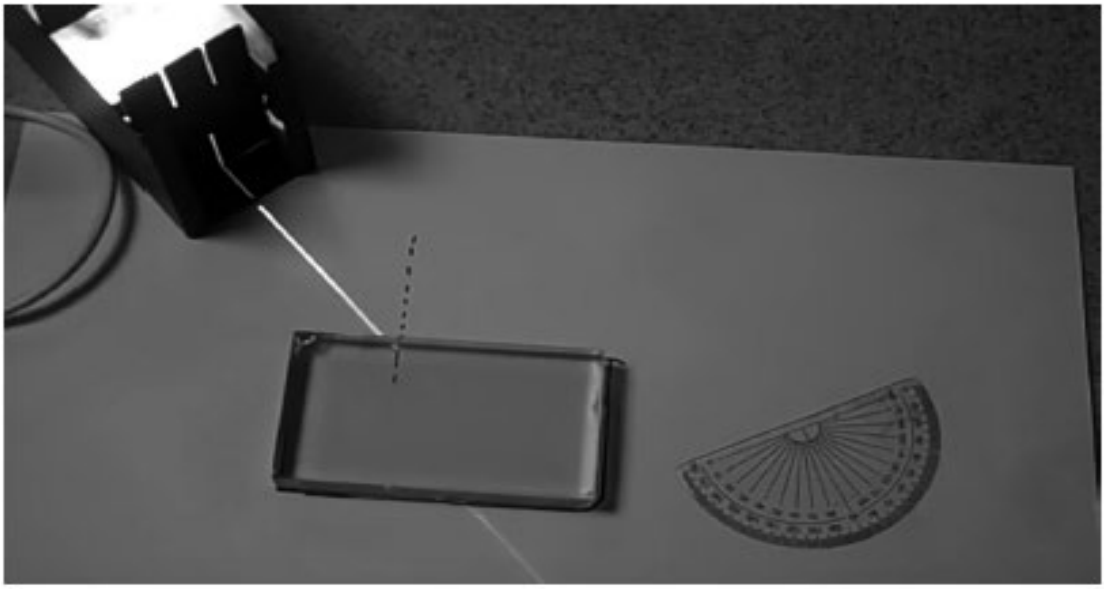


Figure 5

Describe how the student should measure the angle of refraction.

(2)

.....

.....

.....

.....

(Total for question = 2 marks)

Q3.

The diagram in Figure 7 shows two students, P and Q, trying to measure the speed of sound in air.

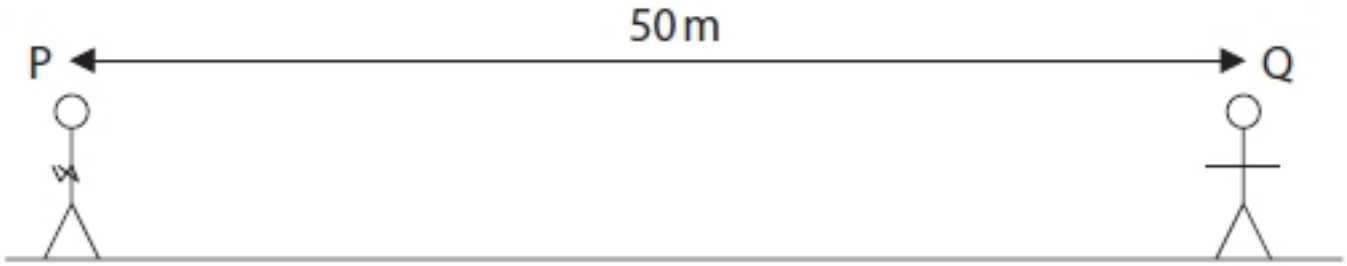


Figure 7

P will clap his hands together.

When Q sees P clap his hands, she will start a timer.

When Q hears the clap, she will stop the timer.

Explain one way the students could improve their method.

(2)

.....

.....

.....

.....

(Total for question = 2 marks)

Q4.

Figure 6 is a simplified diagram to show radio waves from a transmitter moving upwards, then meeting a boundary between lower and upper layers of the atmosphere.

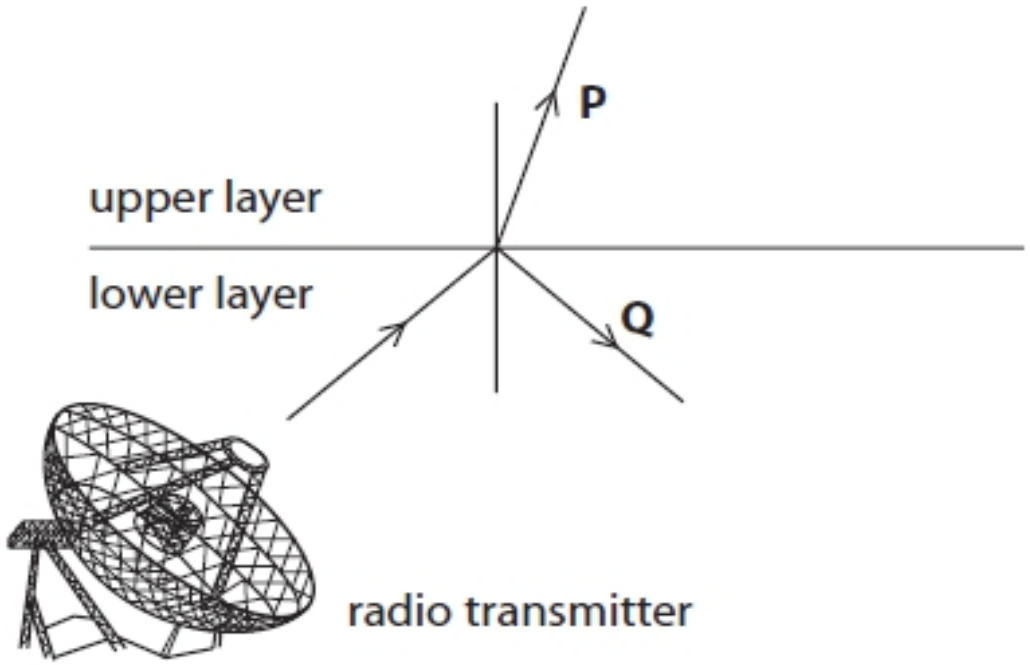


Figure 6

Explain what happens to the radio waves after they meet the boundary between the lower and upper layers as shown in Figure 6.
Your explanation should refer to changes in direction and speed of the waves.

(4)

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 4 marks)

Q5.

Figure 3 shows a ray of light going from air to glass.

Fill in the labels in Figure 3 using words from the box.

critical	incident	normal	reflected	refracted

(3)

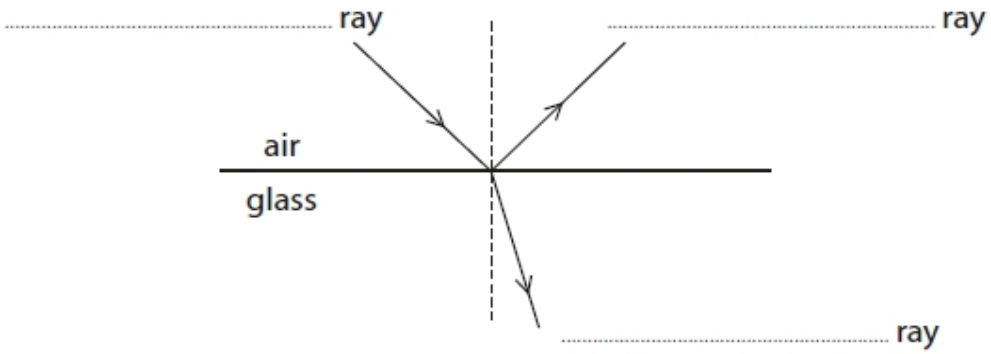


Figure 3

(Total for question = 3 marks)

Q6.

When white light crosses the boundary between air and glass, it can split up into the colours of the spectrum.
Explain, in terms of speed, why the light behaves like this.

(3)

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 3 marks)

Q7.

Figure 7 shows a tuning fork.

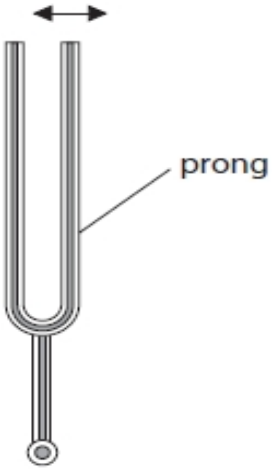


Figure 7

When the prongs of the tuning fork are struck, the prongs vibrate in the directions shown by the arrows on Figure 7.
Describe how the vibrating tuning fork causes a sound wave to travel through the air.

You may add to the diagram if it helps your answer.

(2)

.....

.....

.....

.....

(Total for question = 2 marks)

Q8.

Which colour of visible light has the longest wavelength?

(1)

- ☒ A blue
- ☒ B green
- ☒ C red
- ☒ D yellow

(Total for question = 1 mark)

Q9.

This question is about light.

* Figure 11a shows refraction of light at a boundary between glass and air.
Figure 11b shows total internal reflection of light at a boundary between glass and air.

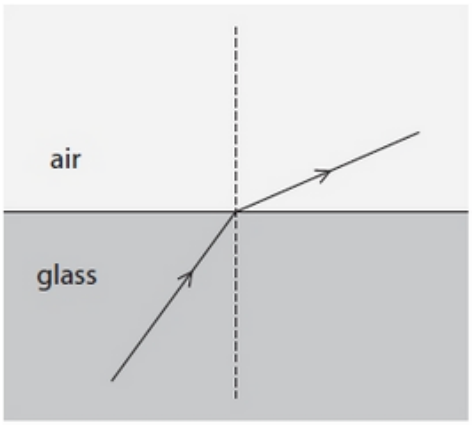


Figure 11a

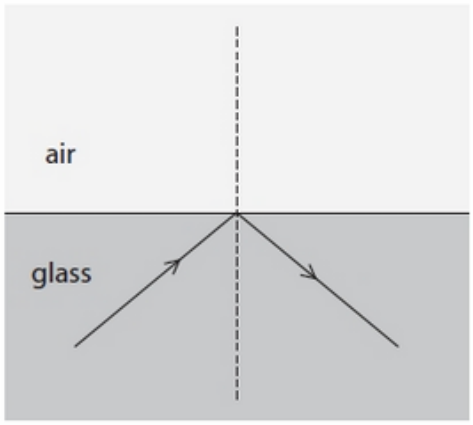


Figure 11b

Use Figure 11a and Figure 11b to explain refraction and total internal reflection.

You may add to Figure 11a and Figure 11b to help with your answer.

(6)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 6 marks)

Mark Scheme – Wave Behaviours

Q1.

Question Number	Answer	Additional guidance	Mark
	A description including particles (at end) vibrate (more) (about fixed positions) (1) cause neighbouring particles to vibrate (more) (1)	 allow atoms / ions / molecules for particles vibrations passed along OR reference to longitudinal waves / compressions and rarefactions	**(2)**

Q2.

Question number	Answer	Additional guidance	Mark
	A description including two from: trace / mark where the ray went into and out of(through) the glass block / line on either side of glass block(1) (remove block) join entry and exit points (of ray of light) (1) use the protractor to measure the angle between the refracted/drawn ray and the normal (1)	 accept 90° line etc.	**(2)**

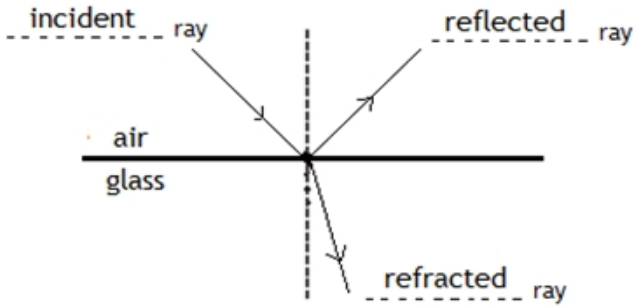
Q3.

Question Number	Answer	Additional guidance	Mark
	An explanation linking: make the distance between students larger (1) OR viable alternative method such as use microphones / sound sensors / datalogger (to start and stop timer) (1) **with:** to give a more measurable time (1) OR to remove (variable) reaction times (at start and end) / to reduce effect of reaction times / improve accuracy of timing (1)	50 m is too short (a distance to produce a measurable time) gives a longer time – more accurate measurement do not accept 'more accurate' without qualification for either method	**(2)**

Q4.

Question number	Answer	Additional guidance	Mark
	explanation linking: wave P refracts (towards the normal) (1) because P slows down (1) AND wave Q is reflected (at an equal angle from the boundary) (1) without change of speed of Q (1)	accept 'upper layer' for 'P' accept 'wavelength decreases' accept 'bends' for 'refracts' in this instance accept 'lower layer' for 'Q' accept 'wavelength unchanged' accept 'wave Q bounces off' (at an equal angle) allow one mark for refraction and reflection if no other mark awarded	**(4)**

Q5.

Question Number:	Answer	Additional guidance	Mark
		All 3 labels correct 3 marks 2 labels correct 2 marks 1 label correct 1 mark	**(3)**

Q6.

Question Number	Answer	Additional guidance	Mark
	an explanation linking: (the colours have) different wavelengths (1) different wavelengths / colours travel at different speeds (1) so refract by different amounts (1)	allow the word frequencies for wavelengths for refract allow bend/change direction/follow different path	**(3)** AO 2 1

Q7.

Question Number	Answer	Additional guidance	Mark
	a description to include: (the prong makes the) air vibrate/oscillate (1) in the same direction as /parallel to the wave travels (1)	causes compressions and rarefactions in air transfers ke to air longitudinal credit can be given for a labelled diagram	**(2)** AO 1 1

Q8.

Question Number	Answer	Mark
	C red **The only correct answer is C red** **A** is not correct because blue has a shorter wavelength than red **B** is not correct because green has a shorter wavelength than red **D** is not correct because yellow has a shorter wavelength than red	**(1)**

Q9.

Question number	Indicative content	Mark
*	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. **Refraction** • Angle of incidence marked • Angle of refraction marked • Angles are measured from the normal • Angle of refraction is bigger than the angle of incidence • Rays of light travel in straight lines • Refraction occurs at a boundary between two materials of different (optical) density • The angle of incidence is less than the angle of refraction when light passes into a less dense medium (glass into air) • Refraction is a change in direction of a light ray. • Refracted rays bend away from the normal when light passes into a less dense medium (glass into air) • The ray in the more dense medium (glass) travels more slowly ORA **Total Internal Reflection** • Possible critical angle marked • Light stays inside the glass • Only occurs when the incident light is in the more dense medium • Only occurs when the incident angle is equal to greater than the critical angle • Critical angle for glass is about 42° • Angle of incidence is equal to the angle of reflection	**(6)** **AO1**

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1–2	Demonstrates elements of physics understanding, some of which is inaccurate. Understanding of scientific, enquiry, techniques and procedures lacks detail. (AO1) Presents a description which is not logically ordered and with significant gaps. (AO1)
Level 2	3–4	Demonstrates physics understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas, enquiry, techniques and procedures is not fully detailed and/or developed. (AO1) Presents a description of the procedure that has a structure which is mostly clear, coherent and logical with minor steps missing. (AO1)
Level 3	5–6	Demonstrates accurate and relevant physics understanding throughout. Understanding of the scientific ideas, enquiry, techniques and procedures is detailed and fully developed. (AO1) Presents a description that has a well-developed structure which is clear, coherent and logical. (AO1)

Level	Mark	Additional Guidance	General additional guidance – the decision within levels e.g. - At each level, as well as content, the scientific coherency of what is stated will help place the answer at the top, or the bottom, of that level.
	0	No rewardable material.	
Level 1	1–2	Additional guidance isolated fact(s) about refraction or total internal reflection(TIR)	Possible candidate responses naming of any rays of light or any angles in text or on diagrams light changes direction/bends TIR ray stays inside the glass / does not go into air refracted ray goes through glass and air
Level 2	3–4	Additional guidance simple description of refraction and TIR or facts about one and more detail of the other	Possible candidate responses Angle or ray identified For refraction light changes direction from glass into air or TIR angles are equal inside the glass
Level 3	5–6	Additional guidance detailed description of refraction and TIR	Possible candidate responses For refraction light changes direction from glass into air AND TIR angles are equal inside the glass