AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 6.6.1.1

Transverse and longitudinal waves

Mark schemes and examiner comments

Tier	**Foundation**
Question groups	**6**
Available paper years	**2018–2025**

Using this booklet

1. Booklet answer numbers match the question booklet.
2. Use the original question number within marking tables.
3. Examiner comments are included where available.

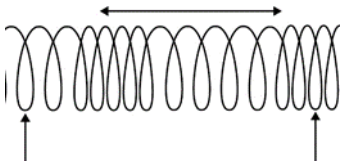
Name: _____ **Date:** _____

Where a precise marking extract is unavailable, the full source document is included in an appendix. Any missing mark scheme is explicitly identified.

6.6.1.1 Transverse and longitudinal waves

Answer 01 · Mark scheme

June 2018 | 8464/P/2F | Original Q2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	 rarefaction compression		3	AO1 6.6.1.1
02.2	longitudinal		1	AO1 6.6.1.1

6.6.1.1 Transverse and longitudinal waves

Answer 01 · Mark scheme

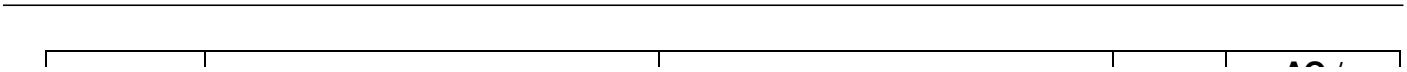
June 2018 | 8464/P/2F | Original Q2

Question	Answers	Mark	AO / Spec. Ref.
02.3	**Level 2:** The method would lead to the production of a valid outcome. Key steps are identified and logically sequenced.	3–4	AO2
	Level 1: The method would not necessarily lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2	AO1
	No relevant content	0	
	Indicative content • measure the distance between the student with the bricks and the wall • trundle wheel or tape measure • measure the time taken from banging the bricks to the echo • double the measured distance to give the distance travelled or half the time • use: $\text{speed} = \frac{\text{distance travelled}}{\text{time}}$ • repeat timings • remove anomalies • calculate a mean		6.6.1.2
Total			**8**

6.6.1.1 Transverse and longitudinal waves

Answer 01 · Mark scheme

June 2018 | 8464/P/2F | Original Q2



6.6.1.1 Transverse and longitudinal waves

Answer 02 · Mark scheme

June 2019 | 8464/P/2F | Original Q7

Question	Answers	Mark	AO / Spec. Ref.	ID
07.1	**Level 3:** The design/plan would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	5–6	AO1 6.6.1.2	E
	Level 2: The design/plan would not necessarily lead to a valid outcome. Most steps are identified, but the plan is not fully logically sequenced.	3–4		
	Level 1: The design/plan would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2		
	No relevant content.	0		
	Indicative content • if two quantities have been determined, v = f λ can be used to find the third. **Frequency** • use a stopclock • count the number of waves passing a point in a fixed time period • divide the time by the number of waves to determine the time for one wave, T • f = 1/T • read the frequency off the oscillator **Wavelength** • use a camera to freeze the image • use a metre rule to measure the distance between two wavefronts • count the number of waves between the wavefronts • divide distance by the number of waves to determine λ **Velocity** • determine a mean value of frequency • determine a mean value of wavelength • measure the time it takes one wavefront to travel the length of the screen • measure the length of the screen • speed = distance / time To access Level 3 there must be a description of how frequency, wavelength and velocity can be determined			

6.6.1.1 Transverse and longitudinal waves

Answer 02 · Mark scheme

June 2019 | 8464/P/2F | Original Q7

07.2	(the duck) moves perpendicular to the direction of wave travel	duck moves up and down is insufficient	1	AO2 6.6.1.1	E
07.3	mean maximum height = 511 **and** mean minimum height = 500 511 – 500 = 11 11 / 2 = 5.5 (mm)	an answer of 5.5 (mm) gains **3** marks 1 allow a calculated difference from incorrect means allow their difference divided by 2 any correct method of determining the mean amplitude can score 3 marks	1 1 1	AO2 6.6.1.2	E
Total			**10**		

6.6.1.1 Transverse and longitudinal waves

Answer 03 · Mark scheme

June 2022 | 8464/P/2F | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	**A** = rarefaction **B** = wavelength		1 1	AO1 6.6.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	f = 4000 Hz		1	AO2
	$T = \frac{1}{4000}$	allow a correct substitution using an incorrectly / not converted value of f	1	AO2
	T = 0.00025	allow a correct calculation using an incorrectly / not converted value of f	1	AO2
	seconds **or** s		1	AO1 6.6.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	wave speed = frequency × wavelength **or** $v = f\lambda$		1	AO1 6.6.1.2

6.6.1.1 Transverse and longitudinal waves

Answer 03 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	$v = 348$	allow a value in the range 347 to 348 subsequent marks may only be awarded if value for v is in the range 343 to 349	1	AO2 6.6.1.2
	$348 = 300 \times \lambda$	allow a correct substitution using an incorrect value of v read from graph	1	
	$\lambda = \frac{348}{300}$	allow a correct rearrangement using an incorrect value of v read from graph	1	
	1.16 (m)	allow 1.2 (m) allow a correct calculation using an incorrect value of v read from graph allow a maximum of **2** marks for use of v = 330 m/s	1	

Total Question 6		11

6.6.1.1 Transverse and longitudinal waves

Answer 04 · Mark scheme

June 2023 | 8464/P/2F | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	compression rarefaction	this order only	1 1	AO1 6.6.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	longitudinal waves transfer energy		1	AO1 6.6.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	amplitude		1	AO2 6.6.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	340 (m/s)	allow answers in the range 339 to 340 (m/s)	1	AO2 6.6.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	$s = 340 \times 0.20$ $s = 68$ m	 allow ecf from question **04.4**	1 1	AO2 6.6.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6	the higher the temperature the greater the speed (so) time taken is less	do not accept the greater the speed the higher the temperature	1 1	AO3 6.6.1.2

Total Question 4	9

6.6.1.1 Transverse and longitudinal waves

Answer 05 · Mark scheme

June 2024 | 8464/P/2F | Original Q3

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	energy		1	AO1 6.6.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	330 m/s		1	AO1 6.5.4.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	frequency amplitude		1 1	AO1 6.6.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	4000 Hz		1	AO1 6.6.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	$T = \frac{1}{4000}$ 0.00025 (s)	allow ecf from question **03.4**	1 1	AO1 6.6.1.2

6.6.1.1 Transverse and longitudinal waves

Answer 05 · Mark scheme

June 2024 | 8464/P/2F | Original Q3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.6	compression rarefaction	either order	1 1	AO1 6.6.1.1

Total Question 3	9

6.6.1.1 Transverse and longitudinal waves

Answer 06 · Mark scheme

June 2025 | 8464/P/2F | Original Q2

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	colour of water		1	AO1 6.6.2.2 RPA 21

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	initial temperature of water		1	AO1 6.6.2.2 RPA 21

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	measuring cylinder		1	AO1 6.6.2.2 RPA 21

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	$\frac{80.0 - 65.0}{5.0}$ = 3 (°C / minute)	allow $\frac{65.0 - 80.0}{5.0}$ allow $\frac{15.0}{5.0}$ allow – 3 (°C / minute)	1 1	AO2 6.6.2.2 RPA 21

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	*y*-axis labelled rate of change of temperature in °C / minute *y*-axis scale of 1.0 °C / minute per cm bars plotted correctly	unit must be present allow a tolerance of ± ½ small square ignore width of bars	1 1 1	AO2 6.6.2.2 RPA 21

6.6.1.1 Transverse and longitudinal waves

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	answer between 5.0 and 6.1 (°C / minute)	do **not** accept 5.0 (°C / minute) do **not** accept 6.1 (°C / minute)	1	AO3 6.6.2.2 RPA 21

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.7	infrared		1	AO1 6.6.2.2 6.6.2.4 RPA 21

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.8	energy		1	AO1 6.6.2.2 RPA 21

Total Question 2	**11**

6.6.1.1 Transverse and longitudinal waves

Answer 03 · Examiner comments June 2022 | 8464/P/2F | Original Q6

Question 6 (Standard demand)

06.1 Of the 60% of students that scored marks on this question the vast majority were able to identify the wavelength for 1 mark but were not able to identify the rarefaction.

06.2 60% of students scored 2 marks on this question. Only 5% of students performed the conversion from kHz to Hz. Very few students gave the correct unit.

06.3 Nearly 90% of students were able to select the correct equation.

06.4 The majority of students did not appear to understand what was required to answer this question. The vast majority of those that did understand what was required scored full marks, with 20% of students awarded four marks. Some students did read the correct value from the graph, but then wrote that as their final answer. Many students just multiplied 200 by 28.

Answer 04 · Examiner comments June 2023 | 8464/P/2F | Original Q4

Question 4 (Low demand and standard demand)

04.1 Nearly 30% of students scored two marks on this question. Of the 50% that scored one mark, the majority correctly labelled the compression.

04.2 75% of students knew that longitudinal waves transfer energy.

04.3 Approximately 40% of students knew that the amplitude changes. The most popular incorrect response was wavelength.

04.4 90% of students read the correct speed off the graph. As the line does not cross at exactly 340, a tolerance was allowed and many students picked up the mark for an answer between 339 and 340.

04.5 Over 80% of students used their value from question 04.4 in the equation and scored two marks. A small number of students did not use their value from question 04.4 despite the instruction to do so.

04.6 Approximately 25% of students identified that when the temperature of the air increases, the speed increases. Of those that did, only a very small minority of students went on to state that therefore the time would decrease. Many students contradicted themselves by stating that the speed would increase with temperature, but then said that the time would increase.

6.6.1.1 Transverse and longitudinal waves

Answer 05 · Examiner comments

June 2024 | 8464/P/2F | Original Q3

Question 3 (low demand)

03.1 Over 90% of students knew that waves transfer energy.

03.2 A little over 30% of students knew the speed of sound in air.

03.3 This question required students to compare two different waves. 80% of students gained at least 1 mark and 45% gained both marks. The majority of students that only gained 1 mark correctly stated that wave A had a greater frequency but did not identify that both waves had the same amplitude.

03.4 About three-quarters of students correctly selected 4000 Hz as the same as 4 kHz.

03.5 Just over half of students correctly calculated the period using the equation given. Students who correctly used their incorrect answer from question 03.4 were still able to gain full marks for this question.

03.6 About 80% of students scored at least 1 mark on this question, and 25% of students scored 2 marks. There was approximately an even number of 1-mark answers that selected either compression or rarefaction.

6.6.1.1 Transverse and longitudinal waves

Answer 06 · Examiner comments June 2025 | 8464/P/2F | Original Q2

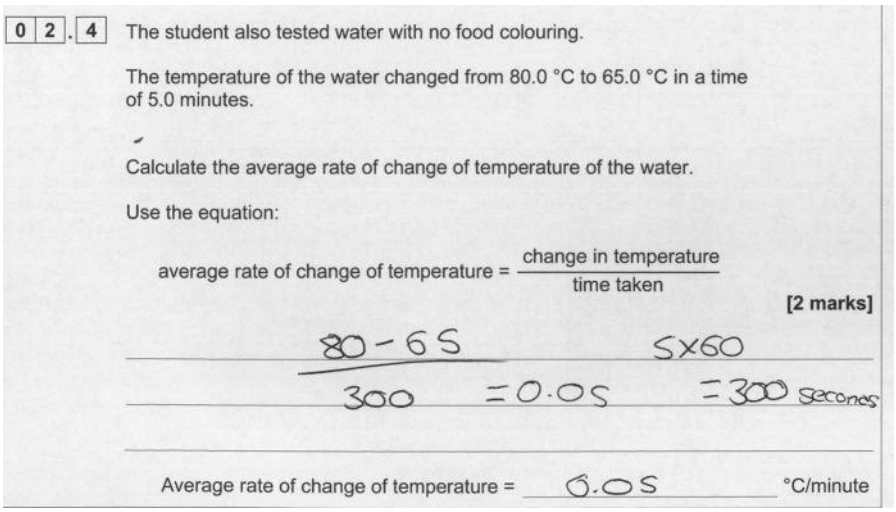
Question 2 (Low demand)

02.1 About half the students correctly identified the independent variable.

02.2 Only about 40% could identify a control variable.

02.3 Slightly more than 8 in 10 students recalled that a volume of water should be measured using a measuring cylinder.

02.4 This question was answered correctly by almost three quarters of students.
Of those who answered incorrectly, it was relatively common for students to divide a temperature by time, rather than dividing the change in temperature by time.



0 2 . 4 The student also tested water with no food colouring.

The temperature of the water changed from 80.0 °C to 65.0 °C in a time of 5.0 minutes.

Calculate the average rate of change of temperature of the water.

Use the equation:

average rate of change of temperature = change in temperature / time taken

[2 marks]

80 - 65 = 15
15 / 300 = 0.05
5 x 60 = 300 seconds

Average rate of change of temperature = 0.05 °C/minute

This student did not recognise that the answer line needed an answer given in °C/minute and calculated a rate in °C/second. Students who did this could still be awarded one mark.

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6.6.1.1 Transverse and longitudinal waves

Answer 06 · Examiner comments

June 2025 | 8464/P/2F | Original Q2

02.5 The vast majority of students gained at least one mark on this question, with the most common mark awarded being for the scale on the *y*-axis. The most common mark not scored by students was because they either did not attempt to label the *y*-axis, did not include units in their label, or labelled the *y*-axis incorrectly. A common incorrect label was to write '*y*-axis' instead of writing 'rate of change of temperature in °C/minute'.

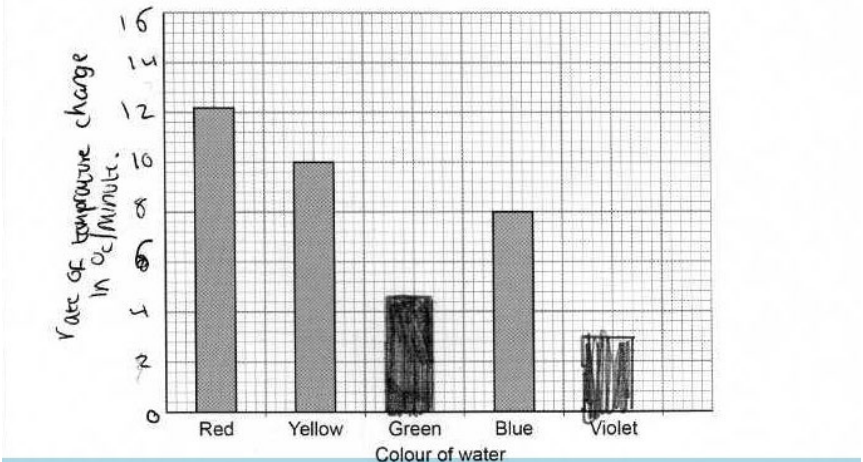
0 2 . 5 Complete **Figure 4**.

You should:

- label the *y*-axis
- add a scale to the *y*-axis
- draw bars for the green water and the violet water.

[3 marks]

Figure 4



This student added an incorrect scale. The height of the bars was marked independently from the scale the students chose – the heights needed to be consistent with the bars for Red, Yellow and Blue already drawn on the paper – so even if this student had drawn their two bars to be consistent with their incorrect scale, they would have not gained credit for this.

02.6 Just over half of students estimated a valid answer. A common incorrect approach was to determine the difference between the values for red and yellow, rather than to determine a value between these two values.

02.7 About 50% of students recognised that colour affects the rate of emission of infrared.

02.8 Slightly more than 60% identified that cooling occurred because the radiation transfers energy.

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