AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 6.6.1.2

Properties of waves

Mark schemes and examiner comments

Tier	**Foundation**
Question groups	**14**
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.

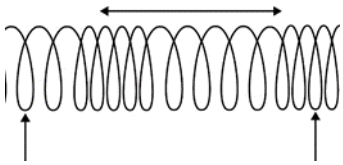
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Where a precise marking extract is unavailable, the full source document is included in an appendix. Any missing mark scheme is explicitly identified.

6.6.1.2 Properties of 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

6.6.1.2 Properties of waves

Answer 01 · Mark scheme

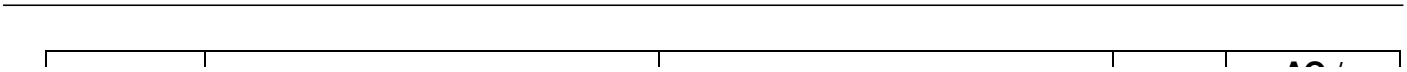
June 2018 | 8464/P/2F | Original Q2

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**

6.6.1.2 Properties of waves

Answer 01 · Mark scheme

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



6.6.1.2 Properties of waves

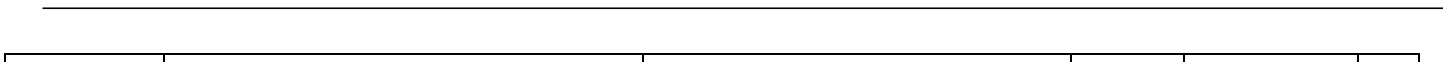
Answer 02 · Mark scheme June 2019 | 8464/P/2F | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
05.1	velocity frequency wavelength		1 1 1	AO1 6.6.2.3	G
05.2	so people are not exposed to (as much) gamma radiation because gamma radiation can damage human tissue	allow less gamma radiation reaches the Earth's surface allow increases the risk of cancer or (cell) mutation allow gamma rays are ionising ignore any reference to temperature / heating of the atmosphere	1 1	AO1 6.6.2.3	E
05.3	(microwaves) are used in (satellite) communications	ignore any reference to temperature / heating of the atmosphere	1	AO2 6.6.2.4	E
05.4	can cause skin cancer / premature ageing	allow sunburn allow eye / skin damage cancer on its own is insufficient	1	AO1 6.6.2.3	E
05.5	risk from UV radiation is highest in July / summer two correct readings from the bar chart which support their comparison	allow any sensible comparison of named months / seasons if no other mark scored, two correct readings from the graph scores **1** mark	1 1	AO3 6.6.2.3	E
Total			**9**		

6.6.1.2 Properties of waves

Answer 02 · Mark scheme

June 2019 | 8464/P/2F | Original Q5



6.6.1.2 Properties of waves

Answer 03 · Mark scheme June 2019 | 8464/P/2F | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
06.1	(4 - 0) + (10 - 7) **or** 4 + 3 **or** 10 - 3 7 (s)	an answer of 7 (s) gains **2** marks	1 1	AO2 6.5.4.1.5	E
06.2	gradient = $\frac{0-2}{24-14}$ (-) 0.2 (m/s^2)	an answer of 0.2 (m/s^2) gains **2** marks allow readings from any two points correctly substituted allow correct use of $a = \frac{\Delta v}{t}$	1 1	AO2 6.5.4.1.5	E
06.3	(there are no wires) to get tangled / disconnected	allow easier to move arms allow wires are inconvenient allow easier to transfer data	1	AO3 6.6.2.4	E
06.4	wave speed = frequency × wavelength	allow v = f λ allow any correct re-arrangement	1	AO1 6.6.1.2	E
06.5	300 000 000 = 2 400 000 000 × λ λ = $\frac{300\,000\,000}{2\,400\,000\,000}$ λ = 0.125 (m)	an answer of 0.125 (m) or 0.13 (m) scores **3** marks allow λ = 0.13 (m)	1 1 1	AO2 6.6.1.2	E
06.6	range is far enough (for most uses) power is not too great so the battery will not drain quickly	allow power not too great so the phone will not overheat allow the range per milliwatt is greatest or 4 metres	1 1	AO3 6.6.2.4	E

6.6.1.2 Properties of waves

Answer 03 · Mark scheme

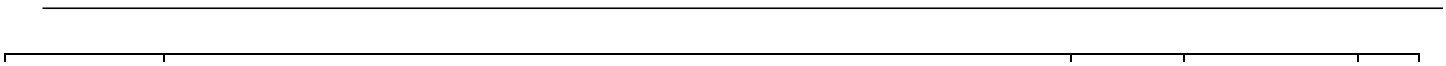
June 2019 | 8464/P/2F | Original Q6

Total			**11**		

6.6.1.2 Properties of waves

Answer 03 · Mark scheme

June 2019 | 8464/P/2F | Original Q6



6.6.1.2 Properties of waves

Answer 04 · 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			

6.6.1.2 Properties of waves

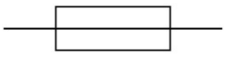
Answer 04 · Mark scheme

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**		

6.6.1.2 Properties of waves

Answer 05 · Mark scheme November 2020 | 8464/P/1F | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	swap the blue wire and the green and yellow wire	allow connect the blue wire to the neutral pin and the yellow and green wire to the earth pin. allow swap the earth and neutral wires ignore the earth wire and neutral wire are wrongly connected	1	AO2 6.2.3.2
05.2	230 (V) 50 (Hz)		1 1	AO1 6.2.3.1 6.2.3.2
05.3	0 (V)		1	AO1 6.2.3.2
05.4			1	AO1 6.2.1.1
05.5	the person could get an electric shock because there is a current in the person	allow so the person could be electrocuted allow because the person provides a connection (from the washing machine) to earth allow because there is a potential difference across the person	1 1	AO3 6.2.3.2

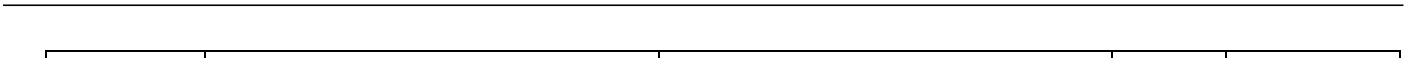
6.6.1.2 Properties of waves

05.6	the charge flows through the earth wire (instead of the person) because the resistance of the earth wire is much less than that of a person	 allow so the case does not become live allow so the fuse will break / melt / blow	1 1	AO3 6.2.3.2
Total			**9**	

6.6.1.2 Properties of waves

Answer 05 · Mark scheme

November 2020 | 8464/P/1F | Original Q5



6.6.1.2 Properties of waves

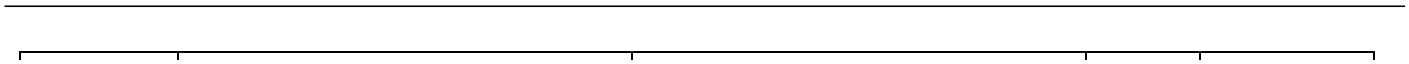
Answer 06 · Mark scheme November 2020 | 8464/P/2F | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	A		1	AO1 6.6.1.2
05.2	B		1	AO1 6.6.1.2
05.3	D		1	AO1 6.6.1.2
05.4	v = 1650 × 0.200 v = 330 (m/s)		1 1	AO2 6.6.1.2
05.5	0.004 s		1	AO2 6.6.1.2
05.6	$0.004 = \frac{1}{\text{frequency}}$ $\text{frequency} = \frac{1}{0.004}$ F = 250 (Hz)	allow ecf from question **05.5**	1 1 1	AO2 6.6.1.2
Total			**9**	

6.6.1.2 Properties of waves

Answer 06 · Mark scheme

November 2020 | 8464/P/2F | Original Q5



6.6.1.2 Properties of waves

Answer 07 · Mark scheme

November 2021 | 8464/P/2F | Original Q4

Question	Answers	Mark	AO / Spec. Ref.
04.1	**Level 2:** The design would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	3–4	AO1 6.6.1.2
	Level 1: The design 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 **Wavelength** • place a metre rule at the side of the screen perpendicular to the wave fronts • use the metre rule to measure the length of the screen • take a photograph of the shadow on the screen • count the number of complete waves on the screen • determine the wavelength by dividing the length of the by the number of complete waves **or** • place a metre rule at the side of the screen perpendicular to the wave fronts • take a photograph of the shadow on the screen • use the metre rule to measure the distance between two wave front **Frequency** • count the number of waves that pass a given point • time how long it takes for the waves to pass that point using a stop clock • frequency is number of waves divided by time taken **or** • put a stop clock on the screen • use a digital video camera to record the waves passing a point • replay in slow motion and count the number of waves passing a point in 1 second There must be a description of both frequency and wavelength measurement to access level 2		

6.6.1.2 Properties of waves

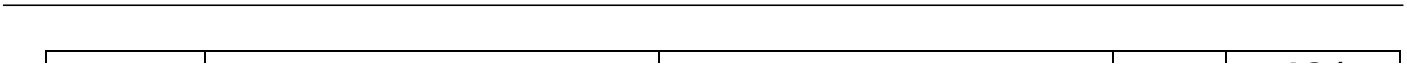
Answer 07 · Mark scheme

04.2	12.5 (Hz)		1	AO2 6.6.1.2
04.3	to reduce the effect of random errors		1	AO1 6.6.1.2
04.4	period = $\frac{1}{20}$ period = 0.05 (s)	allow 0.050 (s)	1 1	AO2 6.6.1.2
04.5	v = 20 × 0.012 v = 0.24 (m/s)		1 1	AO2 6.6.1.2
Total			**10**	

6.6.1.2 Properties of waves

Answer 07 · Mark scheme

November 2021 | 8464/P/2F | Original Q4



6.6.1.2 Properties of waves

Answer 08 · 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

6.6.1.2 Properties of waves

Answer 08 · Mark scheme

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

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**

Answer 09 · 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

6.6.1.2 Properties of waves

Answer 10 · Mark scheme

June 2023 | 8464/P/2F | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	**A** radio waves **B** microwaves **C** X-rays	allow **1** mark if 2 correct	2	AO1 6.6.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	**Similarity** any **one** from: • same speed (in a vacuum) • both transfer energy • both transverse	allow both can travel through a vacuum allow both are ionising allow both can harm living tissue allow both can be used for medical treatment / imaging	1	AO1 6.6.2.2
	Difference any **one** from: • gamma has a higher frequency • gamma has a shorter wavelength • gamma is more ionising • gamma is more penetrating	allow gamma has more energy	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	refraction		1	AO1 6.6.2.2

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

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.5	$3.0 \times 10^{8} = f \times 5.0 \times 10^{-7}$ $f = \dfrac{3.0 \times 10^{8}}{5.0 \times 10^{-7}}$ $f = 6 \times 10^{14}$ (Hz)	 allow a correct rearrangement using incorrect powers of 10 allow a correct calculation of f using incorrect powers of 10 allow 6.0×10^{14} (Hz)	1 1 1	AO2 6.6.1.2

Total Question 6	9

6.6.1.2 Properties of waves

Answer 11 · 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

6.6.1.2 Properties of waves

Answer 11 · 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**

6.6.1.2 Properties of waves

Answer 12 · Mark scheme

June 2024 | 8464/P/2F | Original Q6

Question 6

Question	Answers	Mark	AO / Spec. Ref.
06.1	**Level 2:** The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.	3–4	AO1 6.6.1.2 RPA20
	Level 1: The method 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 • use the signal generator to adjust the frequency • keep the number of masses the same • move the wooden bridge • observe a steady / stationary wave pattern • use the metre rule to measure the wavelength • repeat using different values of frequency • repeat for different stationary wave patterns		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	$v = f \times \lambda$		1	AO1 6.6.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	$35.1 = 45.0 \times \lambda$		1	AO2 6.6.1.2
	$\lambda = \frac{35.1}{45.0}$		1	
	$\lambda = 0.78$	allow 0.780	1	

Total Question 6	8

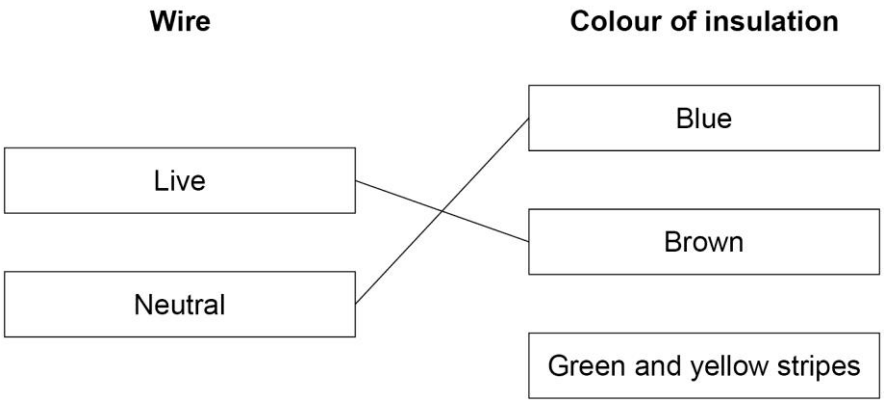
6.6.1.2 Properties of waves

Answer 13 · Mark scheme

June 2025 | 8464/P/1F | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	50 Hz		1	AO1 6.2.3.1

Question	Answers	Mark	AO / Spec. Ref.
04.2	 do **not** accept more than one line from a box on the left	1 1	AO1 6.2.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	power = potential difference × current **or** $P = VI$		1	AO1 6.2.4.1

6.6.1.2 Properties of waves

Answer 13 · Mark scheme

June 2025 | 8464/P/1F | Original Q4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	2100 = 230 × *I*		1	AO2 6.2.4.1
	$I = \frac{2100}{230}$		1	
	I = 9.13…		1	
	I = 9.1 (A)	allow an answer calculated using the numbers from the question given to two significant figures	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	18 000 = 0.0080 × *L*		1	AO2 6.3.2.3
	$L = \frac{18\,000}{0.0080}$		1	
	L = 2 250 000 (J/kg)	allow 2 300 000	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6	efficiency = $\frac{75\,600}{84\,000}$		1	AO2 6.1.2.2
	efficiency = 0.9		1	
	OR			
	efficiency = $\frac{75\,600}{84\,000}$ × 100 (1)			
	efficiency = 90% (1)			

6.6.1.2 Properties of waves

Answer 13 · Mark scheme

June 2025 | 8464/P/1F | Original Q4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.7	less energy is wasted	allow power for energy throughout	1	AO1
	(so) costs less to run **or** (so) uses less electricity / energy	allow so the appliance is used for less time	1	AO2 6.1.2.1 6.1.2.2 6.2.4.2

Total Question 4	15

6.6.1.2 Properties of waves

Answer 14 · Mark scheme

June 2025 | 8464/P/2F | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	microwaves		1	AO1 6.6.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	gamma rays		1	AO1 6.6.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	the time taken for one wave to pass a fixed point		1	AO1 6.6.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	48 GHz = 48 000 000 000 Hz	allow 48 GHz = 48×10^9 Hz subsequent marks may be awarded if an incorrectly / not converted value of f is used	1	AO2
	$T = \frac{1}{48\ 000\ 000\ 000}$		1	AO2
	$T = 2.08\ldots \times 10^{-11}$	allow 0.000 000 000 0208… allow 0.000 000 000 021 allow 2.1×10^{-11}	1	AO2
	s	allow seconds	1	AO1 6.6.1.2

6.6.1.2 Properties of waves

Answer 14 · Mark scheme

June 2025 | 8464/P/2F | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	any **one** from: • speed (in a vacuum / air) • they can travel through a vacuum • they transfer energy • they are transverse		1	AO1 6.6.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6	cables may not go to remote areas **or** it is expensive to lay cables	allow satellites may give faster data transfer	1	AO3 6.6.2.4

Total Question 5	**9**

6.6.1.2 Properties of waves

Answer 07 · Examiner comments November 2021 | 8464/P/2F | Original Q4

Question 4 (Low demand)

04.1 Very few students demonstrated a good understanding of this Required Practical Activity. 15% of students did not attempt the question, and over 60% of students' answers contained no relevant content. Approximately 15% of students were able to suggest an appropriate measurement using correct equipment, but did not give any description of what these measurements were for. Fewer students wrote level 2 answers that would produce a valid outcome. It is important that students know how to carry out the Required Practical Activities.

04.2 Nearly 70% of students were able to calculate the mean in this question part.

04.3 60% of students knew that taking repeat readings and calculating a mean reduced the effect of random errors.

04.4 This low demand calculation was very well answered, with the vast majority of students scoring 2 marks.

04.5 This low demand calculation was also very well answered, with very few students unable to score 2 marks.

Answer 08 · 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.

6.6.1.2 Properties of waves

Answer 09 · 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.

Answer 10 · Examiner comments June 2023 | 8464/P/2F | Original Q6

Question 6 (standard demand)

06.1 Fewer than 25% of students could identify all the missing parts of the spectrum. 70% of students either scored zero marks or did not attempt the question. A significant number of students wrote answers that were nothing to do with the electromagnetic spectrum.

06.2 Only 2% of students we able to give a similarity and a difference. The similarity was more accessible and was how the majority of the 15% that scored one mark got the mark. Many

6.6.1.2 Properties of waves

Answer 10 · Examiner comments June 2023 | 8464/P/2F | Original Q6

identified that they are both transverse. For the difference, most students did not refer to a property of electromagnetic waves. A little over 15% of students did not attempt the question.

06.3 Approximately 20% of students knew that the process is refraction. A little over 15% of students did not attempt the question.

06.4 This question was well answered with over 90% of students getting the mark. Students were given the equation sheet, which will have contributed to the overall performance on this question.

06.5 25% of students were able to substitute correctly and give the correct answer to the question to the correct order of magnitude. Approximately 20% of students correctly rearranged and substituted but did not use their calculator to evaluate the numbers in standard form, so scored 2 marks.

Answer 11 · 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.

6.6.1.2 Properties of waves

Answer 12 · Examiner comments

June 2024 | 8464/P/2F | Original Q6

Question 6 (standard demand)

06.1 Students found this question difficult, and fewer than 10% gained more than 1 mark. Although based on Required Practical Activity 20, for most students this appeared to be an unfamiliar experiment and they were unable to answer the question.

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6.6.1.2 Properties of waves

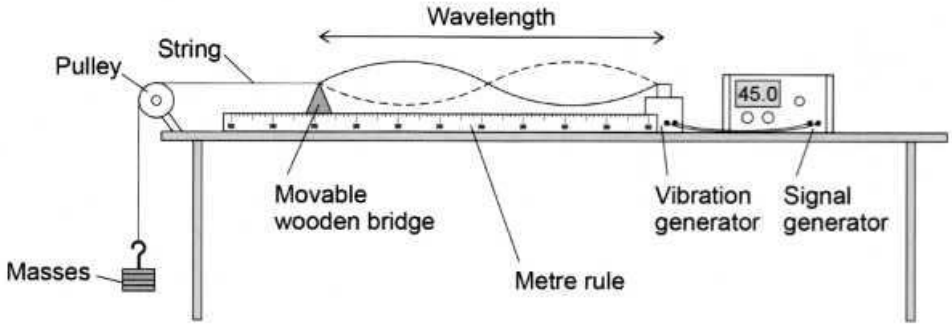
Answer 12 · Examiner comments June 2024 | 8464/P/2F | Original Q6

To access Level 2, the method needed to lead to a *valid* outcome: most students just described what was shown to them in Figure 11 and did not add anything of value. Most of the students that did score marks were able to describe changing the frequency with the signal generator or measuring the wavelength with a ruler.

0 1 A teacher demonstrated how the frequency of a wave on a string affects the wavelength of the wave.

Figure 1 shows the equipment used.

Figure 1



The frequency of the signal generator is adjusted so that the wave shown in **Figure 1** is seen.

At this frequency the string vibrates between the two positions shown in **Figure 1**.

0 1 . 1 Describe a method the teacher could use to investigate how the frequency of the wave affects the wavelength.

[4 marks]

you would first set up by putting ~~and~~ a metre ruler on the table place a signal generator and connect it to the vibration generator then connect a piece of string along the top of the vibration generator attaching it to the pulley adding masses to keep it ~~tht~~ tightened then move the movable wooden bridge to increase/decrease the string length and use the results on the signal generator to record the measurements.

In this response (from a Higher tier paper) the student has mostly written a description of the equipment set-up in the diagram. There is nothing of relevance to a method here, so no marks.

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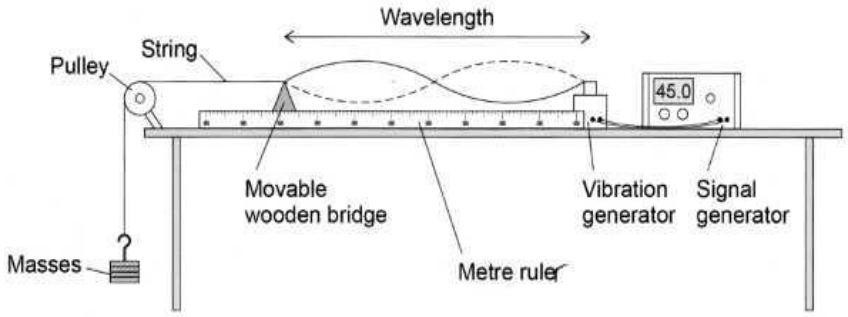
6.6.1.2 Properties of waves

Answer 12 · Examiner comments June 2024 | 8464/P/2F | Original Q6

0 6 A teacher demonstrated how the frequency of a wave on a string affects the wavelength of the wave.

Figure 11 shows the equipment used.

Figure 11



The frequency of the signal generator is adjusted so that the wave shown in **Figure 11** is seen.

At this frequency the string vibrates between the two positions shown in **Figure 11**.

0 6 . 1 Describe a method the teacher could use to investigate how the frequency of the wave affects the wavelength.

[4 marks]

To investigate how the frequency of the wave-length affects the wave, the teacher could adjust the frequency of the signal generator and measure the wavelength of the string with the metre ruler, recording the results. Repeating this a few times; everytime adjusting the frequency of the signal generator, the teacher can then look at the results and see if there is any correlation between the two (the frequency of the wave and the wavelength.)

This student has described how to change the independent variable and then how to measure the dependent variable. This answer does not quite get into Level 2 as it is not clear that this is repeated at different frequencies and so would not lead to a valid outcome. However, 2 marks are awarded.

06.2 This question was well answered with the majority of students selecting the correct equation.

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Answer 12 · Examiner comments June 2024 | 8464/P/2F | Original Q6

06.3 This calculation proved more demanding than the ones earlier on in the paper. A little over half of students scored marks, most of whom scored all 3 marks for correctly rearranging the equation and calculating the wavelength. Of the students that did not score any marks, most just multiplied the two numbers together.

Answer 13 · Examiner comments June 2025 | 8464/P/1F | Original Q4

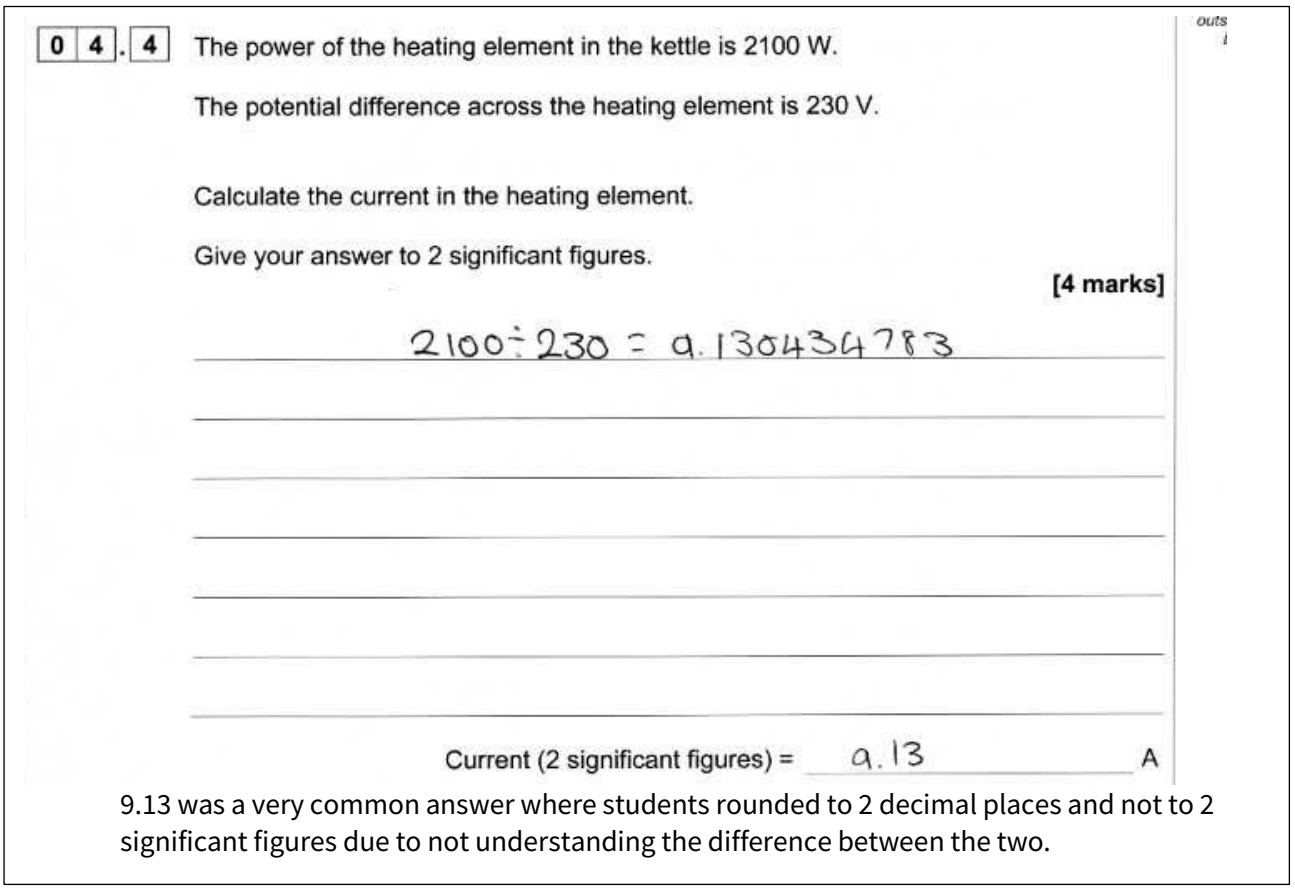
Question 4 (Low and standard demand)

04.1 45% of students selected the correct answer for the frequency of the UK mains electricity supply.

04.2 Just over 20% of students gained 1 mark for correctly identifying the colour of the insulation on one of the wires. 35% of students were able to identify both the colours of the insulation.

04.3 Students now have the equation sheet to select the equation from, so 90% of students gained the mark on this question. Approximately 5% of students selected the incorrect equation.

04.4 The vast majority of students who correctly substituted into the equation scored the 3 calculation marks. Approximately 75% of students gained 3 marks, but only 35% of students gained the mark for the significant figures. Many students gave their answer to 2 decimal places and not to two significant figures.



0 4 . 4 The power of the heating element in the kettle is 2100 W.

The potential difference across the heating element is 230 V.

Calculate the current in the heating element.

Give your answer to 2 significant figures.

[4 marks]

2100 ÷ 230 = 9.130434783

Current (2 significant figures) = 9.13 A

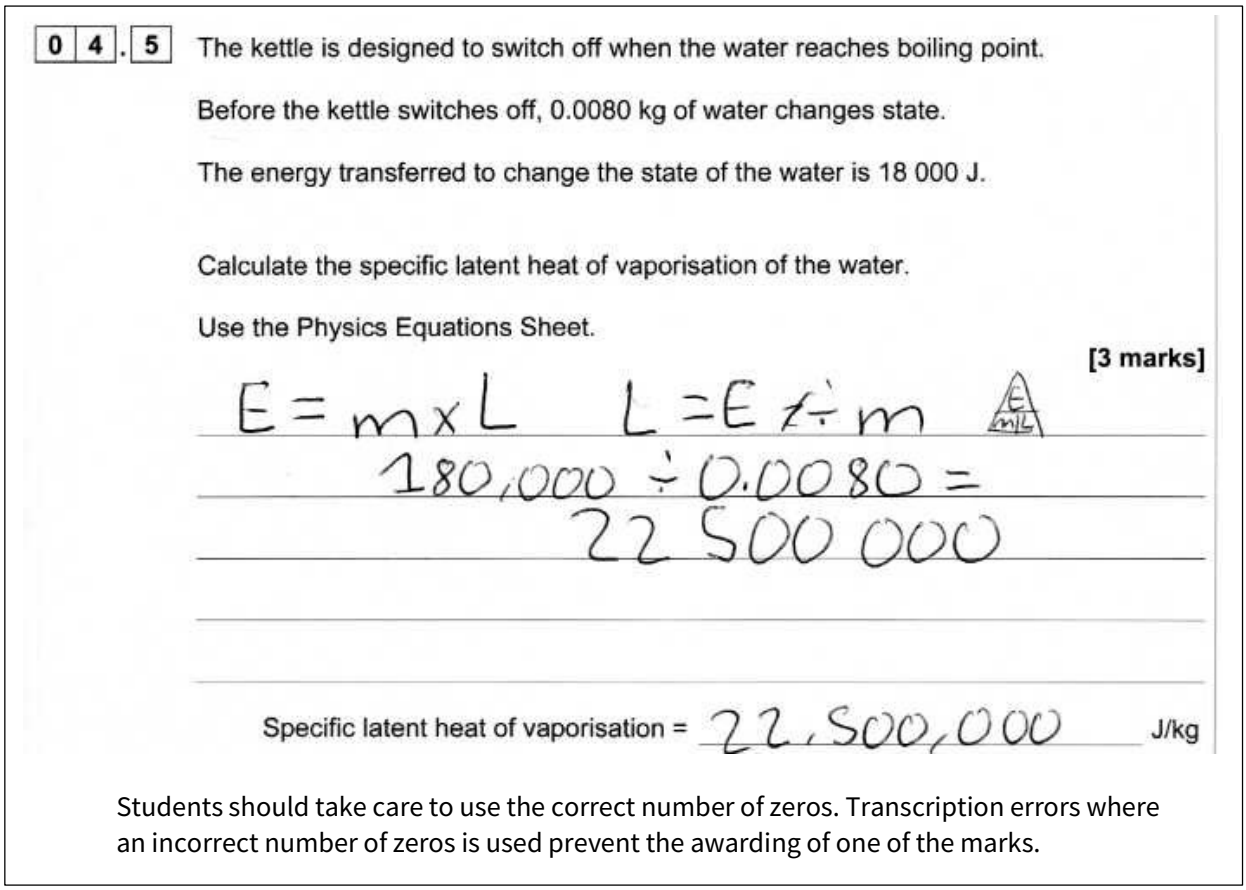
9.13 was a very common answer where students rounded to 2 decimal places and not to 2 significant figures due to not understanding the difference between the two.

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6.6.1.2 Properties of waves

Answer 13 · Examiner comments June 2025 | 8464/P/1F | Original Q4

04.5 This calculation proved to be more challenging with approximately 50% of students gaining 3 marks. The vast majority of students who substituted correctly were able to rearrange the equation correctly and then arrive at the correct answer. Most students who did not gain any marks either did not select the correct equation from the equation sheet or did an incorrect initial substitution.



0 4 . 5 The kettle is designed to switch off when the water reaches boiling point.

Before the kettle switches off, 0.0080 kg of water changes state.

The energy transferred to change the state of the water is 18 000 J.

Calculate the specific latent heat of vaporisation of the water.

Use the Physics Equations Sheet.

[3 marks]

$E = m \times L$ $L = E \div m$

$180,000 \div 0.0080 =$

$22\,500\,000$

Specific latent heat of vaporisation = 22,500,000 J/kg

Students should take care to use the correct number of zeros. Transcription errors where an incorrect number of zeros is used prevent the awarding of one of the marks.

04.6 This calculation was well answered with approximately 90% of students gaining 2 marks.

04.7 40% of students gained a mark on this question, but only 3% gained both marks. Very few explained that higher efficiency means less energy is wasted. Many students answered in terms of a kettle due to the previous question and explained that the appliance would complete its task in less time. This was awarded a mark due to the context of the question.

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6.6.1.2 Properties of waves

Answer 14 · Examiner comments

June 2025 | 8464/P/2F | Original Q5

Question 5 (Low and standard demand)

05.1 About 40% of students recalled that microwaves are used to transfer data to satellites.

05.2 Slightly more than half the students remembered that gamma rays have the greatest frequency.

05.3 Just under half selected the definition for the period of a wave.

05.4 Nearly three quarters of students gained at least some credit, but a very small proportion of students were able to calculate the correct answer and give the correct unit. About a third of students scored 3 marks.
It was relatively common to see students writing incorrect calculations, such as '1/48 = 48', and there was a surprising number who decided to give their answer to one significant figure to this question, which is rarely 6.

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6.6.1.2 Properties of waves

Answer 14 · Examiner comments

June 2025 | 8464/P/2F | Original Q5

0 5 . 4 Data is transmitted to the satellites by electromagnetic waves with a frequency of 48 GHz.

Calculate the period of waves with a frequency of 48 GHz.

Use the Physics Equations Sheet.

Choose the unit from the box.

[4 marks]

J	N/kg	s

48 ÷ 1000 = 0.048

1 ÷ 0.048 = 20.8

Period = 20.8 Unit S

This student clearly identified that 48 GHz needed to be converted to Hz but was unsure how to go about this. They scored 2 marks for the calculation, and a further mark for selecting the correct unit.

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6.6.1.2 Properties of waves

Answer 14 · Examiner comments June 2025 | 8464/P/2F | Original Q5

05.5 Only a small minority of students gave a property that is the same for all electromagnetic waves. Many wrote about uses of the waves, rather than their properties, and it was relatively common to see answers that described the waves as something that can be used to transmit data, for example.

0 5 . 5 The satellites receive and transmit data using electromagnetic waves with different frequencies.

Give **one** property that is the same for electromagnetic waves with different frequencies.

[1 mark]

do not need mediums to travel through

This response was awarded the mark for the idea that electromagnetic waves can travel through a vacuum. Alternative wording to express correct physics is always acceptable, unless a mark scheme term is underlined.

05.6 Approximately a fifth of students gave an acceptable answer to this question. Many were confused about the difference between a connection to the internet and a connection to the national grid or to a power source, with many answers referring to solar power, and some referring to benefits to the environment of solar power.

0 5 . 6 Most homes are connected to the internet using cables.

Suggest **one** reason why homes in some areas of the UK are connected to the internet by satellites.

[1 mark]

satellites give off energy, each solar panel is charged by sun, therefore each ~~of~~ satellite gives electric energy

This response illustrates the incorrect link shown by many students between a connection to an electrical energy supply and a connection to the internet.

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