AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 5.7.1.3

Properties of hydrocarbons

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.

5.7.1.3 Properties of hydrocarbons

Answer 01 · Mark scheme June 2018 | 8464/C/2F | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	condenses		1	AO1 5.7.1.2
06.2	the fractions have different boiling points		1	AO1 5.7.1.2 5.7.1.3
06.3	propane	do **not** accept propene	1	AO2 5.7.1.1
06.4	C_nH_{2n+2}		1	AO1 5.7.1.1
06.5	$CH_4 + \mathbf{2}\ O_2 \rightarrow CO_2 + \mathbf{2}\ H_2O$	allow multiples	1	AO2 5.1.1.1 5.7.1.3
06.6	bromine water		1	AO1 5.7.1.4
06.7	to assess the environmental impact (of the stages in the life of a product)	allow to see the effect / harm / damage on the Earth / environment / planet ignore references to energy, pollution, carbon footprint, carbon dioxide, sustainability	1	AO1 5.10.2.1

5.7.1.3 Properties of hydrocarbons

Answer 01 · Mark scheme

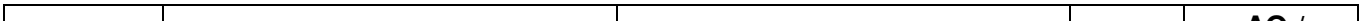
June 2018 | 8464/C/2F | Original Q6

Question	Answers	Mark	AO / Spec. Ref.
06.8	**Level 2:** Scientifically relevant features are identified; the ways in which they are similar / different is made clear and the magnitude of the similarity / difference noted.	3–4	AO3
	Level 1: Relevant features are identified and differences noted.	1–2	AO2
	No relevant content	0	
	Indicative content • burning 10 000 bags produces 10 kg more of carbon dioxide than landfill • putting 10 000 bags in landfill produces 0.02 kg more of solid residue than burning. • putting 10 000 bags in landfill produces 50% more sulfur dioxide than burning • burning 10 000 bags produces 25 kg of carbon dioxide, but landfill only produces15 kg • putting 10 000 bags in landfill produces 0.07 kg of solid residue but burning only produces 0.05 kg • landfill produces less carbon dioxide than burning • landfill produces more solid residue than burning • burning produces less sulfur dioxide than landfill		5.10.2.1 5.10.2.2 5.9.2.2
Total			**11**

5.7.1.3 Properties of hydrocarbons

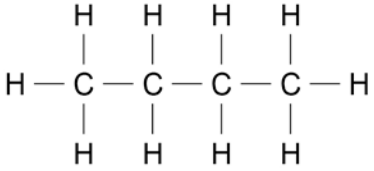
Answer 01 · Mark scheme

June 2018 | 8464/C/2F | Original Q6



5.7.1.3 Properties of hydrocarbons

Answer 02 · Mark scheme June 2019 | 8464/C/2F | Original Q4

04.1	any **two** from: • high temperature • catalyst • steam • high pressure • low oxygen atmosphere	ignore heat / hot allow a temperature between 400 °C and 900 °C allow aluminium oxide, alumina, porous pot, zeolites	2	AO1 5.7.1.4
04.2		all bonds and atoms must be present	1	AO1 5.7.1.1
04.3	carbon dioxide water	in either order allow CO_2 allow H_2O	1 1	AO1.1 5.7.1.3
04.4	bromine (water) turns (from orange / brown / yellow to) colourless	do **not** accept bromide MP2 is dependent on MP1 allow decolourises ignore clear	1 1	AO1 5.7.1.4
04.5	sustainable development		1	AO1 5.10.1.1
Total			**8**	

5.7.1.3 Properties of hydrocarbons

Answer 02 · Mark scheme

June 2019 | 8464/C/2F | Original Q4

Question	Answers	Extra information	Mark	AO / Spec. Ref.

5.7.1.3 Properties of hydrocarbons

Answer 03 · Mark scheme November 2020 | 8464/C/2F | Original Q6

06.1	$C_3H_8 + 5\ O_2 \rightarrow 3\ CO_2 + 4\ H_2O$	allow multiples	1	AO2 5.1.1.1 5.7.1.3
06.2	(bubble gas through) lime water	MP2 is dependent upon correct response in MP1 allow (bubble gas through) calcium hydroxide (solution)	1	AO1.2 5.8.2.3
	turns milky / cloudy / white **or** white precipitate forms		1	
06.3	C_3H_6		1	AO2 5.1.1.1 5.7.1.4
06.4	burning / lit splint	MP2 is dependent upon correct response in MP1 allow flame do **not** accept glowing splint	1	AO1 5.8.2.1
	burns with a (squeaky) pop sound	allow pops	1	
06.5	bromine (water)	do **not** accept bromide	1	AO1 5.7.1.4
	(colour change) orange	allow 1 mark for colourless (to) orange	1	
	(to) colourless		1	
		ignore clear		
Total			**9**	

5.7.1.3 Properties of hydrocarbons

Answer 03 · Mark scheme

November 2020 | 8464/C/2F | Original Q6

5.7.1.3 Properties of hydrocarbons

Answer 04 · Mark scheme November 2021 | 8464/C/2F | Original Q7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	plankton **or** (ancient) biomass	allow microscopic plants / animals	1	AO1 5.7.1.1
07.2	propane	allow C_3H_8	1	AO1 5.7.1.1

5.7.1.3 Properties of hydrocarbons

Answer 04 · Mark scheme

November 2021 | 8464/C/2F | Original Q7

Question	Answers	Mark	AO / Spec. Ref.
07.3	**Level 2:** Scientifically relevant features are identified; the way(s) in which they are similar / different is made clear and (where appropriate) the magnitude of the similarity / difference is noted.	4–6	AO3
	Level 1: Relevant features are identified and differences noted.	1–3	AO1 AO2
	No relevant content	0	
	Indicative content • methane has 1 carbon atom, hexane has 6 • methane has 4 hydrogen atoms, hexane has 14 • both contain C – H bonds • only hexane contains C – C bonds • both are hydrocarbons • hexane has a higher melting point than methane (or converse) • hexane has a higher boiling point than methane (or converse) • methane is a gas at room temperature • hexane is a liquid at room temperature • both are small molecules • hexane has larger molecules than methane • weak forces between molecules • forces between hexane molecules stronger than between methane molecules • hexane is more viscous than methane • both are flammable • methane is more flammable than hexane (or converse) • possible products of combustion from both are: carbon, carbon monoxide, carbon dioxide, water • neither conduct electricity		5.2.2.4 5.7.1.1 5.7.1.3

5.7.1.3 Properties of hydrocarbons

Answer 04 · Mark scheme

07.4	C_8H_{18}		1	AO2 5.3.1.1 5.7.1.4
07.5	bromine (water) turns (from orange / brown) to colourless	 MP2 is dependent on MP1 allow decolourises ignore clear	1 1	AO1 5.7.1.4
Total			**11**	

5.7.1.3 Properties of hydrocarbons

Answer 05 · Mark scheme

June 2023 | 8464/C/2F | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	$CH_4 + \mathbf{2}\,O_2 \rightarrow CO_2 + \mathbf{2}\,H_2O$		1	AO2 5.7.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	hydrocarbon molecules in petrol have fewer carbon atoms than those in diesel petrol has a lower boiling point (range) than diesel	allow converse throughout allow petrol is more flammable than diesel allow petrol is less viscous than diesel	1 1	AO3 5.7.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	oxygen		1	AO1 5.8.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	air	allow the atmosphere allow from volcanoes	1	AO1 5.9.1.1 5.9.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	global dimming		1	AO2 5.9.3.1

5.7.1.3 Properties of hydrocarbons

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6	(carbon monoxide is) colourless **or** (carbon monoxide is) odourless	ignore clear	1	AO1 5.9.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.7	(diesel) burns at a high temperature **or** (diesel) burns at a temperature greater than 100 °C		1	AO2
	(which is) above the boiling point of water		1	AO3 5.2.2.1 5.9.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.8	sulfur dioxide (is produced when diesel is burnt)		1	AO1 5.9.3.1 5.9.3.2
	(which causes) acid rain		1	
	(which results in) any **one** from: • damage to buildings / statues / bridges • damage to trees / plants • damage to aquatic life • acidification of lakes / rivers / soil • respiratory problems	allow (which affects) asthma	1	

Total Question 5	**12**

5.7.1.3 Properties of hydrocarbons

Answer 06 · Mark scheme

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

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	$C_{12}H_{26}$		1	AO2 5.7.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	any **one** from: • (a water bath) will control the temperature • (a water bath) will not set dodecane on fire	 allow dodecane is flammable	1	AO3 5.7.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	volume of dodecane		1	AO3 5.7.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	line extrapolated to 75 °C value at 75 °C read from extrapolated line	 allow a tolerance of ± ½ a small square	1 1	AO3 AO2 5.7.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	as the temperature increases the time taken decreases (so) the viscosity decreases	ignore references to rate	1 1	AO3 5.7.1.3

Total Question 5	7

5.7.1.3 Properties of hydrocarbons

Answer 04 · Examiner comments November 2021 | 8464/C/2F | Original Q7

Question 7 (low and standard demand)

Students found this question challenging, with a significant number of scripts left blank.

Knowledge of the hydrocarbons was very limited. Very few students knew what decomposed to form crude oil – many appeared to confuse “decomposition” with “composition” and gave hydrocarbons as their answer. Similarly, in question, 07.2 Lithium was a common answer as

students had used the Periodic Table to find the third element rather than naming the third hydrocarbon.

Students often failed to address the command word to compare the structure and properties of the two hydrocarbons. Many students rewrote the information provided in the rubric without elaboration, for which no credit was given.

Concluding Remarks

The demand of this paper was similar to that of papers set for this specification in previous series.

Students scored well on questions involving the use of data and knowledge of the Earth's atmosphere and climate change, but often had difficulty in making links between each stage of a question. Very few students recognised in question 01.3 that the anhydrous copper sulfate would react with any moisture in the air as in the equation in question 01.1.

Practical work is at the heart of the specification. The importance of the use of variables in experiments is paramount. In question 06.1, when identifying control variables students should refer back to the method provided, where in this instance the volume of hydrochloric acid was given. Many answers referred to the "amount" of acid or metal which is insufficient to gain credit, likewise, adding a "piece" of magnesium which does not indicate that either the length or mass has been controlled. Reading through the method will also reveal what is being changed in subsequent repeats as the independent variable.

Students adopted a range of methods to answer the mathematical questions, which is to be encouraged as credit can be gained by showing working. They should also take careful note of any additional instructions. In question 04.6, the final mark was often not gained because their answer was not given to 2 significant figures.

In questions, such as question 07.3, where comparisons are to be made from given data, students should be encouraged to answer accordingly using a comparative and not rewrite the information that is provided without any elaboration. This does not gain any credit as the student has not added any value to their answer. Some excellent answers were seen where the students expanded upon the data, for example, to explain why the molecules had different melting and boiling points or they deduced their physical states.

5.7.1.3 Properties of hydrocarbons

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.

5.7.1.3 Properties of hydrocarbons

Answer 05 · Examiner comments June 2023 | 8464/C/2F | Original Q5

Question 5

05.1 Around a third of students successfully balanced the equation. Having to balance two numbers in the equation led to many students trying to add other atoms, usually C and/or H to the equation.

05.2 One in five students gained both marks for comparing petrol and diesel. A further third gained one mark. On this occasion, students needed to interpret what the table headings meant, so many were not able to gain credit as they referred to the range of numbers of carbons, rather than the number of carbons and similarly, though more infrequent, for the boiling points.

05.3 Three in five students identified oxygen as the common element in the compounds released from a car engine.

05.4 Only 15% of students were able to identify that nitrogen came from the air. Much more common suggestions were from the engine or the diesel fuel.

05.5 This question tested a little known part of the specification, with fewer than one in twenty identifying global dimming as a consequence of particulates in the atmosphere. By far the most common incorrect response was for global warming.

05.6 Just below half of students could answer that carbon monoxide is either colourless or odourless. Many students gave both, despite being asked for one.

05.7 Fewer than one in ten gained any marks on this question, which was applying ideas from across the specification. Just a statement that water evaporates was insufficient for credit, as there needed to be a realisation that water is produced as a vapour, rather than turning into a vapour during the process.

Answer 05 · Examiner comments June 2023 | 8464/C/2F | Original Q5

05.8 Around one in ten students gained at least one mark on this question, usually for recognising that sulfur is responsible for acid rain. The consequences of acid rain were not well known, and even fewer knew that sulfur enters the atmosphere as sulfur dioxide. Global warming was the most common incorrect response.

5.7.1.3 Properties of hydrocarbons

Answer 06 · Examiner comments June 2025 | 8464/C/2F | Original Q5

Question 5 (Standard demand)

05.1 Students found it difficult to give the correct formula for dodecane. They frequently used wrong numbers or added additional letters in their response.
Where students did know the correct numbers of carbon and hydrogen atoms, the numbers were often not written as subscripts but the same size as the letters. The correct use of subscript and superscript is always a requirement in writing chemical formulae.
A significant minority of students wrote the general formula of the alkanes or simply substituted 12 for n without doing the necessary calculation for the number of hydrogen atoms.

05.2 Students found it difficult to explain why a water bath was used in preference to a Bunsen burner. Very few recognised that dodecane was flammable. Common incorrect responses included reference to speed of heating or the Bunsen / water bath being too hot. Only 10% of students recognised the idea of controlling the temperature.

05.3 A large number of students was able to state the volume of dodecane as either 40 cm^3, 100 cm^3, just cm^3 alone, or simply 'volume'. The most common response was using incorrect terminology, 'amount of dodecane', as amount is not equivalent to volume.

05.4 Students found the extrapolation of the line difficult. It was often horizontal or not extrapolated far enough. It was also often poorly drawn – many drew thick lines, double lines and feathery lines.
More of the students were able to read the value from their graph, although a common error was not being able to interpret the *y*-axis scale correctly.

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Answer 06 · Examiner comments June 2025 | 8464/C/2F | Original Q5

05.5 Many students achieved one mark but very few achieved both marks. Students could often state the relationship between an increase in temperature and the time taken for the dodecane to flow, as they had the graph to help them. They struggled however to then link this to viscosity. The poor quality of written communication often resulted in students contradicting themselves in this question.