AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 5.7.1.3

Properties of hydrocarbons

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**7**
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/2H | Original Q1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	condenses		1	AO1 5.7.1.2
01.2	the fractions have different boiling points		1	AO1 5.7.1.2 5.7.1.3
01.3	propane	do **not** accept propene	1	AO2 5.7.1.1
01.4	C_nH_{2n+2}		1	AO1 5.7.1.1
01.5	CH_4 + **2** $O_2 \rightarrow CO_2$ + **2** H_2O	allow multiples	1	AO2 5.1.1.1 5.7.1.3
01.6	bromine water		1	AO1 5.7.1.4
01.7	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

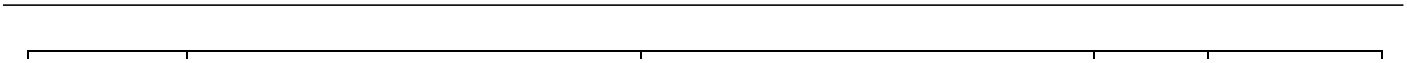
June 2018 | 8464/C/2H | Original Q1

Question	Answers	Mark	AO / Spec. Ref.
01.8	**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/2H | Original Q1



5.7.1.3 Properties of hydrocarbons

Answer 02 · Mark scheme June 2019 | 8464/C/2H | Original Q7

07.1	heat or vaporise (oil)	maximum of **3** marks if incorrect reference made to cracking ignore fractional distillation ignore fracking	1	AO1 5.7.1.2
	temperature gradient in column	allow column is cooler at the top or allow column is hotter at the bottom	1	
	(vapour) condenses (into fractions)		1	
	depending on boiling point of fraction	allow at different levels	1	

07.2	different amounts of oxygen available	allow complete combustion **and** incomplete / partial combustion	1	AO2 5.9.3.1

07.3	$2\ C_4H_{10} + 9\ O_2 \rightarrow 8\ CO + 10\ H_2O$	allow correct multiples / halves	1	AO2 5.7.1.3 5.9.3.1 5.1.1.1

5.7.1.3 Properties of hydrocarbons

Answer 02 · Mark scheme

June 2019 | 8464/C/2H | Original Q7

07.4	short wavelength radiation which enters the atmosphere	because uv / ultra violet radiation which enters the atmosphere	1	AO1.1 5.9.2.1
	is absorbed by materials **and** re-emitted		1	
	as a longer wavelength radiation	as ir / infrared radiation	1	
	(the longer wavelength radiation is trapped by) a greenhouse gas / carbon dioxide / methane which stops radiation escaping (from the atmosphere)	allow so temperature increases	1	

Total			**10**

5.7.1.3 Properties of hydrocarbons

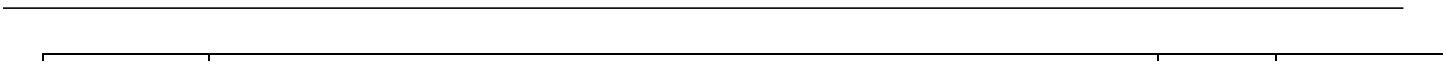
Answer 03 · Mark scheme November 2020 | 8464/C/2H | Original Q1

01.1	$C_3H_8 + 5\ O_2 \rightarrow 3\ CO_2 + 4\ H_2O$	allow multiples	1	AO2 5.1.1.1 5.7.1.3
01.2	(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	
01.3	C_3H_6		1	AO2 5.1.1.1 5.7.1.4
01.4	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	
01.5	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/2H | Original Q1



5.7.1.3 Properties of hydrocarbons

Answer 04 · Mark scheme November 2020 | 8464/C/2H | Original Q5

05.1	plankton	allow biomass allow (marine) animals / organisms ignore plants	1	AO1 5.7.1.1
	buried in mud	allow compressed under mud allow compressed in sedimentary rock ignore fossilised	1	
	over a long period of time **or** over millions of years		1	

05.2	crude oil heated		1	AO1 5.7.1.2
	(hydrocarbons / liquids) evaporate	allow (hydrocarbons / liquids) vaporise / boil	1	
	vapours / gases condense		1	
	fractions have different boiling points **or** fractions collect at different levels depending upon boiling point		1	

05.3	C_nH_{2n+2}		1	AO1 5.7.1.1

5.7.1.3 Properties of hydrocarbons

Answer 04 · Mark scheme

05.4	the boiling point increases as the number of (carbon) atoms increases (because the weak) intermolecular forces increase **or** (because the weak) forces between the molecules increase (and these intermolecular forces increase) as the size of the molecules increases	max **2** marks for incorrect reference to particles **/** bonds allow converse	1 1 1	AO1 AO2 AO3 5.2.2.4 5.7.1.3

05.5	(as number of carbon atoms increase) the time increases (because) the viscosity increases	MP2 dependent on correct response in MP1	1 1	AO3 5.7.1.3

Total			**13**

5.7.1.3 Properties of hydrocarbons

Answer 04 · Mark scheme

November 2020 | 8464/C/2H | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.

5.7.1.3 Properties of hydrocarbons

Answer 05 · Mark scheme

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

5.7.1.3 Properties of hydrocarbons

Answer 05 · Mark scheme

November 2021 | 8464/C/2H | Original Q2

Question	Answers	Mark	AO / Spec. Ref.
02.3	**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

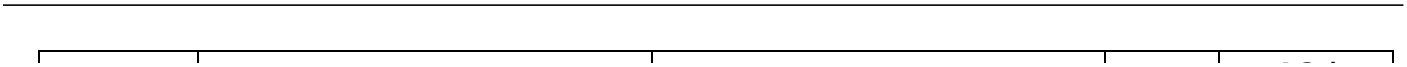
5.7.1.3 Properties of hydrocarbons

02.4	C_8H_{18}		1	AO2 5.3.1.1 5.7.1.4
02.5	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

November 2021 | 8464/C/2H | Original Q2



5.7.1.3 Properties of hydrocarbons

Answer 06 · Mark scheme

June 2023 | 8464/C/2H | Original Q1

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	$CH_4 + \mathbf{2}\,O_2 \rightarrow CO_2 + \mathbf{2}\,H_2O$		1	AO2 5.7.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	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.
01.3	oxygen		1	AO1 5.8.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	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.
01.5	global dimming		1	AO2 5.9.3.1

5.7.1.3 Properties of hydrocarbons

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.6	(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.
01.7	(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.
01.8	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 1	12

5.7.1.3 Properties of hydrocarbons

Answer 07 · Mark scheme

June 2025 | 8464/C/2H | Original Q1

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	$C_{12}H_{26}$		1	AO2 5.7.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	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.
01.3	volume of dodecane		1	AO3 5.7.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	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.
01.5	 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 1	7

5.7.1.3 Properties of hydrocarbons

Answer 01 · Examiner comments

June 2018 | 8464/C/2H | Original Q1

Question 1 (standard demand)

01.1 83% of students achieved this mark. None of the other three possible answers proved to be dominant.

01.2 79% of students achieved this mark. 'The fractions have different melting points' proved to be dominant wrong answer.

01.3 49% of students gained credit, recognising the alkane to be propane. Most popular incorrect answer was butane. Some students gave a formula even though the question asked for the name of the alkane.

01.4 The correct answer of C_nH_{2n+2} was the most commonly selected response by students (77%) although C_nH_{2n} proved to be the most effective distractor.

01.5 56% of students successfully balanced equation for the combustion of methane. Multiples were regularly seen, and credit accordingly given.

01.6 The correct answer of bromine water was chosen by 67% of students. Anhydrous copper sulfate proved to be the most effective distractor.

01.7 28% of students knew the definition from the specification or were able to give an equivalent statement. A large number of vague incorrect responses were seen encompassing issues such as pollution, sustainability, energy and carbon footprint.

5.7.1.3 Properties of hydrocarbons

Answer 01 · Examiner comments June 2018 | 8464/C/2H | Original Q1

01.8 In this 'extended response' question students were asked to compare the two methods for the disposal of biodegradable plastic bags using information given in Table 1.

26% of students gained full marks on this question and a further 38% of students achieved marks at level 2. To access level 2, students were expected to 'note the magnitude' of the differences, as stated in the generic level descriptor in the mark scheme.

17% of students achieved marks in level 1 by giving some comparisons of the gases and residue either in qualitative terms or by quoting values from Table 1.

The least creditworthy responses discussed in general terms the effect on the environment of burning waste plastic or the benefits of burning plastic bags to generate electricity. Students writing these responses made little reference to the information in Table 1 and many of these students ignored the key command word, 'Compare'. However, the higher-attaining students had logically worked their way down the information in Table 1, comparing and calculating differences when constructing their answer.

5.7.1.3 Properties of hydrocarbons

Answer 02 · Examiner comments

June 2019 | 8464/C/2H | Original Q7

Question 7 (high demand)

07.1 This question produced a good spread of marks, with around 83% of students gaining some credit for their answer. A minority of students gained all four marks, whilst just over half of the students gained either 1 or 2 marks. Students most commonly did not include the idea that the fractionating column had a temperature gradient. Some students explained in detail what each of the fractions was used for and a few students incorrectly incorporated 'cracking' into their response.

07.2 Almost 60% students were able to correctly identify 'different amounts of oxygen' or state that 'the first reaction is complete combustion and the second is incomplete combustion'. Some students wrote 'carbon dioxide and water' which did not answer the question that was asked. Several students stated that 'in reaction one the hydrocarbon is an alkane and in the other reaction it is an alkene'.

07.3 Just over 43% of students successfully balanced the equation for the combustion of butane. Multiples were regularly seen, and full credit was available if these were correct.

07.4 Many students were unable to describe in detail the greenhouse effect in terms of long and short wavelength radiation. Responses were confused as to which type of wavelength would pass through the atmosphere; 'reflected' or 'bounced off' were not creditworthy alternatives to 'longer wavelengths being re-emitted'. About 32% of students gained one mark for identifying that the 'temperature increases'.

Approximately 10% of students made no attempt at this question.

5.7.1.3 Properties of hydrocarbons

Answer 02 · Examiner comments

June 2019 | 8464/C/2H | Original Q7

Use of statistics

Statistics used in this report may be taken from incomplete processing data. However, this data still gives a true account on how students have performed for each question.

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 — November 2021 | 8464/C/2H | Original Q2

Question 2 (standard demand)

Very few were able to correctly identify what is decomposed to form crude oil, many appeared to confuse “decomposition” with “composition” and gave hydrocarbons as their answer. However, the naming of alkanes was well known.

In the comparision of methane and hexane most students focused their attention on the comparison of the boiling points and the relative numbers of atoms in each molecule, using only the information provided. There was some confusion evident around the negative values of the melting points. A significant number of students stated that methane has a higher melting point than hexane. Better answers linked the information to the physical states of the hydrocarbons. Some excellent answers were seen where the students expanded upon the data, for example, to

Answer 05 · Examiner comments — November 2021 | 8464/C/2H | Original Q2

explain why the molecules had different melting and boiling points in terms of the strength of their intermolecular forces or they deduced their physical states.

Answer 06 · Examiner comments — June 2023 | 8464/C/2H | Original Q1

Question 1

01.1 Four in five students successfully balanced the equation.

01.2 Just over two 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 weren’t 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.

01.3 Nearly nine in ten students identified oxygen as the common element in the compounds released from a car engine.

01.4 Just over a third of students were able to identify that nitrogen came from the air. Much more common suggestions were from the engine or the diesel fuel.

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

01.6 Just below three quarters of students answered that carbon monoxide is either colourless or odourless. Many students gave both, despite being asked for one.

5.7.1.3 Properties of hydrocarbons

Answer 06 · Examiner comments June 2023 | 8464/C/2H | Original Q1

01.7 Around one in ten gained two marks on this question, with a further quarter gaining one. The question 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.

01.8 Around half of 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 known by about a quarter, however, around than one in ten knew that sulfur enters the atmosphere as sulfur dioxide and so gained all marks. Again, global warming was the most common incorrect response here.

Answer 07 · Examiner comments June 2025 | 8464/C/2H | Original Q1

Question 1 (Standard demand)

01.1 Many students were able to give the correct formula for dodecane, however a significant number failed to write the numbers as subscript therefore not being awarded the mark. Correct use of subscript and superscript is always required when writing chemical formulae.

01.2 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 being too hot. Only a quarter of students recognised the idea of the water bath controlling the temperature.

01.3 This question was attempted by the vast majority of students. Students were 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 incorrect response was using the terminology of 'amount of dodecane', as amount is not equivalent to volume. Consequently, only just over half of responses gained this mark.

01.4 Students found the extrapolation of the line quite difficult. It was often horizontal or poorly drawn with many thick lines, double lines and feathery lines. They were better at reading the value from their line. A significant number however applied an incorrect scale when reading from their extrapolated line.

01.5 Students were often able to state the relationship between increase in temperature and time taken for the dodecane to flow using the graph to help them. They were less confident however in stating how this linked to viscosity. A significant number linked faster flowing to being more viscous.

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