AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 5.10.2.1

Life cycle assessment

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**3**
Available paper years	**2018–2022**

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.

5.10.2.1 Life cycle assessment

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

5.10.2.1 Life cycle assessment

Answer 01 · Mark scheme

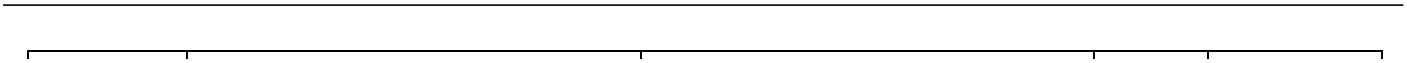
June 2018 | 8464/C/2H | Original Q1

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**

5.10.2.1 Life cycle assessment

Answer 01 · Mark scheme

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



5.10.2.1 Life cycle assessment

Answer 02 · Mark scheme

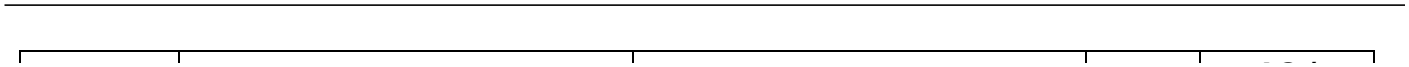
November 2021 | 8464/C/2H | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	at high temperatures (in the engine) nitrogen reacts with oxygen (to produce nitrogen dioxide)		1 1 1	AO1 5.9.3.1
05.2	(**X**=) (33×7) – [(37×3)+35+34+29] = 22 (micrograms per m^3)	allow 33x7 = (37x3)+35+34+29+**X**	1 1	AO2 5.9.3.1
05.3	countryside data has smallest values (so) 2 is a higher proportion / percentage of the value	 allow (so) countryside is ± 2 out of a value between 6 to 8	1 1	AO3 5.9.3.1
05.4	$2\,NO_2 \rightarrow N_2 + 2\,O_2$	allow multiples or halves allow 1 mark for N_2 **and** O_2	2	AO2 5.3.1.1 5.10.1.1
05.5	a resource which will run out	allow a non-sustainable resource	1	AO1 5.10.1.1
05.6	(because carbon dioxide is emitted in) extracting / processing raw materials (and) manufacturing (and) disposal at the end of its useful life		1 1 1	AO2 5.9.2.4 5.10.2.1
Total			13	

5.10.2.1 Life cycle assessment

Answer 02 · Mark scheme

November 2021 | 8464/C/2H | Original Q5



5.10.2.1 Life cycle assessment

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	butane		1	AO2 5.7.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	(molecule) made up of carbon and hydrogen (atoms) only		1	AO1 5.7.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	$C_{11}H_{24} \rightarrow C_5H_{10} + 2\,C_2H_4 + C_2H_6$ **OR** $C_{11}H_{24} \rightarrow C_5H_{10} + 2\,C_3H_6 + H_2$ (2) **OR** $C_{11}H_{24} \rightarrow C_5H_{10} + 2\,C_2H_6 + C_2H_2$ (2)	allow **1** mark for $2\,C_2H_4$ allow **1** mark for C_2H_6 allow **1** mark for $2\,C_3H_6$ allow **1** mark for H_2 allow **1** mark for $2\,C_2H_6$ allow **1** mark for C_2H_2	2	AO2 5.1.1.1 5.3.1.1 5.7.1.4

5.10.2.1 Life cycle assessment

Answer 03 · Mark scheme

June 2022 | 8464/C/2H | Original Q4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	C_2H_6 is useful as a fuel	allow smaller molecule so useful as a fuel	1	AO1 5.7.1.3 5.7.1.4
	(because more) flammable (than larger molecules)		1	
	OR			
	C_2H_4 / C_3H_6 / C_5H_{10} is used to make polymers (1)	allow C_2H_4 / C_3H_6 / C_5H_{10} is used to make plastics allow C_2H_4 / C_3H_6 / C_5H_{10} is used to make other chemicals		
	(because more) reactive (than alkanes) (1)			
		if a named product is given, allow **1** mark for a correct use and **1** mark for a correct linked reason		

5.10.2.1 Life cycle assessment

Question	Answers	Mark	AO / Spec. Ref.
04.5	**Level 3:** A judgement, strongly linked and logically supported by a sufficient range of correct reasons is given.	5–6	AO3 5.9.2.2 5.10.1.1 5.10.2.1
	Level 2: Some logically linked reasons are given. There may also be a simple judgement.	3–4	
	Level 1: Relevant points are made. They are not logically linked.	1–2	
	No relevant content	0	
	Indicative content • production of plastic uses more hydrocarbons which are from non-renewable crude oil • production of plastic produces more greenhouse gases in the atmosphere which contributes to global warming • production of plastic produces more sulfur dioxide which causes acid rain • production of plastic produces more oxides of nitrogen which cause acid rain and respiratory problems • disposal of plastic produces more waste which increases landfill • burning plastic produces fumes which are toxic so cause respiratory problems • lifetime cost of plastic frames is less • plastic frames have lower costs for maintaining • the total energy consumption for plastic frames is greater than for wooden frames • judgement		

Total Question 4		**12**

5.10.2.1 Life cycle assessment

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.

5.10.2.1 Life cycle assessment

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.

Answer 02 · Examiner comments November 2021 | 8464/C/2H | Original Q5

Question 5 (standard, standard / high and high demand)

The idea that nitrogen and oxygen from the air react together in the engine was not well known. Many students incorrectly stated that nitrogen dioxide was present in the fuel. Heat from the engine was insufficient to gain marking point 1 as there must be an indication of high temperature.

Non-renewable was a common response for a "finite resource" which did not gain credit as marks were awarded for the definition.

Students appeared to have a good understanding of the idea of a carbon footprint. Some excellent answers were seen where carbon emissions were linked to each stage in the life cycle of the car. Some students simply focused on the manufacture of both the car and its raw materials and failed to address the disposal.

5.10.2.1 Life cycle assessment

Answer 03 · Examiner comments

Question 4

There is only a small section on organic chemistry in this specification. However in responses students do not appear to have consolidated the ideas of organic chemistry.

04.1 Just over half of the students were able to identify butane from the picture.

04.2 There were only 2 in 5 students who were able to correctly quote this definition.

04.3 Students found balancing the cracking equation quite challenging, often making up molecules that fitted rather than working out possible molecules from prior knowledge.

04.4 It was anticipated that students would choose one of their products or identify one as an alkane or an alkene and quote a use. This was very rare, and students were given some leeway in identifying a use. Explanations as to why the molecule was used were even rarer.

04.5 Students found the start of this question very accessible, comparing the data supplied. Direct comparisons only allowed access to level 1, however, and links to the problems caused were required to make further progress. Nearly 10% of students were able to reach level 3. A judgement (which many students gave) and comparisons of both economic and environmental factors was required to do this. On evaluate questions, students need to bring in some of their own knowledge to access the higher levels.