AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.10.2.1

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.

4.10.2.1 Life cycle assessment

Answer 01 · Mark scheme

June 2018 | 8462/2H | Original Q10

Question	Answers	Mark	AO / Spec. Ref.
10.1	**Level 3:** A judgement, strongly linked and logically supported by a sufficient range of correct reasons, is given.	5–6	AO3
	Level 2: Some logically linked reasons are given. There may also be a simple judgement.	3–4	AO3
	Level 1: Relevant points are made. They are not logically linked.	1–2	AO2
	No relevant content	0	
	Indicative content **raw materials** • crude oil finite **or** will run out (so will be unavailable for other uses) • wood is a renewable resource • wood involves land use for forestry (so less available for agriculture / food) • wood may involve deforestation (so reduces biodiversity) **manufacturing** • both require energy which may be derived from finite fuels (so they run out more quickly) • paper more energy intensive (so more pollution is possible) • the need for more energy for paper potentially releases more carbon dioxide to the atmosphere (so increases global warming) • paper involves higher water usage (so increases the potential for water pollution) • paper cups are heavier to transport (so have higher energy requirement) • packaging requirements similar (so neither has an advantage) **usage** • both single-use (so neither has an advantage) **disposal** • paper releases more energy if incinerated (so more energy can be used for other purposes) • paper will decompose (so will not remain in landfill) • poly(styrene) could release toxins on incineration • poly(styrene) will not decompose (so will remain in landfill) • poly(styrene) can be used to manufacture other products (so conserves energy **or** finite resources) • both can cause litter **or** visual pollution		4.10.1.1 4.10.2.1

4.10.2.1 Life cycle assessment

Answer 01 · Mark scheme

June 2018 | 8462/2H | Original Q10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.2	$\frac{1000}{8.3} \times 550$ (kJ) = 6.63×10^4 (kJ)	an answer of 6.63×10^4 (kJ) scores **2** marks allow $6.6265060240963 \times 10^4$ (kJ) correctly rounded allow 66265.060240963 (kJ) correctly rounded for **1** mark	1 1	AO2 4.10.2.1
10.3	(melamine is a) thermosetting (polymer) (which) contains crosslinks / bonds (between polymer chains)	 do **not** accept reference to intermolecular forces allow (so) it decomposes	1 1	AO3 4.10.3.3 AO2 4.10.3.3
Total			**10**	

4.10.2.1 Life cycle assessment

Answer 02 · Mark scheme

November 2020 | 8462/2H | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	any **two** from: energy used in: • extraction of raw materials • processing raw materials • manufacturing • transportation • cleaning non-disposable plates • disposal • recycling	allow energy used to make food plate materials	2	AO3 4.10.2.1

Question 5 (continued)

Question	Answers	Mark	AO/ Spec. Ref
05.2	**Level 2:** A judgement, strongly linked and logically supported by a sufficient range of correct reasons, is given.	3–4	AO3 4.10.1.1 4.10.2.1 4.10.2.2
	Level 1: Some logically linked reasons are given. There may also be a simple judgement.	1–2	
	No relevant content	0	
	Indicative content **Raw materials** • Trees are renewable • Crude oil and clay are finite **Manufacturing and packaging** • Paper plates use the least packaging so conserve raw materials • Paper plates need less transportation overall as more plates in a 10 dm^3 cardboard box **Use and operation** • Paper plates are single use so must be replaced most often • Ceramic plates last longer than polymer plates so must be replaced less often **Disposal** • Polymer / ceramic plates take up landfill which is running out • Paper / polymer plates can be used to make new products • Recycling conserves raw materials **Reasoned judgement**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	(wet) clay is shaped		1	AO1 4.10.3.3
	(and) heated in a furnace	allow (and) heated in a kiln / oven allow (and) fired	1	

Total			8

4.10.2.1 Life cycle assessment

Answer 03 · Mark scheme

June 2022 | 8462/2H | Original Q3

Question 3

Question	Answers	Mark	AO / Spec. Ref
03.1	**Level 3:** A judgement, strongly linked and logically supported by a sufficient range of correct reasons, is given.	5–6	AO3 4.10.1.1 4.10.2.1
	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 **raw materials** • crude oil is finite • quarrying / mining pollute the environment • glass uses more energy to process raw materials **manufacturing** • glass uses more energy to make bottles • glass is heavier so takes more energy to transport **use and operation** • glass bottles are reusable • reuse of glass conserves (natural) resources • reuse of glass consumes energy during washing • reuse of glass consumes water during washing **disposal** • both glass and polymer bottles can be recycled • recycling polymer conserves finite resources • recycling glass and polymer uses less energy than making new glass and polymer • both methods reduce use of landfill **other points** • energy needed may be derived from fossil fuels • use of fossil fuels causes (specified) pollution • total energy for glass (bottle) (7500 kJ) is greater than total energy for polymer (bottle) (1800 kJ) **reasoned judgement**		

4.10.2.1 Life cycle assessment

Answer 03 · Mark scheme

June 2022 | 8462/2H | Original Q3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	mass = density × volume mass = 0.40 × 40 = 16 (g)		1 1 1	AO2 4.10.1.1 4.10.2.1

Total Question 3		9

Answer 01 · Examiner comments

June 2018 | 8462/2H | Original Q10

Question 10 (standard / high & high demand)

10.1 This was an 'extended response', 'level marked' question. There were three levels and the command word was 'evaluate'. The question was marked holistically. Most answers considered all three relevant stages of a Life Cycle Assessment for both types of cup.

However, many answers failed to consider the environmental impact of the factors discussed. For example, students might say that paper cups are heavier to transport, but did not go on to say what environmental impact that might have in terms of more pollution from lorries, or a greater energy requirement burning more fossil fuels and adding to climate change. This limited their mark to level 2, as did failure to give a strongly linked judgement.

Some students misinterpreted 'recyclable' as 'reusable': the terms are not synonymous. The question stated that both types of cup are disposable, ie single use.

Some answers focussed on the economics or ease of use of the cup, rather than environmental impact. Most students were able to acquire at least one mark with 50% of students achieving four marks. 22% of students made it into level 3.

10.2 A mark was often missed through inappropriate rounding to a whole number of cups at an intermediate stage in the working. Others rounded 1000 ÷ 83 to 120.5, then multiplied this figure by 550 and quoted an answer to five significant figures. This gave an answer which did not fit the correct value. Had they rounded to two, three or four significant figures they would have achieved the mark. It is never appropriate to quote an answer to more significant figures than an earlier intermediate step. 50% of students achieved both marks.

10.3 Many students tainted an otherwise good answer by referring to intermolecular forces, often alongside a reference to cross-links. They seem not to realise that the cross-links are covalent bonds.

Others were confused and referred to strong bonds or cross-links between monomers. Some referred to layers rather than chains. 21% of students achieved both marks here, although many more gained a mark for 'thermosetting'.

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.

4.10.2.1 Life cycle assessment

Answer 02 · Examiner comments November 2020 | 8462/2H | Original Q5

Question 5 (standard and standard / high demand)

05.1 A significant number of students did not realise they were being asked to name the processes for which the energy requirement needed to be known, but instead tried to guess which material would use more energy.

05.2 Very few students gave a reasoned judgement and so were unable to access level 2. Some did not even have comparisons, but simply described the characteristics of each material in isolation. Some referred to deforestation, missing the point that more trees can be grown. Many made valid comparisons of the number of plates that could be packaged in a box and of the number of times each plate could be used, but did not go on to look at the consequences, such as the relative energy cost of transporting the plates or the need for replacement of the plates. Few referred to the conservation of raw materials, either in the context of the number of uses or the lack of recyclability. There was confusion between the terms reusable and recyclable. Some were highly focused on energy usage, even though no energy data was provided.

05.3 Some students knew that moulding and heating were involved, but often did not mention a furnace, kiln or oven. There were some references to heating clay **before** it is shaped.

Answer 03 · Examiner comments June 2022 | 8462/2H | Original Q3

Question 3 (Standard demand)

03.1 In this extended response question, the command word was 'evaluate'. This command word demands a reasoned judgement to be given for a fully complete answer. The vast majority of students did not include a judgement and were therefore unable to access Level 3. Only about 10% of students gained 5 or 6 marks.

Even some students who did give a judgement gained a mark in Level 1 (1-2) often by only comparing the values given in the table or a mark in Level 2 (3-4), by introducing only one or two pieces of 'added value' information about the impacts of the data provided. Roughly 30% of students gained a Level 1 mark and nearly 60% were awarded a Level 2 mark

03.2 Well over 90% of the students gained all three marks on this calculation.