AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.7.3.3

Amino acids (HT only)

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**8**
Available paper years	**2010–2025**

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.

4.7.3.3 Amino acids (HT only)

Answer 01 · Mark scheme

January 2010 | CHY3H | Original Q7 | Legacy

Question 7

question	answers	extra information	mark
7(a)	some mention that a proton is a hydrogen ion / H^+ (as an acid) it / aminoethanoic acid has lost / donated a proton / hydrogen ion (as a base) it / aminoethanoic acid has gained / accepted a proton / hydrogen ion	this mark can be gained in either part	1 1 1
7(b)(i)	0.11(04)	correct answer with or without working = **2** marks if answer incorrect (0.15 × 18.4) / 25 gains **1** mark	2
7(b)(ii)	phenolphthalein	allow any correct single acid-base indicator that changes colour in the appropriate pH range (8 – 10) do **not** accept UI / litmus / methyl orange	1
Total			**7**

4.7.3.3 Amino acids (HT only)

Answer 01 · Mark scheme

January 2010 | CHY3H | Original Q7 | Legacy

CHY3H

4.7.3.3 Amino acids (HT only)

Answer 02 · Mark scheme

June 2012 | CH1HP | Original Q4 | Legacy

Question 4

question	answers	extra information	mark
4(a)	any **two** from: • carbon dioxide dissolves in water/oceans • marine organisms use (dissolved) carbon dioxide to form their shells/skeletons **or** limestone was formed from the shells/skeleton of marine organisms • plants / algae photosynthesise/ absorb/use carbon dioxide	accept carbon dioxide became locked up in sedimentary rocks/carbonates/limestone **or** precipitation or formation of insoluble carbonates accept remains of plants/algae/ marine organisms contain locked up carbon dioxide/carbon in the form of fossil fuels do **not** accept plants use carbon dioxide for respiration	2
4(b)(i)	because these gases/molecules contain the elements / atoms in amino acids **or** the gases / they contain carbon, hydrogen and nitrogen	ignore oxygen	1

Question 4 continues on the next page . . .

4.7.3.3 Amino acids (HT only)

CH1HP

Question 4 cont'd…

question	answers	extra information	mark
4(b)(ii)	any **two** from: • nobody knows what was in the Earth's early atmosphere • there may not have been (continuous) lightning • Miller and Urey selected only the gases needed to produce amino acids	ignore small-scale / timescale ignore references to water/oceans or other theories accept these gases / hydrogen / methane / ammonia may not have been in the Earth's early atmosphere accept carbon dioxide / nitrogen may have been in the Earth's early atmosphere accept reference to Venus' present atmosphere ignore concentration of gases	2
Total			**5**

4.7.3.3 Amino acids (HT only)

Answer 02 · Mark scheme June 2012 | CH1HP | Original Q4 | Legacy

CH1HP

4.7.3.3 Amino acids (HT only)

Answer 03 · Mark scheme

January 2013 | CH1HP | Original Q8 | Legacy

question	answers	extra information	mark
8(a)	methane		1
	because at the surface temperature of -179°C only methane has melted but has not boiled	accept a correct explanation using the boiling points(and melting points) of the gases **or** methane is a liquid **and** all the others are gases	1
8(b)	CH_4 is a hydrocarbon **or** methane / carbon monoxide contains carbon **or** carbon monoxide + hydrogen → hydrocarbon		1
	nitrogen **and** hydrogen are present in Titan's atmosphere **or** nitrogen + hydrogen → ammonia		1
	carbon monoxide contains oxygen **or** carbon monoxide + hydrogen / methane → water		1
	amino acids contain carbon, hydrogen, nitrogen + oxygen **or** amino acids can be made from (methane), hydrogen, carbon monoxide and nitrogen **OR** lightning / ultraviolet / electrical discharge / high energy needed for reaction		1
Total			**6**

UMS conversion calculator www.aqa.org.uk/umsconversion

4.7.3.3 Amino acids (HT only)

Answer 04 · Mark scheme June 2017 | CH1HP | Original Q5 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
5(a)(i)	any **one** from: • all these gases / hydrogen / methane / water vapour / ammonia may not have been in the Earth's early atmosphere • the conditions of the reaction were not like those on early Earth • many different amino acids are needed for life processes	ignore no proof / evidence **or** no one was there **or** references to religion **or** meteorites / comets. allow nobody knows what was in the Earth's early atmosphere allow very little (0.5%) in the Earth's early atmosphere allow nobody knows what the conditions were on early Earth allow only simple amino acids **/** glycine were produced	1	**AO3** 1.7.2d;e
5(a)(ii)	any **three** from: • used by plants / algae **or** for photosynthesis • absorbed / dissolved by oceans • locked up in sedimentary rocks / carbonates / limestone • locked up in fossil fuels	ignore volcanoes allow stored in for locked up allow stored in for locked up mention of respiration: maximum two marks	3	**AO1** 1.7.2f;g;h
5(b)(i)	helium / He **and** neon / Ne	both needed	1	**AO2** 1.7.2j

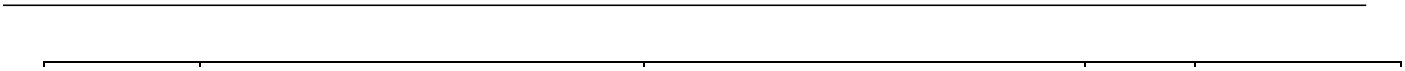
4.7.3.3 Amino acids (HT only)

5(b)(ii)	carbon dioxide would be solid **or** would block pipes	ignore freezes allow forms dry ice	1	**AO3** 1.7.2j
5(b)(iii)	 the other gas is argon / Ar because they have similar boiling points **or** there is only 3 °C difference in boiling points	mark independently	 1 1	**AO2** 1.7.2j
5(c)	 **stage 1:** oxygen reacts with carbon so carbon content decreases **or** carbon forms carbon dioxide **stage 2:** (other metals added) to form an alloy so the steel has a specific property / specific use	mark independently allow because cast iron is (too) brittle allow to stop layers sliding allow because pure iron is (too) soft	 1 1 1 1	**AO1** **AO2** 1.3.2a;b;c
Total			**12**	

4.7.3.3 Amino acids (HT only)

Answer 04 · Mark scheme

June 2017 | CH1HP | Original Q5 | Legacy

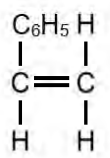


4.7.3.3 Amino acids (HT only)

Answer 05 · Mark scheme

June 2019 | 8462/2H | Original Q6

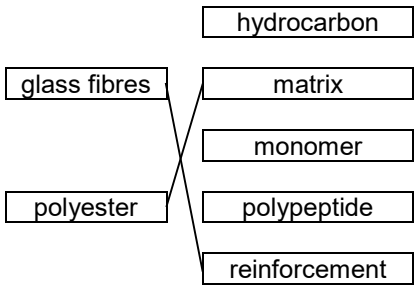
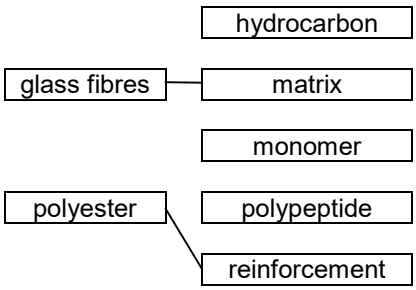
Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	C=C bond in correct position 3× C-H **and** 1× C-C bond in correct positions	 do **not** accept any additional bonds or atoms ignore brackets and n before and after displayed structural formula an answer of  scores **2** marks	1 1	AO2 4.7.3.1
06.2	carboxylic acid (group)	allow carboxyl (group)	1	AO1 4.7.2.4
06.3	water	allow H_2O	1	AO1 4.7.3.2
06.4	(polyester is) thermosoftening (polyester has) no cross-links	allow (polyester is) thermoplastic ignore thermoforming allow intermolecular forces are weak do **not** accept references to breaking covalent bonds or breaking chains	1 1	AO1 AO3 4.10.3.3

4.7.3.3 Amino acids (HT only)

Answer 05 · Mark scheme

June 2019 | 8462/2H | Original Q6

06.5		allow for **1** mark: 	1 1	AO3 4.10.3.3
06.6	any **two** from: (to make the board) • harder • stronger • tougher • more rigid • waterproof	must be implied comparative statements	2	AO3 4.10.3.3
Total			**10**	

4.7.3.3 Amino acids (HT only)

Answer 06 · Mark scheme

November 2020 | 8462/2H | Original Q9

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	**test:** (use a) glowing splint **result:** relights	do **not** accept burning splint dependent on correct test in MP1 ignore with a pop	1 1	AO1 4.8.2.2 4.9.1.3
09.2	starch cellulose	 allow glycogen	1 1	AO1 4.7.3.4
09.3	2		1	AO1 4.7.3.3
09.4	water	allow H_2O	1	AO1 4.7.3.3
09.5	ammonia nitrogen	 if no other mark awarded, allow **1** mark for NO / NO_2 / N_2O / NO_x or equivalent named compounds	1 1	AO3 4.7.3.3 4.9.1.2

4.7.3.3 Amino acids (HT only)

Question 9 (continued)

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.6	two polymer chains	allow two polymer strands	1	AO1 4.7.3.4
	four (different) monomers / nucleotides	allow four (different) bases allow cytosine, guanine, adenine and thymine allow C G A T	1	
	(double) helix	allow spiral	1	
		if no other mark awarded, allow **1** mark for DNA		

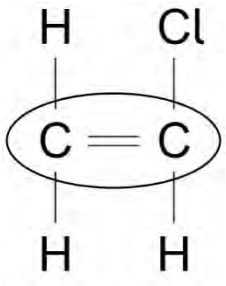
Total			**11**	

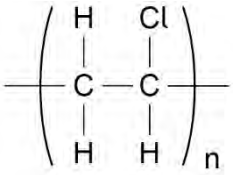
4.7.3.3 Amino acids (HT only)

Answer 07 · Mark scheme

June 2023 | 8462/2H | Original Q8

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1			1	AO1 4.7.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.2	C-C bond 3x C-H **and** 1x C-Cl bonds 2x single bonds extending through brackets **and** n below halfway	an answer of  scores **3** marks	1 1 1	AO2 4.7.3.1

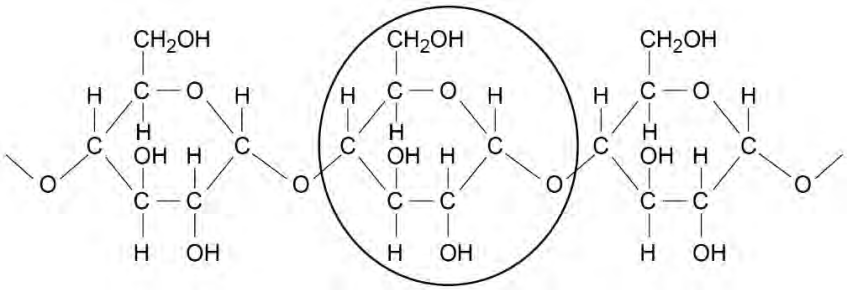
Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.3	composites		1	AO1 4.10.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.4	water	allow H_2O	1	AO1 4.7.3.3

4.7.3.3 Amino acids (HT only)

Answer 07 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.5	(M_r of NH_2 and COOH) = (2 × 1) + 14 + 12 + (2 × 16) + 1 =) 61 (M_r of section = 75 – 61) = 14	 allow correct use of incorrectly determined M_r of NH_2 and COOH	1 1	AO2 4.3.1.2 4.7.3.3

Question	Answers	Mark	AO / Spec. Ref.
08.6		1	AO2 4.7.3.1 4.9.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.7	starch	allow cellulose allow glycogen allow polysaccharide	1	AO3 4.7.3.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.8	nucleotides		1	AO1 4.7.3.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.9	double helix	ignore DNA	1	AO1 4.7.3.4

Total Question 8	12

4.7.3.3 Amino acids (HT only)

Answer 08 · Mark scheme

June 2025 | 8462/2H | Original Q7

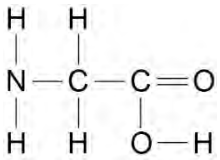
Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	(**A**) ethanediol (**B**) hexanedioic acid		1 1	AO1 4.7.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	polyester		1	AO1 4.7.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	water	allow H_2O	1	AO1 4.7.3.2

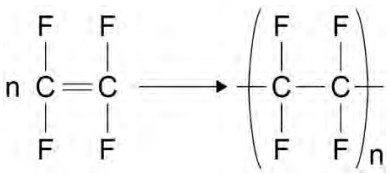
Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4	polypeptide	allow polyamide ignore protein	1	AO1 4.7.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.5			1	AO2 4.7.2.4 4.7.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.6	protein		1	AO1 4.7.3.3

4.7.3.3 Amino acids (HT only)

Answer 08 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.7	4 × C-F **and** 1 × C-C bonds		1	AO2 4.7.3.1
	2 × single bonds extending through brackets		1	
	n after polymer repeating unit		1	
		an answer of  scores **3** marks		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.8	long chain molecules	allow long chains of monomers	1	AO1 4.10.3.3
	with covalent bonds between the chains	allow with cross links between the chains ignore intermolecular forces	1	

Total Question 7	12

4.7.3.3 Amino acids (HT only)

Answer 06 · Examiner comments — November 2020 | 8462/2H | Original Q9

Question 9 (standard / high and high demand)

09.1 This part was not very well attempted. Those students who gave the correct test almost always gave the correct result too. However, many tests for carbon dioxide were seen, because students had focused on the first bullet point rather than the whole question. Splints that have been **put out** do not relight. Nor do **lighted** splints as they are already burning.

Answer 06 · Examiner comments — November 2020 | 8462/2H | Original Q9

09.2 These polymers were not well known. Other naturally occurring polymers were frequently seen, such as DNA and proteins. Many students stated that water, oxygen and carbon dioxide are polymers.

09.3 The majority of students knew that there are two functional groups in amino acids.

09.4 The majority of students knew that water was the other product of the polymerisation.

09.5 The vast majority of students scored the mark for nitrogen. Very few scored the mark for ammonia.

09.6 Most students identified a double helix, fewer mentioned four monomers, nucleotides or bases and very few referred to two polymer chains.

4.7.3.3 Amino acids (HT only)

Answer 07 · Examiner comments

June 2023 | 8462/2H | Original Q8

Question 8 (standard, standard / high and high demand)

08.1 The majority of students correctly circled the C=C group. A common mistake for those who didn't gain the mark was identifying the C-Cl bond or to circle the double bond alone without including the carbon atoms. More than half of students gained this mark.

08.2 There was a wide range of responses to this question. In the majority of answers MP2 was achieved with 3x C-H and 1x C-Cl bonds drawn correctly. Incorrect answers often lacked extended bonds or failed to extend them far enough or failed to replace the C=C bond by C-C.

08.3 A wide range of responses were seen to this question. Common incorrect responses included alloys, polymers, formulations, mixtures and ceramics. Around one-third of students gained this mark.

08.4 A wide range of responses were seen to this question. Common incorrect answers included alkene, hydrogen, named alkanes and alkenes, protein and nitrogen. Around one-half of students gained this mark.

08.5 Many students got this question correct. Those achieving one mark often got this for calculating the M_r of NH_2 and COOH and adding them for MP1. For those who didn't gain any marks a common mistake was subtracting the M_r of NH_2 and COOH from each other. Around three-quarters of students gained both marks

08.6 A wide variety of answers were seen. Incorrect responses included students circling individual side groups such as -OH or $-CH_2OH$ or some including both bridging oxygen atoms or neither. Correct answers varied in which repeating unit they circled – there are six valid alternatives. Nearly half of the students gained the mark.

08.7 The most common correct answers seen were starch, cellulose or glycogen. Polysaccharide was less commonly seen. Incorrect responses included alcohol, amino acids, proteins and a whole range of polymer names including polyester. Fewer than one-third of students gained this mark.

Answer 07 · Examiner comments

June 2023 | 8462/2H | Original Q8

08.8 Many students gave the answer 'bases' or gave the names of DNA bases. Fewer than one-third responded 'nucleotides'.

08.9 The majority of students (9/10) knew the shape of DNA. A common incorrect response was 'DNA'.

4.7.3.3 Amino acids (HT only)

Answer 08 · Examiner comments June 2025 | 8462/2H | Original Q7

07.1 Although these compounds are clearly identified in the specification, very few had learnt them. Common attempts to give the names included di-ethanol and di-butanoic acid.

07.2 Around 15% of students correctly identified a polyester. The most common incorrect response was for an ester.

07.3 Just over two thirds of students correctly identified water as the small molecule produced during this condensation polymerisation reaction.

07.4 1 in 5 students gained the mark for this item by correctly identifying a polypeptide. Polyglycine was the most common incorrect response, but protein was also seen. The definition of a polypeptide is given in the specification, but many students could not apply the definition to the context given.

07.5 The structural formula of glycine is given in the specification, but only 15% of students were able to recognise that the displayed structure of the carboxylic acid functional group was required. It was expected that all bonds were shown, so -OH was insufficient, when -O-H was required. Many students added bonds to the amine, as well as adding amines to the carbon atom where the carboxylic acid group was required.

07.6 Three quarters of students correctly identified the definition of a protein that is given in the specification.

07.7 Two thirds of students gained all three marks on this familiar application for an unfamiliar polymer. Far fewer students than previously left the double bond between the two carbon atoms. The most common mistake was adding the trailing bonds incorrectly, often not breaking the line of the brackets.

07.8 The description of the structure of a thermosetting polymer was not well known by students with only 1 in 5 gaining any marks on this item. More students knew the idea of cross links between chains than the idea of the structure consisting of long chain molecules. A lot of the incorrect responses were definitions of thermosetting polymers in terms of heating and melting.