AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.2.2.4

Properties of small molecules

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**14**
Available paper years	**2007–2025**

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.

4.2.2.4 Properties of small molecules

Answer 01 · Mark scheme June 2007 | CHY1B | Original Q7 | Legacy

Seven	**1**	**3**	**3**	**2**

Answer 02 · Mark scheme June 2008 | CHY1AP | Original Q4 | Legacy

Four	**2**	**4**	**2**	**2**

Answer 03 · Mark scheme March 2009 | CHY1AP | Original Q6 | Legacy

Six	**3**	**1**	**4**	**2**

4.2.2.4 Properties of small molecules

Answer 04 · Mark scheme

June 2009 | CHY2H | Original Q6 | Legacy

Question 6

question	answers	extra information	mark
6(a)	C H O		
	0.60 0.15 0.40	**1** mark for dividing the correct amount or multiples of correct amount by A_r	1
	12 1 16		
	= 0.05 = 0.15 = 0.025	**1** mark for proportions	1
	2 6 1	**1** mark for whole number ratio – accept any multiple	1
	C_2H_6O	**1** mark for correctly written simplest formula correct formula without working gets only **2** marks correct formula gains full marks provided steps 1 and 2 are correct. ecf can be allowed from step 2 to 3 **or** step 3 to 4 formula can be in any order eg OH_6C_2	1
6(b)	intermolecular forces / bonds		1
	are weak	(covalent) bonds are weak = 0	1
	or		
	forces between molecules **or** bonds between molecules (1)	(attractive) forces are weak = 1	
	are weak (1)	if no marks awarded, allow low boiling point **or** small M_r for **1** mark	

Question 6 continues on the next page…

4.2.2.4 Properties of small molecules

CHY2H

Question 6 Continued

question	answers	extra information	mark
6(c)(i)	to check the safety of the perfume (owtte)	accept references to possible harmful / dangerous effects of perfume **or** possible reactions on skin eg to show it does not damage skin / cause cancer etc. allow to see what it smells like <u>on the skin</u> allow so the company do not have to test on animals	1

Question 6 continues on the next page…

CHY2H

Question 6 Continued

question	answers	extra information	mark
6(c)(ii)	any **two** from: idea from text **linked with** an explanation • the company claim to have tested the product: but we cannot be certain they have **or** how thorough they are **or** how accurately reported • companies did not disclose how they did their tests: so they could not be checked **or** so they could not be shown to be reliable / valid **or** so they could not be repeated • companies may not have repeated their tests: so they may not be reliable • companies do their own tests: so they may be biased **or** so they may not be truthful about their results **or** so they may not be reliable • the companies are using different tests: so the results cannot be compared **or** so results will be different **or** so results will not be fair / valid / reliable • companies would not give false information because of damage to reputation **or** it might lead to litigation	or converse eg companies should disclose how they did their tests so that results can be checked etc. or converse eg independent tests should be done so as to ensure there is no bias etc. or converse eg companies should do the same tests so that the results will be fair etc.	2
Total			**9**

4.2.2.4 Properties of small molecules

Answer 05 · Mark scheme January 2010 | CHY2H | Original Q3 | Legacy

Question 3

question	answers	extra information	mark
3(a)	$^{2}_{1}H$	2 and 1 must be on the left 2 must be above half-way on the H and the 1 below half-way accept diagram with 2 <u>different</u> particles in centre and 1 particle on circle	1
3(b)(i)	18	ignore working ignore units	1
3(b)(ii)	forces (of attraction) between molecules **or** bonding between molecules **or** intermolecular forces /intermolecular bonds are weak **or** not much energy needed to break them **or** easily overcome	 must be linked to first mark if no other mark awarded allow <u>small</u> molecules / small M_r for **1** mark allow forces / bonds are weak for **1** mark do **not** allow covalent bonding is weak	1 1

Question 3 continues on next page

4.2.2.4 Properties of small molecules

CHY2H

Question 3 contd

3(c)	H-2 atoms have 1 proton and 1 neutron H-1 atoms have one proton **or** H-2 atom has one neutron (1) H-1 atom has no neutrons (1)	any reference to <u>more</u> protons = **0** marks allow H-2 has more neutrons / particles for **1** mark allow H-2 has two particles and H-1 has one particle for **1** mark allow H-2 atom has one more neutron for **2** marks **NB** heavy water (molecule) has 2 <u>more</u> neutrons = **2** marks heavy water (molecule) has more neutrons / particles = **1** mark if no other mark awarded then heavy water molecule has M_r of 20 = **1** mark ignore reference to electrons	 1 1
Total			**6**

4.2.2.4 Properties of small molecules

Answer 05 · Mark scheme January 2010 | CHY2H | Original Q3 | Legacy

CHY2H

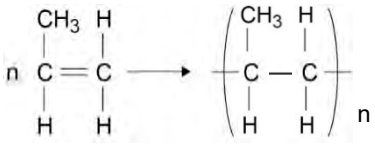
Answer 06 · Mark scheme March 2011 | CHY1BP | Original Q4 | Legacy

Four	**3**	**2**	**3**	**2**

4.2.2.4 Properties of small molecules

Answer 07 · Mark scheme

June 2018 | 8462/2H | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	water	allow H_2O allow hydrogen chloride **or** HCl	1	AO1 4.7.3.2
06.2		an answer of  scores **3** marks		AO2 4.7.3.1
	single C–C bond and nothing added to the trailing bonds		1	
	3 × H and CH_3 correct	must be four single bonds	1	
	n at bottom right		1	
		must be fully correct to score all **3** marks		
06.3	any **two** from: • poly(propene) comes from a non-renewable source • poly(propene) requires a lot of energy to make • poly(propene) is not biodegradable • a wool carpet needs replacing more often • wool requires the use of large areas of land (which could be used to grow food crops)	allow converse arguments allow poly(propene) will run out must refer to the carpet, not just the fibre ignore references to cost ignore pollution ignore landfill	2	AO3 4.10.1.1

4.2.2.4 Properties of small molecules

Answer 07 · Mark scheme

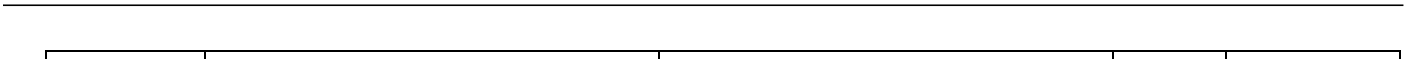
June 2018 | 8462/2H | Original Q6

Question	Answers	Extra information	Mark	AO/ Spec. Ref.
06.4	any **four** from: advantages of polyester • better flame resistance (so burns less easily) • higher melting point (so melts less easily) • absorbs water so less likely to ignite disadvantages of polyester: • high density so uniform is heavy • absorbs water so firefighter gets wet • absorbs water so uniform becomes heavy • justified conclusion	allow converse arguments throughout. **max 3** marks if only advantages or only disadvantages of one type of fibre allow good flame resistance so protects the firefighter allow high melting point so uniform is not damaged	4	AO3 4.7.3.1 4.7.3.2
Total			**10**	

4.2.2.4 Properties of small molecules

Answer 07 · Mark scheme

June 2018 | 8462/2H | Original Q6

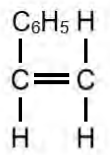


4.2.2.4 Properties of small molecules

Answer 08 · Mark scheme

June 2019 | 8462/2H | Original Q6

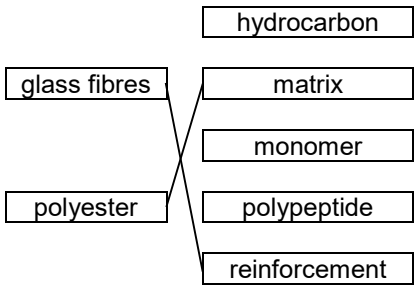
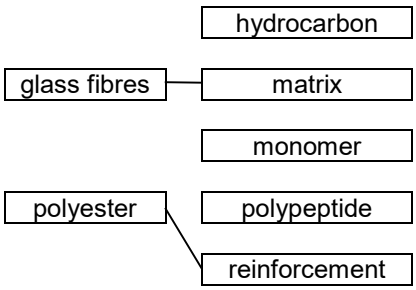
Question 6

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

4.2.2.4 Properties of small molecules

Answer 08 · 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**	

4.2.2.4 Properties of small molecules

Answer 09 · Mark scheme November 2020 | 8462/1H | Original Q1

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	poly(ethene) water		1 1	AO2 4.2.1.4 4.2.2.4 4.2.2.5

Question 1 continued

Question	Answers	Mark	AO/ Spec. Ref
01.2	**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	AO1 4.2.1.2 4.2.1.3 4.2.1.4
	Level 1: Relevant features are identified and differences noted.	1–3	
	No relevant content	0	
	Indicative content • (both) carbon dioxide and silicon dioxide are made up of atoms • (but) magnesium oxide is made up of ions • (both) silicon dioxide and magnesium oxide are giant structures • (but) carbon dioxide is small molecules • with weak intermolecular forces • all three compounds have strong bonds • (both) carbon dioxide and silicon dioxide are formed from two non-metals • (so) bonds formed are covalent • (so) electron (pairs) are shared (between atoms) • (but) magnesium oxide is formed from a metal and a non-metal • (so) bonds in magnesium oxide are ionic • (so) electrons are transferred • from magnesium to oxygen • two electrons are transferred • bonds in silicon dioxide are single bonds • (where) each silicon forms four bonds • (and) each oxygen forms two bonds • (but) in carbon dioxide the bonds are double bonds • (where) carbon forms two double bonds • (and) oxygen forms one double bond ignore properties e.g. melting point, electrical conductivity		

Total			8

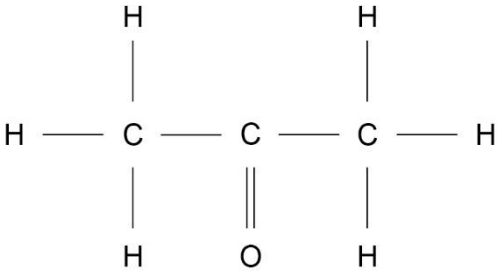
4.2.2.4 Properties of small molecules

Answer 10 · Mark scheme November 2021 | 8462/1H | Original Q1

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	spherical	allow ball-shaped ignore round / circular	1	AO1 4.2.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	any **one** from: • drug delivery (round the body) • hydrogen storage • anti-oxidants • reduction of bacterial growth • catalysts • (cylindrical fullerenes for) strengthening materials • (spherical fullerenes for) lubricants		1	AO1 4.2.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3			1	AO2 4.2.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	C_3H_6O	allow CH_3COCH_3 allow elements in any order	1	AO2 4.2.1.4

Question 1 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	the intermolecular forces are weak		1	AO1 4.2.2.1 4.2.2.4

Question	Answers	Mark	AO/ Spec. Ref
01.6	**Level 3**: Relevant points (reasons/causes) are identified, given in detail and logically linked to form a clear account.	5–6	AO1 4.2.2.6 4.2.3.2
	Level 2: Relevant points (reasons/causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.	3–4	
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2	
	No relevant content	0	
	Indicative content • bonds are covalent • giant / macromolecular structure • three (covalent) bonds per carbon atom **or** only three electrons per carbon atom used in (covalent) bonds • so one electron per carbon atom (is delocalised) • these delocalised electrons • can move through the structure • carrying (electrical) charge • so graphite conducts electricity • layered structure • of (interlocking) hexagonal rings • with weak (intermolecular) forces between layers **or** no (covalent) bonds between layers • so the layers can slide over each other • so graphite is soft and slippery		

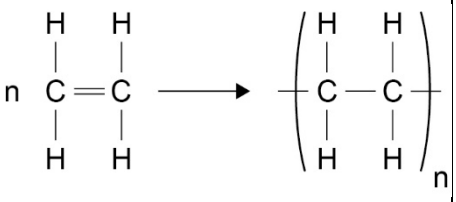
Total			11

4.2.2.4 Properties of small molecules

Answer 11 · Mark scheme

November 2021 | 8462/2H | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1		if equation incorrect allow **1** mark for 5 single bonds **or** allow **1** mark for n	2	AO1 4.7.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2		allow converse statements about thermosetting polymers		
	(poly(ethene)) melts	allow thermosoftening polymers melt	1	AO1
	(so) can be reshaped (into new products)		1	AO3 4.10.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	use different (reaction) conditions	allow use different temperatures / pressures	1	AO1 4.10.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4		allow converse statements about LDPE		AO3 4.10.3.3
	(in HDPE) polymer chains / molecules are closer together	allow (HDPE has) unbranched polymer chains / molecules	1	
	(so) more atoms per unit volume	allow (so) more molecules per unit volume	1	

Question 4 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	circle around HO– **or** –OH on monomer **A**		1	AO2 4.7.2.3 4.7.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6	H_2O **and** HCl	must be in this order	1	AO3 4.7.3.2

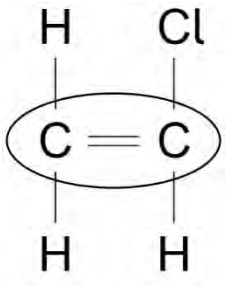
Total			9

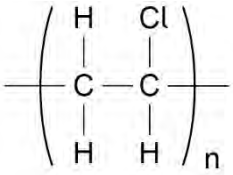
4.2.2.4 Properties of small molecules

Answer 12 · 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

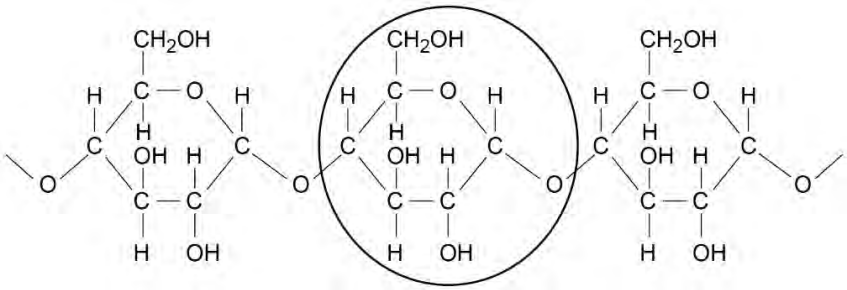
Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.3	composites		1	AO1 4.10.3.3

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

4.2.2.4 Properties of small molecules

Answer 12 · 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

4.2.2.4 Properties of small molecules

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	CaS		1	AO2 4.2.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	calcium (atom) loses electrons		1	AO2 4.2.1.1 4.2.1.2
	sulfur (atom) gains electrons		1	
	reference to transfer of two electrons		1	
	calcium forms positive ions **and** sulfur forms negative ions	allow Ca^{2+} (ions) **and** S^{2-} (ions) are formed allow calcium ions **and** sulfide ions are formed	1	

4.2.2.4 Properties of small molecules

Answer 13 · Mark scheme

Question	Answers	Mark	AO / Spec. Ref.
02.3	**Level 2:** Scientifically relevant facts, events or processes are identified and given in detail to form an accurate account.	3–4	AO1 4.2.1.1 4.2.1.4 4.2.2.6 4.2.3.2
	Level 1: Facts, events or processes are identified and simply stated but their relevance is not clear.	1–2	
	No relevant content	0	
	Indicative content • giant structure • layers • of hexagonal rings • each (carbon) atom forms three bonds • has no covalent bonds between layers • with delocalised electrons • one delocalised electron from each carbon atom • the bonds are covalent • with shared (pairs of) electrons • the (covalent) bonds are strong		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	the molecules do not have an (overall electric) charge	allow there are no ions allow there are no delocalised electrons	1	AO1 4.2.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	poly(ethene) has stronger intermolecular forces to overcome than methane		1	AO1 4.2.2.4 4.2.2.5

Total Question 2	11

4.2.2.4 Properties of small molecules

Answer 14 · Mark scheme

June 2025 | 8462/2H | Original Q7

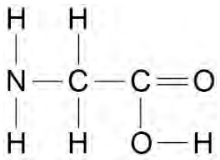
Question 7

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

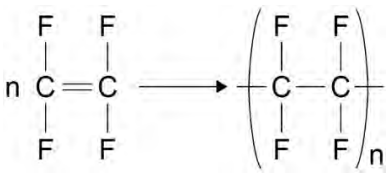
Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4	polypeptide	allow polyamide ignore protein	1	AO1 4.7.3.3

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

4.2.2.4 Properties of small molecules

Answer 14 · 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**

Answer 07 · Examiner comments

June 2018 | 8462/2H | Original Q6

Question 6 (standard / high & high demand)

06.1 There was a variety of incorrect answers for the small molecule lost during condensation polymerisation, some of which were not molecules. However, 56% of students knew the answer was water.

06.2 Of those students who lost marks here, there was no clear-cut marking point that caused the problem. Some students did not make it clear that the bond joined on to the C atom of the methyl group, but were given benefit of the doubt provided it didn't join to the H_3. 28% of students gave faultless answers.

06.3 This question was not answered well, mainly because students did not appreciate that they were making a comparison with both of the fibres used alone.

- Some students restated the question stem by saying 'wool wears out quickly'.
- There was little mention of land usage for wool production or that poly(propene) is not biodegradable.
- There were many uncreditworthy references to cost, and the greater comfort of wool.
- Many students failed to make it clear whether they were talking about the fibre or the carpet, or whether they were comparing the mixed fibre carpet with wool or poly(propene) alone.

Most students who achieved any marks at all (39%) were only able to score one of the available marks.

06.4 This was generally well answered with 99% of students achieving at least one mark. There were various advantages and disadvantages given for the uniform absorbing water as covered by the marking points on the mark scheme (including an advantage of 'it would absorb lots of sweat'). 44% of the students were able to achieve all four marks.

4.2.2.4 Properties of small molecules

Answer 09 · Examiner comments November 2020 | 8462/1H | Original Q1

Question 1 (standard demand)

01.1 Few students scored both marks. Diamond and sodium chloride were both commonly seen incorrect responses.

01.2 Many students were unable to reach the higher marks because they did not make direct comparisons. Instead, they gave separate descriptions of the three compounds. Many also referred to the properties of the compounds, which were not required. The phrase 'intermolecular forces' was used indiscriminately to describe interactions between ions or in giant covalent structures, as well as between molecules.

Answer 10 · Examiner comments November 2021 | 8462/1H | Original Q1

Question 1 (standard demand)

01.1 There were many good answers but some focused on the hexagonal arrangement of bonds rather than the molecule as a whole. Others did not appear to realise the shape is three dimensional and described the molecule as a circle.

01.2 Many students knew the uses as catalysts, for drug delivery round the body, as lubricants' and for strengthening other materials. There were, however, some vague answers such as 'in medicine'.

01.3 This was well done. A few students drew double bonds between all the atoms. Some students did not appear to realise that all they had to do was copy the positions of the atoms and replace each shared pair of electrons with a line.

01.4 This was answered well, although a number of students had two oxygen atoms in their formula. A few appeared to misunderstand the question and gave the relative formula mass.

01.6 Some students gave full, detailed accounts of both properties. The reasons for the slipperiness of graphite were better understood than its electrical conductivity, though many did not refer to the weakness of the forces between the layers. There was some poor use of language in the description of the structure, with atoms, molecules and ions being used interchangeably. A fairly common misconception is that there are gaps between the layers, allowing 'electricity' to somehow slip through. Many students did not seem to appreciate that the electric current is delocalised electrons themselves flowing through the structure.

4.2.2.4 Properties of small molecules

Answer 11 · Examiner comments

November 2021 | 8462/2H | Original Q4

Question 4 (standard, standard / high and high demand)

04.1 Around half of the students either drew five single bonds or wrote ‘n’. Around one third provided a completely correct response.

04.2 Many of the students scored one mark, usually for stating that poly(ethene) melts. The consequence in terms of recycling was less well known.

04.3 How poly(ethene) is produced from ethene was not well known.

04.4 Approaching half of the students scored one mark but only a tiny number scored both. The fact that the chains are closer together or unbranched was well known but not how that linked to density.

04.5 Some students seem to think that any -OH is an alcohol group even if it is part of a carboxylic acid group. Other students circled whole molecules rather than functional groups.

04.6 Very few students were able to use the diagrams to work out that hydrogen chloride was the small molecule formed when a polyester was produced from monomers **A** and **B**.

Answer 12 · 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 12 · Examiner comments

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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'.

Answer 13 · Examiner comments

June 2025 | 8462/1H | Original Q2

Question 2 (standard demand)

02.1 Fewer than half of students could count the ions and realise that the ratio was 1:1 so the formula is CaS. Some tried to do it from the formulae of the ions but often wrote $CaSO_4$. Ca_9S_9 was a common incorrect answer, as was 9CaS. A formula was required, not an equation; equations did not gain credit.

02.2 More than three fifths of students gave fully correct answers, and nearly all scored at least 3 marks. The main omission was not saying what ions were formed. Students sometimes contradicted themselves by describing the atoms sharing electrons as well as those electrons being transferred. Any mention of sharing electrons negated the first three marking points. The correct formula of the sulfide ion was sometimes contradicted by an incorrect name such as 'sulfur ion' or 'sulfate ion'.

02.3 This was well answered by the majority of students, with two thirds reaching level 2. The question discriminated well. Many referred to the giant structure, the layers, the covalent bonds and the delocalised electrons. Fewer referred to the hexagonal rings of carbon atoms, with some incorrectly referring to the layers themselves as hexagonal. Many tried to refer to each carbon atom having three bonds, but some could not express themselves clearly, for example by leaving out the word atom or by implying that the whole structure contained only 3 bonds or 3 atoms. Fewer referred to the strength of the covalent bonds, with some incorrectly saying that covalent bonds are weak. Many also referred to the lack of covalent bonds between layers or the presence of weak intermolecular forces between the layers, but some referred to intermolecular forces without specifying their location. Very few referred to covalent bonds being shared pairs of electrons or to the fact that there is one delocalised electron per carbon atom. Many students introduced properties of graphite, which were not asked for and did not gain credit.

02.4 Very few gave the expected answer, which is the syllabus statement that small molecules do not have an overall electric charge. Some did try to refer to this but were not clear enough; 'they do not have an overall charge' does not necessarily refer to the small molecules since the subject of the sentence was 'substances. More than half did score the mark, but this was usually due to a reference to the lack of delocalised electrons. Some stated that there was no space for delocalised electrons, which is not the same thing and did not gain credit. Some stated that there are no mobile ions, which is ambiguous as it could mean that there are ions, but they are not mobile; this would not be correct.

02.5 Just over a half of students gave the correct reason, with 'poly(ethene) has more covalent bonds to break than methane' being the most popular distractor. Some ticked 2 boxes – usually the first and last; this automatically scores zero when the instruction is to tick **one** box.

4.2.2.4 Properties of small molecules

Answer 14 · 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.