AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.2.3.1

Diamond

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**6**
Available paper years	**2010–2022**

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.

4.2.3.1 Diamond

Answer 01 · Mark scheme

Question 3

question	answers	extra information	mark
3(a)	2,4 (drawn as crosses) on shells	accept dots / e / - etc.	1
3(b)(i)	hard	allow rigid / high melting point do **not** allow references to bonding ignore strong ignore unreactive ignore structure	1
3(b)(ii)	any **three** from • giant structure / lattice / macromolecular • covalent (bonds) • (covalent) bonds are strong • (each) carbon / atom forms four bonds **or** (each) carbon / atom bonded to four other atoms	max **2** if ionic / metallic / molecule / intermolecular bonds **or** incorrect number of bonds allow many bonds accept needs lots of energy to break bonds (owtte)	3

Question 3 continues on the next page

4.2.3.1 Diamond

CHY 2H

Question 3 continued

question	answers	extra information	mark
3(c)	any **three** from: graphite • has delocalised / free electrons **or** electrons that can move through / around the structure • each carbon is joined to three other carbon atoms **or** one electron from each atom is free / delocalised diamond • has no free / delocalised electrons **or** no electrons that move around the structure • all the electrons are used for bonding **or** each carbon joined to four other carbon atoms	max **2** if ionic / ions / metallic / molecule 'it' needs to be qualified do **not** accept the electrons move unless qualified (around structure etc) allow graphite has three bonds do **not** accept the electrons do not move allow diamond has 4 bonds	3
Total			**8**

4.2.3.1 Diamond

Answer 01 · Mark scheme

June 2010 | CHY2H | Original Q3 | Legacy

CHY 2H

4.2.3.1 Diamond

Answer 02 · Mark scheme

Question 1

question	answers	extra information	mark
1(a)	2,4	allow electrons in any position on correct shells	1
1(b)	(electron) 79 neutron 118	 allow phonetic spelling	1 1 1
1(c)(i)	16 **and** 9	in this order	1
1(c)(ii)	any **two** from: • (100% / pure) gold is soft • (alloyed) to make the metal hard(er) • gold is expensive **or** alloy is less expensive	ignore reasons about colour / lustre / corrosion / rarity allow layers can slide in pure gold ignore just 'the ring is an alloy' allow (alloyed) to stop the layers sliding allow (alloyed) to make the metal strong	2
Total			**7**

4.2.3.1 Diamond

Answer 02 · Mark scheme January 2012 | CH1HP | Original Q1 | Legacy

CH1HP

4.2.3.1 Diamond

Answer 03 · Mark scheme

June 2012 | CH2HP | Original Q7 | Legacy

Question 7

question	answers	extra information	mark
7(a)	**Graphite:**	it = graphite	
	because the layers (of carbon atoms) in graphite can move / slide		1
	this is because there are only weak intermolecular forces **or** weak forces between layers	accept Van der Waals' forces allow no covalent bonds between layers	1
	Diamond:		
	however, in diamond, each carbon atom is (strongly / covalently) bonded to 4 others	allow diamond has three dimensional / tetrahedral structure	1
	so no carbon / atoms able to move / slide	allow so no layers to slide **or** so diamond is rigid	1
7(b)	because graphite has delocalised electrons / sea of electrons	allow free / mobile / roaming electrons	1
	which can carry charge / current **or** move through the structure		1
	however, diamond has no delocalised electrons	accept however, diamond has all (outer) electrons used in bonding	1
Total			**7**

UMS Conversion Calculator www.aqa.org.uk/umsconversion

4.2.3.1 Diamond

Answer 04 · Mark scheme

June 2013 | CH2HP | Original Q5 | Legacy

Question 5

question	Answers	extra information	Mark
5(a)	because atoms / ions / particles in alloy are different (sizes)	do **not** allow reference to molecules ignore reference to compounds	1
	so layers distorted		1
	(and layers / atoms / ions / particles) don't slide **or** slide less easily		1
		accept all marking points in a suitably labelled or annotated diagram	
		if no other mark awarded accept an alloy is a mixture **or** contains different metals / elements for **1** mark	
5(b)		max **3** marks if incorrect bonding	
	giant structure **or** lattice **or** macromolecule		1
	strong bonds (between carbon / atoms)		1
	covalent (bonds)		1
	each carbon / atom forms 4 bonds	accept tetrahedral	1
		if no other marks awarded, allow carbon (atoms) for **1** mark	
5(c)		reference to incorrect bonding = max **3**	
		reference to 'weak covalent bonds' = max **2**	
		allow correctly drawn diagram for first two marking points eg. (tangled) lines with no cross-links	
	chains **or** large molecules	ignore layers	1
	with intermolecular forces **or** forces between chains	allow bonds for forces accept no cross-links	1
	that are weak	must relate to 2nd marking point	1
	and are easily overcome/ broken (when heated)	accept molecules / chains can flow / move	1
Total			**11**

4.2.3.1 Diamond

Answer 05 · Mark scheme

June 2016 | CH2HP | Original Q6 | Legacy

Question	Answers	Extra information	Mark	AO / SpecRef
6(a)		reference to incorrect particles **or** incorrect bonding **or** incorrect structure = **max 1**		AO1/AO2 2.2.4a; 2.1.1h
	has delocalised electrons	accept free (moving) electrons	1	
	(so electrons) can move through the structure/metal	accept (so electrons) can carry charge through the structure/metal accept (so electrons) can form a current	1	
6(b)		reference to intermolecular forces/bonds **or** incorrect particles = **max 1**		AO1 2.2.3a,b
	giant structure	accept lattice accept each atom forms four bonds (with other carbon atoms) ignore macromolecular	1	
	strong bonds	accept covalent do **not** accept ionic	1	

Question 6 continues on the next page

4.2.3.1 Diamond

Question 6 continued

6(c)	thermosetting polymers do not melt (when heated) due to cross-links (between chains)	reference to smart polymers = **max 1** accept converse argument accept thermosetting polymers do not change shape (when heated) accept thermosetting polymers have high(er) melting points ignore thermosetting polymers do not soften (when heated) accept due to bonds between chains	1 1	AO1/AO2 2.2.5b
Total			**6**	

4.2.3.1 Diamond

Answer 06 · Mark scheme

June 2022 | 8462/1H | Original Q3

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	giant structure	allow macromolecular allow (giant) lattice	1	AO1 4.2.3.1
	covalent (bonds)		1	
	four bonds per carbon / atom		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	(covalent) bonds are strong		1	AO1 4.2.2.1
	(and many covalent) bonds must be broken		1	4.2.2.6 4.2.3.1
	(so) a lot of energy is required		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	fullerene		1	AO1 4.2.3.3

4.2.3.1 Diamond

Answer 06 · Mark scheme

June 2022 | 8462/1H | Original Q3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	any **one** from: • (C_{70} is) hollow • (C_{70} is) unreactive • (C_{70} is) not toxic • (C_{70} has) a large surface area to volume ratio	ignore references to ease of movement around the body allow (C_{70}) acts as a cage allow (C_{70}) traps the drug	1	AO3 4.2.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	(moles of C_{70} molecules = $\frac{1}{70}$ =) $0.0\dot{1}42857\dot{}$		1	AO2 4.3.2.1
	(molecules =) $0.0\dot{1}42857\dot{} \times 6.02 \times 10^{23}$	allow correct use of an incorrect attempt at the calculation of the number of moles of C_{70} molecules	1	
	$= 8.6 \times 10^{21}$		1	

Total Question 3		11

4.2.3.1 Diamond

Answer 06 · Examiner comments

June 2022 | 8462/1H | Original Q3

Question 3 (Standard, standard/high and high demand)

03.1 This was generally well answered. Some students omitted to mention that diamond is a giant structure, and a few stated that each atom is bonded to three others instead of four, despite the diagram provided. Although the majority of students mentioned covalent bonding, many contradicted themselves by referring to intermolecular forces; these are not present in diamond and negated the mark for covalent bonding.

03.2 There were many excellent answers. However, a large number of students contradicted themselves by referring to ‘strong intermolecular forces’ as well as strong bonds. There are no intermolecular forces in diamond, let alone strong ones. Students sometimes referred to ‘more energy’ required to break the bonds. This did not gain credit as there was no idea of what the energy was being compared with.

03.3 Most students correctly identified the molecule as a fullerene.

03.4 Many students answered correctly in terms of the hollow shape of the molecule. Only a few referred to its non-toxic or unreactive nature. Some students concentrated on the ease of movement of the molecule around the body. This did not gain credit, as this does not explain why the molecule is useful for drug delivery.

03.5 More than a third of students scored all three marks. Partial credit could be obtained by those who attempted to calculate the number of moles of molecules made by 1 mole of carbon atoms, and then multiplying their answer by the Avogadro constant. There were many attempts to calculate various masses or relative molecular masses which were not relevant to the question set.