AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.2.2.6

Giant covalent structures

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**27**
Available paper years	**2008–2025**

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.

4.2.2.6 Giant covalent structures

Answer 01 · Mark scheme

January 2008 | CHY1H | Original Q2 | Legacy

No matching mark scheme was available in the supplied archive for this question.

Answer 02 · Mark scheme

January 2008 | CHY2H | Original Q4 | Legacy

The full source mark scheme begins on page 57. Follow original question 4 in that document.

4.2.2.6 Giant covalent structures

Answer 03 · Mark scheme

June 2008 | CHY2H | Original Q4 | Legacy

question	answers	extra information	mark
4	any **four** points from: • high melting point owtte • <u>many</u> **or** <u>all</u> atoms joined together • each silicon (atom) joined to four oxygen (atoms) **or** each oxygen joined to two silicon • <u>covalent</u> (bonds) • many bonds would need to be broken • strong bonds • lot of energy / heat needed to break bonds • giant / macromolecular / lattice / diamond structure • unreactive • rigid / hard structure • no free electrons • poor conductor of heat	max **3** if ionic / metallic bonding mentioned ignore electrostatic ignore molecules / intermolecular forces ignore boiling point allow hard to break bonds allow high temperature needed to break bonds allow doesn't react with materials within furnace = **1** mark giant covalent structure = **2** marks	4
Total			**4**

4.2.2.6 Giant covalent structures

Answer 03 · Mark scheme

June 2008 | CHY2H | Original Q4 | Legacy

COMPONENT NUMBER: CHY2H

COMPONENT NAME: Additional Science / Chemistry

STATUS: Final

DATE: June 2008

4.2.2.6 Giant covalent structures

Answer 04 · Mark scheme

June 2009 | CHY2H | Original Q4 | Legacy

Question 4

question	answers	extra information	mark
4	**five** ideas from the following for one mark each • each carbon / atom joined / bonded to three other carbon / atoms **or** each carbon forms 3 bonds • in layers • only weak forces (of attraction) / bonds between layers • layers / atoms can slide over each other • one electron on each carbon is not used for bonding • electrons delocalised **or** electrons free • electrons carry the charge / current • giant structure / lattice • covalent (bonds) • strong bonds **or** a lot of energy needed to break bonds	reference to ionic bonding = **max 4** diagrams could be used: • to show layered structure • to show that each carbon is bonded to three other carbon atoms • to show giant structure (at least 3 rings required) allow weak electrostatic / intermolecular forces /bonds between layers allow 'sea' of electrons	5
Total			**5**

4.2.2.6 Giant covalent structures

Answer 04 · Mark scheme

June 2009 | CHY2H | Original Q4 | Legacy

CHY2F

4.2.2.6 Giant covalent structures

Answer 05 · Mark scheme

Question 2

question	answers	extra information	mark
2(a)(i)	any **one** from: • contain metals / filaments / wires • contain other / toxic chemicals / materials • different type of glass	ignore contamination without explanation accept named metal(s) accept named chemical(s) / material(s) accept glass would not melt ignore thicker / thinner glass	1
2(a)(ii)	any **one** from: • (glass bottles are) recycled • need to be more expensive glass **or** strong / thicker / different glass (to be reused) • damaged / weaker (with reuse) • need to be cleaned / transported • different sizes / shapes / colours • no refunds paid	 accept made to be used only once accept glass bottles are made of readily available materials **or** thin / cheap glass accept need to be sorted	1
2(a)(iii)	any **two** from: • low / less energy / heat or lower temperature needed • low / less fuel burned • no (carbon dioxide) from carbonate(s)	allow converse arguments ignore no energy without explanation ignore no fuel without explanation accept less fuel for extraction / transportation of raw materials accept name(s) of this carbonate(s)	2
2(b)(i)	46		1

Question 2 continues on the next page…

CHY1H

Question 2 continued

question	answers	extra information	mark
2(b)(ii)	any **one** from: • (more) imported (as wine bottles) • not much green glass made in the UK • not a high demand (for green glass)	accept come from / made in other countries **or** made elsewhere	1
2(b)(iii)	any **two** from: • more (clear) glass is produced (64%) than recycled (40%) • (clear) glass going to landfill • (more) raw materials needed / extracted / quarried • (more) heat / energy / fuel would be needed • (more) carbon dioxide produced	accept not enough (clear) glass is recycled allow 'thrown away' ignore they will run out accept high carbon footprint / carbon emissions **or** global warming	2
Total			**8**

4.2.2.6 Giant covalent structures

Answer 05 · Mark scheme

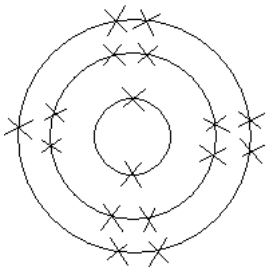
January 2010 | CHY1H | Original Q2 | Legacy

CHY1H

4.2.2.6 Giant covalent structures

Answer 06 · Mark scheme

Question 1

question	answers	extra information	mark
1(a)		accept dots / crosses / e must be drawn on diagram electrons do not need to be paired ignore brackets or + or −charges ignore 2,8,7	1
1(b)	(one) electron lost / given away / transferred from sodium / transferred to chlorine owtte	recognition that electrons are involved must be linked to electrons accept loses electron(s) for **2** marks NB loses 2 or more electrons gains **1** mark reference to sharing / covalent max **1** mark ignore charges on ions formed	1 1
1(c)(i)	any **one** from: • ions / atoms / they are / it is negatively charged / anions • opposite (charges) attract	 accept they are negative accept they are attracted or it is oppositely charged ignore opposite forces attract	1
1(c)(ii)	hydrogen	accept H_2 ignore H or H^+	1

Question 1 continues on next page

CHY2H

Question 1 continued

question	answers	extra information	mark
1(d)(i)	poisons released into environment (owtte)	accept any sensible idea of harm / harmful / poisons / poisonous / pollution / damaging do **not** accept answers such as global warming / ozone layer etc. ignore safety unless qualified	1
1(d)(ii)	any **one** sensible idea eg • loss of work / unemployment **or** company goes out of business • any adverse effect on local economy (owtte) • any adverse effect on paper production / cost of paper / cost of water (treatment) • chlorine (compounds) have been used (for many years) without causing harm owtte • only a tiny amount of chlorine is released so it would not cause harm	eg shops / house prices etc. allow less expensive to use chlorine or converse ignore uses of chlorine to treat drinking water unless qualified	1
1(d)(iii)	ideas related to bias	accept more reliable or valid or fair ignore more accurate / fair test	1
Total			**8**

4.2.2.6 Giant covalent structures

Answer 06 · Mark scheme

January 2010 | CHY2H | Original Q1 | Legacy

CHY2H

4.2.2.6 Giant covalent structures

Answer 07 · Mark scheme January 2010 | CHY2H | Original Q4 | Legacy

Question 4

question	answers	extra information	mark
4(a)	any **four** from:	max **3** marks if any reference made to covalent / ionic bonding / molecules **or** intermolecular forces **or** graphite / diamond **or** forces of attraction between electrons and then ignore throughout	4
	• giant structure / lattice	ignore layers	
	• positive ions		
	• sea of electrons **or** delocalised / free electrons	ignore electrons can move	
	• awareness of outer shell / highest energy level electrons are involved		
	• (electrostatic) attractions / bonds between electrons and positive ions		
	• bonds / attractions (between atoms/ ions) are strong	allow hard to break for strong ignore forces unqualified	
	• a lot of energy / heat is needed to break these bonds / attractions	ignore high temperature	

Question 4 continues on next page

4.2.2.6 Giant covalent structures

CHY2H

Question 4 continued

question	answers	extra information	mark
4(b)(i)	that they are <u>very</u> small **or** 1–100 nanometres **or** a few (hundred) atoms	accept tiny / really small / a <u>lot</u> smaller / any indication of very small eg microscopic, smaller than the eye can see ignore incorrect numerical values if very small is given	1
4(b)(ii)	any **2** from: • one (non-bonded) electron from each atom • delocalised / free electrons • electron carry / form / pass current / charge	 allow sea of electrons ignore electrons can move ignore carry electricity	2
Total			**7**

4.2.2.6 Giant covalent structures

Answer 07 · Mark scheme January 2010 | CHY2H | Original Q4 | Legacy

CHY2H

Answer 08 · Mark scheme March 2010 | CHY1AP | Original Q7 | Legacy

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

4.2.2.6 Giant covalent structures

Answer 09 · Mark scheme

June 2010 | CHY2H | Original Q3 | Legacy

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

4.2.2.6 Giant covalent structures

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**

4.2.2.6 Giant covalent structures

Answer 09 · Mark scheme June 2010 | CHY2H | Original Q3 | Legacy

CHY 2H

4.2.2.6 Giant covalent structures

Answer 10 · Mark scheme

June 2010 | CHY2H | Original Q4 | Legacy

Question 4

question	answers	extra information	mark
4(a)(i)	84 / 84.5 / 83.98	correct answer with or without working gains **3** marks (moles of NaN_3 =) 130/65 (1) moles of nitrogen = 3 (1) mass of nitrogen = 3 x 28 = 84 (1) **or** 2 x (23 + (3 x 14)) (1) 3 x (2 x14) (1) **or** $2NaN_3$ = 130 (1) $3N_2$ = 84 (1) if answer is incorrect then look for evidence of correct working. allow ecf from previous stage **1** mark lost for each mistake in the working if they do not have the correct answer.	3
4(a)(ii)	72 / 72.24 / 72.2 **or** 69 **or** 68.8	allow ecf from part (i) × 0.86 ignore working	1
4(b)(i)	2 **and** 5		1
4(b)(ii)	any **one** from: • corrosive / burns • alkaline / basic • attacks / destroys / damages living tissue / cells	do **not** accept acidic allow irritant ignore reference to reactivity ignore reference to silicates ignore harmful / toxic	1
Total			**6**

4.2.2.6 Giant covalent structures

Answer 10 · Mark scheme June 2010 | CHY2H | Original Q4 | Legacy

CHY 2H

4.2.2.6 Giant covalent structures

Answer 11 · Mark scheme

January 2012 | CH1HP | Original Q1 | Legacy

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**

4.2.2.6 Giant covalent structures

Answer 11 · Mark scheme

January 2012 | CH1HP | Original Q1 | Legacy

CH1HP

4.2.2.6 Giant covalent structures

Answer 12 · Mark scheme

January 2012 | CH1HP | Original Q4 | Legacy

Question 4

question	answers	extra information	mark
4(a)(i)	reduction	accept redox / smelting	1
4(a)(ii)	3 4 3		1
4(b)(i)	55	ignore other units	1
4(b)(ii)	water	accept sodium hydroxide accept correct formulae H_2O or NaOH	1
4(b)(iii)	any **one** from: • save energy / fuel for transporting the ore • (old) quarries nearby for waste/red mud	accept less (cost of) transport allow transported quickly	1

Question 4 continues on the next page …….

CH1HP

Question 4 cont'd…

question	answers	extra information	mark
4(c)	**Environmental** any **one** from: • less mining / quarrying (of bauxite) • less landfill space needed / used • less use of fossil fuels / energy • less carbon dioxide produced **Ethical or social** any **one** from: • saves resources • creates (local) employment • more people aware of the need for recycling	 allow loss of habitat / less qualified noise pollution allow less red mud / waste allow using resources more than once if answers reversed and both correct award **1** mark allow less qualified noise pollution if not given in environmental	1 1
Total			**7**

4.2.2.6 Giant covalent structures

Answer 12 · Mark scheme

January 2012 | CH1HP | Original Q4 | Legacy

CH1HP

4.2.2.6 Giant covalent structures

Answer 13 · 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

4.2.2.6 Giant covalent structures

Answer 14 · Mark scheme

January 2013 | CH2HP | Original Q2 | Legacy

question	answers	extra information	mark
2(a)(i)	because they are positively charged	accept they are positive / H^+ accept oppositely charged **or** opposites attract ignore they are attracted	1
2(a)(ii)	gains one / an electron	accept $H^+ + e^- \rightarrow H$ or multiples allow gains electrons	1
2(b)	3 bonding pairs 1 lone pair	 accept 2 non-bonding electrons on outer shell of nitrogen	1 1
2(c)(i)	hydroxide / OH^-	do **not** accept sodium hydroxide	1
2(c)(ii)	$H^+ + OH^- \rightarrow H_2O$	ignore state symbols ignore word equation	1

4.2.2.6 Giant covalent structures

January 2013

CH2HP

question	answers	extra information	mark
2(d)	Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5.		6

0 marks	**Level 1 (1-2 marks)**	**Level 2 (3-4 marks)**	**Level 3 (5-6 marks)**
No relevant content.	There are basic descriptions of advantages or disadvantages of the electrolysis cells.	There are clear descriptions of environmental or economic advantages or disadvantages of the electrolysis cells. Comparisons may be implied.	There are detailed descriptions of environmental and economic advantages and disadvantages, comparing the electrolysis cells.

examples of chemistry points made in the response:

Accept converse where appropriate.

- mercury cell is more expensive to construct
- mercury is recycled but membranes must be replaced
- mercury is toxic but membrane / polymer is not
- removing traces of mercury from waste is expensive
- mercury cell uses more electricity
- mercury cell produces chlorine that is purer
- mercury cell produces higher concentration / better quality of sodium hydroxide (solution)

Total			**12**

4.2.2.6 Giant covalent structures

Answer 14 · Mark scheme

January 2013

CH2HP

4.2.2.6 Giant covalent structures

Answer 15 · Mark scheme

January 2013 | CH2HP | Original Q6 | Legacy

question	answers	extra information	mark
6		reference to incorrect bonding **or** incorrect particles **or** incorrect structure = max **3**	
	high melting point	accept will not melt (at high temperatures) ignore withstand high temperatures	1
	because a lot of energy needed to break bonds		1
	because it is covalent **or** has strong bonds	accept bonds are hard to break	1
	and because it is a giant structure **or** a macromolecule **or** a lattice	ignore many bonds	1
Total			**4**

4.2.2.6 Giant covalent structures

Answer 15 · Mark scheme

January 2013

CH2HP

4.2.2.6 Giant covalent structures

Answer 16 · 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**

4.2.2.6 Giant covalent structures

Answer 17 · Mark scheme June 2014 | CH2HP | Original Q5 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
5(a)	nanotubes can slide (over each other) because no (covalent) bonds between the nanotubes	allow nanotubes can roll (over each other) *accept weak forces between the nanotubes **or** weak intermolecular forces* *allow layers for nanotubes throughout*	1 1	1 / 2.2.3d	E
5(b)	delocalised electrons *so (delocalised) electrons* can move through the graphite	*accept free electrons* *accept so (delocalised) electrons can carry charge through the graphite*	1 1	1 + 2 / 2.2.3c/e	E
Total			**4**		

4.2.2.6 Giant covalent structures

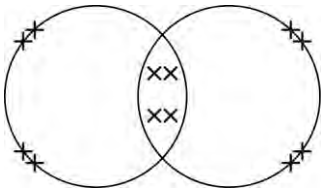
Answer 17 · Mark scheme

June 2014 | CH2HP | Original Q5 | Legacy



4.2.2.6 Giant covalent structures

Answer 18 · Mark scheme June 2014 | CH2HP | Original Q7 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
7(a)	*weaker bonds* ***or*** *fewer bonds* ***or*** *disruption to lattice*	*allow (other substances) react with the silicon dioxide* *ignore weaker / fewer forces* *do **not** accept reference to intermolecular forces / bonds*	1	2 / 2.2.3a	E
7(b)(i)	Na_2O	*do **not** accept brackets or charges in the formula*	1	2 / 2.1	E
7(b)(ii)	 2 bonding pairs 2 lone pairs on each oxygen	*electrons can be shown as dots, crosses, e or any combination* *accept 4 electrons within the overlap* *accept 4 non-bonding electrons on each oxygen*	 1 1	1 / 2.1	E
7(c)	*lattice / regular pattern / layers / giant structure / close-packed arrangement* (of) positive ions **or** (of) atoms (with) delocalised / free electrons	reference to incorrect particles **or** incorrect bonding **or** incorrect structure = max **2**	 1 1 1	1 / 2.1.1h/i	E
Total			**7**		

4.2.2.6 Giant covalent structures

Answer 19 · 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		1	
		accept free (moving) electrons		
	(so electrons) can move through the structure/metal		1	
		accept (so electrons) can carry charge through the structure/metal		
		accept (so electrons) can form a current		
6(b)		reference to intermolecular forces/bonds **or** incorrect particles = **max 1**		AO1 2.2.3a,b
	giant structure	accept lattice	1	
		accept each atom forms four bonds (with other carbon atoms)		
		ignore macromolecular		
	strong bonds	accept covalent	1	
		do **not** accept ionic		

Question 6 continues on the next page

4.2.2.6 Giant covalent structures

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**	

4.2.2.6 Giant covalent structures

Answer 20 · Mark scheme

June 2017 | CH2HP | Original Q3 | Legacy

The full source mark scheme begins on page 72. Follow original question 3 in that document.

4.2.2.6 Giant covalent structures

Answer 21 · Mark scheme June 2018 | 8462/1H | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	solid (zinc chloride) does not conduct (electricity) **or** zinc chloride needs to be in solution **or** molten	allow liquid / aqueous	1	AO1 4.4.3.1
	(because) ions cannot move in the solid **or** (as) ions can (only) move in liquid / solution	do **not** accept references to movement of electrons in zinc chloride	1	
06.2		allow free electrons for delocalised electrons		AO1 4.2.3.2
	each carbon / atom forms 3 (covalent) bonds		1	
	one electron per carbon / atom is delocalised		1	
	(so) these electrons carry charge through the graphite **or** (so) these electrons move through the structure	ignore carry current / electricity	1	
		if no other mark scored, allow **1** mark for delocalised / free electrons		
06.3	use measuring cylinders (instead of test tubes)	allow use burettes allow use (gas) syringes allow Hoffmann voltameter	1	AO3 4.4.3.4
	(because) test tubes cannot measure volume **or** (because) test tubes have no graduations / scale	allow (so that) volume can be measured	1	

4.2.2.6 Giant covalent structures

Answer 21 · Mark scheme

June 2018 | 8462/1H | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	any **three** from: • the volume of hydrogen collected is directly proportional to the time • the rate of collection of hydrogen is 0.45 (cm^3/min) • up to 8 minutes chlorine is collected at an increasing rate • after 8 minutes the rate of collection of chlorine is the same as that of hydrogen **or** after 8 minutes the rate of collection of chlorine is 0.45 (cm^3/min)	allow the (volume of) hydrogen is collected at a constant / steady rate allow any value from 6 to 8 minutes allow initially chlorine is collected at an increasing rate allow any value from 6 to 8 minutes allow after 8 minutes the (volume of) chlorine is collected at a constant / steady rate if neither bullet point 3 nor bullet point 4 is awarded allow **1** mark for chlorine is collected slowly up to 8 minutes and then more quickly allow any value from 6 to 8 minutes	3	AO2 4.4.3.4
06.5	chlorine reacts with water **or** chlorine dissolves (in the solution)		1	AO3 4.3.5 4.4.3.4

4.2.2.6 Giant covalent structures

Answer 21 · Mark scheme

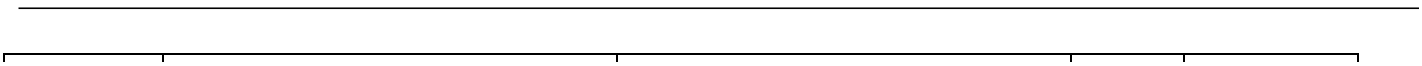
June 2018 | 8462/1H | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.6		an answer of 2.75×10^{-4} (mol) or 2.8×10^{-4} (mol) scores **3** marks an answer of 0.000275 / 0.00028 / 2.75×10^{-1} / 2.8×10^{-1} (mol) / scores **2** marks an incorrect answer for one step does **not** prevent allocation of marks for subsequent steps		AO2 4.3.5
	(volume=) $\frac{6.6}{1000}$ (dm^3) **or** 0.0066 (dm^3)	allow 6.5 (cm^3) for 6.6 (cm^3)	1	
	(moles=) $\frac{0.0066}{24}$	allow use of incorrect volume from step 1	1	
	= 2.75×10^{-4} (mol)	allow 2.8×10^{-4} (mol) allow answer from incorrect calculation given in standard form alternative approach for marking points 1 and 2 24 dm^3 = 24 000 cm^3 (1) (moles =) $\frac{6.6}{24\,000}$ (1)	1	
Total			**14**	

4.2.2.6 Giant covalent structures

Answer 21 · Mark scheme

June 2018 | 8462/1H | Original Q6



4.2.2.6 Giant covalent structures

Answer 22 · 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		

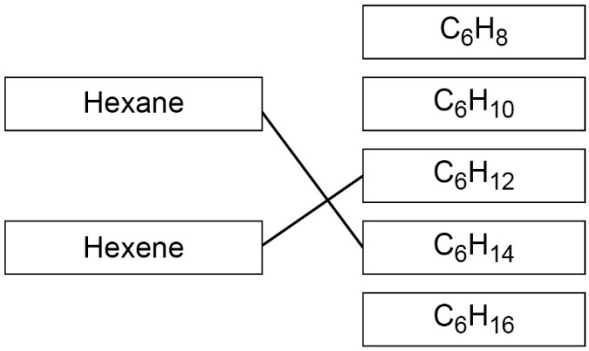
Total			8

4.2.2.6 Giant covalent structures

Answer 23 · Mark scheme

November 2020 | 8462/2H | Original Q3

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	 additional line from a box on the left negates the mark for that box		1 1	AO2 4.7.1.1 4.7.2.1
03.2	(remains) orange (becomes) colourless	must be in this order allow no (colour) change ignore initial colour ignore clear	 1 1	AO2 4.7.1.4

Question 3 (continued)

Question	Answers	Mark	AO/ Spec. Ref
03.3	**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 AO2
	Level 1: Relevant features are identified and differences noted.	1–3	
	No relevant content	0	4.7.1.1 4.7.1.3 4.7.1.4 4.7.2.1 4.7.2.2 4.9.3.1
	Indicative content **Structure and bonding** • both are hydrocarbons • both contain two carbon atoms (per molecule) • ethane contains six hydrogen atoms (per molecule) • (but) ethene contains four hydrogen atoms (per molecule) • both have covalent bonds • ethane contains a single C—C bond • (but) ethene contains a double bond • both contain C—H bonds • both small molecules **Reactions** • both react with oxygen in complete combustion reactions • to produce water and carbon dioxide • both react with oxygen in incomplete combustion reactions • to produce water, carbon monoxide and carbon • incomplete combustion is more likely with ethene • ethene decolourises bromine water • (but) ethane does not decolourise bromine water • ethene is more reactive (than ethane) • ethene can react with hydrogen (to produce ethane) • ethene can react with water (to produce ethanol) • ethene can react with halogens (to produce halogenoalkanes) • ethene can undergo addition reactions • ethene can polymerise (to produce poly(ethene)) ignore physical properties ignore references to flammability		

Total			10

4.2.2.6 Giant covalent structures

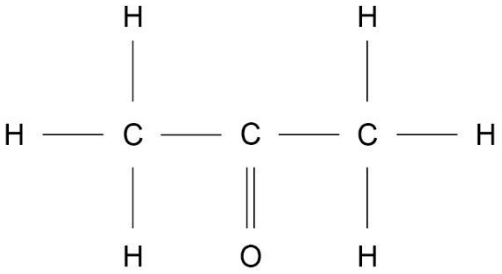
Answer 24 · Mark scheme

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

4.2.2.6 Giant covalent structures

Answer 25 · 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

4.2.2.6 Giant covalent structures

Answer 25 · 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

4.2.2.6 Giant covalent structures

Answer 26 · Mark scheme

June 2022 | 8462/1H | Original Q7

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	silicon is less reactive than carbon (because) carbon displaces silicon (from silicon dioxide)	ignore references to hydrogen allow converse allow silicon is below carbon (in the reactivity series) ignore (because) carbon reduces silicon dioxide	1 1	AO3 4.4.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	more energy is needed (to obtain aluminium) (because) aluminium is obtained (from aluminium oxide) by electrolysis	ignore references to electricity	1 1	AO3 4.4.1.3 4.4.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	both products are solid		1	AO3 4.4.1.3

4.2.2.6 Giant covalent structures

Answer 26 · Mark scheme

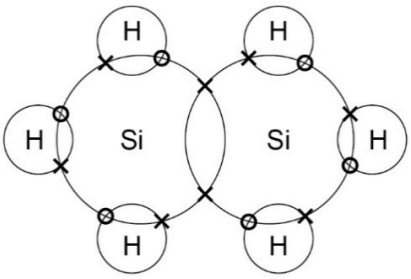
June 2022 | 8462/1H | Original Q7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4	(M_r of SiO_2 = 28 + (2 × 16)) = 60		1	AO2 4.3.1.2 4.3.2.1 4.3.2.2
	(conversion 1.2 kg =) 1200 (g)		1	
	(number of moles of SiO_2 = $\frac{1200}{60}$) = 20	allow correct use of an incorrectly converted or unconverted mass of SiO_2 allow correct use of an incorrectly calculated M_r of SiO_2	1	
	(number of moles of Mg = 20 × 2) = 40	allow correct use of an incorrectly calculated number of moles of SiO_2	1	
	(mass of Mg = 40 × 24) = 960 (g)	allow correct use of an incorrectly calculated number of moles of Mg	1	
	alternative approach:			
	(M_r of SiO_2 = 28 + (2 × 16)) = 60 (1)			
	48 g Mg reacts with 60 g SiO_2 (1)	allow correct use of an incorrectly calculated M_r of SiO_2		
	(conversion 1.2 kg =) 1200 (g) (1)			
	48 × $\frac{1200}{60}$ (g Mg reacts with 1200 g SiO_2) (1)	allow correct use of an incorrectly calculated mass of Mg and / or incorrectly converted or unconverted mass of SiO_2		
	= 960 (g) (1)			

4.2.2.6 Giant covalent structures

Answer 26 · Mark scheme

June 2022 | 8462/1H | Original Q7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.5		allow any combination of x, •, o, $e^{(-)}$ for electrons	1	AO2 4.2.1.4

4.2.2.6 Giant covalent structures

Answer 26 · Mark scheme

June 2022 | 8462/1H | Original Q7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.6	(volume of oxygen for 30 cm^3 Si_2H_6 = 3.5 × 30) = 105 (cm^3)		1	AO2 4.3.2.4 4.3.5
	(volume of excess oxygen = 150 – 105) = 45 (cm^3)	allow correct use of an incorrectly calculated volume of oxygen for 30 cm^3 Si_2H_6	1	
	(volume of water (vapour) = 3 × 30) = 90 (cm^3)		1	
	(volume of gases = 45 + 90) = 135 (cm^3)	allow correct use of incorrectly calculated volumes of excess oxygen and / or water vapour	1	
	allowed alternative approach: (moles Si_2H_6 = $\frac{0.03}{24}$ =) 0.00125 (1)			
	(moles water vapour formed = 3 × 0.00125 =) 0.00375 **and** (moles oxygen used = 3.5 × 0.00125 =) 0.004375 (1)	allow correct use of an incorrectly calculated number of moles of Si_2H_6		
	(moles excess oxygen = $\frac{0.15}{24}$ - 0.004375 =) 0.001875 (1)	allow correct use of an incorrectly calculated number of moles of oxygen used		
	(volume of gases = 24 × (0.00375 + 0.001875) = 0.135 dm^3 =) 135 (cm^3) (1)	allow correct use of an incorrectly calculated number of moles of excess oxygen and / or moles of water vapour formed		

Total Question 7		15

4.2.2.6 Giant covalent structures

Answer 27 · Mark scheme

June 2025 | 8462/1H | Original Q2

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	

4.2.2.6 Giant covalent structures

Answer 27 · 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

4.2.2.6 Giant covalent structures

Version 1.0: 0108

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Additional Science 4463 / Chemistry 4421

CHY2H Unit 2 Chemistry

Mark Scheme

2008 examination – January series

4.2.2.6 Giant covalent structures

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this Mark Scheme are available to download from the AQA Website: www.aqa.org.uk

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4.2.2.6 Giant covalent structures

MARK SCHEME

Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following lines is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. (Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.)

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which candidates have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error/contradiction negates each correct response. So, if the number of error/contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

4.2.2.6 Giant covalent structures

Example 1: What is the pH of an acidic solution? (1 mark)

Candidate	Response	Marks awarded
1	4,8	0
2	green, 5	0
3	red*, 5	1
4	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Candidate	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a candidate writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Full marks can be given for a correct numerical answer, as shown in the column 'answers', without any working shown.

However if the answer is incorrect, mark(s) can be gained by correct substitution / working and this is shown in the 'extra information' column;

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Unexpected Correct Answers not in the Mark Scheme

The Examiner should use professional judgement to award credit where a candidate has given an unexpected correct answer which is not covered by the mark scheme. The Examiner should consult with the Team Leader to confirm the judgement. The Team Leader should pass this answer on to the Principal Examiner with a view to informing all examiners.

4.2.2.6 Giant covalent structures

CHY2H

Question 1

question	answers	extra information	mark
(a)	sensible line of best fit which goes through or close to all the points **except** the anomalous point	allow wobbly / short double lines ± ½ square	1
(b)	loss of gas / loss of CO_2	idea of gas produced / formed	1
(c)	7		1
(d)(i)	steeper line from around the same starting point and left of the points levelling off at 99	allow crosses if they are fully correct for **1** mark accept short level line at 99 ± ½ square	1 1
(d)(ii)	any **three** from: • particles / molecules / atoms/ ions have more energy • move faster • collide more often **or** more chance of collisions **or** bump into each other more • collide with more force / energy **or** more particles have the activation energy **or** more collisions result in reaction **or** more collisions are successful	 allow given / gain / get energy ignore move about more ignore vibrate more / faster ignore collide quicker / faster	3
total			8

4.2.2.6 Giant covalent structures

CHY2H

Question 2

question	answers	extra information	mark
(a)	any **one** from: • they are made of layers • atoms / ions / particles / layers (of atoms) can slide over each other	do **not** accept line / rows / lattice	1
(b)	any **one** from: • smaller / tiny **or** very small • correct size range 1 to 100 nanometres • a few hundred atoms in size	do **not** allow small alone if they state smaller and give a size outside range ignore size if it is less than 20,000	1
(c)	harder plus **one** from: • so does not wear as quickly / erode as quickly • less vulnerable to damage owtte • because they have a high surface area to volume ratio **or** stronger (1) plus **one** from: (1) • less likely to break / do not break • not as vulnerable to damage owtte • do not bend out of shape • because they have a high surface area to volume ratio	ignore corrode harder to wear down = **1** mark accept withstand pressure harder and stronger alone gains **1** mark	1 1
total			4

4.2.2.6 Giant covalent structures

CHY2H

Question 3

question	answers	extra information	mark
(a)	N_2O		1
(b)	13.8 to 14	gains full marks without working if answer incorrect 13 gains **1** mark **or** 14/101 × 100 gains **1** mark	2
total			3

4.2.2.6 Giant covalent structures

CHY2H

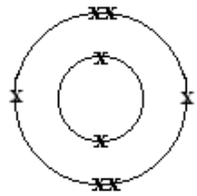
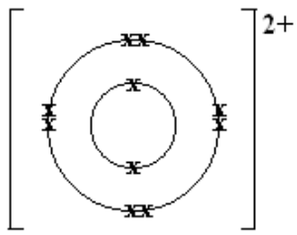
Question 4

question	answers	extra information	mark
(a)	electric current / electricity		1
	plus **one** from:		1
	• is passed through ionic compound / substance / electrolyte • passed through molten/aqueous compound / substance	must be linked to electricity allow liquid compound / substance do **not** allow solution / liquid alone	
	• causing decomposition	accept split up / breakdown / breaking up owtte ignore separated accept elements are formed ignore new substances form	
(b)	hydrogen	accept H_2 do **not** accept H / H^2	1
(c)	one electron from each atom	accept each carbon is bonded to three other carbon atoms leaving one (unbonded) electron owtte	1
	is delocalised / free (to move)	must be linked to electrons answers of delocalised / free electrons only, gains **1** mark accept each carbon is bonded to three other carbon atoms leaving delocalised / free electrons = **2** marks **maximum 1** mark if graphite described as a metal / giant ionic lattice	1
total			5

4.2.2.6 Giant covalent structures

CHY2H

Question 5

question	answers	extra information	mark
(a)	any **one** from: • gives out heat / energy • transfers energy from a substance to the surroundings • ΔH / energy change / enthalpy change is negative	accept releases / gives off owtte ignore references to light	1
(b)	$2Mg + O_2 \rightarrow 2MgO$	accept correct multiples / fractions	1
(c)		electrons do not need to be paired accept dots / circles / e instead of crosses do **not** allow 2.6 without diagram	1
(d)		electrons do not need to be paired allow without brackets must have the charge accept dots / circles / e instead of crosses ignore extra empty outer shells ignore nucleus do **not** allow $[2.8]^{2+}$ without diagram	1

continued…

4.2.2.6 Giant covalent structures

CHY2H

Question 5 continued…

question	answers	extra information	mark
(e)	oppositely charged (ions / atoms)	allow positive and negative(ions / atoms)	1
	(they) attract	must be in correct context accept held by electrostatic forces ignore ionic bonding **maximum 1** if they refer to intermolecular forces / attractions / covalent bonds	1
(f)	magnesium chloride	accept $MgCl_2$ (if correctly written)	1
total			7

4.2.2.6 Giant covalent structures

CHY2H

Question 6

question	answers	extra information	mark
(a)	**Compound A** any **one** from: • sodium bromide • potassium bromide • ammonium bromide • hydrogen bromide • any metal bromide except silver and lead. **Compound B** silver nitrate	accept correct formulae accept silver sulfate	1 1
(b)	the silver compound will decompose / silver ions be reduced to silver (owtte)	accept film would darken owtte accept any idea of light changing silver bromide / silver ions / silver nitrate / silver sulfate allow 'forms a black solid' / it would turn black	1
(c)	precipitation	accept descriptions of precipitation reactions accept double decomposition accept precipitate do **not** allow displacement	1
(d)	electrons are gained	 the second mark **must** be linked to electrons accept it / silver / silver ions gains electrons for **both** marks ignore references to oxygen	1 1
total			6

4.2.2.6 Giant covalent structures

CHY2H

Question 7

question	answers	extra information	mark
(a)	1213.8 to 1214.3 correct answer not given then check working 1) moles of $N_2 = \frac{1000}{28}$ $= 35.7$ mol 2) moles of $NH_3 = 2 \times$ (answer from (1)) $= 71.4$ mol 3) mass of NH_3 = (answer from 2) × 17 $= 71.4 \times 17 = 1214$ g **or** • 28g of $N_2 \rightarrow 34$g of NH_3 • 1g of $N_2 \rightarrow \frac{34}{28}$ $= 1.214$g NH_3 • 1000 g of $N_2 \rightarrow 1000 \times 1.214$ $= 1214$g **or** • $1000 \times \frac{34}{28}$ **or** **other correct methods**	gains **3** marks without working **1** mark for each correct step do **not** penalise rounding errors in this part **1** mark for each correct step do **not** penalise rounding errors in this part allow error carried forward eg gains **2** marks if correct answer not given $1000 \times \frac{28}{34}$ gains **1** mark, **2** marks if correctly calculated (823.5g) $1000 \times \frac{28}{17}$ gains **1** mark if calculated correctly (1647.05g) look for the key ideas in the methods above	3

continued…

4.2.2.6 Giant covalent structures

CHY2H

Question 7 continued…

question	answers	extra information	mark
(b)	25 / 25.035 **or** ecf from (a)	gains **2** marks even when there is no working incorrect answer then 304/(their answer from (a)) × 100 gains **1** mark	2
	or using figures from part (b)		
	27.6 / 28	gains **2** marks even when there is no working accept 27 for **1** mark if answers incorrect then304/1100 × 100 gains **1** mark	
(c)(i)	increase yield		1
	reaction is exothermic		1
	or		
	allow decreased yield because rate of reaction is slower / fewer collisions for **2** marks	**must** get both points for **2** marks	
(c)(ii)	increase yield		1
	plus **one** from: • more (gaseous) reactant molecules than (gaseous) product molecules (owtte) • increased rate of reaction / more collisions	accept greater volume on the left than the right owtte	1

continued…

4.2.2.6 Giant covalent structures

CHY2H

Question 7 continued…

question	answers	extra information	mark
(d)	any **one** from: **economic** • large town provides workforce • workers do not have to travel far to the factory. (owtte) • transport infrastructure already in place for large town. (owtte) • factory brings prosperity to town (owtte) • factory provides employment • reduced tourism • reduction in local house prices • any other sensible economic factor linked to town		1
	any **one** from: **safety** • escape of dangerous / harmful chemicals / gases (owtte) • danger of increased traffic • risk of explosion.(owtte) /danger of high pressure • consequences of an accident could be severe if the town is close • any other sensible safety idea	do **not** allow polluting gases unqualified	1

continued…

4.2.2.6 Giant covalent structures

CHY2H

Question 7(d) continued…

question	answers	extra information	mark
	any **one** from: **environmental** • factory might be unsightly (owtte) • screening of factory (owtte) • loss of habitats (owtte) • plant trees/ hedges etc on and around plant site • pollution of water / air / soil could harm plants / animals **or** noise pollution • CO_2 is produced by burning fuels / heating • CO_2 causes global warming / any effect of global warming • eye sore • any other sensible environmental factor	must be explained	1
total			12

4.2.2.6 Giant covalent structures

GCSE

Additional Science / Chemistry

CH2HP
Final Mark scheme

4408 / 4402
June 2017

Version/Stage: v1.0

4.2.2.6 Giant covalent structures

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from aqa.org.uk

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4.2.2.6 Giant covalent structures

Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded
- the Assessment Objectives and specification content that each question is intended to cover.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.
At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.
In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening and underlining

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**.
Different terms in the mark scheme are shown by a / ; eg allow smooth/free movement.

2.4 Any wording that is underlined is essential for the marking point to be awarded.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error/contradiction negates each correct response. So, if the number of error/contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution?

[1 mark]

Student	Response	Marks awarded
1	green, 5	0
2	red*, 5	1
3	red*, 8	0

4.2.2.6 Giant covalent structures

Example 2: Name two planets in the solar system.

[2 marks]

Student	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, Sun, Mars, Moon	0

3.2 Use of chemical symbols/formulae

If a student writes a chemical symbol/formula instead of a required chemical name, full credit can be given if the symbol/formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Full marks can be given for a correct numerical answer, without any working shown. However, if the answer is incorrect, mark(s) can be gained by correct substitution/working and this is shown in the 'extra information' column or by each stage of a longer calculation.

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only. Papers should be constructed in such a way that the number of times errors can be carried forward are kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation 'ecf' in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Accept/allow

Accept is used to indicate an equivalent answer to that given on the left-hand side of the mark scheme. Allow is used to denote lower-level responses that just gain credit.

3.9 Ignore/Insufficient/Do not allow

Ignore or insufficient is used when the information given is irrelevant to the question or not enough to gain a marking point. Any further correct amplification could gain the marking point.
Do **not** allow means that this is a wrong answer which, even if the correct answer is given, will still mean that the mark is not awarded.

4 Quality of Written Communication and levels marking

In Question 2 students are required to produce extended written material in English, and will be assessed on the quality of their written communication as well as the standard of the scientific response.

Students will be required to:
- use good English
- organise information clearly
- use specialist vocabulary where appropriate.

The following general criteria should be used to assign marks to a level:

Level 1: Basic

- Knowledge of basic information.
- Simple understanding.
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail.
- The spelling, punctuation and grammar are very weak.

Level 2: Clear

- Knowledge of accurate information.
- Clear understanding.
- The answer has some structure and organisation, use of specialist terms has been attempted but not always accurately, some detail is given.
- There is reasonable accuracy in spelling, punctuation and grammar, although there may still be some errors.

Level 3: Detailed

- Knowledge of accurate information appropriately contextualised.
- Detailed understanding, supported by relevant evidence and examples.
- Answer is coherent and in an organised, logical sequence, containing a wide range of appropriate or relevant specialist terms used accurately.
- The answer shows almost faultless spelling, punctuation and grammar.

4.2.2.6 Giant covalent structures

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1(a)(i)	a smooth curve through or close to all points except (30,12)		1	AO2 2.4
1(a)(ii)	correct reading from the curve in 1(a)(i) (cm^3)	allow a tolerance of +/- 0.5 cm^3	1	AO2 2.4
1(a)(iii)	45-50 (seconds)		1	AO3 2.4
1(a)(iv)	line becomes less steep because gas is produced more slowly	ignore line levels out or plateaus allow examples with figures, eg 12 cm^3 gas from 0 to 20s but 1.5 cm^3 gas in last 20s ignore reaction has stopped or no more gas produced	1 1	AO3 2.4
1(a)(v)	0.6 (cm^3 per second)	allow 0.55 to 0.65	1	AO2 2.4
1(b)(i)	 temperature volume (of hydrogen peroxide)	concentration of hydrogen peroxide = max **1** ignore amount (of hydrogen peroxide)	 1 1	AO3 2.4
1(b)(ii)	 rate increases because more particles (in the same volume) so frequency of collisions increases	incorrect reference to energy = max **2** accept particles closer together allow greater chance of collisions ignore more collisions	 1 1 1	AO1 2.4.1e

4.2.2.6 Giant covalent structures

1(c)	(increasing the amount of catalyst) increases rate same final volume of gas	accept steeper graph or graph levels off earlier	1 1	**AO2** 2.4.1g
Total			**13**	

4.2.2.6 Giant covalent structures

<table>
<tr><th>Question</th><th>Answers</th><th>Extra information</th><th>Mark</th><th>AO / Spec. Ref.</th></tr>
<tr><td>2</td><td></td><td></td><td>6</td><td rowspan="6">AO1
2.1.1h
2.2.4b,c
2.2.5a,b</td></tr>
<tr><td colspan="4">Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5 and apply a ‘best-fit’ approach to the marking.</td></tr>
<tr><td colspan="4"><table>
<tr><th>0 marks</th><th>Level 1
(1–2 marks)</th><th>Level 2
(3–4 marks)</th><th>Level 3
(5–6 marks)</th></tr>
<tr><td>no relevant information given</td><td>a statement about the structure or a property of a metal
or
a statement about the structure or a property of a polymer</td><td>a statement about the structure or a property of a metal
and
a statement about the structure or a property of a polymer</td><td>a statement about the structure or a property of a metal
and
a statement about the structure or a property of a polymer
and
at least one statement linking structure and property</td></tr>
</table></td></tr>
<tr><td colspan="4">Statements shown as HT only are credited on both FT and HT.
However, HT only means that these statements are not expected in a FT answer.</td></tr>
<tr><td colspan="4">Examples of chemistry points made in response

Metal:

Properties
shiny
hardness
(tensile) strength
melting point/boiling point
density
malleable/flexible
ductile
conduct electricity or thermal energy</td></tr>
</table>

4.2.2.6 Giant covalent structures

Structure • metals contain atoms /((positive) ions HT only) • (the atoms/(positive) ions/particles are) closely packed / in a regular pattern / in a giant structure/in layers / in a lattice • strong bonds/(electrostatic attractions HT only) • (metal has delocalised electrons HT only) **Polymer:** **Properties** • flexible • melting/boiling point • density • can be shaped/moulded • poor conductor of electricity or thermal energy **Structure** • polymer consists of chains • polymer chains may be tangled • polymer has no cross links. • (polymer has weak intermolecular forces HT only) **Level 3:** **Examples of linked statements:** • metal can be bent and shaped because the layers can slide • some metals are soft because layers can slide • some metals are hard because they have strong bonds and/ or (the atoms/(positive) ions/particles) are closely packed / in a regular pattern / in a giant structure/ in a lattice • metal has high melting/boiling point because they have strong bonds and/ or (the atoms/(positive) ions/particles) are closely packed / in a regular pattern / in a giant structure / in a lattice • metal is strong because of strong bonds • some metals are dense because the atoms are closely packed • (metal can conduct thermal energy and electricity because metal has delocalised electrons HT only) • thermosoftening polymer melts when heated because it has no cross-links (or has weak intermolecular forces HT only) • thermosoftening polymer is flexible because the chains can move over each other	

Total			**6**

4.2.2.6 Giant covalent structures

Question	Answers	Extra Information	Mark	AO / Spec. Ref
3(a)(i)	2 bonding pairs 4 unbonded electrons on each atom	accept dots, crosses, e, - or any combination ignore any electrons on any inner shells if no other mark awarded allow **1** mark for 1 bonding pair and 6 unbonded electrons on each atom	1 1	**AO2** 2.1.1g
3(a)(ii)	covalent	allow convalent and covelant ignore single or double ignore shared, shared bond or sharing	1	**AO1** 2.1.1g
3(a)(iii)	weak intermolecular forces require little energy to overcome	reference to weak covalent or weak ionic bonds = **0** accept weak intermolecular bonds MP2 dependent on MP1 if no other mark awarded allow 1 mark for simple/small molecules	1 1	**AO1** **AO2** 2.2.1a,b

4.2.2.6 Giant covalent structures

3(b)(i)	**2** Mg + O_2 → **2** MgO	accept multiples	1	**AO2** 2.2.2
3(b)(ii)		reference to incorrect particles **or** incorrect bonding **or** incorrect structure = max **2**		**AO1** **AO2** 2.1.1a,b,c,f
	magnesium loses (electrons) **and** oxygen gains (electrons)		1	
	two (electrons transferred)		1	
	noble gas structure **or** 8 electrons in outer shells **or** (electrostatic) attraction between ions **or** forms ionic bonds	accept full outer shell (of electrons)	1	
3(b)(iii)	particles 1-100 nm in size	accept contain a few hundred atoms/ions accept have a high surface area to volume ratio ignore reference to (very) small particles do **not** accept smaller than an atom/ion	1	**AO1** 2.2.6a

4.2.2.6 Giant covalent structures

3(c)	has a high melting point	allow will not melt allow a lot of energy needed to melt ignore boiling point reference to incorrect particles or incorrect bonding or incorrect structure = max **1** from MP2 and MP3	1	**AO1** **AO2** 2.2.3a
	because all atoms linked to other atoms	allow giant structure/lattice ignore many bonds	1	
	by covalent bonds	allow strong bonds allow a lot of energy needed to break bonds accept giant covalent structure for MP2 and MP3	1	
Total			**13**	

4.2.2.6 Giant covalent structures

Question	Answers	Extra Information	Mark	AO / Spec. Ref
4(a)	add copper oxide and (sulfuric) acid		1	**AO1** **AO2** 2.6.1b,c
	excess (copper oxide)		1	
	filter (to remove excess)	ignore impurities	1	
	heat /boil / evaporate / leave (to crystallise)	do **not** accept to dryness	1	
4(b)	(M_r CuO =) 79.5		1	**AO2** 2.3.3c
	24.95/249.5 **or** 0.1 **OR** 79.5/249.5 **or** 0.3186…	allow ecf for M_r CuO from step 1 allow correct rounding to min 2SF	1	
	(24.95/249.5 x 79.5=) 7.95	allow ecf for M_r CuO from step 1 allow ecf from step 2 of incorrect calculation/ rounding of correct ratio allow correct rounding to min 2SF correct answer with or without working gains 3 marks	1	
4(c)(i)	as wealth decreases, ethene production decreases (with the exception of country C or D)	accept converse	1	**AO2** **AO3** 2.6
	sulfuric acid production is not linked to wealth		1	

4.2.2.6 Giant covalent structures

4(c)(ii)	use of products of ethene has increased	allow use of polymers / plastics / ethanol / poly(ethene) has increased ignore use of ethene as a (bio)fuel ignore cost	1	**AO3** 2.2.5
Total			**10**	

4.2.2.6 Giant covalent structures

Question	Answers	Extra Information	Mark	AO / Spec. Ref
5(a)(i)	draw line on paper put (dots of) inks on line place (bottom of) paper in solvent / water any **one** from: line drawn in pencil allow dots of ink to dry line above solvent lid		1 1 1 1	**AO1** 2.3.2b
5(a)(ii)	any **two** from: • A has 3 colours **and** B has 4 colours • 2 colours are the same • **A** has 1 colour not in **B and B** has 2 colours not in **A**	accept 3 colours are different if no other mark awarded allow **one** more colour in ink **B** than in ink **A** (or converse)	2	**AO3** 2.3.2b
5(b)(i)	substances carried by gas through column / tube / coil (packed with solid) (different substances move through the column) at different speeds	 accept (different) substances come out at different times or have different retention times	1 1 1	**AO1** 2.3.2c
5(b)(ii)	(relative) molecular mass	allow (relative) formula mass allow RFM, RMM, M_r	1	**AO1** 2.3.2c
Total			**10**	

4.2.2.6 Giant covalent structures

Question	Answers	Extra Information	Mark	AO / Spec. Ref
6(a)(i)	tick (✓) by: the initial temperature reading was too low		1	**AO3** 2.5
6(a)(ii)	the reaction is exothermic	allow energy is given out	1	**AO3** 2.5.1b
6(b)(i)	(positive/hydrogen) ions gain electrons hydrogen is below sodium in the reactivity series so hydrogen / H_2 is produced	accept (positive/hydrogen) ions are reduced accept reference to high reactivity of sodium If no other mark awarded allow hydrogen (and sodium) ions **or** positive ions are attracted to negative electrode for **1** mark	1 1 1	**AO1** **AO2** 2.7.1c,f,i
6(b)(ii)	**2** (Cl^-) → **Cl_2 + 2e^-**	must be completely correct allow multiples	1	**AO1** 2.7.1g
6(b)(iii)	solution is alkaline because sodium hydroxide / NaOH is produced **or** sodium hydroxide / NaOH is left over	accept hydroxide (ions) / OH^- is produced **or** hydroxide (ions) / OH^- is left over	1 1	**AO1** **AO2** 2.7.1i; 2.6.2d
Total			**8**	

4.2.2.6 Giant covalent structures

Answer 21 · Examiner comments

June 2018 | 8462/1H | Original Q6

Question 6 (standard, standard / high and high demand)

06.1 Students found it difficult to score both marks on this question, although 77% of students scored one or more marks. Lower-attaining students simply stated that the electrolyte was a solid, without further explanation. Others incorrectly referred to the movement of delocalised electrons, rather than ions. Some refereed to zinc instead of zinc chloride.

06.2 Students struggled to put sufficient detail into their answers, although no more was required than what is directly stated in the specification. 9% of students achieved all three marks.

A lot of weakly expressed ideas were seen. Instead of stating that each atom forms three covalent bonds, many students stated that graphite has three covalent bonds, or that three out of four carbon atoms are bonded, both of which are untrue.

Very few said that each carbon atom has one delocalised electron: a statement directly from the specification. Those who did score the marks for the structure often didn't say that delocalised electrons move or carry charge **through** the structure. They often implied the delocalised electrons just moved around at random. Many students misunderstood the process of electrical conductivity completely, thinking that it is something to do with layers sliding over each other.

Some students referred to other properties such as softness, instead of confining their answer to the question posed.

06.3 58% of students did not achieve a mark for this question. The investigation was stated to be about the relationship between volume and time, but the diagram showed no means of measuring volume. The expected answer was to use inverted measuring cylinders so that volume (not 'amount') could be measured.

Although it would pose practical difficulties, the idea of using gas syringes was also accepted (on the grounds that it could be made to work if they were attached to funnels placed over the electrodes). Many suggested changing the electrodes as graphite is not inert, suggesting a lack of understanding of the required practical. Some students suggested that the apparatus is upside down.

4.2.2.6 Giant covalent structures

Answer 21 · Examiner comments

June 2018 | 8462/1H | Original Q6

06.4 Although 75% of students achieved one mark, usually for the trend in the hydrogen graph, just 7% achieved three marks.

In order to score the mark for proportionality of the hydrogen graph, both variables had to be stated, not just 'it is proportional'. Alternatively, a steady rate of collection would gain the mark. It had not been anticipated that students would calculate the rate of collection, but those who did were awarded credit. Some referred to proportionality correctly, but did not state which gas they were referring to.

The chlorine line posed more difficulty. Many described the chlorine line after 8 minutes as proportional. It is not as it shows a linear relationship, where the volume of chlorine increases at a steady rate.

Students are very unsure of how to describe trends in curved graphs; the idea of the chlorine being collected at an increasing rate (which could be expressed as faster and faster) being very rarely seen.

As in other questions, the language used by students created a barrier to attaining marks. 'It remains constant' could mean the gas volume no longer changes, rather than the rate of collection.

06.5 2% of students were able to answer this question. Many students either had not read or understood the statement that the number of moles of each gas produced is the same.

There were attempts to justify the difference in terms of reactivity, formula mass, size of molecules, pressure difference or the concentration of H^+ and Cl^- in solution. Some students referred to the length of time taken for the chlorine to react, rather than to be formed. Others suggested the molar volume was different for different gases, ignoring what they know from the part of the specification on gas volumes.

The formation of chlorine and hydrogen is part of the electrolysis required practical, so students should not be completely unfamiliar with the bubbles of chlorine taking longer to form. They should also be familiar with 'chlorine water' from their work on Group 7.

06.6 Students found this calculation on a new area of the specification quite difficult, with 26% of students providing a fully correct answer.

It was necessary to read off the correct volume from the graph and change the units from cm^3 to dm^3, or to change those of the gas molar volume to cm^3/mol, but many students didn't do this. Many students also struggled to express their answer in standard form.

4.2.2.6 Giant covalent structures

Answer 22 · 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 23 · Examiner comments November 2020 | 8462/2H | Original Q3

Question 3 (standard demand)

03.1 The vast majority of students scored both marks here. Again some reversed the responses and there was no pattern in the selection of the distractors.

03.2 Quite well answered, with the majority of students gaining at least one mark. A very wide range of colours for bromine water were seen in addition to orange, including red, yellow, brown and intermediate shades. A common error was to assert that the bromine water **becomes** orange upon addition to hexane. The difference between colourless and clear is now well understood by most.

03.3 This part was not very well answered by many, usually because they focused exclusively on structure and bonding at the expense of reactions, which could indicate that they didn't read the question carefully enough or didn't refer back to the question when constructing their response. Structure and bonding were well understood, but few of the reactions were mentioned. Additionally, students often reversed their answers because they confused ethane and ethene or the formation of their handwriting made it unclear whether a compound name ended 'ane' or 'ene'. The command word 'compare' demands that students mention both compounds to access level 2 and there were some imprecise comparisons such as 'ethane undergoes complete combustion whereas ethene undergoes incomplete combustion'. Because of these points, rather fewer than half of students were able to access level 2.

4.2.2.6 Giant covalent structures

Answer 24 · 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.

4.2.2.6 Giant covalent structures

Answer 25 · 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.

4.2.2.6 Giant covalent structures

Answer 26 · Examiner comments

June 2022 | 8462/1H | Original Q7

Question 7 (Standard, standard/high and high demand)

07.1 This was well answered, with more than half of students scoring both marks. There was, however, some ambiguous use of the word ‘it’ such as ‘it shows that it is below carbon because it displaces it’. If it was not clear what ‘it’ referred to, credit was not given.

07.2 Only 10% of students were awarded both marks, although nearly 60% scored at least one mark. Many students realised that aluminium is extracted by electrolysis, although some stated that aluminium would be extracted by the use of a more reactive metal. Although many mentioned the high energy cost of electrolysis, few compared electrolysis to the lower energy cost of heating coal to obtain carbon. Other students did state that extracting aluminium requires more energy than forming carbon, but did not explain why.

07.3 Many students realised that the products both being solids would make their physical separation difficult. Some appeared to misunderstandd what ‘separate’ means, and described the difficulty of decomposing magnesium oxide; this did not gain credit. Another common incorrect approach was to say that magnesium is high in the reactivity series. Whilst true, this was not relevant to the question set.

07.4 Those students who adopted a systematic approach, either using moles or reacting masses by proportion, had little difficulty in scoring most or all of the marks. In a multi-step calculation it is essential that each step is shown in the working so that marks for working can be awarded. The most common error was to use 48, instead of 24, for the M_r of Mg, giving an answer that was twice the correct value. Nearly all students carried out the unit conversion correctly. Some students calculated the correct final answer (960 g) but used an incorrect method. Such responses did not score full marks.

4.2.2.6 Giant covalent structures

Answer 26 · Examiner comments June 2022 | 8462/1H | Original Q7

07.5 This was well answered. However, there were many blank responses.

07.6 This was a high demand calculation, and students found it difficult to analyse the correct approach to take. The gas molar volume was not provided, because it was not needed. Indeed, with the water being formed as a gas, a value of 24 dm^3/mol was not correct. Even so, those students who adopted the approach of converting gas volumes to moles were given full credit if they succeeded. Few did, as a four-step calculation with simple numbers was turned into a seven-step calculation with a unit conversion by electing to follow this approach.

Students needed to use the equation to realise that the SiO_2 formed is a solid, not a gas. They were also told that the oxygen is in excess; that means that the Si_2H_6 is the limiting reactant, and that the gases after reaction would therefore be the water vapour and the remaining oxygen. All that was therefore necessary was to multiply the volume of Si_2H_6 by 3 to find the volume of water vapour formed, and by 7/2 to find the volume of oxygen used. Subtracting that volume from 150 cm^3 would then give the volume of excess oxygen, and adding the volumes of the two appropriate gases together gave the final answer. Only one sixth of students scored at least one mark, which was usually for calculating the volume of water vapour produced.

Answer 27 · 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.