AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.2.3.2

Graphite

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**11**
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.

4.2.3.2 Graphite

Answer 01 · Mark scheme

January 2008 | CHY2H | Original Q4 | Legacy

The full source mark scheme begins on page 28. Follow original question 4 in that document.

4.2.3.2 Graphite

Answer 02 · 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**

4.2.3.2 Graphite

Answer 02 · Mark scheme

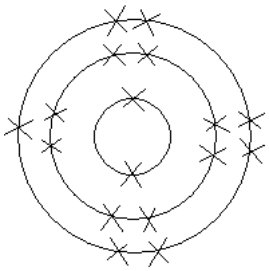
June 2009 | CHY2H | Original Q4 | Legacy

CHY2F

4.2.3.2 Graphite

Answer 03 · 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**

4.2.3.2 Graphite

Answer 03 · Mark scheme

CHY2H

4.2.3.2 Graphite

Answer 04 · Mark scheme

Question 4

question	answers	extra information	mark
4(a)	any **four** from: • giant structure / lattice • positive ions • sea of electrons **or** delocalised / free electrons • 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 • a lot of energy / heat is needed to break these bonds / attractions	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 ignore layers ignore electrons can move allow hard to break for strong ignore forces unqualified ignore high temperature	4

Question 4 continues on next page

4.2.3.2 Graphite

CHY2H

Question 4 continued

question	answers	extra information	mark
4(b)(i)	that they are very small **or** 1–100 nanometres **or** a few (hundred) atoms	accept tiny / really small / a lot 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**

4.2.3.2 Graphite

Answer 04 · Mark scheme

CHY2H

4.2.3.2 Graphite

Answer 05 · 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

4.2.3.2 Graphite

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**

4.2.3.2 Graphite

Answer 05 · Mark scheme

June 2010 | CHY2H | Original Q3 | Legacy

CHY 2H

4.2.3.2 Graphite

Answer 06 · 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

4.2.3.2 Graphite

Answer 07 · 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

4.2.3.2 Graphite

Answer 07 · Mark scheme

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

4.2.3.2 Graphite

Answer 07 · Mark scheme

January 2013

CH2HP

4.2.3.2 Graphite

Answer 08 · 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**		

4.2.3.2 Graphite

Answer 08 · Mark scheme

June 2014 | CH2HP | Original Q5 | Legacy



4.2.3.2 Graphite

Answer 09 · 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	

4.2.3.2 Graphite

Answer 09 · 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

4.2.3.2 Graphite

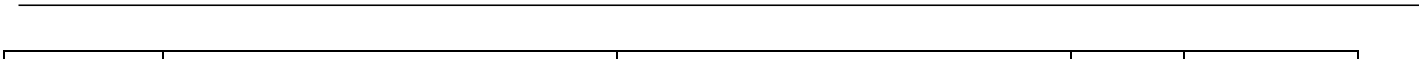
Answer 09 · Mark scheme

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**	

4.2.3.2 Graphite

Answer 09 · Mark scheme

June 2018 | 8462/1H | Original Q6



4.2.3.2 Graphite

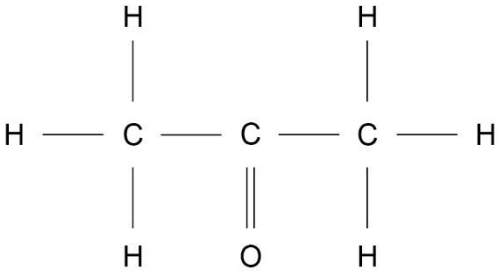
Answer 10 · Mark scheme

November 2021 | 8462/1H | Original Q1

Question 1

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

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

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

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

4.2.3.2 Graphite

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

4.2.3.2 Graphite

Answer 11 · 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	

4.2.3.2 Graphite

Answer 11 · 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

4.2.3.2 Graphite

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

4.2.3.2 Graphite

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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Dr Michael Cresswell Director General

4.2.3.2 Graphite

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.

4.2.3.2 Graphite

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.

4.2.3.2 Graphite

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 <u>more</u> often **or** <u>more</u> chance of collisions **or** bump into each other <u>more</u> • collide with <u>more</u> force / energy **or** <u>more</u> particles have the activation energy **or** <u>more</u> collisions result in reaction **or** <u>more</u> collisions are successful	 allow given / gain / get energy ignore move about more ignore vibrate more / faster ignore collide quicker / faster	3
total			8

4.2.3.2 Graphite

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

4.2.3.2 Graphite

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

4.2.3.2 Graphite

CHY2H

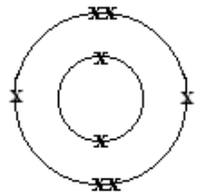
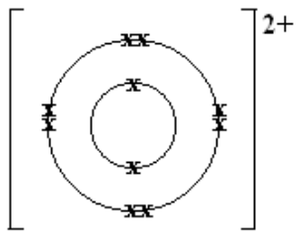
Question 4

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

4.2.3.2 Graphite

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…

4.2.3.2 Graphite

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

4.2.3.2 Graphite

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

4.2.3.2 Graphite

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 × (answer from (1)) = 71.4 mol 3) mass of NH_3 = (answer from 2) × 17 = 71.4 × 17 = 1214 g **or** • 28g of N_2 → 34g of NH_3 • 1g of N_2 → $\frac{34}{28}$ = 1.214g NH_3 • 1000 g of N_2 → 1000 × 1.214 = 1214g **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…

4.2.3.2 Graphite

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…

4.2.3.2 Graphite

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** • <u>escape</u> of dangerous / harmful chemicals / gases (owtte) • <u>danger</u> 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…

4.2.3.2 Graphite

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

4.2.3.2 Graphite

Answer 09 · 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.

4.2.3.2 Graphite

Answer 09 · Examiner comments

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.

4.2.3.2 Graphite

Answer 10 · Examiner comments

November 2021 | 8462/1H | Original Q1

Question 1 (standard demand)

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

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

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

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

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

4.2.3.2 Graphite

Answer 11 · 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.