

# GCSE 2004

## *June Series*



## Mark Scheme

### Chemistry Specification B *3421/H*

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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.

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## GCSE CHEMISTRY

### INFORMATION FOR 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. Boldening

- 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 / ; e.g. allow smooth / free movement.)

#### 3. Marking points

##### 3.1 Marking of Quality of Written Communication

Where *Quality of written communication* appears in the mark scheme, one mark is to be awarded for either of the following points:

- Using correct scientific terms
- Correct sequencing or linking of ideas or points

The mark scheme will specify which of the points is to be awarded in a particular question. A QoWC mark can be awarded for a scientific answer, even if it is not accurate. It cannot be awarded for a nonsensical or non-scientific answer.

On the script, the QoWC tick should be identified by a ‘q’ written next to it.

##### 3.2 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.

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

### 3.3 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.

### 3.4 The marking of quantitative relationships

Full credit can be given for a correct quantitative relationship expressed in:

- named units;
- physical quantities;
- standard symbols;
- a combination of physical quantities and units.

No credit can be given for any quantitative relationship expressed in terms of:

- a combination of physical quantities, units and symbols;
- a diagram, e.g. the ohm's law triangle, unless the rest of the answer shows clearly that the candidate understands the relationships involved.

### 3.5 Marking procedure for calculations

**3.5.1** 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;
- if the answer is correct, but an incorrect relationship is written in the working, then no marks can be awarded (see 3.5.2).

**3.5.2** Where calculations are based on incorrectly recalled relationships, neither the incorrectly recalled relationship, nor the resulting calculation based on the incorrect relationship, will be credited.

### 3.6 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.

### 3.7 Errors carried forward

There should be no error carried forward from a previous answer which has been based on wrong science. Any error in the answers to a structured question should be penalised once only.

Examples

- (a) A candidate who calculates average speed using  $\text{speed} = \text{time}/\text{distance}$  **and** then proceeds to use this incorrect answer to calculate an acceleration based on the correct quantitative relationship should be given credit for the use of the correct acceleration relationship but none for either numerical answer.
- (b) A candidate who incorrectly calculates average speed using  $\text{speed} = \text{distance}/\text{time}$  and then proceeds to use this incorrect value to calculate an acceleration based on the correct quantitative relationship, should be given credit for the use of both correct quantitative relationships **and** for the correct substitution and use of the incorrect value in the calculation of the rate of acceleration.

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.

### 3.8 Phonetic spelling

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

### 3.9 Brackets

(.....) is 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.

### 3.10 Interpretation of marginal points

There will be times when the answer is almost, but not quite, correct. Some examiners would award a mark while others would not. In any one script, an attempt should be made to balance these nearly correct answers by giving the mark on some occasions but not on others. If this is not done, the marking would end up being too lenient or too harsh.

### 3.11 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.



**GCSE Chemistry  
Higher Tier 3421/H**

3421/H Q1

question	answers	extra information	mark
(a)(i)	coke	allow coal ignore carbon	1
(ii)	any plausible description of a difference based on diagram or their knowledge e.g. use of water power <b>or</b> smaller scale <b>or</b> use of bellows <b>or</b> use of cold air <b>or</b> slower speed / less efficient	accept converse argument but must be clear	1
(b)(i)	to remove / lose oxygen (owtte)	accept answer in terms of electrons (gain electrons) but <b>not</b> hydrogen	1
(ii)	iron <b>and</b> carbon dioxide	both for <b>1</b> mark accept Fe <b>and</b> CO <sub>2</sub> do <b>not</b> accept Fe and CO <sup>2</sup>	1
(c)	to remove impurities / acidic compounds	accept to form slag (owtte) accept correct chemical description suggesting impurities allow to stop furnace getting blocked	1
(d)	sodium is <u>higher</u> in the reactivity series  than carbon	it = sodium  accept sodium is (very) high in the reactivity series accept sodium is <u>too</u> reactive accept sodium is more reactive than iron / calcium  sodium is reactive = <b>0</b> marks  must be a comparison with carbon for both marks	1  1
(e)(i)	chromium <b>or</b> nickel	accept Cr <b>or</b> Ni	1
(ii)	does not rust / corrode <b>or</b> does not react with water <b>or</b> does not oxidise	ignore references to heat conductivity / conduction or appearance (e.g. tarnish) ignore melting point  any reference to electrical conductivity = <b>0</b> marks	1
total			9

## 3421/H Q2

question	answers	extra information	mark
(a)	catalyst <b>or</b> speeds up the reaction (owtte)	accept lowers activation energy <b>not</b> just helps reaction to take place ignore increased surface area	1
(b)	C <sub>8</sub> H <sub>18</sub>	allow H <sub>18</sub> C <sub>8</sub> must be upper case do <b>not</b> accept powers	1
(c)	B because it is a gas <b>or</b> because it has small molecules <b>or</b> because <u>they</u> are small	position <b>and</b> reason for mark allow it has a lower / <u>very</u> low boiling point than A ignore references to solubility accept does not condense do <b>not</b> accept light molecules <b>or</b> bubbles into B do <b>not</b> accept <u>it</u> is small	1
(d)	breakdown of a substance (owtte)  by the action of heat (owtte)	do <b>not</b> accept decompose unqualified	1  1
(e)	<b>Quality of written communication</b>	if the written communication makes sense and it is in context then award Q mark  Q ✓ Q X	1
	large to small molecules <b>or</b> scientific word that implies smaller, e.g. alkene / ethane / petrol	any name or formula of alkane / alkene smaller than decane	1
	either advantages of smaller molecules <b>or</b> disadvantages of larger molecules e.g. hydrocarbons with large molecules are limited in their usefulness	<b>or</b> converse for smaller molecules	1
	large hydrocarbon molecules do not ignite easily / do not flow easily / are not very volatile	<b>or</b> converse for smaller molecules	
	more large hydrocarbon molecules are produced than are needed	<b>or</b> converse for smaller molecules	
	smaller molecules are useful as fuels alkenes / products can be used to make polymers		
(f)	(fractional) distillation	accept fractionation accept good description do <b>not</b> accept just diagram	1
total			9

## 3421/H Q3

question	answers	extra information	mark
(a)(i)	argon <b>and</b> potassium <b>or</b> tellurium <b>and</b> iodine <b>or</b> cobalt <b>and</b> nickel	accept correct symbols allow argon <b>and</b> calcium	1
(ii)	it would place them in incorrect <u>groups</u> (owtte)	idea of <u>not</u> being placed with elements which have similar properties <b>or</b> converse argument  accept would not have same number of electrons in outer shell allow it would put them in wrong period if linked to argon and potassium / calcium  do <b>not</b> accept reasons based just on protons do <b>not</b> accept metals and non-metals mixed up	1
(b)	any <b>two</b> from:  • each successive atom has one more electron  • atoms in the same group have the same number of electrons in their <u>outer</u> shells / energy levels  • across a period an energy level / shell is being filled  • in the next period the next energy level / shell is being filled	number of electrons in outer shell = group number  accept period number = shell number	2
total			4



## 3421/H Q4

question	answers	extra information	mark
(a)	hydrogen	accept H <sub>2</sub> do <b>not</b> accept H	1
(b)	litmus paper / Universal Indicator paper / pH paper  bleached / turns white <b>or</b> loses its colour	allow any suitable <u>named</u> indicator  do <b>not</b> accept bleached cloth / leaves etc.  allow second mark unless <u>incorrect</u> indicator given  allow starch iodide paper (1) goes black / blue black (1)  allow potassium iodide solution (1) goes brown / orange / black precipitate (1)	1  1
(c)	because they have a negative charge <b>or</b> opposite charges attract	accept (because) it is Cl <sup>-</sup> accept chlorine, Cl <b>or</b> chlorine ions has a negative charge  do <b>not</b> accept Cl <sup>-</sup> on its own do <b>not</b> accept Cl <sub>2</sub> o.e. has negative charge	1
(d)	kill bacteria / germs, etc. <b>or</b> sterilise / disinfect	accept destroys bacteria etc. ignore clean / purify water (owtte) do <b>not</b> accept just gets rid of bacteria	1
(e)	hydroxide (ion)	accept OH <sup>-</sup>	1
total			6

## 3421/H Q5

question	answers	extra information	mark
(a)	100	ignore units $40 + 12 + (3 \times 16)$ for <b>1</b> mark	2
(b)	40	( <b>ecf</b> from part (a) can get <b>2</b> marks) $\frac{40}{\text{their (a)}} \times 100$ for <b>1</b> mark	2
(c)	0.5	( <b>ecf</b> from part (b) can get <b>2</b> marks) $1.25 \times \left( \frac{\text{their (b)}}{100} \right)$ <b>or</b> other correct working for <b>1</b> mark	2
(d)	gas produced <b>or</b> carbon dioxide / CO <sub>2</sub> produced		1
total			7

## 3421/H Q6

question	answers	extra information	mark
(a)	$\text{Na}_2\text{CO}_3$	accept $(\text{Na}^+)_2\text{CO}_3^{2-}$ 2 and 3 below halfway  do <b>not</b> accept $\text{Na}_2 + \text{CO}_3$	1
(b)(i)	correct number of electrons (18)	accept any combination of dots and crosses	1
	2, 8, 8	2, 8, 8 written on rings = <b>1</b> mark	1
(ii)	loses 2 electrons <b>or</b> loses <u>both</u> electrons	loses electrons = <b>1</b> mark  any answers about gaining electrons = <b>0</b> marks	2
(c)(i)	5	accept multiples if all correct	1
(ii)	6	accept multiples if all correct	1
total			7

3421/H Q7

question	answers	extra information	mark
	<p><b>Quality of written communication</b></p>	<p>if the written communication makes sense and it is in context then award Q mark</p> <p>Q ✓ QX</p>	1
	<p>any <b>one</b> from:</p> <ul style="list-style-type: none"> <li>• earth movements</li> <li>• movement of tectonic plates</li> <li>• tectonic activity / collision of plates</li> <li>• mountain creation</li> <li>• deep burial / pushed downwards</li> <li>• contact with magma</li> </ul>	<p>any stated activity within the crust accept earthquakes / volcanoes / forces in the crust accept <u>folding</u></p> <p>do <b>not</b> accept simply describing sedimentation</p>	1
	<p>any <b>one</b> from:</p> <ul style="list-style-type: none"> <li>• (created) high temperatures / heat / very hot</li> <li>• (created) <u>high</u> pressures</li> <li>• (caused) recrystallisation / crystalline rearrangement</li> </ul>	<p>any reference to melting loses this mark</p> <p>do <b>not</b> accept hot unqualified</p> <p>accept idea of more pressure e.g. earthquake creates pressure</p> <p>accept formation of new minerals</p>	1
total			3

## 3421/H Q8

	answers	extra information	mark
(a)	all lead nitrate reacted <b>or</b> no lead nitrate left <b>or</b> enough KI to react with lead nitrate <b>or</b> to remove all the lead ions <b>or</b> to get maximum amount of $PbI_2$	ignore comments about speed do <b>not</b> accept to remove all the lead	1
(b)	precipitate	allow phonetic spelling do <b>not</b> accept ppt	1
(c)	filter / filtration / centrifuge / decant	do <b>not</b> accept sieve	1
(d)	any <b>one</b> from: <ul style="list-style-type: none"> <li>• removes (soluble) impurities</li> <li>• removes (unreacted) KI</li> <li>• removes <math>KNO_3</math></li> <li>• removes (excess) solution</li> <li>• removes nitrates</li> </ul>	purifying is insufficient do <b>not</b> accept removes potassium do <b>not</b> accept removes iodide	1
(e)	answer based on filter paper, desiccator, suitable solvent, (gentle) heat, drying cabinet, oven etc.  e.g. place between dry filter paper, allow to dry e.g. use propanone, allow to evaporate e.g. leave on sunny window sill e.g. leave in a draught	accept any method of heating i.e. bunsen / hairdryer etc. accept leave to evaporate / stand <b>or</b> leave in a warm room  the answer leave / evaporate /  draught alone is insufficient	1
(f)	wear gloves / mask <b>or</b> fume-cupboard <b>or</b> wash hands afterwards	ignore goggles / labcoat <b>or</b> extractor fan / do not touch etc.	1
total			6

## 3421/H Q9

	answers	extra information	mark
(a)(i)	vanadium(V) oxide <b>or</b> $V_2O_5$ <b>or</b> vanadium pentoxide	accept vanadium oxide <b>or</b> vanadium V oxide do <b>not</b> accept vanadium, vanadium(IV) oxide, platinum etc.	1
(ii)	(concentrated) sulphuric acid <b>or</b> $H_2SO_4$	do <b>not</b> accept <u>dilute</u> sulphuric acid	1
(iii)	oleum / fuming sulphuric acid <b>or</b> $H_2S_2O_7$ <b>or</b> $H_2SO_4.SO_3$		1
(b)(i)	all points correct  smooth curve	$\pm \frac{1}{2}$ square  reasonable attempt thickness $\pm \frac{1}{2}$ square	1  1
(ii)	585 range 580 – 590 <b>or</b> correct from ‘their’ graph		1
(c)(i)	$H_2SO_4 = 2 + 32 + 64$  $= 98$	<b>or</b> $32 + 2 + 16 + 1 \frac{1}{2} \times 32$ <b>or</b> $32 + 18 + 48$ $= 98$ allow proof by subtraction answer alone gets <b>0</b> marks	1  1
(ii)	answers based on less $SO_3$ available for stage 3 etc	answers relating to reversible reaction ideas acceptable	1
(d)	sodium hydroxide gives hydroxide ions / $OH^-$ (Arrhenius)  answers based on the link between hydroxide <u>ions</u> / $OH^-$ and hydrogen ions / $H^+$ (from the acid) (Arrhenius) <b>or</b> sodium hydroxide / $OH^-$ reacts with hydrogen ions / $H^+$  answers based on the idea that hydrogen ions / $H^+$ are protons (Brønsted & Lowry)	answers based on the <u>link</u> between hydroxide <u>ions</u> / $OH^-$ and protons (from the acid) (Brønsted & Lowry) <b>or</b> sodium hydroxide / $OH^-$ accepts protons  answers based on the idea that protons are hydrogen ions (Arrhenius)	1  1  1
total			12

## 3421/H Q10

question	answers	extra information	mark
(a)	A	accept a <b>or</b> 2, 8, 18, 18, 8, 1	1
(b)	outer shell further from nucleus <b>or</b> outer shell electron less strongly attracted to nucleus <b>or</b> outer shell more shielded  so outer shell electron lost <u>more</u> easily (owtte)	do <b>not</b> accept more shells <b>or</b> larger / bigger atoms alone  accept correct converse linked to lithium 'it' must be linked to caesium outer must be used once at least for both marks	1  1
total			3

## 3421/H Q11

question	answers	extra information	mark
(a)(i)	any <b>three</b> from: <ul style="list-style-type: none"> <li>• particles / they gain energy</li> <li>• particles / they move faster</li> <li>• collide more often <b>or</b> more collisions <b>or</b> more chance of collision</li> <li>• have more energy when they collide <b>or</b> more energetic collisions <b>or</b> more collisions with activation energy</li> </ul>	accept move more violently ignore vibrate faster <b>or</b> start to move only <b>or</b> more active do <b>not</b> accept move more  accept more successful / fruitful / violent / forceful collisions accept more likely to react	3
(ii)	does not work above 45° C <b>or</b> denatured / damaged / destroyed <b>or</b> only works best at an optimum temperature	some indication of optimum temperature do <b>not</b> accept killed / do not work accept only work over a narrow pH range ignore deactivated <b>or</b> decreases activity <b>or</b> explanations about cost <b>or</b> not removed with product	1
(b)(i)	lower temperature needed (owtte) high yield of product (owtte) only one product <b>or</b> (virtually) no other products (owtte)	read the whole explanation first, may be more than one mark on one statement  accept 10° C alone  accept no waste products / by products ignore explanations involving cost or specificity of enzymes	1 1 1
(ii)	so it functions for a long time <b>or</b> lasts longer <b>or</b> more effective over a longer period	answer must be time related	1
(iii)	enzyme is trapped in / fixed to / bonded to (owtte) / trapped / held to  (inert) solid / resin / (alginate) beads, network / surface / matrix etc.	do <b>not</b> accept deposited <b>or</b> absorbed	1 1
total			10



## 3421/H Q12

question	answers	extra information	mark
(a)	react with oxygen / oxidise / burn in oxygen / burning / combustion <b>or</b> tungsten to tungsten oxide <b>or</b> makes an oxide	key idea is oxidation ignore breaking ignore fire / flames / exothermic ignore react with air	1
(b)	it is (very) unreactive / not reactive / inert / does not react with tungsten <b>or</b> it is a noble gas <b>or</b> it is in group 0 or 8 or 18	do <b>not</b> accept unreactive / inert metal <b>or</b> argon is not <u>very</u> reactive	1
	full outer shell (of electrons) / 8 electrons in outer shell		1
	does not need to gain / lose / swap / transfer / share electrons <b>or</b> does not need to form bonds	does not bond ionically / covalently	1
total			4

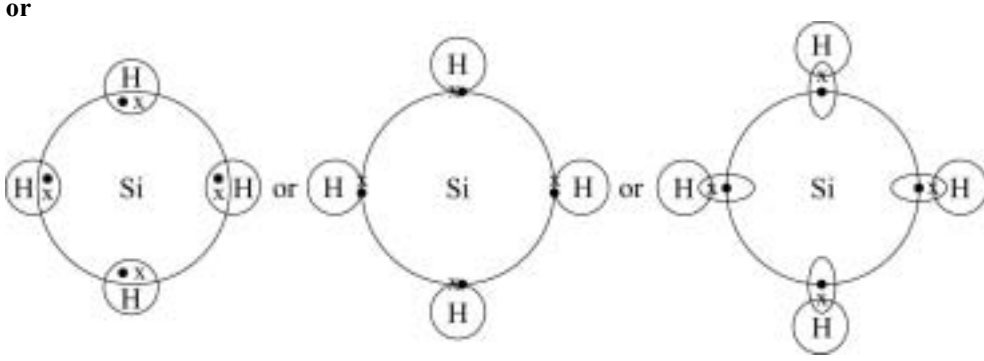
## 3421/H Q13

question	answers	extra information	mark
(a)	poly(tetrafluoroethene) <b>or</b> polytetrafluoroethene	accept PTFE or Teflon	1
(b)	double bond  all other atoms and bonds correct including F for fluorine  $\begin{array}{c} \text{F} \quad \text{F} \\   \quad   \\ -\text{C} = \text{C}- \\   \quad   \\ \text{F} \quad \text{F} \end{array}$	$\begin{array}{c} \text{F} \quad \text{F} \\ \diagdown \quad / \\ \text{C} = \text{C} \\ / \quad \diagdown \\ \text{F} \quad \text{F} \end{array}$ ignore n in front <b>or</b> $\begin{array}{cc} \text{F} & \text{F} \\   &   \\ \text{C} & - & \text{C} \\   &   \\ \text{F} & \text{F} \end{array} = 1 \text{ mark}$ $\left( \begin{array}{cc} \text{F} & \text{F} \\   &   \\ \text{C} & = & \text{C} \\   &   \\ \text{F} & \text{F} \end{array} \right)_n = 1 \text{ mark}$ $\text{CF}_2 = \text{CF}_2 = 1 \text{ mark}$ do <b>not</b> accept structures with more than 2 C atoms	1  1
(c)	any <b>three</b> from:  <ul style="list-style-type: none"> <li>• <u>many</u> monomers / (small) molecules / tetrafluoroethene molecules</li> <li>• (monomers, molecules etc.) join / bond / link / combine / attach</li> <li>• to form one molecule <b>or</b> to form a long-chain <b>or</b> to form a large molecule</li> <li>• no other substances are produced / one substance formed (definition of addition)</li> <li>• idea of <u>double bond</u> breaking / opening / opens / bond being used to join to another molecule <b>or</b> the double bond becomes a single bond</li> </ul>	allow <u>many</u> tetrafluoroethenes many particles alone is insufficient do <b>not</b> accept many polymers  allow many particles <u>join</u> allow many atoms <u>join</u> do <b>not</b> accept collide / add ignore polymerise do <b>not</b> accept many polymers join	3
total			6

## 3421/H Q14

question	answers	extra information	mark
(a)	low / lower / lowest temperature ( <b>or</b> 100 °C from graph)	2 marks for comments related to temperature ignore references to catalyst	1
	any <b>one</b> from:		1
	<ul style="list-style-type: none"> <li>(forward) reaction exothermic</li> <li>if the temperature is increased the yield of product will decrease <b>or</b> reaction right to left</li> </ul>	<b>or</b> reverse reaction endothermic high temperature favours reverse reaction <b>or</b> reverse argument the lower the temperature the greater the yield = 2 marks	
	high / higher / highest pressure (or greater than 200 atm. from graph)	2 marks for comments related to pressure	1
(b)	any <b>one</b> from:		1
	<ul style="list-style-type: none"> <li>four reactant molecules but only two product molecules (owtte)</li> <li>increase in pressure favours the reaction which produces the least number of molecules</li> </ul>	reverse reaction goes from 2 molecules / moles / volumes to 4 molecules / moles / volumes decrease in pressure favours the back reaction because it produces the most molecules	
	any <b>three</b> from:		3
total	<ul style="list-style-type: none"> <li>at low temperatures the reaction is too slow</li> <li>450 °C gives a reasonable yield at a fast rate / compromise between yield and rate</li> <li>200 atm. gives a reasonable yield at a reasonable cost / safely / compromise between yield and cost / safety</li> <li>catalyst works better at higher temperature</li> <li>(very) high pressures could be dangerous (owtte)</li> <li>(very) high pressures are expensive (owtte)</li> <li>(yield is not too important because) unreacted gases can be recycled</li> </ul>	} or 450°C and 200 atm / these are compromise conditions for 1 mark  safety factor	
			7

## 3421/H Q15

question	answers	extra information	mark
(a)	$M_r(\text{SiO}_2) = 60$ $60 \text{ g SiO}_2 \rightarrow 28 \text{ g Si}$ $2.14 \text{ g SiO}_2 \rightarrow 1 \text{ g Si}$  OR $M_r(\text{SiO}_2) = 60$ (1) moles of silicon needed $= \frac{1}{28} = 0.0357$ mass of $\text{SiO}_2$ needed $= 0.0357 \times 60$ (1) $= 2.14 \text{ g}$ (1)  OR $M_r(\text{SiO}_2) = 60$ (1) mass $\text{SiO}_2 = 1 \times \left(\frac{60}{28}\right)$ (1) $= 2.14 \text{ g}$ (1)	if $M_r$ incorrect ecf for max 2  correct answer for <b>3</b> marks  allow 2, 2.1, 2.14 (or anything rounding to 2.14), 2.16 or 2.2 a unit is not required but an incorrect unit loses the third mark  allow 2, 2.1, 2.14 (or anything rounding to 2.14), 2.16 or 2.2  allow 2, 2.1, 2.14 (or anything rounding to 2.14), 2.16 or 2.2	1  1  1
(b)(i)	$\text{MgO(s)} + 2\text{HCl(aq)} \rightarrow \text{MgCl}_2\text{(aq)} + \text{H}_2\text{O(l)}$	penalise incorrect symbols correctly balanced equation for <b>1</b> mark state symbols for <b>1</b> mark  allow correct multiples / fractions	2
(ii)	$\begin{array}{c} \text{H} \\ \times \\ \bullet \\ \text{H} \times \text{Si} \times \text{H} \\ \times \\ \bullet \\ \text{H} \end{array}$  or 	ignore inner shell electrons of silicon allow correct drawings without symbols must clearly indicate four shared pairs of electrons with one electron from each atom	1

continued:

## 3421/H Q15 continued

question	answers	extra information	mark																
(iii)	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center; width: 50%;"><b>Si</b></td> <td style="text-align: center; width: 50%;"><b>H</b></td> </tr> <tr> <td style="text-align: center;"><math>\frac{1.4}{28}</math></td> <td style="text-align: center;"><math>\frac{0.15}{1}</math></td> </tr> <tr> <td style="text-align: center;">= 0.05</td> <td style="text-align: center;">= 0.15</td> </tr> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">3</td> </tr> </table>	<b>Si</b>	<b>H</b>	$\frac{1.4}{28}$	$\frac{0.15}{1}$	= 0.05	= 0.15	1	3	<p>for whole number ratio can be implied</p> <p>accept H<sub>3</sub> Si <b>or</b> any correct formula with 1:3 ratio</p> <p>if in step 1 they get either of ratios incorrect they lose first 2 marks but can be ecf for 3<sup>rd</sup> and 4<sup>th</sup> mark</p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td>evidence of mass / A<sub>r</sub></td> <td style="text-align: right;"><b>1 mark</b></td> </tr> <tr> <td>proportions of each</td> <td style="text-align: right;"><b>1 mark</b></td> </tr> <tr> <td>whole number ratio</td> <td style="text-align: right;"><b>1 mark</b></td> </tr> <tr> <td>correct formula</td> <td style="text-align: right;"><b>1 mark</b></td> </tr> </table>	evidence of mass / A <sub>r</sub>	<b>1 mark</b>	proportions of each	<b>1 mark</b>	whole number ratio	<b>1 mark</b>	correct formula	<b>1 mark</b>	<p>1</p> <p>1</p> <p>1</p> <p>1</p>
<b>Si</b>	<b>H</b>																		
$\frac{1.4}{28}$	$\frac{0.15}{1}$																		
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correct formula	<b>1 mark</b>																		
(iv)	<b>C</b>	accept c	1																
(c)	<p>any <b>four</b> from:</p> <ul style="list-style-type: none"> <li>• giant structure / macromolecule / lattice / giant molecule</li> <li>• each silicon atom joined to four other atoms</li> <li>• covalent bonds</li> <li>• bonds are strong <b>or</b> large amount of energy needed to break bonds</li> <li>• large number of bonds to be <u>broken</u></li> </ul>	<p>allow giant molecular / giant atomic structure</p> <p>(or diagram)</p> <p>accept hard to break bonds</p> <p>mention of giant <b>ionic</b> structure <b>or</b> intermolecular forces <b>or</b> intermolecular bonds max <b>1 mark</b></p> <p>diamond <b>or</b> carbon discussion max <b>3 marks</b> unless clearly linked to silicon</p>	4																
total			15																

## 3421/H Q16

	answers	extra information	mark
	statement regarding redox e.g. impurities oxidised		1
	statement about acid-based reaction e.g.: <u>acidic</u> (oxides) impurities removes / neutralises / reacts with calcium carbonate / calcium oxide	do <b>not</b> accept impurities taken out as slag	1
	<u>basic</u> CaCO <sub>3</sub> / CaO reacts with / removes / neutralises impurities		
	any <b>three</b> from:		3
	<ul style="list-style-type: none"> <li>• recycled / scrap iron</li> <li>• (pure) oxygen used</li> <li>• non-metal impurities oxidised to (acidic) oxides</li> <li>• sulphur removed by magnesium</li> <li>• add other metals or C</li> </ul>	do <b>not</b> accept air	
	<ul style="list-style-type: none"> <li>• <b>one</b> suitable balanced equation e.g. CaCO<sub>3</sub> → CaO + CO<sub>2</sub> CaCO<sub>3</sub> + SiO<sub>2</sub> → CO<sub>2</sub> + CaSiO<sub>3</sub> CaO + SiO<sub>2</sub> → CaSiO<sub>3</sub> Mg + S → MgS C + O<sub>2</sub> → CO<sub>2</sub></li> </ul>	one correct, one incorrect lose this mark  do <b>not</b> accept 2CO + O <sub>2</sub> → 2CO <sub>2</sub>	
		talk about blast furnace only <b>max 2</b> marks	
		for acid-based reaction <b>1</b> mark	
		any suitable equation from blast furnace <b>1</b> mark	
		talk about blast furnace then go on to correct process ignore blast furnace	
total			5

## 3421/H Q17

	answers	extra information	mark
(a)	<p><b>Quality of written communication</b></p> <p>any <b>three</b> from:</p> <ul style="list-style-type: none"> <li>nitric acid in <u>burette</u></li> <li>add nitric acid until <u>indicator</u> changes (colour)</li> <li>note (burette) volume used <b>or</b> final reading</li> <li>accuracy: e.g. repeat</li> </ul>	<p><b>must</b> be a description of a titration no titration = <b>0</b> marks</p> <p>for correct sequencing of 2 of first 3 bullet points i.e. 1 + 2 <b>or</b> 2 + 3 <b>or</b> 1 + 3</p> <p>do <b>not</b> accept biuret can be inferred from 3<sup>rd</sup> point</p> <p>can be named acid-base indicator colour change does not have to be correct</p> <p>accept white tile <b>or</b> dropwise near end <b>or</b> white background <b>or</b> swirling the flask <b>or</b> read meniscus at eye level</p>	<p>1</p> <p>3</p>
(b)	<p>e.g. formula method:</p> $25 \times M_{\text{NH}_3} = 0.25 \times 20$ $M_{\text{NH}_3} = 0.2$ <p><b>OR</b></p> <p>moles <math>\text{NH}_3</math> = moles <math>\text{HNO}_3</math>  <math display="block">= \frac{20}{1000} \times 0.25 = 0.005 \text{ moles} \quad (1)</math> <p>concentration <math>\text{NH}_3</math>  <math display="block">= \frac{0.005 \times 1000}{25} = 0.2 \quad (1)</math></p> </p>	<p>correct answer alone = <b>2</b></p>	<p>1</p> <p>1</p>
(c)	<p>sodium hydroxide <b>or</b> potassium hydroxide <b>or</b> lithium hydroxide <b>or</b> calcium hydroxide</p> <p>ammonia produced</p>	<p>ignore mention of alkali</p> <p>accept gas produced turns (damp) (red) litmus blue (not blue litmus) <b>or</b> <u>alkaline</u> gas produced any suitable named indicator e.g. UI with consequential marking white fumes / smoke with (concentrated) HCl do <b>not</b> accept white gas wrong test = <b>0</b> marks</p>	<p>1</p> <p>1</p>
total			8

## 3421/H Q18

	answers	extra information	mark
(a)(i)	general formula	accept named series <b>plus</b> correct general formula do <b>not</b> accept just $C_nH_{2n+1}OH$	1
	any <b>one</b> from: <ul style="list-style-type: none"> <li>increases / differs by a regular (fixed) amount / 14 / <math>CH_2</math></li> <li>same / similar <u>chemical</u> properties</li> <li>trend in <u>physical</u> properties</li> </ul>	same functional group do <b>not</b> accept similar properties do <b>not</b> accept same structure	1
(ii)	$\begin{array}{ccccccc} & H & & H & & & \\ &   & &   & & & \\ H & - C & - & C & - O & - & H \\ &   & &   & & & \\ & H & & H & & & \end{array}$	all atoms and all bonds  allow $\begin{array}{ccccccc} & H & & H & & & \\ &   & &   & & & \\ H & - C & - & C & - & OH \\ &   & &   & & & \\ & H & & H & & & \end{array}$ do <b>not</b> accept $CH_3CH_2OH$	1
(b)	continuous faster	batch slower accept as comparison i.e. continuous is fast and batch is slow	1
	continuous gives purer / pure (product) / 100%	batch gives less pure / impure product <b>or</b> have to distil <b>or</b> batch is only 15% accept just continuous gives a pure product without comparison ignore comments about yield	1
	e.g. continuous uses finite (non-renewable) resources	batch uses non-finite (renewable) resources  [ignore reference to catalysts as catalysts are used in both processes]	1

continued:



