



ASSESSMENT and  
QUALIFICATIONS  
ALLIANCE

# Mark scheme

# June 2003

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## GCSE

### Chemistry

3421

Foundation

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# FOUNDATION TIER 3421/F

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

### 3. Marking points

#### 3.1 Marking of Quality of Written Communication

Examiners are reminded of the need to assess QoWC by the following statement appearing in the appropriate parts of the mark scheme:

*The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.*

The maximum marks available to a candidate whose answer is not well expressed will be (the number of marks available –1).

### 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.

**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 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**  
**Foundation Tier 3421/F**

**3421/F Q1**

question	answers	extra information	mark
(a)	D		1
(b)	B		1
(c)	F		1
(d)	G		1
(e)	H		1
total			5

**3421/F Q2**

question	answers	extra information	mark
(a)	Sensible method of collection such as:  over water  downward delivery  gas syringe	do <b>not</b> accept sealed collection tube <b>or</b> balloon  tube half-way or more down and empty container no lid needed  labelled or graduations	1
(b)(i)	limewater <b>or</b> calcium hydroxide / Ca(OH) <sub>2</sub> (solution)		1
(ii)	turns cloudy / milky / chalky / white precipitate		1
total			3

## 3421/F Q3

question	answers	extra information	mark
(a)	oxygen <b>or</b> air <b>or</b> O <sub>2</sub>		1
(b)(i)	platinum		1
(ii)	oxidation		1
(c)(i)	potassium hydroxide	accept correct formulae	1
	water		1
(ii)	fertiliser		1
(iii)	H <sup>+</sup>	accept hydrogen but <b>not</b> H	1
total			7

## 3421/F Q4

question	answers	extra information	mark
(a)	hydrocarbons		1
(b)	evaporation		1
	condensation		1
	distillation	allow fractional distillation	1
(c)	lower <b>and</b> more		1
(d)(i)	any sensible answer e.g. bags, bottles etc		1
(ii)	broken down/decomposed by microorganisms	accept rots / decays	1
(iii)	any <b>two</b> from: litter / dumping / eyesore animals eating / trapped / tangled / suffocating etc. burning causes pollution / toxic fumes etc. buried waste takes up valuable land	allow other sensible environmental problems  do <b>not</b> accept harmful / damage	2
total			9

## 3421/F Q5

question	answers	extra information	mark
	clay		1
	limestone		1
	water		1
total			3

## 3421/F Q6

question	answers	extra information	mark
(a)	(good) conductor of electricity	conductor of electricity and heat (+/-) = 0  accept can be drawn into wires <b>or</b> ductile  ignore flexible	1
(b)	strong	accept tough <b>or</b> hard <b>or</b> high tensile strength	1
(c)	reference to <u>colour</u>		1
total			3



## 3421/F Q7

question	answers	extra information	mark
(a)	<p><b>Quality of written communication</b>  <i>The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.</i></p> <p>any <b>three</b> from:</p> <p>floats</p> <p>fizzes/bubbles <b>or</b> produces a gas</p> <p>indicator goes blue / purple / violet (alkaline colour)</p> <p>water level in test tube goes down <b>or</b> gas fills the test tube</p> <p>lithium 'dissolves' (owtte)</p> <p>moves around (on surface of water)</p> <p>steam</p>	<p>maximum 2 marks if ideas not well expressed</p> <p>do <b>not</b> accept flames</p> <p>ignore reference to heat</p>	3
(b)	<p>lithium <u>hydroxide</u></p> <p>hydrogen</p>		1 1
(c)	more violent / reactive	accept a description of the reaction which indicates greater violence	1
(d)(i)	decreases		1
	and then slows down <b>or</b> levels off		1
(ii)	26(°C)		1
total			9

## 3421/F Q8

question	answers	extra information	mark
(a)	any <b>two</b> from: could explode (owtte) <u>reacts</u> with oxygen (air) ignites easily <b>or</b> flammable <b>or</b> fire risk (owtte)	accept 'pop'	2
(b)(i)	lighter / less dense than air	accept each has a <u>very</u> low density	1
(ii)	any <b>two</b> from: noble gas so (very) unreactive <b>or</b> inert will not burn / explode / react	accept group 0, 8 or 18 <b>or</b> has full shells accept 'not reactive'	2
total			5

## 3421/F Q9

question	answers	extra information	mark
(a)	endothermic <b>and</b> because it takes in heat / energy	<b>both</b> for one mark	1
(b)(i)	reversible reaction (or explanation)		1
(ii)	add water	do <b>not</b> accept cooling <b>or</b> reverse the reaction	1
total			3

## 3421/F Q10

question	answers	extra information	mark
(a)	water (molecules) contain two hydrogen atoms and one oxygen atom	all water molecules have the formula H <sub>2</sub> O for <b>2</b> marks  water molecules contain hydrogen and oxygen (atoms) for <b>1</b> mark  water is H <sub>2</sub> O for <b>1</b> mark	2
(b)(i)	atom A has no <u>neutrons</u> / atom B has one <u>neutron</u>	allow different numbers of <u>neutrons</u>	1
(ii)	isotopes		1
total			4

## 3421/F Q11

	answers	extra information	mark
(a)	carbon	accept correct symbol C  do <b>not</b> accept hydrogen	1
(b)(i)	carbon	substance not chosen from list = <b>0</b>	1
	oxidised		1
	water		1
(ii)	carbon monoxide		1
	carbon	do <b>not</b> accept soot	1
	poisonous		1
	oxygen		1
total			8

## 3421/F Q12

	answers	extra information	mark
(a)	rutile		1
	titanium chloride		1
	sodium		1
(b)	not toxic		1
	very strong		1
total			5

## 3421/F Q13

	answers	extra information	mark
(a)	yellow / yellow orange / orange		1
(b)(i)	zinc carbonate		1
(ii)	copper bromide		1
(iii)	magnesium sulphate		1
(c)	(white) <u>precipitate</u> / solid	do <b>not</b> accept cloudy <b>or</b> milky do <b>not</b> accept residue  green precipitate = <b>0</b>	1
total			5

## 3421/F Q14

	answers	extra information	mark
(a)	corrosive		1
(b)(i)	any <b>three</b> from: white → yellow → brown goes black steam / gas / fumes effervescence / rises up / expands time delay (owtte)	ignore exothermic	3
(ii)	dehydrates		1
total			5

## 3421/F Q15

	answers	extra information	mark
(a)(i)	40		1
(ii)	24 (g) (at 30°C) 40 - 24 = 16	ecf from (i)  correct answer <b>2</b> marks	1 1
(b)	any <b>one</b> from: water (H <sub>2</sub> O) is not a liquid below 0°C / freezes at 0°C  exists as ice below 0°C  water (H <sub>2</sub> O) is not a liquid above 100°C  exists as steam above 100°C / boils at 100°C		1
total			4

## 3421/F Q16

question	answers	extra information	mark
(a)(i)	5(%)		1
(ii)	0.35	$\frac{5}{100} \times 7$ for 1 mark	2
(b)(i)	reduction	accept (it's) reduced  do <b>not</b> accept redox / deoxidation	1
(ii)	heat with / reduce / react with <b>or</b> (chemical) reaction  with a metal / element / substance higher in reactivity  <b>or</b> electrolysis: molten           (1) electrolysis    (1)	ignore displace accept higher <u>named</u> elements <b>or</b> symbol accept carbon monoxide / coal / coke  correct word equation for 2 marks correct formulas for 1 mark correct <u>balanced</u> symbol equation for 2 marks	1  1
total			6

## 3421/F Q17

question	answers	extra information	mark
(a)(i)	accurate plotting of points ( $\pm \frac{1}{2}$ square)	<b>2</b> marks for all points <b>1</b> mark for 3 or 4 points	2
	sensible smooth curve	reasonable attempt do <b>not</b> accept double lines <b>or</b> dot to dot	1
(ii)	accurately read from <u>their</u> graph to $\pm \frac{1}{2}$ square		1
(b)(i)	(as temperature increases) rate <u>increases</u>	accept speeds up, gets faster, gets quicker accept higher speed do <b>not</b> accept gets bigger / higher unqualified do <b>not</b> accept answers about time on its own	1
(ii)	<b>Quality of written communication</b> <i>The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.</i>	<i>maximum 2 marks if ideas not expressed well</i>	3
	any <b>three</b> from: particles have more energy particles move faster more collisions more energetic / successful / harder collisions	for converse maximum 2 marks higher kinetic energy do <b>not</b> accept move more or vibrate more accept greater rate of collisions more particles have activation energy	
(c)	concentration (of solutions) <b>or</b> volume (of solutions)	accept 'how much of' accept references to intensity of colour accept same endpoint accept rate of stirring / shaking do <b>not</b> accept reference to solids <b>or</b> catalysts etc ignore containers do <b>not</b> accept pH	1
total			9

## 3421/F Q18

question	answers	extra information	mark
(a)	magnesium is <u>higher</u> in reactivity (than iron) <b>or</b> Mg is <u>more</u> reactive (than Fe)	must be a comparison do <b>not</b> accept Mg corrodes <u>faster</u> (than Fe)	1
	magnesium corrodes / reacts / loses electrons instead (of iron)	sacrificial idea  do <b>not</b> accept magnesium ‘rusts’ instead of iron	1
(b)	sensible answers such as:  difficult to repair / paint or replace a long underground pipe <b>or</b> easier to replace magnesium <b>or</b> easier to carry out inspections	accept to stop pipes corroding causing <u>leaks</u> accept idea of cost of replacing pipe accept damage to pipe  do <b>not</b> accept pollution do <b>not</b> accept corrosion unqualified	1
total			3



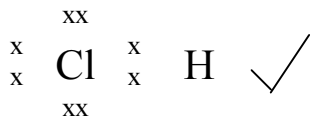
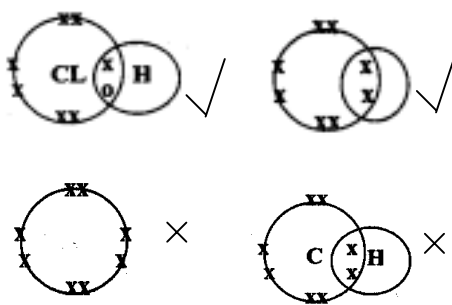
## 3421/F Q19

question	answers	extra information	mark
(a)	<p>any <b>three</b> from:</p> <p><u>less</u> / little / not much carbon dioxide <b>or</b> give a %age &lt; 1%</p> <p>more / a lot of nitrogen <b>or</b> give 78-80%</p> <p>(more) / (some) oxygen <b>or</b> give a %age 20-21%</p> <p>references to pollutant gases in general <b>or</b> named examples</p> <p>more / some water (vapour)</p> <p>some / 1% argon</p> <p>ozone (layer) on earth</p>	<p>accept reverse answers if unambiguous</p> <p>do <b>not</b> accept just different throughout</p> <p>do <b>not</b> accept more "other gases"</p> <p>e.g. CO, SO<sub>2</sub>, NO, NOX etc.</p> <p>ignore other noble gases</p>	3
(b)	<p>any <b>two</b> from:</p> <p>removed carbon dioxide</p> <p>released oxygen</p> <p>caused carbon from carbon dioxide to become locked in sedimentary rocks</p> <p>the oxygen they produced reacted with methane and ammonia</p> <p>produced nitrogen (must be linked to fourth point)</p>	<p>ignore reference to respiration / photosynthesis unless qualified</p> <p>accept correct word / symbol equation for photosynthesis for <b>2</b> marks</p> <p>converted / changed CO<sub>2</sub> to oxygen for <b>2</b> marks</p>	2
total			5

## 3421/F Q20

question	answers	extra information	mark
(a)	coke / carbon / C	do <b>not</b> accept coal	1
	<u>hot</u> air	do <b>not</b> accept oxygen	1
	slag / calcium silicate / CaSiO <sub>3</sub>		1
(b)(i)	2 3	accept <u>correct</u> multiples  do <b>not</b> accept any added different chemicals	1
(ii)	iron oxide <b>or</b> Fe <sub>2</sub> O <sub>3</sub> / iron (III) oxide	ignore iron ore / haematite do <b>not</b> accept iron (II) oxide do <b>not</b> accept Fe <sup>3+</sup>	1
(c)(i)	160	ignore units  (2 × 56) + (3 × 16) for <b>1</b> mark	2
(ii)	70	$\frac{2 \times 56}{160} (\times 100)$ for <b>1</b> mark  allow ecf from part (i)	2
(iii)	700	allow ecf from part (ii)	1
total			10

## 3421/F Q21

question	answers	extra information	mark
(a)	bonding pair in the overlap <b>and</b> 6 other electrons arranged around the chlorine  e.g. 	must have either circles or symbols  need not be pairs but must not be in the overlap region accept without H and Cl if clear accept all x's or all o's  	1
(b)	$\text{H}_2 + \text{Cl}_2 \rightarrow 2\text{HCl}$	accept multiples <b>or</b> fractions accept correct formulae but not balanced for <b>1</b> mark  correctly balanced equation containing 'correct' lower / upper case symbols gets <b>1</b> mark e.g. $\text{h}_2 + \text{cl}_2 \rightarrow 2\text{HCL}$	2
(c)	$\text{MgCl}_2$	accept $\text{Mg}^{2+}(\text{Cl}^-)_2$	1
(d)	because magnesium chloride is made of ions <b>or</b> is ionic          hydrogen chloride is made of molecules <b>or</b> is covalent	accept there are strong forces of attraction between the ions / particles in $\text{MgCl}_2$ <b>or</b> strong electrostatic attractions accept more energy to separate particles in $\text{MgCl}_2$  do <b>not</b> accept $\text{MgCl}_2$ molecules do <b>not</b> accept reference to breaking bonds  accept there are only weak forces of attraction (between the particles / molecules) in HCl  do <b>not</b> accept weak covalent bonds do <b>not</b> accept reference to breaking bonds do <b>not</b> accept $\text{MgCl}_2$ is a solid and HCl is a gas	1          1
total			6

## 3421/F Q22

	answers	extra information	mark
(a)(i)	not fully ionised / dissociated <b>or</b> partially ionised	accept weak acids <b>produce</b> fewer H <sup>+</sup> if equal concentration <b>or</b> equal amounts of acid specified  do <b>not</b> accept just weakly ionised	1
(ii)	Test: Universal Indicator / pH indicator / full range indicator	do <b>not</b> accept other indicators	1
	Result: e.g. stronger is a darker red <b>or</b> weaker is orange, yellow, paler red etc. <b>or</b> correct pH numbers < 7  <b>or</b> pH meter (1)  correct pH values (1)  <b>or</b> Test: Mg / Zn / Fe / Sn or a carbonate / hydrogencarbonate (1)  Result: e.g. stronger is quicker / faster rate / more bubbles / more gas / more correctly named gas (1)	accept redder accept pink for paler red  do <b>not</b> accept green  result linked  Any suitable test but not titration	1
(b)	<b>Quality of written communication</b> <i>The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.</i>  acids produce hydrogen ions  acids are proton donors  Link: hydrogen ions (Arrhenius) and protons (Bronsted-Lowry)	<i>maximum 2 marks if ideas not well expressed</i>	1  1  1
total			6

## 3421/F Q23

	answers	extra information	mark
(a)	water came into contact with rocks / ground / soil	ignore mountains erode gets first mark	1
	ions or compounds or chemicals <b>or</b> they dissolved / soluble / leached / reacts / forms a solution	do <b>not</b> accept gets picked up  accept water dissolves them from the rocks for <b>2</b> marks	1
(b)(i)	calcium <b>or</b> magnesium	accept $\text{Ca}^{2+}$ <b>or</b> $\text{Mg}^{2+}$ <b>or</b> Ca <b>or</b> Mg  do <b>not</b> accept $\text{Ca}^+$ alone	1
(ii)	answers must involve both calcium and magnesium  Ridgway: $\text{Ca} + \text{Mg} = 53$  Homeland: $\text{Ca} + \text{Mg} = 27$	totals required for 2 marks   accept there is (almost) twice as much Magnesium and Calcium in Ridgway water for <b>1</b> mark	1  1
	(iii)	equal volumes / quantities / amounts of water  add soap with shaking / mixing / agitation  the harder sample (Ridgway) needs 2× more soap to give lather <b>or</b> the less hard sample (Homeland) needs half as much soap to give lather can get twice as much scum with harder (Ridgway) sample	1  1  1
total			8

## 3421/F Q24

	answers	extra information	mark
(a)	aluminium is high in / near the top of the reactivity series / very reactive	more reactive than iron <b>or</b> copper <b>or</b> zinc  do <b>not</b> accept just reactive	1
(b)	sodium hydroxide <b>or</b> potassium hydroxide	accept NaOH / KOH	1
(c)	(dilute) sulphuric acid	accept H <sub>2</sub> SO <sub>4</sub>  do <b>not</b> accept concentrated sulphuric acid	1
(d)	$4\text{Al} + 3\text{O}_2 \rightarrow 2\text{Al}_2\text{O}_3$	accept multiples <b>or</b> fractions	1
total			4