Version 1.0: 0109

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Additional Science 4463 / Chemistry 4421

CHY2H Unit Chemistry 2

Mark Scheme

2009 examination – January series

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.

Set and published by the Assessment and Qualifications Alliance.

The Assessment and Qualifications Alliance (AQA) is a company limited by guarantee registered in England and Wales (company number 3644723) and a registered charity (registered charity number 1073334).
Registered address: AQA, Devas Street, Manchester M15 6EX *Dr Michael Cresswell Director General*

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.

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.

COMPONENT NUMBER: CHY2H

COMPONENT NAME: Additional Science / Chemistry

STATUS: Final

DATE: January 2009

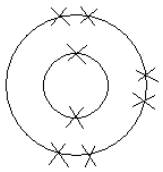
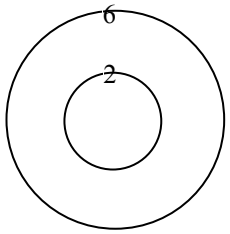
question	answers	extra information	mark
1(a)	152	correct answer with **or** without working = **2 marks** 56 + 32 + (4 ×16) gains **1** mark ignore any units	2
1(b)	152g(rams)	ecf from the answer to (a) and g must have unit g / gram / gramme / grams etc accept g / mol **or** g per mole **or** g $mole^{-1}$ **or** g/mol **or** g per mol **or** g mol^{-1} do **not** accept g m do **not** accept G	1
1(c)	76(g)	ecf from their answer to (a) or (b) divided by 2 ignore units	1
Total			**4**

COMPONENT NUMBER: CHY2H

COMPONENT NAME: Additional Science / Chemistry

STATUS: Final

DATE: January 2009

question	answers	extra information	mark
2(a)(i)	 **or** 	allow any arrangement of electrons on the shells accept o, x, - **or** e as representing electrons	1
2(a)(ii)	nucleus	accept nucleus (protons plus neutrons) do **not** accept protons plus neutrons on its own allow nuclei / nucles / neucleus / phonetic spelling do **not** accept neutron	1

Question 2 continued on next page...

COMPONENT NUMBER: CHY2H

COMPONENT NAME: Additional Science / Chemistry

STATUS: Final

DATE: January 2009

Question 2 continued...

question	answers	extra information	mark
2(b)	it has **2** more neutrons **or** converse **or** O-16 has 8 neutrons (**1 mark**) O-18 has 10 neutrons (**1 mark**)	accept 'it has more neutrons' **or** 'different number of neutrons' for **1 mark** '2 more protons / electrons + correct number of neutrons' = max **1** mark if incorrectly calculated but shows more neutrons in 0-18 allow for **1** mark accept it has more particles **or** it has 2 more particles for **1** mark ignore any reference to charges just 2 more without reference to particles = **0** marks	2
Total			**4**

COMPONENT NUMBER: CHY2H

COMPONENT NAME: Additional Science / Chemistry

STATUS: Final

DATE: January 2009

question	answers	extra information	mark
3(a)	he made urea / organic compound / he made another organic compound	ignore 'he made it' unless qualified eg accept he made it from non-living material **or** not made from animals / plants	1
3(b)	any **one** from: sensible ideas eg • famous scientists / eminent scientists / high status scientists accepted the life-force theory (owtte) • sensible references to lack of status of Wöhler • was not in line with accepted ideas of time / religious beliefs etc • other sensible answers eg fake / anomalous result **or** lack of evidence / proof **or** not reliable **or** not repeated owtte	 eg it was a new idea accept only made 1 compound	1
3(c)	sensible idea such as: Wöhler made another organic compound **or** more evidence **or** repeated it	accept 'other scientists repeated his experiment / made other organic compounds'	1
3(d)(i)	nitric (acid)	Spelling must be correct accept HNO_3 correctly written ignore hydrogen nitrate	1
3(d)(ii)	evaporate **or** allow to crystallise	allow heat / boil / cool do **not** allow freeze ignore filtration ignore distillation	1

Question 3 continued on next page...

COMPONENT NUMBER: CHY2H

COMPONENT NAME: Additional Science / Chemistry

STATUS: Final

DATE: January 2009

Question 3 continued...

question	answers	extra information	mark
3(e)	any **two** from: • more of the starting materials end up as useful products • less / fewer reactants / atoms <u>used</u> **or** method 1 has more reactants / atoms <u>used</u> • method 1 has 4 reactants • method 2 has 2 reactants • less / fewer (waste) products / atoms in the products **or** method 1 has more (waste) products / atoms in products • in method one there are 2 waste products / 15 waste atoms (or similar idea) • in method two there is only one waste product / only 3 wasted atoms **or** correctly calculated atom economies for both marks method 1 : 21.3% (1) method 2 : 76.9% (1) **or** atom economy equation correctly stated (1) atom economy = $\frac{M_r \text{ of useful product}}{\text{(total) } M_r \text{ of reactants}} \times 100$ atom economy = $\frac{M_r \text{ of useful product}}{\text{(total) } M_r \text{ of products}} \times 100$ sensible explanation of why method 1 has a higher atom economy in terms of the equation (or converse) (1)	accept 'less chemicals / compounds /substances <u>used</u>' ignore less elements / materials used accept method 1 <u>uses</u> 4 chemicals accept method 2 <u>uses</u> 2 chemicals accept less waste accept unwanted chemicals for waste products accept converse accept comparison of named waste products for both marks eg in method 2 only H_2O is wasted whereas in method 1 KNO_3 and $Pb(OH)_2$ is wasted ignore purification / pollution accept 21% accept 77%	2
Total			**7**

COMPONENT NUMBER: CHY2H

COMPONENT NAME: Additional Science / Chemistry

STATUS: Final

DATE: January 2009

question	answers	extra information	mark
4(a)(i)	increase (owtte) **or** gets hotter	ignore gives out heat / takes in heat	1
4(a)(ii)	any **two** from: • <u>bonds</u> are strong • a lot of energy needed to break bonds • <u>all</u> atoms are joined by (covalent) bonds • a large number of bonds would need to be broken	accept hard to break allow heat for energy accept forms lattice reference to ionic / metallic = **1** mark intermolecular forces /forces between molecules = max **1** mark ignore electrostatic many strong bonds need to be broken = **2** marks accept 'double bonds' as equivalent to bonds	2

Question 4 continued on next page…

COMPONENT NUMBER: CHY2H

COMPONENT NAME: Additional Science / Chemistry

STATUS: Final

DATE: January 2009

Question 4 continued…

question	answers	extra information	mark
4(b)	any **two** from: • particles have more energy • particles move faster • particles collide more often **or** more collisions • more particles / particle collisions have the activation energy **or** more of the particles / particle collisions have enough energy to react **or** collisions are more energetic / harder (owtte) **or** more of the collisions are successful	 ignore more vibrations ignore move more accept answers such as hit / bump if electrons rather than particles stated then max **1** mark there are more collisions and more of the collisions are successful = **2** marks accept more collisions per second / unit of time for **2** marks accept 'more successful collisions' for **1** mark	2
Total			**5**

COMPONENT NUMBER: CHY2H

COMPONENT NAME: Additional Science / Chemistry

STATUS: Final

DATE: January 2009

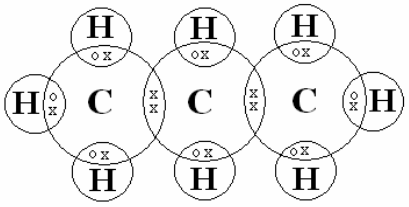
question	answers	extra information	mark
5(a)	1–100 nm in size **or** a few (hundred) atoms in size	accept very / really small / tiny **or** 10^{-9} accept billionth of a metre **or** any number that implies very small accept measured in nanometres if answer 'very small' ignore incorrect numerical values	1
5(b)	any **two** from: • less tennis balls need to be made • tennis balls last longer **or** don't have to replace as often • less materials / resources / fuel used up / saves resources • less energy used **or** making tennis balls uses energy • less pollution caused • less waste	accept saving materials accept saving energy accept named pollutant accept global warming / greenhouse effect eg fewer tennis balls going to landfill	2
Total			**3**

COMPONENT NUMBER: CHY2H

COMPONENT NAME: Additional Science / Chemistry

STATUS: Final

DATE: January 2009

question	answers	extra information	mark
6(a)		allow all dots **or** all crosses **or** combination **or** all e / e^- **or** – **or** other suitable symbols centre of symbols must be on **or** inside overlapping areas within reason	1
6(b)(i)	any **two** from: • no change initially **or** stays constant at the beginning • increase • slowly at first and then more rapidly	accept converse arguments allow vapour pressure is 0 at any temperature <–100°C for **1** mark accept positive correlation accept explanation based on kinetic theory eg particles have more kinetic energy allow reasonable attempt at using numbers	2
6(b)(ii)	–44 (using graph)	accept –43 to –45	1

Question 6 continued over page…

COMPONENT NUMBER: CHY2H

COMPONENT NAME: Additional Science / Chemistry

STATUS: Final

DATE: January 2009

Question 6 continued…

question	answers	extra information	mark
6(c)	• intermolecular forces / bonds **or** forces / bonds between molecules • bonds / forces are weak	**covalent** bonds are weak = **0** marks if they do not gain either of the marks on the left then allow simple covalent / molecular / made of small molecules for **1** mark	1 1
Total			**6**

COMPONENT NUMBER: CHY2H

COMPONENT NAME: Additional Science / Chemistry

STATUS: Final

DATE: January 2009

question	answers	extra information	mark
7(a)	any **two** from: • outer shell electrons / electrons in highest energy level (in metals) • electrons are delocalised / sea of electrons • electrons are free **or** electrons move around **or** electrons are free to flow **or** electrons attracted to positive terminal • electrons carry charge / current **or** electrons form the current / electrons transfer charge / electrons pass charge	ignore electrons carry electricity ignore reference to positively charged atoms / ions if they state electrons have +ve charge = max **1** mark if they state covalent bonding then max **1** mark	2
7(b)	ions can move / are attracted to electrode **or** attracted to named electrode **or** ions are charged **or** ions form / carry the current **or** ions form the charge	accept ions are free allow 'they' for ions	1
7(c)(i)	electron gain	ignore hydrogen reduces charge	1
7(c)(ii)	sodium hydroxide **or** NaOH **or** caustic soda	do **not** allow hydroxide alone	1

Question 7 continued over page…

COMPONENT NUMBER: CHY2H

COMPONENT NAME: Additional Science / Chemistry

STATUS: Final

DATE: January 2009

Question 7 continued…

question	answers	extra information	mark
7(c)(iii)	$2Cl^- - 2e^- \rightarrow Cl_2$ **or** $2Cl^- \rightarrow Cl_2 + 2e^-$	allow fractions **or** multiples allow e **or** e^- do **not** allow e^+	1
Total			**6**

COMPONENT NUMBER: CHY2H

COMPONENT NAME: Additional Science / Chemistry

STATUS: Final

DATE: January 2009

question	answers	extra information	mark
8(a)	2.61 / range 2.5 to 2.7	correct answer with **or** without **or** with wrong working gains **2** marks (accept answers between 2.5 and 2.7) if answer incorrect moles of salicylic acid = 2/138 = 0.0145 moles ie 2/138 **or** 0.0145 gains **1** mark **or** (180/138) × 2 gains **1** mark **or** 1 g → 180/138 = (1.304 g) gains **1** mark (**not** 1.304g alone)	2
8(b)	42.1 range 40.7 to 42.3 if they do not have an answer to part (a) **or** they choose not to use their answer then: • yield = (1.1 / 2.5) × 100 (1) • = 44	accept correct answer with **or** without **or** with wrong working for **2** marks ecf ie (1.1 / their answer from (a)) × 100 correctly calculated gains **2** marks if answer incorrect percentage yield = 1.1 / 2.61 × 100 gains **1** mark accept 44 for **2** marks with no working	2

Question 8 continues on the next page...

COMPONENT NUMBER: CHY2H

COMPONENT NAME: Additional Science / Chemistry

STATUS: Final

DATE: January 2009

Question 8 continued...

question	answers	extra information	mark
8(c)	any **one** from: • errors in weighing • some (of the aspirin) lost • not all of the reactant may have been converted to product • the reaction is reversible • side reactions • reactants impure • not heated for long enough • not hot enough for reaction to take place	do **not** allow 'lost as a gas' eg reaction didn't go to completion allow loss of some reactants accept other products / chemicals ignore waste products	1
8(d)	any **one** from: • use lower temperature • use less fuel / energy • produce product faster **or** speed up reaction • more product produced in a given time (owtte) • increased productivity • lowers activation energy	ignore references to use of catalyst	1
Total			**6**

COMPONENT NUMBER: CHY2H

COMPONENT NAME: Additional Science / Chemistry

STATUS: Final

DATE: January 2009

question	answers	extra information	mark
9(a)	fewer product molecules than reactant molecules (owtte) **or** 3 reactant molecules and 1 product **or** 3 volumes of gas becomes 1 volume of gas	accept forward reaction produces fewer molecules accept left hand side for reactants and right hand side for products accept high pressure favours the side with fewer molecules ignore references to reaction rate	1
9(b)	any **three** from: • low temperature gives best yield **or** high temperature gives poor yield • because the reaction is exothermic • reaction too slow at low temperature **or** reaction faster at high temperature • temperature used gives a reasonable yield at a fast rate / compromise explained	 accept add heat as increased temperature **or** 'less' as poor yield accept reverse argument if clearly expressed accept add heat and reaction goes faster allow get less product but it takes less time for **2** marks	3
Total			**4**