AQA

GCSE
Chemistry

8462/1H – PAPER 1 – HIGHER TIER

Mark scheme

8462

June 2018

Version/Stage: 1.1 Final

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

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

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

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
- the Assessment Objectives and specification content that each question is intended to cover.

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

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

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

2. Emboldening and underlining

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

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

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

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

3. Marking points

3.1 Marking of lists

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

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

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

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

[1 mark]

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

Example 2: Name two planets in the solar system.

[2 marks]

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

3.2 Use of chemical symbols / formulae

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

3.3 Marking procedure for calculations

Marks should be awarded for each stage of the calculation completed correctly, as students are instructed to show their working. Full marks can, however, be given for a correct numerical answer, without any working shown.

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 is kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation ecf in the marking scheme.

3.6 Phonetic spelling

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

3.7 Brackets

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

3.8 Allow

In the mark scheme additional information, 'allow' is used to indicate creditworthy alternative answers.

3.9 Ignore

Ignore is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

3.10 Do not accept

Do **not** accept means that this is a wrong answer which, even if the correct answer is given as well, will still mean that the mark is not awarded.

4. Level of response marking instructions

Extended response questions are marked on level of response mark schemes.

- Level of response mark schemes are broken down into levels, each of which has a descriptor.
- The descriptor for the level shows the average performance for the level.
- There are two marks in each level.

Before you apply the mark scheme to a student's answer, read through the answer and annotate it (as instructed) to show the qualities that are being looked for. You can then apply the mark scheme.

Step 1: Determine a level

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptor for that level. The descriptor for the level indicates the different qualities that might be seen in the student's answer for that level. If it meets the lowest level then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer.

When assigning a level you should look at the overall quality of the answer. Do **not** look to penalise small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level.

Use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 2 with a small amount of level 3 material it would be placed in level 2 but be awarded a mark near the top of the level because of the level 3 content.

Step 2: Determine a mark

Once you have assigned a level you need to decide on the mark. The descriptors on how to allocate marks can help with this.

The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do **not** have to cover all of the points mentioned in the indicative content to reach the highest level of the mark scheme.

You should ignore any irrelevant points made. However, full marks can be awarded only if there are no incorrect statements that contradict a correct response.

An answer which contains nothing of relevance to the question must be awarded no marks.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	any **one** from: • metal • (metal) hydroxide • (metal) carbonate • alkali	allow named example allow correct formula ignore base allow ammonium hydroxide allow ammonium carbonate allow soluble base allow ammonia	1	AO1 4.4.2.1 4.4.2.2 4.4.2.3
01.2	$Ca(NO_3)_2$	allow $Ca^{2+}(NO_3^-)_2$	1	AO2 4.4.2.2

Question	Answers	Mark	AO / Spec. Ref.
01.3	**Level 3:** The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	5–6	AO1 4.4.2.3
	Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.	3–4	
	Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2	
	No relevant content	0	
	Indicative content • use magnesium oxide and sulfuric acid • add sulfuric acid to a beaker • warm sulfuric acid • add magnesium oxide • stir • continue adding until magnesium oxide is in excess • filter • using a filter paper and funnel • to remove excess magnesium oxide • heat solution in an evaporating basin • to crystallisation point • leave to crystallise • pat dry with filter paper credit may be given for diagrams		

Total			**8**

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	FeS_2	do **not** accept equations	1	AO2 4.2.1.3
02.2	26 30 26	must be this order	1 1 1	AO2 4.1.1.4 4.1.1.5
02.3	any **two** from: • iron has a high(er) melting / boiling point • iron is dense(r) • iron is hard(er) • iron is strong(er) • iron is less reactive • iron has ions with different charges • iron forms coloured compounds • iron can be a catalyst	allow the converse statements for sodium allow transition metal for iron allow Group 1 metal for sodium ignore references to atomic structure ignore iron rusts allow iron is less malleable / ductile allow specific reactions showing difference in reactivity allow iron is magnetic	2	AO1 4.1.2.5 4.1.3.1 4.1.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	carbon is more reactive (than nickel)	allow converse	1	AO1 4.4.1.2 4.4.1.3
	(so) carbon will displace / replace nickel (from nickel oxide) **or** (so) carbon will remove oxygen (from nickel oxide)	allow (so) nickel ions gain electrons allow (so) carbon transfers electrons to nickel (ions)	1	
02.5		an answer of 67.8 (%) scores **3** marks an answer of 67.8160919 (%) or correctly rounded answer to 2, 4 or more sig figs scores **2** marks an incorrect answer for one step does **not** prevent allocation of marks for subsequent steps		AO2 4.3.3.2
	(total M_r of reactants =) 87		1	
	(percentage atom economy) $= \frac{59}{87} \times 100$	allow (percentage atom economy) $= \frac{59}{\text{incorrectly calculated } M_r} \times 100$	1	
	= 67.8 (%)	allow an answer from an incorrect calculation to 3 sig figs	1	
Total			**11**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	copper, zinc, sodium chloride solution		1	AO2 4.5.2.1
03.2	a reactant is used up	allow the reaction stops allow electrolyte / electrode / ions / metal / metal hydroxide / alkali for reactant	1	AO1 4.5.2.1
03.3	the reaction is not reversible		1	AO1 4.5.2.1
03.4	$2H_2 + O_2 \rightarrow 2H_2O$	allow fractions / multiples allow **1** mark for O_2	2	AO1 AO2 4.1.1.1 4.5.2.2

Question	Answers	Mark	AO / Spec. Ref.
03.5	**Level 3:** A judgement, strongly linked and logically supported by a sufficient range of correct reasons, is given.	5–6	AO3
	Level 2: Some logically linked reasons are given. There may also be a simple judgement.	3–4	AO3
	Level 1: Relevant points are made. This is not logically linked.	1–2	AO2
	No relevant content	0	
	Indicative content (see below)		4.4.3.4 4.5.2.1 4.5.2.2

Indicative content

reasons why fuel cells could be judged as better

from the table	from other knowledge
• time for refuelling a fuel cell is faster than recharging **or** a fuel cell does not need to be recharged • a fuel cell has a greater range	• hydrogen can be renewable if made by electrolysis using renewable energy • lithium-ion batteries can catch fire • produces only water **or** no pollutants produced • lithium-ion batteries may release toxic chemicals on disposal • lithium-ion batteries (eventually cannot be recharged so) have a finite life

reasons why the lithium-ion battery could be judged as better

from the table	from other knowledge
• lithium-ion uses energy more efficiently • cost of lithium-ion car much less • cost of recharging much less than refuelling with hydrogen	• hydrogen is often made from fossil fuels so is not renewable • charging points are more widely available than hydrogen filling stations • hydrogen takes up a lot of space **or** is difficult to store • hydrogen can be highly flammable / explosive • no emissions produced • (catalyst in the hydrogen fuel-cell eventually becomes poisoned so) have a finite life

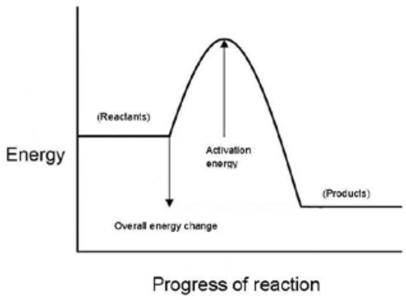
Total			**11**

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	B		1	AO1 4.1.1.3
04.2	C		1	AO2 4.1.1.3
04.3	A		1	AO2 4.1.1.3
04.4	sum of protons and neutrons	allow number of protons and neutrons	1	AO1 4.1.1.5
04.5	between 69.5 and 70.0		1	AO2 4.1.1.6
04.6	Chadwick provided the evidence to show the existence of neutrons	allow Chadwick discovered neutrons	1	AO1 4.1.1.3
	(this was necessary because) isotopes have the same number of protons **or** (this was necessary because) isotopes are atoms of the same element	allow (this was necessary because) isotopes have the same atomic number ignore isotopes have the same number of electrons	1	AO3 4.1.1.5
	but with different numbers of neutrons	allow but with different mass (numbers)	1	AO1 4.1.1.5
Total			**8**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	all 4 metals labelled and suitable scale on *y*-axis	magnesium value must be at least half the height of the grid	1	AO2 4.4.1.2 4.5.1.1
	all bars correctly plotted	allow a tolerance of ± ½ a small square ignore width and spacing of bars allow **1** mark if copper not included and other 3 bars plotted correctly	1	
05.2		ignore because it is exothermic ignore references to copper		AO3 4.5.1.1
	temperature increases	allow (because) energy / 'heat' is transferred to the surroundings allow energy / 'heat' is given out	1	
	or			
	temperature does not decrease	allow energy / 'heat' is not taken in (from the surroundings) allow the energy of the products is less than the energy of the reactants		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	suitable method described		1	AO3 4.4.1.2 4.5.1.1
	the observations / measurements required to place in order	dependent on a suitable method	1	
	an indication of how results would be used to place the unknown metal in the reactivity series		1	
	a control variable to give a valid result		1	
	approaches that could be used **approach 1:** add the unknown metal to copper sulfate solution (1) measure temperature change (1) place the metals in order of temperature change (1) any **one** from (1): • same volume of solution • same concentration of solution • same mass / moles of metal • same state of division of metal **approach 2:** add the metal to salt solutions of the other metals **or** heat the metal with oxides of the other metals (1) measure temperature change (only if salt solutions used) **or** observe whether a chemical change occurs (1) place the metals in order of temperature change **or** compare whether there is a reaction to place in correct order (1) any **one** from (1): • same volume of salt solutions • same concentration of salt solutions • same (initial) temperature of salt solutions • same mass / moles of metal **or** metal oxide • same state of division of metal **or** metal oxide			

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3 cont.	**approach 3:** add all of the metals to an acid (1) measure temperature change or means of comparing rate of reaction (1) place the metals in order of temperature change or rate of reaction (1) any **one** from (1): • same volume of acid • same concentration of acid • same (initial) temperature of acid • same mass / moles of metal • same state of division of metal **approach 4:** set up electrochemical cells with the unknown metal as one electrode and each of the other metals as the other electrode (1) measure the voltage of the cell (1) place the metals in order of voltage (1) any **one** from (1): • same electrolyte • same concentration of electrolyte • same temperature of electrolyte			

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4		an answer of:  scores **3** marks		AO1 4.5.1.2
	correct shape for exothermic reaction	the reactant and product lines needed not be labelled do **not** accept incorrectly labelled reactant and product lines	1	
	labelled activation energy		1	
	labelled (overall) energy change		1	
		ignore arrow heads		
Total			**10**	

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	

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

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**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	potassium chloride **and** iodine	either order allow KCl for potassium chloride and I_2 for iodine	1	AO1 4.1.2.6
07.2		allow converse statements allow energy levels for shells throughout		AO1 4.1.2.6
	(chlorine's) outer electrons / shell closer to the nucleus	allow chlorine has fewer shells allow chlorine atom is smaller than iodine atom ignore chlorine has fewer outer shells	1	
	(so) the chlorine nucleus has greater attraction for outer electrons / shell	allow chlorine has less shielding do **not** accept incorrect types of attraction	1	
	(so) chlorine gains an electron more easily		1	
		maxf 2 marks can be awarded if the answer refers to chloride / iodide instead of chlorine / iodine		
07.3	hydrogen chloride is made of small molecules	allow hydrogen chloride is simple molecular	1	AO1 4.1.2.6 4.2.1.4 4.2.2.4
	(so hydrogen chloride) has weak intermolecular forces	do **not** accept reference to bonds breaking unless applied to intermolecular bonds	1	
	(intermolecular forces) require little energy to overcome		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4		an answer of 290 (kJ/mol) scores **4** marks an answer of 188 (kJ/mol) scores **3** marks an incorrect answer for one step does **not** prevent allocation of marks for subsequent steps		AO2 4.5.1.3
	(bonds broken = 4(412) + 193 =)1841		1	
	(bonds formed = 3(412) + 366 + **X** =) 1602 + **X**		1	
	−51 = 1841 − (1602 + **X**)	allow use of incorrectly calculated values of bonds broken and / or bonds formed from steps 1 and 2 for steps 3 and 4	1	
	(X =) 290 (kJ/mol)	allow a correctly calculated answer from use of −51 = bonds formed – bonds broken	1	
	OR alternative method ignoring the 3 unchanged C–H bonds (412 + 193 =) 605 (1) 366 + **X** (1) −51 = 605 − (366 + **X**) (1) (**X** =) 290 (kJ/mol) (1)			

Total			Mark
Total			**11**

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	chlorine is toxic	allow carbon monoxide is toxic allow poisonous for toxic ignore harmful / deadly / dangerous allow a poisonous gas is used / produced allow titanium chloride is corrosive	1	AO3 4.1.2.6 4.4.1.3
08.2	any **one** from: • very exothermic reaction • produces a corrosive solution • produces hydrogen, which is explosive / flammable	 allow explosive allow violent reaction ignore vigorous reaction ignore sodium is very reactive allow caustic for corrosive ignore alkaline allow flames produced ignore sodium burns	1	AO3 4.1.2.5 4.4.1.3
08.3	argon is unreactive / inert oxygen (from air) would react with sodium / titanium **or** water vapour (from air) would react with sodium / titanium	allow argon will not react (with reactants / products / elements) allow elements / reactants / products for sodium / titanium	1 1	AO3 4.1.2.4 4.1.2.5 4.4.1.1 4.4.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.4	metal chlorides are usually ionic	allow titanium chloride is ionic	1	AO1 4.1.2.6 4.1.3.1 4.2.1.2 4.2.2.3 4.2.2.4
	(so)(metal chlorides) are solid at room temperature **or** (so)(metal chlorides) have high melting points	allow titanium chloride for metal chlorides	1	
	(because) they have strong (electrostatic) forces between the ions **or** (but) must be a small molecule or covalent	ignore strong ionic bonds allow molecular allow alternative approach: titanium chloride must be covalent **or** has small molecules (1) with weak forces between molecules do **not** accept bonds unless intermolecular bonds(1) (but) metal chlorides are usually ionic (1)	1	
08.5	sodium (atoms) lose electrons	do **not** accept references to oxygen	1	AO1 4.4.1.4
08.6	$Na \rightarrow Na^{+} + e^{-}$	do **not** accept e for e^{-}	1	AO2 4.1.1.1 4.4.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.7		an incorrect answer for one step does **not** prevent allocation of marks for subsequent steps		AO2 4.3.1.2 4.3.2.1 4.3.2.2 4.3.2.4
	(M_r of $TiCl_4$ =) 190		1	
	(moles Na) = $\frac{20\,000}{23}$ =) 870 (mol	allow **1** mark for 0.870 mol Na **and** 0.211 mol $TiCl_4$	1	
	$\left(\text{moles } TiCl_4 = \frac{40\,000}{190} =\right)$ 211 (mol)	allow use of incorrectly calculated M_r from step 1	1	
	either (sodium is in excess because) 870 mol Na is more than the 844 mol needed **or** (because) 211 mol $TiCl_4$ is less than the 217.5 mol needed	the mark is for correct application of the factor of 4 other correct reasoning showing, with values of moles or mass, an excess of sodium or insufficient $TiCl_4$ is acceptable allow use of incorrect number of moles from steps 2 and / or 3 alternative approaches: **approach 1:** (M_r of $TiCl_4$ =) 190(1) (40 kg $TiCl_4$ needs) $\frac{40}{190} \times 4 \times 23$ (kg Na) (1) (=) 19.4 (kg) (1) so 20 kg is an excess (1) **approach 2:** (M_r of $TiCl_4$ =) 190(1) (20 kg Na needs) $\frac{20}{4 \times 23} \times 190$ (kg $TiCl_4$) (1) (=) 41.3 (kg) (1) so 40 kg is not enough (1)	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.8		an answer 12.5 (kg) scores **2** marks		AO2 4.3.3.1
	(actual mass =) $\frac{92.3}{100} \times 13.5$ **or** (actual mass =) 0.923×13.5		1	
	= 12.5 (kg)	allow 12 / 12.46 / 12.461 / 12.4605 (kg)	1	
Total			**15**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	(strong because) completely ionised (in aqueous solution)	ignore pH allow dissociated for ionised do **not** accept hydrogen is ionising do **not** accept H^+ are ionised	1	AO1 4.3.4 4.4.2.6
	(dilute because) small amount of acid per unit volume	ignore low concentration	1	AO1 4.3.4 4.4.2.6
09.2	5.0	allow 5	1	AO2 4.4.2.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.3		an incorrect answer for one step does **not** prevent allocation of marks for subsequent steps		AO2 4.3.4 4.4.2.5
	(titre): chooses titrations 3, 4, 5		1	
	average titre = 22.13 (cm^3)	allow average titre = 22.13(3…) (cm^3) allow a correctly calculated average from an incorrect choice of titrations	1	
	(calculation): (moles NaOH = $\frac{22.13}{1000} \times 0.105 = 0.002324$)	allow use of incorrect average titre from step 2	1	
	(moles H_2SO_4 = ½ × 0.002324 =) 0.001162	allow use of incorrect number of moles from step 3	1	
	(concentration = $\frac{0.001162}{25} \times 1000$) = 0.0465 (mol/$dm^3$)	allow use of incorrect moles from step 4	1	
		alternative approach for step 3, step 4 and step 5 $\frac{2}{1} = \frac{22.13 \times 0.105}{25.0 \times \text{conc. } H_2SO_4}$ (1) (concentration H_2SO_4 =) $\frac{22.13 \times 0.105}{25.0 \times 2}$ = 0.0465 (mol/dm^3) (1) an answer of 0.046473 **or** 0.04648 correctly rounded to at least 2 sig figs scores marking points 3, 4 and 5 an answer of 0.092946 **or** 0.09296 **or** 0.185892 **or** 0.18592 correctly rounded to at least 2 sig figs scores marking points 3 and 5		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.4	pipette measures a fixed volume (accurately) (but) burette measures variable volume	 allow can measure drop by drop	1 1	AO1 4.4.2.5
09.5	(moles =) $\frac{30}{1000} \times 0.105$ **or** 0.00315 (mol) **or** (mass per dm^3 =) 0.105×40 **or** 4.2 (g) (mass = $\frac{30}{1000} \times 0.105 \times 40$) = 0.126 (g)	an answer of 0.126 (g) scores **2** marks an answer of 126(g) scores **1** mark an incorrect answer for one step does **not** prevent allocation of marks for subsequent steps	1 1	AO2 4.3.2.5 4.3.4 4.4.2.5
Total			**12**	