GCSE
CHEMISTRY
8462/1H

Paper 1 Higher Tier

Mark scheme

June 2022

Version: 1.0 Final Mark Scheme



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 Examiner.

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

Copyright information

AQA retains the copyright on all its publications. However, registered schools/colleges for AQA are permitted to copy material from this booklet for their own internal use, with the following important exception: AQA cannot give permission to schools/colleges to photocopy any material that is acknowledged to a third party even for internal use within the centre.

Copyright © 2022 AQA and its licensors. All rights reserved.

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 their 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 (for example, a scientifically correct answer that could not reasonably be expected from a student's knowledge of the specification).

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**.
Alternative words in the mark scheme are shown by a solidus 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 errors / 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** magnetic materials.

[2 marks]

Student	Response	Marks awarded
1	iron, steel, tin	1
2	cobalt, nickel, nail*	2

3.2 Use of symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, or uses symbols to denote quantities in a physics equation, 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. At any point in a calculation students may omit steps from their working. If a subsequent step is given correctly, the relevant marks may be awarded.

Full marks are **not** awarded for a correct final answer from incorrect working.

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

An error can be carried forward from one question part to the next and is shown by the abbreviation 'ecf'.

Within an individual question part, an incorrect value in one step of a calculation does not prevent all of the subsequent marks being awarded.

3.6 Phonetic spelling

Marks should be awarded if spelling is not correct but the intention is clear, **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 <u>not</u> 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.

3.11 Numbered answer lines

Numbered lines on the question paper are intended to support the student to give the correct number of responses. The answer should still be marked as a whole.

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, if necessary, 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. With practice and familiarity you will find that for better answers you will be able to quickly skip through the lower levels of the mark scheme.

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.

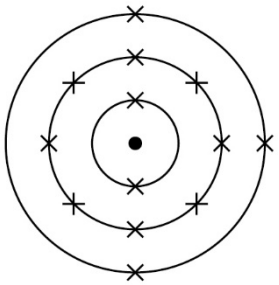
An answer which contains nothing of relevance to the question must be awarded no marks.

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	**D**		1	AO3 4.1.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	**B**		1	AO3 4.1.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	any **two** from: (Group 1 elements) • have lower melting / boiling points • have lower densities • are less strong • are softer	allow converse statements for transition elements allow (Group 1 elements are) more malleable / ductile allow (Group 1 elements) are not useful as catalysts ignore transition elements form coloured compounds ignore transition elements form ions with different charges ignore references to chemical properties	2	AO1 4.1.3.1 4.1.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4		allow any combination of x, •, o, $e^{(-)}$ for electrons	1	AO2 4.1.1.7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	delocalised electrons	allow free electrons	1	AO1 4.2.1.5 4.2.2.8
	(the electrons) carry (electrical) charge	ignore current / electricity for charge	1	
	(the electrons move) through the metal / aluminium / structure	ignore throughout for through	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.6	ionic		1	AO1 4.2.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.7	magnesium (atom) loses electrons		1	AO2 4.2.1.1 4.2.1.2
	oxygen (atom) gains electrons		1	
	two electrons (are transferred)		1	
	magnesium ions **and** oxide ions are formed	allow Mg^{2+} (ions) **and** O^{2-} (ions) are formed allow magnesium forms positive ions and oxygen forms negative ions allow (both) form a complete outer shell	1	

Total Question 1		**13**

Question 2

Question	Answers	Mark	AO/ Spec. Ref
02.1	**Level 3:** The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.	5–6	AO1 4.5.1.1 RPA 4
	Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the plan 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 • **measure volume of (hydrochloric) acid** • with a measuring cylinder • pour (hydrochloric) **acid into a suitable container** eg polystyrene cup • measure the initial temperature (of hydrochloric acid) • with a thermometer • **add a known mass of sodium carbonate** • measured with a balance • stir • **measure the highest temperature reached** • **repeat with different masses of sodium carbonate** **or** **add successive masses of sodium carbonate to the same mixture** • repeat the whole investigation • use the same starting temperature • use the same volume of (hydrochloric) acid each time • use the same concentration of (hydrochloric) acid each time		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2 View with Figure 3	change in highest temperature	allow a tolerance of ± ½ a small square	1	AO2 4.5.1.1 RPA 4
	corresponding change in mass	allow a tolerance of ± ½ a small square	1	
	(gradient =) $\frac{\text{change in highest temperature}}{\text{change in mass}}$	allow correct use of an incorrectly determined change in highest temperature and / or change in mass	1	
	(gradient =) 1.6		1	
	°C/g	allow °C/gram(s)	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3 View with Figure 3	extrapolates line to the *y*-axis		1	AO2 4.5.1.1 RPA 4
	20.6 (°C)	allow a tolerance of ± ½ a small square allow a correctly determined value from an incorrectly extrapolated line	1	
	alternative approach:			
	(highest temperature at 1.0 g – change in highest temperature per gram =) 22.2 – 1.6 (1)	allow correct use of value determined for gradient in question **02.2**		
	= 20.6 (°C) (1)			

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	**C**		1	AO3 4.5.1.1 RPA 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	(**X**) energy (**Y**) (overall) energy change		1 1	AO1 4.5.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	(level of) products is below (level of) reactants	allow the energy decreases (overall) allow energy is transferred to the surroundings ignore references to bond making / breaking	1	AO1 4.5.1.2

Total Question 2		**17**

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	giant structure	allow macromolecular allow (giant) lattice	1	AO1 4.2.3.1
	covalent (bonds)		1	
	four bonds per carbon / atom		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	(covalent) bonds are strong		1	AO1 4.2.2.1
	(and many covalent) bonds must be broken		1	4.2.2.6 4.2.3.1
	(so) a lot of energy is required		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	fullerene		1	AO1 4.2.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	any **one** from: • (C_{70} is) hollow • (C_{70} is) unreactive • (C_{70} is) not toxic • (C_{70} has) a large surface area to volume ratio	ignore references to ease of movement around the body allow (C_{70}) acts as a cage allow (C_{70}) traps the drug	1	AO3 4.2.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	$\left(\text{moles of } C_{70} \text{ molecules} = \frac{1}{70} = \right) 0.01\dot{4}2857\dot{1}$		1	AO2 4.3.2.1
	(molecules =) $0.01\dot{4}2857\dot{1} \times 6.02 \times 10^{23}$	allow correct use of an incorrect attempt at the calculation of the number of moles of C_{70} molecules	1	
	$= 8.6 \times 10^{21}$		1	

Total Question 3		11

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	(zinc oxide) solid remaining	allow (zinc oxide) solid no longer disappears ignore references to colour / effervescence	1	AO1 4.2.2.2 4.4.2.2 4.4.2.3 RPA 1

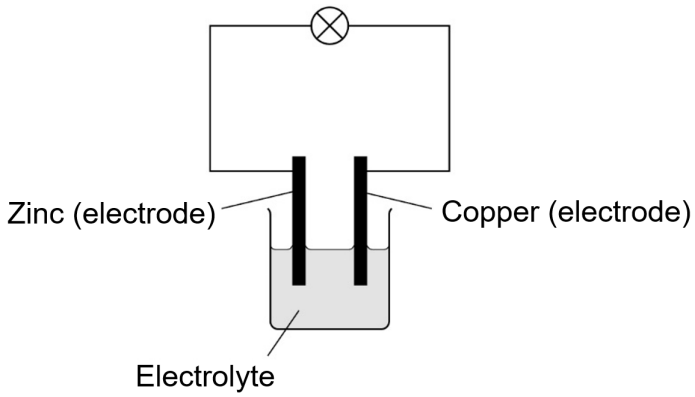
Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	(excess) zinc oxide can be filtered off	allow converse statements for hydrochloric acid allow separation / removal of (excess) zinc oxide is easier ignore to ensure all the (hydrochloric) acid is used up	1	AO1 4.4.2.2 4.4.2.3 RPA 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	any **one** from: • zinc hydroxide • zinc carbonate	allow $Zn(OH)_2$ allow $ZnCO_3$	1	AO1 4.4.2.2 4.4.2.3 RPA1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	heat (the solution) until crystallisation point is reached	allow heat (the solution) until crystals start to form allow heat (the solution) to reduce the volume allow heat (the solution) to evaporate (some of the water)	1	AO1 4.4.2.3 RPA 1
	leave the solution (to cool / crystallise)		1	
		if no other mark is awarded allow **1** mark for heat the solution to dryness		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	$Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu$	ignore state symbols	1	AO2 4.4.1.2 4.4.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6	zinc (atoms) lose (2) electrons	do **not** accept references to oxygen	1	AO2 4.4.1.2 4.4.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.7	(a diagram showing)	ignore voltmeter / ammeter regardless of location		AO1 4.5.2.1
	solution in a container	ignore labels	1	
	zinc electrode **and** copper electrode both inserted into solution	ignore polarities on electrodes	1	
	complete circuit that would function as an electrochemical cell including a labelled electrolyte	allow a named electrolyte in solution allow a named molten electrolyte do **not** accept cell / battery in external circuit do **not** accept a wire between the electrodes	1	
	an answer of  scores **3** marks			

Total Question 4		**10**

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	any **one** from: • more vigorous bubbling (for rubidium) • bigger / brighter flame (for rubidium)	allow converse statements for potassium allow (rubidium) catches fire more quickly allow (rubidium) moves around more quickly allow (rubidium) explodes allow (rubidium) disappears more quickly allow (rubidium) melts more quickly	1	AO3 4.1.2.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2		allow energy level for shell throughout allow converse argument in terms of potassium		AO1 4.1.2.5 4.4.1.2
	(rubidium's) outer shell / electron is further from the nucleus	allow the (rubidium) atom is larger allow (rubidium) has more shells	1	
	(so) there is less (electrostatic) attraction between the nucleus and the outer electron (in rubidium)	allow (so) there is more shielding between the outer electron and the nucleus (in rubidium)	1	
	(so) the (outer) electron (in rubidium) is more easily lost	allow (so) less energy is needed to remove the (outer) electron (in rubidium)	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	$2\ Rb + 2\ H_2O \rightarrow 2\ RbOH + H_2$	ignore state symbols allow multiples allow **1** mark for H_2 allow **1** mark for RbOH	3	AO2 4.1.1.1 4.1.2.5 4.3.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	the noble gases have boiling points that increase going down the group		1	AO1 4.1.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	(relative atomic mass =) $\frac{(90.48 \times 20)+(0.27 \times 21)+(9.25 \times 22)}{100}$	allow (relative atomic mass =) $\frac{1809.6 + 5.67 + 203.5}{100}$ allow (relative atomic mass =) 18.096 + 0.0567 + 2.035	1	AO2 4.1.1.6
	= 20.1877		1	
	= 20.2	allow an answer correctly rounded to 3 significant figures from an incorrect calculation which uses all of the values in **Table 1** ignore units	1	

Total Question 5		**11**

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	$Na^+ + e^- \rightarrow Na$		1	AO2 4.4.3.2 4.4.3.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	so the products do not react (to reform sodium chloride)		1	AO3 4.4.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	ion		1	AO3 4.4.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	hydrogen / H^+ (ions) hydroxide / OH^- (ions)		1 1	AO1 4.4.3.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.5	sodium hydroxide	allow NaOH	1	AO2 4.4.3.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.6	sodium ions and hydroxide ions are left (in solution)		1	AO2 4.4.3.4
	(because) hydrogen ions are discharged / reduced (at the negative electrode to form hydrogen)	allow (because) hydrogen ions gain electrons (at the negative electrode to form hydrogen) allow (because at the negative electrode) $2\ H^+ + 2\ e^- \rightarrow H_2$	1	
	(and because) chloride ions are discharged / oxidised (at the positive electrode to form chlorine)	allow (and because) chloride ions lose electrons (at the positive electrode to form chlorine) allow (and because at the positive electrode) $2\ Cl^- \rightarrow Cl_2 + 2\ e^-$	1	

Total Question 6		**9**

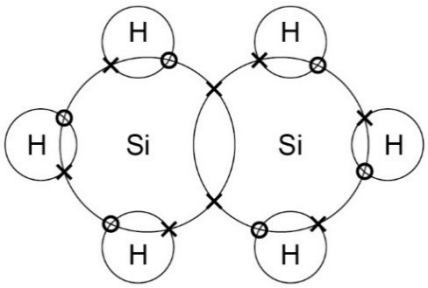
Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	silicon is less reactive than carbon	ignore references to hydrogen allow converse allow silicon is below carbon (in the reactivity series)	1	AO3 4.4.1.3
	(because) carbon displaces silicon (from silicon dioxide)	ignore (because) carbon reduces silicon dioxide	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	more energy is needed (to obtain aluminium)	ignore references to electricity	1	AO3 4.4.1.3 4.4.3.3
	(because) aluminium is obtained (from aluminium oxide) by electrolysis		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	both products are solid		1	AO3 4.4.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4	(M_r of SiO_2 = 28 + (2 × 16)) = 60		1	AO2 4.3.1.2 4.3.2.1 4.3.2.2
	(conversion 1.2 kg =) 1200 (g)		1	
	(number of moles of SiO_2 = $\frac{1200}{60}$) = 20	allow correct use of an incorrectly converted or unconverted mass of SiO_2 allow correct use of an incorrectly calculated M_r of SiO_2	1	
	(number of moles of Mg = 20 × 2) = 40	allow correct use of an incorrectly calculated number of moles of SiO_2	1	
	(mass of Mg = 40 × 24) = 960 (g)	allow correct use of an incorrectly calculated number of moles of Mg	1	
	alternative approach:			
	(M_r of SiO_2 = 28 + (2 × 16)) = 60 (1)			
	48 g Mg reacts with 60 g SiO_2 (1)	allow correct use of an incorrectly calculated M_r of SiO_2		
	(conversion 1.2 kg =) 1200 (g) (1)			
	48 × $\frac{1200}{60}$ (g Mg reacts with 1200 g SiO_2) (1)	allow correct use of an incorrectly calculated mass of Mg and / or incorrectly converted or unconverted mass of SiO_2		
	= 960 (g) (1)			

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.5		allow any combination of x, •, o, $e^{(-)}$ for electrons	1	AO2 4.2.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.6	(volume of oxygen for 30 cm^3 Si_2H_6 = 3.5 × 30) = 105 (cm^3)		1	AO2 4.3.2.4 4.3.5
	(volume of excess oxygen = 150 – 105) = 45 (cm^3)	allow correct use of an incorrectly calculated volume of oxygen for 30 cm^3 Si_2H_6	1	
	(volume of water (vapour) = 3 × 30) = 90 (cm^3)		1	
	(volume of gases = 45 + 90) = 135 (cm^3)	allow correct use of incorrectly calculated volumes of excess oxygen and / or water vapour	1	
	allowed alternative approach: (moles Si_2H_6 = $\frac{0.03}{24}$ =) 0.00125 (1)			
	(moles water vapour formed = 3 × 0.00125 =) 0.00375 **and** (moles oxygen used = 3.5 × 0.00125 =) 0.004375 (1)	allow correct use of an incorrectly calculated number of moles of Si_2H_6		
	(moles excess oxygen = $\frac{0.15}{24}$ - 0.004375 =) 0.001875 (1)	allow correct use of an incorrectly calculated number of moles of oxygen used		
	(volume of gases = 24 × (0.00375 + 0.001875) = 0.135 dm^3 =) 135 (cm^3) (1)	allow correct use of an incorrectly calculated number of moles of excess oxygen and / or moles of water vapour formed		

Total Question 7		**15**

Question 8

Question	Answers	Mark	AO/ Spec. Ref
08.1	**Level 3:** Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.	3-4	AO1 4.3.2.5 4.4.2.4 4.4.2.6
	Level 2: Relevant points (reasons / causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.	1-2	
	No relevant content	0	
	Indicative content <u>General principle</u> • pH depends on H^+ ion concentration • the higher the concentration of H^+ ions the lower the pH <u>Strength</u> • the stronger an acid the greater the ionisation / dissociation (in aqueous solution) • (so) the stronger the acid the lower the pH <u>Concentration</u> • the higher the concentration of an acid the more acid / solute in the same volume (of solution) • (so) the higher the concentration of the acid the lower the pH		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.2	the mean of titration numbers 2 to 5 values is calculated	allow identification of titration by titration number or volume	1	AO3 4.4.2.5 RPA2
	(because) 23.90 (cm^3) is an anomalous result	allow (because) 23.90 (cm^3) is not concordant allow (because) 23.90 (cm^3) is too high a value allow (because) the first titration is a rough value	1	
		allow for **2** marks an answer of (because) the mean is taken of the values within 0.10 (cm^3)		
		allow for **2** marks an answer of (because) the mean is taken of the concordant values		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.3	(moles $Ba(OH)_2$ = $\frac{23.50}{1000} \times 0.100$) = 0.00235		1	AO2 4.3.4 4.4.2.5 RPA2
	(moles HCl = 0.00235 × 2 =) 0.00470	allow correct use of an incorrectly calculated number of moles of $Ba(OH)_2$	1	
	(concentration =) $0.00470 \times \frac{1000}{25.0}$	allow correct use of an incorrectly calculated number of moles of HCl	1	
	= 0.188 (mol/dm^3)		1	
	alternative approach:			
	$\left(\text{ratio } \frac{\text{moles HCl}}{\text{moles } Ba(OH)_2} = \right)$	allow inverted expression		
	$\frac{2}{1} = \frac{25.0 \times \text{concentration}}{23.50 \times 0.100}$ (**2**)	allow **1** mark for the expression with an incorrect mole ratio		
	(concentration =) $\frac{2 \times 23.50 \times 0.100}{25.00}$ (1)	allow correct use of the expression with an incorrect mole ratio		
	= 0.188 (mol/dm^3) (1)			

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.4	there are no ions that are free to move	allow there are no ions in solution allow there are no ions free to carry the charge	1	AO3 4.2.2.3 4.4.2.2 4.4.2.4 4.4.2.5
	(because) barium sulfate is solid / insoluble		1	
	(and) hydrogen ions have reacted with hydroxide ions to produce water	allow (and) water is a covalent / molecular substance	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.5	the mixture (now) contains barium ions and hydroxide ions that are free to move	allow excess barium hydroxide solution contains ions	1	AO3 4.2.2.3 4.4.2.2 4.4.2.4 4.4.2.5

Total Question 8		**14**