AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.4.2.5

Titrations (chemistry only)

Mark schemes and examiner comments

Tier	**Foundation**
Question groups	**20**
Available paper years	**2007–2025**

Using this booklet

1. Booklet answer numbers match the question booklet.
2. Use the original question number within marking tables.
3. Examiner comments are included where available.

Name: _____ **Date:** _____

Where a precise marking extract is unavailable, the full source document is included in an appendix. Any missing mark scheme is explicitly identified.

4.4.2.5 Titrations (chemistry only)

Answer 01 · Mark scheme

March 2007 | CHY1A | Original Q7 | Legacy

Seven	**3**	**2**	**4**	**2**

4.4.2.5 Titrations (chemistry only)

Answer 02 · Mark scheme

Question 3

question	answers	extra information	mark
(a)(i)	burette		1
(a)(ii)	conical flask	accept conical / flask	1
(b)(i)	an indicator		1
(b)(ii)	changed colour		1
(b)(iii)	titration		1
(c)	3	correct answer = **2** marks (1 × 3) or (1 × 750/250) = **1** mark	2
(d)(i)	hydrogen		1
(d)(ii)	is partially ionised		1
total			9

4.4.2.5 Titrations (chemistry only)

Answer 02 · Mark scheme

January 2008 | CHY3F | Original Q3 | Legacy

CHY3F

4.4.2.5 Titrations (chemistry only)

Answer 03 · Mark scheme

Question 2

question	answers	extra information	mark
2(a)	burette		1
2(b)	indicator changed colour	allow any indication of colour change	1
2(c)(i)	0.2 **or** 18.3 to 18.5		1
2(c)(ii)	18.4		1
2(c)(iii)	improve reliability	allow improve accuracy allow to calculate a mean / average **or** get rid of anomalous result ignore fair test / correct results / random results	1
Total			**5**

4.4.2.5 Titrations (chemistry only)

Answer 03 · Mark scheme

January 2010 | CHY3F | Original Q2 | Legacy

CHY3F

4.4.2.5 Titrations (chemistry only)

Answer 04 · Mark scheme

June 2019 | CHY3F | Original Q1 | Legacy

Question 1

question	answers	extra information	mark
1(a)(i)	H^+		1
1(a)(ii)	OH^-		1
1(a)(iii)	lower than		1
1(b)	with HCl: UI goes red / pink has a pH 0 ,1 ,2 **or** 3 **or** with ethanoic acid: UI goes orange / yellow (1) has a pH 4 / or above (but less than 7) (1)	 allow a comparison eg redder than ethanoic acid allow a comparison eg has pH less than ethanoic acid. do **not** accept an incorrect pH. allow a comparison with HCl allow a comparison with HCl	 1 1
1(c)	completely		1
1(d)(i)	conical flask		1
1(d)(ii)	titration		1
1(d)(iii)	repeat **or** take average	allow compare with another students results	1
Total			**9**

4.4.2.5 Titrations (chemistry only)

Answer 04 · Mark scheme

June 2010 | CHY3F | Original Q1 | Legacy

CHY3F

4.4.2.5 Titrations (chemistry only)

Answer 05 · Mark scheme

January 2011 | CHY3F | Original Q3 | Legacy

Question 3

question	answers	extra information	mark
3(a)(i)	hydrogen		1
3(a)(ii)	partially		1
3(b)(i)	same size / mass / amount / length of magnesium (ribbon) **or** same concentration of acids	allow react for same time ignore repeats ignore volume / amount of acid	1
3(b)(ii)	bubbles / gas given off **or** magnesium disappears / dissolves / reacts slower with ethanoic acid **or** faster with hydrochloric acid		1 1
3(c)(i)	titration	allow titration identified in box if answer line blank	1
3(c)(ii)	burette		1
3(c)(iii)	(indicator) changed colour	allow solution changes colour but not vinegar ignore specific colours	1
Total			8

4.4.2.5 Titrations (chemistry only)

Answer 05 · Mark scheme

January 2011 | CHY3F | Original Q3 | Legacy

CHY3F

Answer 06 · Mark scheme

June 2011 | CHY1BP | Original Q6 | Legacy

Six	**1**	**2**	**1**	**3**

4.4.2.5 Titrations (chemistry only)

Answer 07 · Mark scheme

Question 3

question	answers	extra information	mark
3(a)(i)	sodium hydroxide solution blue		1 1
3(a)(ii)	barium chloride white		1 1
3(b)	fully ionised in water		1
3(c)(i)	H^+ ions		1
3(c)(ii)	lower than		1
3(d)(i)	(indicator) changed colour / goes colourless	ignore clear / discoloured	1
3(d)(ii)	13.9 **or** (titration) 2		1
3(d)(iii)	13.2	ecf from 3(d)(ii)	1
Total			**10**

4.4.2.5 Titrations (chemistry only)

Answer 07 · Mark scheme

June 2011 | CHY3F | Original Q3 | Legacy

CHY3F

4.4.2.5 Titrations (chemistry only)

Answer 08 · Mark scheme

June 2013 | CH3FP | Original Q9 | Legacy

Question 9

question	answers	extra information	Mark
9	Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5.		6

0 marks	Level 1 (1-2 marks)	Level 2 (3-4 marks)	Level 3 (5-6 marks)
No relevant content.	There is a simple description of using some of the equipment.	There is a description of an experimental method involving a measurement, **or** including addition of alkali to acid (or vice versa).	There is a description of a titration that would allow a successful result to be obtained.

examples of chemistry points made in the response could include:

- acid in (conical) flask
- volume of acid measured using pipette
- indicator in (conical) flask
- sodium hydroxide in burette
- white tile under flask
- slow addition
- swirling
- colour change
- volume of sodium hydroxide added

Extra information

- allow acid in the burette to be added to sodium hydroxide in the (conical) flask
- allow any specified indicator

colour change need not be specified

Total			6

UMS Conversion Calculator: www.aqa.org.uk/umsconversion

4.4.2.5 Titrations (chemistry only)

Answer 09 · Mark scheme

June 2014 | CH3FP | Original Q3 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
3(a)(i)	burette		1	1 / 3.4.1g	A
3(a)(ii)	indicator		1	1 / 3.4.1g	A
3(a)(iii)	colour change		1	1 / 3.4.1g	E
3(b)(i)	any **one** from: • volume of (hydrochloric) acid • concentration of (hydrochloric) acid • concentration of (sodium) hydroxide	*allow amount of (hydrochloric) acid* allow concentration of alkali	1	3 / 3.4.1g	E
3(b)(ii)	22.3(0)		1	2 / 3.4.1g	G
Total			**5**		

4.4.2.5 Titrations (chemistry only)

Answer 09 · Mark scheme

June 2014 | CH3FP | Original Q3 | Legacy



4.4.2.5 Titrations (chemistry only)

Answer 10 · Mark scheme

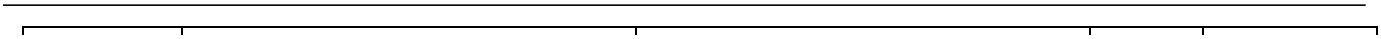
June 2015 | CH3FP | Original Q7 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
7(a)(i)	(19.5 + 18.5 + 19.0)/3	allow (23.0 +19.5 + 18.5 + 19.0)/4 for **1** mark	2	**AO2/ AO3** 3.4.1.g
7(a)(ii)	R P Q	allow Q P R for **1** mark	2	**AO3** 3.4.1.g
7(b)	any **two** from: • repeat more times • calculate a mean • measure to one decimal place		2	**AO3** 3.4.1.g
7(c)	both students get similar results / similar pattern		1	**AO3** 3.4.1.g
Total			**7**	

4.4.2.5 Titrations (chemistry only)

Answer 10 · Mark scheme

June 2015 | CH3FP | Original Q7 | Legacy



Answer 11 · Mark scheme

June 2016 | CH3FP | Original Q6 | Legacy

The full source mark scheme begins on page 38. Follow original question 6 in that document.

4.4.2.5 Titrations (chemistry only)

Answer 12 · Mark scheme

June 2017 | CH3FP | Original Q4 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
4(a)	any **two** from: • floats • moves around • fizzes / bubbles / gas • melts / spherical • dissolves / gets smaller / disappears • (lilac) flame / burns / sparks	ignore hydrogen	2	**AO1** **AO2** 3.1.3a
4(b)(i)	burette		1	**AO1** 3.4.1g
4(b)(ii)	indicator	allow any named indicator	1	**AO1** 3.4.1g
4(b)(iii)	add alkali until end point / until acid is neutralized / colour change any **one** from: • swirl • add dropwise / slowly • take reading of volume of alkali used.	ignore clear accept read initial and final volumes of alkali	1 1 1	**AO1** **AO3** 3.4.1g
4(b)(iv)	any **one** from: • volume of acid • concentration of acid • concentration of hydroxide.	allow amount of acid	1	**AO3** 3.4.1g
4(c)(i)	(18.2 + 19.0 + 18.6)/3 = 18.6	correct answer with or without working gains 2 marks allow ((23.8 + 18.2 + 19.0 + 18.6)/4 =)19.9 for 1 mark	1 1	**AO2** **AO3** 3.4.1g

4.4.2.5 Titrations (chemistry only)

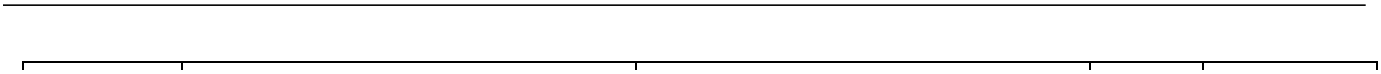
Answer 12 · Mark scheme

4(c)(ii)	any **two** from: • repeat more times • (calculate) a mean • measure to one decimal place.		2	**AO3** 3.4.1g
Total			**12**	

4.4.2.5 Titrations (chemistry only)

Answer 12 · Mark scheme

June 2017 | CH3FP | Original Q4 | Legacy



4.4.2.5 Titrations (chemistry only)

Answer 13 · Mark scheme

June 2019 | 8462/1F | Original Q9

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	H^+		1	AO1 4.4.2.4
09.2	hydrochloric (acid) water	allow HCl allow H_2O	1 1	AO2 4.4.2.2
09.3	burette	do **not** accept biuret	1	AO1 4.4.2.5
09.4	27.6 (cm^3)	allow 27.60 (cm^3)	1	AO2 4.4.2.5

Question 9 continued

Question	Answers	Mark	AO/ Spec. Ref
09.5	**Level 3**: The design/plan would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	5–6	AO3 AO1
	Level 2: The design/plan would not necessarily lead to a valid outcome. Most steps are identified, but the plan is not fully logically sequenced.	3–4	AO1 x 2
	Level 1: The design/plan would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2	AO1 x 2
	No relevant content	0	
	Indicative content allow converse using acid added to alkali Key steps • measure the volume of acid • add indicator to the acid • add sodium hydroxide solution • until the colour changes • record volume of sodium hydroxide solution added • repeat procedure with the other acid Use of results • compare the two volumes of sodium hydroxide solution to find which sample **P** or **Q** is more concentrated Other points • pipette to measure volume of acid • use a few drops of indicator • swirl • use a white tile • rough titration to find approximate end point • add dropwise near the endpoint • read volume from bottom of meniscus • repeat and take a mean		4.4.2.5

Total			**11**

4.4.2.5 Titrations (chemistry only)

Answer 14 · Mark scheme

November 2020 | 8462/1F | Original Q7

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	nitric acid		1	AO2 4.4.2.2 RPA 1
07.2	zinc oxide		1	AO2 4.4.2.2 RPA 1
07.3	magnesium bromide		1	AO2 4.1.1.1
07.4		allow a tolerance of 1 cm^3 on volumes allow a tolerance of 0.2 on pH values		AO2 4.4.2.4
	(from 0) to 20 cm^3 the pH increases (gradually)	allow increase from pH 1 to pH 3	1	
	at 20 cm^3 the pH changes from pH 3 to pH 11	allow sudden / steep increase at 20 cm^3 allow sudden / steep increase from pH 3 to pH 11	1	
	from 20 cm^3 the pH increases (gradually)	allow (gradual) increase from pH 11 if no other marks awarded allow **1** mark for a description of the three stages with no values used.	1	

Question 7 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.5	20 (cm^3)	allow 20.0 (cm^3)	1	AO3 4.4.2.4
07.6	red		1	AO3 4.4.2.4
07.7	$\frac{0.06}{25(.0)} \times 100$ = 0.24 (%)		1 1	AO2 4.4.2.5
07.8	(pipette) measures volume more accurately **or** (pipette has a) smaller (percentage) uncertainty	allow (pipette is) more accurate	1	AO3 4.4.2.5 RPA 2
Total			**11**	

4.4.2.5 Titrations (chemistry only)

Answer 15 · Mark scheme

November 2021 | 8462/1F | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	H^+		1	AO1 4.4.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	neutralisation		1	AO1 4.4.2.2 4.4.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	$H_2SO_4 + 2\,KOH \rightarrow K_2SO_4 + 2\,H_2O$	allow multiples	1	AO2 4.1.1.1 4.4.2.2 4.4.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	14		1	AO1 4.4.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	pipette		1	AO3 4.4.2.5 RPA2

Question 5 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6	add potassium hydroxide (solution) to the (conical) flask add (a few drops of) indicator add the (sulfuric) acid (from the burette) until the colour (of the indicator) changes read the volume from the burette		1 1 1 1 1	AO1 4.4.2.5 RPA2

Total			**10**

4.4.2.5 Titrations (chemistry only)

Answer 16 · Mark scheme

June 2022 | 8462/1F | Original Q3

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	B		1	AO3 4.4.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	C		1	AO3 4.4.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	zinc (oxide) sulfuric (acid)	allow ZnO allow H_2SO_4	1 1	AO2 4.4.2.2

4.4.2.5 Titrations (chemistry only)

Answer 16 · Mark scheme

June 2022 | 8462/1F | Original Q3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	pH → Colour of universal indicator 1 → Green 7 → Red do **not** accept more than one line from a box on the left		1 1	AO1 4.4.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	neutralisation		1	AO1 4.4.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.6	burette		1	AO1 4.4.2.5 RPA2

Total Question 3		8

4.4.2.5 Titrations (chemistry only)

Answer 17 · Mark scheme

June 2023 | 8462/2F | Original Q10

Question 10

Question	Answers	Mark	AO/ Spec. Ref
10.1	**Level 3:** The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.	5–6	AO1 4.8.3.1 4.8.3.4 RPA7
	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 (potassium ions) • **place sample on (clean metal) wire** • **introduce into (blue / non-luminous) flame** • using (Bunsen) burner • **observe lilac flame colour** • which shows presence of potassium (ions) (bromide ions) • **dissolve sample** • in (distilled) water • in test tube • add (dilute) nitric acid • **add silver nitrate (solution)** • using (dropping) pipette • **observe cream precipitate (formed after addition of silver nitrate solution)** • which shows presence of bromide (ions)		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.2	flame emission spectroscopy		1	AO1 4.8.3.7

4.4.2.5 Titrations (chemistry only)

Answer 17 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.3	any **one** from: • (more) accurate • (more) sensitive • fast(er) • determine the concentration of ions present	allow requires a small(er) sample	1	AO1 4.8.3.6

Total Question 10	8

4.4.2.5 Titrations (chemistry only)

Answer 18 · Mark scheme

June 2024 | 8462/1F | Original Q2

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	(**A**) pipette (**B**) conical flask (**C**) burette		1 1 1	AO1 4.4.2.5 RPA2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	methyl orange (solution) **or** phenolphthalein (solution)	allow litmus (solution) do **not** accept universal indicator	1	AO1 4.4.2.5 RPA2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	colour change	ignore clear	1	AO1 4.4.2.5 RPA2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	any **two** from: • swirl • add the acid drop by drop • read (burette) at eye level • ensure no bubbles in burette • use a white tile • repeat **and** take a mean	allow read (burette) at the bottom of the meniscus	2	AO1 4.4.2.5 RPA2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	16.6 cm^3		1	AO2 4.4.2.5 RPA2

4.4.2.5 Titrations (chemistry only)

Answer 18 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	trial 2 and trial 3		1	AO3 4.4.2.5 RPA2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.7	$BaCl_2$		1	AO2 4.1.1.1 4.4.2.2

Total Question 2	**10**

4.4.2.5 Titrations (chemistry only)

Answer 19 · Mark scheme

June 2025 | 8462/1F | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	titration		1	AO1 4.4.2.5 RPA 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	indicator	allow any named indicator	1	AO1 4.4.2.5 RPA 2

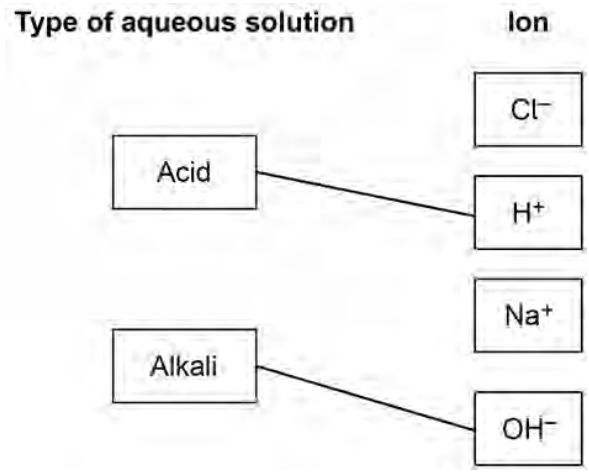
Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	burette		1	AO1 4.4.2.5 RPA 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	add the acid dropwise (near the end point) **or** swirl the flask		1	AO3 4.4.2.5 RPA 2

4.4.2.5 Titrations (chemistry only)

Answer 19 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	use of 8.95, 9.00 and 8.85 **only**		1	AO3
	(mean volume =) $\frac{8.95 + 9.00 + 8.85}{3}$	allow (mean volume =) $\frac{26.80}{3}$ allow correct use of incorrect values of volume	1	AO2
	= 8.933333 (cm^3)		1	AO2
	= 8.93 (cm^3)	allow an answer correctly rounded to 3 significant figures from an incorrect calculation which uses the values in the question	1	AO2 4.4.2.5 RPA 2

Question	Answers	Mark	AO / Spec. Ref.
04.6	 do **not** accept more than one line from a box on the left	1 1	AO1 4.4.2.4

Total Question 4	10

4.4.2.5 Titrations (chemistry only)

Answer 20 · Mark scheme

June 2025 | 8462/2F | Original Q8

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	(a burette is) more accurate (than a measuring cylinder)	allow (a burette has) a higher resolution ignore precise	1	AO3 4.10.1.2 RPA8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.2	the mass of (dissolved) solids		1	AO1 4.10.1.2 RPA8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.3	reheat (the evaporating basin and contents) (and reweigh) until constant mass	 allow for **2** marks heat to constant mass	1 1	AO3 4.10.1.2 RPA8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.4	subtract the mass of the (empty) evaporating basin from the mass of the evaporating basin and contents (at the end of the experiment)	allow subtract initial mass from the final mass	1	AO1 4.10.1.2 RPA8

4.4.2.5 Titrations (chemistry only)

Answer 20 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.5	(allow mean mass =) $\frac{0.35 + 0.37 + 0.33 + 0.34}{4}$	(allow mean mass =) $\frac{1.39}{4}$	1	AO2 4.3.2.5 4.10.1.2 RPA8
	= 0.3475 (g)		1	
	(conversion 10 cm^3 =) 0.01 dm^3		1	
	(mean concentration =) $\frac{0.3475}{0.01}$	allow correct use of incorrectly determined mean mass allow correct use of incorrect / no conversion of volume	1	
	= 34.75 (g/dm^3)	allow 34.75 (g/dm^3) correctly rounded to at least 2 significant figures	1	
	alternative approach 1 (conversion 10 cm^3 =) 0.01 dm^3 (1)			
	(concentrations =) $\frac{0.35}{0.01}$ $\frac{0.37}{0.01}$ $\frac{0.33}{0.01}$ $\frac{0.34}{0.01}$ (1)	allow correct use of incorrect / no conversion of volume		
	= 35 37 33 34 (1)			
	(mean concentration =) $\frac{35 + 37 + 33 + 34}{4}$ (1)	(allow mean concentration =) $\frac{139}{4}$ allow correct use of incorrectly determined concentrations		
	= 34.75 (g/dm^3) (1)	allow 34.75 (g/dm^3) correctly rounded to at least 2 significant figures		

	alternative approach 2 using total mass and total volume (total mass = 0.35 + 0.37 + 0.33 + 0.34 =) 1.39 (g) (1) (total volume = 10 + 10 + 10 + 10 =) 40 cm^3 (1) (conversion 40 cm^3 =) 0.04 dm^3 (1) (mean concentration =) $\frac{1.39}{0.04}$ = 34.75 (g/dm^3) (1)	 allow correct use of incorrectly determined total mass allow correct use of incorrect / no conversion of total volume allow 34.75 (g/dm^3) correctly rounded to at least 2 significant figures		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.6	the samples were taken from different places		1	AO3 4.10.1.2

Total Question 8	**11**

4.4.2.5 Titrations (chemistry only)

AQA

GCSE
Chemistry

CH3FP
Mark scheme

4402
June 2016

Version/Stage: 1.0 Final

4.4.2.5 Titrations (chemistry only)

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

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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 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.

PMT

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	Pluto, Mars, Moon	1
2	Pluto, 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

Full marks can be given for a correct numerical answer, 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 or by each stage of a longer calculation.

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 '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 Accept / allow

Accept is used to indicate an equivalent answer to that given on the left-hand side of the mark scheme. Allow is used to denote lower-level responses that just gain credit.

3.9 Ignore / Insufficient / Do not allow

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

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

4. Quality of Written Communication and levels marking

In Question 6 students are required to produce extended written material in English, and will be assessed on the quality of their written communication as well as the standard of the scientific response.

Students will be required to:

- use good English
- organise information clearly
- use specialist vocabulary where appropriate.

The following general criteria should be used to assign marks to a level.

Level 1: Basic

- Knowledge of basic information
- Simple understanding
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail
- The spelling, punctuation and grammar are very weak.

Level 2: Clear

- Knowledge of accurate information
- Clear understanding
- The answer has some structure and organisation, use of specialist terms has been attempted but not always accurately, some detail is given
- There is reasonable accuracy in spelling, punctuation and grammar, although there may still be some errors.

Level 3: Detailed

- Knowledge of accurate information appropriately contextualised
- Detailed understanding, supported by relevant evidence and examples
- Answer is coherent and in an organised, logical sequence, containing a wide range of appropriate or relevant specialist terms used accurately
- The answer shows almost faultless spelling, punctuation and grammar.

4.4.2.5 Titrations (chemistry only)

Question	Answers	Extra information	Mark	AO / SpecRef
1(a)	atomic weights electrons proton numbers	must be in this order	1 1 1	AO1 3.1.1a, 3.1.2a
1(b)(i)	H/hydrogen	allow H_2 or h	1	AO3 3.1.3b,c
1(b)(ii)	one / 1	allow alkali metals	1	AO2 3.1.3a
1(b)(iii)	Potassium (K)		1	AO1 3.1.3b
1(b)(iv)	Iron has a higher density than potassium Iron forms ions that have different charges		1 1	AO1/AO2 3.1.3c,d
1(c)	any **three** from: • melts • fizzes / bubbles / effervesces • sodium floats • size of the sodium decreases • sodium moves	allow gas produced allow dissolves / disappears allow two marks for moves around on the surface of the water	3	2AO1 / 1AO2 3.1.3a
Total			**11**	

4.4.2.5 Titrations (chemistry only)

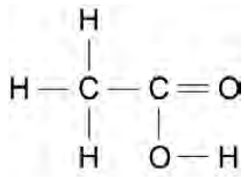
Question	Answers	Extra information	Mark	AO / SpecRef
2(a)(i)	Ca^{2+}		1	AO1 3.2.1b
2(a)(ii)	advantage: hard water is good for the development of bones disadvantage: hard water needs more soap to form lather		1 1	AO3 3.2.1a, 3.2.1f
2(b)(i)	scum		1	AO1 3.2.1a
2(b)(ii)	soft water		1	AO1 3.2.1c
2(c)	carbon: improves taste ion-exchange resin: removes hardness silver: reduces microbes		1 1 1	AO1/AO2/AO3 3.2.2b
Total			8	

4.4.2.5 Titrations (chemistry only)

Question	Answers	Extra information	Mark	AO / SpecRef
3(a)	water / H_2O	allow steam or hydrogen oxide	1	AO1 3.3.1i
3(b)(i)	A		1	AO2 3.3.1d
3(b)(ii)	exothermic products (energy) lower than reactants (energy)		1 1	AO2/AO3 3.3.1d,e
3(b)(iii)	1860 (kJ)		1	AO2 3.3.1d
3(c)(i)	22.5 38.7 16.2	 allow ecf for correct subtraction	1 1 1	AO2 3.3.1a
3(c)(ii)	50 (g)		1	AO2 3.3.1a
3(c)(iii)	20.1 (kJ)	allow propanol ignore 3	1	AO3 3.3.1a
3(c)(iv)	as the number of carbon atoms (in one molecule of alcohol) increases the heat energy given out increases (when the alcohol is burned)		1	AO3 3.3.1a
3(c)(v)	any **two** from: • no lid • no insulation • no draught shield • incomplete combustion • inaccurate measurement • no repeats (to calculate a mean)	Allow heat / energy loss to surroundings for any one of these marks	2	AO3 3.3.1a
3(c)(vi)	-O-H		1	AO1 3.6.1a
Total			**14**	

Question	Answers	Extra information	Mark	AO / SpecRef
4(a)(i)	nitrogen: air hydrogen: natural gas		1 1	AO1 3.5.1a
4(a)(ii)	as a catalyst so the reaction speeds up	 allow lowers activation energy or so a lower temperature can be used	1 1	AO1/AO2 3.5.1b
4(a)(iii)	cooled ammonia condenses / liquefies	 allow nitrogen **and** hydrogen remain in the gaseous state	1 1	AO1/AO2 3.5.1b
4(a)(iv)	recycled	allow reused or returned to the reactor	1	AO1 3.5.1b
4(b)	reversible arrows hydrogen **and** ammonia		1 1	AO1 3.5.1b
Total			**9**	

4.4.2.5 Titrations (chemistry only)

Question	Answers	Extra information	Mark	AO / SpecRef
5(a)(i)	fizz / effervescence / bubbles	allow calcium carbonate decreases in size or dissolves	1	AO2/AO3 3.4.1d, 3.6.2b
	because carbon dioxide produced / released	allow because gas produced / released	1	
	limewater turns cloudy / milky / white		1	
	because (a precipitate of or solid) calcium carbonate forms	allow because of carbon dioxide if not already credited	1	
5(a)(ii)		allow –OH do not allow lower case 'h'	1	AO1 3.6.2a
5(a)(iii)	acid	must be in this order ignore any name of an acid	1	AO1 3.6.2b
	ester(s)		1	
5(b)	white (precipitate) no change no change no change	all four correct 2 marks any two correct 1 mark	2	AO2 3.4.1e,f
5(c)(i)	lilac red	must be in this order allow purple	1 1	AO1 3.4.1a
5(c)(ii)	colours are masked / changed by each flame colour		1	AO3 3.4.1a
Total			12	

4.4.2.5 Titrations (chemistry only)

Question	Answers	Extra information	Mark	AO / SpecRef
6			6	2AO1 / 3AO2 / 1AO3 3.4.1g

Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5 and apply a 'best-fit' approach to the marking.

0 marks	Level 1 (1–2 marks)	Level 2 (3–4 marks)	Level 3 (5–6 marks)
No relevant content.	There is a simple description of using some of the apparatus.	There is a description of an experimental method including addition of acid to alkali which may include an indicator or colour change and may include a measurement of volume**.**	There is a description of titrations that would allow a comparison to be made between the two solutions of hydrochloric acid.

examples of chemistry points made in the response could include:

- acid in burette **or** flask
- alkali/sodium hydroxide **or** acid in burette or flask
- volume of acid **or** alkali measured using the pipette
- indicator in flask
- white tile under the flask
- slow addition
- swirling/mixing
- colour change of indicator
- burette volume measured

Total		6

Answer 13 · Examiner comments June 2019 | 8462/1F | Original Q9

Question 9 (standard demand)

09.1 Approximately 50% of students correctly identified H^+ as the ion produced by all acids in aqueous solution.

The most common incorrect response was OH^-

09.2 Approximately 15% of students scored both marks for completing the word equation.

The correct answers 'hydrochloric' (acid) and 'water' were seen in approximately equal numbers.

Common incorrect responses included:

- chloric / chlorine (for the reactant)
- hydrogen (for the product).

09.3 The name 'burette' was not well known with only approximately a third of students scoring the mark. Phonetic equivalents of this word also scored the mark but not 'biuret' (as this is a reagent used in biology).

Common incorrect responses included:

- thermometer
- pipette

Answer 13 · Examiner comments June 2019 | 8462/1F | Original Q9

- syringe
- measuring cylinder.

09.4 Approximately 50% of students were able to take a correct reading from the burette scale.

The most common incorrect answer was 28.4 cm^3.

09.5 Even though this extended response question drew on their experience of a required practical activity, approximately 20% of students did not attempt it. A similar proportion scored 0 marks.

Approximately 10% of students achieved a Level 3 mark.

In many cases, at least one of the key steps in this titration was omitted, which therefore meant that students were not able to access Level 3.

4.4.2.5 Titrations (chemistry only)

Answer 16 · Examiner comments — June 2022 | 8462/1F | Original Q3

Question 3 (Low and standard demand)

03.1 This question was answered correctly by the majority of students, who recognised that copper would not react. Incorrect responses were almost equally divided between **A** and **D**.

03.2 This question was answered correctly by nearly all students.

03.3 Fewer than half of students scored both marks, although three quarters named one substance correctly. Most students realised that the appropriate metal oxide would be zinc oxide. However, fewer could correctly name the acid, with hydrochloric acid being a popular response.

03.4 Nearly three-quarters of students scored at least one mark, with nearly half scoring both.

03.5 Nearly 80% of students identified the correct type of reaction.

03.6 Over 80% of students correctly identified the apparatus as a burette. The majority of the rest gave a response of pipette.

Answer 17 · Examiner comments — June 2023 | 8462/2F | Original Q10

Question 10 (Standard demand)

10.1 This extended response question used the command word 'plan'.

A simplistic approach to the level descriptors might be:

Level 3 – will produce the expected outcomes.
Level 2 – might produce the expected outcomes with additions or modifications.
Level 1 – will not produce the expected outcomes.

However, the marking of extended response questions must always be holistic, so a best-fit approach must always be followed.

Key steps were shown in the indicative content in **bold**.

Most students found this question very difficult with only around 6% of students managing at least a mark in Level 2 and only 25% of students gaining at least 1 mark.

The flame test for the potassium ions was seen more often than the test for the bromide ion, with some students identifying the flame colour but not being able to describe how to carry out the test. Many responses failed to include putting the sample of medicine on the wire or making it clear that the Bunsen was lit. A number of students placed the wire under the Bunsen or did not make it clear that the Bunsen was lit. Some students thought that they needed to sterilise an inoculating loop before using in a flame test.

Many students mixed up the tests by carrying out flame tests on all the reagents.

The test for bromide ions was poorly understood with less than 1% of students recognising that silver nitrate should be added to the medicine and being able to state the correct test result.

Around one-fifth of students scored a Level 1 mark by using the medicine or correct test result in their response and including some relevant points in the correct context from the question.

10.2 The instrumental method was known by very few students with only 1% of students being able to correctly identify flame emission spectroscopy. Most students who attempted the question mentioned laboratory or industrial processes such as fractional distillation or electrolysis. More than a third of the students did not attempt this question.

10.3 Over 30% of students correctly identified an advantage for using an instrumental method over a chemical test. The most popular correct responses were rapidity and accuracy. One quarter of the students did not answer this question.

4.4.2.5 Titrations (chemistry only)

Answer 17 · Examiner comments

June 2023 | 8462/2F | Original Q10

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.

Answer 18 · Examiner comments

Question 2 (low and standard demand)

02.1 Over half of students named all three pieces of equipment correctly, with three quarters scoring at least two marks. The burette was often called a measuring cylinder, and the conical flask a beaker. The burette and pipette were sometimes reversed.

02.2 Students found this difficult – many gave names of acids or alkalis, or substances totally unrelated such as iodine. Of those who did give an indicator, many gave universal indicator, which is not suitable for a titration. The most common correctly named indicator was phenolphthalein; any reasonable attempt at the spelling was accepted.

02.3 This was answered well, with nearly two thirds of students giving 'colour change' or a description of one. 'Clear' is not a description of a colour so was insufficient for a mark.

02.4 A third of students scored one mark, but far fewer scored both. Many students did not realise that they had been given the correct apparatus, and merely had to say what they would do to use that apparatus accurately. Instead, most suggested using other, less accurate, equipment such as a measuring cylinder or a beaker. The most common correct answer was to add the acid drop by drop. A few suggested repeating the experiment, without also saying to take a mean of the results. Some students suggested using a measuring cylinder to measure acid into the burette, not understanding what a burette does.

02.5 Two thirds of students gave the correct reading. The most common distractor was 17.4 cm^3.

02.6 Three quarters of students identified the closest pair of results.

02.7 Students found this standard demand question difficult. Just over a third of students identified the formula of barium chloride, but the distractor Ba_2Cl was even more popular.

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4.4.2.5 Titrations (chemistry only)

Answer 19 · Examiner comments — June 2025 | 8462/1F | Original Q4

Question 4 (low and standard demand)

04.1 Nearly three quarters chose the correct answer. Distillation was a very popular distractor.

04.2 Fewer than a third of students realised that the substance should be an indicator or were able to name one. Universal indicator was the most popular named indicator; this was accepted although it is not really appropriate for a titration. Acid and alkali were popular incorrect responses, as was liquid.

04.3 About five sixths of students chose burette as the correct answer.

04.4 Only two fifths of students realised that the acid should be added dropwise and / or that the solution should be swirled. One popular misconception was that the addition should be timed. Stirring was not accepted as an alternative to swirling, but adding the acid slowly was accepted as an alternative to dropwise or drop by drop.

Answer 19 · Examiner comments — June 2025 | 8462/1F | Original Q4

04.5 Most students knew how to calculate a mean, and the majority could round to 3 significant figures. However, some thought that 9.00, rather than 8.45, was the anomalous result; students need to look beyond the first digit. Quite a few placed a dot over the 3 in 8.93 of their final answer, indicating a recurring decimal, which was therefore an infinite number of significant figures not 3. Over two thirds of students scored at least 3 marks, with two fifths scoring full marks.

04.6 Only a quarter of students could identify both ions correctly. The ion present in an acid was known more often than the ion in an alkali. Many knew the correct two ions but had them the wrong way round. A significant number identified the ions in sodium chloride rather than in an acid and an alkali.

4.4.2.5 Titrations (chemistry only)

Answer 20 · Examiner comments

June 2025 | 8462/2F | Original Q8

Question 8

08.1 Just over half of students gave the correct answer here. Many who did not gain the mark did not give the required comparative answer.

08.2 A third of students correctly identified the dependent variable. The most common incorrect response was the volume of seawater.

08.3 There was little understanding of heating to constant mass. It was clear that few students used the method to help support their answer and so most answered in terms of looking in some way to see if the water was still there – touch it/ use a paper towel/ stir it etc. The most common response was to heat for longer or heat over 100°C.

08.4 The clarity of expression of students meant that only 1 in 5 students gained this mark. Often mass was not mentioned, or the calculation was the wrong way round. Using the mass of the basin and 10cm^3 of water was also commonly seen. Students often did not go back to the method to aid them in answering this item.

08.5 Over half of students gained 4 of the 5 marks on this calculation. The most common error was not converting the volume at all or converting it incorrectly. Another error seen included taking anomalies out of the data given. If anomalies are present, students will be told to ignore anomalous results. Students also sometimes forgot to divide by 4 to get a mean. Marks could be awarded for other steps when one step was completed incorrectly.

08.6 Fewer than a quarter of students correctly suggested that samples were taken from different areas in the sea. Many re-worded the question.