



A' Level Chemistry

Year 1

Unit 2: AOS Titrations

Summer Examination Revision Pack

The questions in this pack should be attempted **AFTER** completing all other revision.



Grade Accelerator

Recall Definitions
Drawing Diagrams
Using Equations
Drawing Graphs



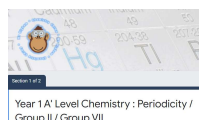
Condensed Notes

Keywords & Definitions
Key Concepts
Application
Key Skills

Quizlet

Quizlet Classes

Flashcard Based
Games
Tests & Quizzes
Keyword Spell Checker



Online Forms

Take Time to Answer
Use Paper & Calculator
Work It Out
Review Missed Marks

Use the 3 Wave Process when completing these revision packs.



1. Complete the questions without assistance
(Can't answer a question? Leave it and move on)
2. Use your notes to fill any gaps after step 1
3. Use the mark scheme to fill in any remaining gaps.

1. Having gaps after step 1 is normal, that's why we are doing revision!

2. If your notes don't help during step 2, they are not good enough!
(Change your note taking method and try to understand the problem)

3. If you don't understand why the mark scheme answer is correct, **see Andy.**



If you struggle with the questions in the pack, **STOP!** and complete some more revision.



If you come to a complete dead-end, **STOP!** and speak to **Andy** asap.

- 3** This question is about a white solid, MHCO_3 , that dissolves in water and reacts with hydrochloric acid to give a salt.



A student was asked to design an experiment to determine a value for the M_r of MHCO_3 . The student dissolved 1464 mg of MHCO_3 in water and made the solution up to 250 cm^3 .

25.0 cm^3 samples of the solution were titrated with $0.102 \text{ mol dm}^{-3}$ hydrochloric acid. The results are shown in **Table 1**.

Table 1

	Rough	1	2	3
Initial burette reading / cm^3	0.00	10.00	19.50	29.25
Final burette reading / cm^3	10.00	19.50	29.25	38.90
Titre / cm^3	10.00	9.50	9.75	9.65

- 0 3** . **1** Calculate the mean titre and use this to determine the amount, in moles, of HCl that reacted with 25.0 cm^3 of the MHCO_3 solution.

[3 marks]

- 0 3** . **2** Calculate the amount, in moles, of MHCO_3 in 250 cm^3 of the solution. Then calculate the experimental value for the M_r of MHCO_3 . Give your answer to the appropriate number of significant figures.

[3 marks]



- 0 3 . 3** The student identified use of the burette as the largest source of uncertainty in the experiment.

Using the same apparatus, suggest how the procedure could be improved to reduce the percentage uncertainty in using the burette.

Justify your suggested improvement.

[2 marks]

Suggestion _____

Justification _____

- 0 3 . 4** Another student is required to make up 250 cm^3 of an aqueous solution that contains a known mass of MHCO_3 . The student is provided with a sample bottle containing the MHCO_3 .

Describe the method, including apparatus and practical details, that the student should use to prepare the solution.

[6 marks]

More answer space is available on page 8



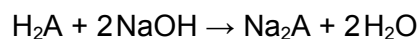


Question	Marking Guidance	Mark	Comments
03.1	Selects correct titres $\text{mean titre} = \frac{9.75 + 9.65}{2}$ $= 9.7(0) \text{ cm}^3$ $\text{mol HCL} = 0.102 \times \frac{9.70}{1000} = 9.89 \times 10^{-4}$ (allow 9.9×10^{-4} for M3 but check not via 4 titres in which case only 1 mark)	1	If 3 or more titres used them MAX 1 for conseq M3
		1	Calculates mean
		1	Calculates mol (working or result gains credit)
			9.92×10^{-4} scores 1 if all 4 titres used 9.83×10^{-4} scores 1 if titres 1,2,and 3 used
03.2	$\text{mol MHCO}_3 = \text{ANS } 3.1 \times 10 (= 9.89 \times 10^{-3})$ $\text{Mr} = \frac{1464/1000}{M1}$ $\text{Mr} = 148 \text{ (3sf)}$	1	Use ecf if wrong mean calculated above
		1	
		1	Allow ecf following wrong mass conversion
03.3	Suggestion: Use a larger mass of solid OR use a more concentrated solution of MHCO_3 OR less concentrated / more dilute solution of HCl OR more MHCO_3 Justification: So a larger titre/reading will be needed OR larger volume of HCl	1	Cannot score justification mark unless suggestion correct, but suggestion could be after justification
		1	Assume reference to the solution means the MHCO_3

Question	Marking Guidance	Mark	Comments
03.4	<p>This question is marked using levels of response.</p> <p>Level 3 - Must use volumetric flask to access level 3</p> <p>Answer is communicated coherently and shows a logical progression from stage 1 to stage 2 then stage 3.</p> <p>6 marks - All stages are covered and the description of each stage is complete</p> <p>5 marks – all stages are covered but up to 2 omissions/errors from different stages. If 2 omissions/errors from same stage only level 2 possible</p> <p>Level 2</p> <p>Answer is mainly coherent and shows progression from stage 1 to stage 3</p> <p>4 marks - All stages are covered but 3 omissions/errors</p> <p>3 marks – all stages are attempted</p> <p>Level 1</p> <p>Answer includes isolated statements but these are not presented in a logical order or show confused reasoning.</p> <p>2 marks – 2 stages attempted</p> <p>1 mark – 1 stage attempted</p> <p>Level 0</p> <p>0 marks</p> <p>Insufficient correct chemistry to gain a mark.</p>	6	<p>Indicative Chemistry content</p> <p>Stage 1: transfers known mass of solid</p> <ul style="list-style-type: none"> a) Weigh the sample bottle containing the solid on a (2 dp) balance b) Transfer to beaker* and reweigh sample bottle c) Record the difference in mass <p>Or</p> <ul style="list-style-type: none"> d) Place beaker* on balance and tare e) Transfer solid into beaker f) Record mass <p>Or</p> <ul style="list-style-type: none"> g) Known mass provided h) Transfers (known) mass into beaker* i) Wash all remaining solid from sample bottle into beaker <p>Allow use of weighing boat</p> <p>*Allow other suitable glassware including volumetric flask</p> <p>Stage 2: Dissolves in water</p> <ul style="list-style-type: none"> a) Add distilled / deionised water b) Stir (with a glass rod) or swirl c) Until all solid has dissolved <p>Stage 3: Transfer, washing and agitation</p> <ul style="list-style-type: none"> a) Transfer to <u>volumetric / graduated</u> flask. Allow if a clear description/diagram given eg long necked flask with 250cm³ mark b) With washings c) Make up to 250cm³ / mark with water d) Shakes/inverts/mixes

0 6

A student does an investigation to determine the relative formula mass, M_r , of a solid unknown diprotic acid, H_2A



- 250 cm³ of aqueous solution are prepared using 1300 mg of H_2A
- A pipette is used to add 25.0 cm³ of 0.112 mol dm⁻³ aqueous sodium hydroxide to a conical flask.
- This aqueous sodium hydroxide is titrated with the acid solution.

The titration results are shown in **Table 3**.

Table 3

	Rough	1	2	3
Final volume / cm³	27.35	26.75	38.90	35.70
Initial volume / cm³	0.00	0.35	12.15	9.20
Titre / cm³	27.35	26.40	26.75	26.50

0 6

. 1

Use the results to calculate the M_r of H_2A

[5 marks]

M_r of H_2A _____



0 6 . 2

The uncertainty in using the pipette in this experiment is $\pm 0.06 \text{ cm}^3$

Calculate the percentage uncertainty in using the pipette.

[1 mark]

% uncertainty _____

0 6 . 3

Before adding the solution from the burette in the rough titration, there was an air bubble below the tap.

At the end of this titration the air bubble was not there.

Explain why this air bubble increases the final burette reading of the rough titration.

[1 mark]

0 6 . 4

During the titration the student washed the inside of the conical flask with some distilled water.

Suggest why this washing does **not** give an incorrect result.

[1 mark]

8

Turn over for the next question

Turn over ►



Question	Marking guidance	Additional Comments/Guidelines	Mark
06.1	Average titre = 26.45 cm ³	M1 = average of concordant titres	1
	$n(\text{NaOH}) = (25 \times 0.112 / 1000) = 2.80 \times 10^{-3} \text{ mol}$	M2 – this value only	1
	$n(\text{acid in titre}) = 2.80 \times 10^{-3} / 2 = 1.40 \times 10^{-3} \text{ mol}$	M3 = M2/2	1
	$n(\text{acid in } 250 \text{ cm}^3) = 1.40 \times 10^{-3} \times 250/26.45 = 0.0132 \text{ mol}$	M4 = M3 x 250/M1	1
	$M_r = \text{mass} / \text{moles} = 1.300/0.0132 = 98.2\text{-}98.5$	M5 = (1.300/M4) = answer M _r must be given to at least 1dp Alternatives: 98.6 – scores 4 92.9 – scores 4 87.8 – scores 3 49.3 – scores 3 49.1 – scores 4	1
06.2	% uncertainty = $0.06/25.0 \times 100 = 0.24 \%$		1
06.3	Some solution/acid replaces air bubble / Solution/acid fills below the tap / Air bubble takes up volume that would be filled by solution/acid	Score for the idea that: Acid/solution replaces air/bubble/fills jet space Allow acid/solution fills the bubble/gap 'The final reading is higher than the volume added' is not enough.	1
06.4	Does not react (with the alkali) / does not change the number of moles (of alkali)	Allow water is a product / water is not a reagent	1

0 2

This question is about a titration.

A student dissolves an unknown mass of sodium hydroxide in water to make 200 cm³ of an aqueous solution.

A 25.0 cm³ sample of this sodium hydroxide solution is placed in a conical flask and is titrated with 0.150 mol dm⁻³ sulfuric acid.

The equation for this reaction is shown.

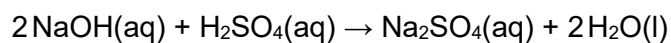


Table 1 shows the results of the titrations.

Table 1

Titration	Rough	1	2	3
Final reading / cm ³	20.75	40.35	21.05	40.60
Initial reading / cm ³	0.00	20.75	1.20	21.05
Titre / cm ³	20.75	19.60	19.85	19.55

0 2**1**

Calculate the mass of sodium hydroxide used to make the original solution.

[5 marks]

Mass of sodium hydroxide _____ g



0 2 . 2

The student uses a funnel to fill the burette with sulfuric acid before starting the titration. After filling, the student forgets to remove the funnel from the top of the burette.

Suggest why this might affect the titre volume recorded.

[1 mark]

0 2 . 3

State **one** advantage of using a conical flask rather than a beaker for the titration.

[1 mark]

7

Turn over for the next question

Turn over ►

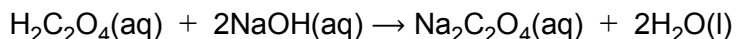


Question	Marking guidance	Additional Comments/Guidelines	Mark
02.1	<p>M1 Volume of $\text{H}_2\text{SO}_4 = (19.60 + 19.55) / 2 =$ $= (19.575 \text{ cm}^3 / 19.58 \text{ cm}^3)$</p> <p>M2 Moles of $\text{H}_2\text{SO}_4 = \text{concentration} \times \text{volume}$ $= 0.150 \times (19.575 / 1000)$ $(= 2.936 \times 10^{-3} \text{ mol})$</p> <p>M3 Moles of NaOH in $25 \text{ cm}^3 = 2.936 \times 10^{-3} \times 2 = (5.87 \times 10^{-3} \text{ mol})$</p> <p>M4 Moles of NaOH in original 200 cm^3 sample $= 5.87 \times 10^{-3} \times 8$ $(= 0.04698 \text{ mol})$</p> <p>M5 Mass of NaOH $= \text{Mr} \times \text{moles} = 40.0 \times 0.04698$ $= 1.88 \text{ g} (1.9 \text{ g})$</p>	<p>M1 = calculation of mean titre</p> <p>M2 = $\text{M1} \times 10^{-3} \times 0.150$</p> <p>M3 = $\text{M2} \times 2$</p> <p>M4 = $\text{M3} \times 8$</p> <p>M5 = 1.879g</p> <p>Allow correct alternative approaches</p>	5
02.2	Additional drops of solution could have entered the burette from the funnel, (making the value on the burette lower).	Must imply that solution from funnel drips into burette	1
02.3	Less chance of splashing/losing any solution using a conical flask (when swirling)	Allow easier to swirl	1

0	5
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Ethanedioic acid ($\text{H}_2\text{C}_2\text{O}_4$) is a diprotic acid. Beekeepers use a solution of this acid as a pesticide.

A student carried out a titration with sodium hydroxide solution to determine the mass of the acid in the solution. The student repeated the titration until concordant titres were obtained.



0	5	.	1
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The student found that 25.0 cm^3 of the ethanedioic acid solution reacted completely with 25.30 cm^3 of $0.500 \text{ mol dm}^{-3}$ sodium hydroxide solution.

Calculate the mass, in mg, of the acid in 25.0 cm^3 of this solution.

[4 marks]

Mass of acid _____ mg

0	5	.	2
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The student used a wash bottle containing deionised water when approaching the end-point to rinse the inside of the conical flask.

Explain why this improved the accuracy of the titration.

[1 mark]

0	5	.	3
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Give the meaning of the term concordant titres.

[1 mark]



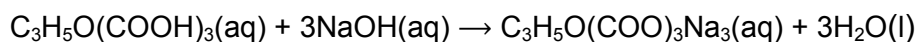
Question	Marking Guidance	Mark	Comments
05.1	<p>M1 Amount NaOH = $0.02530 \times 0.500 = 0.01265$ mol</p> <p>M2 Amount acid = 0.006325 mol (i.e. M1÷2)</p> <p>M3 $M_r = 90(.0)$</p> <p>M4 mass acid = 569 (mg) (allow 567 to 576) (i.e. M2 x M3 in mg)</p>	<p>1</p> <p>1</p> <p>1</p> <p>1</p>	<p>$567-590 = 4$ marks $0.567-0.590 = 3$ marks</p> <p>Allow ECF at each stage</p> <p>M3 can be scored from use of value of $90(.0)$ within working</p> <p>M4 should be to at least 2sf. Any individual marks for M1/2/3 should be to at least 2sf (or 90 for M3)</p> <p>$1134-1180 = 3$ marks (due to not dividing moles of NaOH by 2) $1.134-1.180 = 2$ marks (due to not dividing moles of NaOH by 2 and not converting to mg)</p>
05.2	<p>Idea that it ensures all ethanedioic acid / acid / sodium hydroxide / alkali / reactants are in the mixture / solution / reaction or</p> <p>the idea that some of the ethanedioic acid / acid / sodium hydroxide / alkali / reactants would be on the sides of the flask</p>	1	the idea that it is the transfer of all the acid/alkali alone is not enough
05.3	<p>Titres that are within 0.1 cm^3 of each other</p>	1	<p>Units are needed</p> <p>Allow $0.05-0.15 \text{ cm}^3$</p> <p>Do not allow idea of identical results</p> <p>Allow answers that refer to titres that are within the uncertainty of the burette/apparatus of each other</p>

0 2

Citric acid, $\text{C}_3\text{H}_5\text{O}(\text{COOH})_3$, occurs naturally in many fruits and can also be synthesised in the laboratory for use as a food flavouring. A student analysed a sample of citric acid to determine its percentage purity.

The student dissolved 784 mg of impure citric acid in water to prepare 250 cm^3 of solution in a volumetric flask.

The student titrated 25.0 cm^3 samples of this solution with $0.0500 \text{ mol dm}^{-3}$ sodium hydroxide solution using phenolphthalein as the indicator.

**0 2 . 1**

The student rinsed the burette before filling it with the sodium hydroxide solution.

State why the student should use sodium hydroxide solution rather than water for the final rinse of the burette.

[1 mark]

0 2 . 2

The student carried out several titrations. The results are shown in **Table 2**.

Complete **Table 2** to show the titre in each titration.

[1 mark]**Table 2**

Titration	Rough	1	2	3
Final reading / cm^3	25.2	23.95	47.65	24.10
Start reading / cm^3	0.0	0.05	23.95	0.10
Titre / cm^3				

0 2 . 3

Calculate the mean titre using the concordant results.
Give your answer to the appropriate number of significant figures.

[2 marks]

Mean titre _____ cm^3



0 2 . 4

The total uncertainty when using the burette is $\pm 0.15 \text{ cm}^3$. This is the combination of uncertainties in the start reading, final reading and the determination of the end point.

Use your answer to Question **02.3** to calculate the percentage uncertainty for the use of the burette in this experiment.

[1 mark]

Percentage uncertainty _____ %

0 2 . 5

Use your answer to Question **02.3** to find the mass, in mg, of citric acid dissolved in 250 cm^3 of the solution.

The relative molecular mass (M_r) of citric acid is 192.0

[3 marks]

Mass _____ mg

0 2 . 6

Calculate the percentage purity of this sample of citric acid.

[1 mark]

Percentage purity _____ %

9

Turn over ►

Question	Marking Guidance	Mark	Comments
2.1	use of water would <u>dilute</u> the NaOH OR use of water would change the <u>concentration</u> of NaOH OR to ensure the <u>concentration</u> of the NaOH is not changed OR	1	Ignore reference to weakening the solution, watering down the solution, contaminate Allow it would give a titre value that is larger it would decrease the pH of the NaOH (any additional qualifying reason given must be correct)
2.2	Rough = 25.2, 1 = 23.90, 2 = 23.70, 3 = 24.00	1	Need all four (with rough to 1dp and the other three to 2dp)
2.3	M1 use of titrations 1 & 3 only M2 23.95 (cm ³)	1 1	M1 is for choosing correct titres M2 is for calculating the mean to 2dp for their chosen titres 24.0 cm ³ = 1 mark (wrong number of decimal places) 24 cm ³ = 1 mark (only if it is clear that titration 2 is not included) 23.86 cm ³ = 1 mark (used all three titrations) 23.9 cm ³ = 0 marks (used all three titrations and wrong number of decimal places) If error(s) made in 2.2, allow ECF from 2.2, where they choose concordant titres and find the mean (can score M1 and M2)
2.4	$(\frac{0.15}{23.95} \times 100) = 0.63\%$	1	(0.6263%) Allow any correct value with at least 2 significant figures based on their answer to 2.3. Rounding must be correct.

2.5	<p>M1 moles NaOH = $\frac{23.95}{1000} \times 0.0500$ (= 0.001198)</p> <p>M2 moles acid in flask = $\frac{M1}{3} \times 10$ (= 0.003992)</p> <p>M3 mass acid (= 0.003992 x 192.0 = 0.766 g) = 766 (mg)</p>	1 1 1	<p>Correct answer to at least 2sf = 3 marks (allow 760-770 mg)</p> <p>Correct value in grams (lose M3) = 2 marks (allow 0.76-0.77 g)</p> <p>Allow ECF at each stage (including those based on value from 2.3)</p> <p>Incorrect answers that are a factor of 10 too small lose M2 (76-77 mg = 2 marks, 0.076-0.077 g = 1 mark)</p> <p>(if use 25 cm³ for volume of NaOH, then max 2 marks (M2 and M3 for 800 mg)</p>
2.6	<p>($\frac{\text{Answer to Q02.5}}{784} \times 100$) = 97.7 or 97.8%</p>	1	<p>Allow any correct value to at least 2 significant figures based on their answer to Q02.5 (values may be over 100% if 2.5 is incorrect)</p>

0 8

A student is provided with a 5.60 g sample of ethanoic acid (CH_3COOH) contaminated with sodium ethanoate (CH_3COONa).

The student dissolves the sample in deionised water and makes the volume up to 200 cm^3

The student removes 25.0 cm^3 samples of the solution and titrates them with 0.350 mol dm^{-3} sodium hydroxide solution.

Table 3 shows the results of these titrations.

Table 3

	Rough	1	2	3
Final volume / cm^3	20.85	41.10	20.50	40.80
Initial volume / cm^3	0.00	20.85	0.00	20.50
Titre / cm^3	20.85	20.25	20.50	20.30

0 8**. 1**

Use the results in **Table 3** to calculate the mean titre value.

Use the mean titre to calculate the percentage by mass of sodium ethanoate in the original sample.

[6 marks]

Mean titre value _____ cm^3



Percentage by mass _____

0 8 . 2

The student rinses the burette with deionised water before filling with sodium hydroxide solution.

State and explain the effect, if any, that this rinsing will have on the value of the titre.

[2 marks]

8

Turn over for the next question

Turn over ►



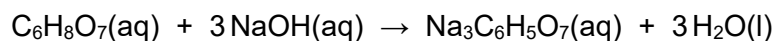
Question	Marking guidance	Additional Comments/Guidelines	Mark
08.1	M1: Mean titre = $\frac{20.25+20.30}{2} = 20.275 \text{ cm}^3$	Allow M1 = 20.28 cm ³	1
	M2 Amount of NaOH = $0.35 \times (20.275 \div 1000)$ = 0.00709625 mol	M2 = $M1 \times 10^{-3} \times 0.35$	1
	Amount of ethanoic acid in 25 cm ³ = 0.00709625 mol		1
	M3 Amount of ethanoic acid in 200 cm ³ = 0.05677 mol	M3 = $M2 \times 8$	
	M4 Mass of ethanoic acid in sample = 60.0×0.05677 = 3.4062 g	M4 = $M3 \times 60.0$	1
	M5 Mass of sodium ethanoate = $5.6 - 3.4062$ = 2.1938 g	M5 = $5.6 - M4$	1
	M6 percentage CH ₃ COONa = $(2.1938 \div 5.6) \times 100$ = 39.1 %	M6 = $(M5 \div 5.6) \times 100$ (39.1 – 39.2) Accept alternative methods M5 = $(M4 \div 5.6) \times 100$ followed by M6 = $100 - M5$	1

Question	Marking guidance	Additional Comments/Guidelines	Mark
08.2	M1 Titre value would increase / larger value		1
	M2 Because the sodium hydroxide solution would be more dilute		1

0	2
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This question is about acid–base titrations.

Citric acid reacts with sodium hydroxide.



0	2	.	1
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A student makes a solution of citric acid by dissolving some solid citric acid in water.

Describe a method to add an accurately known mass of solid to a beaker to make a solution.

[2 marks]

0	2	.	2
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The student dissolves 0.834 g of citric acid in water and makes the solution up to 500 cm³

Calculate the concentration, in mol dm^{−3}, of citric acid in this solution.

[3 marks]

Concentration _____ mol dm^{−3}

Turn over ►



The student uses this method to complete a titration.

- Rinse a burette with distilled water.
- Fill the burette with sodium hydroxide solution.
- Use a measuring cylinder to transfer 25 cm³ of the citric acid solution into a conical flask.
- Add 5 cm³ of indicator.
- Slowly add the sodium hydroxide solution from the burette into the conical flask.
- Add the sodium hydroxide solution dropwise near the end point until the indicator just changes colour.
- Repeat the titration to get concordant results.

The method used by the student includes three practical steps that will lead to an inaccurate final result.

For each of these three steps

- identify the mistake
- explain why it is a mistake
- suggest how the mistake can be overcome.

[6 marks]

[illegible]

[illegible]

0 2 . 4

Table 1 shows the student's burette readings after the mistakes in the practical procedure have been corrected.

Table 1

	Rough	Run 1	Run 2	Run 3
Final reading / cm³	23.65	22.95	46.05	26.30
Start reading / cm³	0.00	0.00	22.95	3.40
Titre / cm³	23.65			

Complete **Table 1**.

Use the data in **Table 1** to calculate the mean titre.

[2 marks]

Mean titre _____ cm³

0 2 . 5

The total uncertainty in the use of the burette is $\pm 0.15 \text{ cm}^3$

Calculate the percentage uncertainty in the use of the burette in **Run 1**.

[1 mark]

Percentage uncertainty _____



Question	Marking guidance	Additional Comments/Guidelines	Mark
02.1	<p>M1 measure the mass of the weighing boat (or similar) and solid</p> <p>M2 Add the solid to a beaker (or other suitable container) and then reweigh the weighing boat (and subtract to find the mass of solid added.)</p> <p>OR</p> <p>M1 Place weighing boat on a balance and zero the balance</p> <p>M2 Add the solid to a beaker (or other suitable container), wash out weighing boat and transfer washing to the beaker.</p>	<p>M1 place (an empty) beaker on balance and zero</p> <p>M2 add the solid to the beaker and record the mass</p> <p>OR</p> <p>M1 place (an empty) beaker on balance and measure its mass</p> <p>M2 add the solid to the beaker and subtract mass of empty beaker from the total mass</p>	<p>1</p> <p>1</p> <p>(2 x AO1)</p>

Question	Marking guidance	Additional Comments/Guidelines	Mark
02.2	<p>M1 M_r citric acid = 192.0</p> <p>M2 Amount of citric acid = Mass / M_r $= 0.834 / 192$ $= 0.0043438 \text{ (mol)}$</p> <p>M3 Concentration = moles / volume $= 0.0043438 / 0.5$ $= 0.00869 \text{ (mol dm}^{-3}\text{)}$</p>	<p>M2 conseq on M1</p> <p>M3 conseq on M2</p> <p>Alternative Method M1 Concentration (g/dm^3) = $0.834 / 0.50 = 1.668$ M2 M_r citric acid = 192.0 M3 Concentration (mol/dm^3) = $M1/M2 = 0.00869$</p>	<p>1</p> <p>1</p> <p>1</p> <p>(3 x AO2)</p>

Question	Marking guidance	Additional Comments/Guidelines	Mark
02.3	<p>This question is marked using levels of response. Refer to the Mark Scheme Instructions for Examiners for guidance on how to mark this question.</p>	Use best three of these four stages	6 (3 x AO1, 3 x AO3)
	<p>Level 3: Three stages are covered and the explanation of each stage is generally correct and virtually complete. Answer is well structured with no repetition or irrelevant points. Accurate and clear expression of ideas with no errors in use of technical terms.</p>	<p>Stage 1</p> <ol style="list-style-type: none"> Problem – using a measuring cylinder Explanation – large uncertainty / not accurate enough Improvement – use a (volumetric) pipette (Not dropping pipette) 	
	<p>Level 2: Three stages are covered but the explanation of each stage may be incomplete or may contain inaccuracies OR two stages are covered and the explanations are generally correct and virtually complete. Answer shows some attempt at structure. Ideas are expressed with reasonable clarity with, perhaps, some repetition or some irrelevant points. Some minor errors in use of technical terms.</p>	<p>Stage 2</p> <ol style="list-style-type: none"> Problem – too much indicator Explanation – may react and affect the endpoint reading Improvement – use a smaller volume (2-6 drops) 	
	<p>Level 1: Two stages are covered but the explanation of each stage may be incomplete or may contain inaccuracies, OR only one stage is covered but the explanation is generally correct and virtually complete. Answer includes isolated statements but these are not presented in a logical order or show some confusion. Answer may contain valid points which are not clearly linked to an argument structure. Errors in the use of technical terms.</p>	<p>Stage 3</p> <ol style="list-style-type: none"> Problem – rinsing the burette with distilled or deionised water Explanation – will slightly dilute the alkali solution Improvement – rinse the burette with alkali solution 	
	<p>Level 0 Insufficient correct chemistry to gain a mark.</p>	<p>Stage 4</p> <ol style="list-style-type: none"> Problem – adding alkali solution until the indicator “just” changes colour Explanation – acid may not have fully reacted (as mixture not swirled) Improvement – add alkali solution until a permanent colour change is seen. 	

Question	Marking guidance	Additional Comments/Guidelines	Mark						
02.4	Calculates the titres for each of 1,2,3 as <table><tr><td>1</td><td>2</td><td>3</td></tr><tr><td>22.95</td><td>23.10</td><td>22.90</td></tr></table>	1	2	3	22.95	23.10	22.90	Allow 22.9(25) cm ³	1
	1	2	3						
22.95	23.10	22.90							
Averages concordant titres: (22.95 + 22.90) ÷ 2 = 22.93 cm ³	1 (2 x AO1)								

Question	Marking guidance	Additional Comments/Guidelines	Mark
02.5	(0.15 / 22.95) × 100 = 0.65%	0.15 / (Their Run 1) × 100	1 (AO1)