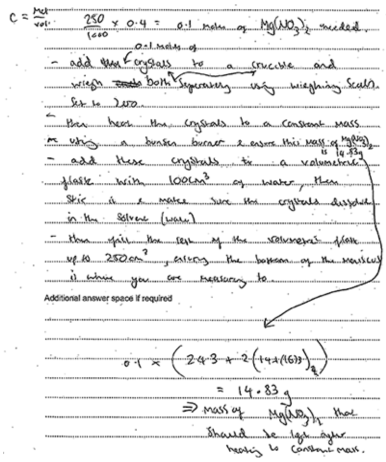
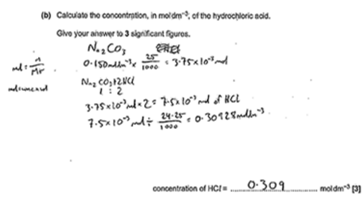
Mark scheme - Acids

Question			Answer/Indicative content	Marks	Guidance
1			*Please refer to the marking instructions on this mark scheme for guidance on how to mark this question.* **Level 3 (5–6 marks)** Calculates the correct mass of $Mg(NO_3)_2•6H_2O$ or $Mg(NO_3)_2$. **AND** Explains the preparation steps, with most fine detail. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** Attempts a calculation which is partly correct. **AND** Outlines the preparation steps, with some fine detail. *There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.* **Level 1 (1–2 marks)** Attempts the calculation but makes little progress or makes errors. **OR** Briefly outlines the preparation steps, which may be incomplete *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* **0 marks** No response or no response worthy of credit.	6(AO2.8×2) (AO2.3×2) (AO2.7×2)	**Indicative scientific points may include:** **Calculation:** $n = \frac{250.0}{1000} \times 0.4000 =$ **0.1(000)** (mol) $M(Mg(NO_3)_2•6H_2O) = 256.3$ Mass = 0.1000 × 256.3 = **25.63** g **OR** $M(Mg(NO_3)_2) = 148.3$ Mass = **14.83** g **ALLOW** small slip/rounding errors such as errors on M_r (e.g. use of 24 instead of 24.3 for Mg A_r) **Preparation steps (apparatus and method):** • Weigh mass of crystals • Dissolve in (distilled/deionised) water • Transfer to 250 cm^3 volumetric flask • Make up to the mark with more water so that bottom of meniscus is on the mark **IGNORE** removing the water of crystallisation ***Fine detail:*** • 2 or more decimal place balance • Rinse beaker and transfer washings to flask • Use of dropping pipette when filling to mark • Stopper, invert several times to mix <u>**Examiner's Comments**</u> Most candidates focused on removing the water of crystallisation, often going to great depths of explanation, with apparatus diagrams, of how to remove it. Some candidates then went on to explain how to make a standard solution and could be given marks. Calculations for the mass required were often correct or could be given some marks.

					Exemplar 3  c = mol/vol 250/1000 × 0.4 = 0.1 moles of $Mg(NO_3)_2$ needed. 0.1 moles of - add the crystals to a crucible and weigh both separately using weighing scales set to zero. - then heat the crystals to a constant mass using a bunsen burner & ensure this mass of $Mg(NO_3)_2$ is 14.83g - add these crystals to a volumetric flask with 100cm³ of water, then stir it & make sure the crystals dissolve in the solvent (water) - then fill the rest of the volumetric flask up to 250cm³, along the bottom of the meniscus is where you are measuring to. Additional answer space if required 0.1 × (24.3 + 2(14+(16×3))) = 14.83 g ⇒ mass of $Mg(NO_3)_2$ that should be left after heating to constant mass. This in a response of a common approach to this question, it was given 4 marks. Despite calculating the mass properly, the candidate then put all their efforts into describing removing the water of crystallisation and left out the valuable fine detail required for a Level 3 response.
			Total	**6**	
2	a	i	Titre/cm^3 | 24.20 | 23.85 | 24.30 | ✓ Correct subtractions to obtain titres **to 2 DP**	2 (AO2.4)	**DO NOT ALLOW** 24.2 **OR** 24.3 **<u>Examiner's Comments</u>** Most candidates added correct titres for the three titrations. However, an error made by a quarter of candidates was to omit the zero as the second decimal place in the first and third titres. This should have been usual practice from candidate experience of practical work and has also been highlighted as a common error in previous exam series.
		ii	mean titre = $\frac{24.20 + 22.30}{2}$ = 24.25 (cm^3) ✓ *i.e. using concordant (consistent) titres*	(AO2.4)	**DO NOT ALLOW** mean of all three titres, i.e. $\frac{24.20 + 23.85 + 22.30}{3}$ = 24.10/24.12 **ALLOW ECF** from incorrect concordant titres from 22a(i) **<u>Examiner's Comments</u>** Most candidates identified that the first and third titres were concordant and calculated the mean titre that should be used as 24.25 cm^3. About a third of candidates calculated the mean of all 3 titres as 24.10 or 24.12 cm^3. Normal practice in titrations would be to select the closest titres.

					OCR support The Practical Skills handbook contains guidance on correct practice for recording titration results and calculating average titre values in Appendix 4: Measurements, which can be shared with students: https:/www.ocr.org.uk/Images/208932-chemistry-practical-skills-handbook.pdf.
	b		**FIRST CHECK THE ANSWER ON ANSWER LINE IF answer = 0.309 (mol dm^{-3}) award 3 marks** -- ***n*****(Na_2CO_3)** $= 0.150 \times \frac{25.00}{1000}$ $= 3.75 \times 10^{-3}$ (mol) ✓ ***n*****(HCl)** $= 2 \times n(Na_2CO_3)$ $= 7.50 \times 10^{-3}$ (mol) ✓ **[HCl] to 3 SF** $= n(\text{HCl}) \times \frac{1000}{\text{mean titre from } \mathbf{b(i)}}$ $= 7.50 \times 10^{-3} \times \frac{1000}{24.25}$ = 0.309 (mol dm^{-3}) ✓ **3 SF** required	3 (AO2.8×3)	**ALLOW 3SF** or more throughout **IGNORE** trailing zeroes, e.g. **ALLOW** 0.075 for 0.00750 -- **ALLOW ECF** from 2 × incorrect *n*(Na_2CO_3) **ALLOW ECF** from incorrect *n*(HCl), **OR** from *n*(Na_2CO_3) if *n*(HCl) stage omitted **ALLOW ECF** from incorrect mean titre in **b(ii)** -- **COMMON ERROR for 3 marks** From 24.10 cm^3 (mean of all 3 titres in **b(ii)**), [HCl] = 0.311 (mol dm^{-3}) **Examiner's Comments** **Exemplar 3**  Many candidates were able to calculate the amount of Na_2CO_3 in the titration as 0.00375 mol although a common error was to calculate the amount of Na_2CO_3 in the 250 cm^3 volumetric flask as 0.0375 mol. Most candidates were credited for the amount of HCl: twice their calculated amount of Na_2CO_3. Candidates then need to scale up this value by 1000/mean titre to obtain the concentration as 0.309 mol dm^{-3}, and to quote the answer to 3 significant figures. Many candidates scaled

					up using 50.0, the burette volume, rather than their mean titre, resulting in a concentration 0.15 or 1.5 mol dm^{-3}. A significant number also rounded their value to 2 rather than 3 significant figures. Candidates are advised to show clear working so that credit can be given for such responses by applying error carried forward. The working shown in this response is clear. Many candidates working was more jumbled, with unreferenced numbers common.
	c		***Pipette:*** $\frac{0.04}{25.0} \times 100 = 0.16$ **OR** 0.2 (%) ✓ ***Burette:*** (using any of 3 titres or mean titre), e.g. $\frac{0.05 \times 2}{24.20} \times 100 = 0.41$ **OR** 0.4 (%) ✓ Response does **NOT** need a statement of whether pipette or burette has greater % uncertainty.	2 (AO3.1×2)	**ALLOW** % uncertainties to *1 SF or more, rounded correctly* --- Other burette volumes: $\frac{0.05 \times 2}{23.85} \times 100 = 0.42$ **OR** 0.4 (%) $\frac{0.05 \times 2}{24.30} \times 100 = 0.41$ **OR** 0.4 (%) $\frac{0.05 \times 2}{24.25} \times 100 = 0.41$ **OR** 0.4 (%) **ALLOW burette volume of 50 cm^3, i.e.** $\frac{0.05 \times 2}{50} \times 100 = 0.2\%$ **ALLOW ECF** from incorrect titre in **22(a)** **IF BOTH** calculations are 'correct' but ×100 is omitted **BOTH** times, **ALLOW** 1 mark <u>**Examiner's Comments**</u> Most candidates The calculations here should have reflected practical work carried out by candidates. Candidates were expected to realise that the pipette volume involves one measurement requiring the uncertainty of ±0.04 provided being used. As the volume measured by a burette uses two measurements, the uncertainty of ±0.05 must then be doubled to obtain the percentage uncertainty. It was very common for the burette value to be obtained using 0.05 rather than the doubled 0.10; some candidates doubled both uncertainties. Another common

<table>
<tr><td></td><td></td><td></td><td></td><td></td><td>error was to use the volume of the burette of 50 cm3 rather than the volume of solution measured in the burette.

OCR support

The Practical Skills handbook contains guidance on calculating uncertainties in Appendix 4: Measurements, which can be shared with students: https:/www.ocr.org.uk/Images/208932-chemistry-practical-skills-handbook.pdf.</td></tr>
<tr><td></td><td></td><td></td><td>**Total**</td><td>**7**</td><td></td></tr>
<tr><td>3</td><td>a</td><td></td><td>Releases **OH^-** (ions in aqueous solution) ✓</td><td>1</td><td>**ALLOW** containing **OH^-** ions
IGNORE mention of pH

Examiner's Comments

Many candidates stated a Brønsted–Lowry definition or gave pH values. Of the candidates that did mention OH^- ions, most did not state 'releases' OH^- ions in solution, although they were credited with the mark.</td></tr>
<tr><td></td><td>b</td><td>i</td><td><table><tr><td>Final reading/ cm^3</td><td>27.30</td><td>27.00</td><td>27.75</td></tr><tr><td>Initial reading/ cm^3</td><td>0.45</td><td>0.60</td><td>1.25</td></tr><tr><td>Titre/cm^3</td><td>26.85</td><td>26.4**0**</td><td>26.5**0**</td></tr></table>
Initial and final readings
All burette readings (×6) correct ✓

Titres recorded to **two decimal places** with the last figure either **0 or 5**
Correct subtractions to obtain final titre values ✓

Mean titre calculated from concordant results
Correct mean titre = **26.45** (cm^3) ✓

Mean titre recorded to accuracy of burette
Final answer recorded to **two decimal places** with the last figure either **0 or 5** ✓</td><td>4</td><td>**ANNOTATE ANSWER WITH TICKS AND CROSSES ETC**

ALLOW missing zeroes for burette readings
i.e. 0.6 for 0.60
27 **OR** 27.0 for 27.00

ALLOW ECF from incorrect burette readings

IF MEAN IS CALCULATED FROM ECF, IT MUST BE FROM CLOSEST TITRES

ALLOW ecf from incorrect mean
DO NOT ALLOW 26.5 cm^3
Question asks for nearest 0.05 cm^3

Examiner's Comments

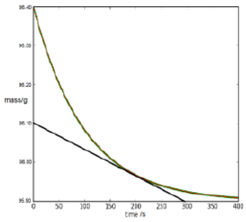
Most candidates were able to accurately record the burette readings and made the correct subtractions. Despite the examination question requesting the mean titre to be recorded to the accuracy of the burette, many candidates did not do this. A common error was taking a mean of all three readings</td></tr>
</table>

					instead of only the concordant results; this led the candidates to give an answer of 26.58 which lost them 2 marks.
		ii	$\frac{2 \times 0.05}{26.85} \times 100 = 0.37(2)$ (%) ✓	1	**ALLOW** 0.4 up to full calculation display of 0.372439478 **ALLOW ECF FOR CORRECT CALCULATION FROM 1 (c) (i) OR USE OF ANY TITRE** **Examiner's Comments** A good attempt by many candidates but some did not know how to calculate this or did not multiply by 2.
		iii	Use a (250 cm^3) **volumetric** flask (instead of a beaker)✓	1	**IGNORE** graduated flask **Examiner's Comments** Although there were some excellent descriptions of the correct processes, such as inverting the apparatus to ensure mixing and then making the solution up to the mark, many candidates could not name a volumetric flask.
	c	i	**FIRST CHECK ANSWER ON ANSWER LINE** If answer = 118 (g mol^{-1}) award 4 marks If answer = 108 (g mol^{-1}) award 3 marks *n*(NaOH) $= 0.112 \times \frac{25.0}{1000} = 0.00280$ (mol) ✓ *n*(**A**) in 25.0 cm^3 $= \frac{0.00280}{2} = 0.00140$ (mol) ✓ **n**(**A**) in 250 cm^3 $= 0.00140 \times \frac{250.0}{27.30} = 0.0128$ (mol) ✓ Molar mass, *M*(**A**) to nearest whole number. $= \frac{1.513}{0.0128} = 118$ (g mol^{-1}) ✓	4	**ANNOTATE ANSWER WITH TICKS AND CROSSES ETC** Throughout: **IGNORE** trailing zeroes in intermediate working, e.g. For *n*(NaOH) **ALLOW** 0.0028 for 0.00280 **ALLOW ECF** from incorrect *n*(NaOH) **ALLOW ECF** from incorrect *n*(A) **OR** *n*(NaOH) **ALLOW** 3 sig fig up to full calculator display correctly rounded (0.012820512) **ALLOW ECF** from incorrect *n*(NaOH) **Possible ECFs for 3 marks** 1.513 ÷ (0.00140 × 250/25) = 108 1.513 ÷ 0.00140 = **1081** No ÷2 for n(**A**) • Molar mass **A** = 59 (g mol^{-1}) Using mean titre of 26.45 cm^3 from **1c(i)** • Molar mass **A** = 114 (g mol^{-1}) Using 27.3 × 0.112 in M1 and then 25.0 in M3 • Molar mass **A** = 99 (g mol^{-1})

					Examiner's Comments Although there were some excellent descriptions of the correct processes, such as inverting the apparatus to ensure mixing and then making the solution up to the mark, many candidates could not name a volumetric flask.
		ii	Structure of dicarboxylic acid $HOOCCH_2CH_2COOH$ **OR** $HOOCCH(CH_3)COOH$ ✓ **STRUCTURE MUST MATCH** M_r from answer to 1 d) i) (within 10 AMU)	1	**ALLOW** correct structural **OR** skeletal **OR** displayed formulae **OR** a combination **ALLOW** incorrect connectivity e.g -HO **ALLOW ECF** from incorrect molar mass in **(d)(i)** but only if 2 × COOH possible and M_r is a close match to (**d) (i) within 10 AMU** **Examiner's Comments** Most candidates that obtained a sensible value for the previous question managed to draw a creditable structure. Allowing error carried forward meant that feasibly derived structures could be credited a mark.
	d		A solution of known concentration ✓	1	**ALLOW** description of concentration **Examiner's Comments** Many candidates gave a good description of standard conditions or stated 1 mol dm^{-3}, but that did not answer the question so no marks could be credited.
			Total	**13**	
4	a		Not correct about the solid remaining in the weighing bottle (weighed by difference) **AND** Correct about the solution in the beaker (1) Rinse out the beaker with distilled water and transfer to the volumetric flask **before** making up to 250 cm^3 (1)	2	
	b	i	Initial reading = 0.60 (cm^3) Final reading = 22.80 (cm^3) Titre = 22.20 cm^3 Initial and final values recorded to two decimal places **AND** titre recorded to the nearest 0.05 cm^3 with correct units	1	
		ii	Suggests repeating the titration to obtain consistent / concordant results (those that agree to within 0.1	1	

			cm^3) **AND** calculating the mean titre		
	c	i	*n*(HC*l*) = (0.100)(answer to **(c)(i)**/1000) = 0.00222 (mol) (1) *n*(M_2CO_3) = 0.00222/2 = 0.00111 (mol) (1)	2	**allow ecf** from **(b)(i)**
		ii	*n*(M_2CO_3) in total = 0.00111 x 10 = 0.0111 mol (1) Molar mass = 1.58/0.0111 = 142.3 g mol^{-1} (1) Mass of M = (142.3 − 60)/2 = 41.15 (= K) (1) K_2CO_3 (1)	4	**Note**: molar mass is between K_2CO_3 (138.2) and $SrCO_3$ (147.6); only possible match for a Group 1 carbonate is K_2CO_3.
			Total	**10**	
5			(Acid) releases H^+ ions/ H^+ donor **AND** (weak acid) partially dissociates/ionises ✓	**1**	**ALLOW** H^+ **OR** proton **IGNORE** vague responses that do not imply a number, e.g. • poor proton donor **IGNORE** 'doesn't easily dissociate' **IGNORE** 'a strong acid completely dissociates' *Question is about a weak acid* **Examiner's Comments** Most candidates were aware that an acid is a proton donor but many candidates gave imprecise responses for the concept of a weak acid. Good candidates used the expected term 'partial dissociation', but weaker candidates often focused on a lower concentration of hydrogen ions, pH range or indicator colour.
			Total	**1**	
6	a	i	carbon dioxide lost/evolved/given off/or produced as a gas ✓	1	**DO NOT ALLOW** water or steam or CO_2 evaporates **Examiner's Comments** Candidates who failed to state that the gas being lost was CO_2 could not access the mark for this question. Vague answers relating to water being produced, products being gases, products being lost or a gas evolved were often given by Candidates.

					If there is an alternative answer, check to see if there is any ECF credit possible
		ii	**FIRST CHECK ANSWER ON THE ANSWER LINE** **IF answer = 1.85 OR 1.845 g award 3 marks** …………………………………………… *n*(HNO_3) $= 1.25 \times \frac{20.0}{1000} = 0.0250$ mol ✓ *n*($SrCO_3$) $= \frac{0.0250}{2} = 0.0125$ mol ✓ *m*($SrCO_3$) = 0.0125 × 147.6 = 1.845 g **OR** 1.85 g ✓	3	**ALLOW ECF** from incorrect *n*(HNO_3) molar mass of $SrCO_3$ = 147.6 (g mol^{-1}) **ALLOW ECF** from incorrect *n*($SrCO_3$) **Examiner's Comments** The vast majority of candidates were able to complete this calculation arriving at the correct answer to score all three available marks. The most common error was in calculating the amount, in moles, of the $SrCO_3$ from the stoichiometry given in the equation. This resulted in an answer which was twice that expected however two marks could still be obtained by applying error carried forward. Answer = 1.845 g or 1.85 g
	b	i	rate of reaction decreases **AND** concentration decreases / reactants are used up ✓	1	**ALLOW** reaction slows down **ALLOW** concentration of reactants decreases.
		i	less frequent collisions ✓	1	**ALLOW** fewer collisions per unit time **OR** collisions less often **OR** decreased rate of collision **IGNORE** less successful collisions / less collisions less chance of collisions **Examiner's Comments** Very few candidates were able to explain the change in the rate of the reaction during the first 200 seconds of the experiment. This relatively straightforward question required a statement that the rate decreases as the concentration of the reactants decreases due to there being less frequent collisions. Although a large number of candidates were able to state that the rate decreases few were able to explain why. This was possibly due to candidates having to apply their

					understanding in an unfamiliar context rather than from a lack of knowledge
		ii	Attempted tangent on graph drawn to line at approximately t = 200 s ✓	1	
		ii	Gradient (y/x) e.g. $\frac{0.20}{290}$ = 6.9×10^{-4} ✓ 	1	**ALLOW** 1 SF up to calculator value, in range 5×10^{-4} to 8×10^{-4} **IGNORE** units **IGNORE** sign **Examiner's Comments** This was the first time AS level candidates have been required to calculate a rate of reaction from a graph and many found this quite testing. Although many knew that a tangent was required only the most able candidates were able to arrive at a value for the gradient that was within the expected range. Candidates sometimes took as their values the point at which their tangent cut the axes rather than calculating the change in mass or change in time. Acceptable range 5×10^{-4} to 8×10^{-4}
	c		Flask **OR** beaker **AND** balance **AND** stopwatch **OR** stop clock **OR** other timing device ✓	1	**DO NOT ALLOW** round-bottomed flask. **IGNORE** weighing scales
			Records **mass** at time intervals ✓	1	**ALLOW** 'weigh at time intervals'
			Time interval quoted between 10-50s ✓	1	**Examiner's Comments** This was the second question that required candidates to describe an experiment that they could have carried out as part of their course. Even if this experiment had not been completed in class, candidates should be able to recognise that mass needs to be measured over a period of time. As the reaction was between an acid and a carbonate a suitable named reaction vessel such as a beaker or flask was required. A balance was needed for mass measurement and a timing device to monitor time. A simple statement that mass should be recorded at a given time interval scored two marks with one mark being allocated to suitable apparatus. At this level it is expected that candidates will be familiar

					with the correct names for the apparatus required to carry out an investigation.
			Total	**11**	
7	a	i	Mol of H_2SO_4 = 0.100 × 18.00 / 1000 = 1.80 × 10^{-3} mol ✓	1	**ALLOW** calculator value or rounding to 2 significant figures or more but **IGNORE** 'trailing zeroes' throughout Q4. eg 0.200 is allowed as 0.2 **Examiner's Comments** This opening part to the calculation was relatively straightforward and almost all candidates scored this mark. Even when the mark was not awarded it was often not because of a lack of knowledge of the formula but because the student used the incorrect volume of 29.50 cm^3.
		ii	Mol of NaOH in = 1.80 × 10^{-3} × 2 × 1000 / 25.0 = 0.144 mol dm^{-3} ✓	1	**ALLOW** ECF for (a)(i) × 2 × 1000 / 25 **Examiner's Comments** Candidates who had answered correctly part **(i)** were able to give the right answer here but some muddled the stoichiometric ratio. Another source of error was to use the wrong volume of NaOH, with some opting to use 200 cm^3 as this was the total volume of solution X.
	b	i	**Check the answer line.** **If answer = 0.0184 mol award 2 marks** Mol of $NaHCO_3$ in 25.0 cm^3 = [0.100 × 11.50 / 1000] × 2 = 0.00230 mol ✓ Mol of $NaHCO_3$ in 200 cm^3 = 0.00230 × 200 / 25.0 = 0.0184 mol ✓	2	**If there is an alternative answer, check to see if there is any ECF credit possible using working below.** **ALLOW** for an alternative method for M1 Total mol of H_2SO_4 used = [0.100 × 29.50 / 1000] = 0.00295 mol Mol of H_2SO_4 reacting with $NaHCO_3$ = 0.00295 – answer to (a)(i) Expected answer = .00295 – 0.00180 = 0.00115 mol Mol of $NaHCO_3$ in 25.0 cm^3 = 0.00115 × 2 = 0.00230 mol **ALLOW** ECF for **mol** of $NaHCO_3$ × 200 / 25.0 For ECF in M2 titration values of 11.50 or 29.50 must have been used in M1 Second marking point is for scaling up number of mol of $NaHCO_3$ by 200 / 25.0 (Usually seen as '8') **Examiner's Comments**

					This was probably the most challenging question on the paper and many candidates could not see the route to the answer. Encouragingly many did see the need to find the difference in the two titres and so their calculations did involve 11.50 cm^3. The second mark for scaling up the amount was not often awarded.
		ii	Mass of $NaHCO_3$ = 0.0184 × 84.0 = 1.55 g ✓ **(must be three significant figures)**	1	**ALLOW** ECF for **(b)(i)** × 84.0 correctly calculated and rounded to three significant figures. **Examiner's Comments** In essence this was a very easy question that simply required candidates to multiply their answer to (i) by 84.0 and give the answer to 3 significant figures.
			Total	**5**	
8	a		Base: A substance which readily accepts H^+ ions (from an acid) ✓ Alkali: releases OH^- ions into (aqueous) solution ✓	2	**ALLOW** proton acceptor **ALLOW** Is soluble and releases OH^- ions (into aqueous solution) **Examiner's Comments** Of the two parts, the definition of base was more often given correctly. A few weaker candidates described a base in terms of the reaction with acids to give salts but most gave the correct answer. The description of an alkali was less well answered with some commenting on the presence of OH^- ions and others on the solubility but few doing both.
	b		Nitric acid **OR** HNO_3 ✓ $CaCO_3 + 2HNO_3 \rightarrow Ca(NO_3)_2 + H_2O + CO_2$ ✓	2	**ALLOW** reagent mark if no response is seen but HNO_3 is seen in the equation **IGNORE** calcium carbonate on reagent line **ALLOW** multiples **IGNORE** state symbols **DO NOT ALLOW** H_2CO_3 for $H_2O + CO_2$ **Examiner's Comments** Most students identified the reagent as nitric acid but the equation proved more challenging. Most common errors were to give the formula as H_2NO_3 or calcium nitrate as $CaNO_3$.
			Total	**4**	

9		i	Hydrogen ✓	1	**ALLOW** H_2 **IGNORE** 'H' **Examiner's Comments** This question was well answered although the erroneous appearance of water as a product of the reaction between an acid and a metal was seen relatively frequently.
		ii	$Ce_2(SO_4)_3$ ✓ (Cerium) loses **three** electrons (to form 3+ ion) ✓	2	**ALLOW** alternative phrases for 'loses' eg 'gives away', 'donates' **IGNORE** '3 electrons transferred' unless a correct direction is given eg **ALLOW** (Ce) transfers 3 electrons to …**OR** (Ce) transfers 3 electrons forming Ce^{3+} **IGNORE** references to sulfate gaining electrons **IGNORE** references to reduction and oxidation **Examiner's Comments** This question was slightly more challenging and discriminated well. Some candidates missed the fact that the cerium was in the +3 oxidation state and gave the formula as $CeSO_4$ along with an explanation that involved the loss of 2 electrons. However, a significant number of candidates did not focus upon the instruction in the question to explain 'in terms of the number of electrons transferred' and gave responses based solely upon changes in oxidation number.
		iii	A hydrogen **ion** (of an acid) has been replaced by a metal **ion** ✓	1	For hydrogen ion: **ALLOW** 'H^+' **OR** 'proton' but **DO NOT ALLOW** 'H' **OR** 'hydrogen' without 'ion' For metal ion: **ALLOW** 'cerium ion' **OR** 'Ce^{3+}' **OR** 'Ce^{2+}' **OR** 'Ce ion' But **DO NOT ALLOW** 'Ce' without 'ion' **OR** 'cerium' without 'ion' **IGNORE** 'ammonium ion' **Examiner's Comments** A good number of candidates had no problem with this question but slightly weaker students talked vaguely about the reaction of metals with acids and clearly did not realise that the question was really examining how well they understood the definition of a salt.
			Total	**4**	

10		i	H_3PO_4 ✓	1	**ALLOW** formula if seen as reactant in an equation **IGNORE** name **Examiner's Comments** This question was well answered although it was common to see incorrect formulae such as HPO_4 from weaker candidates.
		ii	Calcium oxide **OR** calcium hydroxide **OR** calcium carbonate ✓	1	**IGNORE** formulae **IGNORE** lime, quicklime and limestone **Examiner's Comments** Nearly all candidates knew the answer to this question, but not all gained the mark here as many gave the formula of the base rather than its name, despite the question stressing the need for the name.
			Total	**2**	
11	a		volumetric flask **AND** (graduated) pipette	1	**allow** graduated flask **ignore** burette
	b		**FIRST CHECK THE ANSWER ON THE ANSWER LINE** **IF** answer = 73.9 or 73.93 (g mol^{-1}) award 3 marks for calculation n(NaOH) = (25.25/1000) × 0.120 = 3.03×10^{-3} (mol) (1) n(acid in 250 cm^3 flask) = $3.03 \times 10^{-3} \times 10 = 3.03 \times 10^{-2}$ (mol) (1) molar mass of unknown acid = $2.24/3.03 \times 10^{-2}$ = 73.9 (g mol^{-1}) (1)	3	**If there is an alternative answer, check to see if there is any ECF credit possible using working below**
	c		Repeat titration until (two) titrations are concordant / agree within 0.1 cm^3 (1) Calculate mean titre from concordant titres (1)	2	**ignore** just 'repeat the titration' (needs qualifying).
			Total	**6**	