Cambridge International AS & A Level

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CHEMISTRY **9701/34**

Paper 3 Advanced Practical Skills 2 **October/November 2018**

MARK SCHEME

Maximum Mark: 40

Published

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

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Generic Marking Principles

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

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GENERIC MARKING PRINCIPLE 5: Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).
GENERIC MARKING PRINCIPLE 6: Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

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Question	Answer	Marks
1(a)	**I** Unambiguous data recorded (mass or g) • two weighings with clear indication to what they refer. • (mass of) **FB 1**, correctly subtracted **and** between 2.80 and 3.00	**1**
	II All the following data is recorded • rough titration: both burette readings **and** the titre • initial and final burette readings for **two** (or more) accurate titrations	**1**
	III Titre values recorded for accurate titrations, **and correct headings** and units in the **accurate** titration table • initial / start **and** (burette) reading / volume (*allow vol, but not V*) • final / end **and** (burette) reading / volume • titre **or** volume / FB 2 **and** used / added *(not 'difference' or 'total volume')* • unit: / cm^3 **or** (cm^3) **or** in cm^3 (for each heading) **or** cm^3 unit given for each volume recorded	**1**
	IV All accurate burette readings are recorded to the nearest 0.05 cm^3. *The requirement to record to 0.05 applies to burette readings, including 0.00 cm^3 (if this was the initial reading), but it does **not** apply to the titre.* *Do **not** award this mark if:* • *50(.00) is used as an initial burette reading* • *more than one final burette reading is 50.(00)* • *any burette reading is greater than 50.(00)*	**1**
	V The **final** accurate titre recorded is within 0.10 cm^3 of any other accurate titre.	**1**
	Examiner calculates supervisor mean titre and hence the supervisor's value of mean tire / mass of **FB 1**. Examiner calculates candidate's mean titre and hence the candidate's value of mean tire / mass of **FB 1**. Examiner compares the two values.	
	Q Award **VI**, **VII** and **VIII** if $\delta \leqslant$ **0.10** ($cm^3 g^{-1}$)	**1**
	Q Award **VI** and **VII** if **0.10** $< \delta \leqslant$ **0.30**	**1**
	Q Award **VI** only if **0.30** $< \delta \leqslant$ **0.50**	**1**

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Question	Answer	Marks
1(b)	**Candidate calculates the mean correctly.** • Candidate must take the average of two (or more) titres that are within a total spread of not more than 0.20 cm^3. • Working / explanation must be shown ***or*** ticks must be put next to the two (or more) accurate readings selected. • The mean should be quoted to **2 dp**, and be rounded to nearest 0.01 cm^3. *(e.g. 26.667 cm^3 must be rounded to 26.67 cm^3)* Two special cases, where the mean need not be to 2 dp: • Allow mean expressed to 3 dp **only** for 0.025 or 0.075 *(e.g. 26.325 cm^3)* • Allow mean if expressed to 1 dp, if **all** accurate burette readings were given to 1 dp **and** the mean is **exactly** correct. *(e.g. 26.0 and 26.2 = 26.1 is allowed)* *(e.g. 26.0 and 26.1 = 26.1 is wrong – mean should be 26.05)* *Do **not** award this mark if:* • *The rough titre was used to calculate the mean.* • *The candidate did only one accurate titration.* ***Note**: the candidate's mean will sometimes be marked correct even if it was different from the mean calculated by the Examiner for the purpose of assessing accuracy.*	**1**
1(c)(i)	All answers quoted in parts **(ii)–(v)** are given to 3 or 4 sig fig. *A minimum of **three** answers is required to earn this mark*	**1**
1(c)(ii)	**Correctly calculates moles of HC*l*** No of moles of HC*l* used = $0.105 \times {}^{\text{mean titre}} / {}_{1000}$	**1**
1(c)(iii)	**Equation with correct state symbols and moles $NaHCO_3$ correct** $NaHCO_3(aq/s) + HCl(aq) \rightarrow NaCl(aq) + CO_2(aq/g) + H_2O(l)$ **and** no of moles of $NaHCO_3$ = ans in **(ii)**	**1**
1(c)(iv)	**Correctly uses (c)(iii) for moles of $NaHCO_3$** No of moles of $NaHCO_3$ in **FB 1** = 10 × answer **(iii)**	**1**
1(c)(v)	**Correctly uses answer (c)(iv) in calculating % by mass of $NaHCO_3$** % by mass = $({}^{\text{ans (iv)} \times 84} / {}_{\text{mass of FB1 used in (a)}}) \times 100$ *84 may be shown as the sum of the A_r values.*	**1**

Question	Answer	Marks
2(a)	**I Six headings and units in list/table of data**: • Mass of crucible and lid *(not 'weight' in any reading)* • Mass of crucible, lid and **FB 1** (or 'contents before heating') • Mass of crucible, lid and residue / contents after first heating / heating 1 / owtte • Mass of crucible, lid and residue / contents after 2nd heating • Mass of **FB 1** (used) • Mass of residue *Do not allow 'mass of **FB 1** after heating' in third or fourth weighing.* *Unit must be given correctly in each case* *Inclusion or not of lid must be consistent.*	**1**
	II Four weighings recorded, all in the space provided • Four weighings (or more) recorded in the space provided. • All readings recorded to same number of decimal places. • Final weighing is within 0.04 g of the previous one. *If balance used read to 1 dp, the 3rd and 4th readings must be the same.*	**1**
	III Mass of FB 1 and residue, both written in the space provided • Mass of **FB 1** used, correctly subtracted • Mass of **FB 1** used was between 2.8 and 3.0 g • Mass of residue correctly subtracted.	**1**
	Accuracy marks • For assessment of accuracy, examiner must check and correct (if necessary) the masses of **FB 1** used and of residue obtained by the supervisor and by the candidate. • Work out ratio $\frac{\textbf{mass of FB 1}}{\textbf{mass of residue}\ \text{(from lower mass weighing)}}$ for the supervisor (2 dp) • Work out ratio (mass **FB 1**: mass residue) for candidate (2 dp) • Calculate δ, the difference between these two ratios. **Award IV and V if $\delta \leqslant 0.05$** **Award IV if $0.05 < \delta \leqslant 0.10$**	**2**

Question	Answer	Marks
2(b)(i)	**Correctly calculates moles of CO_2** • No of moles CO_2 = $^{\text{mass lost}}/_{62}$ • Answer must be correct and expressed to 2–4 sig fig. *Mass loss must be correctly subtracted, **either** using original weighings **or** using the masses of FB1 and residue.*	**1**
2(b)(ii)	**Correctly uses (i) for mass of $NaHCO_3$** Mass of $NaHCO_3$ = ans **(i)** × 2 × 84 **and** answer to 2–4 sig fig Do not penalise sf more than once in **2(b)**	**1**
2(b)(iii)	**Correctly calculates percentage mass of $NaHCO_3$** % = $^{\text{ans (ii)}}/_{\text{mass of FB1 used}}$ × 100 **and** answer to 2–4 sig fig.	**1**
2(c)(i)	To obtain constant mass *(owtte)* This shows that the reaction / decomposition is complete / **only** Na_2CO_3 is left	**1**
	*Allow: to remove **all** CO_2 **and** H_2O*	**1**
2(c)(ii)	(Assumption is that) the impurity does not decompose when heated **or** The impurity does not react with air when heated **or** The impurity does not react with $NaHCO_3$ / Na_2CO_3 on heating	**1**
2(c)(iii)	Disagree because there is no frothing / spitting out (owtte)	**1**
2(c)(iv)	Possible answers, stating and explaining which experiment is more accurate: • Titration, because repeated titres are consistent. • Gravimetric, because fewer measurements / fewer cumulative / combined errors • Gravimetric, because heating is to constant mass. • Gravimetric, because colour change (of methyl orange) is indistinct / gradual.	**1**

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Question	Answer	Marks
	FB 4 is a mixture of Na_2CO_3 + NaCl	
3(a)(i)	Fizzing / effervescence / bubbling	**1**
	Gas / CO_2 turns lime water milky / cloudy white **or** gas gives white precipitate with lime water	**1**
3(a)(ii)	White ppt with $AgNO_3$ **and** ppt is soluble in (excess) ammonia / colourless solution formed.	**1**
3(a)(iii)	**Either equation correct**: $Na_2CO_3 + 2HNO_3 \rightarrow 2NaNO_3 + CO_2 + H_2O$ **or** $Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$	**1**
3(b)(i)	Blue precipitate (with $CuSO_4$) **and** (pale) (**not** dark) blue solution (formed with H_2SO_4)	**1**
	Fizzing / effervescence / bubbling with acid in **both** this test and addition of acid to $BaCO_3$ ppt in next test.	**1**
	White precipitate (with Ba^{2+}) **and** precipitate dissolves / colourless solution formed (with HNO_3)	**1**
	Yellow / orange-yellow / yellowy-orange (solution) (formed)	**1**
	White / off-white precipitate (with Ag^+)	**1**
	Fizzes / bubbles / effervescence (with HNO_3) **or** ppt is partially soluble (in HNO_3) *(owtte)*	**1**
3(b)(ii)	Fizzing / effervescence / bubbling **with aluminium**	**1**
3(b)(iii)	Sodium chloride / NaCl	**1**
3(b)(iv)	Mark ecf on colour Yellow: alkaline / neutral / **weakly** acidic Orange: neutral / weakly acidic	**1**

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