Cambridge International AS & A Level

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CHEMISTRY **9701/31**

Paper 3 Advanced Practical Skills 1 **October/November 2017**

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.

Cambridge International is publishing the mark schemes for the October/November 2017 series for most Cambridge IGCSE®, Cambridge International A and AS Level components and some Cambridge O Level components.

Question	Answer	Marks
1(a)	**I** All the following data is recorded • both burette readings **and** the titre for the rough titration • initial and final burette readings for **two** (or more) accurate titrations *Headings and units are **not** required for this mark*	**1**
	II Titre values recorded for accurate titrations, **and** appropriate headings and units in the accurate titration table • initial / start (burette) reading / volume / value • final / end (burette) reading / volume / value • titre **or** volume / **FA 4 and** used / added • unit: / cm^3 **or** (cm^3) **or** in cm^3 (for each heading) **or** cm^3 unit given for each volume recorded	**1**
	III All accurate burette readings are 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**
	IV The final accurate titre recorded is within 0.10 cm^3 of any other accurate titre.	**1**
	Examiner rounds any accurate burette readings to the nearest 0.05 cm^3, checks subtractions and then selects the "best" titres using the hierarchy: • identical titres *then* • accurate titres within 0.05 cm^3, *then* • accurate titres within 0.10 cm^3, *etc.* These best titres should be used to calculate the mean titre, expressed to nearest 0.01 cm^3. Examiner compares candidate's mean titre value with that of the Supervisor.	
	Award **V**, **VI** and **VII** if $\delta \leqslant 0.20$ (cm^3)	**1**
	Award **V** and **VI** if $0.20 < \delta \leqslant 0.40$	**1**
	Award **V**, only, if $0.40 < \delta \leqslant 0.60$	**1**

Question	Answer	Marks
1(b)	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. 26.666 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 – 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.* • *Burette readings were incorrectly subtracted to obtain **any** of the accurate titre values.* • *All burette readings used to calculate the mean were recorded as integers*	**1**
1(c)(i)	**Correctly calculates** No of moles of thiosulfate used $= 0.105 \times \frac{\text{mean titre}}{1000}$ to 3 or 4 sf	**1**
1(c)(ii) and (iii)	**Correct use of data in both parts** **(ii)** moles I_2 = 0.5 × ans **(i)** **and** **(iii)** moles **FA1** = 0.025 × 0.0197 (= 0.000493, 0.0004925)	**1**

Question	Answer	Marks
1(c)(iv)	**Correctly calculates answer, expressed as integer** No of moles $= \frac{\textbf{(ii)}}{\textbf{(iii)}}$	**1**
1(c)(v)	**Correct balancing and value of x** **First** mark: integer in answer **(iv)** shown in front of I_2 **and** correct number of moles of I^- entered in equation	**1**
	Second mark: any equation fully balanced $IO_3^- + 5I^- + 6H^+ \rightarrow 3I_2 + 3H_2O$	**1**
1(c)(vi)	Oxidation state **=** 2**x** – 1.	**1**

Question	Answer	Marks
2(a)	**I** **(i)** (Goes) yellow **(ii)** (On cooling, becomes) white solid / residue / powder	**1**
	II:Table of data Appropriate headings: Mass of crucible and lid Mass of crucible, lid and **FA 5** (or "contents before heating") Mass of crucible, lid and residue / ZnO / contents after heating Mass of **FA 5** used Mass of residue	**1**
	III: Weighings shown in list / table Six weighings all recorded in the space provided All weighings recorded to same number of decimal places (one or more)	**1**
	IV: Both masses of FA 5 and residue, correctly subtracted • Masses of **FA 5** used recorded on pages 4 and 5, correctly subtracted • Masses of **FA 5** used were between 2.1 – 2.5 and 1.5 – 1.9 g • Masses of residue recorded on page 5, correctly subtracted	**1**
	Examiners check and correct (if necessary) the masses of **FA 5** used and masses of ZnO obtained by the supervisor and by the candidate for both experiments. Examiners calculate the ratio $\frac{\text{mass of FA 5}}{\text{mass of ZnO}}$ for the supervisor and candidate for each experiment to 2 dp and take the average of the two to 2 dp. Examiner calculates δ the difference between these two ratios. **Award V** **if δ for Expt 1 $\leqslant$ 0.10** **Award VI** **if δ for Expt 2 $\leqslant$ 0.10**	**2**
2(b)(i)	M_r = 99.4	**1**
2(b)(ii)	M_r = 125.4 + 99.4y	**1**
2(b)(iii)	No of moles $= \frac{\text{mass of FA 5 (expt 1)}}{\text{ans (ii)}}$	**1**

Question	Answer	Marks
2(b)(iv)	No of moles ZnO = (1 + y) × answer **(iii)**	**1**
2(b)(v)	**Correctly calculates moles of ZnO** • No of moles ZnO $= \frac{\text{mass of residue}}{81.4}$ • Answer must be expressed to 2 or more significant figures	**1**
2(b)(vi)	Use of **(iv)** = **(v)** with working shown **and** an answer to 1 dp	**1**
2(c)(i)	Heat (crucible and residue) to constant mass **or cool** in a desiccator	**1**
2(c)(ii)	Experiment 1 because (larger masses) have lower percentage error (in weighing).	**1**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td rowspan="2">3(a)</td><td>Tabulation of observations
Clear presentation of results to show FA 6, FA 7 and FA 8 with the reagents specified.</td><td>1</td></tr>
<tr><td>
<table>
<tr><th></th><th>H_2SO_4</th><th>NaOH</th></tr>
<tr><td>FA 6</td><td>fizzing / bubbling or pale brown gas (formed) or
yellow solution (formed) or goes yellow</td><td>no reaction / no change / no ppt</td></tr>
<tr><td>FA 7</td><td>no reaction / no change</td><td>on warming, gas / NH_3 turns litmus blue</td></tr>
<tr><td>FA 8</td><td>white precipitate</td><td>no reaction / no change / no ppt or (faint) white ppt and insoluble in excess NaOH</td></tr>
</table>
2 correct boxes for each mark
</td><td>3</td></tr>
<tr><td rowspan="2">3(b)</td><td>Add silver nitrate followed by ammonia or silver nitrate and nitric acid (and ammonia)</td><td>1</td></tr>
<tr><td>FA 7 cream ppt and FA 8 no reaction / no change / no ppt</td><td>1</td></tr>
</table>

Question	Answer	Marks
3(c)(i)	For **FA 6** and **FA 7** or **FA 8** not identified in **(b)** as a halide uses NaOH + A*l* **and** there is evidence of heating mixture	**1**
	Observations for **both** compounds tested gas / ammonia turns (red) litmus blue	**1**
3(c)(ii)	Uses the same unknowns as **(i)** and adds a named dilute acid or correct formula Allow if "acid" on reagent line and correct formula given in table, or adds (acidified) potassium manganate(VII)	**1**
	Observations: both must be correct for the reagent selected. **If HC*l* or HNO_3 used** • with **FA 6**, fizzing / bubbling or pale brown gas (formed) or yellow solution (formed) or goes yellow • with **FA 7**, no reaction • with **FA 8**, no reaction **If H_2SO_4 used** • with **FA 6**, fizzing / bubbling or pale brown gas (formed) or yellow solution (formed) or goes yellow • with **FA 7,** no reaction • with **FA 8**, white precipitate **If acidified $KMnO_4$ used** • with **FA 6**, decolourised / goes colourless / loses purple colour • with **FA 7**, no reaction / $KMnO_4$ not decolourised (or stays purple) • with **FA 8**, white / pink (allow "pale purple") precipitate formed	**1**
3(d)	**Correct formulae of unknowns** • **FA 6** is $NaNO_2$ • **FA 7** is NH_4Br • **FA 8** is $Ba(NO_3)_2$ / $Ca(NO_3)_2$ three formulae correct = 2 marks one formula correct = 1 mark	**2**