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CHEMISTRY **9701/31**

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

MARK SCHEME

Maximum Mark: 40

Published

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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**

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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**

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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**

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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**

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<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>

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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**

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