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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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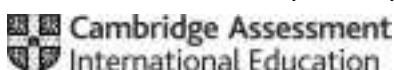
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Question	Answer	Marks
1(a)	I All the following data is recorded - both burette readings and the titre for the rough titration - initial and final burette readings for two (or more) accurate titrations <i>Headings and units are not required for this mark</i>	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: / cm³ or (cm³) or in cm³ (for each heading) or cm³ unit given for each volume recorded	1
	III All accurate burette readings are to the nearest 0.05 cm³. <i>The requirement to record to 0.05 applies to burette readings, including 0.00 cm³ (if this was the initial reading), but it does not apply to the titre.</i> <i>Do not award this mark if:</i> 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 cm³ of any other accurate titre.	1
	Examiner rounds any accurate burette readings to the nearest 0.05 cm³, checks subtractions and then selects the “best” titres using the hierarchy: - identical titres <i>then</i> - accurate titres within 0.05 cm³, <i>then</i> - accurate titres within 0.10 cm³, <i>etc.</i> These best titres should be used to calculate the mean titre, expressed to nearest 0.01 cm³. Examiner compares candidate’s mean titre value with that of the Supervisor.	
	Award V, VI and VII if $\delta \leq 0.20$ (cm³)	1
	Award V and VI if $0.20 < \delta \leq 0.40$	1
	Award V, only, if $0.40 < \delta \leq 0.60$	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 $\text{I}_2 = 0.5 \times \text{ans (i)}$ 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 = $\frac{(ii)}{(iii)}$	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 ⁺ → 3I ₂ + 3H ₂ O	1
1(c)(vi)	Oxidation state = 2x – 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 ≤ 0.10 Award VI if δ for Expt 2 ≤ 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 = $(1 + y) \times$ 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

Question	Answer	Marks												
3(a)	Tabulation of observations Clear presentation of results to show FA 6 , FA 7 and FA 8 with the reagents specified.	1												
	<table><tr><td></td><td>H₂SO₄</td><td>NaOH</td></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 / NH₃ 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>		H₂SO₄	NaOH	FA 6	fizzing / bubbling or pale brown gas (formed) or yellow solution (formed) or goes yellow	no reaction / no change / no ppt	FA 7	no reaction / no change	on warming, gas / NH ₃ turns litmus blue	FA 8	white precipitate	no reaction / no change / no ppt or (faint) white ppt and insoluble in excess NaOH	3
		H₂SO₄	NaOH											
	FA 6	fizzing / bubbling or pale brown gas (formed) or yellow solution (formed) or goes yellow	no reaction / no change / no ppt											
FA 7	no reaction / no change	on warming, gas / NH ₃ turns litmus blue												
FA 8	white precipitate	no reaction / no change / no ppt or (faint) white ppt and insoluble in excess NaOH												
2 correct boxes for each mark														
3(b)	Add silver nitrate followed by ammonia or silver nitrate and nitric acid (and ammonia)	1												
	FA 7 cream ppt and FA 8 no reaction / no change / no ppt	1												

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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 + Al 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 HCl or HNO₃ 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 H₂SO₄ 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 KMnO₄ used - with FA 6, decolourised / <u>goes</u> colourless / loses purple colour - with FA 7, no reaction / KMnO₄ 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 NaNO₂ FA 7 is NH₄Br FA 8 is Ba(NO₃)₂ / Ca(NO₃)₂ three formulae correct = 2 marks one formula correct = 1 mark	2