GradeMax

Cambridge International AS & A Level

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CHEMISTRY **9701/31**

Paper 3 Advanced Practical Skills 1 **May/June 2017**

MARK SCHEME

Maximum Mark: 40

Published

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Question	Answer	Marks
1(a)	**I:** 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 *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 • final / end (burette) reading / volume • titre **or** volume used / added *(not "difference")* • 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 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**
	IV: Final uncorrected titre is within 0.10 cm^3 of any previous uncorrected accurate titre.	**1**

Question	Answer	Marks
Examiner rounds any accurate burette readings to the nearest 0.05 cm^3, check subtractions and then select 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 tire value with that of the Supervisor.		
	Award **V**, **VI** and **VII** if $\delta \leqslant$ **0.30** (cm^3)	**1**
	Award **V** and **VI** if **0.30** $< \delta \leqslant$ **0.50**	**1**
	Award **V**, only, if **0.50** $< \delta \leqslant$ **0.80**	**1**
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)*	**1**

Question	Answer	Marks
1(b)	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* ***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(c)(i)	No of moles of thiosulfate used = $0.110 \times {}^{\text{mean titre}}/_{1000}$ (expressed to 3 or 4 sig fig)	**1**
1(c)(ii) + (iii)	Equation balanced $I_2 + \mathbf{2}Na_2S_2O_3 \rightarrow Na_2S_4O_6 + \mathbf{2}NaI$ **and** no of moles of I_2 = 0.5 × ans. in (i)	**1**
1(c)(iv)	**Correct answer,** No of moles of copper(II) ions = 2 × answer (iii) **(**expressed to 3 or 4 sig fig)	**1**
1(c)(v)	$M_r = {}^{26.0}/_{\text{ans (iv)}} \times {}^{25}/_{1000}$	**1**
	Total:	**12**

Question	Answer	Marks
2(a)	**I: Table of data**, to include: • Unit "covering" all weighings, or given for each weighing • No repeat headings *(i.e. **not** two lists of weighings)* • Appropriate headings for the three weighings: Mass of crucible and lid Mass of crucible, lid and **FA 5** (or "contents before heating") Mass of crucible, lid and residue / CuO / contents after heating	**1**
	II: Weighings recorded • Six weighings recorded in the space provided. • All weighings recorded to same number of decimal places (one or more) • Label/heading to indicate which is Expt 1 and Expt 2	**1**
	III: Both masses of FA 5 and residue, correctly subtracted • Masses of **FA 5** used recorded on page 4, correctly subtracted • Masses of **FA 5** used were between 2.5 – 3.0 g and 1.5 – 2.0 g • Masses of residue recorded on page 4, correctly subtracted	**1**
	For assessment of accuracy, examiner must check and correct (if necessary) the masses of **FA 5** used and of CuO obtained by the supervisor and by the candidate for Experiment 1. • Examiner works out the ratio $^{\text{mass of FA5}}/_{\text{mass of CuO}}$ for the supervisor (2 dp) • Examiner works out the ratio (mass **FA 5**: mass CuO) for the candidate (2 dp) • Examiner calculates δ the difference between these two ratios. **Award IV and V if $\delta \leqslant 0.08$** **Award IV if $0.08 < \delta \leqslant 0.15$**	**2**
	VI: Observations made during heating Solid goes black / black residue (formed) **or** reference to blue/green flame	**1**
2(b)(i)	• No of moles CuO = $^{\text{mass of residue}}/_{79.5}$ • Answer must be correct and expressed to 3 or 4 sig fig	**1**

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Question	Answer	Marks
2(b)(ii)	• No of moles of **FA 5** = $^{\text{answer (i)}}/_{2}$ • M_r = $^{\text{mass of FA 5 used}}/_{\text{no of moles of FA 5}}$	1
2(b)(iii)	M_r = $^{\text{mass of FA5 used in Expt} \times 79.5 \times 2}/_{\text{mass of residue (CuO)}}$	1
2(b)(iv)	M_r of **FA 5** calculated from A_r values = 239	1
2(b)(v)	Candidate should • correctly calculate the 2.5% of M_r in **(iv)** = 5.98 / 6.0, **and** • make a correct statement about the accuracy of the accepted formula, based on their result(s). **or** correctly calculate % difference for their result(s) from M_r in **(iv) and** correct comment	1
2(c)(i)	• heat (crucible and residue) to constant mass • heat more gently for longer period • cool in a desiccator	1
	• to ensure that decomposition (of **FA 5**) is complete **or** to ensure that <u>all</u> the residue is CuO • to prevent escape of dust / smoke / solid (during heating)	1
2(c)(ii)	Larger masses have lower <u>percentage</u> error in weighing	1
	Total:	14

Question	Answer	Marks
FA 6 is $Cu(NO_3)_2$; **FA 7** is $FeCl_3$		
3(a)(i)	• melts ***or*** dissolves ***or*** blue liquid / solution formed • condensation ***or*** steam / vapour produced • black residue / solid • brown gas / fumes • gas / oxygen relights a glowing spill *4 or 5 observations correct = 2 marks* *2 or 3 observations correct = 1 mark*	**2**
3(a)(ii)	**FA 6** is $Cu(NO_3)_2$	**1**
3(b)(i)	• with KI, **FA 7** gives a brown / red-brown / red / orange solution • with starch, blue / blue-black / dark colour	**1**
	• with **FA 6**, blue precipitate (formed) • on heating, (blue precipitate) turns black • With **FA 7**, red-brown / brown / rust ppt. (formed)	**1**
	• With **FA 6**, no reaction / no change / no ppt. • With **FA 7**, white precipitate formed	**1**
	• With **FA 6**, (pale) blue precipitate, then • deep/dark blue (solution) with excess • With **FA 7**, red-brown / brown / rust precipitate (forms)	**1**
	Mg test **Both observations correct** With **FA 6**, brown / black precipitate / solid formed **or** blue colour fades / disappears With **FA 7**, fizzing / bubbling / effervescence	**1**
	Test for hydrogen: (gas) “pops” with lighted splint	**1**

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Question	Answer	Marks
3(b)(ii)	**FA 7** is acidic, because it fizzes / produces hydrogen with magnesium	**1**
3(b)(iii)	$Fe^{3+}(aq) + 3OH^{-}(aq) \rightarrow Fe(OH)_3(s)$	**1**
3(b)(iv)	Redox because iodine was produced (from iodide ions)	**1**
3(b)(v)	You can't be certain about the colour of the precipitate (with $AgNO_3$) due to the coloured solution / colour of **FA 7**. **or** You can't be sure whether the precipitate with $AgNO_3$ is white / AgC*l* or cream / AgBr	**1**
3(b)(vi)	Ammonia would react with the Fe^{3+} ions in **FA 7** (masking the effect of ammonia on AgC*l*) **or** The cation in **FA 7** gives a precipitate with ammonia (so the precipitate of AgC*l* would not appear to dissolve).	**1**
	Total:	**14**