Cambridge International AS & A Level

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CHEMISTRY **9701/33**

Paper 3 Advanced Practical Skills 1 **October/November 2016**

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.

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Question	Answer	Marks
1(a)	Initial and final readings and titre value for rough **and** initial and final reading for **two** (or more) accurate titrations	1
	Appropriate headings and units **and** the volume of **FA 2** added is recorded for each accurate titration. Headings must match readings Initial/start (burette) **and** reading/volume Final/end (burette) **and** reading/volume Titre **or** volume/vol/**FA 2 and** used/added (*not "difference", "total", "V"*) Units: /cm^3 or (cm^3) or in cm^3 or cm^3 for each volume.	1
	All accurate burette readings (initial and final) recorded to nearest 0.05 cm^3 *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
	Final uncorrected titre is within 0.10 cm^3 of any previous uncorrected accurate titre.	1
Examiner rounds any accurate burette readings to the nearest 0.05 cm^3, checks subtractions and then selects the 'best' accurate titres using the hierarchy: identical titres; titres within 0.05 cm^3; titres within 0.1 cm^3; etc., to calculate mean correct to 0.01 cm^3. Examiner compares candidate's titre value with that of the Supervisor.		
	V, **VI** and **VII** Award **V**, **VI** and **VII** for $\delta \leq 0.30\,cm^3$ Award **V** and **VI** for $0.30 < \delta \leq 0.50\,cm^3$ Award **V** only for $0.50 < \delta \leq 0.80\,cm^3$	1 1 1 **7**

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Question	Answer	Marks
1(b)	Calculation of the mean Check mean titre is correctly calculated from clearly selected values (ticks or working) • Candidate must average two (or more) titres where the total spread is $\leq 0.20\,cm^3$. • Working must be shown or ticks must be put next to the two (or more) accurate readings selected. • The mean should normally be quoted to 2 dp rounded to the nearest 0.01. [*e.g.* 26.667 must be rounded to 26.67.] Two special cases where the mean may not be to 2 dp: allow mean to 3 dp only for 0.025 or 0.075 e.g. 26.325; allow mean to 1 dp if **all** accurate burette readings were given to 1 dp (ignoring initial given as 0) and the mean is exactly correct. [*e.g.* 26.0 and 26.2 = 26.1 is correct but 26.0 and 26.1 = 26.1 is incorrect.] Do **not** award this mark if: • the rough titre was used to calculate the mean; • the candidate carried out only 1 accurate titration; • burette readings were incorrectly subtracted to obtain any of the accurate titre values; • **all** burette readings (resulting in titre values used in the calculation of the mean) are integers. ***Note**: the candidate's mean will sometimes be marked as correct even if it is different from the mean calculated by the examiner for the purpose of assessing accuracy*	1 **1**
1(c)(i)	**I** Correctly calculates: $\frac{(b)}{1000} \times 0.0200$	1
1(c)(ii) and 1(c)(iii)	**II** Correctly uses: **(i)** $\times$ 5/2 **and** **(ii)**/0.025 or **(ii)** $\times$ 1000/25	1
1(c)(iv)	Correctly calculates: **(iii)** $\times$ 10 **or** **(ii)** $\times$ 1000/25 $\times$10	1

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Question	Answer	Marks
	3 or 4 significant figures in final answers to all parts (*minimum 3 parts attempted*)	1 **4**
	Total:	**12**

Question	Answer	Marks
2(a)	Examiner to calculate 10% and 20% of Supervisor's time and round this to nearest second. Candidate's time compared with supervisor's time. Award 2 marks if time within 10% of supervisor Award 1 mark if time within 20% of supervisor	**2**
2(b)(i)	Correctly calculates: $2.61 \times 10^{-5} \times$ reaction time from **(a)**	1

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Question	Answer	Marks
2(b)(ii)	Correctly uses: **(i)** × 0.080 **or (i)** × 80/1000 and no additional working	1
2(b)(iii) and 2(b)(iv)	Correctly uses: 2 × ans **(ii)** **and** **(iii)**/0.020 **or** **(iii)** × 1000/20 Time recorded to nearest second in **(a)** and **(c)** **and** 2 – 4 sf in all answers in **(b)** (minimum 3 parts attempted)	1 1 **4**
2(c)	Examiner calculates ratio of reaction time **(a)**/reaction time **(b)** Award if 1.80 ⩽ ratio ⩽ 2.80	1 **1**
2(d)(i)	Time is less/shorter **because** the amount/volume/concentration of **thiosulfate/FA 6** is less (ora) Time is approximately half **because** (the amount/no. of moles/concentration of) the **thiosulfate/FA 6** is **half**.	1 1

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Question	Answer	Marks
2(d)(ii)	(No because) the error is greater in **(c)** with some explanation e.g. because more readings taken/water added The **measuring cylinder** is used more times in **(c)** **or** **smaller volumes**/10 cm^3 instead of 20 cm^3 are measured in **(c)** **or** **6** rather than **5** readings taken/more reagents used/water **also** added/added in addition **or** smaller volumes therefore greater percentage error	1 1 **4**
	Total:	**11**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td colspan="3">FA 7 is $ZnSO_4$; FA 8 is $(NH4)_2Fe(SO4)_2$; FA 9 is $CrK(SO_4)_2$; FA 10 is $MnSO_4$; FA 11 is $NaNO_2$</td></tr>
<tr><td>3(a)</td><td>Selects NaOH and NH_3

Single table to show results with both NaOH and NH_3.
No repeat headings. At least two of the FAs tested

<table>
<tr><th></th><th>FA 7</th><th>FA 8</th><th>FA 9</th><th>FA 10</th></tr>
<tr><td>NaOH</td><td>white ppt</td><td>green ppt</td><td>grey-green ppt</td><td>off-white/ pale brown/ buff ppt</td></tr>
<tr><td>excess</td><td>soluble</td><td>insoluble</td><td>soluble</td><td>insoluble</td></tr>
<tr><td>NH_3</td><td>white ppt</td><td>green ppt</td><td>grey-green ppt</td><td>off-white/ pale brown/ buff ppt</td></tr>
<tr><td>excess</td><td>soluble</td><td>insoluble</td><td>insoluble</td><td>insoluble</td></tr>
</table>

FA 8 ppt turning brown in air with either NaOH or NH_3
FA 9 ppt dissolves to form (dark) green solution with excess NaOH
FA 10 darkens/goes brown with either NaOH or NH_3</td><td>1

1

1

1

1

1

1
1
1</td></tr>
</table>

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Question	Answer	Marks
	<table><tr><th>FA 7</th><th>FA 8</th><th>FA 9</th><th>FA 10</th></tr><tr><td>Zn^{2+}</td><td>Fe^{2+}</td><td>Cr^{3+}</td><td>Mn^{2+}</td></tr></table> Award 1 mark for 2 correct ions. Award 2 marks for all 4 correct.	 1 1 **11**
3(b)	(dark) brown ppt/solid/suspension/deposit **and** effervescence/bubbling/fizzing positive test for oxygen – (gas/ O_2) relights glowing splint	1 1 **2**
3(c)(i)	blue solution **and** effervescence/bubbling/fizzing **or** brown fumes/gas	1
3(c)(ii)	NO_2^- **or** nitrite from either blue solution or brown gas	1

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Question	Answer	Marks
3(c)(iii)	selects NaOH and A*l* (for nitrite or nitrate) **or** selects (acidified) potassium manganate(VII)/ potassium permangate/ $KMnO_4$ If carbonate in **(ii)** (from bubbling without brown gas in **(i)**) then allow use of limewater to test gas If halide from no reaction then allow use of $AgNO_3$ **and** NH_3 If sulfate/sulfite from no reaction then allow use of $BaCl_2$/$Ba(NO_3)_2$ **and** HC*l*/HNO_3 Warming (with NaOH and A*l*) **and** gas/ammonia turns (damp red) litmus (paper) blue **or** Decolourises MnO_4^-	1 1 **4**
	Total:	**17**

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