Cambridge International AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

CHEMISTRY **9701/33**

Paper 33 (Advanced Practical Skills 1) **May/June 2018**

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.

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Generic Marking Principles

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

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GENERIC MARKING PRINCIPLE 5: Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).
GENERIC MARKING PRINCIPLE 6: Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

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Question	Answer	Marks
1(a)	**I** Initial and final readings and titre recorded for rough titration **and** accurate titre details tabulated *(minimum 2 × 2 'boxes')*	**1**
	II All **three** headings and units correct for accurate titrations Headings: initial / final (burette) **and** reading / volume / vol **or** reading / volume / vol at start / finish (but not V) **and** volume / **FA 2 and** added / used **or** titre **and** Units: (cm^3) **or** / cm^3 **or** in cm^3 [or cm^3 by every entry]	**1**
	III All accurate burette readings are recorded to the 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)* • *there is only one accurate titration*	**1**
	IV The **final** accurate titre recorded is within 0.10 cm^3 of any other accurate titre. *Do **not** award the mark if any 'accurate' burette readings (apart from initial 0) are given to **zero** dp.*	**1**
For assessment of accuracy (Q marks) the examiner should round all burette readings to the nearest 0.05 cm^3. Subtractions should be checked. The 'best' titres should be selected using the hierarchy: two (or more) identical; then 2 (or more) within 0.05 cm^3; then two (or more) within 0.1 cm^3 etc. These best titres should be used to calculate the mean corrected titre to the nearest 0.01 cm^3 and this compared to the supervisor value. Award accuracy marks as shown below.		
	V, VI and VII Award **V, VI and VII** for $\delta \leqslant 0.20$ cm^3 Award **V and VI** for $0.20 < \delta \leqslant 0.30$ cm^3 Award **V** for $0.30 < \delta \leqslant 0.50$ cm^3	**3**

Question	Answer	Marks
1(b)	Candidate must average two (or more) accurate titres with total spread of not more than 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. Example: 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 eg 26.325;* *allow mean 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 correct but 26.0 and 26.1 = 26.1 is incorrect.* *Do **not** award this mark if:* *the spread of selected titres is greater than 0.20 cm^3;* *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, excluding initial 0, (resulting in titre values used in calculation of 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(c)(i)	Correctly calculates: **(b)** × 0.105 / 1000 **and** moles H^+ = moles NaOH **and** answers to 3 or 4 sf	**1**
1(c)(ii)	Expression: H^+ from **(c)(i)** × (1000 / 25) **and** answer to 3 or 4 sf	**1**
1(c)(iii)	Correctly calculates 6.10 / 126 = 4.84(1) × 10^{-2} **and** answer to 3 or 4 sf	**1**
1(c)(iv)	Expression **(c)(ii)** / **(c)(iii)** **and** makes correct statement regarding **FA 1** based on answer	**1**

Question	Answer	Marks

Question	Answer	Marks
2(a)	**I** Table with appropriate headings to show 11 results Volume **FA 3 or FA 3** / cm^3 **or** burette readings and Temperature / Temp / T **or** ºC Allow initial temperature recorded on a separate line under method section. Allow volume added and allow vol / V for volume. The figures in this section may relate to total volume added (0, 5, 10, ...) or volume added each time (0, 5, 5, 5, ...) or be burette readings	**1**
	II All temperatures recorded to .0 or .5 ºC All results follow the pattern (up and down)	**1**
Round thermometer readings to the nearest .5 ºC Examiner to calculate (and correct) supervisor's ΔT – initial T to highest T recorded in table. Calculate candidate's ΔT from table, calculate δ from supervisor and award marks as shown.		
	III and IV Award **III** and **IV** if $\delta \pm 1.0$ ºC Award **III** if $\delta \pm 2.5$ ºC	**2**
2(b)	Axes labelled **and** uniform scales chosen for plotted points (and T_{max} plus 2 ºC) to occupy more than half the available space on both axes	**1**
	All recorded points plotted (min of 8 recorded). Points must be accurate to within half a small square, be clearly on a line or not on a line (whichever is appropriate). If crosses used must be centred on correct point, not be large blobs.	**1**
	Two lines of best fit drawn (can be straight or curved) – one for increase in temperature and the other for decrease in temperature.	**1**
	Both lines are extrapolated to cross or to a discontinuity	**1**
2(c)	Records correctly from graph candidate's max T and vol **FA 3**	**1**
2(d)(i)	Correctly uses: Energy = (vol from **(c)** + 25) $\times$ 4.2 $\times$ (max T – initial T)	**1**
2(d)(ii)	Correctly calculates: moles **X** = 25 $\times$ 2.00 / 1000 = 0.05	**1**

Question	Answer	Marks
2(d)(iii)	Expression: **(d)(i)** / (**(d)(ii)** × 1000) **or** correct answer **and** answer to 2 to 4 sf with **negative** sign	**1**
2(e)	Repeat the experiment with volumes of **FA 3** near to that needed for T_{max} / near the end point	**1**
2(f)	(**X** less exothermic than HC*l* shows) it is a **weak** acid/ shows **X** is not HC*l* / small(er) acid dissociation (constant)	**1**
	Some of the energy that could be released is used to ionise H**X**	**1**

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td colspan="3">FA 5 is 0.1 mol dm^{-3} H_2SO_4; FA 6 is 1.0 mol dm^{-3} H_2SO_4; FA 7 is 1.0 mol dm^{-3} HCl;
FA 8 is $Mg(OH)_2$; FA 9 is NH_4Cl</td></tr>
<tr><td rowspan="4">3(a)</td><td>Choice of suitable reagents in table / clear layout.
One reagent to show sulfate or chloride ($BaCl_2$ or $Ba(NO_3)_2$ or $AgNO_3$)
One reagent to show different concentration of H^+ in samples with sulfate (Mg, Zn, named carbonate)</td><td>1</td></tr>
<tr><td>White ppt with FA 7 and $Ag^+(aq)$ / white ppt with FA 5 and FA 6 with $Ba^{2+}(aq)$ and no (visible) reaction / no change / no ppt for others (ignore faint white ppt with Ag^+)
For each reagent used all three observations must be recorded and correct</td><td>1</td></tr>
<tr><td>Difference in rate of bubbling / fizzing / effervescence of FA 5 and FA 6 with suitable metal or carbonate
Allow less and more fizz without time being mentioned</td><td>1</td></tr>
<tr><td>FA 5 is 0.1 mol dm^{-3} H_2SO_4;
FA 6 is 1.0 mol dm^{-3} H_2SO_4;
FA 7 is (1.0 mol dm^{-3}) HCl.</td><td>1</td></tr>
<tr><td>3(b)(i)</td><td>2* = 1 mark
<table>
<tr><th>FA 8</th><th>FA 9</th></tr>
<tr><td>Blue / blue-green / blue-purple / dark green*
pH 8–11*</td><td>Yellow or orange-yellow or orange*
pH 3–6*</td></tr>
<tr><td>Water vapour /condensation / steam*</td><td>Any two * from this box:
sublimes / solid or white forms on cold part / top of tube / white smoke *
Effect on litmus red to blue* Allow blue litmus to red on strong heating*</td></tr>
<tr><td>White ppt / white solid*
insoluble in excess*</td><td>No (observable) reaction / no change / no ppt and</td></tr>
<tr><td>White ppt / white solid*
insoluble in excess *</td><td>No (observable) reaction / no change / no ppt *</td></tr>
</table></td><td>6</td></tr>
<tr><td>3(b)(ii)</td><td>(gas / ammonia) turns (red) litmus blue</td><td>1</td></tr>
</table>

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Question	Answer	Marks
3(b)(iii)	any 2 correct answers for 1 mark all 4 correct answers for 2 marks	
	FA 8 Mg^{2+} OH^- **FA 9** NH_4^+ unknown	**2**

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