Cambridge International AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

CHEMISTRY **9701/31**

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

Cambridge International is publishing the mark schemes for the October/November 2018 series for most Cambridge IGCSE™, Cambridge International A and AS Level components and some Cambridge O Level components.

PUBLISHED

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.

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.

Question	Answer	Marks
1(a)	**I** Table drawn with suitable headings **and** units; Temperature / T and time / t / °C, (s) or / minutes or mins or min	**1**
	II Table completed with all temperature readings from 0 to 9 minutes at half minute intervals **and** 2 balance readings shown to the same number of decimal places	**1**
	III All recorded thermometer readings to .5 °C with at least one ending in .0 °C and at least one ending in .5 °C.	**1**
	Calculate ΔT from T at 2 minutes to T_{max} from table. Compare with supervisor ΔT. Award **IV** if ΔT within 1 °C of supervisor. Award **IV** and **V** if ΔT within 0.5 °C of supervisor.	**2**
1(b)(i)	Axes unambiguously labelled. Scale chosen so that plotted points (and 2 °C extra on y-axis) occupy more than half the available space in both directions.	**1**
	All recorded points plotted. Points plotted to within half a small square. Points that should be on lines must be on the line and points that should not be on lines must not be on lines. Do not award if crosses / blobs are > half square thick.	**1**
	Two straight lines of best fit drawn (with a ruler) – one up 2 minutes and the other after the maximum temperature.	**1**
	Both lines extrapolated to 2½ minutes.	**1**
1(b)(ii)	Candidate ΔT to at least 1 decimal place is within half a small square or 1 decimal place (whichever is more appropriate) of examiner's calculated ΔT.	**1**
1(c)(i)	Correctly calculates energy evolved = $25 \times 4.2 \times \Delta T$ ΔT from **(b)(ii)** or table **and** answer to 2–4 sf	**1**
1(c)(ii)	Correct **use of** moles Na_2CO_3 = **(c)(i)** / 27000	**1**
	Correct **use of** % mass Na_2CO_3 = moles × 106 / sum of A_r **and** answer to 2–4 sf	**1**

Question	Answer	Marks
1(c)(iii)	Correct use of % Na_2CO_3 = **(c)(ii)** / mass **FA1** used **and** answer to 2–4 sf.	**1**
1(d)	Assumption: the impurity does not react with **hydrochloric acid** or **FA 2** **or** impurities are not alkaline	**1**
1(e)	Data with unambiguous headings (**not** weight). **and** Correct subtraction of mass and ΔT.	**1**
	Examiner calculates expression: mass **FA 1** $\times \Delta T$ in **(e)** / mass **FA 3** $\times \Delta T$ in **(a)** to 2 decimal place. Award mark if this value lies in range 0.80 to 1.25	**1**
1(f)	All 4 stages in **method** (same as **(c)(i)** – **(iii)**) scores 2 marks 2 or 3 stages shown clearly scores 1	**2**
1(g)	First box ticked (If there is a temperature fall after the max in Method 1 then this is more accurate) **because** as heat lost is compensated for / cooling curve plotted **OR** Third box ticked (special case if no temp fall in **(a)**) If there is no temperature fall after the maximum in Method 2 then both seem to be equally accurate **because** the temperature rise is potentially the same for both methods.	**1**
1(h)	(The student used) fewer moles / less amount of carbonate	**1**
	(The temperature increase is less and hence calculated) enthalpy change would be less exothermic / ΔH is less negative.	**1**
1(i)	**Correctly calculates** Moles Na_2CO_3 = (3 / 106) $\times$ 0.8 = 0.0226 / 0.02264	**1**
	Ratio 1: 2 moles HC*l* =0.0452 / 0.0453	**1**

Question	Answer	Marks
	Vol HC*l* = 0.0452 / 0.002 = 22.6(0) / 22.7(0) cm^3 and answer to 3 or 4 significant figures (or nearest 0.05 cm^3)	**1**

Question	Answer	Marks
FA 4 is sodium chloride; **FA 6** is copper(II) carbonate; **FA 7** is a mixture of zinc sulfate and zinc nitrate		
2(a)(i)	Make a solution of **FA 4** and add aqueous $AgNO_3$	**1**
	white ppt shows anion is Cl^-	**1**
2(a)(ii)	$Ag^+(aq) + Cl^-(aq) \rightarrow AgCl(s)$	**1**
2(b)(i)	**Hydrochloric acid** Effervescence / bubbling **and** blue / green / cyan / turquoise solution formed	**1**
	gas / CO_2 turns limewater milky / cloudy white / chalky / forms a white ppt	**1**
	Ammonia (pale) blue ppt **and** dark blue solution with excess	**1**
	Heating (**FA 6**) turns black / black solid formed / it turns black	**1**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>2(b)(ii)</td><td>2 * = 1 mark
<table>
<tr><td>NaOH</td><td>White ppt *
sol in excess *</td></tr>
<tr><td>NH_3</td><td>White ppt *
sol in excess *</td></tr>
<tr><td>$AgNO_3$</td><td>No reaction / no ppt *</td></tr>
<tr><td>$Ba(NO_3)_2$</td><td>White ppt *</td></tr>
<tr><td>HNO_3</td><td>Ppt remains / no change*</td></tr>
<tr><td>NaOH and warm</td><td>No gas / no reaction *</td></tr>
<tr><td>+ A /</td><td>Gas / NH_3 / effervescence / fizzing / bubbles* turns litmus blue *</td></tr>
</table></td><td>5</td></tr>
<tr><td>2(b)(iii)</td><td>Cations: Cu^{2+} and Zn^{2+} / copper(II) and zinc</td><td>1</td></tr>
<tr><td>2(b)(iv)</td><td>Anions: any two of CO_3^{2-}, NO_3^-, NO_2^-, SO_4^{2-} / carbonate, nitrate, nitrite, sulfate</td><td>1</td></tr>
<tr><td>2(b)(v)</td><td>NO_3^-, NO_2^- / nitrate and nitrite / nitrate(V) and nitrate(III)</td><td>1</td></tr>
</table>