CAMBRIDGE
International Education

Cambridge International AS & A Level

CHEMISTRY **9701/35**

Paper 3 Advanced Practical Skills 1 **May/June 2024**

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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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 descriptions 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.

Science-Specific Marking Principles

1	Examiners should consider the context and scientific use of any keywords when awarding marks. Although keywords may be present, marks should not be awarded if the keywords are used incorrectly.
2	The examiner should not choose between contradictory statements given in the same question part, and credit should not be awarded for any correct statement that is contradicted within the same question part. Wrong science that is irrelevant to the question should be ignored.
3	Although spellings do not have to be correct, spellings of syllabus terms must allow for clear and unambiguous separation from other syllabus terms with which they may be confused (e.g. ethane / ethene, glucagon / glycogen, refraction / reflection).
4	The error carried forward (ecf) principle should be applied, where appropriate. If an incorrect answer is subsequently used in a scientifically correct way, the candidate should be awarded these subsequent marking points. Further guidance will be included in the mark scheme where necessary and any exceptions to this general principle will be noted.
5	'List rule' guidance For questions that require ***n*** responses (e.g. State **two** reasons …): • The response should be read as continuous prose, even when numbered answer spaces are provided. • Any response marked *ignore* in the mark scheme should not count towards ***n***. • Incorrect responses should not be awarded credit but will still count towards ***n***. • Read the entire response to check for any responses that contradict those that would otherwise be credited. Credit should **not** be awarded for any responses that are contradicted within the rest of the response. Where two responses contradict one another, this should be treated as a single incorrect response. • Non-contradictory responses after the first ***n*** responses may be ignored even if they include incorrect science.

6 Calculation specific guidance Correct answers to calculations should be given full credit even if there is no working or incorrect working, **unless** the question states 'show your working'. For questions in which the number of significant figures required is not stated, credit should be awarded for correct answers when rounded by the examiner to the number of significant figures given in the mark scheme. This may not apply to measured values. For answers given in standard form (e.g. $a \times 10^n$) in which the convention of restricting the value of the coefficient (a) to a value between 1 and 10 is not followed, credit may still be awarded if the answer can be converted to the answer given in the mark scheme. Unless a separate mark is given for a unit, a missing or incorrect unit will normally mean that the final calculation mark is not awarded. Exceptions to this general principle will be noted in the mark scheme.
7 Guidance for chemical equations Multiples / fractions of coefficients used in chemical equations are acceptable unless stated otherwise in the mark scheme. State symbols given in an equation should be ignored unless asked for in the question or stated otherwise in the mark scheme.

Question	Answer	Marks
1(a)	**I** A single table with 4 headings for results with indication of the four items of data to be recorded (volume of **FA 1**, volume of water, time and rate) **AND** two experiments carried out **II** Correct headings and units for four required items of data: • volume of **FA 1** (used) **AND** / cm^3 **OR** (cm^3) **OR** in cm^3 • volume of (distilled) water **AND** / cm^3 **OR** (cm^3) **OR** in cm^3 • (reaction) time **AND** / s **OR** (s) **OR** in seconds • rate **AND** /s^{-1} **OR** (s^{-1}) **OR** in s^{-1} **III** Precision of data recorded: • Volume of **FA1** recorded to 2 decimal places with the final digit being 0 or 5 • Volume of Water recorded to 1 decimal place with the final digit being 0 or 5 • all times to the nearest second **IV** Rates correctly calculated using 1000 / time.	**6**
	Accuracy marks Correct times for each of experiments 1 and 2 to the nearest second. Calculate $\frac{\text{time for experiment2}}{\text{time for experiment1}}$ correct to 2 decimal places.	
	V Award if ratio, t_2 / t_1 = 1.80 – 2.20 **VI** Award if ratio, t_2 / t_1 = 1.90 – 2.10	
1(b)(i)	total volume was the same for both experiments **OR** the volume of water + **FA1** is 20 cm^3 in both experiments	**1**
1(b)(ii)	**M1 FA 1** + distilled water = 20.00 cm^3 **AND** volume of **FA 1** is at least 2.5 cm^3 from other experiments **M2 FA 2** = 10.0 cm^3 **AND FA 3** = 20.0 cm^3	**2**
1(c)	time would increase **AND** (extra) thiosulfate reacts with more iodine / more iodine has to be formed to / before it can react with starch	**1**

Question	Answer	Marks
1(d)	so concentration of KI / I^- remains almost constant **OR** only the concentration of $S_2O_8^{2-} / K_2S_2O_8$ affects the rate	**1**

Question	Answer	Marks
2(a)	**I** Records 16 thermometer readings with appropriate times and correctly displayed units. **II** Records two balance readings and correctly calculated mass of **FA 5** added with correctly displayed unit. **III** Balance readings consistent to either 2 or 3 decimal places **AND** thermometer readings to .0 °C or .5 °C. At least one must be .0 °C and one .5 °C.	**5**
	Accuracy marks Correct relevant thermometer readings to nearest .5 °C before subtraction. Calculate the difference δ between supervisor and candidate values.	

ΔT_{sup} / °C	<5.0	5.0–9.5	10.0–14.5	15.0–19.5
IV	±0.5	±1.0	±2.0	±2.5
V	0	±0.5	±1.5	±2.0

2(b)	**I** Temperature on *y*-axis and time on *x*-axis with unambiguous labels and units **II** Linear scales based on 1, 2 or 5 **AND** scale chosen so that plotted points occupy more than half the available space along each axis including 2 °C below minimum temperature recorded. **III** All points recorded plotted correctly to within half a small square **AND** a minimum of 9 temperatures recorded. **IV** Draws two lines of best fit **AND** both lines are extrapolated to $2^1/_2$ minutes **AND** temperature at $2^1/_2$ minutes is less than or equal to lowest temperature recorded.	**4**

Question	Answer	Marks
2(c)(i)	Correct value of ΔT from graph to 1 decimal place	**1**
2(c)(ii)	Correctly calculates energy = $25 \times 4.18 \times \Delta T$ (J) **AND** answer to 2–4 significant figures.	**1**
2(c)(iii)	Correctly calculates amount of ammonium chloride $n(NH_4Cl) = {}^{\text{mass from (a)}}/_{53.5}$ (mol) **AND** answer to 2–4 significant figures.	**1**
2(c)(iv)	Correctly uses $\Delta H = {}^{\text{(c)(ii)}}/_{\text{(c)(iii)}} \times 1000$ (kJ mol^{-1}) **AND** correct sign (+) **AND** answer correct to 2–4 significant figures	**1**
2(d)	Correct expression $\{(0.5 \times 2)/(T_0 - T_4)\} \times 100$	**1**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td colspan="3">FA 6 is $KMnO_4$(s), FA 8 is Na_2CO_3(aq) and FA 9 is $CuSO_4$ (aq) + H_2SO_4</td></tr>
<tr><td>3(a)(i)</td><td>M1 Any two of:
• FA 6 / solid is (dark) purple crystals
• solid jumps around
• solid becomes darker / black residue forms
M2 gas relights glowing splint
M3 oxygen</td><td>3</td></tr>
<tr><td>3(a)(ii)</td><td>M1 (filtrate is dark) green (solution)
M2 (solution) turns pink/ purple</td><td>2</td></tr>
<tr><td>3(b)(i)</td><td>
<table>
<tr><th></th><th>FA 8</th><th>FA 9</th></tr>
<tr><td>Test 1: + acid(aq):</td><td>effervescence (owtte) *
tests <u>gas/ CO_2</u> with limewater*
gas/ CO_2 gives white ppt (with limewater) *</td><td>no change / solution stays blue *</td></tr>
<tr><td>Test 2: + NaOH(aq) then excess</td><td>no change *

on warming:
no change / no gas (turning red litmus blue)*</td><td>(pale) blue ppt *
insoluble in excess *

on warming:
(ppt) turns black *</td></tr>
<tr><td>Test 3: + $BaCl_2$/$Ba(NO_3)_2$ then HNO_3</td><td>white ppt *

effervescence (with acid) *
forms (colourless) solution / ppt dissolves *</td><td>white ppt *

insoluble (in acid) / no change *</td></tr>
<tr><td>Test 4: FA 8 + FA 9</td><td></td><td>effervescence *
(pale) blue ppt *</td></tr>
</table>
2* = 1 mark (round down) (16 * available MAX 7 marks)
</td><td>7</td></tr>
</table>

Question	Answer	Marks
3(b)(ii)	**FA 8** unknown and CO_3^{2-} **FA 9** Cu^{2+} and H^+ and SO_4^{2-} All correct = 2 marks, 3 correct = 1 mark	**2**
3(b)(iii)	*Any one of:* $Cu^{2+}(aq) + 2OH^-(aq) \rightarrow Cu(OH)_2(s)$ $Cu(OH)_2(s) \rightarrow CuO(s) + H_2O(l)$	**1**