Cambridge Assessment International Education

Cambridge International AS & A Level

CHEMISTRY **9701/33**

Paper 3 Advanced Practical Skills 1 **March 2020**

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 March 2020 series for most Cambridge IGCSE™, Cambridge International A and AS Level components and some Cambridge O Level components.

[Turn over

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.

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 (see examples below)

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** Titration data shown • two burette readings for the rough titration • titre for rough titration • initial **and** final burette readings for **two** (or more) accurate titrations	**1**
	II Titre values for accurate titrations recorded **and** appropriate headings and units in accurate titration table • initial / start **and** (burette) reading / volume • final / end **and** (burette) reading / volume • titre **or** volume / **FA 1 and** used / added • 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.	**1**
	IV The final accurate titre recorded is within 0.10 cm^3 of any other accurate titre.	**1**
	Award **V**, **VI** and **VII** if $\delta \leqslant$ **0.20** (cm^3) Award **V** and **VI** if **0.20 < $\delta \leqslant$ 0.40** Award **V** only if **0.40 < $\delta \leqslant$ 0.60**	**3**
1(b)	Correctly calculates mean titre from two (or more) accurate titres where the **total** spread is $\leqslant$ 0.20 cm^3 **AND** Answer is given to 2 dp **AND** Working must be shown or ticks must be put next to the two (or more) accurate titres selected	**1**
1(c)(i)	All final answers in **1(c)** are quoted to 3 or 4 significant figures Minimum of four answers attempted	**1**
1(c)(ii)	Correctly calculates number of moles of $KMnO_4$ used = $0.03(00) \times \frac{\text{mean titre}}{1000}$	**1**
1(c)(iii)	Two correct multiplying factors shown • answer **(ii)** $\times$ 2.5 • (subsequent answer) (mol of H_2O_2) $\times$ 40 ($\times \frac{1000}{25}$)	**1**

Question	Answer	Marks
1(c)(iv)	Correctly calculates concentration of H_2O_2 = final answer in **(iii)** $\times$ 10	**1**
1(c)(v)	Correctly uses (iv) to find moles of O_2 = answer **(iv)** $\times$ 0.5	**1**
	Correctly uses (iv) to find 'volume strength' = moles of $O_2 \times 24$ Answer for default value = 12.24 vol	**1**
1(d)	% error pipette = 0.24 **and** % error burette = 0.4(0) **OR** 2×0.05 (cm^3) is greater (than 0.06 / pipette error) Working must be shown	**1**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td rowspan="2">2(a)</td><td>I Table (or two lists) showing unambiguous headings and data for both experiments in the space provided:
• two initial thermometer readings + values
• two final / highest thermometer readings + values
• two temperature rises / changes + values</td><td>1</td></tr>
<tr><td>II Recording of data
• correct units ‘covering’ all thermometer readings
• all four readings recorded to .0 or .5 °C
• both rises in temperature correctly calculated</td><td>1</td></tr>
<tr><td rowspan="4"></td><td>III Award this mark based on the table below</td><td>1</td></tr>
<tr><td>IV Award this mark based on the table below</td><td>1</td></tr>
<tr><td><table>
<tr><td>ΔT_{sup} (ºC)</td><td>$\Delta T \geqslant 15.0$</td><td>$15 > \Delta T \geqslant 10.0$</td><td>$10 > \Delta T \geqslant 5.0$</td><td>$\Delta T < 5.0$</td></tr>
<tr><td>δ</td><td>2.0</td><td>1.5</td><td>1.0</td><td>0.5</td></tr>
</table></td><td></td></tr>
<tr><td>V Award mark if both the candidate’s corrected temperature rises are within 1.0 °C of each other</td><td>1</td></tr>
<tr><td>2(b)(i)</td><td>Correctly calculates heat produced = 30 × 4.2 × temp rise for expt 1
AND answer given to 2–4 sf</td><td>1</td></tr>
<tr><td>2(b)(ii)</td><td>Correctly uses number of moles H_2O_2 = 0.03 × answer to 1(c)(iv)
AND answer given to 2–4 sf
Answer for default value = 0.0306 / 0.031 mol</td><td>1</td></tr>
<tr><td>2(b)(iii)</td><td>Correct expression for enthalpy change
• Enthalpy change = $\frac{\textbf{ans (i)}}{\textbf{ans (ii)}} \times \frac{1}{1000}$
• Negative sign must be shown
• Answer is shown to 2–4 sf</td><td>1</td></tr>
</table>

Question	Answer	Marks
2(c)(i)	(**FA 5** / MnO_2 is a) catalyst	**1**
	(Student is wrong:) the mass of MnO_2 used does not alter the heat produced / enthalpy change / temperature change (for decomposition of H_2O_2)	**1**
2(c)(ii)	Student is correct: energy / heat released is greater because more / greater (moles / molecules of) hydrogen peroxide / **FA 3** is used in Experiment 2 **AND** more moles / molecules / greater amount of water / solution / **FA 3** / hydrogen peroxide heated is greater (in the same proportion)	**1**

Question	Answer	Marks
	FA 6 is $(NH_4)_2Fe(SO_4)_2$(aq); **FA 7** is KI(aq); **FA 8** is HC*l*(aq)	
3(a)(i)	Green precipitate **and** insoluble / no change in excess (NaOH)	**1**
	(Green) precipitate darkens and / or goes brown	**1**
	(When mixture heated) gas / ammonia turns (red) litmus blue	**1**
	Both cations in **FA 6** identified • Fe^{2+} ions / iron(II) • Ammonium / NH_4^+	**1**
3(a)(ii)	Goes brown / rust / red-brown / orange-brown **AND** bubbles / fizzing / effervescence	**1**
3(a)(iii)	$Fe^{2+} \rightarrow Fe^{3+} + e^-$ / $Fe^{2+} - e^- \rightarrow Fe^{3+}$	**1**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>3(b)(i)</td><td>Award one mark for every two correct observations (*) as shown in table below</td><td>5</td></tr>
<tr><td colspan="3">
<table>
<tr><td rowspan="2">test</td><td colspan="2">observations</td></tr>
<tr><td>FA 7</td><td>FA 8</td></tr>
<tr><td>Test 1
+ Na_2CO_3(s)</td><td>no (visible) reaction / no change / no precipitate / solid (carbonate) dissolves / no effervescence *</td><td>effervescence / fizzing / bubbles *
gas / CO_2 gives a white ppt with limewater / turns limewater milky / cloudy white / chalky *</td></tr>
<tr><td>Test 2
+ $H^+/KMnO_4$(aq)</td><td>solution turns yellow / brown / orange-brown / red-brown / yellow-brown *</td><td>no (visible) reaction / no change / $KMnO_4$ / solution stays purple / colourless solution turns purple / purple solution formed *</td></tr>
<tr><td>+ starch(aq)</td><td>(turns) dark blue / deep blue / blue-black / black *</td><td>ignore</td></tr>
<tr><td>Test 3
+ $AgNO_3$(aq)</td><td>(pale) yellow ppt (formed) *</td><td>white ppt (formed) *</td></tr>
<tr><td>+ NH_3(aq)</td><td>(ppt) insoluble / does not dissolve / no change *</td><td>(ppt) dissolves / soluble / gives a colourless solution *</td></tr>
</table>
</td></tr>
<tr><td>3(b)(ii)</td><td>Anion in FA 7 is iodide (ion) / I^- must be concluded from a (pale) yellow precipitate</td><td>1</td></tr>
<tr><td>3(b)(iii)</td><td>FA 8 is hydrochloric acid / HCl</td><td>1</td></tr>
<tr><td>3(b)(iv)</td><td>One suitable test for H^+ (reagent and observation) in any acid identified in (b)(iii)
• named pH indicator and correct final colour
OR
• add magnesium and fizzes or gas / H_2 pops with a lighted splint</td><td>1</td></tr>
</table>