Cambridge Assessment International Education

Cambridge International AS & A Level

CHEMISTRY **9701/31**

Paper 3 Paper 31 (Advanced Practical Skills 1) **May/June 2020**

MARK SCHEME

Maximum Mark: 40

Published

Students did not sit exam papers in the June 2020 series due to the Covid-19 global pandemic.

This mark scheme is published to support teachers and students and should be read together with the question paper. It shows the requirements of the exam. The answer column of the mark scheme shows the proposed basis on which Examiners would award marks for this exam. Where appropriate, this column also provides the most likely acceptable alternative responses expected from students. Examiners usually review the mark scheme after they have seen student responses and update the mark scheme if appropriate. In the June series, Examiners were unable to consider the acceptability of alternative responses, as there were no student responses to consider.

Mark schemes should usually be read together with the Principal Examiner Report for Teachers. However, because students did not sit exam papers, there is no Principal Examiner Report for Teachers for the June 2020 series.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the June 2020 series for most Cambridge IGCSE™ and Cambridge International A & AS Level components, and some Cambridge O Level components.

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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.

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.

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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.

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Question	Answer	Marks
1(a)	**I** The following headings and data are recorded in the space provided • mass of container with **FA 1** • mass of (empty) container • mass of **FA 1** used, correctly subtracted • consistent decimal places for weighings (at least one d.p.)	**1**
	II All the following data is recorded • two burette readings **and** titre for the rough titration • initial and final burette readings for **two** (or more) accurate titrations	**1**
	III Titre values recorded for accurate titrations, **and Appropriate headings** and units in the **accurate** titration table • initial / start (burette) reading / volume • final / end (burette) reading / volume • titre **or** volume used / added / **or** FA 1 added *(not 'difference' or 'total' or 'amount')* • unit: / cm^3 **or** (cm^3) **or** in cm^3 (for each heading) **or** cm^3 unit given for each volume recorded	**1**
	IV All accurate burette readings are recorded to the nearest 0.05 cm^3.	**1**
	V The **final** accurate titre recorded is within 0.10 cm^3 of any other accurate titre	**1**
	Award **VI**, **VII** and **VIII** if $\delta \leqslant$ **0.020** ($cm^3\ g^{-1}$) Award **VI** and **VII** if **0.020 < $\delta \leqslant$ 0.040** Award **VI**, only if **0.040 < $\delta \leqslant$ 0.060**	**3**
1(b)	**Candidate calculates the mean correctly.** • Candidate must take the average of two (or more) titres that are within a total spread of not more than 0.20 cm^3. • Working/explanation must be shown ***or*** ticks must be put next to the two (or more) accurate readings selected. • The mean should be quoted to **2 dp** and be rounded to nearest 0.01 cm^3.	**1**
1(c)(i)	**Correct calculation** (expressed to 3 or 4 sf) No of moles of $KMnO_4$ used = $0.0200 \times {}^{\text{mean titre}}/_{1000}$ *The candidate's mean titre must be used in the calculation*	**1**

Question	Answer	Marks
1(c)(ii)	**Correct use of (i) to calculate concentration of FA 4** Concentration of **FA 4** = ans **(i)** $\times 5 \times {}^{1000}/_{25}$	**1**
1(c)(iii)	**Correct expression for M_r** $M_r =$ ${}^{\text{mass of FA 1 used} \times 4}/_{\text{answer (ii)}}$ alternatively: M_r = ans **(i)** / 4	**1**

Question	Answer	Marks
2(a)	**I Unambiguous table of data** • Mass of cup • Mass of cup + **FA 5** • Mass of **FA 5** used • Initial temperature or temperature of water / °C • Final / maximum temperature / °C • Temperature rise / °C • Both experiments must be attempted	**1**
	II Readings recorded appropriately • All four thermometer readings recorded to .0 or .5. • All four subtractions correct (two masses and two temp rises). • No thermometer reading is less than 10 °C • Mass of FA 5 used for first experiment is 4.0–4.2 g • Mass of FA 5 used for second experiment is 5.0–5.2 g	**1**
	III + IV Accuracy marks Check and correct temp subtractions for candidate and supervisor. Round each measured temperature to 0.5 °C if necessary Compare the temperature rises for the two experiments.	
	Award **III** if candidate's rise is within 1.0 °C of supervisor in **Expt 1**.	**1**
	Award **IV** if candidate's rise within 1.0 °C of supervisor in **Expt 2**.	**1**
2(b)(i)	**Correct calculation of energy change (2, 3 or 4 sf)** Energy change = $30 \times 4.2 \times$ temp rise (J)	**1**
2(b)(ii)	**Correct calculation of no of moles of Na_2CO_3 used (2–4 sf)** $n = {}^{\text{mass claimed}} / {}_{106}$	**1**
2(b)(iii)	**Correct use of (i) and (ii) to calculate enthalpy change (2–4 sf)** Enthalpy change = $-{}^{\text{energy}} / {}_{1000 \times \text{moles}}$	**1**

Question	Answer	Marks
2(c)(i)	**Accuracy improvement** Plot graph to obtain better (estimate of) temp rise or plot a cooling curve	**1**
2(c)(ii)	**Error** = 0.5	**1**
	Correct calculation of % error to 2 or more sig fig % error = $^{2 \times 0.5}$ / $_{\text{temp rise (expt 2)}} \times 100$	**1**

Question	Answer	Marks
	FA 1/FA 6 is $(NH_4)_2Fe(SO_4)_2.6H_2O$**;** **FA 7** is H_2O_2; **FA 8** is ethanol	
3(a)(i)	Reagents used are NaOH **and** NH_3	**1**
	FA 6 dissolved in (distilled) water (before carrying out tests)	**1**
	Observations with both cold alkalis • With NaOH: green ppt, insoluble in excess • With NH_3: green ppt, insoluble in excess **OR** • If only one of NaOH or NH_3 was selected, award this mark if the observation is correct, but it must include 'ppt turns brown'.	**1**
	Observation when heated with NaOH Fizzing/bubbling **and** gas/NH_3 turns (moist red) litmus to blue	**1**
	Both ions correctly identified Iron(II) **and** ammonium (Fe^{2+} **and** NH_4^+)	**1**

Question	Answer	Marks
3(a)(ii)	**Anion test and first observation** • Add barium nitrate/chloride • White precipitate	**1**
	Observation with acid and conclusion: • white ppt is insoluble in specified mineral acid (**not** H_2SO_4) • sulfate / SO_4^{2-} present	**1**
3(a)(iii)	**Ionic equation** *Any one of the following equations, provided that the appropriate test was carried out.* • $Fe^{2+}(aq) + 2OH^-(aq) \rightarrow Fe(OH)_2(s)$ • $NH_4^+(aq) + OH^-(aq) \rightarrow NH_3(g) + H_2O(l \text{ or } g)$ • $Ba^{2+}(aq) + SO_4^{2-}(aq) \rightarrow BaSO_4(s)$	**1**
3(a)(iv)	**Correct use of M_r to calculate no of moles water.** Mass of water = (392) - 55.8 -192.2 – 36	**1**
	• $n(H_2O) = {}^{392-284}/_{18}$ (expressed as integer)	**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">observation(s)</td></tr>
<tr><td>FA 5</td><td>FA 6</td></tr>
<tr><td>Test 1</td><td>$KMnO_4$ decolorised*.

fizzing/bubbling/effervescence or gas relights glowing spill*
.....
No (further) change</td><td>no reaction
$KMnO_4$ not decolorised
and
.....
$KMnO_4$ goes from purple to colourless (solution)*</td></tr>
<tr><td>Test 2</td><td>Red-brown/ brown solution formed*

.....
Mixture goes to (dark) blue / blue-black*</td><td>No change
and
.....
No change*</td></tr>
<tr><td>Test 3</td><td>Yellow or colourless solution formed*</td><td>(On standing) off-white / pale yellow <u>precipitate</u> formed*.</td></tr>
<tr><td>Test 4</td><td>No change / pale yellow (solution) formed*
.....
Red-brown / brown / rust <u>precipitate</u> (formed)*
Ignore fizzing</td><td></td></tr>
</table>
</td></tr>
<tr><td rowspan="2">3(b)(ii)</td><td>FA 8 is ethanol or propan-2-ol or butan-2-ol (or any secondary 2-ol)
Correct reference to the <u>CHI_3 test</u> or to $CH_3CH(OH)$- or CH_3CO group</td><td>1</td></tr>
<tr><td>Correct reference to the redox reaction with $KMnO_4$ (provided that FA 8 was identified as an alcohol/aldehyde).</td><td>1</td></tr>
<tr><td>3(b)(iii)</td><td>FA 7 is an <u>oxidising agent</u> because <u>iodine</u> is formed.</td><td>1</td></tr>
</table>