Cambridge Assessment International Education

0Cambridge O Level

CHEMISTRY **5070/41**

Paper 4 Alternative to Practical **May/June 2021**

MARK SCHEME

Maximum Mark: 60

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.

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	<u>'List rule' guidance</u> 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.

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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)	Measuring cylinder	**1**
1(a)(ii)	Conical flask / Erlenmeyer flask	**1**
1(b)	**M1** No more effervescence / fizzing when solid added(1) **M2** Undissolved solid / green solid (1)	**2**
1(c)	**M1** Filter paper contains a green solid (1) **M2** Filtrate is a blue solution (1)	**2**

Question	Answer	Marks
2(a)	**M1** 20.8 inserted in table for 0.100 mol / dm^3 AND 23.6 inserted in table for 0.500 mol / dm^3 (1) **M2** 0.80 inserted for maximum temperature change for 0.100 mol / dm^3 AND 3.60 inserted for maximum temperature change for 0.100 mol / dm^3 (1)	**2**
2(b)	Repeat the experiment	**1**
2(c)	7 or 8 points plotted correctly ± half a square (2 marks) 6 points plotted correctly ± half a square (1 mark)	**2**
2(d)	**M1** Single line of best fit within one square of all the non-anomalous points up to 0.9 mol / dm^3 (1) **M2** Single line within one square of last 3 points **and** both lines extended to intersect. (1)	**2**
2(e)	Correct value from student's line of best fit ± half a square	**1**
2(f)	Correct value from student's line of best fit ± half a square	**1**
2(g)	Correct value from intersection of student's lines of best fit ± half a square	**1**

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Question	Answer	Marks
2(h)	*Any one from:* insulation / lagging (the beaker) use a polystyrene cup / use insulating material for the beaker use a lid / bung / cover over the beaker	**1**

Question	Answer			Marks
3(a)	tests	observations	conclusions	**1**
	Aqueous ammonia is added to the mixture.	A green precipitate is formed which is insoluble in excess aqueous ammonia.	**Chromium(III) ion / Cr^{3+} AND Iron(II) ion / Fe^{2+} (1)**	
3(b)	Aqueous sodium hydroxide is added to the mixture. the mixture is warmed.	A green precipitate is formed which is soluble in excess aqueous sodium hydroxide. A gas is also produced which turns damp red litmus paper blue.	**Chromium ion / Cr^{3+} (1)** **Ammonium ion / NH_4^+ (1)** **Ammonia / NH_3 produced (1)**	**3**
3(c)	Excess dilute nitric acid is added to the mixture followed by aqueous silver nitrate.	**Effervescence / fizzing / bubbling (1)** **Gas turns limewater milky (1)** **Yellow precipitate (1)**	**Carbon dioxide formed (1)** CO_3^{2-} ions are in the mixture. Iodide ions are in the mixture	**4**
3(d)	**M1** Aqueous barium chloride / aqueous $BaCl_2$ / aqueous barium nitrate / aqueous $Ba(NO_3)_2$ (1) **M2** Dilute nitric acid / aqueous HNO_3 or Dilute hydrochloric acid / aqueous HCl (1)	**M3** white precipitate (1)	SO_4^{2-} ions are in the mixture	**3**

Question	Answer	Marks
4	**Method:** **M1** Chooses **ANY** suitable named apparatus e.g. flask / beaker / test tube / measuring cylinder **M2** Chooses suitable apparatus to measure time e.g. stopwatch / stop clock / timer **M3** Mix iron(III) nitrate and sodium thiosulfate (and start timing) **M4** Records time for solution to turn colourless (pale blue / colourless if copper sulfate is present) **M5** Repeats with copper(II) sulfate added **M6** Keeps quantities constant e.g. volumes or concentrations **M7** Keeps temperature constant. **M8** The reaction containing copper(II) sulfate has shorter time ORA **M9** A shorter time indicates a greater rate ORA **Alternative method** **M1** Chooses **ANY** suitable named apparatus e.g. flask / beaker / test tube / measuring cylinder **M2** Sets up 2 experiments to run simultaneously. **M3** Mixes iron(III) nitrate and sodium thiosulfate **M4** Mixes iron(III) nitrate sodium thiosulfate and copper(II) sulfate **M5** Notes which one turns colourless first. **M6** Keeps quantities constant e.g. volumes or concentrations **M7** Keeps temperature constant. **M8** The reaction containing copper(II) sulfate turns colourless first ORA **M9** The one which turns colourless first has a greater rate ORA	**9**

Question	Answer	Marks
5(a)(i)	Mass of carbonate = 4.20 (g)	**1**
5(a)(ii)	Mass lost = 2.20 (g)	**1**
5(b)	To make sure the reaction is complete / to obtain constant mass	**1**
5(c)(i)	Gas leaves the apparatus / gas escapes (from the apparatus)	**1**
5(c)(ii)	0.05 (mols)	**1**
5(c)(iii)	0.05 (mols)	**1**

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Question	Answer	Marks
5(c)(iv)	4.20 / 0.05 = 84	**1**
5(c)(v)	M + 12 + (3 × 16) = 84 M = 84 – 60 = 24	**2**
5(c)(vi)	Question Removed	
5(d)(i)	Gas syringe	**1**
5(d)(ii)	54 (cm^3)	**1**
5(d)(iii)	0.00225 (mols)	**1**
5(d)(iv)	Gas lost / escapes / leaves the flask (when adding acid) / low resolution on scale of syringe	**1**
5(d)(v)	**M1** Acid corrosive (1) **M2** Wear safety goggles / avoid contact with eyes (1)	**2**

Question	Answer	Marks
6(a)	<table><tr><td>titration number</td><td>1</td><td>2</td><td>3</td></tr><tr><td>final burette reading</td><td>24.2</td><td>47.8</td><td>24.7</td></tr><tr><td>initial burette reading</td><td>0.0</td><td>24.2</td><td>1.3</td></tr><tr><td>volume of acid added</td><td>24.2</td><td>23.6</td><td>23.4</td></tr><tr><td>best titration result (✓)</td><td></td><td>✓</td><td>✓</td></tr></table> Average = 23.5	**4**
6(b)	10 / 1000 × 0.1 = 0.001	**1**
6(c)	0.0005	**1**

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Question	Answer	Marks
6(d)	$0.0005 / 23.5 \times 1000 = 0.02127$ **0.0213** to 3 significant figures	**1**

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