Cambridge Assessment International Education

Cambridge IGCSE™

CHEMISTRY **0620/04**

Paper 4 Theory (Extended) **For examination from 2023**

MARK SCHEME

Maximum Mark: 80

Specimen

This document has **10** pages. Any blank pages are indicated.

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.

Generic Science 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.

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.

- **;** separates marking points
- **/** separates alternatives within a marking point
- **R** reject
- **I** ignore (mark as if this material was not present)
- **A** accept (a less than ideal answer which should be marked correct)
- **COND** indicates mark is conditional on previous marking point
- **OWTTE** or words to that effect (accept other ways of expressing the same idea)
- **AW** alternate wording (where responses vary more than usual)
- **underline** actual word given must be used by candidate (grammatical variants accepted)
- **max** indicates the maximum number of marks that can be awarded
- **ECF** credit a correct statement that follows a previous wrong response
- **( )** the word / phrase in brackets is not required, but sets the context
- **ORA** or reverse argument

Question	Answer	Marks
1(a)(i)	1 melting	**1**
	2 condensing	**1**
	3 freezing	**1**
	4 boiling **OR** evaporation	**1**
1(a)(ii)	Any **one** from: • boiling happens at a specific temperature • evaporation happens over a range of temperatures • evaporation is a surface process • boliing happens throughout the liquid	**1**
1(b)	*separation:* touching	**1**
	arrangement: regular	**1**
	motion: vibrate	**1**
1(c)	formulae	**1**
	balance, $4X + 3O_2 \rightarrow 2X_2O_3$	**1**

Question	Answer	Marks
2(a)	2 , 8 , 8 , 2	**1**
2(b)(i)	same number of (**OR** 2) outer electrons	**1**
2(b)(ii)	(Sr has) outer electrons in the 5th shell / different numbers of shells	**1**
2(c)(i)	hydrogen	**1**
2(c)(ii)	hydroxide **OR** OH^-	**1**
2(c)(iii)	$7 < pH \leqslant 12$	**1**
2(c)(iv)	$Ca(OH)_2$	**1**
	rest of equation: $Ca + 2H_2O \rightarrow Ca(OH)_2 + H_2$	**1**

Question	Answer	Marks
2(d)(i)	Mg shown with new outer shell with 8 crosses	1
	both C*l* with new outer shells each with 7 dots and 1 cross	1
	'2+' charge on Mg **AND** '–' charge on each C*l*	1
2(d)(ii)	high melting point or high boiling point	1
	good electrical conductivity when aqueous **OR** good electrical conductivity when molten	1
2(e)	formulae	1
	state symbols, $Ag^+(aq) + Cl^-(aq) \rightarrow AgCl(s)$	1

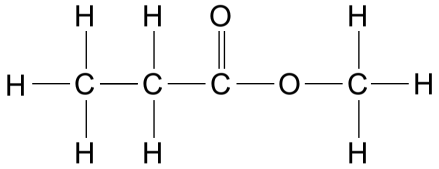
Question	Answer	Marks
3(a)	form coloured compounds / ions	1
	act as catalysts	1
3(b)(i)	copper: +2 to +1	1
	oxygen: –2 to 0	1
	decrease in oxidation number is reduction **AND** increase in oxidation number is oxidation	1
3(b)(ii)	mol CuO = (1.60 ÷ 80) = 0.02(00) (mol)	1
	mol O_2 = (M1 ÷ 4 = 0.02 ÷ 4) = 0.005(00) (mol)	1
	vol O_2 = M2 × 24.0 = 0.005 × 24.0 = 0.12(0) dm^3	1
3(c)(i)	iron is more reactive than copper	1
3(c)(ii)	$Fe + CuSO_4 \rightarrow Cu + FeSO_4$	1
3(c)(iii)	electrolysis	1

Question	Answer	Marks
4(a)(i)	proton donor	**1**
4(a)(ii)	(an acid that is) completely dissociated in aqueous solution	**1**
4(b)(i)	no more fizzing	**1**
	($ZnCO_3$) stops dissolving **OR** a (white) solid remains	**1**
4(b)(ii)	to use up all the acid / H^+ ions	**1**
4(b)(iii)	a solution that can hold no more solute	**1**
	at the specified temperature	**1**
4(b)(iv)	zinc oxide **OR** zinc hydroxide	**1**
4(b)(v)	barium sulfate is insoluble	**1**
4(c)(i)	yellow	**1**
4(c)(ii)	$0.2(00) \times 25(.0) \div 1000 = 5(.00) \times 10^{-3}$ **OR** 0.005(00) (mol)	**1**
	$5(.00) \times 10^{-3} \div 2 = 2.5(0) \times 10^{-3}$ **OR** 0.0025(0) (mol)	**1**
	$2.5(0) \times 10^{-3} \times 1000 \div 20(.0) = 0.125$ (mol / dm^3)	**1**
	$0.125 \times 98 = 12.3$ (g / dm^3) **OR** 12.25 (g / dm^3)	**1**

Question	Answer	Marks
5(a)(i)	gradient decreases	**1**
5(a)(ii)	concentration of HC*l* is decreasing **OR** answers in terms of numbers of reactant molecules decreasing	**1**
5(a)(iii)	200 seconds	**1**
5(b)	new line steeper than printed line, starts at origin and levels before 200 seconds	**1**
	new line reaches same final volume as printed line	**1**
5(c)(i)	minimum energy that colliding particles	**1**
	must have to react	**1**

Question	Answer	Marks
5(c)(ii)	(particles) have more energy and so move faster	**1**
	more frequent collisions between particles	**1**
	a greater percentage of collisions / particles have energy greater than the activation energy, E_a	**1**

Question	Answer	Marks
6(a)	C_4H_6	**1**
	propyne	**1**
6(b)(i)	Any **two** from: • (contain the) same functional group • differ from one member to the next by a $–CH_2–$ unit • trend in physical properties • similar chemical properties	**2**
6(b)(ii)	$C_nH_{2n–2}$	**1**
6(b)(iii)	*test:* bromine water **OR** aqueous bromine	**1**
	result: changes to colourless **OR** decolourises	**1**
6(c)(i)	four C atoms shown with double bond between C2 and C3	**1**
	rest of structure	**1**
6(c)(ii)	one shared pair of electrons between each H and a C atom	**1**
	two shared pairs of electrons between the C atoms and no other unpaired electrons	**1**
6(d)(i)	one product is formed	**1**
6(d)(ii)	temperature above 100 °C **OR** steam is used; **A** a quoted pressure 20–100 atm	**1**
6(d)(iii)	acidified aqueous	**1**
	(potassium) manganate(VII)	**1**

Question	Answer	Marks
7(a)(i)	methyl propanoate	**1**
		**1**
7(a)(ii)	any four carbon ester not named in **7(a)(i)**	**1**
7(b)(i)	diol	**1**
7(b)(ii)	condensation	**1**