Cambridge Assessment International Education

Cambridge IGCSE™

CHEMISTRY **0620/03**

Paper 3 Theory (Core) **For examination from 2023**

MARK SCHEME

Maximum Mark: 80

Specimen

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

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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.

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).

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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	'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.

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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.

Abbreviations used 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

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Question	Answer	Marks
1(a)(i)	**B**	**1**
1(a)(ii)	**B**	**1**
1(a)(iii)	**E**	**1**
1(a)(iv)	**C**	**1**
1(b)	number of electrons in O^{2-} ion = 10	**1**
	number of neutrons in S = 18	**1**
	number of protons in S = 16 **AND** in O^{2-} = 8	**1**

Question	Answer	Marks
2(a)(i)	25 (mg)	**1**
2(a)(ii)	potassium / K^+	**1**
2(a)(iii)	eight electrons in outer shell and none added elsewhere	**1**
2(a)(iv)	add acidified aqueous silver nitrate	**1**
	white **AND** precipitate	**1**
2(a)(v)	tap water contains dissolved ions / tap water contains impurities **ORA**	**1**
2(b)	ammonium sulfate (3rd box ticked)	**1**
2(c)(i)	COOH group circled	**1**
2(c)(ii)	$C_3H_6O_3$	**1**

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Question	Answer	Marks
3(a)	Any **three** from: • crystal dissolves • (cobalt(II) chloride) particles go from close together to spread out / particles go into solution / particles go into the water • diffusion • random movement of particles / particles move anywhere (in the liquid) / particles move in all directions • particles collide / particles bounce off each other • (bulk) movement of particles from higher to lower concentration / movement of particles down a concentration gradient	**3**
3(b)(i)	reversible reaction	**1**
3(b)(ii)	blue	**1**
	pink	**1**
3(c)(i)	cobalt < zinc < magnesium < barium if 2 marks not scored, 1 mark for all reversed / one consecutive pair reversed	**2**
3(c)(ii)	100 (°C)	**1**
3(d)	Any **two** from: • Co has high melting point / boiling point **ORA** for Li • Co has high density **ORA** for Li • Co has catalytic activity **ORA** for Li • Co forms coloured compounds **ORA** for Li • Co compounds have variable oxidation states / form ions with different charges **ORA** for Li • Co is hard / Co is strong **ORA** for Li • Co less reactive **ORA** for Li / Li reacts rapidly with water / Co does not react with water / Co reacts slowly with water • Co is magnetic **ORA** for Li	**2**
3(e)	6 (CoO)	**1**
3(f)	Co_3O_4 loses oxygen / cobalt oxide loses oxygen / it loses oxygen / oxygen removed from cobalt oxide / oxidation number of Co is reduced	**1**

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Question	Answer	Marks
4(a)(i)	reaction complete / reaction finished / no more sulfuric acid left	**1**
4(a)(ii)	3 min / 180 s (unit needed)	**1**
4(a)(iii)	line with steeper gradient and starting at (0,0)	**1**
	line ends at same volume and before the line already drawn	**1**
4(b)	faster reaction / rate increases / reaction speeds up	**1**
	(zinc) powder has a larger surface area **ORA**	**1**
4(c)(i)	(substance containing) atoms of two or more different elements bonded / joined together	**1**
4(c)(ii)	H^+	**1**
4(c)(iii)	red	**1**
4(c)(iv)	98 if 2 marks not scored, 1 mark for S = (1 × 32) = 32 **OR** O = (4 × 16) = 64	**2**

Question	Answer	Marks
5(a)	diamond does not conduct	**1**
	sulfur does not conduct	**1**
5(b)	low boiling point	**1**
5(c)(i)	strong force of attraction	**1**
	between + and – ions / between oppositely charged ions	**1**
5(c)(ii)	does not conduct when solid but conducts when molten	**1**
	higher boiling point	**1**
5(d)	(low) density	**1**
5(e)	*the anode:* bromine / Br_2	**1**
	the cathode: potassium / K	**1**

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Question	Answer	Marks
6(a)	oxides	**1**
6(b)	max **four** from: ***reaction with a named acid*** max **three** from: • forms a salt • correctly named sodium salt from correctly named acid • water formed • neutralisation reaction ***reaction with an ammonium salt*** max **three** from: • ammonia produced / NH_3 produced • forms a (different) salt • correctly named salt from named ammonium salt • water formed • gas turns (damp) red litmus blue	**4**
6(c)	pH 10	**1**
6(d)	2nd box down ticked (potassium chloride)	**1**
	3rd box down ticked (sodium phosphate)	**1**
6(e)(i)	car engines	**1**
6(e)(ii)	acid rain	**1**

Question	Answer	Marks
7(a)	*colour of astatine:* black / grey-black	**1**
	boiling point of bromine: any value between 0 and 177 (°C)	**1**
	state of iodine at 190 °C: gas / vapour	**1**
7(b)(i)	potassium chloride	**1**
7(b)(ii)	chlorine is more reactive than bromine	**1**

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Question	Answer	Marks
7(b)(iii)	pair of electrons in overlap area between the atoms	**1**
	six unbonded electrons on each C*l* atom in the molecule	**1**

Question	Answer	Marks
8(a)(i)	2 (H_2) and 2 (H_2O)	**1**
8(a)(ii)	(g) = gas	**1**
	(l) = liquid	**1**
8(a)(iii)	exothermic	**1**
8(b)	**only** water formed	**1**
	water not a pollutant / no CO_2 formed	**1**
8(c)	decreasing use of fossil fuels / use renewable fuels	**1**
	reduction in livestock farming	**1**
8(d)	carbon dioxide	**1**
	water	**1**
8(e)(i)	breakdown of larger alkanes	**1**
	into smaller alkanes **AND** an alkene / ethene / H_2	**1**
8(e)(ii)	$C_{10}H_{22}$	**1**

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