
CHEMISTRY

9701/23

Paper 2 AS Level Structured Questions

May/June 2019

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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This document consists of **9** printed pages.

PUBLISHED**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:

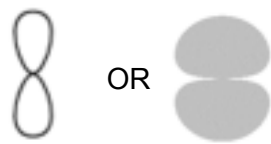
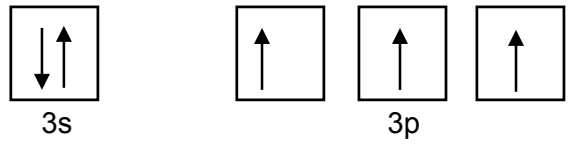
Rules must be applied consistently e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

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.

Question	Answer	Marks
1(a)(i)	All have the same nucleon number OR same sum / total number of protons + neutrons	1
1(a)(ii)	(different) number of protons, neutrons and electrons	1
1(b)	M1 $x / 100 \times 32 + (100 - x / 100 \times 34) = 32.09$ M2 $(32x + 3400 - 34x) = 3209$ so $x = 95.5$ M3 S^{32} 95.5% AND S^{34} 4.5%	3
1(c)(i)	1s	1
1(c)(ii)	 OR 	1
1(c)(iii)	M1 3p M2 It is less attracted to the nucleus (so takes less energy to lose) OR It is the highest energy orbital (which is occupied) / it is in the highest energy orbital	2
1(d)(i)		1
1(d)(ii)	M1 (in S, the electron is removed from the) 2 electrons in (3) p orbital OR a pair of electrons in (3) p (orbital / sub-shell) M2 (paired electrons) repel	2

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Question	Answer	Marks
2(a)(i)	held in regular / uniform arrangement	1
2(a)(ii)	M1 covalent (bonds) AND (temporary) induced dipoles M2 (temporary) induced dipoles	2
2(b)(i)	2	1
2(b)(ii)	iodine (atom / s) donates a pair of electrons (to the Al-I covalent bond / s).	1
2(c)(i)	$2\text{H}_2\text{SO}_4 + 14\text{HI} \rightarrow 7\text{I}_2 + 8\text{H}_2\text{O} + \text{H}_2\text{S} + \text{S}$ M1 correct species M2 correctly balanced equation	2
2(c)(ii)	<i>explain with ref to ox no's why the reaction in (c)(i) is a redox reaction</i> M1 I (oxidation number increases) from -1 to 0 = oxidation / reducing agent M2 S (oxidation number decreases) from $(+) 6$ to 0 OR -2 = reduction / oxidising agent	2

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Question	Answer	Marks
3(a)	white light / flame AND (produces a) white / grey solid / ash / powder / smoke	1
3(b)(i)	$\text{MgO} + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2\text{O}$	1
3(b)(ii)	neutralisation	1
3(c)	M1 giant (structure / lattice) M2 (so) lots of energy needed to break the bonds OR strong bonds	2
3(d)(i)	$\text{MgCO}_3(\text{s}) \rightarrow \text{MgO}(\text{s}) + \text{CO}_2(\text{g})$	1
3(d)(ii)	(thermal) decomposition	1

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Question	Answer	Marks
4(a)	M1 sulfur impurities OR sulfur in fossil fuels M2 converted into SO ₂ by combustion / burning sulfur OR heat sulfur with oxygen (from the air)	2
4(b)(i)	M1 1 mol SO ₂ → 1 mol H ₂ SO ₄ 64.1 g / tonne → 98.1 g / tonne M2 SO ₂ → $98.1 / 64.1 \times 1590 = 2433.369735$ tonnes	2
4(b)(ii)	high (enough) temperature / (a lot of) heat (energy) is produced AND to break (strong) triple bond in N ₂ / break N≡N AND nitrogen (and oxygen) from the air / atmosphere react Award two marks for three correct points Award one mark for two correct points	2
4(b)(iii)	lightning	1
4(b)(iv)	M1 nitrogen dioxide increases the rate OR lowers the activation energy M2 (NO ₂) is regenerated by reaction of NO with O ₂ (in the air) OR NO (formed) reacts with O ₂ (in air) to (re)form NO ₂	2

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Question	Answer	Marks
5(a)(i)	pentanenitrile	1
5(a)(ii)	a lone pair / electron pair donor	1
5(a)(iii)	$(:)\text{CN}^-$ / $^-(:)\text{CN}$ / cyanide ion	1
5(a)(iv)	Br (atom) is replaced (with / by CN / nitrile)	1
5(b)	M1 <i>reagent</i> Ammonia M2 <i>conditions</i> heat with under pressure / heat in a sealed tube	2
5(c)(i)	M1 Increasing reactivity from $\text{Cl} \rightarrow \text{Br} \rightarrow \text{I}$ M2 Due to decreasing strength of C-X bond (from C-Cl to C-Br to C-I) OR Less energy needed to break C-X (from C-Cl to C-Br to C-I)	2
5(c)(ii)	M1 tertiary / 3° halogenoalkane M2 (carbo)cation / intermediate is stable M3 due to (3) electron releasing/donating methyl groups / + I groups (attached to central C) OR (positive) inductive effect of the (three) methyl groups /	3
5(c)(iii)	Any formula / name for any primary halogenoalkane i.e. 1-chlorobutane / 1-bromobutane / 1-iodobutane	1

Question	Answer	Marks
6(a)(i)	Orange / brown to colourless / decolourises	1
6(a)(ii)	any non-ambiguous structures of:	
	X $(\text{CH}_3)_2\text{C} = \text{CH}_2 / (\text{CH}_3)_2\text{CCH}_2$	1
	Y $\text{CH}_3\text{CH}_2\text{CH} = \text{CH}_2 / \text{C}_2\text{H}_5\text{CHCH}_2$	1
	Z $\text{CH}_3\text{CH} = \text{CHCH}_3 / \text{CH}_3\text{CHCHCH}_3$	1
6(a)(iii)	C_4H_8	1
6(b)(ii)	V = primary / 1° alcohol	1
	W = tertiary / 3° alcohol	1
6(b)(ii)	$\text{CH}_3(\text{CH}_2)_2\text{CH}_2\text{OH} + \text{Na} \rightarrow \text{CH}_3(\text{CH}_2)_2\text{CH}_2\text{ONa} + \frac{1}{2} \text{H}_2$	1
6(b)(iii)	M1 Reagent $\text{H}^+ / \text{Cr}_2\text{O}_7^{2-}$ M2 Observations for V orange to green M3 Observations for W no change / remains orange	3