Cambridge International AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

CHEMISTRY **9701/21**

Paper 2 AS Level Structured Questions **May/June 2018**

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.

Cambridge International is publishing the mark schemes for the May/June 2018 series for most Cambridge IGCSE™, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

Cambridge Assessment International Education

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**:

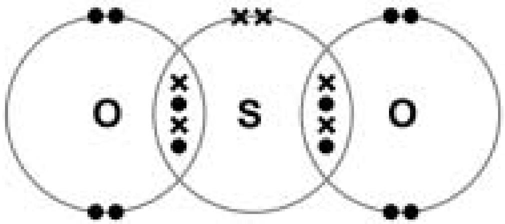
- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can 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:

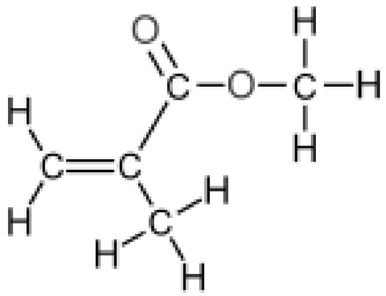
Rules must be applied consistently e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

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)	(It is a substance that) speeds up a reaction	**1**
	(by creating an alternative pathway / mechanism with) lower E_a	**1**
1(a)(ii)	(a heterogeneous catalyst is in a) different state / phase (to the reactants)	**1**
1(b)	−196 + 6S=O = (4 × 534) + 496	**1**
	S=O = 2828 / 6 = 471(.3)	**1**
1(c)	**1** = **B**	**1**
	2 = **A**	**1**
	3 = **D**	**1**
1(d)(i)	Increases rate **AND** explanation re collisions	**1**
	By increasing number / proportion of / more molecules / particles / species with $E \geqslant E_a$	**1**
	(So) increases frequency of successful collisions / more successful collisions per unit time / higher chance of successful collisions per unit time / higher proportion of successful collisions per unit time	**1**
1(d)(ii)	(Increasing T) decreases yield (of SO_3)	**1**
	(Forward) reaction is exothermic (or reverse argument)	**1**
	So increasing T shifts (equilibrium) reaction to left / towards reactants / in endothermic direction (to oppose the change in T)	**1**
1(e)	$H_2S_2O_7 + H_2O \rightarrow 2H_2SO_4$	**1**

Question	Answer	Marks
1(f)(i)		**1**
1(f)(ii)	fully ionises/dissociates	**1**
	(Brønsted-Lowry acid is a) proton / H^+ donor	**1**
1(f)(iii)	$H_2SO_4(l)/(aq) + H_2O(l) \rightarrow HSO_4^-(aq) + H_3O^+(aq)$	
	species and balancing	**1**
	correct state symbols on left hand side; all products aqueous	**1**

Question	Answer	Marks
2(a)	Different (hydrocarbon) molecules have different numbers of electrons	**1**
	so different strengths / numbers / amount of VdW / IMFs / id-id	**1**
2(b)	Produces more useful / more valuable / higher demand substances / alkanes / alkenes	**1**
2(c)(i)	$C_{12}H_{26} \rightarrow 2C_2H_4 + C_8H_{18}$	**1**
2(c)(ii)	addition polymerisation	**1**

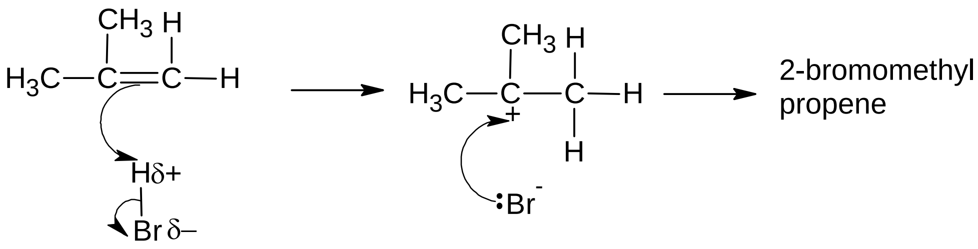
Question	Answer	Marks
2(c)(iii)	*two from* save space in landfill avoid litter prevent eyesore non-biodegradable conserves non-renewable resources harmful incineration products harmful to wildlife	**2**
2(c)(iv)		
	correct monomer	**1**
	fully displayed	**1**

Question	Answer	Marks
3(a)(i)	increasing attraction between nucleus and (outer) electrons	**1**
	increasing nuclear charge with similar shielding / (electrons in) same (outer) shell	**1**
3(a)(ii)	(ions of Na to Si have) lost outer shell / outer electrons OR atoms have one more shell than (corresponding) ions OR effective nuclear charge is greater for the ion	**1**

Question	Answer	Marks
3(a)(iii)	(P to C*l* form ions by) gaining electrons (to the same outer shell / p sub-shell)	**1**
	Increased repulsion between electrons in same / outer shell / p sub-shell	**1**
3(b)(i)	(outer) electron removed from <u>3p</u> subshell / orbital	**1**
	(3p) higher in energy / more shielded / further from the nucleus	**1**
3(b)(ii)	(outer) electron for S is paired in a <u>p orbital</u> / S has a full <u>p orbital</u>	**1**
	causing (spin / electron) pair repulsion (which reduces attraction)	**1**
3(c)(i)	oxidation numbers / states of elements (Na-Si) increase from +1 to +4 / by 1 every time	**1**
	increasing number of valence electrons / $NaCl$, $MgCl_2$, $AlCl_3$,$SiCl_4$ / number of chlorines matches group number	**1**
	chlorine oxidation number / state –1 in all / stays the same	**1**
3(c)(ii)	$NaCl \rightarrow Na^+ + Cl^-$	**1**
	$SiCl_4 + 2H_2O \rightarrow SiO_2 + 4HCl$	**1**
3(c)(iii)	(see table below)	**2**

	structure	bonding
sodium chloride	giant / ionic	ionic
silicon(IV) chloride	simple / molecular	covalent

Question	Answer	Marks
4(a)(i)	Iodoform / triiodomethane	**1**
4(a)(ii)	butan-2-ol	**1**
4(b)	$CH_3CH_2CH_2CH_2OH$ $(CH_3)_3COH$ $(CH_3)_2CHCH_2OH$	**2**
4(c)(i)	oxidation / redox	**1**
4(c)(ii)	acidified / H^+ **AND** potassium / sodium dichromate((VI)) or formulae	**1**
4(c)(iii)	*In any order:*	
	but-1-ene	**1**
	but-2-ene	**1**
	cis / *Z-* AND *trans* / *E-*	**1**

Question	Answer	Marks
4(d)(i)		
	curly arrow from C=C to H	1
	correct dipole on HBr and curly arrow from bond of HBr to Br	1
	tertiary intermediate cation	1
	Br^- with curly arrow from lone pair	1
4(d)(ii)	(carbo)cation / tertiary ion / tertiary intermediate (more) stable (than primary)	1
	due to electron-releasing / (positive) inductive effect of more alkyl / methyl groups	1