Cambridge International AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

CHEMISTRY **9701/21**

Paper 2 AS Structured Questions **October/November 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.

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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.

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Question	Answer	Marks
1(a)(i)	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^6\ (4s^0)$	**1**
1(a)(ii)	–1	**1**
1(b)	**M1** attraction/hold **M2 positive** ions / cations **AND** delocalised electrons (may be seen in a labelled diagram)	**2**
1(c)(i)	**M1** acid rain **M2** • destroys / damages / weathers / erodes / buildings / statues • kills/harms fish / coral / plants / crops / trees / deforestation • leaches salts / ions (aluminium) from soil (into rivers / lakes) • leaches away soil nutrients • breathing difficulties • lowers pH / increases acidity of soil / rivers / oceans / seas	**2**
1(c)(ii)	balanced equation with $11O_2$ and $8SO_2$ **M1**: O_2 and SO_2 **M2**: 11 and 8	**2**
1(c)(iii)	**M1** *is for process of calculating number of moles of* Fe_2O_3 33.18 ÷ 159.6 (= 0.2079 mol) **M2** *for correct use of stoichiometry and 120.0 with candidate's* ***M1*** **M2** (0.2079) × 4 / 2 × 120.0 = 49.89 (g)	**2**
1(c)(iv)	(0.37/(0.37+49.89)) = 0.74	**1**

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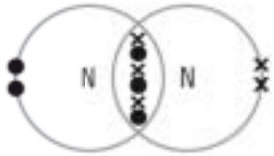
Question	Answer	Marks
2(a)(i)	1 mark for each bullet, max 2 • triple bond • non-polar / no dipole • needs a lot of energy to break / strong	**2**
2(a)(ii)	 6 e^- between atoms **AND** two electrons on each N atom	**1**
2(b)(i)	(lightning) provides the (high) activation energy	**1**
2(b)(ii)	**M1** $NO + ½ O_2 \rightarrow NO_2$ **M2** $2NO_2 + H_2O + ½ O_2 \rightarrow 2HNO_3$	**2**
2(c)	**M1** fertiliser / nitrates dissolve in (river / ground water) **OR** fertiliser / nitrates are washed / leached out / flows into (river/groundwater) **M2** algal bloom / promote algal growth / explosion of plant growth **AND** sunlight is blocked out (preventing photosynthesis) / plants can no longer carry out photosynthesis (and die) **AND** bacteria break down or decay **dead** organisms / plants / algae **M3** drop in oxygen (concentration)	**3**
2(d)(i)	to increase / raise pH	**1**
2(d)(ii)	**M1** ammonia / NH_3 **M2** displaces NH_3	**2**

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Question	Answer	Marks
2(d)(iii)	**M1** effervescence / fizzing / bubbling **M2** solid disappears	**2**
2(d)(iv)	$2Ca(NO_3)_2 \rightarrow 2CaO + 4NO_2 + O_2$	**1**

Question	Answer	Marks
3(a)(i)	**M1** gas / vapour (particles / molecules) in **equilibrium** (with liquid / solid) **M2** greater proportion of gas (particles) than liquid (particles) (in comparison to a liquid of lower vapour pressure)	**2**
3(a)(ii)	–17.(0) (kJ mol^{-1}) ✓✓✓ **M1** $\Delta H_r = x(-482.2) + y(-92.3) - v(-103.2) - w(-273.3)$ where x y v and w are integers $\geqslant 1$ (ignore stoichiometry) **M2** use of correct stoichiometry where $x = 1$ $y = 2$ $v = 1$ and $w = 2$	**3**
3(a)(iii)	**M1** in a different phase / state from reactants **M2** a substance that speeds up a (chemical) reaction **M3** catalyst is regenerated / not used up / undergoes temporary chemical change / recovered unchanged	**3**
3(b)(i)	**Human activity** creates / additional / more/increase / thicker layer in greenhouse gas(es) / $CHCl F_2$ **OR** **Human activity** has an impact on climate change / temperature at earth's surface / temperature of sea	**1**
3(b)(ii)	**M1** traps (more)heat **M2** (in the atmosphere leading to) greater global warming or wtte	**2**
3(b)(iii)	ozone depletion / thinning	**1**
3(c)(i)	addition	**1**

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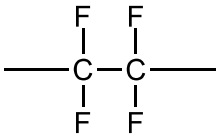
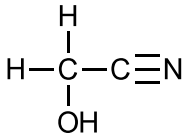
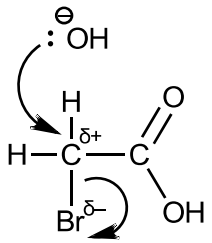
Question	Answer	Marks
3(c)(ii)		**1**
3(c)(iii)	molecule unreactive / inert	**1**
3(c)(iv)	non-biodegradable creates toxic / harmful gases / HF / CO_2 / CO **if burnt**	**2**

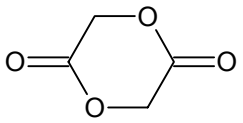
Question	Answer	Marks
4(a)		**4**

reagent	observation with glycolic acid	does a reaction occur? ✓ / ×	functional group
Na_2CO_3(aq)	effervescence / fizzing / bubbling	✓	COOH / carboxylic acid
2,4–DNPH	no visible reaction owtte	×	(no group required)
acidified $Cr_2O_7^{2-}$	orange to green	✓	–OH / alcohol

1 mark for each in column 2 (obs)

1 mark for COOH **and** OH

Question	Answer	Marks
4(b)(i)		**1**
4(b)(ii)	hydrochloric / sulfuric / nitric / phosphoric acid	**1**
4(b)(iii)	free-radical substitution	**1**
4(b)(iv)	UV (light) / sunlight	**1**
4(b)(v)	 **M1** lone pair on $^{-}$OH **AND** curly arrow from lone pair to C of C—Br **M2** correct dipole on C—Br **AND** curly arrow from bond to Br	**2**
4(c)(i)	reducing agent / reductant	**1**
4(c)(ii)	$C_2H_2O_3 + 2[H] \rightarrow C_2H_4O_3$ **M1** for correct molecular formulae $C_2H_2O_3$ and $C_2H_4O_3$ **M2** for balancing	**2**

Question	Answer	Marks
4(d)(i)	**EITHER** Glycolic acid would have: **M1 2500–3000** due to RCO_2-H **M2** range within 3200–3650 due to RO–H **OR** Spectrum Y would NOT have: **M1 2500–3000** due to RCO_2-H **M2** range within 3200–3650 due to RO–H	**2**
4(d)(ii)	 **M1** ANY ester group **AND** valid $C_4H_4O_4$ molecule **M2** correct cyclic structure	**2**