Cambridge International AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

CHEMISTRY **9701/22**

Paper 2 AS Structured Questions **October/November 2017**

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.

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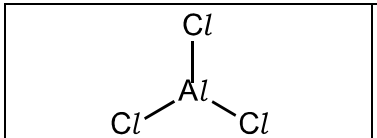
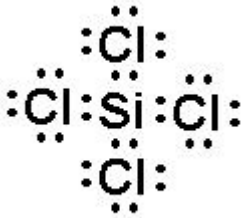
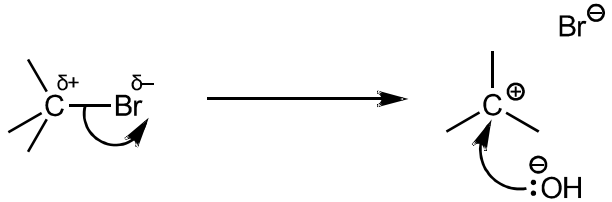
Question	Answer	Marks
1(a)	 trigonal planar 120°  (trigonal) pyramid(al) 100–107° 3 marking points for each box: diagram, name and shape. for each box: all three correct = 2 marks two correct = 1 mark	**4**
1(b)(i)	$SiCl_4$ simple / molecular **AND** Van der Waals' / id-id forces / London / dispersion forces / IMFs	**1**
	NaCl ionic **OR** giant	**1**
	bonding (in NaCl) stronger (than forces in $SiCl_4$) owtte	**1**
1(b)(ii)	$SiCl_4$ has more electrons ORA	**1**
	stronger Van der Waals' / id-id forces / London / dispersion forces / IMFs	**1**
1(b)(iii)		**1**

Question	Answer	Marks
2(a)	−444	**1**
2(b)(i)	(higher rate / rate increases) due to higher frequency of successful collisions	**1**
	more molecules / particles with $E \geqslant E_a$	**1**
2(b)(ii)	(percentage decomposition of PCl_5) increases	**1**
	(forward) reaction is endothermic	**1**
2(c)	rates of forward and reverse / backward reactions are equal	**1**
	closed / sealed system/container	**1**
2(d)(i)	n_{TOTAL} = 1.20 + 0.80 + 0.80 OR 2.80 (mol) **OR** mole fraction = 1.20 / 2.80 OR 0.429	**1**
	$p PCl_5$ = $1 \times 10^5 \times (1.20 / 2.80)$ = 4.29×10^4 (Pa)	**1**
2(d)(ii)	$K_p = \frac{p PCl_3 \times p Cl_2}{p PCl_5}$	**1**
2(d)(iii)	1.91×10^4	**1**
	Pa	**1**

Question	Answer	Marks
3(a)	(IE) <u>decreases / lower</u> because increasing **distance** of outer electron(s) from nucleus **OR** increasing distance of outer / valence shell from nucleus **OR** increased **shielding** / screening (from inner shells)	**1**
	reduces nuclear **attraction** (for electrons)	**1**
3(b)(i)	(Melting point) <u>increases / higher</u> because (molecules have an) increasing (number of) electrons	**1**
	increasing strength / number / amount of IMFs / Van der Waals' / id–id / London / dispersion (forces)	**1**
3(b)(ii)	increased metallic / (cat)ionic radius / size OR decreasing (cat)ion charge-density	**1**
	decreased attraction (of ions) for delocalised / outer electrons	**1**
3(c)(i)	reaction 1: HNO_3 or nitric((V)) acid	**1**
	reaction 2: water / H_2O	**1**
3(c)(ii)	barium oxide	**1**
	$2Ba + O_2 \rightarrow 2BaO$	**1**
3(c)(iii)	NO_2 / nitrogen dioxide / nitrogen(IV) oxide **AND** O_2 / oxygen	**1**
	(red / yellow-)brown gas **OR** gas given off that relights glowing splint	**1**
3(c)(iv)	<u>white</u> ppt / solid / suspension	**1**
	of $BaSO_4$ / barium sulfate **OR** $Mg(OH)_2$ / magnesium hydroxide	**1**
	$BaSO_4$ is insoluble **OR** $Mg(OH)_2$ is insoluble / partially / slightly / sparingly soluble	**1**

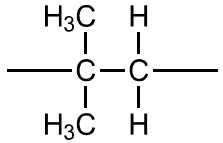
<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>4(a)</td><td>
<table>
<tr><td>1</td><td>concentrated H_2SO_4 / H_3PO_4 AND NaBr

OR (red) P / Br_2
OR HBr</td><td>substitution</td></tr>
<tr><td>2</td><td>aqueous / dilute NaOH / KOH</td><td>hydrolysis
OR substitution</td></tr>
<tr><td>3</td><td>concentrated H_2SO_4 / H_3PO_4
OR Al_2O_3 / P_4O_{10} / pumice / porous pot / SiO_2</td><td>dehydration</td></tr>
<tr><td>4</td><td>(ethanolic) HBr</td><td>addition</td></tr>
</table>
4 marks for column 1 (one per row) 1 mark for col 2
</td><td>5</td></tr>
<tr><td>4(b)</td><td> 

M1
correct dipole on $^{\delta+}C—Br^{\delta-}$ AND curly arrow from C—Br bond to Br

M2 correct intermediate with + charge

M3 curly arrow from lone pair on $\overset{\ominus}{:}OH$ to C^+ of carbocation</td><td>3</td></tr>
</table>

Question	Answer	Marks
4(c)(i)	(different molecules) same molecular formula / same numbers of atoms of each (type of) element	**1**
	different structural formulae / displayed formulae	**1**
	chain / skeletal functional group position(al) / regioisomerism two types correct = 1 mark, all three correct = 2 marks	**2**
4(c)(ii)	S_N / nucleophilic substitution	**1**
	no (stable) (carbo)cation / intermediate is formed	**1**
	only one alkyl group / fewer alkyl / methyl groups (compared to reaction 2) **AND** limited (+)I / inductive effect / less electron donating (effect)	**1**
4(d)(i)	mirror images are super(im)posable **OR** not chiral / no chirality / no chiral/asymmetric carbon/centre / achiral	**1**
	one or both C/end of **double bond** has identical groups **/** 2 methyl groups / 2 H (atoms)	**1**
4(d)(ii)	addition	**1**
	 marking points: • correct number of tetravalent carbon atoms in backbone, with extension bonds • correct groups on backbone carbon atoms **and** only one repeat unit	**2**
4(d)(iii)	not/non- biodegradable / harmful combustion products	**1**

Question	Answer	Marks
4(e)	2-bromo-2-methylpropane	**1**
	1-bromo-2-methylpropane	**1**