Cambridge International AS & A Level

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CHEMISTRY **9701/22**

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

MARK SCHEME

Maximum Mark: 60

Published

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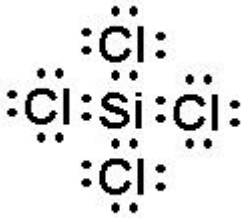
Question	Answer	Marks
1(a)	 3 marking points for each box: diagram, name and shape. for each box: all three correct = 2 marks two correct = 1 mark	**4**
1(b)(i)	$SiCl_4$ simple / molecular **AND** Van der Waals' / id-id forces / London / dispersion forces / IMFs	**1**
	NaCl ionic **OR** giant	**1**
	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**

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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)	<u>rates</u> 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**

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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**

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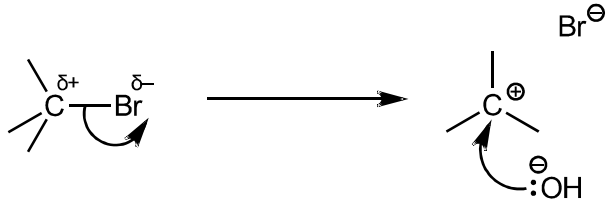
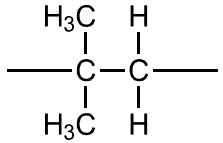
<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>4(a)</td><td>
<table>
<tr><td>1</td><td>concentrated H_2SO_4 / H_3PO_4 AND NaBr

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**

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

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