
CHEMISTRY**9701/22**

Paper 2 AS Structured Questions

October/November 2017

MARK SCHEME

Maximum Mark: 60

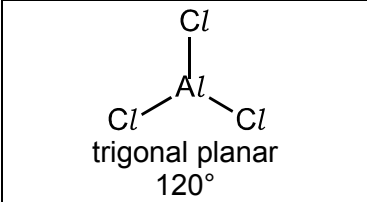
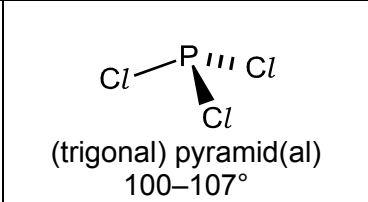
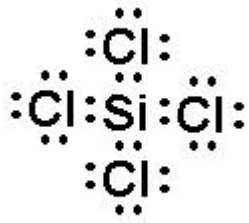
Published

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.

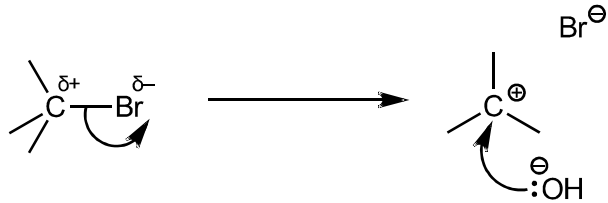
Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the October/November 2017 series for most Cambridge IGCSE[®], Cambridge International A and AS Level components and some Cambridge O Level components.

Question	Answer	Marks
1(a)	<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p>trigonal planar 120°</p> </div> <div style="text-align: center;">  <p>(trigonal) pyramid(al) 100–107°</p> </div> </div> <p>3 marking points for each box: diagram, name and shape. for each box: all three correct = 2 marks two correct = 1 mark</p>	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 $E \geq E_a$	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)	$n_{\text{TOTAL}} = 1.20 + 0.80 + 0.80$ OR 2.80 (mol) OR mole fraction = $1.20 / 2.80$ OR 0.429	1
	$p_{\text{PCl}_5} = 1 \times 10^5 \times (1.20 / 2.80) = 4.29 \times 10^4$ (Pa)	1
2(d)(ii)	$K_p = \frac{p_{\text{PCl}_3} \times p_{\text{Cl}_2}}{p_{\text{PCl}_5}}$	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 ₂ O	1
3(c)(ii)	barium oxide	1
	2Ba + O ₂ → 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

Question	Answer		Marks											
4(a)	<table border="1"> <tr> <td data-bbox="322 220 383 403">1</td> <td data-bbox="383 220 949 403"> concentrated H_2SO_4 / H_3PO_4 AND NaBr OR (red) P / Br_2 OR HBr </td> <td data-bbox="949 220 1196 403">substitution</td> </tr> <tr> <td data-bbox="322 403 383 491">2</td> <td data-bbox="383 403 949 491">aqueous / dilute NaOH / KOH</td> <td data-bbox="949 403 1196 491">hydrolysis OR substitution</td> </tr> <tr> <td data-bbox="322 491 383 611">3</td> <td data-bbox="383 491 949 611"> concentrated H_2SO_4 / H_3PO_4 OR Al_2O_3 / P_4O_{10} / pumice / porous pot / SiO_2 </td> <td data-bbox="949 491 1196 611">dehydration</td> </tr> <tr> <td data-bbox="322 611 383 659">4</td> <td data-bbox="383 611 949 659">(ethanolic) HBr</td> <td data-bbox="949 611 1196 659">addition</td> </tr> </table> <p data-bbox="477 667 1187 703" style="text-align: center;"><i>4 marks for column 1 (one per row) 1 mark for col 2</i></p>	1	concentrated H_2SO_4 / H_3PO_4 AND NaBr OR (red) P / Br_2 OR HBr	substitution	2	aqueous / dilute NaOH / KOH	hydrolysis OR substitution	3	concentrated H_2SO_4 / H_3PO_4 OR Al_2O_3 / P_4O_{10} / pumice / porous pot / SiO_2	dehydration	4	(ethanolic) HBr	addition	5
1	concentrated H_2SO_4 / H_3PO_4 AND NaBr OR (red) P / Br_2 OR HBr	substitution												
2	aqueous / dilute NaOH / KOH	hydrolysis OR substitution												
3	concentrated H_2SO_4 / H_3PO_4 OR Al_2O_3 / P_4O_{10} / pumice / porous pot / SiO_2	dehydration												
4	(ethanolic) HBr	addition												
4(b)	 <p data-bbox="324 954 1187 1021">M1 correct dipole on $\delta^+\text{C}-\text{Br}^{\delta-}$ AND curly arrow from C—Br bond to Br</p> <p data-bbox="324 1053 817 1093">M2 correct intermediate with + charge</p> <p data-bbox="324 1125 1086 1189">M3 curly arrow from lone pair on $:\text{OH}^-$ to C^+ of carbocation</p>		3											

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
	$ \begin{array}{c} \text{H}_3\text{C} \quad \text{H} \\ \quad \\ \text{---C---C---} \\ \quad \\ \text{H}_3\text{C} \quad \text{H} \end{array} $ marking points: <ul style="list-style-type: none"> • 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