CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2013 series

9701 CHEMISTRY

9701/22

Paper 2 (AS Structured Questions), maximum raw mark 60

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 will not enter into discussions about these mark schemes.

Cambridge is publishing the mark schemes for the October/November 2013 series for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level components and some Ordinary Level components.



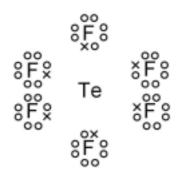
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1 (a)

number of bond pairs	number of lone pairs	shape of molecule	formula of a molecule with this shape
3	0	trigonal planar	BH ₃
4	0	tetrahedral	CH₄ allow other Group IV hydrides
3	1	pyramidal or trigonal pyramidal	NH₃ allow other Group V hydrides
2	2	non-linear or bent or V-shaped	H₂O allow other Group VI hydrides

1 mark for each correct row (3×1) [3]

(b) (i)



(1)

(ii) octahedral **or** square-based bipyramid (1)

(iii) 90° (1) [3]

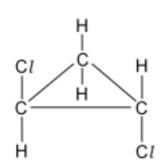
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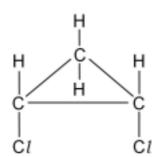
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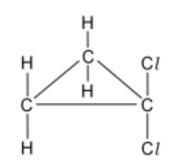
(b) (i) electrophilic addition

(1)

(ii)







1 mark for each correct structure allow correctly drawn optical isomers of the first structure

 (3×1) [4]

[Total: 5]

3 (a) (i) anode
$$Cl^{-}(aq) \rightarrow \frac{1}{2} Cl_{2}(g) + e^{-}$$
 (1)

cathode
$$H^{+}(aq) + e^{-} \rightarrow \frac{1}{2}H_{2}(g)$$
 or $2H_{2}O(I) + 2e^{-} \rightarrow H_{2}(g) + 2OH^{-}(aq)$ (1)

(b) sodium

burns with a yellow **or** orange flame **or** forms a white solid allow – **once only** – colour of chlorine disappears (1) $2Na + Cl_2 \rightarrow 2NaCl$ (1)

phosphorus

burns with a white **or** yellow flame **or** colour of chlorine disappears – if **not** given for Na – **or**

for PC l₅ forms a white or pale yellow solid

for PC
$$l_3$$
 forms a colourless liquid (1)

$$P + 2\frac{1}{2}Cl_2 \rightarrow PCl_5$$
 or $P_4 + 10Cl_2 \rightarrow 4PCl_5$

or

$$P + 1\frac{1}{2}Cl_2 \rightarrow PCl_3$$
 or $P_4 + 6Cl_2 \rightarrow 4PCl_3$

equation must refer to compound described (1) [4]

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(c) cold di	ute aqueous NaOH		
NaOC <i>l</i> +1			(1) (1)
hot cor	centrated aqueous NaOH		
NaC <i>l</i> O ₃ +5			(1) (1) [4
(d) MgC <i>l</i> ₂	6.5 to 6.9		(1)
SiC14	0 to 3		(1)
•	dissolves without reaction or slight or partial hydrolysis occurs		(1)
•	reacts with water or nydrolysis occurs		(1)
	$2H_2O \rightarrow SiO_2 + 4HCl$ or $4H_2O \rightarrow Si(OH)_4 + 4HCl$ or		

[Total: 16]

(1)

[5]

4 (a) (i)
$$H_2X + 2NaOH \rightarrow Na_2X + 2H_2O$$
 (1)

 $SiCl_4 + 4H_2O \rightarrow SiO_2.2H_2O + 4HCl$

(ii)
$$n(OH^-) = \frac{21.6 \times 0.100}{1000} = 2.16 \times 10^{-3} \text{ mol}$$
 (1)

(iii)
$$n(\mathbf{R}) = n(H_2X) = \frac{2.16 \times 10^{-3}}{2}$$

= 1.08 × 10⁻³ mol in 25.0 cm³ (1)

(iv)
$$n(\mathbf{R}) = 1.08 \times 10^{-3} \times \frac{250}{25.0} = 0.0108 \text{ mol in } 250 \text{ cm}^3$$
 (1)

(v) 0.0108 mol of
$$\mathbf{R} = 1.25 \,\mathrm{g}$$
 of \mathbf{R}
1 mol of $\mathbf{R} = \frac{1.25 \times 1}{0.0108} = 115.7 = 116 \,\mathrm{g}$ (1) [5]

Pa	ge 5		Mark Scheme	Syllabus	Paper	
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(b)	I	$M_{\rm r}$ o	of S = 116 of T = 134 of U = 150 all three needed		(1)	[0]
	(11)	3			(1)	[2]
(c)	or H	:. H ₂ : ₃ PO:	SO_4 followed by H_2O O_4 followed by H_2O or O_4 catalyst		(1 + 1)	
	S into	O_4	to poidified an oald dilute allugling		(1)	
	cold	allut	te acidified or cold dilute alkaline		(1)	
		₁₀ or	conc. H_2SO_4 or conc. H_3PO_4 or Al_2O_3 t in each case		(1)	[5]
(d)	T rea	actin	ng with an excess of Na			
	NaO	₂ CC	CH(ONa)CH ₂ CO ₂ Na		(1)	
	U rea	actin	ng with an excess of Na ₂ CO ₃			
	NaO	₂ CC	CH(OH)CH(OH)CO₂Na		(1)	[2]
(e)	C		H C-OH C=C HO-C H OH OH U		/4\	
			ect structures abels		(1) (1)	[2]

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(f) correct ring of C and O atoms, i.e.

$$\begin{array}{cccc}
C & C \\
\parallel & C
\end{array}$$
(1)

correct compound, i.e.

(hydrogen atoms do not need to be shown)

[Total: 18]

[2]

[2]

[2]

(1)

(1)

(1)

- 5 (a) (i) alkanes or paraffins not hydrocarbons
 - (ii) $2C_4H_{10} + 13O_2 \rightarrow 8CO_2 + 10H_2O$
 - (b) (i) carbon allow graphite (1)
 - (ii) $2C_4H_{10} + 5O_2 \rightarrow 8C + 10H_2O$ allow balanced equations which include CO and/or CO_2 (1)
 - (c) enthalpy change when 1 mol of a substance (1) is burnt in an excess of oxygen/air under standard conditions or is completely combusted under standard conditions (1) [2]

(d) (i)
$$m = \frac{pVM_r}{RT} = \frac{1.01 \times 10^5 \times 125 \times 10^{-6} \times 44}{8.31 \times 293}$$
 g (1)

$$= 0.228147345 g$$

$$= 0.23 g$$
 (1)

(ii) heat released = m c
$$\delta$$
 T = 200 × 4.18 × 13.8 J (1) = 11536.8 J = 11.5 kJ (1)

(iii) 0.23 g of propane produce 11.5 kJ 44 g of propane produce $\frac{11.5 \times 44}{0.23}$ kJ = 2200 kJ mol⁻¹ (1) [5]

(e)	(i)	from methane to butane there are more electrons in the molecule therefore greater/stronger van der Waals' forces	(1) (1)	
	(ii)	straight chain molecules can pack more closely therefore stronger van der Waals' forces or reverse argument	(1) (1)	[4]

Mark Scheme

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[Total: 15]

Paper 22

Syllabus

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