

## **MARK SCHEME for the October/November 2013 series**

### **9701 CHEMISTRY**

**9701/21**

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.

Page 2	Mark Scheme	Syllabus	Paper
	GCE AS/A LEVEL – October/November 2013	9701	21

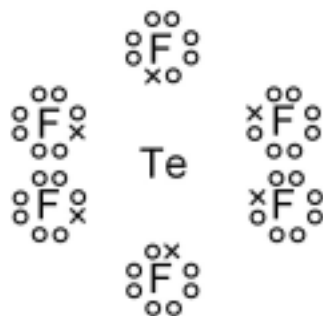
1 (a)

number of bond pairs	number of lone pairs	shape of molecule	formula of a molecule with this shape
3	0	trigonal planar	BH <sub>3</sub>
4	0	tetrahedral	CH <sub>4</sub> allow other Group IV hydrides
3	1	pyramidal <b>or</b> trigonal pyramidal	NH <sub>3</sub> allow other Group V hydrides
2	2	non-linear <b>or</b> bent <b>or</b> V-shaped	H <sub>2</sub> O 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]

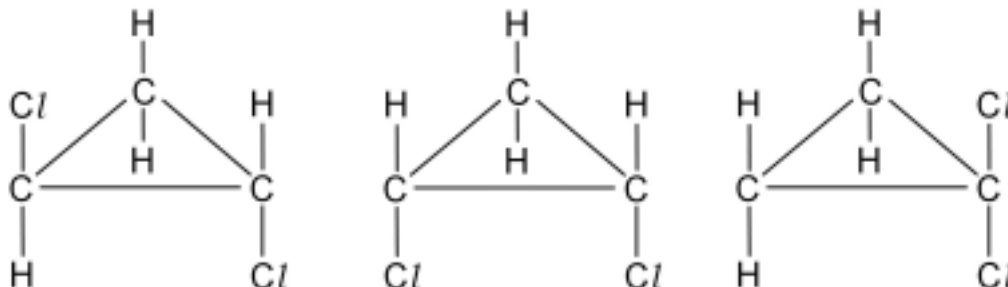
[Total: 6]

Page 3	Mark Scheme	Syllabus	Paper
	GCE AS/A LEVEL – October/November 2013	9701	21

2 (a)  $117^\circ$  to  $120^\circ$  (1) [1]

(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**  
 $2H_2O(l) + 2e^- \rightarrow H_2(g) + 2OH^-(aq)$  (1)

(ii) because iron in steel will react with chlorine (1) [3]

(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  $PCl_5$**  forms a white **or** pale yellow solid

**for  $PCl_3$**  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]

Page 4	Mark Scheme	Syllabus	Paper
	GCE AS/A LEVEL – October/November 2013	9701	21

(c) cold dilute aqueous NaOH

NaOCl (1)  
+1 (1)

hot concentrated aqueous NaOH

NaClO<sub>3</sub> (1)  
+5 (1) [4]

(d) MgCl<sub>2</sub> 6.5 to 6.9 (1)

SiCl<sub>4</sub> 0 to 3 (1)

MgCl<sub>2</sub> dissolves without reaction **or**  
slight **or** partial hydrolysis occurs (1)

SiCl<sub>4</sub> reacts with water **or**  
hydrolysis occurs (1)

SiCl<sub>4</sub> + 2H<sub>2</sub>O → SiO<sub>2</sub> + 4HCl **or**  
SiCl<sub>4</sub> + 4H<sub>2</sub>O → Si(OH)<sub>4</sub> + 4HCl **or**  
SiCl<sub>4</sub> + 4H<sub>2</sub>O → SiO<sub>2</sub>·2H<sub>2</sub>O + 4HCl (1) [5]

[Total: 16]

4 (a) (i) H<sub>2</sub>X + 2NaOH → Na<sub>2</sub>X + 2H<sub>2</sub>O (1)

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

(iii)  $n(\text{R}) = n(\text{H}_2\text{X}) = \frac{2.16 \times 10^{-3}}{2}$   
 $= 1.08 \times 10^{-3} \text{ mol in } 25.0 \text{ cm}^3$  (1)

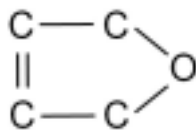
(iv)  $n(\text{R}) = 1.08 \times 10^{-3} \times \frac{250}{25.0} = 0.0108 \text{ mol in } 250 \text{ cm}^3$  (1)

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



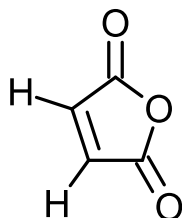
Page 6	Mark Scheme	Syllabus	Paper
	GCE AS/A LEVEL – October/November 2013	9701	21

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



(1)

correct compound, i.e.



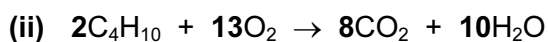
(1) [2]

(hydrogen atoms do not need to be shown)

[Total: 18]

5 (a) (i) alkanes **or** paraffins **not** hydrocarbons

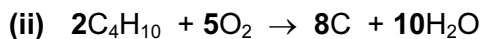
(1)



(1) [2]

(b) (i) **carbon** allow graphite

(1)



allow balanced equations which include CO and/or CO<sub>2</sub>

(1) [2]

(c) enthalpy change when 1 mol of a substance  
is burnt in an excess of oxygen/air under standard conditions  
**or** is completely combusted under standard conditions

(1)

(1) [2]

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

(1)

$$= 0.228147345 \text{ g}$$

$$= 0.23 \text{ g}$$

(1)

(ii) heat released =  $m c \delta T = 200 \times 4.18 \times 13.8 \text{ J}$   
= 11536.8 J = 11.5 kJ

(1)

(1)

(iii) 0.23 g of propane produce 11.5 kJ  
44 g of propane produce  $\frac{11.5 \times 44}{0.23} \text{ kJ}$   
= 2200 kJ mol<sup>-1</sup>

(1) [5]

Page 7	Mark Scheme	Syllabus	Paper
	GCE AS/A LEVEL – October/November 2013	9701	21

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

**[Total: 15]**