

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

### **9701 CHEMISTRY**

**9701/23**

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.

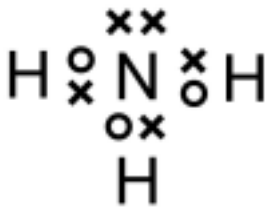
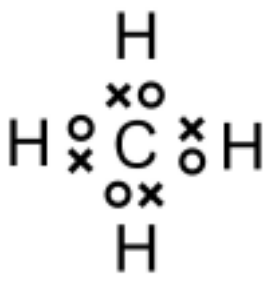
Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

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	23

1 (a)

$\text{NH}_3$ 	$\text{CH}_4$ 
pyramidal	tetrahedral

**both** 'dot-and-cross' diagrams correct  
 $\text{NH}_3$  is pyramidal **or** trigonal pyramidal  
 $\text{CH}_4$  is tetrahedral

(1)  
(1)  
(1) [3]

(b) (i) nitrogen and hydrogen have different electronegativities  
 $\text{N}-\text{H}$  bond has a dipole **or**  
 $\text{N}^{\delta-}-\text{H}^{\delta+}$  **or**  
bonding pair is unequally shared

(1)  
  
(1)

(ii) molecule is not symmetrical **or**  
dipoles do not cancel out

(1)

(iii)  $\text{NH}_3$  has higher boiling point than expected from  $M_r$  value **or**  
has higher boiling point than methane  
**or**  $\text{NH}_3$  is soluble in water

(1) [4]

(c) three covalent  $\text{N}-\text{H}$  bonds  
one co-ordinate (dative covalent)  $\text{N}-\text{H}$  bond  
one ionic bond between  $\text{NH}_4^+$  and  $\text{Cl}^-$

(1)  
(1)  
(1) [3]

**[Total: 10]**

Page 3	Mark Scheme	Syllabus	Paper
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- 2 (a) (i) alkanes **or** paraffins **not** hydrocarbons (1)
- (ii)  $1\text{C}_9\text{H}_{20} + 14\text{O}_2 \rightarrow 9\text{CO}_2 + 10\text{H}_2\text{O}$  (1) [2]
- (b) (i) carbon (1)  
carbon monoxide (1)  
(names required)
- (ii) CO is toxic **or** affects or combines with haemoglobin  
**or** carbon causes respiratory problems (1)
- (iii)  $2\text{C}_{14}\text{H}_{30} + 15\text{O}_2 \rightarrow 28\text{C} + 30\text{H}_2\text{O}$  **or**  
 $2\text{C}_{14}\text{H}_{30} + 29\text{O}_2 \rightarrow 28\text{CO} + 30\text{H}_2\text{O}$   
**or** other balanced equations such as  
 $\text{C}_{14}\text{H}_{30} + 11\text{O}_2 \rightarrow 7\text{C} + 7\text{CO} + 15\text{H}_2\text{O}$   
 $\text{C}_{14}\text{H}_{30} + 18\text{O}_2 \rightarrow 7\text{CO} + 7\text{CO}_2 + 15\text{H}_2\text{O}$  (1) [4]
- (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) working **must** be shown
- (i) heat released =  $m c \delta T = 250 \times 4.18 \times 34.6$  (1)  
 $= 36157 \text{ J} = 36.2 \text{ kJ}$  (1)
- (ii)  $M_r$  of  $\text{C}_{14}\text{H}_{30} = 198$  (1)  
mass of  $\text{C}_{14}\text{H}_{30} = 1.00 \times 0.763 = 0.763 \text{ g}$  (1)  
0.763 g of  $\text{C}_{14}\text{H}_{30}$  produce 36.2 kJ  
198 g of  $\text{C}_{14}\text{H}_{30}$  produce  $\frac{36.2 \times 198}{0.763}$   
 $= 9394 \text{ kJ mol}^{-1}$  (1) [5]

[Total: 13]

Page 4	Mark Scheme	Syllabus	Paper
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3 (a) (i)

halogen	melting point/°C	colour
chlorine	-101	green, yellow <b>or</b> greenish-yellow
bromine	-7	orange <b>or</b> red <b>or</b> brown
iodine	114	grey <b>accept</b> black

chlorine and bromine **both** correct

(1)

iodine correct **for solid**

(1)

(ii) down the Group

there are more electrons in the molecule

(1)

hence stronger van der Waals' forces

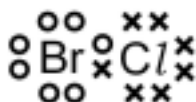
(1) [4]

(b) (i)

chlorine	$1s^2 2s^2 2p^6 3s^2 3p^5$
bromine	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^5$
<b>or</b>	$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^5$

**both** needed (1)

(ii)



(1) [2]

(c) (i) gas **or** low boiling liquid

(1)

$\text{BrCl}$  has fewer electrons than  $\text{Br}_2$

(1)

hence weaker van der Waals' forces

(1)

(ii) accept colours in the range yellow, orange, red, brown

(1) [4]

(d) (i) **initially** solution begins to turn yellow/brown

(1)

**after several minutes** black/dark grey solid formed

(1)

(ii)  $\text{Cl}_2 + 2\text{KI} \rightarrow 2\text{KCl} + \text{I}_2$

(1)

(iii)  $\text{BrCl} + 2\text{KI} \rightarrow \text{KCl} + \text{KBr} + \text{I}_2$

(1)

(iv) as oxidising agents

(1) [5]

**[Total: 15]**

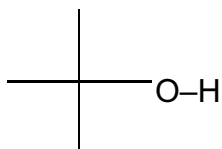
Page 5	Mark Scheme	Syllabus	Paper
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- 4 (a) (i) structural **or** functional group isomerism (1)
- (ii) **R** primary alcohol **and** carboxylic acid – **not** 'acid' (1)  
**S** primary alcohol **and** ester (1)  
**T** primary alcohol **and** ester (1)
- (iii) **with Na<sub>2</sub>CO<sub>3</sub>**  
carboxylic acid (1)
- (iv) **with Na**  
alcohol **and** carboxylic acid (1) [6]
- (b) (i)  $n(\text{CO}_2) = \frac{24.0}{24000} = 0.001 \text{ mol}$  (1)
- (ii) 0.002 mol of **Q** → 0.001 mol of CO<sub>2</sub>  
1 mol of **Q** → 0.5 mol of CO<sub>2</sub> (1) [2]
- (c) (i)  $n(\text{H}_2) = \frac{48.0}{24000} = 0.002 \text{ mol}$  (1)
- (ii) 0.002 mol of **Q** → 0.002 mol of H<sub>2</sub>  
1 mol of **Q** → 1 mol of H<sub>2</sub> (1) [2]
- (d) **Q** is isomer **R** (1)
- with sodium carbonate**  
 $2\text{HOCH}_2\text{CH}_2\text{CO}_2\text{H} + \text{Na}_2\text{CO}_3 \rightarrow 2\text{HOCH}_2\text{CH}_2\text{CO}_2\text{Na} + \text{H}_2\text{O} + \text{CO}_2$   
correct products (1)  
balanced (1)
- with sodium metal**  
 $\text{HOCH}_2\text{CH}_2\text{CO}_2\text{H} + 2\text{Na} \rightarrow \text{NaOCH}_2\text{CH}_2\text{CO}_2\text{Na} + \text{H}_2$   
correct products (1)  
balanced (1) [5]

[Total: 15]

Page 6	Mark Scheme	Syllabus	Paper
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5 (a)



(1) [1]

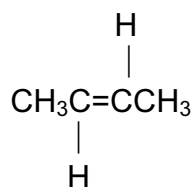
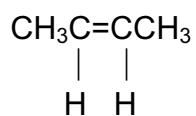
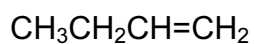
(b)

W	CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> CO <sub>2</sub> H
X	CH <sub>3</sub> CH <sub>2</sub> COCH <sub>3</sub>
Y	(CH <sub>3</sub> ) <sub>2</sub> CHCO <sub>2</sub> H
Z	no reaction

(4 × 1) [4]

(c) alcohol is **X** (no mark for this)

**products** are



(any two) [2]

**[Total: 7]**