

## **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.

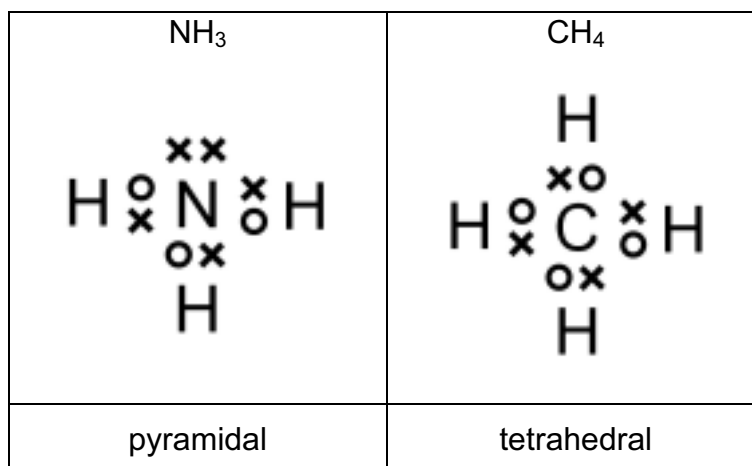
Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

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.

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1 (a)



both 'dot-and-cross' diagrams correct (1)  
 $\text{NH}_3$  is pyramidal **or** trigonal pyramidal (1)  
 $\text{CH}_4$  is tetrahedral (1) [3]

- (b) (i) nitrogen and hydrogen have different electronegativities (1)  
 $\text{N-H}$  bond has a dipole **or**  
 $\text{N}^{\delta-} - \text{H}^{\delta+}$  **or**  
bonding pair is unequally shared (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  $\text{N-H}$  bonds (1)  
one co-ordinate (dative covalent)  $\text{N-H}$  bond (1)  
one ionic bond between  $\text{NH}_4^+$  and  $\text{Cl}^-$  (1) [3]

[Total: 10]

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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 J = 36.2 kJ (1)
- (ii)  $M_r$  of  $\text{C}_{14}\text{H}_{30} = 198$  (1)  
mass of  $\text{C}_{14}\text{H}_{30} = 1.00 \times 0.763 = 0.763$  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 kJ mol<sup>-1</sup> (1) [5]

[Total: 13]

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3 (a) (i)

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

chlorine and bromine **both** correct (1)  
iodine correct **for solid** (1)

(ii) down the Group (1)  
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)  
BrCl has fewer electrons than Br<sub>2</sub> (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)  $Cl_2 + 2KI \rightarrow 2KCl + I_2$  (1)

(iii)  $BrCl + 2KI \rightarrow KCl + KBr + I_2$  (1)

(iv) as oxidising agents (1) [5]

**[Total: 15]**

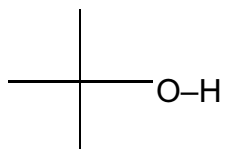
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- 4 (a) (i) structural **or** functional group isomerism (1)
- (ii) **R** primary alcohol **and** carboxylic acid – **not** 'acid' (1)  
**S** primary alcohol **and** ester (1)  
**T** primary alcohol **and** ester (1)
- (iii) **with Na<sub>2</sub>CO<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]

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5 (a)



(1) [1]

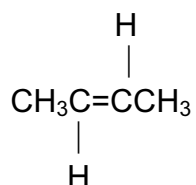
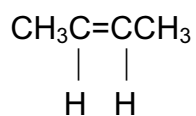
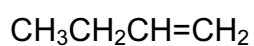
(b)

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]