CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2013 series

9701 CHEMISTRY

9701/23 Paper 2 (AS Structured Questions), maximum raw mark 60

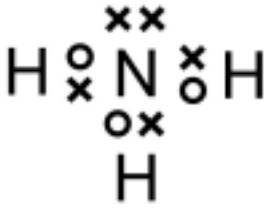
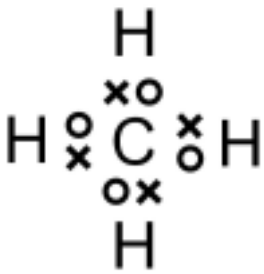
This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, 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.

1 (a)

NH_3	CH_4
	
pyramidal	tetrahedral

both 'dot-and-cross' diagrams correct (1)
NH_3 is pyramidal **or** trigonal pyramidal (1)
CH_4 is tetrahedral (1) [3]

(b) (i) nitrogen and hydrogen have different electronegativities (1)
N–H bond has a dipole **or**
$N^{\delta-}—H^{\delta+}$ **or**
bonding pair is unequally shared (1)

(ii) molecule is not symmetrical **or**
dipoles do not cancel out (1)

(iii) NH_3 has higher boiling point than expected from M_r value **or**
has higher boiling point than methane
or NH_3 is soluble in water (1) [4]

(c) three covalent N–H bonds (1)
one co-ordinate (dative covalent) N–H bond (1)
one ionic bond between NH_4^+ and Cl^- (1) [3]

[Total: 10]

2 (a) (i) alkanes **or** paraffins **not** hydrocarbons (1)

(ii) **1**C_9H_{20} + **14**O_2 → **9**CO_2 + **10**H_2O (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**$C_{14}H_{30}$ + **15**O_2 → **28**C + **30**H_2O **or**

2$C_{14}H_{30}$ + **29**O_2 → **28**CO + **30**H_2O

or other balanced equations such as

$C_{14}H_{30}$ + **11**O_2 → **7**C + 7CO + **15**H_20

$C_{14}H_{30}$ + **18**O_2 → **7**CO + 7CO_2 + **15**H_20 (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 δT = 250 × 4.18 × 34.6 (1)
= 36157 J = 36.2 kJ (1)

(ii) M_r of $C_{14}H_{30}$ = 198 (1)
mass of $C_{14}H_{30}$ = 1.00 × 0.763 = 0.763 g (1)
0.763 g of $C_{14}H_{30}$ produce 36.2 kJ
198 g of $C_{14}H_{30}$ produce $\frac{36.2 \times 198}{0.763}$
= 9394 kJ mol^{-1} (1) [5]

[Total: 13]

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 **accept** black

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

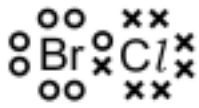
(ii) down the Group
there are more electrons in the molecule (1)
hence stronger van der Waals' forces (1) [4]

(b) (i)

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

both needed (1)

(ii)



(1) [2]

(c) (i) gas **or** low boiling liquid (1)
BrCl has fewer electrons than Br_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) $Cl_2 + 2KI \rightarrow 2KCl + I_2$ (1)

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

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

[Total: 15]

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_2CO_3**
carboxylic acid (1)

(iv) **with Na**
alcohol **and** carboxylic acid (1) [6]

(b) (i) $n(CO_2) = \frac{24.0}{24000} = 0.001$ mol (1)

(ii) 0.002 mol of **Q** $\rightarrow$ 0.001 mol of CO_2
1 mol of **Q** $\rightarrow$ 0.5 mol of CO_2 (1) [2]

(c) (i) $n(H_2) = \frac{48.0}{24000} = 0.002$ mol (1)

(ii) 0.002 mol of **Q** $\rightarrow$ 0.002 mol of H_2
1 mol of **Q** $\rightarrow$ 1 mol of H_2 (1) [2]

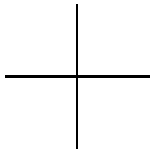
(d) **Q** is isomer **R** (1)

with sodium carbonate
$\mathbf{2}HOCH_2CH_2CO_2H + Na_2CO_3 \rightarrow \mathbf{2}\ HOCH_2CH_2CO_2Na + H_2O + CO_2$
correct products (1)
balanced (1)

with sodium metal
$HOCH_2CH_2CO_2H + \mathbf{2}Na \rightarrow NaOCH_2CH_2CO_2Na + H_2$
correct products (1)
balanced (1) [5]

[Total: 15]

5 (a)



(1) [1]

(b)

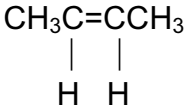
W	$CH_3CH_2CH_2CO_2H$
X	$CH_3CH_2COCH_3$
Y	$(CH_3)_2CHCO_2H$
Z	no reaction

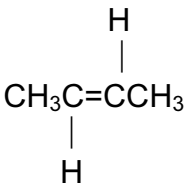
(4 × 1) [4]

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

products are

$CH_3CH_2CH=CH_2$





(any two) [2]

[Total: 7]