**UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS**

**GCE Advanced Subsidiary Level and GCE Advanced Level**

# MARK SCHEME for the May/June 2010 question paper

# for the guidance of teachers

## 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.

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**1** **(a)** enthalpy change when 1 mol of a compound is formed (1)
from its elements (1)
in their standard states under standard conditions (1) [3]

**(b)** **(i)**

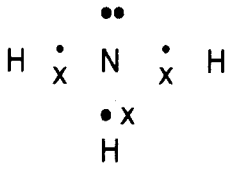
| | $N_2H_4(l)$ + | $O_2(g)$ → | $N_2(g)$ + | $2H_2O(g)$ |
|---|---|---|---|---|
| $\Delta H_f^o$/kJ mol$^{-1}$ | +50.6 | | | –241.8 |

$\Delta H^o_{reaction}$ = 2(–241.8) – (+50.6) (1)
= –534.2 kJ mol$^{-1}$ (1)

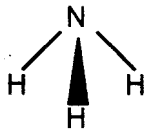
**(ii)** $E_a$ is too high (1)

**(iii)** products are $H_2O$ and $N_2$ which are harmless/non toxic
**or** are already present in the atmosphere (1) [4]

**(c)** **(i)** 'dot-and-cross' diagram (1)

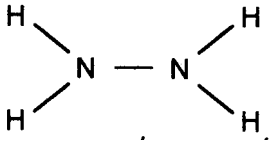



**(ii)**




(1)

**(iii)** minimum is




allow bond angle around N atom between 109$^o$ and 104$^o$ (1) [4]

**(d)** –2 (1) [1]

**[Total: 12]**

**2** **(a)** the energy required to remove one electron from each atom (1)
in one mole of gaseous atoms (1)
**or**
the enthalpy change in kJ $mol^{-1}$ for (1)
$M(g) \rightarrow M^+(g) + e^-$ (1) [2]

**(b)** **(i)** first ionisation energy decreases down Group 1 (1)
outermost electron is further from nucleus
or has greater shielding (1)

**(ii)** outermost electron experiences less attraction
**or** formation of $M^+$ cation becomes easier down Group 1 (1) [3]

**(c)** **(i)** $n(Li) = \frac{0.83}{6.9} = 0.12$ (1)

**(ii)** 2 mol Li $\rightarrow$ 1 mol $H_2$
0.12 mol Li $\rightarrow \frac{1 \times 0.12}{2} = 0.06$ mol $H_2$ (1)
volume of $H_2 = 0.06 \times 24.0 = 1.44 dm^3$ (1)

**(iii)** 2 mol Li $\rightarrow$ 2 mol LiOH
0.12 mol Li $\rightarrow$ 0.12 mol LiOH in 0.50 $dm^3$ (1)
$[LiOH] = \frac{0.12 \times 1}{0.50} = 0.24$ mol $dm^{-3}$ (1) [5]

**(d)** sodium burns with a yellow flame
**or** white solid formed
**or** colour of chlorine disappears (1)

$2Na + Cl_2 \rightarrow 2NaCl$ (1) [2]

**[Total: 12]**

**3** **(a)** **(i)** Ca (1)

**(ii)** S **or** C [allow H ($H_2O_2$) or N (NO, $NO_2$)] (1)

**(iii)** He (1)

**(iv)** A*l* (1)

**(v)** Si **or** Ge (1)

**(vi)** A*l* (1) [6]

**(b)** any **two** from N **or** O **or** F (1) [1]

**(c)** **(i)** $Al_2O_3$ **or** $SiO_2$ (1)

**(ii)** $SO_2$ **or** $P_2O_3/P_4O_6$ (1)
and and
$SO_3$ **or** $P_2O_5/P_4O_{10}$ (1)

**(iii)** $Na_2O$ (1)

**(iv)** $Al_2O_3$ (1) [5]

**[Total: 12]**

**4** **(a)** **reaction 1** free radical substitution (1)

**reaction 2** elimination (1) [2]

**(b)** **(i)** in reaction 4 $CH_3C(OH)(CN)CH_3$ (1)

**(ii)** in reaction 3 $I^-$ (1)

**(iii)** in reaction 3 $CH_3I$
**or** in reaction 4 $CH_3COCH_3$ (1) [3]

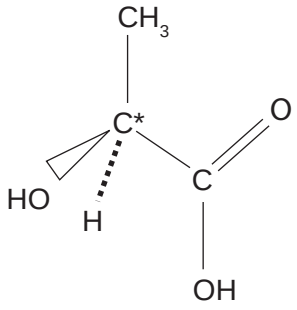
**(c)** a species which has a lone pair of electrons
**or** which reacts with an electron deficient ($\delta$+) centre in a molecule (1) [1]

**(d)** in reaction 3 $OH^-$ (1)
in reaction 4 $CN^-$ (1) [2]

**(e)** $\pi$ bonding is electron rich (1) [1]

**[Total: 9]**

**5 (a)**




[3]

**(b)**

| | reagent(s) | condition(s) |
|---|---|---|
| step 1 | $Cr_2O_7^{2-}$ / $H^+$ (1) | distil off aldehyde (1) |
| step 2 | HCN in presence of $CN^-$ **or** KCN + dil $H_2SO_4$ (1) | room temperature (1) |
| step 3 | aqueous mineral acid/ /$H_2SO_4$/HC/ **not** $HNO_3$ (1) | heat under reflux (1) |

in **each** case, the reagent must be correct before the condition mark is awarded [6]

**(c) (i)** a protein (1)

**(ii)** 2,4-dinitrophenylhydrazine/Brady's reagent (1)
yellow-orange-red ppt. (1)

**(iii)** acidified $K_2Cr_2O_7$ **or** Lucas test **or** $CH_3CO_2H/H^+$ (1)
colour changes **or** cloudiness **or** fruity smell
from orange to green (1)

**(iv)** LiA/$H_4$/$NaBH_4$
**or** $H_2$/Ni etc. (1) [6]

**[Total: 15]**