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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UNIVERSITY of CAMBRIDGE
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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)**

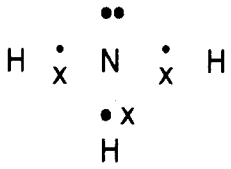
	$N_2H_4(l)$ +	$O_2(g)$ →	$N_2(g)$ +	$2H_2O(g)$
ΔH_f^o/kJ mol^{-1}	+50.6			–241.8

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

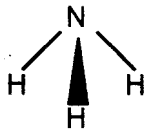
(ii) E_a is too high (1)

(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)

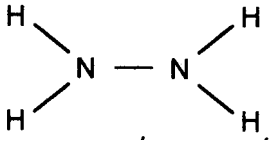


(ii)



(1)

(iii) minimum is



allow bond angle around N atom between 109° and 104° (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]

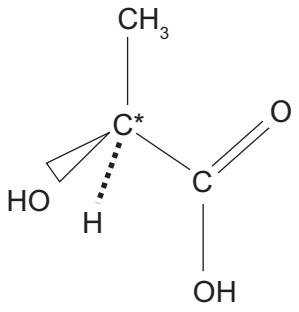
(c) a species which has a lone pair of electrons
or which reacts with an electron deficient (δ+) centre in a molecule (1) [1]

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

(e) π 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/HCl/ **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]