

**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.

Mark schemes must be read in conjunction with the question papers and the report on the examination.

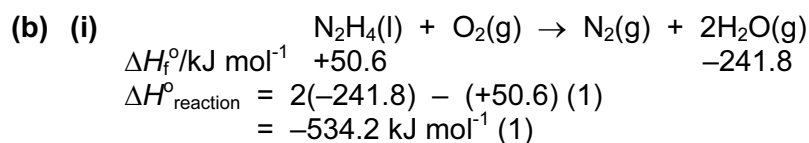
- CIE will not enter into discussions or correspondence in connection with these mark schemes.

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Page 2	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE AS/A LEVEL – May/June 2010	9701	23

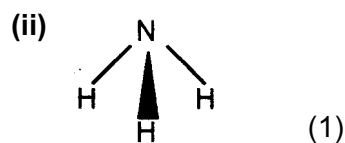
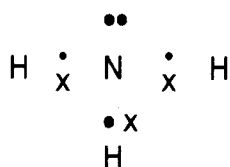
- 1 (a) enthalpy change when 1 mol of a compound is formed (1)
 from its elements (1)
 in their standard states under standard conditions (1) [3]



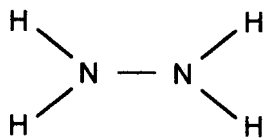
(ii) E_a is too high (1)

(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)



(iii) minimum is



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

(d) -2 (1) [1]

[Total: 12]

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	GCE AS/A LEVEL – May/June 2010	9701	23

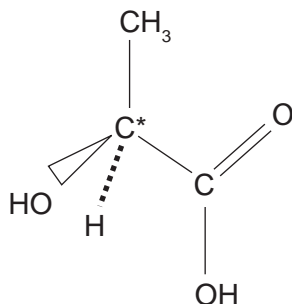
- 2 (a) the energy required to remove one electron from each atom (1)
in one mole of gaseous atoms (1)
or
the enthalpy change in kJ mol^{-1} for (1)
 $\text{M(g)} \rightarrow \text{M}^+(\text{g}) + \text{e}^-$ (1) [2]
- (b) (i) first ionisation energy decreases down Group 1 (1)
outermost electron is 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) $n(\text{Li}) = \frac{0.83}{6.9} = 0.12$ (1)
- (ii) $2 \text{ mol Li} \rightarrow 1 \text{ mol H}_2$
 $0.12 \text{ mol Li} \rightarrow \frac{1 \times 0.12}{2} = 0.06 \text{ mol H}_2$ (1)
volume of $\text{H}_2 = 0.06 \times 24.0 = 1.44 \text{ dm}^3$ (1)
- (iii) $2 \text{ mol Li} \rightarrow 2 \text{ mol LiOH}$
 $0.12 \text{ mol Li} \rightarrow 0.12 \text{ mol LiOH in } 0.50 \text{ dm}^3$ (1)
 $[\text{LiOH}] = \frac{0.12 \times 1}{0.50} = 0.24 \text{ mol dm}^{-3}$ (1) [5]
- (d) sodium burns with a yellow flame
or white solid formed
or colour of chlorine disappears (1)
- $2\text{Na} + \text{Cl}_2 \rightarrow 2\text{NaCl}$ (1) [2]

[Total: 12]

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	GCE AS/A LEVEL – May/June 2010	9701	23

- 3 (a) (i)** Ca (1)
- (ii) S **or** C [allow H (H₂O₂) or N (NO, NO₂)] (1)
- (iii) He (1)
- (iv) Al (1)
- (v) Si **or** Ge (1)
- (vi) Al (1) [6]
- (b)** any **two** from N **or** O **or** F (1) [1]
- (c) (i)** Al₂O₃ **or** SiO₂ (1)
- (ii) SO₂ **or** P₂O₃/P₄O₆ (1)
and and
SO₃ **or** P₂O₅/P₄O₁₀ (1)
- (iii) Na₂O (1)
- (iv) Al₂O₃ (1) [5]
- [Total: 12]**
- 4 (a) reaction 1** free radical substitution (1)
- reaction 2** elimination (1) [2]
- (b) (i)** in reaction 4 CH₃C(OH)(CN)CH₃ (1)
- (ii) in reaction 3 I⁻ (1)
- (iii) in reaction 3 CH₃I
or in reaction 4 CH₃COCH₃ (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	$\text{Cr}_2\text{O}_7^{2-} / \text{H}^+$ (1)	distil off aldehyde (1)
step 2	HCN in presence of CN^- or $\text{KCN} + \text{dil H}_2\text{SO}_4$ (1)	room temperature (1)
step 3	aqueous mineral acid/ $\text{H}_2\text{SO}_4/\text{HCl}/$ 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 $\text{K}_2\text{Cr}_2\text{O}_7$ or Lucas test or $\text{CH}_3\text{CO}_2\text{H}/\text{H}^+$ (1)
colour changes or cloudiness or fruity smell
from orange to green (1)

(iv) $\text{LiAlH}_4/\text{NaBH}_4$
or H_2/Ni etc. (1)

[6]

[Total: 15]