

**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.

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

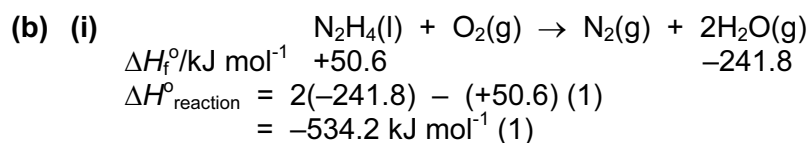
- CIE will not enter into discussions or correspondence in connection with these mark schemes.

CIE is publishing the mark schemes for the May/June 2010 question papers for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.



| Page 2 | Mark Scheme: Teachers' version | Syllabus | Paper |
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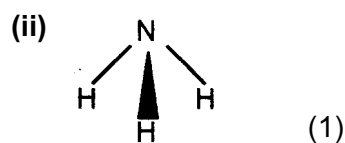
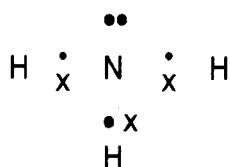
- 1 (a) enthalpy change when 1 mol of a compound is formed (1)  
 from its elements (1)  
 in their standard states under standard conditions (1) [3]



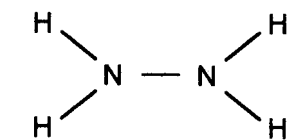
(ii)  $E_a$  is too high (1)

(iii) products are  $\text{H}_2\text{O}$  and  $\text{N}_2$  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  $109^\circ$  and  $104^\circ$  (1) [4]

(d)  $-2$  (1) [1]

[Total: 12]

| Page 3 | Mark Scheme: Teachers' version | Syllabus | Paper |
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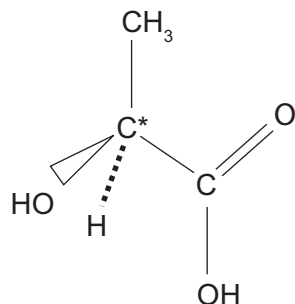
- 2 (a) the energy required to remove one electron from each atom (1)  
in one mole of gaseous atoms (1)  
**or**  
the enthalpy change in  $\text{kJ mol}^{-1}$  for (1)  
 $\text{M(g)} \rightarrow \text{M}^{\text{+}}(\text{g}) + \text{e}^{-}$  (1) [2]
- (b) (i) first ionisation energy decreases down Group 1 (1)  
outermost electron is further from nucleus  
or has greater shielding (1)
- (ii) outermost electron experiences less attraction  
**or** formation of  $\text{M}^{\text{+}}$  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]

| Page 4 | Mark Scheme: Teachers' version | Syllabus | Paper |
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- 3 (a) (i) Ca (1)
- (ii) S or C [allow H (H<sub>2</sub>O<sub>2</sub>) or N (NO, NO<sub>2</sub>)] (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) Al<sub>2</sub>O<sub>3</sub> or SiO<sub>2</sub> (1)
- (ii) SO<sub>2</sub> or P<sub>2</sub>O<sub>3</sub>/P<sub>4</sub>O<sub>6</sub> (1)  
and and  
SO<sub>3</sub> or P<sub>2</sub>O<sub>5</sub>/P<sub>4</sub>O<sub>10</sub> (1)
- (iii) Na<sub>2</sub>O (1)
- (iv) Al<sub>2</sub>O<sub>3</sub> (1) [5]
- [Total: 12]
- 4 (a) reaction 1 free radical substitution (1)
- reaction 2 elimination (1) [2]
- (b) (i) in reaction 4 CH<sub>3</sub>C(OH)(CN)CH<sub>3</sub> (1)
- (ii) in reaction 3 I<sup>-</sup> (1)
- (iii) in reaction 3 CH<sub>3</sub>I  
or in reaction 4 CH<sub>3</sub>COCH<sub>3</sub> (1) [3]
- (c) a species which has a lone pair of electrons  
or which reacts with an electron deficient (δ<sup>+</sup>) centre in a molecule (1) [1]
- (d) in reaction 3 OH<sup>-</sup> (1)  
in reaction 4 CN<sup>-</sup> (1) [2]
- (e) π bonding is electron rich (1) [1]
- [Total: 9]

5 (a)



[3]

(b)

|        | reagent(s)   | condition(s)               |
|--------|--|----------------------------|
| step 1 | $\text{Cr}_2\text{O}_7^{2-} / \text{H}^+$<br>(1)   | distil off aldehyde<br>(1) |
| step 2 | HCN in presence of $\text{CN}^-$<br><b>or</b><br>$\text{KCN} + \text{dil H}_2\text{SO}_4$<br>(1) | room temperature<br>(1)    |
| step 3 | aqueous mineral acid/ $\text{H}_2\text{SO}_4/\text{HCl}/$<br><b>not</b> $\text{HNO}_3$<br>(1)    | heat under reflux<br>(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**  $\text{H}_2/\text{Ni}$  etc. (1)

[6]

[Total: 15]