

**UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS**

GCE Advanced Subsidiary and Advanced Level

**MARK SCHEME for the November 2004 question paper**

**9701 CHEMISTRY**

**9701/02**

**Paper 2 (Structured Questions), maximum raw mark 60**

This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. This shows the basis on which Examiners were initially instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began. Any substantial changes to the mark scheme that arose from these discussions will be recorded in the published *Report on the Examination*.

All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes must be read in conjunction with the question papers and the *Report on the Examination*.

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

CIE is publishing the mark schemes for the November 2004 question papers for most IGCSE and GCE Advanced Level syllabuses.

**Grade thresholds** taken for Syllabus 9701 (Chemistry) in the November 2004 examination.

	maximum mark available	minimum mark required for grade:		
		A	B	E
Component 2	60	45	39	25

The thresholds (minimum marks) for Grades C and D are normally set by dividing the mark range between the B and the E thresholds into three. For example, if the difference between the B and the E threshold is 24 marks, the C threshold is set 8 marks below the B threshold and the D threshold is set another 8 marks down. If dividing the interval by three results in a fraction of a mark, then the threshold is normally rounded down.

November 2004

GCE A AND AS LEVEL

**MARK SCHEME**

**MAXIMUM MARK: 60**

**SYLLABUS/COMPONENT: 9701/02**

**CHEMISTRY**  
**Paper 2 (Structured Questions)**

Page 1	Mark Scheme	Syllabus	Paper
	A and AS LEVEL – NOVEMBER 2004	9701	2

1 (a)  $K_c = \frac{[H_2][I_2]}{[HI]^2}$  (1) [1]

(b)  $K_c = \frac{0.274 \times 0.274}{(1.47)^2} = 0.035$  (1) [1]

(c) At room temperature:

iodine is a solid/solids not  $K_c$  expression (1)

$[I_2(g)]$  is small/concn too small to be measured (1)

it takes longer to reach equilibrium/reaction is slower (1) [2 max]

(d) (i)  $\Delta H_{\text{reacn}} = \Delta H \text{ for bonds broken} - \Delta H \text{ for bonds made}$  (1)

(ii)  $2H-I \rightarrow H-H + I-I$

$2 \times 299$                       436 151 values (1)

$\Delta H = 2 \times 299 - (436 + 151)$

$= + 11 \text{ kJ mol}^{-1}$  (1) [3]

(e) (i) An acid that is completely ionised (1)

(ii)  $HI + H_2O \rightarrow H_3O^+ + I^-$

(iii)  $I^-$  (1) [3]

[Total 10]

2 (a)  $4Al + 3O_2 \rightarrow 2Al_2O_3$  (1) [1]

(b) some answers may contain diagrams which are equivalent to the words given below

(i)  $Al_2O_3$  has a giant structure of ions ( $Al^{3+}$  and  $O^{2-}$ ) (1)

held together by strong ionic bonds (1)

or a giant structure of atoms (1)

with strong covalent bonding throughout the lattice (1) (2 max)

(ii)  $SO_3$  consists of small molecules

or is simple molecular

not simple covalent (1)

held together by weak van Waals' forces (1)

Page 2	Mark Scheme	Syllabus	Paper
	A and AS LEVEL – NOVEMBER 2004	9701	2

(iii)  $\text{SiO}_2$  is giant covalent/macromolecular (1)

with strong covalent bonds (1)

$\text{P}_4\text{O}_{10}$  is a simple molecular (as in  $\text{SO}_3$ ) (1)

[7]

(c) (i)  $\text{Na}_2\text{O} + \text{H}_2\text{O} \rightarrow \text{NaOH}$

or  $\text{MgO} + \text{H}_2\text{O} \rightarrow \text{Mg(OH)}_2$  (1)

(ii)  $\text{P}_4\text{O}_{10} + 6\text{H}_2\text{O} \rightarrow 4\text{H}_3\text{PO}_4$

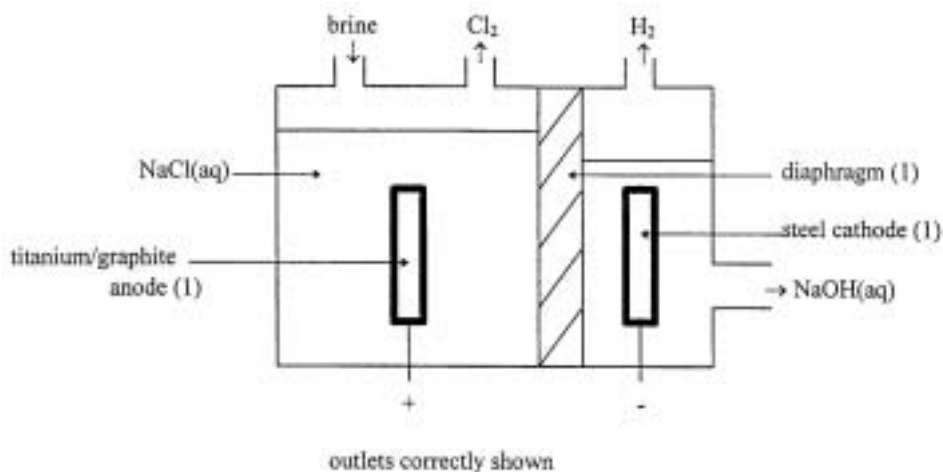
or  $\text{P}_4\text{O}_{10} + 2\text{H}_2\text{O} \rightarrow 4\text{HPO}_3$

or  $\text{SO}_3 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{SO}_4$  (1)

[2]

[Total 10]

3 (a) (i)



[4]

(ii) **anode**  $2\text{Cl}^-(\text{aq}) \rightarrow \text{Cl}_2(\text{g}) + 2\text{e}^-$

**cathode**  $2\text{H}^+(\text{aq}) + 2\text{e}^- \rightarrow \text{H}_2(\text{g})$  (1)

or  $2\text{H}_2\text{O}(\text{l}) + 2\text{e}^- \rightarrow \text{H}_2(\text{g}) + 2\text{OH}^-(\text{aq})$  (1)

[2]

(iii) **anode** Cl goes from -1 to 0 (1)

**cathode** H goes from -1 to 0 (1)

[2]

(iv) sodium hydroxide (answer may be on diagram) (1)

[1]

Page 3	Mark Scheme	Syllabus	Paper
	A and AS LEVEL – NOVEMBER 2004	9701	2

(v) manufacture of

soap                      detergents

paper                      degreasing fluids

rayon                      aluminium

glass                      dyes

bleach/ $\text{NaClO}$ /Javel/Jik/Jenola

any 2 [1]

(b) (i)  $\text{H}_2 + \text{Cl}_2 \rightarrow 2\text{HCl}$  (1)

(ii)  $\text{HCl} + \text{H}_2\text{O} \rightarrow \text{H}_3\text{O}^+ + \text{Cl}^-$  (1)

thus bonding goes from covalent to ionic

[2]

(c) (i)  $\text{AgNO}_3(\text{aq}) + \text{HCl}(\text{aq}) \rightarrow \text{AgCl}(\text{s}) + \text{HNO}_3(\text{aq})$

or  $\text{Ag}^+(\text{aq}) + \text{Cl}^-(\text{aq}) \rightarrow \text{AgCl}(\text{s})$  (1)

white ppt. forms (1)

(ii) ppt. dissolves to give colourless solution (1)

$\text{AgCl}(\text{s}) + 2\text{NH}_3(\text{aq}) \rightarrow [\text{Ag}(\text{NH}_3)_2]^+(\text{aq}) + \text{Cl}^-(\text{aq})$

or  $\text{Ag}^+(\text{aq}) + 2\text{NH}_3(\text{aq}) \rightarrow [\text{Ag}(\text{NH}_3)_2]^+(\text{aq})$  (1)

Correct state symbols in **either (i) or (ii)** (1)

[5]

[Total 17]

4 (a) (i)  $\text{C}_{10}\text{H}_{20}\text{O}$  (1)

(ii) 156

allow e.c.f. on (a) (i) (1)

[2]

(b) (i) primary (1)

alcohol (1)

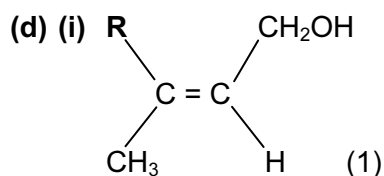
(ii) alkene (1)

[3]

(c) carbon atom number 6 circled (1)

[1]

Page 4	Mark Scheme	Syllabus	Paper
	A and AS LEVEL – NOVEMBER 2004	9701	2

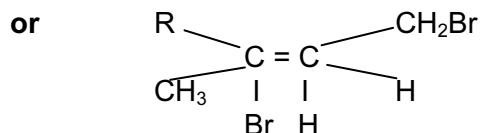
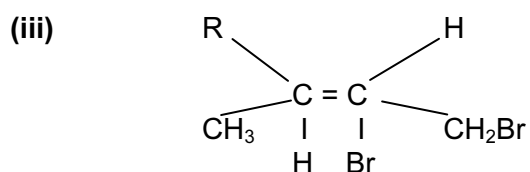
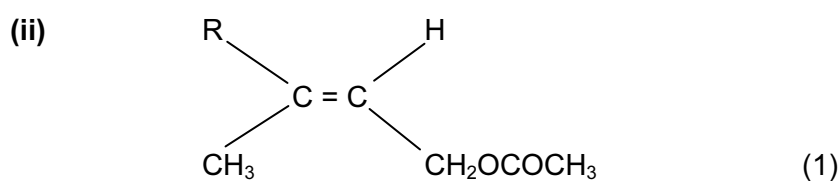
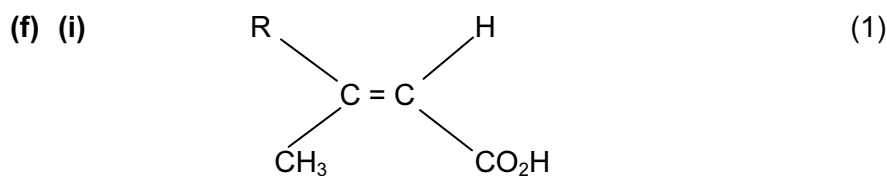


(ii) it does not have chiral C atom (1)

[2]

(e) bromine is decolourised (1)

[1]

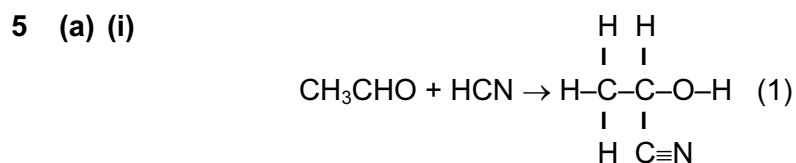


correct addition of HBr (1)

substitution of  $-\text{CH}_2\text{OH}$  by Br (1)

[4]

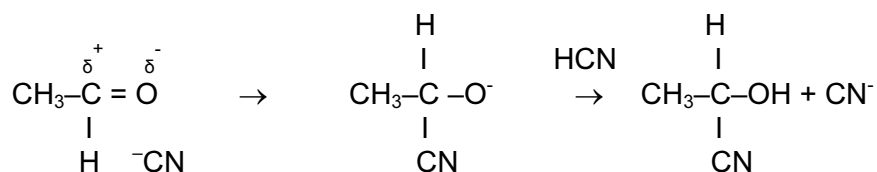
[Total 13]



(ii) nucleophilic addition (1)

Page 5	Mark Scheme	Syllabus	Paper
	A and AS LEVEL – NOVEMBER 2004	9701	2

(iii)



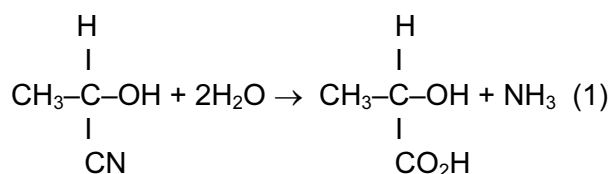
C = O dipole correctly shown (1)

attack on C<sup>δ+</sup> by CN<sup>-</sup> (1)

correct intermediate/correct curly arrow on C = O (1)

CN<sup>-</sup> regenerated (1)**[5 max]**

(b) (i)



(ii) hydrolysis (1)

**[2]**(c) CH<sub>3</sub>CHO → CH<sub>3</sub>CH(OH)CO<sub>2</sub>H

44

90

both M<sub>r</sub> values correct (1)

4.40 g → 9.00 g

$$\% \text{ yield} = \frac{5.40 \times 100}{9.00}$$

expression (1)

= 60%

value (1)

**[3]****[Total 10]**