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*.

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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)

UNIVERSITY of CAMBRIDGE
International Examinations

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

(b) $K_c = \dfrac{0.274 \times 0.274}{(1.47)^2} = 0.035$ (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)** ΔH_{reacn} = ΔH for bonds broken – ΔH for bonds made (1)

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

2 x 299 436 151 values (1)

ΔH = 2 x 299 – (436 + 151)

= + 11 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)

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(iii) SiO_2 is giant covalent/macromolecular (1)

with strong covalent bonds (1)

P_4O_{10} is a simple molecular (as in SO_3) (1) **[7]**

(c) (i) $Na_2O + H_2O \rightarrow NaOH$

or $MgO + H_2O \rightarrow Mg(OH)_2$ (1)

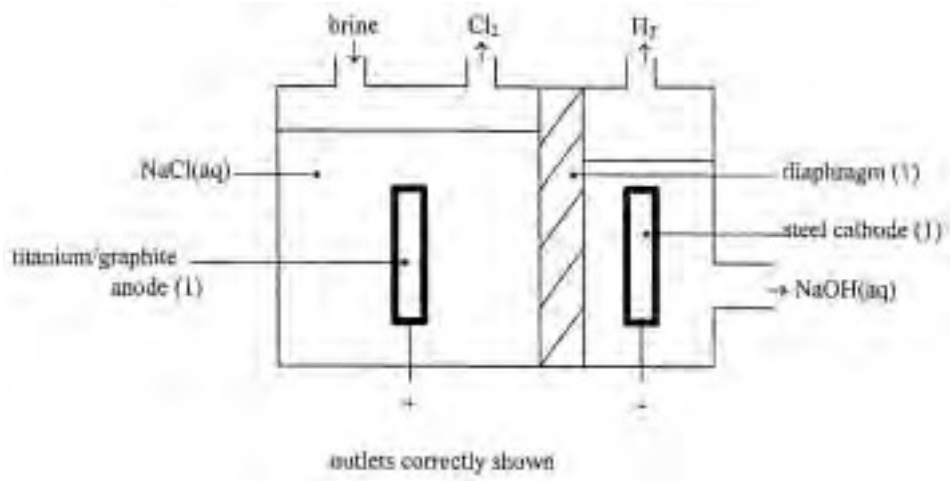
(ii) $P_4O_{10} + 6H_2O \rightarrow 4H_3PO_4$

or $P_4O_{10} + 2H_2O \rightarrow 4HPO_3$

or $SO_3 + H_2O \rightarrow H_2SO_4$ (1) **[2]**

[Total 10]

3 (a) (i)



[4]

(ii) anode $2Cl^-(aq) \rightarrow Cl_2(g) + 2e^-$

cathode $2H^+(aq) + 2e^- \rightarrow H_2(g)$ (1)

or $2H_2O(l) + 2e^- \rightarrow H_2(g) + 2OH^-(aq)$ (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]**

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(v) manufacture of

soap detergents

paper degreasing fluids

rayon aluminium

glass dyes

bleach/NaC*l*O/Javel/Jik/Jenola **any 2 [1]**

(b) (i) $H_2 + Cl_2 \rightarrow 2HCl$ (1)

(ii) $HCl + H_2O \rightarrow H_3O^+ + Cl^-$ (1)

thus bonding goes form covalent to ionic **[2]**

(c) (i) $AgNO_3(aq) + HCl(aq) \rightarrow AgCl(s) + HNO_3(aq)$

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

white ppt. forms (1)

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

$AgCl(s) + 2NH_3(aq) \rightarrow [Ag(NH_3)_2]\,Cl(aq)$

or $Ag^+(s) + 2NH_3(aq) \rightarrow [Ag(NH_3)_2]^+(aq)$ (1)

Correct state symbols in **either (i) or (ii) (**1) **[5]**

[Total 17]

4 (a) (i) $C_{10}H_{20}O$ (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]**

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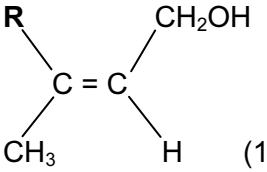
(d) (i)

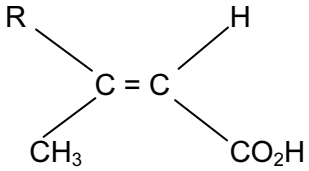


(1)

(ii) it does not have chiral C atom (1) **[2]**

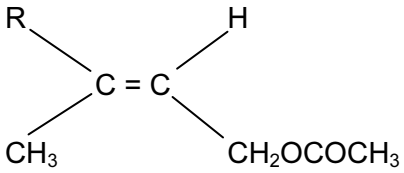
(e) bromine is decolourised (1) **[1]**

(f) (i)



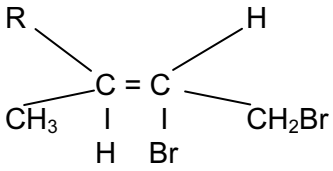
(1)

(ii)

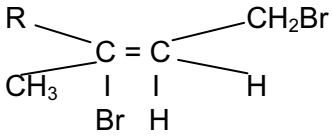


(1)

(iii)



or

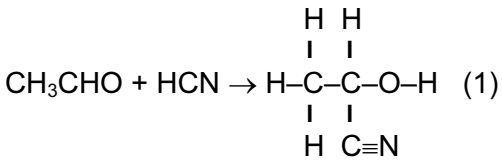


correct addition of HBr (1)

substitution of -CH_2OH by Br (1) **[4]**

[Total 13]

5 (a) (i)



(1)

(ii) nucleophilic addition (1)

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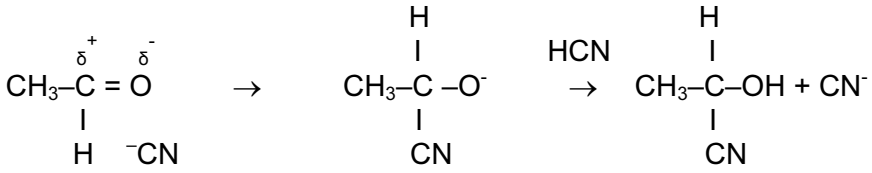
(iii)



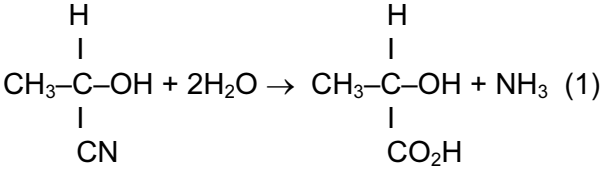
C = O dipole correctly shown (1)

attack on C $^{\delta+}$ by CN^- (1)

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

CN^- regenerated (1) **[5 max]**

(b) (i)



(ii) hydrolysis (1) **[2]**

(c) $CH_3CHO \rightarrow CH_3CH(OH)CO_2H$

44 90 **both** M_r values correct (1)

4.40 g → 9.00 g

% yield = $\frac{5.40 \times 100}{9.00}$ expression (1)

= 60% value (1) **[3]**

[Total 10]

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