INTERNATIONAL BACCALAUREATE
BACCALAURÉAT INTERNATIONAL
BACHILLERATO INTERNACIONAL

MARKSCHEME

May 2000

CHEMISTRY

Standard Level

Paper 2

10 pages

SECTION A

1. (a) $K_c = \dfrac{[H^+][CN^-]}{[HCN]}$ ***[2]***

*(Award **[1 mark]** for products as numerator reactants as denominator; award **[1 mark]** for correct symbols.)*

(b) $HCN > CH_3COOH > HF > HCl$ ***[1]***

(c) $HCl < HF < CH_3COOH < HCN$ ***[1]***

(d) H^+ / H_3O^+, CH_3COO^-, CH_3COOH ***[1]***

(e) Fluoride, ***[1]***
F^- ***[1]***

(f) Measure conductivity ***[1]***
greater for HCl ***[1]***

OR Chemical reaction
e.g. add magnesium metal to each solution ***[1]***
more vigorous reaction with HCl ***[1]***

2. (a) Either: remove one electron ***[1]***
gaseous/free atoms ***[1]***

Or: $\underline{Na\,(g)} \rightarrow \underline{Na^+(g)} + \underline{e^-}$ (or e) ***[2]***

*(Deduct **[1 mark]** for each underlined term omitted.)*

(b) Decreases. ***[1]***

(c) K ***[1]***

Outer electron is furthest from the nucleus/it has the lowest IE/outer electron is least strongly attracted. ***[1]***

(d) Greater/higher ***[1]***
Second electron is nearer to the nucleus/in a lower energy level, more difficult to remove. ***[1]***

3. (a) Increases. ***[1]***

(b) Pressure doubles. ***[1]***

Since double the number of collisions ***[1]***
on the walls of the container. ***[1]***

SECTION B

4. (a) (i) Mg, Fe, Cu, Ag *[1]*

(ii) Loss/removal of electrons; *[1]*
Fe/Cu/Mg *[1]*

(iii) Reduction/decrease in oxidation number; *[1]*
Cu^{2+} / Ag^{+} / Fe^{2+} *[1]*

(iv) Mg *[1]*

It reduces Fe^{2+}; Fe reduces Cu^{2+}; Cu reduces Ag^{+}. *[1]*

OR It reduces Fe^{2+} to Fe, which can then reduce everything else. *[1]*

OR It is the most reactive (of the metals shown). *[1]*

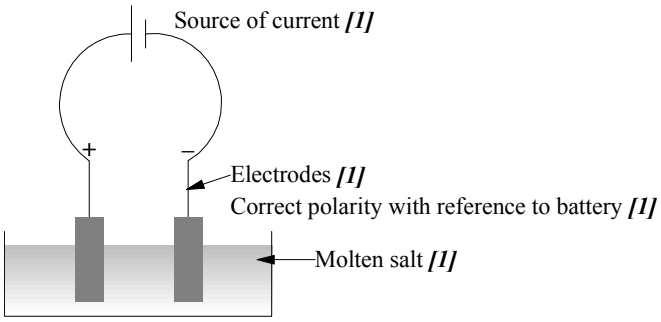
(v) Ag^{+} *[1]*

Every metal present can reduce it to Ag. *[1]*

(vi) Does not react *[1]*

It has too low an electrode potential/too low in reactivity series/less reactive than Mg. *[1]*

(b)



(c) At the cathode; *[1]*
electrons are given to the cations/positive ions; *[1]*
electrons are removed from the anions/negative ions; *[1]*
(at the anode)
copper formed (at the cathode); *[1]*
chlorine formed (at the anode); *[1]*

Summary: electron loss *[1]* electron gain *[1]*
copper formed *[1]* chlorine formed *[1]*
related to correct electrode in **one** case *[1]*
(*e.g.* Cu at cathode **OR** Cu^{2+} gains $2e^{-}$ at cathode.)

5. (a) (i) Enthalpy of products – enthalpy of reactants *[1]*
Specified temperature (*e.g.* 298 K) *[1]*
Specified pressure (*e.g.* 1.013×10^5 Pa) *[1]*

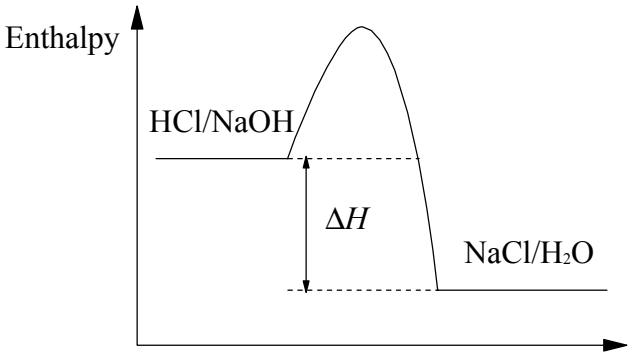
(ii) Take a **known volume** of sodium hydroxide solution *[1]*
of **known molarity/concentration** *[1]*
record its temperature *[1]*
and place in an **insulated vessel**. *[1]*
Add a solution of HCl, of known temperature, such that an **equal/excess number of moles is added**. *[1]*
Stir/mix, *[1]*
record the maximum **rise in temperature**. *[1]*

Need: Temperature rise *[1]*.
ΔH = Total mass (or volume) × temperature rise × specific heat capacity *[1]*

Divide by number of moles (of limiting reactant if excess or of other reactant used) *[1]* (*i.e.* factor to convert to 1 mole).

(Any 9 points)

(iii)



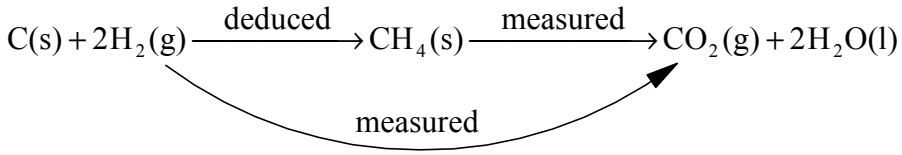
Overall diagram: enthalpy label and two different levels; *[1]*
labelled enthalpy levels – $NaCl / H_2O$ must be lower; *[1]*
enthalpy change shown; *[1]*
products more stable than reactants/reaction exothermic. *[1]*

continued…

Question 5 continued

(b) Hess's Law enables enthalpy changes which cannot be found experimentally to be calculated from other experimental results. ***[1]***
Suitable example; ***[1]***
Intermediate stage shown; ***[1]***
Show which enthalpies can be measured, hence which deduced. ***[1]***

Example:



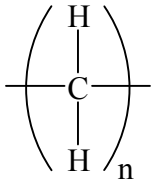
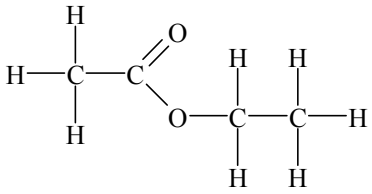
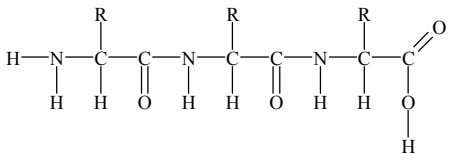
(Award 1st mark for overall equation, i.e. example; award 2nd mark for intermediate; award 3rd mark for showing ΔH_f deduced from enthalpies of combustion.)

6. (a) Butane has a higher boiling point than ethane since the molecule is **larger/heavier/greater M_r** ***[1]***
and so has **greater intermolecular**/Van der Waals' forces. ***[1]***
Ethane is non-polar whereas bromoethane is polar ***[1]***
and **larger/heavier/greater M_r** ***[1]***
so has greater intermolecular forces/Van der Waals' forces ***[1]***
which **require more energy to break**. ***[1]***
Ethanol is **more polar** than bromoethane ***[1]***
and has **hydrogen bonding** which requires more energy to break. ***[1]***

Note: "Intermolecular forces," "Van der Waals' forces," "more energy needed" should be credited **once** only for **any** of the 3 pairs.

(N.B. Maximum of 8 marking points taken from the 3 pairs.)

(b)

	Type of reaction	Reagent	Conditions	Structural formula
(i)	addition ***[1]***	—	high pressure initiator ***[2×1]***	 ***[1]***
(ii)	esterification ***[1]***	ethanoic acid ***[1]***	heat/reflux **OR** H_2SO_4 ***[1]***	 ***[1]***
(iii)	condensation ***[1]***	—	heat ***[1]***	 ***[1]*** for CONH bond ***[1]*** for rest of molecule