INTERNATIONAL BACCALAUREATE
BACCALAURÉAT INTERNATIONAL
BACHILLERATO INTERNACIONAL

MARKSCHEME

November 2000

CHEMISTRY

Standard Level

Paper 2

SECTION A

1. (a) (i) pH = 2.6 (accept 2.5 to 2.7) ***[1]***

(ii) pH = 2.0 (accept 2) ***[1]***

$[H^+] = 0.01\,\text{mol}\,\text{dm}^{-3}$ (accept mol/l **OR** M) ***[1]***

(No mark without units.)

(iii) 15.3 cm^3 – 15.6 cm^3 *(units not needed)* ***[1]***

(iv) $0.016\,\text{mol}\,\text{dm}^{-3}$ *(ECF from (iii))* ***[1]***

(b) (i) A strong acid is (almost) fully dissociated (ionised) whereas a weak acid is partly dissociated. ***[1]***

(ii) amount (moles) $= 0.5 \times 0.5 = 0.250$ mol *(units not needed)* ***[1]***
$m = 0.25 \times 60 = 15$ g *(units needed)* ***[1]***

2. (a) Cu^+ $+1$; Cu0, Cu^{2+} $+2$. *(any two correct **[1]**, + sign needed)* ***[1]***

(b) $Cu^+ \rightarrow Cu^{2+} + e^-$ ***[1]***

(c) $Cu^+ + e^- \rightarrow Cu$ ***[1]***

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

Units cancel for reactants and products / for numerator and denominator. ***[1]***

(b) Concentration of product / HI greater (than $[H_2]$ and $[I_2]$) ***[1]***

(c) It will have no effect. ***[1]***

(d) As the reaction is endothermic, increasing *T* will shift equilibrium position to the right. ***[1]***

4. (a) $CH_3CH_2CH_2OH$ 1-propanol **OR** propan-1-ol *(need both for mark)* ***[1]***

$$\begin{array}{l} CH_3\,\underset{\displaystyle\underset{\displaystyle OH}{|}}{CH}\,CH_3 \end{array}$$ 2-propanol **OR** propan-2-ol *(need both for mark)* ***[1]***

(If only both names are correct or only both formulas, award ***[1]****)*

(b) $CH_3COOH + CH_3CH_2CH_2OH \rightarrow CH_3COOC_3H_7 + H_2O$ ***[1]***

OR $C_2H_4O_2 + C_3H_7OH \rightarrow CH_3COOC_3H_7 + H_2O$

propyl ethanoate (**OR** 2-propyl ethanoate **OR** isopropyl ethanoate) ***[1]***

SECTION B

5. (a) mass number = number of (protons + neutrons) *[1]*
atomic number = number of protons (= Z) *[1]*
number of electrons = number of protons (= Z) *[1]*
number of neutrons = A – Z *[1]*

(b) C : 2, 4 (accept 2.4) *[1]*
$^{12}C^{4-}$: 6 protons, 6 neutrons
10 electrons *[1]*
Protons and neutrons in the nucleus and electrons in shells / orbits *[1]*
[1]

(c) If fraction of $^{35}Cl = x$, then $35.0x + 37.0(1-x) = 35.5$ / other sensible working *[1]*

75 % ^{35}Cl. *[1]*

Similar: number of electrons / number of electron shells / number of valence e^- / chemical properties; *[1]*

(Accept any two.)

Different: physical property (which depends on mass). (Accept different boiling points **OR** different rates of diffusion **OR** different melting points **OR**…) *[1]*

(d) (i) Atomic radii: For halogens an increase because valence electrons are placed in successive energy levels *[1]*
further away from the nucleus. *[1]*
In period 3, radii decreases as electrons are placed in the **same** main energy level. *[1]*
Increased nuclear charge increases attraction for valence electrons (pulling them closer). *[1]*

(ii) $Mg(g) \rightarrow Mg^{+}(g) + e^{-}$ *[1]*

(Both state symbols needed.)

Once the first outer electron is removed, the second outer electron experiences more attraction / atom becomes more positively charged *[1]*

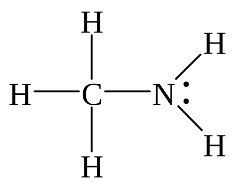
Third electron comes from inner energy level / second energy level *[1]*
that is closer to the nucleus / more strongly attracted. *[1]*

6. (a) (i) Example: H_2O / NH_3 / HF *etc.* ***[1]***
Electrons shared unequally ***[1]***
Different electronegativities ***[1]***
polar bonds ***[1]***
dipole–dipole interaction between molecules ***[1]***

(ii) Diamond or SiO_2 or SiC or Si or graphite. ***[1]***
covalent bonding ***[1]***
present throughout the structure / involving all atoms *(OWTTE)* ***[1]***

(iii) NH_4Cl or Na_2CO_3 *etc.* ***[1]***
Covalent bonding **within** NH_4^+, CO_3^- or… ***[1]***
Electrostatic interaction **between** oppositely charged ions. ***[1]***
Three-dimensional (or 3-D) lattice / network solid ***[1]***

(b)



$109\frac{1}{2}^{\circ}$ (around the carbon). ***[1]***
Four electron pairs / charge centres arranged **as far apart as possible** / repel equally ***[1]***
107° / less than 109° (around N) ***[1]***
Lone pair of electrons (on N) repels more strongly. ***[1]***

(c) Ethane: non-polar bonds ***[1]***
experiences **only weak** van der Waal's forces. ***[1]***

Aminoethane: polar N—H bonds ***[1]***
so has H—bonding as well ***[1]***

(If answer implies aminoethane is polar and has dipole–dipole interaction then award only ***[1]****.)*

7. (a) (i) The rate of reaction decreases. ***[1]***
less frequent collisions between reactants ***[1]***

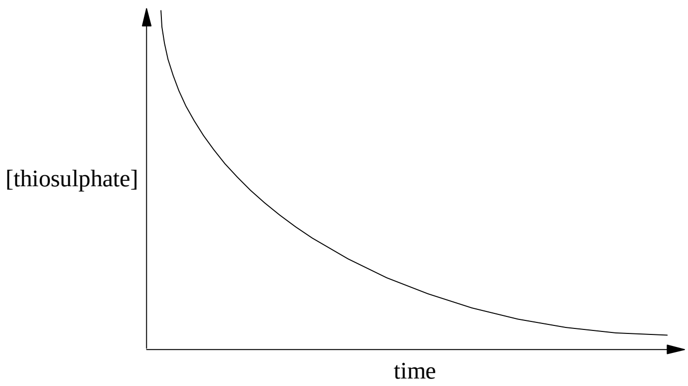
(ii) The rate decreases ***[1]***
because extra liquid decreases thiosulfate concentration, ***[1]***
so thiosulphate - H^+ collisions are less frequent. ***[1]***

(iii) The rate is increased ***[1]***
because at the higher temperature, kinetic energy increases **OR** the particles move faster ***[1]***
more frequent collisions ***[1]***
more energetic collisions ***[1]***

(iv) The rate is unaffected because ***[1]***
concentration of thiosulfate solution is not affected by size of solid. ***[1]***

(b) Because an increase in concentration increases only collision frequency ***[1]***
increasing temperature increases both frequency and energy of collisions / number of particles with $E \geq E_a$. ***[1]***

(c) (i)



*(Award **[1]** for correct labelling of axes and **[1]** for shape of graph.)* ***[2]***

(ii) draw slopes/tangents at different times ***[1]***
rate (at time *t*) = slope / gradient (at that time) ***[1]***

(iii) measuring cylinders (or pipette(s)), flask (or beaker) and stopclock or stopwatch. ***[1]***

some means of deciding when the amount precipitated is "visible" and so to stop timing ***[1]***
keep [HCl] constant / keep temperature constant / control all variables apart from $\left[S_2O_3^{2-}\right]$ ***[1]***