INTERNATIONAL BACCALAUREATE
BACCALAURÉAT INTERNATIONAL
BACHILLERATO INTERNACIONAL

MARKSCHEME

May 2001

CHEMISTRY

Standard Level

Paper 2

11 pages

SECTION A

1. (a) $C + \frac{1}{2}O_2 \rightarrow CO$ (*ignore state symbols*) ***[1]***

some evidence of working *e.g.* cycle or changing sign of ΔH ***[1]***

–110.5 (*units not required*) ***[1]***

(–110.5 on its own scores ***[3])*** ***[3 max]***

(b) absorbs heat / ΔH is positive / absorbs energy / products have more energy than reactants. ***[1]***

(c) (i) Breaking bonds $C{=}C$; $4(C{-}H)$; $3(O{=}O)$ ***[1]***

Making bonds $2(O{=}C{=}O)$; $2(H{-}O{-}H)$ ***[1]***

Breaking +3748 Making –4824 ***[1]***

Enthalpy of combustion = – 1076 *(+1076 scores* ***[3 max]) [1]*** ***[4 max]***

(In the absence of any credit, award ***[1]*** *for breaking (+)* ***and*** *making (–)* ***or*** $\Delta H_c = H_{products} - H_{reactants}$ *.)*

(ii) Exothermic since ΔH_c is negative (*NB consequential on sign in (c) (ii)*). ***[1]***

(If (c) (i) is not attempted, allow exothermic because hydrocarbon combustion gives out heat / OWTTE).

2. (a) $[OH^-] > [H^+]$ / pH > 7 / more OH^- ***[1]***

(Accept OH^- ions formed)

(b) Base ***[1]***

Accepting a proton / (H^+) / hydrogen **ion** ***[1]*** ***[2 max]***

(c) HCO_3^- / hydrogencarbonate / bicarbonate ***[1]***

3. (a) (Atomic number)
Number of protons in an atom / nucleus ***[1]***

(Mass number)
Number of protons and neutrons in an atom / nucleus ***[1]*** ***[2 max]***

(b)

Species	**Protons**	**Neutrons**	**Electrons**
$^{14}_{6}C$	6	8	6
$^{19}_{9}F^{-}$	9	10	10
$^{40}_{20}Ca^{2+}$	20	20	18
	[1]	***[1]***	***[1]***

[3 max]

(c) Fluorine/ F_2 ***[1]***
F_2 gains electrons / F_2 is reduced / oxidation number decreases ***[1]***
or
Ca loses electrons / Ca oxidation number increases ***[1]*** ***[2 max]***

SECTION B

4. (a) Change of concentration of reactant/product with time ***[1]***
Identify feasible reaction ***[1]***
State what is to be measured ***[1]***
Record time for specific event ***[1]***
Plot graph of reciprocal time $\left(\frac{1}{t}\right)$ ***[1]*** ***[5 max]***

*(N.B. we are timing **[1]** a specific process e.g. gas/precipitate appearing, etc. **[1])***

(b) (i) If a system at **equilibrium** is disturbed, the **equilibrium** moves in the direction which tends to reduce the disturbance (OWTTE). ***[1]***

(ii) Temperature and pressure / concentration ***[1]*** *(ignore others)*
For the factor chosen, ***[1]*** for effect/influence and ***[1]*** for explanation ***[3 max]***

Temperature: effect depends on whether endothermic or exothermic ***[1]***, explanation ***[1]***
Pressure: effect depends on number of moles of gaseous reactants and products ***[1]***, explanation ***[1]***
Concentration: effect depends on whether change is to reactants or products ***[1]***, explanation ***[1]***

(iii) Molecules must collide in order to react ***[1]***
Not all collisions lead to a reaction ***[1]***
Minimum energy needed/activation energy ***[1]***
Appropriate collision geometry required ***[1]*** ***[4 max]***

(iv) Temperature, concentration/pressure, catalyst, surface area ***[2]***
*(Award **[2]** for 3 or 4 factors and **[1]** for 2 factors)*

*(Award **[1]** for explanation, for example)*

Temperature increase: increases frequency / number of collisions / more molecules have sufficient energy to react ***[1]***

Conc./pressure increase: increase in the number / frequency of collisions ***[1]***

Catalyst: reduces minimum energy needed to react / reduces E_a / provides alternative reaction pathway with lower energy ***[1]***

Surface area: increases number of collisions ***[1]*** ***[3 max]***

(c) $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ (*state symbols and* $\rightleftharpoons$ *required*) ***[1]***

Low temperature, high yield ***[1]***
Low temperature, low rate ***[1]***
High pressure, high yield ***[1]***
High pressure, high rate ***[1]***
} ***[3 max]*** ***[4 max]***

5. (a) *(First **[3]** marks could be scored from a labelled diagram)*
Line spectrum ***[1]***
(Lines) converge ***[1]***
At high energy / high frequency / shorter wave length / blue end of spectrum ***[1]***
Electron transition between energy levels ***[1]*** *(either direction)*
Each transition/line is related to energy difference / $\Delta E = \frac{hc}{\lambda}$ / $E = h\upsilon$ ***[1]*** ***[5 max]***

(b) (i) Ionisation energy: (energy) required to remove one electron ***[1]***
from outermost shell ***[1]***
from gaseous atom ***[1]***
(Allow monatomic element but not gaseous element)

*(Correct equation, with (g) indicated, could score **[2]**)*

Electronegativity: tendency / ability / power to attract (not gain) electrons ***[1]***
of a shared pair / covalent bond ***[1]*** ***[5 max]***

(ii) $2K + 2H_2O \rightarrow 2KOH + H_2$ products correct ***[1]***
balanced ***[1]***

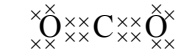
K bigger / e^- farther from the nucleus / K has more electron shells / increased shielding ***[1]***
e^- less strongly attracted / more easily lost ***[1]*** ***[4 max]***

(c) Halogens: electronegativity decreases down group ***[1]***
radius increases down group ***[1]***
shielding effect too ***[1]***
more shells ***[1]***

Period 3: electronegativity increases ***[1]***
radius falls ***[1]***
nuclear charge increases ***[1]***
electrons in same shell ***[1]***

[6 max]

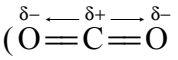
6. (a) (i) Correct Lewis diagram **all** valency e^- must be shown (*lines for lone pairs are acceptable*) ***[1]***



Linear ***[1]***
180° ***[1]*** ***[3 max***

(ii) Diagram or statement showing O more electronegative than C ***[1]***
(Accept C-O bond is polar)

Cancelling out of effect ***[1]***
Molecule not polar ***[1]*** ***[3 max]***


scores ***[2]***)

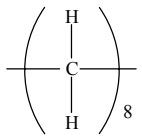
(b) Reference to H– bonding in ethanol/water ***[1]***
Ethane not polar ***[1]***
No H– bonds / only van der Waals ***[1]***
Cholesterol mostly a non-polar chain / hydrocarbon ***[1]*** ***[4 max]***

(c) $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ ***[1]***
Carbon monoxide/carbon (allow soot)/water **OR** CO/C/ H_2O
*(Award **[1]** for any two.)*

*(Award **[1]** for any one of the following:)*
CO: toxic / reduces oxygen carrying capacity of red blood cells / reduces oxygen carrying capacity of haemoglobin

C (particulates): influence climate / increase atmospheric turbidity / attenuate solar radiation / cause respiratory problems ***[3 max]***

(d) Product must show **all** C (8) saturated with H and **no** double bonds ***[1]***

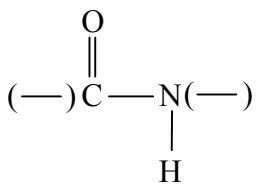
(Allow C_8H_{18} *or* )

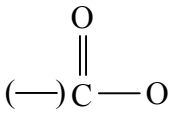
Addition/reduction/hydrogenation/hardening ***[1]*** ***[2 max]***

(e) $H_2N(CH_2)_6NH_2$ / H_2N ~~~ NH_2 / correct name ***[1]***

$HOCH_2CH_2OH$ / HO ~~~ OH / correct name ***[1]***

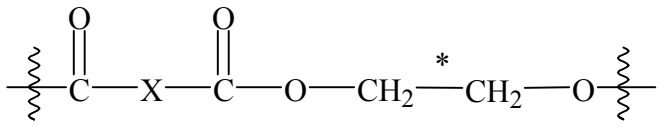
*(Award **[1]** each for the following two structures)*





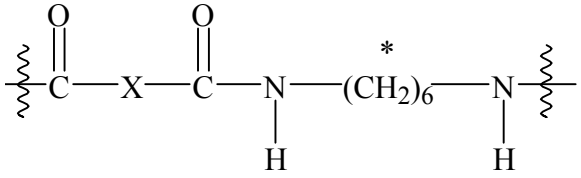
[2]

EITHER the polyester repeating unit



[1]

OR the polyamide repeating unit



[1]

[5 max]

* *This part of the statement should be related to their formulation of the respective monomers and may well be represented in the repeating unit as ~~~ at the location shown (*).*