INTERNATIONAL BACCALAUREATE
BACCALAURÉAT INTERNATIONAL
BACHILLERATO INTERNACIONAL

MARKSCHEME

May 2000

CHEMISTRY

Standard Level

Paper 3

12 pages

OPTION A – HIGHER ORGANIC CHEMISTRY

A1. (a) (i) C_5H_{12} ***[1]***

(ii) $CH_3CH_2CH_2CH_2CH_3$; $CH_3CH(CH_3)CH_2CH_3$; $CH_3C(CH_3)_3$ ***[3]***

(Accept in any order.)

(iii) (Loss of) CH_3 or CH_3^+;
reference to a difference of 15. ***[2]***

(iv) (further loss of) $CH_2^{(+)}$ / $CH_3CH_2^{(+)}$ / $CH_3CH_2CH_2^{(+)}$ / $CH_3CH_2CH_2CH_2^{(+)}$. ***[1]***

(v) **A** = $CH_3C(CH_3)_3$ ***[1]***

B = $CH_3CH_2CH_2CH_2CH_3$ / even $CH_3CH(CH_3)CH_2CH_3$ ***[1]***

Correct naming of **their** A and B. ***[2]***

(b) **A** 1 peak/singlet ***[1]***
similar environment of each (or words to that effect). ***[1]***

B 3 or 4 peaks **consistent** with their choice of **B**. ***[1]***

e.g. $CH_3CH_2CH_2CH_2CH_3$ = 3

(c) Both contain only C—H and C—C bonds. ***[1]***

Total [15 marks]

OPTION B – HIGHER PHYSICAL CHEMISTRY

B1. (a) (i) $pH = 1$ ***[1]***

(ii) Use of $K_a \rightarrow \dfrac{[H^+]^2}{0.1} = 1.7 \times 10^{-5}$ ***[1]***

$([H^+] = 1.30 \times 10^{-3})$

$pH \sim 2.88$ ***[1]***

(Expression $K_a = \dfrac{[H^+]^2}{[CH_3COOH]}$ *scores **[1]** in absence of **any** other credit.)*

(b) Volumes would be the same (each 20 cm^3) ***[1]***

(in each case) all acid particles neutralised / common reaction $H^+ + OH^- = H_2O$ / both monoprotic acids. ***[1]***

(c) A solution which resists changes in pH on addition of small amounts of acid/alkali. ***[1]***

(d) Ethanoic acid ***[1]***
product contains weak acid plus salt of weak acid strong base / CH_3COOH—$CH_3COO^-Na^+$ mixture (or words to that effect). ***[1]***

(e) (i) absence of a weak conjugate base/ Cl^- ions do not react with H^+ (or words to that effect). ***[1]***

(ii) concentration of conjugate base too low/not enough CH_3COO^- ions present (or words to that effect). ***[1]***

Total [10 marks]

B2. (a) $\text{Rate} = k[H_2][NO]^2$

*(Award **[1]** for k, **[1]** for* $[H_2]$ *and **[1]** for* $[NO]^2$. *If* $R \propto [H_2][NO]^2$ *is written, award only **[2]**.)* ***[3]***

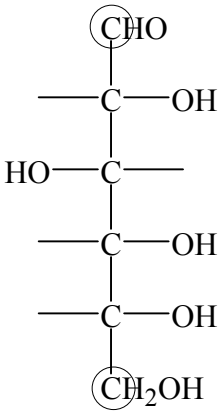
Overall order is 3 (consequential on rate equation). ***[1]***

(b) ×8 (consequential on overall order). ***[1]***

Total [5 marks]

OPTION C – HUMAN BIOCHEMISTRY

C1. (a) (i)



*Award **[1]** for either circled C and **[1]** for the whole structure.* ***[2]***

(ii) In the ring structure of glucose on the C_1 atom/the "carbonyl" C. ***[1]***
the H/OH are in different positions in α/β ***[1]***
OR illustration of this (diagrammatically).

(b) (i) glucose and fructose ***[2]***

(ii) glucose (and glucose) ***[1]***

(c) *(Award **[1]** for any of the below.)*

Food or energy reserves/resources/stores/glycogen/starch
Structure/cell walls/cellulose/chitin. ***[1]***

Total [8 marks]

C2. (a) 6. ***[1]***

(b) (i) Chromatography and electrophoresis. ***[2]***

(ii) *(Award up to **[4]** for the following points for EITHER paper chromatography OR electrophoresis.)*

Paper chromatography:

hydrolyse/release amino acids/heat with acid; ***[1]***
place sample spot on paper; ***[1]***
place paper in solvent (or suitable named solvent); ***[1]***
compare distances travelled/R_f values with known values. ***[1]***

Electrophoresis:

hydrolysis; ***[1]***
'loading' onto origin; ***[1]***
variable voltage/distance moved from origin; ***[1]***
compare isoelectric points (standards) *etc.* ***[1]***

Total [7 marks]

OPTION D – ENVIRONMENTAL CHEMISTRY

			Source		Reduction of emission	
D1.	(a)	(i)	Incomplete combustion of C-containing fuel/named fuel	*[1]*	Use catalytic converter*	*[1]*
		(ii)	Burning sulfur-containing fuel/coal	*[1]*	Desulfurisation/scrubbing (flue gases)	*[1]*
		(iii)	Reaction of gases in air/nitrogen and oxygen (at high temperatrure)	*[1]*	Use catalytic converter*	*[1]*

* allow **catalytic converter** once only

(Award final mark for correct product from one of the above:)

(i) Carbon dioxide;

(ii) Sulfur/sulfate/hydrogen sulfide; *[1]*

(iii) Nitrogen. *[6]*

(b) One of SO_2 or NO_x (however described) *[1]*

EITHER $SO_2 + H_2O \rightleftharpoons H_2SO_3$ *[1]*

OR $2NO + 1\frac{1}{2}O_2 + H_2O \rightarrow 2HNO_3$ (for example)

Total [8 marks]

D2. (a) Amount of oxygen needed to break down organic wastes; *[1]*
Reduced availability of oxygen/fewer living organisms. *[1]*

(b) Secondary treatment; *[1]*
Activated sludge process; *[1]*
Organic matter broken down/oxidised by bacteria. *[1]*

(c) Plant growth encouraged; *[1]*
Oxygen concentration reduced by plant decay. *[1]*
(Allow eutrophication as alternative to either of the above.)

Total [7 marks]

OPTION E – CHEMICAL INDUSTRIES

E1. (a) Accept a temperature **range** 400–550 °C in **each** case. ***[1]***

Pressure 150–500 atm (Haber) 1–2 atm (Contact) ***[1]***

Catalyst iron/iron oxide Vanadium pentoxide/Vanadium(V) oxide ***[1] + [1]***

*(For **each** process, 3 correct conditions **[2]**, 2 correct **[1]**.)*

(b) $N_2 + 3H_2 \rightleftharpoons 2NH_3$ (state symbols NOT required). ***[1]***

*(**Don't** penalise absence of reversible symbol.)*

High temperature increases rate/gives greater rate of reaction ***[1]***
But gives low yield of NH_3 ***[1]***
Some comment on a compromise temperature ***[1]***

(c) **Raw Materials** – naphtha, methane, other hydrocarbon (saturated); ***[1]***

– high temperature/heat/catalyst ***([1]** for any one of the three.)* ***[1]***

*(Award **[1]** for any one of the following equations.)*

$C_7H_{16} \rightarrow C_6H_5CH_3 + 4H_2$
$C_6H_{14} \rightarrow C_6H_6 + 4H_2$
$C_2H_6 \rightarrow C_2H_4 + H_2$
etc.
(even) $CH_4 + H_2O \rightarrow CO + 3H_2$ ***[1]***

Total [11 marks]

E2. (a) *(Award **[2]** for any two of the following:)*

'close' to C_2H_4 source;
close to industries needing polythene;
workforce;
away from residential areas;
etc. ***[2]***

(b) Polar C—Cl bonds in PVC; ***[1]***
stronger intermolecular forces (than polythene). ***[1]***

Total [4 marks]

OPTION F – FUELS AND ENERGY

F1. (a) (i) 219; *[1]*
86. *[1]*

(ii) Mass number No change; *[1]*
Atomic number +1. *[1]*

(b) (i) Time taken for activity to decrease by half (or words to that effect). *[1]*

(ii) 11.7 days. *[1]*
Some working essential, *e.g.* 3-half lives mentioned. *[1]*

(iii) $\frac{7}{8}$ or 0.875 or 87.5 %. *[1]*

(iv) 12.5 % or $\frac{1}{8}$. *[1]*

Total [9 marks]

F2. (a) Zinc *[1]*
and graphite (accept carbon). *[1]*

(b) Voltage – potential difference between electrodes; *[1]*
Power – total quantity of electricity available. *[1]*

Voltage affected by the materials used; *[1]*
Power affected by the quantity of materials used. *[1]*

Total [6 marks]