IB DIPLOMA PROGRAMME
PROGRAMME DU DIPLÔME DU BI
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N04/4/CHEMI/SP3/ENG/TZ0/XX/M+

MARKSCHEME

November 2004

CHEMISTRY

Standard Level

Paper 3

15 pages

General Marking Instructions

After marking a sufficient number of scripts to become familiar with the markscheme and candidates' responses to all or the majority of questions, Assistant Examiners (AEs) will be contacted by their Team Leader (TL) by telephone. The purpose of this contact is to discuss the standard of marking, the interpretation of the markscheme and any difficulties with particular questions. It may be necessary to review your initial marking after contacting your TL. **DO NOT BEGIN THE FINAL MARKING OF YOUR SCRIPTS IN RED INK UNTIL YOU RECEIVE NOTIFICATION THAT THE MARKSCHEME IS FINALISED.** *You will be informed by e-mail, fax or post of modifications to the markscheme and should receive these about one week after the date of the examination. If you have not received them within 10 days you should contact your Team Leader by telephone. Make an allowance for any difference in time zone before calling.* **AEs WHO DO NOT COMPLY WITH THESE INSTRUCTIONS MAY NOT BE INVITED TO MARK IN FUTURE SESSIONS.**

You should contact the TL whose name appears on your "Allocation of Schools listing" sheet.

Note:
Please use a personal courier service when sending sample materials to TLs unless postal services can be guaranteed. Record the costs on your examiner claim form.

1. Follow the markscheme provided, do **not** use decimals or fractions and mark in **RED**.

2. Where a mark is awarded, a tick (✓) should be placed in the text at the **precise point** where it becomes clear that the candidate deserves the mark.

3. Sometimes, careful consideration is required to decide whether or not to award a mark. In these cases write a brief annotation in the **left hand margin** to explain your decision. You are encouraged to write comments where it helps clarity, especially for moderation and re-marking.

4. Unexplained symbols or personal codes / notations on their own are unacceptable.

5. Record subtotals (where applicable) in the right-hand margin against the part of the answer to which they refer next to the mark allocation. Do **not** circle subtotals. **Circle the total mark for the question in the right-hand margin opposite the last line of the answer.**

6. Where an answer to a part question is worth no marks, put a zero in the right-hand margin.

7. For each Option: Add the totals for each question in the Option and write it in the Examiner column on the cover sheet.
Total: Add the marks awarded and enter this in the box marked TOTAL in the Examiner column.

8. After entering the marks on the cover sheet, check your addition to ensure that you have not made an error. Check also that you have transferred the marks correctly to the cover sheet. **We have script checking and a note of all clerical errors may be given in feedback to examiners.**

9. Every page and every question must have an indication that you have marked it. Do this by **writing your initials** on each page where you have made no other mark.

10. If a candidate has attempted more than the required number of Options, mark only the required number of Options in the order in which they are presented in the paper, **unless the candidate has indicated the Options s/he wants to be marked on the cover sheet.**

11. A candidate can be penalised if s/he clearly contradicts him/herself within an answer. Make a comment to this effect in the left hand margin

Subject Details: Chemistry SL Paper 3 Markscheme

General

- Each marking point is usually shown on a separate line or lines.
- Alternative answers are separated by a slash (/) – this means that either answer is acceptable.
- Words underlined are essential for the mark.
- Material in brackets (…) is not needed for the mark.
- The order in which candidates score marks does not matter (unless stated otherwise).
- The use of **OWTTE** in a markscheme (the abbreviation for "or words to that effect") means that if a candidate's answer contains words different to those in the markscheme, but which can be interpreted as having the same meaning, then the mark should be awarded.
- Please remember that many candidates are writing in a second language, and that effective communication is more important than grammatical accuracy.
- In some cases there may be more acceptable ways of scoring marks than the total mark for the question part. In these cases, tick each correct point, and if the total number of ticks is greater than the maximum possible total then write the maximum total followed by **MAX**.
- In some questions an answer to a question part has to be used in later parts. If an error is made in the first part then it should be penalised. However, if the incorrect answer is used correctly in later parts then "follow through" marks can be scored. Show this by writing **ECF** (error carried forward). This situation often occurs in calculations but may do so in other questions.
- Units for quantities should always be given where appropriate. In some cases a mark is available in the markscheme for writing the correct unit. In other cases the markscheme may state that units are to be ignored. Where this is not the case, penalise the omission of units, or the use of incorrect units, once only in the paper, and show this by writing **–1(U)** at the first point at which it occurs.
- Do not penalise candidates for using too many significant figures in answers to calculations, unless the question specifically states the number of significant figures required. If a candidate gives an answer to fewer significant figures than the answer shown in the markscheme, penalise this once only in the paper, and show this by writing **–1(SF)** at the first point at which this occurs.
- If a question specifically asks for the name of a substance, do not award a mark for a correct formula; similarly, if the formula is specifically asked for, do not award a mark for a correct name.
- If a question asks for an equation for a reaction, a balanced symbol equation is usually expected. Do not award a mark for a word equation or an unbalanced equation unless the question specifically asks for this. In some cases, where more complicated equations are to be written, more than one mark may be available for an equation – in these cases follow the instructions in the mark scheme.
- Ignore missing or incorrect state symbols in an equation unless these are specifically asked for in the question.
- Mark positively. Give candidates credit for what they have got correct, rather than penalising them for what they have got wrong.
- If candidates answer a question correctly, but by using a method different from that shown in the markscheme, then award marks; if in doubt consult your Team Leader.

Option A – Higher physical organic chemistry

A1. (a) $C_3H_8O^+$; ***[1]***

Accept more detailed formula such as $CH_3CH_2CH_2OH^+$, $^+$*charge essential.*

(b) CH_3O^+ / CH_2OH^+; ***[1]***

For (a) and (b), charge missing penalize once only.

(c) (A) $CH_3CH_2CH_2OH$;

Accept more detailed formula.

(B) $CH_3CH(OH)CH_3$; ***[2]***

Accept more detailed formula.
Hydrogen(s) missing, penalize once only.
*Award **[1]** if both structures correct but the wrong way round.*

(d) (for m/z = 45) two possible bonds to break / two CH_3 groups could be lost / two ways to make this;
OR
(for m/z = 29) only one bond could break to produce this / one way to make this; ***[1]***

(e) (i) (four) different environments for hydrogen atoms/protons / *OWTTE*;
the number of hydrogen atoms/protons in each environment (are in the ratio 3:2:2:1) / *OWTTE*; ***[2]***

(ii) 3 peaks;
6:1:1; ***[2]***
order not important
*Award **[2]** for the ratio alone.*

A2. (a) $2HI \rightarrow H_2 + I_2$; ***[1]***

Ignore state symbols.

(b) 2;
when [HI] is trebled, rate increases ×9 / *OWTTE*;
Accept equivalent argument based on experiments 1 and 3. ***[2]***

(c) rate = $k[HI]^2$; ***[1]***

ECF from (b)

(d) 4.4×10^{-6}; *(ignore units)* ***[1]***

ECF from (b)

(e) the number of molecules taking part in the slowest or rate-determining step of a reaction / *OWTTE*;
2; ***[2]***

A3. (a) $CH_2ClCOOH \rightleftharpoons CH_2ClCOO^- + H^+$; ***[1]***

Ignore state symbols, accept $\rightarrow$ *and equation for the reaction with water.*

(b) $(K_a) = \frac{[CH_2ClCOO^-][H^+]}{[CH_2ClCOOH]}$; ***[1]***

ECF from (a) if charge(s) missing in equation.

(c) 1.38×10^{-3};

Accept answer in range 1.3 to 1.4 $\times 10^{-3}$*, ignore units.* ***[1]***

(d) ethanoic < iodoethanoic < chloroethanoic; ***[1]***

Option B – Medicines and drugs

B1. (a) (i) interference with nerve impulse transmissions;
relief of anxiety / nervous tension / increase feeling of calm;
reduction of mental activity;
reduction of inhibition; ***[2 max]***
OWTTE
*Award **[1]** each for any two.*

(ii) sleep;
loss of consciousness / anesthesia;
coma;
death;
decreases heart rate / breathing rate; ***[2 max]***
*Award **[1]** each for any two.*

(b) they relieve (the symptoms of) depression / *OWTTE*; ***[1]***

(c) alcoholism / dependence (physical or psychological);
reduction of concentration / judgement / balance / slurring of speech;
increased risk when driving / operating machinery;
involvement in violence / crime;
taking time off work / loss of income;
increased risk of cirrhosis / liver disease / heart disease;
increased risk of stomach problems / gastritis / ulcers;
adverse effects on pregnant women / fetus (*e.g.* miscarriage, low birth weight, abnormalities); ***[4 max]***
OWTTE
*Award **[1]** each for any four.*

(d) diazepam / valium / nitrazepam / mogadon / fluoexetine hydrochloride / prozac; ***[1 max]***
*Award **[1]** for any **two** correct from list.*

(e) the need for larger doses to achieve the desired effect;
increased risk of dependence / increased risk of negative effect / increases toxic effect / *OWTTE;* ***[2]***

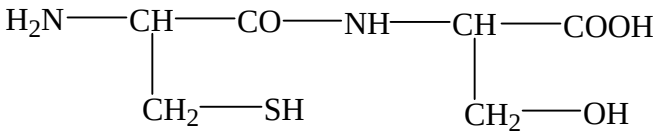
B2. (a) *both contain*
six-membered ring;
five-membered ring;
(tertiary) amine group;
N-has methyl group attached; ***[2 max]***
*Award **[1]** each for any two.*

(b) *short-term effects*
increased heart rate / blood pressure / restriction of blood vessels;
acts as an anti-diuretic / reduction in urine output;

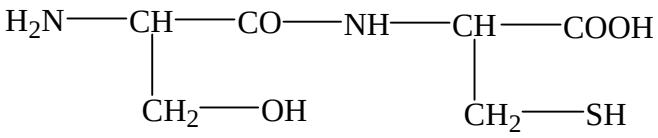
long-term effects
increased risk of heart disease / coronary thrombosis;
risk of becoming addicted / physically dependent;
high cost;
(increased risk of) (lung, mouth, throat) cancer;
(increased risk of) bronchitis / emphysema;
reduction in capacity of blood to carry oxygen;
withdrawal symptoms / weight gain (on quitting); ***[6 max]***
*Award **[1]** each for any six, provided at least one short-term effect given.*

Option C – Human biochemistry

C1. (a) condensation;
water / H_2O ; ***[2]***

(b) 

;



; ***[2]***

(c**)** arg–his–leu;
arg–leu–his;
his–arg–leu;
his–leu–arg;
leu–arg–his;
leu–his–arg; ***[3 max]***
*Award **[3]** for all six correct, **[2]** for five or four, **[1]** for three.*

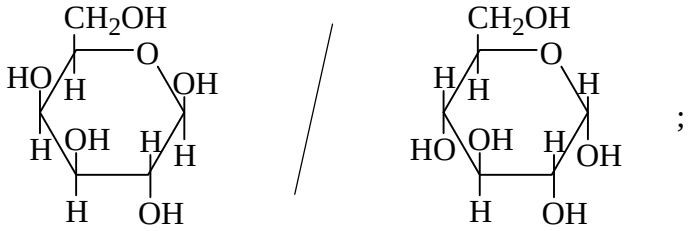
(d) (i) hydrogen bonding; ***[1]***

(ii) van der Waals' forces / hydrophobic interactions / dispersion forces;
ionic bonding / (formation of) salt bridges / electrostatic attractions;
covalent bonding / (formation of) disulfide bridges; ***[2 max]***
*Award **[1]** each for any two.*
Do not accept sulfur bridges on hydrogen bonding.

C2. (a) CH_2O ; ***[1]***

Accept $(CH_2O)_n$.

(b) (i)



(β-) galactose / (α-) glucose ; ***[2]***

Award second mark only if name matches structure.
Do not award second mark if structure is not given.

(ii) (α-) glucose / (β-) galactose; ***[1]***

Whichever not given in (b)(i)

(c) energy (sources);
energy storage / formation of glycogen;
precursors of/formation of other biologically important molecules; ***[2 max]***
*Award **[1]** each for any two.*
Do not accept "to provide structure".

C3 (a) hormone / steroid; ***[1]***

(b) alcohol / hydroxyl *(accept alkanol but not hydroxide or OH)*;
alkene / carbon-carbon double bond ; ***[2]***
Do not accept C=C.
Do not accept methyl/CH_3.

(c) 6; ***[1]***

Option D – Environmental chemistry

D1. (a) precipitation;
high voltage / (voltage between) oppositely charged electrodes;
particulates collect on / are attracted to / electrodes / plates / wire;
solids shaken off / fall to bottom of container; ***[3 max]***
*Award **[1]** each for any three.*

(b) coal / diesel (fuel) / wood; ***[1]***

(c) $CH_4 + O_2 \rightarrow C + 2H_2O$; ***[1]***
Ignore state symbols.

D2. (a) carbon dioxide (dissolves, reacts) / carbonic acid formed;
$CO_2 + H_2O \rightarrow H^+ + HCO_3^-$; ***[2]***
Ignore state symbols.
Accept H_2CO_3 or $2H^+ + CO_3^{2-}$ as products.
Do not accept oxides of nitrogen or sulfur as contributing to naturally acidic rain.

(b) (i) $N_2 + O_2 \rightarrow 2NO$;
Ignore state symbols.
nitric acid / nitrous acid; ***[2]***
Name or formula

(ii) $2NO + 2CO \rightarrow N_2 + 2CO_2$; ***[2]***
Ignore state symbols.
*Award **[1]** for correct products, **[2]** if equation correct.*

D3 (a) the amount of oxygen needed to decompose waste/organic matter;
at a certain temperature / for a certain time / for a given amount of water; ***[2]***

(b) (i) aerobic; ***[1]***

(ii) *carbon*
methane;
Accept marsh gas.

nitrogen
ammonia / amines;

Sulfur
hydrogen sulfide; ***[3]***
Accept correct formulas.

(c) temperature (of river/water) increases;
(amount of) oxygen dissolved decreases;
fish metabolism increases;
specified harmful effect on fish (*e.g.* numbers reduced, some species disappear, death); ***[3 max]***
*Award **[1]** each for any three.*

Option E – Chemical industries

E1. (a) crushed / powdered / pulverized / broken down; ***[1]***

(b) density / gold heavier than impurities; ***[1]***

(c) air;
oil;
ore sticks to oil;
froth / mixture of ore, oil and air rises (to top);
removed / skimmed off; ***[3 max]***
*Award **[1]** each for any three.*

(d) gold is less reactive / lower in reactivity series; ***[1]***
Accept opposite argument for iron.

E2. (a) (i) alumina / aluminium oxide / Al_2O_3; *(accept bauxite)* ***[1]***

(ii) $Al^{3+} + 3e^- \rightarrow Al$;
$2O^{2-} \rightarrow O_2 + 4e^-$; ***[3]***
Ignore state symbols in both cases.
*Award **[2]** for second equation or, if not correct but O_2 appears, award **[1]**.*

(b) (i) limestone/ $CaCO_3$ and air; ***[1]***
Accept lime or oxygen.

(ii) $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$ / $Fe_2O_3 + 3C \rightarrow 2Fe + 3CO$ /
$2Fe_2O_3 + 3C \rightarrow 4Fe + 3CO_2$; ***[2]***
Ignore state symbols.
*Award **[1]** for all formulas correct, **[2]** for balanced equation.*

E3 (a) LDPE has (more) branching / HDPE has less/no branching;
van der Waals' forces (between chains);
weaker forces in LDPE / stronger forces in HDPE;
LDPE has lower melting point / HDPE has higher melting point;
LDPE is more flexible / softer / weaker / HDPE is more rigid / harder / stronger;
LDPE has low tensile strength / HDPE has high tensile strength; ***[4 max]***
*Award **[1]** each for any four.*

(b) (i) melts / softens / changes shape when heated / *OWTTE*; ***[1]***

(ii) thermoset(ting plastic);
contains cross-links / covalent bonds between polymer chains; ***[2]***

Option F – Fuels and energy

F1. (a) marine organisms / animals / plankton;
buried under sediment / rock;
high pressure;
high temperature;
absence of oxygen; ***[3 max]***
*Award **[1]** each for any three.*

(b) $\Delta H_c = \sum \Delta H_f^{\ominus}(\text{products}) - \sum \Delta H_f^{\ominus}(\text{reactants})$ / other suitable method;
$= 6(-394) + 7(-242) - (-167)$;
$= -3891 \ (\text{kJ mol}^{-1})$; ***[3]***
Accept answer in range 3890 to 3900, ignore units unless wrong.
*Award **[3]** for correct final answer, **[2]** for correct value but wrong units or wrong sign.*
*If wrong value then award **[1]** for either 6(–394) or 7(–242).*

(c) heat loss / *OWTTE*; ***[1]***

(d) (because of) greater branching; ***[1]***

F2. (a) involve valence electrons / gain/lose electrons;
bond breaking;
atoms / molecules rearranged / no new atoms formed / nuclei unchanged;
no difference between mass of reactants and mass of products;
energy changes much smaller; ***[2 max]***
*Award **[1]** each for any two.*

(b) *α - decay*
^{214}Pb ;

β - decay
^{218}At ; ***[2]***

(c) 12 min = 4 half-lives;
mass remaining = 0.75 g; ***[2]***
*Correct final answer = **[2]**, units not needed.*

(d) *control rods*
more neutrons / more fissions / nuclear reaction speeds up;
temperature rises;
meltdown;
*Award **[1]** each for any two.*
Do not accept "reaction gets out of control" as equivalent to "reaction speeds up".

presence of oxygen
burning of the moderator / reacts with graphite;
pressure rises;
pressure vessel fails / explodes; *(provided nuclear explosion not implied)*
*Award **[1]** each for any two.*
Do not accept corrodes graphite.

pipe failure
sodium burns (in air);
sodium reacts with water;
hydrogen produced;
risk of fire / explosion (of hydrogen); ***[6 max]***
*Award **[1]** each for any two.*
Accept escape of radioactive material once only in any part.
Accept other reasonable points.