

MARKSCHEME

May 2004

CHEMISTRY

Standard Level

Paper 2

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General Marking Instructions

This is the ONLY markscheme released for this session.

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 only 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 for Section A). Do **not** circle sub-totals. **Circle the total mark for the question in the right-hand margin opposite the last line of the answer.**
6. For Section B, show a mark for each part question (a), (b), *etc.*
7. Where an answer to a part question is worth no marks, put a zero in the right-hand margin.
8. Section A: Add together the total for each question and write it in the Examiner column on the cover sheet.
Section B: Insert the total for each question in the Examiner column on the cover sheet.
Total: Add up the marks awarded and enter this in the box marked TOTAL in the Examiner column.
9. 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.**
10. 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.
11. If a candidate has attempted more than the prescribed number of questions, mark only the required number of answers in the order in which they are presented in the script, **unless the candidate has indicated the questions to be marked on the cover sheet**. Make a comment to this effect in the left hand margin.
12. A candidate can be penalized if he/she clearly contradicts him/herself within an answer. Make a comment to this effect in the left hand margin.

Subject Details: **Chemistry SL Paper 2 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 penalized. 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, penalize 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 penalize 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, penalize 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 incorrectly stated 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 penalizing 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.

SECTION A

1. (a) (i) it is decreasing;
less frequent collisions / fewer collisions per second or (unit) time; [2]
- (ii) reactant(s) used up / reaction is complete; [1]
Do not accept reaction reaches equilibrium.
- (b) (i) it would increase; [1]
Accept a quantitative answer such as “doubles”.
- (ii) more frequent collisions;
collisions or molecules have more energy (*OWTTE*);
more molecules with energy $\geq E_a$; [3]
- (iii) rate would be lower;
smaller surface area; [2]
2. (a) atoms of the same element / same number of protons / same atomic number;
having different numbers of neutrons / different (mass number);
Award only [1] max if reference made to elements but not atoms.
- (b) relative atomic mass = $\frac{36 \times 0.337 + 38 \times 0.0630 + 40 \times 99.6}{100}$;
= 39.98 / 39.99 / 40.0; [2]
- (c) 23 electrons;
26 protons;
30 neutrons; [2]
Award [2] for three correct, [1] for two correct.



Accept dots, crosses, a combination of dots and crosses or a line to represent a pair of electrons.

- (ii) CO₂ is linear;
two charge centres or bonds and no lone pairs (around C);
H₂S is bent / v-shaped / angular;
two bond pairs, two lone pairs (around S); [4]

- (iii) CO₂ is non-polar, H₂S is polar;
bond polarities cancel CO₂ but not in H₂S; [2]

- (b) CH₃Cl – dipole-dipole attractions;
CH₄ – van der Waals' / dispersion / London forces;
CH₃OH – hydrogen bond; [3]

4. (a) (position of) equilibrium shifts to the left / towards reactants;
(forward) reaction is exothermic / ΔH is negative / the reverse reaction is endothermic /
OWTTE; [2]
Do not accept "Le Chatelier's Principle" without some additional explanation.

- (b) (position of) equilibrium shifts to the right / towards products;
fewer gas molecules on the right hand side / volume decreases in forward reaction /
OWTTE; [2]
Do not accept "Le Chatelier's Principle" without some additional explanation.

SECTION B

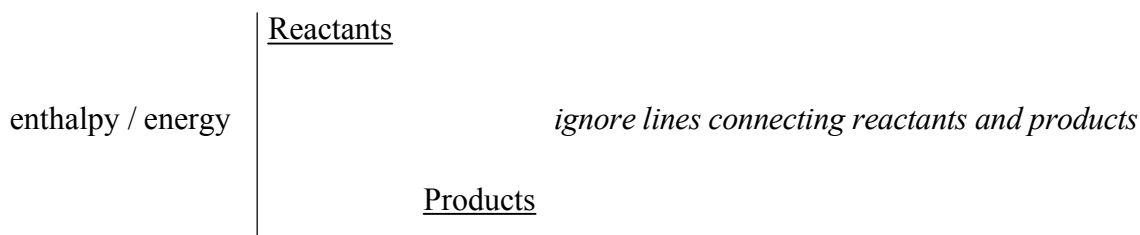
5. (a) (i) $\Delta H = \Delta H_f(\text{products}) - \Delta H_f(\text{reactants}) = (-1669) - (-822)$
 $= -847 \text{ kJ}$

Ignore units;

exothermic (ECF from sign of ΔH);

[3]

(ii)



[1] for the diagram

ECF from sign of ΔH in (a) (i)

298 K / 25 °C AND 1 atm / 101(.3) kPa;

Both needed for the mark.

[2]

- (iii) entropy change will be zero / very small;
 (structure of / bonding in) reactants and products similar / only solids involved;
 the disorder / randomness will not change;

[3]

- (b) a reaction is spontaneous when ΔG^\ominus is negative / non-spontaneous when ΔG^\ominus is positive;
 at high T, ΔG^\ominus is negative;
 (because) $T\Delta S^\ominus$ is greater than ΔH^\ominus ;
 at low T, ΔG^\ominus is positive because $T\Delta S^\ominus$ is smaller than ΔH^\ominus / OWTTE;

[4]

- (c) (i) selection of all the correct bonds or values from Data Booklet;
 $\Delta H = (\text{N}\equiv\text{N}) + 3(\text{H}-\text{H}) - 6(\text{N}-\text{H}) / 944 + 3(436) - 6(388);$
 $= -76 \text{ (kJ)};$

[3]

*Allow ECF for one error (wrong bond energy / wrong coefficient / reverse reaction)
 but not for two errors (so -611, -857, +76, +1088 all score 2 out of 3).*

- (ii) negative;
 decrease in the number of gas molecules / OWTTE;

[2]

- (iii) $\Delta G = \Delta H - T\Delta S;$
 $\Delta G = -76.0 - 300 (-0.0627);$

Award [1] for 300 K.

Award [1] for conversion of units J to kJ or vice versa.

Allow ECF from c(i) from ΔH .

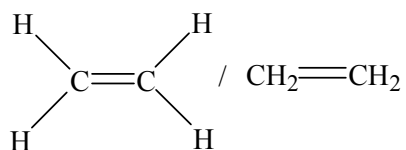
Allow ECF from c(ii) for sign of ΔS .

$= -57.2 \text{ (kJ mol}^{-1}\text{)} \text{ is spontaneous / or non-spontaneous if positive value obtained;}$

[3 max]

6. (a) (i) Fe reactant +2 AND Fe product +3 AND Mn product +2;
Mn reactant +7; [2]
Do not accept Roman numerals.
- (ii) Fe²⁺ / iron(II) ions / ferrous ions; [1]
Do not accept "iron".
- (iii) CH₃OH oxidation state –2;
CH₂O oxidation state 0;
(change is) oxidation / dehydrogenation; [3]
- (b) (i) silver nitrate; [1]
- (ii) oxidation;
Cu → Cu²⁺ + 2e; [2]
- (iii) (silver nitrate) solution turns blue / grey or black or silver solid forms;
copper ions form / Cu²⁺ ions form / silver deposited; [2]
- (c) (i) sodium chloride crystals consist of ions in a rigid lattice / ions can not move about;
when melted the ions are free to move or ions move when a voltage is applied;
in electrolysis positive sodium ions or Na⁺ ions move to the negative electrode or
cathode;
and negative chloride ions or Cl[–] move to the positive electrode or anode; [4]
- (ii) sodium formed at cathode or negative electrode;
Na⁺ + e → Na;
chlorine formed at anode or positive electrode;
2Cl[–] → Cl₂ + 2e; [4]
1st and 3rd marks can be scored in (c) (i).
- (iii) manufacture of sodium and chlorine / one stated use of chlorine or sodium; [1]

7. (a) ethene;



[2]

(b) **A** addition / hydration;

H₂O / water / steam;

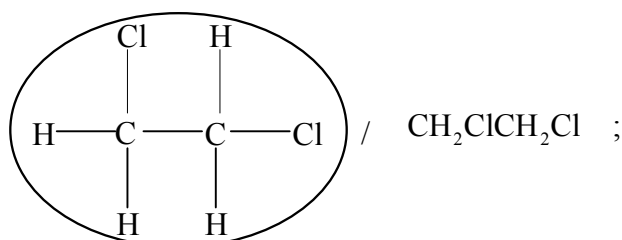
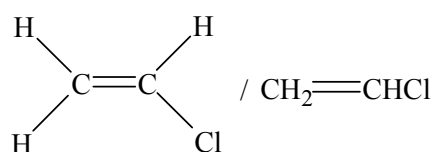
B oxidation;

acidified K₂Cr₂O₇

Accept acidified KMnO₄.

[4]

(c)

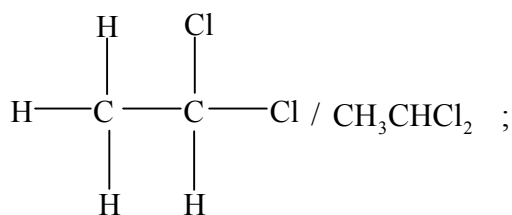


The compound formed directly may be circled or indicated by some other means.

[3]

Accept any other structure showing a Cl atom on each C atom.

(d)



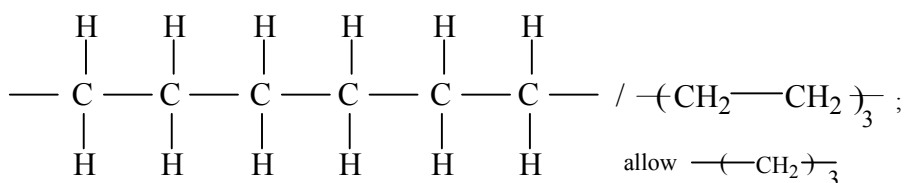
addition across a double bond occurs at both C atoms / OWTTE;

[2]

If 1, 1-dichloroethane is given in (c) accept 1, 2-dichloroethane as the isomer as ECF but

Award [1] max;

(e) addition polymer;



[2]

(f) condensation polymer;

polyesters;

polyamides;

[3]

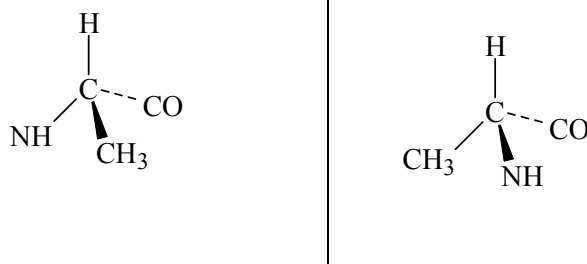
(g) (i) optical isomers rotate the plane of polarized light (in opposite directions); [1]

(ii)



The chiral centre may be indicated by an asterisk, circle, highlight, etc.

(iii)



[2]

Award [1] for one 3-D structure and [1] for showing that the second structure is a mirror image of the first one.
