



MARKSCHEME

November 2004

CHEMISTRY

Standard Level

Paper 2

12 pages

*This markscheme is **confidential** and for the exclusive use of examiners in this examination session.*

*It is the property of the International Baccalaureate and must **not** be reproduced or distributed to any other person without the authorisation of IBCA.*

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 FINALIZED.** 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 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 on the cover sheet the questions to be marked**. 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 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 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.

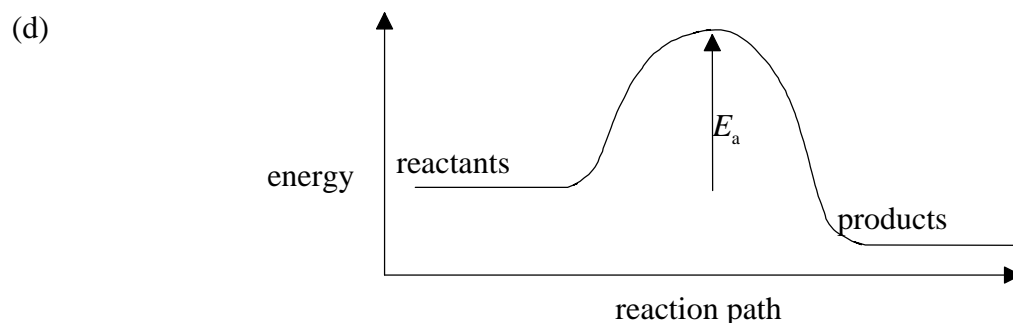
SECTION A

1. (a) to prevent (re)oxidation of the copper / *OWTTE*; [1]
- (b) number of moles of oxygen = $\frac{1.60}{16.00} = 0.10$;
 number of moles of copper = $\frac{6.35}{63.55} = 0.10$;
 empirical formula = Cu (0.10) : O (0.10) = CuO; [3]
Allow ECF.
Award [1] for CuO with no working.
Alternate solution
 $\frac{6.35}{7.95} = 79.8\%$ $\frac{1.60}{7.95} = 20.2\%$
 $\frac{79.8}{63.5} = 1.25$ $\frac{20.2}{16} = 1.29$
- (c) $\text{H}_2 + \text{CuO} \rightarrow \text{Cu} + \text{H}_2\text{O}$; [1]
Allow ECF.
- (d) (black copper oxide) solid turns red / brown;
 condensation / water vapour (on sides of test tube); [2]
Accept change colour.
Do not accept reduction of sample size.
2. (a) (i) a series of (organic) chemicals with the same general formula ($\text{C}_n\text{H}_{2n+2}$) /
 neighbouring members differing by CH_2 / similar chemical properties /
 gradation of physical properties / same functional group / *OWTTE* [2 max]
Award [1] each for any two.
- (ii) a compound containing carbon and hydrogen only; [1]
- (iii) containing only single (carbon to carbon) bonds / no multiple (carbon to carbon)
 bonds / *OWTTE*; [1]
Accept HC containing maximum number of hydrogens.
- (b) (i) boiling point increases as number of carbons increases / *OWTTE*;
 increased surface area / greater Van der Waals' forces / increased M_r /
 increased intermolecular forces / *OWTTE*; [2]
- (ii) exothermic / energy released / products have less energy than reactants; [1]
- (c) carbon dioxide;
 water; [2]
Accept formulas.

3. (a) energy for the conversion of a gaseous molecule into (gaseous) atoms;
(average values) obtained from a number of similar bonds / compounds / *OWTTE*;
 $\text{CH}_4(\text{g}) \rightarrow \text{C}(\text{g}) + 4\text{H}(\text{g})$; [3]
State symbols needed.

- (b) (bond breaking) = 1890 / 654 ;
(bond formation) = 2005 / 769 ;
enthalpy = $-115(\text{kJ mol}^{-1})$; [3]
Allow ECF from bond breaking and forming.
Award [3] for correct final answer.
Penalize [1] for correct answer with wrong sign.

- (c) molecules have insufficient energy to react (at room temperature) / wrong collision geometry / unsuccessful collisions;
extra energy needed to overcome the activation energy / E_a for the reaction; [2]

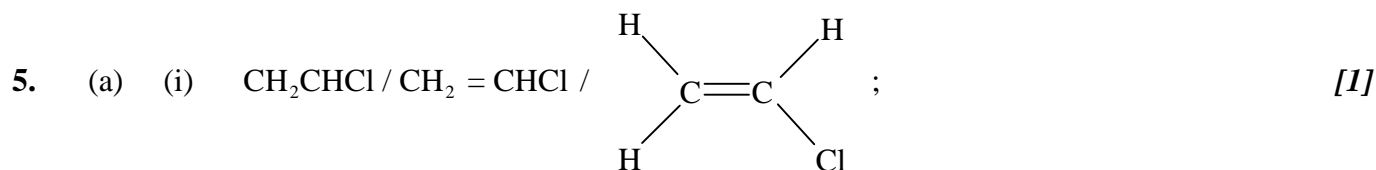


- exothermic shown;
activation energy / E_a shown; [2]
Allow ECF from (b).

4. (a) (pH =) 1;
a tenfold increase in the hydrogen ion / H^+ concentration; [2]
Accept calculation/strong acid / completely ionized (for reason).

- (b) (pH) > 2 and < 7;
(ethanoic acid is a) weak acid / partially ionized in solution; [2]
Accept pH > 1 (ignore reference to < 7) / calculation.

SECTION B



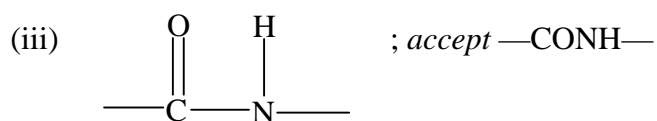
(ii) addition (polymerization);
(carbon-carbon) double bond / unsaturation / *OWTTE*; [2]



(iv) monomers have smaller molecules / surface area than polymers;
with weaker intermolecular / Van der Waals' forces; [2]
Accept opposite argument for polymers.

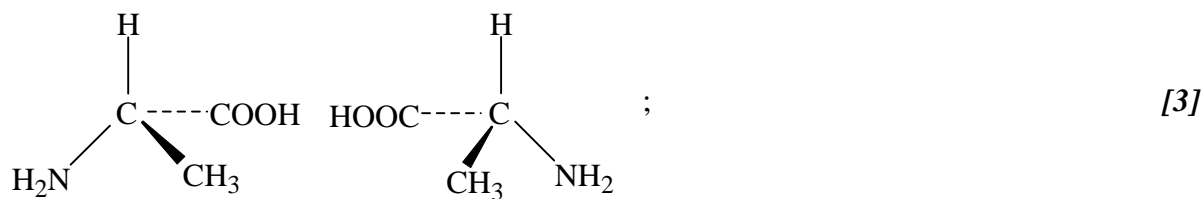
(b) (i) $\text{COOH}(\text{CH}_2)_4\text{COOH}$;
 $\text{NH}_2(\text{CH}_2)_6\text{NH}_2$; [2]
Accept more detailed formulas.
*Award [1] for correct functional groups for **both** compounds but wrong formulas.*

(ii) condensation (polymerization);
two functional groups on each monomer / *OWTTE*; [2]



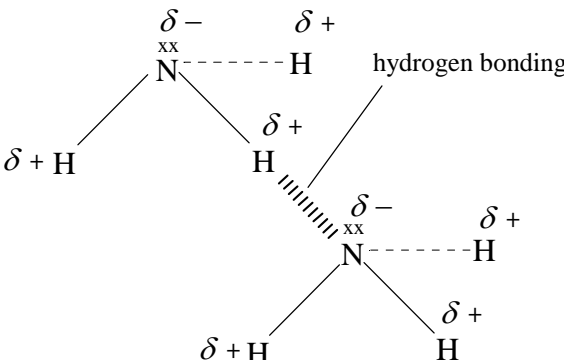
peptide / amide;
water / H_2O ; [3]

- (iv) rotate the plane of (plane-)polarized light;
asymmetric carbon atom / chiral centre;

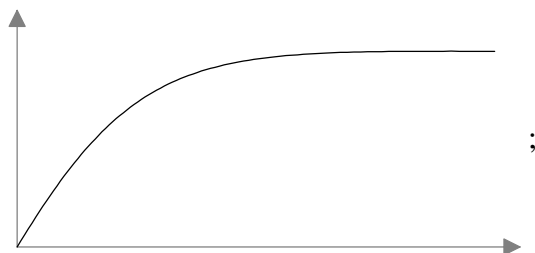


- (v) glycine / Gly / $\text{H}_2\text{N}-\text{CH}_2-\text{COOH}$; [1]

- (vi) flavouring agents / plasticizers / solvents / perfumes;
ethanol;
methanoic acid; [3]

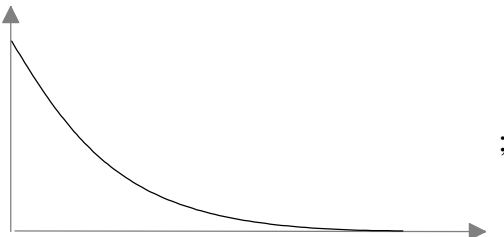
6. (a) (i) period is a horizontal row in the periodic table and a group is a vertical column / *OWTTE*; [1]
- (ii) 2,5;
electrons in two energy levels / shells;
five outer / valence electrons; [3]
- (b) (i) atomic radius of N > O because O has greater nuclear charge;
greater attraction for the outer electrons / *OWTTE*; [2]
- (ii) atomic radius of P > N because P has outer electrons in an energy level further
from the nucleus / *OWTTE*; [1]
- (iii) $N^{3-} > N$ / ionic radius > atomic radius because N^{3-} has more electrons than protons;
so the electrons are held less tightly / *OWTTE*; [2]
Award [1] for greater repulsion in N^{3-} due to more electrons (no reference to protons).
- (c) (i) (relative) measure of an atom's attraction for electrons;
in a bond; [2]
- (ii)
- 
- Suitable diagram indicating
dipoles;
lone pairs of electrons;
hydrogen bonding;* [3]
- (iii) 107° ; [1]
Accept answer in range 107 to 109° .
- (iv) molecule is asymmetrical / *OWTTE*; [1]
- (d) (i) 109.5° ; [1]
- (ii) NH_4^+ has four bonding pairs (around central atom so is a regular tetrahedron);
 NH_3 has three bonding pairs (of electrons) and one non-bonding pair;
non-bonding pairs (of electrons) exert a greater repulsive force; [3]
Accept suitable diagrams.

7. (a) measure volume of carbon dioxide / CO_2 / gas produced / measure pH;



starts at origin and levels off

measure mass of chemicals / apparatus;



starts high and decreases

Graph should show increase as reaction progresses (as HCl is consumed).

[4]

- (b) *Method 1*

use powdered MgCO_3 / *OWTTE*;

particles collide more frequently / increased surface area / *OWTTE* ;

Method 2

increase (reaction) temperature / heat / warm;

more of the collisions are successful / more particles with $E > E_a$ / *OWTTE*;

Method 3

increase acid concentration;

more frequent (reactant) collisions;

Method 4

add catalyst;

lowers activation energy / E_a / *OWTTE*;

Award [2] each for any three methods.

[6 max]

- (c) (i) stays the same;
 MgCO_3 was already in excess;

[2]

- (ii) stays the same;
 same quantities of reactants used;

[2]

- (d) (i) reversible reaction / reaction may proceed in either direction (depending on reaction conditions) equilibrium / dynamic equilibrium; [1]
- (ii) no effect;
catalyst will speed up both forward and reverse reactions (equally) /
increase the rate at which equilibrium is achieved; [2]
- (iii) acidity: no effect;
equilibrium shifts to the right;
 K_c : no change; [3]
-