N10/4/CHEMI/SP2/ENG/TZ0/XX/M

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MARKSCHEME

November 2010

CHEMISTRY

Standard Level

Paper 2

12 pages

1. Follow the markscheme provided, award only whole marks and mark only in **RED**.

2. Where a mark is awarded, a tick/check (✓) **must** be placed in the text at the **precise point** where it becomes clear that the candidate deserves the mark. **One tick to be shown for each mark awarded.**

3. Sometimes, careful consideration is required to decide whether or not to award a mark. In these cases write a brief annotation to explain your decision. You are encouraged to write comments where it helps clarity, especially for moderation and re-marking. It should be remembered that the script may be returned to the candidate.

4. Unexplained symbols or personal codes/notations are unacceptable.

5. Record marks in the right-hand margin against each mark allocation shown in square brackets *e.g.* ***[2]***. The total mark for a question must equal the number of ticks for the question.

6. Do **not** circle sub-totals. **Circle the total mark** for the question in the right-hand margin **at the end of the question.**

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

8. Where work is submitted on additional sheets the marks awarded should be shown as ticks and a note made to show that these marks have been transferred to the appropriate square bracket in the body of the script.

9. For each option: Add the total for each question in the option and write it in the Examiner column on the front cover.
Total: Add the marks awarded and enter this in the box marked TOTAL in the Examiner column on the cover sheet.

10. After entering the marks on the front cover 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. **All scripts are checked and a note of all clerical errors will be given in feedback to examiners.**

11. If an answer extends over more than one page and no marks have been awarded on a section draw a diagonal line through that section to indicate that it has been marked.

12. If a candidate has attempted more than the required number of questions within a paper or section of a paper, mark all the answers and use the marks of those answers that have the highest mark, **unless the candidate has indicated the question(s) to be marked on the front cover**.

13. A mark should not be awarded where there is contradiction within an answer. Make a comment to this effect in the left hand margin.

Subject Details: Chemistry SL Paper 2 Markscheme

Mark Allocation
Candidates are required to answer **ALL** questions in Section A **[30 marks]** and **ONE** question in Section B **[20 marks]**. Maximum total = **[50 marks]**

1. A markscheme often has more marking points than the total allows. This is intentional. Do not award more than the maximum marks allowed for part of a question.

2. Each marking point has a separate line and the end is signified by means of a semicolon (;).

3. An alternative answer or wording is indicated in the markscheme by a slash (/) – either wording can be accepted.

4. Words in brackets ( ) in the markscheme are not necessary to gain the mark.

5. Words that are underlined are essential for the mark.

6. The order of marking points does not have to be as in the markscheme, unless stated otherwise.

7. If the candidate's answer has the same "meaning" or can be clearly interpreted as being of equivalent significance, detail and validity as that in the markscheme then award the mark. Where this point is considered to be particularly relevant in a question it is emphasized by writing ***OWTTE*** (or words to that effect).

8. Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.

9. Occasionally, a part of a question may require an answer that is required for subsequent marking points. If an error is made in the first marking point then it should be penalized. However, if the incorrect answer is used correctly in subsequent marking points then **follow through** marks should be awarded. Indicate this with **ECF** (error carried forward).

10. Only consider units at the end of a calculation. Unless directed otherwise in the markscheme, unit errors should only be penalized once in the paper. Indicate this by writing **–1(U)** at the first point it occurs and **U** on the cover page.

11. Significant digits should only be considered in the final answer. Deduct **1 mark in the paper** for an **error of 2 or more digits** unless directed otherwise in the markscheme.

e.g. if the answer is 1.63:

2	*reject*
1.6	accept
1.63	accept
1.631	accept
1.6314	*reject*

Indicate the mark deduction by writing **–1(SD)** at the first point it occurs and **SD** on the cover sheet.

12. 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.

13. 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 directed otherwise in the markscheme.

14. Ignore missing or incorrect state symbols in an equation unless directed otherwise in the markscheme.

SECTION A

1. (a) all heat is transferred to water/copper sulfate solution / no heat loss;
specific heat capacity of zinc is zero/negligible / no heat is absorbed by the zinc;
density of water/solution $= 1.0$ / density of solution = density of water;
heat capacity of cup is zero / no heat is absorbed by the cup;
specific heat capacity of solution = specific heat capacity of water;
temperature uniform throughout solution; ***[2 max]***
*Award **[1]** each for any two.*
Accept energy instead of heat.

(b) (i) $T_{\text{final}} = 73.0\,(^{\circ}\text{C})$;
Allow in the range 72 to 74 (°C).

$\Delta T = 48.2\,(^{\circ}\text{C})$; ***[2]***
Allow in the range 47 to 49 (°C).
*Award **[2]** for correct final answer*
Allow ECF if T_{final} or $T_{initial}$ correct.

(ii) temperature decreases at uniform rate (when above room temperature) / *OWTTE*; ***[1]***

(iii) $10.1\,(\text{kJ})$; ***[1]***
Allow in the range 9.9 to 10.2 (kJ).

(c) $\left(n_{\text{Zn}} = n_{\text{CuSO}_4} = \dfrac{1.00 \times 50.0}{1000}\right) = 0.0500\,(\text{mol})$; ***[1]***

(d) $-201\,(\text{kJ mol}^{-1})$; ***[1]***
Allow in the range -197 to -206 (kJ mol^{-1}).
Value must be negative to award mark.

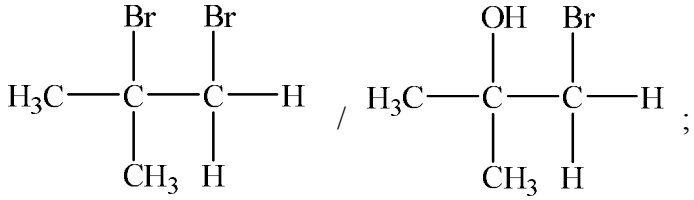
(e) (i) the more reactive the metal the more negative the enthalpy change/the more exothermic the reaction / *OWTTE*; ***[1]***
Do not accept greater enthalpy change.

(ii) any curve with positive gradient which passes through $\Delta H = 0$ at Cu; ***[1]***
Allow point graph or histogram.
Accept either positive or zero enthalpy change for Ag.

2. (a) methylpropene; ***[1]***
Accept 2-methylpropene.

(b) (i) brown/orange/yellow to colourless / bromine is decolorised; ***[1]***

(ii) 1,2-dibromo-2-methylpropane / 1,2-dibromomethylpropane / 1-bromo-2-methylpropan-2-ol / 1-bromomethylpropan-2-ol;
Do not penalize missing commas, hyphens or added spaces.



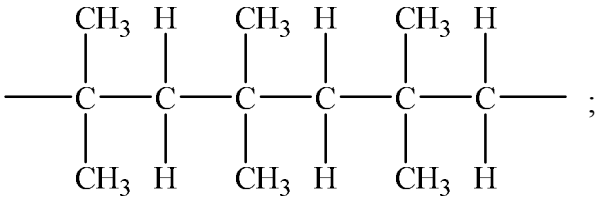
[2]

*Award **[1]** if structure and correct name are given for 2-bromo-2-methylpropan-1-ol.*

(c) (i) synthesis of materials not naturally available/plastics;
chemically unreactive materials produced;
wide range of uses/physical properties / versatile;
cheap;
large industry;
uses a limited natural resource; ***[2 max]***
*Award **[2]** for any two.*

(ii) addition; ***[1]***

(iii)



[1]

Must show continuation bonds.
Ignore bracket around the 6 carbons.
Must have 6 carbons joined to each other along chain.

(iv) monomers are smaller molecules / have smaller surface area than polymers;
Accept monomers have lower molecular mass.

with weaker intermolecular/Van der Waals'/London/dispersion forces; ***[2]***
Accept opposite argument for polymers.

3. (a) (i) ions/particles accelerated by electric field;
ions/particles deflected by magnetic field; ***[2]***
*Award **[1 max]** for acceleration and deflection of ions without reference to fields.*

(ii) prevents collisions / avoid false readings due to presence of other particles; ***[1]***

(b) $\frac{(54 \times 5.95) + (56 \times 91.88) + (57 \times 2.17)}{100}$;
55.90; ***[2]***
*Award **[2]** for correct final answer.*
Answer must be to 2 d.p.

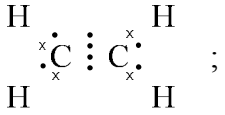
(c) 24; ***[1]***

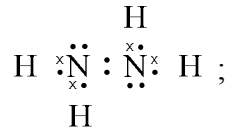
(d) metallic (bonding);
positive ions/cations **and** delocalized/sea of electrons;
electrostatic attraction between the two;
*Award **[2 max]** for description of bonding*

Conductivity:
electrons delocalised/free to move;

Malleability:
atoms/ions/cations can move without breaking bonds / atoms/ions/cations can slide past each other; ***[4]***

SECTION B

4. (a) (i)  ;

 ; ***[2]***

Accept x's, dots or lines for electron pairs.

(ii) *H–C–H:*
any angle between 118° and 122° ;
due to three negative charge centres/electron domains/electron pairs;

H–N–H:
any angle between 104° and 108° ;
due to four negative charge centres/electron domains/electron pairs;
extra repulsion due to lone electron pairs; ***[5]***
Do not allow ECF for wrong Lewis structures.

(b) (i) (relative) measure of an atoms attraction for electrons;
in a covalent bond / shared pair; ***[2]***

(ii) C–H is less polar as C is less electronegative / N–H bond is more polar as N is more electronegative / difference in electronegativity is greater for N-H than C-H; ***[1]***

(iii) bond polarities cancel in C_2H_4 / *OWTTE*; ***[1]***

(c) weaker van der Waals'/London/dispersion/intermolecular forces in ethene;
stronger (intermolecular) hydrogen bonding in hydrazine; ***[2]***
*If no comparison between strengths then **[1 max]**.*

(d) bonds broken: 4 N–H, N–N, O=O / $+2220\,(\text{kJ mol}^{-1})$;
bonds formed: N≡N , 4 O–H / $-2801\,(\text{kJ mol}^{-1})$;
$-581\,(\text{kJ mol}^{-1})$; ***[3]***
*Award **[3]** for correct final answer.*

(e) chloroethane;
(electrophilic) addition; ***[2]***
Do not accept free radical/nucleophilic addition.

(f) (i) acid-base/neutralization; ***[1]***

(ii) 109°/109.5° ; ***[1]***

5. (a) $n_C = \frac{81.7}{12.01} = 6.80$ **and** $n_H = \frac{18.3}{1.01} = 18.1$;
ratio of $1 : 2.67 / 1 : 2.7$;
C_3H_8; ***[3]***
No penalty for using 12 and 1.

(b) C_3H_8; ***[1]***

(c) (i) Br_2/bromine;
UV/ultraviolet light; ***[2]***
Accept hf/hv/sunlight.

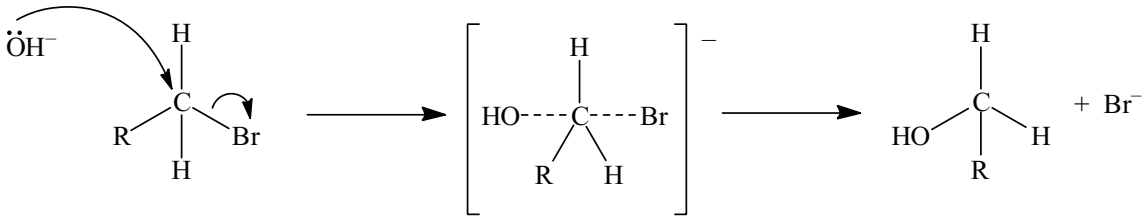
(ii) $Cr_2O_7^{2-}$ / MnO_4^- **and** acidified/ H^+/H_3O^+;
Accept names.
heat / reflux; ***[2]***

(d) *Initiation:*
$Br_2 \rightarrow 2Br\bullet$;

Propagation:
$Br\bullet + RCH_3 \rightarrow HBr + RCH_2\bullet$;
$RCH_2\bullet + Br_2 \rightarrow RCH_2Br + Br\bullet$;

Termination: ***[1 max]***
$Br\bullet + Br\bullet \rightarrow Br_2$;
$RCH_2\bullet + Br\bullet \rightarrow RCH_2Br$;
$RCH_2\bullet + RCH_2\bullet \rightarrow RCH_2CH_2R$; ***[4 max]***
*Award **[1]** for any termination step.*
Accept radical with or without • throughout.
Do not penalise the use of an incorrect alkane in the mechanism.

(e) (i) substitution **and** nucleophilic **and** bimolecular/two species in rate-determining step; ***[1]***
Allow second order in place of bimolecular.

(ii) 

curly arrow going from lone pair/negative charge on O in OH^- to C;
Do not allow curly arrow originating on H in OH^-.

curly arrow showing Br leaving;
Accept curly arrow either going from bond between C and Br to Br in bromoethane or in the transition state.

representation of transition state showing negative charge, square brackets and partial bonds; ***[3]***
Do not penalize if HO and Br are not at 180^o to each other.
Do not award M3 if OH ---- C bond is represented unless already penalised in M1.
Do not penalise the use of an incorrect alkyl chain in the mechanism.

(f) (i) $CH_3OCH_2CH_3$;
$CH_3CHOHCH_3$; ***[2]***
Allow more detailed structural formulas.

(ii) $CH_3CHOHCH_3$ has higher boiling point due to hydrogen bonding;
$CH_3OCH_2CH_3$ has lower boiling point due to Van der Waals'/London/dispersion/dipole-dipole forces;
hydrogen bonds in $CH_3CHOHCH_3$ are stronger;
Allow ecf if wrong structures suggested. ***[2max]***

6. (a) (i) exothermic;

Accept either of the following for the second mark.
increasing temperature favours endothermic/reverse reaction;
as yield decreases with increasing temperature; ***[2 max]***

(ii) yield increases / equilibrium moves to the right / more ammonia;
increase in pressure favours the reaction which has fewer moles of gaseous products; ***[2]***

(iii) (rate increases because) increase in frequency (of collisions);
increase in energy (of collisions);
more colliding molecules with $E \geq E_a$; ***[2 max]***

(b) (i) increase in the oxidation number; ***[1]***

(ii) $(NO_3) + 5$ **and** $(NO_2^-) + 3$; ***[1]***
Accept V and III.
Do not penalize missing charges on numbers.

(c) strong acid completely dissociated/ionized **and** weak acid partially dissociated/ionized;
$HNO_3(aq) \rightarrow H^+(aq) + NO_3^-(aq)$;
$HNO_2(aq) \rightleftharpoons H^+(aq) + NO_2^-(aq)$; ***[3]***
Allow only arrows as shown.
State symbols not needed.
Accept H_2O and H_3O^+.

(d) *With HNO_3:*
faster rate of bubble/gas/hydrogen production;
faster rate of magnesium dissolving;
higher temperature change; ***[2 max]***
Accept opposite argument for HNO_2.
*Award **[1]** if 2 observations given but acid is not identified.*
Reference to specific observations needed.

(e) (i) (nitric acid) $7.5\ cm^3$; ***[1]***

(ii) not valid as nitrous acid reacts with same volume/ $7.5\ cm^3$; ***[1]***

(f) HNO_3;
(higher conductivity for solutions with same concentration as) there are more ions in solution; ***[2]***

(g) change in oxidation numbers: Ag from 0 to +1 **and** N from +5 to +2;
Do not penalise missing charges on numbers.

balanced equation: $3Ag + NO_3^- + 4H^+ \rightarrow 3Ag^+ + NO + 2H_2O$ ***[3]***
*Award **[1]** for correct reactants and product;*
*Award **[3]** for correct balanced equation.*
Ignore state symbols.