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N02/420/S(2)M+

MARKSCHEME

November 2002

CHEMISTRY

Standard Level

Paper 2

10 pages

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) (i) carbon dioxide *(accept correct formula)*; ***[1]***

(ii) $CuCO_3(s) + 2HCl(aq) \rightarrow CuCl_2(aq) + CO_2(g) + H_2O(l)$ ***[2]***
*Award **[1]** for all formulas correct and **[1]** for correct balancing.*
State symbols not required.

(b) volume: 80 (cm^3)
time: 4 (mins) *(both needed for mark)*; ***[1]***

(c) (i) collision frequency greatest at start / decreases with time / *OWTTE*;
(not just a reference to collisions without mentioning time)
greatest concentration / number of reactant particles at start /
concentration / number of reactant particles decreases with time / *OWTTE*; ***[2]***

(ii) mass of $CuCO_3$ less in B / more in A *(not surface area)*;
concentration / amount of acid / HCl less in B / more in A; ***[2]***

(d) a curve with a steeper gradient than A;
but with same final volume; ***[2]***
Do not penalize if not labelled.

2.

	Protons	**Neutrons**	**Electrons**
^{27}Al	13	14	13
$^{24}Mg^{2+}$	12	12	10
$^{16}O^{2-}$	8	8	10
	[1]	***[1]***	***[1]***

[3]

*All three correct for a sub-atomic particle **[1]**.*

3. (a) 600 atm **and** 200 °C *(units needed, do not accept just low temperature and high pressure)*; ***[1]***

(b) (i) yield increases / more ammonia formed; *(not just forward reaction favoured)*
equilibrium shifts to side with fewer **gas** moles / molecules / volumes / *OWTTE;* ***[2]***

(ii) yield decreases / less ammonia formed; *(not just reverse reaction favoured)*
equilibrium shifts in endothermic direction / to side which absorbs energy / *OWTTE*; ***[2]***

(c) at 200 °C / low temperature reaction is (too) slow;
at 600 atm / high pressure the cost / danger is (too) great;
(Do not allow just high cost if no mention of pressure). ***[2]***

SECTION B

4. (a) (i) the energy required to remove an electron from a **gaseous** atom;
(do not award mark if any mention of electron gain) ***[1]***

(ii) I.E. increases along the period from Li to F;
electrons are being added to the same energy level / shell / orbital;
number of protons increases / nuclear charge increases / nuclear attraction increases / *OWTTE (allow atomic radius decreases)*; ***[3]***

(iii) I.E. decreases down the group from Li to Cs;
atomic radius increases / outer electron further from nucleus;
increasing shielding effect / weaker nuclear attraction / increased repulsion by inner electrons / *OWTTE*; ***[3]***

(b)

Na_2O	MgO	Al_2O_3	SiO_2	P_2O_3 / P_4O_6 / P_2O_5 / P_4O_{10}	SO_2 / SO_3
Six correct = ***[3]****, five/four correct =* ***[2]****, three/two correct =* ***[1]****.*					
basic	basic	amphoteric	acidic	acidic	acidic
Six correct = ***[3]****, five/four correct =* ***[2]****, three/two correct =* ***[1]****.*					

If none of last three marks scored, award ***[1]*** *for either basicity decreases or acidity increases across the period.*

(c) (i) the tendency of an atom to attract an electron **pair** / bonding pair in a covalent bond / compound; ***[1]***

(ii) ionic;
large difference in (electronegativity) values / Ca has low electronegativity and S has high electronegativity */ OWTTE*;
(do not accept just the values quoted from the Data Booklet). ***[2]***

(d) (i) metallic;
Mg has more delocalized / free electrons (than Na);
(not just more outer or valence electrons).

(ii) van der Waals' forces / dispersion forces / London forces;
(ignore covalent bonding in Cl_2 *)*
Cl_2 / has higher M_r / is a bigger molecule / chlorine is diatomic and argon is monatomic / *OWTTE*;
(do not award second mark if any reference to breaking of covalent bonds). ***[4]***

5. (a) strong acid is fully ionised / dissociated (in solution);
$HCl(aq) \rightarrow H^+(aq) + Cl^-(aq)$;
weak acid is only partly ionised / dissociated (in solution);
$H_2CO_3(aq) \rightleftharpoons 2H^+(aq) + CO_3^{2-}(aq)$ / $H_2CO_3(aq) \rightleftharpoons H^+(aq) + HCO_3^-(aq)$; ***[4]***
$\rightarrow$ needed in first equation, $\rightleftharpoons$ needed in second equation, state symbols not required, accept equations including water as reagent.

(b) *e.g.* universal indicator; HCl = red
H_2CO_3 = yellow / orange;

electrical conductivity; HCl = high
H_2CO_3 = low;

reaction with metal / metal carbonate; HCl = vigorous
H_2CO_3 = slow; ***[4 max]***
*Any two of the above, **[1]** for test and **[1]** for correct answer for both acids. Accept other suitable answers.*

(c) correct ratio e.g. $10000:1$ / $10^4:1$ / $0.1:0.00001$ / $1:0.0001$ / $10^{-1}:10^{-5}$;
$HCl:H_2CO_3$;
(correct number ratio = [1], correct way round clearly stated).

(d) (i) HCO_3^- and H_2CO_3
base conjugate acid;
HCl and Cl^-
acid conjugate base; ***[2]***

(ii) Brønsted-Lowry; ***[1]***

(e) strong base = barium hydroxide / any group 1 hydroxide;
weak base = ammonia / aminoethane / magnesium hydroxide; ***[2]***
Accept other suitable examples and accept correct formulas.

(f) *Accept any correctly balanced equation with H_2CO_3 and a base identified in (e).*
e.g. $H_2CO_3 + Ba(OH)_2 \rightarrow BaCO_3 + 2H_2O$
or $H_2CO_3 + 2NH_3 \rightarrow (NH_4)_2CO_3$ ***[2]***
*All formulas correct = **[1]**, correct balancing = **[1]**. State symbols not necessary.*

(g) (i) basic / alkaline;

(ii) neutralisation;

(iii) too strong / damages skin / corrosive / *OWTTE*; ***[3]***

6. (a) (homologous series)
group of (organic) compounds with same general formula;
neighbouring members differ by CH_2;
$C_nH_{2n+1}OH$ / any correct alkanol formula; ***[3]***

(functional group)
group of atoms in a compound with characteristic chemical properties / *OWTTE*;
–OH / hydroxyl is functional group in alkanols; ***[2]*** ***[5]***

(b) amine first, acid last;
ester before alkanol; ***[2]***
Accept correct names or formulas.

(c) (i) $CH_3COOH + C_2H_5OH \rightleftharpoons CH_3COOC_2H_5 + H_2O$; ***[2]***
Correct reactants ***[1]****, correct products* ***[1]****. Accept* $\rightarrow$.

(ii) $CH_3COOC_2H_5$ has a sweet / fruity smell / oily drops;
ester; ***[2]***

(iii) dehydrating agent;
catalyst; ***[2]***

(d) (i) bromine (water) / potassium manganate(VII) solution;
decolorises; ***[2]***

(ii) $C_2H_4 + H_2O \rightarrow C_2H_5OH$; ***[1]***

(iii) heat / catalyst / concentrated sulfuric acid; ***[1]***

(e) (i) acidified potassium dichromate(VI);
oxidation / reduction / redox / oxidation-reduction; ***[2]***

(ii) colour changes from orange to green; ***[1]***
Accept any other suitable oxidising agent and correct colour change.