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M02/420/S(2)M+

MARKSCHEME

May 2002

CHEMISTRY

Standard Level

Paper 2

9 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 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.

SECTION A

1. (a) Na 11 protons and 11 electrons ***[1]***;
Al^{3+} 13 protons and 10 electrons ***[1]***;
P^{3-} 15 protons and 18 electrons ***[1]***. ***[3]***

(b) *(Award **[1]** for any two from the following:)*

increasing proton number / nuclear charge ***[1]***;
electrons attracted more strongly to nucleus ***[1]***;
electrons in same shell / energy level / no change in shielding ***[1]***. ***[2]***

(c) Al loses electrons, P gains electrons (*allow equations*) ***[1]***;
phosphide/phosphorus has one more shell / energy level than aluminium ***[1]***. ***[2]***
Allow 2.8 and 2.8.8 for second mark.

(d) (i) $2Na + 2H_2O \rightarrow 2NaOH + H_2$ ***[1]***;
alkaline ***[1]***; ***[2]***

(i) $Cl_2 + H_2O \rightarrow HCl + HClO$ ***[1]***;
acidic ***[1]***. ***[2]***

2. (a) Both are proton acceptors. ***[1]***

(b) (i) sodium hydroxide, more ions / more dissociated ***[1]***

(ii) greater / 12–14 ***[1]***;
more OH^- / less H^+ ***[1]***.
Second mark can only be awarded if the first mark has been achieved. ***[2]***

(c) $NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$ ***[1]***;
acid base ***[1]***; ***[2]***

3. (a) 249.71 (*allow 249–250*) ***[1]***

(b) 0.04005 (*accept 0.04*) ***[1]***

(c) 3.19 (g) ***[1]***

SECTION B

4. (a) **A** is ethanol ***[1]***;
B is ethanal ***[1]***;
C is ethanoic acid ***[1]***;
D is ethyl ethanoate ***[1]***. ***[4]***

(b) (i) esterification / condensation ***[1]***;
(concentrated) sulfuric acid / H_2SO_4 (*not dilute*) ***[1]***;
water / H_2O ***[1]***. ***[3]***

(ii) CH_3CH_2OH ***[1]***;
CH_3COOH ***[1]***. ***[2]***

(iii) flavourings / other valid uses ***[1]***

(c) hydrogen / H_2 ***[1]***;
$2CH_3COOH + Mg \rightarrow (CH_3COO)_2Mg + H_2$ ***[1]***;
magnesium ethanoate ***[1]***. ***[3]***

(d) **B**, **A**, **C** ***[1]***;
B has dipole–dipole attractions ***[1]***;
A has hydrogen bonding ***[1]***;
C has more/stronger hydrogen bonding / forms dimers ***[1]***. ***[4]***

(e) $HCOOCH_3$ ***[1]***;
methyl methanoate ***[1]***. ***[2]***

If full structural formulas are given in (b) (ii) and (e), but the H atoms attached to the C– bonds are omitted, penalize first time only.

(f) asymmetric carbon atom / chiral centre / carbon attached to four different atoms/groups / asymmetric molecule. ***[1]***

5. (a) forward and reverse reactions still occurring / forward and reverse rates equal ***[1]***;
concentrations of reactants and products unchanged ***[1]***. ***[2]***

(b) Reactants and products in the same phase/state. ***[1]***

(c) $K_c = \dfrac{[NH_3]^2}{[N_2][H_2]^3}$

Accept correct expression for K_p
Use of [] and formulas in correct position ***[1]***;
powers correct ***[1]***. ***[2]***

(d) (i) rate increased ***[1]***;
equilibrium constant decreased ***[1]***. ***[2]***

(ii) rate increased ***[1]***;
equilibrium constant unchanged ***[1]***. ***[2]***

(iii) too expensive / greater cost of energy or pipes / more safety precautions / thicker pipes ***[1]***

(e) iron / Fe ***[1]***;
equilibrium constant unchanged ***[1]***;
only temperature affects K_c / catalyst speeds up forward and reverse reactions equally / activation energy reduced by same amount for both forward and reverse reactions ***[1]***. ***[3]***

(f) *(Award* ***[1]*** *for any three of the following:)*

successful collisions need minimum/activation energy / correct geometry ***[1]***;
increasing temperature causes increase in energy of particles ***[1]***;
so increased proportion of successful collisions ***[1]***;
so increased frequency of collisions / more collisions per unit time ***[1]***.
Do not accept just "more collisons". ***[3]***

(g) (i) shifted to right ***[1]***;
to replace the ammonia removed ***[1]***; ***[2]***

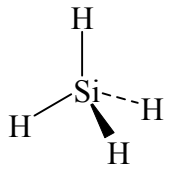
(ii) shifted to right ***[1]***;
fewer gas moles on the right / *OWTTE* ***[1]***. ***[2]***

6. (a) (i) positive ions (*not nuclei*) ***[1]***;
delocalised/sea of electrons ***[1]***;
electrostatic attraction between the two ***[1]***;
electrons free to move ***[1]***.
Any mention of negative ions, first three marks lost. ***[4]***

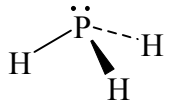
(ii) :F̈:F̈: (*allow* × *or* •, *accept* |F — F|) ***[1]***;
covalent ***[1]***;
shared pairs of electrons ***[1]***;
van der Waals' / dispersion / London forces ***[1]***;
attraction between temporary / fluctuating / oscillating / induced dipoles ***[1]***. ***[5]***

(iii) sodium 2,8,1 (*or diagram or spdf*) ***[1]***;
fluorine 2,7 (*or diagram or spdf*) ***[1]***;
sodium's outer electron transfers to fluorine ***[1]***;
oppositely charged ions / ions formed with complete octets of electrons ***[1]***. ***[4]***

(iv) Ions not free to move in solid / can move in molten state ***[1]***

(b) (i) 

[1];
tetrahedral ***[1]***. ***[2]***

(ii) 

(*lone pair on P not essential for mark*) ***[1]***;
pyramidal ***[1]***. ***[2]***
Dotted line and wedge in structures in (i) and (ii) are not essential, as long as 3-D shapes are implied.

(c) 109° – 109.5° ***[1]***;
non-bonding pairs repel more than bonding pairs ***[1]***.
Do not allow non-bonding pairs repel atoms. ***[2]***