edexcel

Edexcel GCE

Chemistry

6244/01

June 2006

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Results Mark Scheme

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Chemistry

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1. (a) (i) $2Al + 3Cl_2 \rightarrow Al_2Cl_6$
NOT $AlCl_3$
IGNORE state symbols **(1 mark)**

(ii) covalent **(1)**
ALLOW polar covalent
NOT giant covalent
NOT partially covalent

dative (covalent)/co-ordinate **(1)** **(2 marks)**

(b) (i) $SiCl_4 + 2H_2O \rightarrow SiO_2 + 4HCl$
ALLOW $SiCl_4 + 4H_2O \rightarrow Si(OH)_4 + 4HCl$
ALLOW $SiCl_4 + 4H_2O \rightarrow H_4SiO_4 + 4HCl$
ALLOW $SiCl_4 + 3H_2O \rightarrow H_2SiO_3 + 4HCl$ **(1 mark)**

(ii) Fume cupboard **(1)**
as **HCl** is irritant/harmful **(1)** *NOT consequential on (b)(i)*

OR
use small quantities/add slowly/with cooling **(1)**
due to (highly) exothermic reaction **(1)**
NOT "vigorous"

These marks are freestanding within the answer pairs **(2 marks)**

(c) (i) Tetrahedral/tetrahedron/triangular (based) pyramid
NOT pyramid **(1 mark)**

(ii) lone pair on oxygen in water **(1)**
ALLOW omission of oxygen or water

THEN

Either
cannot attack C atom **(1)**
because C atom too small / Cl atom too large **(1)**

OR
C (atom) has no low energy **d**/2d orbitals **(1)**
ALLOW "no available **d** orbitals"
So cannot form (dative covalent) bond **(1)**

OR
C (atom) has no low energy **d**/2d orbitals **(1)**
ALLOW "no available **d** orbitals"
C-Cl broken first **(1)**

If "no 3d orbitals" **2 max** **(3 marks)**

(d) oxidising (agent)/oxidant/can be reduced **(1 mark)**

(e) tin is more stable in +4 than +2 oxidation state **(1)**
MUST have comparison

so Sn(IV) does not oxidise Cl^-/HCl
OR Sn(IV) not oxidising
OR Sn(IV) not reduced (by Cl^-/HCl)
OR SnO_2 reacts as a base **(1)**
(therefore reaction II)
ALLOW ions

OR
(reaction I does not work) because Sn(IV) more stable than Sn(II) **(1)**
because energy required to promote (s) electrons is less than energy gained from bond formation **(1)**

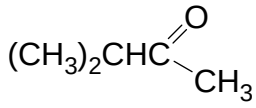
If "reaction I more likely" **(0)** **(2 marks)**

Total 13 marks

2 (a) (i) CHI_3
IGNORE correct name **(1 mark)**

(ii) methyl ketone / CH_3CO- **(1)**
if also include $CH_3CH(OH)$ OR ethanol OR ethanal then **(0)** **(1 mark)**

(iii) structure: (double bond must be shown)



(1)

methylbutanone
OR 3-methylbutan(-2-)one **(1)** *ALLOW* 2-methylbutan(-3-)one
Name only scores on a correct structure NOT consequential on structure **(2 marks)**

(b) (i) aldehyde(s)
IGNORE carbonyl **(1 mark)**

(ii) copper(I) oxide/Cu_2O /cuprous oxide
NOT copper oxide **(1 mark)**

(c) any strong acid
ALLOW HCl/conc H_2SO_4 NOT hydrogen chloride
ACCEPT name or formula
If other reagents with the acid e.g. $K_2Cr_2O_7$ **(0)** **(1 mark)**

(d) (i) effervescence/fizzing/bubbles *NOT* gas evolved
NOT CO_2 evolved

OR
solid dissolves/disappears *NOT* solution formed **(1 mark)**

(ii) $CH_3(CH_2)_3COOH + NaHCO_3 \rightarrow CH_3(CH_2)_3COONa + H_2O + CO_2$
correct formula of pentanoic acid **(1)**
balanced equation **(1)**

ALLOW $CH_3(CH_2)_3CO_2H$ and $CH_3(CH_2)_3CO_2Na$
ALLOW $-COO^-Na^+$ *but not* — O —Na

RCOOH + $NaHCO_3 \rightarrow RCOONa + H_2O + CO_2$ - *Scores 2nd mark IGNORE R*
OR $R.COOH + HCO_3^- \rightarrow RCOO^- + H_2O + CO_2$
(2 marks)

Total 10 marks

3 (a) (i) $-\lg(0.05) = 1.3(0)$
IGNORE sig figs from this point on in this question **(1 mark)**

(ii) $[OH^-] = 1 \times 10^{-14} / 0.05 = 2 \times 10^{-13}$ (mol dm^{-3})
OR via pOH
Correct answer with no working **(1)** **(1 mark)**

(b) (i) $K_a = [H_2PO_4^-][H_3O^+]/[H_3PO_4]$
NOT using H^+ instead of H_3O^+ **(1 mark)**

(ii) $[H_3O^+] = 10^{-1.20}$
$= 0.063$ (mol dm^{-3}) **(1)**

$K_a = \dfrac{0.063^2}{0.500 - 0.063}$ **(1)** *NOT consequential on (b)(i)*
$= 9.08 \times 10^{-3}$ **(1)** mol dm^{-3} **(1)**
$= 9.11 \times 10^{-3}$ if $[H_3O^+]$ not rounded

ALLOW
$K_a = \dfrac{0.063^2}{0.500}$ **(1)**
$= 7.94 \times 10^{-3}$ **(1)** mol dm^{-3} **(1)**
$= 7.96 \times 10^{-3}$ if $[H_3O^+]$ not rounded

ALLOW consequential marking on numerical errors
Correct answer with units and some working **(4)**
(4 marks)

(c) (i) Assign the terms 'acid/base' **(1)**
link the pairs **(1)** **(2 marks)**

(ii) presence of H^+ from the first dissociation keeps equilibrium to left /suppresses ionisation **(1 mark)**

(d) Bromocresol green **(1)**

pK_{in}/range/colour change (of indicator) lies in vertical section
OR
For alternative indicators pK_{in}/range/colour change (of indicator) lie outside vertical section **(1)** **(2 marks)**

Total 12 marks

4 (a) (i) enthalpy/heat/energy change/produced [NOT "required"] when one mole of gaseous ions **(1)**

are dissolved **in excess water/ to infinite dilution (1)** **(2 marks)**

(ii) Bonds formed / attraction between **(1)**

cation and δ^- O/lone pair (in water)
OR anion and δ^+ H (in water) **(1)**

If bond between anion and cation **(0)** **(2 marks)**

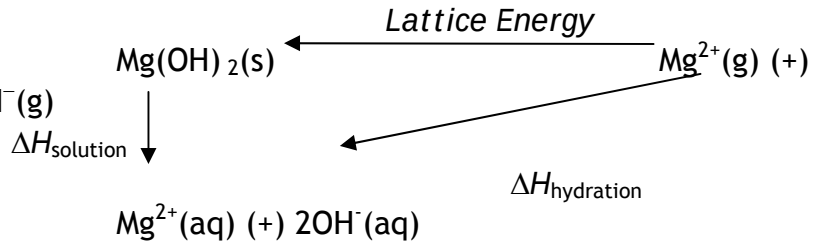
(b) as magnesium has a much smaller **ion** (than barium ion) **(1)**

and has same charge *OR charge shown* **(1)**

so stronger attraction between ions **(1)**
ALLOW stronger bonds between ions

"charge density" scores **1 (out of first 2 marks**)
IGNORE references to polarisation and covalency of the ions **(3 marks)**

(c) (i) cycle:
for each labelled arrow joining correct species.



Species and stoichiometry **(1)**
State symbols **(1)**
Labels appropriate to direction of arrows **(1)** *ALLOW numerical values*
ALLOW cycles using –LE **(3 marks)**

(ii) $\Delta H_{solution} = -$ LE + $\Sigma\Delta H_{hydration}$ *OR* numbers **(1)**

+5 kJ mol^{-1} (1)
Consequential on candidate's cycle e.g.
calculation from cycle with one OH^- giving +555 kJ mol^{-1} **(2)**
BUT correct answer with working **(2)** *even if the (c)(i) cycle is wrong* **(2 marks)**

(d) Calculation of $\Delta H_{solution}$ of $Ba(OH)_2$ as -55 kJ mol^{-1}
OR
LE down by 675 but $\Delta H_{hydration}$ down by 615
ALLOW LE down but $\Delta H_{hydration}$ down by less **(1)**

$\therefore$ $\Delta H_{solution}$ is more exothermic **(1)**

$\therefore$ solubility is greater **(1)**

2nd mark dependent on 1st
3rd mark dependent on 2nd **(3 marks)**

ALLOW consequential marking *if* $\Delta H_{solution}$ *less exothermic*

Total 15 marks

5. (a) (i) chiral carbon marked as one to right of $-C_6H_4-$ **(1 mark)**

(ii) Has non-superimposable mirror images
OR no plane/centre of symmetry
NOT four different groups about the C atom *on its own*
NOT asymmetric C atom **(1 mark**

(b) **rotate** (the) plane (of plane) polarised (monochromatic) light **(1)**
(equally) in opposite directions **(1)**

OR
pass polarised light through sample **(1)**
rotate the plane (equally) in opposite directions **(1)** **(2 marks)**

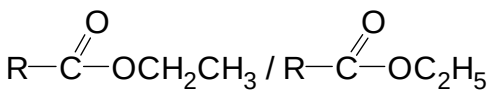
(c) (i) PCl_5 /PCl_3 /$SOCl_2$ *OR* names **(1)**

phosphorus(V) oxide /pentoxide /P_4O_{10}/P_2O_5 **(1)** **(2 marks)**

(ii) Nucleophilic substitution **(1 mark)**

(d) bromine **(1)** *NOT* bromine water
(aqueous) sodium hydroxide/ potassium hydroxide **(1)**
OR
$LiAlH_4$ **(1) then** acid/water **(1)**
OR
H_2 **(1)** Ni/Pt/Pd **(1)**
OR
Na **(1)** ethanol **(1)**

2nd reagent depends on the 1st
Incorrect 2nd reagent negates 1st mark **(2 marks)**

(e) (i) 
Double bond must be shown
Full structural formula must have H's **(1 mark)**

(ii) reaction with **A** is faster/does not need a catalyst/does not need heating **(1)**

and gives higher yield/not reversible/not equilibrium/goes to completion **(1)** **(2 marks)**

(f) Any named strong acid solution **(1)**
ALLOW formulae with indication of state
NOT (conc) H_2SO_4
NOT sulphuric acid

heat under reflux **(1)** – *NOT stand alone but can score if (conc) H_2SO_4 given as the acid*
ALLOW "heat/reflux"

OR
Any named strong aqueous alkali (heat) **(1)**
ALLOW formulae with indication of state

Then add named strong acid **(1)**

(2 marks)

ALLOW formulae

Total 14 marks

6. (a) $K_c = \frac{[H_2]^2 [S_2]}{[H_2S]^2}$

MUST be square brackets **(1 mark)**

(b)

	H_2S	H_2	S_2
Number of moles at equilibrium	(0.350)	0.150	0.075
		(1)	**(1)**
Concentration	0.0175	0.0075	0.00375

(1)
i.e. ÷ 20

$K_c = \frac{[0.0075]^2[0.00375]}{[0.0175]^2}$

$= 6.9 \times 10^{-4}$ **(1)** *award only if concentration used* mol dm^{-3} **(1)**

ALLOW consequential marking on (a) and numerical errors
PENALISE anything other than 2SF in final answer
Units consequential on the K_c expression used

(5 marks)

(c) K_c does not change **(1)**

Change in pressure increases value of numerator more than denominator/quotient bigger, so no longer at equilibrium **(1)**
ALLOW fewer (gas) molecules on LHS

Equilibrium shifts to restore equality (of quotient) with K_c
OR Equilibrium shifts to LHS **(1)**

If K_c changes **max 1**

(3 marks)

(d) (i) no change **(1 mark)**

(ii) Increases **(1 mark)**
If reason given, must be correct

Total 11 marks

Total for paper 75 Marks