ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Chemistry 5421

CHM2 Foundation Physical and Inorganic Chemistry

Mark Scheme

2006 examination - January series

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

CHM2

Question 1

(a)	enthalpy change/ heat energy change when 1 mol of a substance	1
	is completely burned in oxygen	1
	at 298K and 100 kPa or standard conditions	1
	(not 1 atm)	
(b)	$\Delta H = \sum$ bonds broken – $\sum$ bonds formed	1
	= (6 x 412) + 612 +348 + (4.5 x 496) – ((6 x743) + (6 x 463))	1
	= − 1572 $kJmol^{-1}$	1
(c)	by definition ΔH_f is formation from an element	1
(d)	$\Delta H_c = \sum \Delta H_f$ products -$\sum \Delta H_f$ reactants or cycle	1
	= (3 x – 394) + (3 x -242) – (+20)	1
	= − 1928 $kJmol^{-1}$	1
(e)	bond enthalpies are mean/average values	1
	from a range of compounds	1

Total 12

Question 2

(a)	minimum energy	1
	to start a reaction/ for a reaction to occur/ for a successful collision	1
(b)	activation energy is high / few molecules/particles have sufficient energy to react/	
	few molecules/particles have the required activation energy	1
	(or breaking bonds needs much energy)	
(c)	molecules are closer together/ more particles in a given volume	1
	therefore collide more often	1
(d)	many	1
	more molecules have energy greater than activation energy (QoL)	1
(e)	speeds up a reaction but is chemically unchanged at the end	1
(f)	increases the surface area	1

Total 10

Question 3

(a) removal/loss of electrons 1

(b) no change 1
equal number of gaseous moles on either side 1
both sides affected equally 1
increases 1
equilibrium moves to lower the temperature/oppose the change 1
endothermic reaction favoured /forward reaction is endothermic 1

(c) (i) +2 1
+5 1

(ii) $NO_3^- + 4H^+ + 3e^- \rightarrow NO + 2H_2O$ 1

(iii) $Ag \rightarrow Ag^+ + e^-$ 1

(iv) $NO_3^- + 4H^+ + 3Ag \rightarrow NO + 2H_2O + 3\ Ag^+$ 1

Total 12

Question 4

(a) decreases 1
number of shells increases/ shielding increases /atomic size increases 1
weaker attraction (by nucleus) on bonding electrons / weaker attraction (by nucleus) on electron pair in a covalent bond 1

(b) (i) increases 1

(ii) concentrated sulphuric acid 1

(c) white ppt 1
soluble in ammonia 1
cream ppt 1
partially soluble /insoluble in ammonia 1

(d) $Cl_2 + 2NaOH \rightarrow NaCl + NaOCl + H_2O$ 1
bleach 1
disinfectant /steriliser/kills bacteria 1

Total 12

Question 5

(a) energy comes from combustion of coke/ C *(not coal)* 1

(allow this mark if stated that the $C + O_2 \rightarrow CO_2$ reaction is exothermic)

air blown in *(not oxygen)* 1

$C + O_2 \rightarrow CO_2$ 1
$CO_2 + C \rightarrow 2CO$ 1
Fe_2O_3 (1) $+ 3CO \rightarrow 2Fe + 3CO_2$ 1
the carbon dioxide released contributes to global warming (or CO is toxic) 1
(or slag is an eyesore)

limestone is used to remove silicon dioxide / impurities 1
as slag (*or stated under equation*) 1

$CaCO_3 \rightarrow CaO + CO_2$ 1
$CaO + SiO_2 \rightarrow CaSiO_3$ 1
(combination of these two equations gains 2 marks)

(b) oxygen 1
is blown into molten iron (QoL) 1

to give phosphorus oxides or P_4O_{10} or $P_4 + 5O_2 \rightarrow P_4O_{10}$ 1

lime or limeatone removes phosphorus oxides 1
as slag 1
(or $6CaO + P_4O_{10} \rightarrow 2Ca_3(PO_4)_2$ scores the last two marks)

Total 15