OXFORD

INTERNATIONAL
AQA EXAMINATIONS

International A-Level **Chemistry**

CH03 – Unit 3: Inorganic 2 and Physical 2

Mark scheme

9260

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Version/Stage: 1.1 Final

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' 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.

Further copies of this mark scheme are available from aqa.org.uk

Question	Marking guidance	Mark	Comments
01.1	$[Cu(H_2O)_6]^{2+} + 4\ Cl^- \rightleftharpoons [CuCl_4]^{2-} + 6\ H_2O$ ligand substitution/exchange tetrahedral chloride ions are bigger (than water molecules) OR chloride ions have a negative charge	1 1 1 1	Allow →
01.2	spilt of d-orbitals **OR** d electrons move from ground to excited state visible light is absorbed remaining wavelengths are transmitted/reflected.	1 1 1	must have reference to d-electrons or electrons in the (3)d sub shell. do not allow emission of light
01.3	It changes the energy difference between the ground state and excited state	1	
01.4	6	1	
01.5	1,3-diaminopropane **OR** propane-1,3-diamine has a lone pair of electrons on each <u>nitrogen</u> OR each <u>nitrogen</u> is able to donate a pair of electrons	1 1	

01.6	(suitable test reagent such as) named carbonate / magnesium / UI (correct comparative observation based on reagent) fizzes faster with 3+, UI redder with 3+	1 1	

	Total	**13**	

Question	Marking guidance	Mark	Comments
02.1	SiO_2 reacts with bases / NaOH / CaO / $CaCO_3$	1	
02.2			CE = 0/3 if mention of atoms / molecules / metallic
	It is an ionic lattice / giant ionic	1	Allow giant lattice if ions mentioned in answer
	Contains oppositely charged ions/ + and - ions	1	
	with strong forces of attraction between the ions	1	
			Allow a lot of energy to separate oppositely charged ions.
			M3 dependent on M2
			Max 1/3 if mention of electronegativity ie M1 only
02.3	SO_3 is a bigger molecule than SO_2	1	CE = 0 if mention of ions
	so van der Waals' forces between molecules are stronger	1	
02.4	no reaction or no hydrolysis or only dissolving occurs	1	Allow NaCl is the salt of a strong acid and a strong alkali
02.5	Al^{3+} small and highly charged (and weakens the O-H bond the ligand)	1	Allow Al^{3+} is highly polarising
			Allow Al^{3+} weakens the O-H bond
	$[Al(H_2O)_6]^{3+} + H_2O \rightarrow [Al(H_2O)_5(OH)]^{2+} + H_3O^+$	1	Accept equations with more than one H_2O reacting
			Allow formation of H^+

02.6	phosphoric(V) acid or H_3PO_4 **AND** hydrochloric acid or HCl	1	allow phosphoric acid

	Total	**10**	

Question	Marking guidance	Mark	Comments
03.1	$2\ K^+(g) + O^{2-}(g)$ $2\ K(s) + ½\ O_2(g)$	1 1	
03.2	the enthalpy change which accompanies the formation of one mole of gaseous atoms from the element in its standard state (under standard conditions)	1 1	If one mole of element then do not award this mark
03.3	electron and ion both have negative charges and so repel each other	1	Allow have the same charge
03.4	(M1 expression in words or symbols) $\Delta_f H = \Delta_a H$(oxygen) + 2 x $\Delta_a H$(K) + 2 x $\Delta_{IE1} H$ + $\Delta_{1EA} H$ + $\Delta_{2EA} H$ – X OR X = $\Delta_a H$(oxygen) + 2 x $\Delta_a H$(K) + 2 x $\Delta_{IE1} H$ + $\Delta_{1EA} H$ + $\Delta_{2EA} H$ – $\Delta_f H$ (M2 expression with correct numbers) -362 = 248 + (2 x 90) + (2 x 418) + -142 + 844 + -X OR X = 248 + (2 x 90) + (2 x 418) + -142 + 844 + 362 enthalpy of lattice dissociation = (+)2328 kJ mol^{-1}	 1 1 1	2328 scores 3 marks Allow answers given to 3 significant figures

03.5	Experimental lattice enthalpy value allows for/includes covalent interaction / non-spherical ions / distorted ions / polarisation Theoretical lattice enthalpy value assumes only ionic interaction / point charges / no covalent / perfect spheres / perfectly ionic	1 1	Allow discussion of AgCl instead of AgF. Allow AgF has covalent character OR AgF is not perfectly ionic in place of either point for 1 mark. CE = 0 for mention of molecules, atoms, macromolecular, mean bond enthalpy, intermolecular forces, electronegativity

03.6	chloride ion larger (than fluoride ion) (or reverse argument) Attraction between Ag^+ and Cl^- weaker (or reverse argument)	1 1	Penalise chlorine ion once only. Allow chloride ion has smaller charge density but do not allow mass to charge ratio

	Total	**12**	

Question	Marking guidance	Mark	Comments
04.1	second box (yield decreases, K_p stays the same)	1	
04.2	$K_p = \dfrac{p\ C_2H_2\ \times p^3\ H_2}{p^2\ CH_4}$	1	ignore curved brackets, do not accept [ ]
04.3	mole fractions of all three gases CH_4 = 0.125; C_2H_2 = 0.225; H_2 = 0.65(0) partial pressures of all three gases CH_4 = 62.5 kPa; C_2H_2 = 112.5 kPa; H_2 = 325 kPa (answer to 3 significant figures) 9.89×10^5 (units =) kPa^2	1 1 1 1	
	Total	**6**	

Question	Marking guidance	Mark	Comments
05.1	Any two of • no reactions to be reversed • no need for any current to be supplied • substances/consumables can be supplied continuously	2	
05.2	(A) hydrogen / H_2 (C) water / H_2O	1 1	
05.3	(CO_2 + 2 KOH →) K_2CO_3 + H_2O	1	Accept products in either order
05.4	H_2 + 2 OH^- → 2 H_2O + 2 e^-	1	Accept fractions and multiples
05.5	2 H_2 + O_2 → 2 H_2O	1	Accept fractions and multiples
	Total	**7**	

Question	Marking guidance	Mark	Comments
06.1	increase in disorder as **OR** more disorder in products six moles of water on right (compared to 1 mole of solid)	1	Accept six moles of liquid/water more disorganised than 1 mole of solid Allow liquid (on right) more disordered than solid (on left)
06.2	activation energy too/very high	1	
06.3	216 = (198 + 3 X) – (186 + 189) OR 3 X = 216 +186 +189 -198 X = 131 (J K^{-1} mol^{-1})	1 1	Correct answer with or without working scores 2. Mark on for either a transcription or arithmetic error.
06.4	$\Delta G = \Delta H - T\Delta S$ ΔG = 206 – 423(216/1000) ΔG = 115 kJ mol^{-1}	1 1 1	 If no conversion of T or ΔS then can score M1 only Allow unrounded value of 114.632 must have correct units allow answers in J mol^{-1}

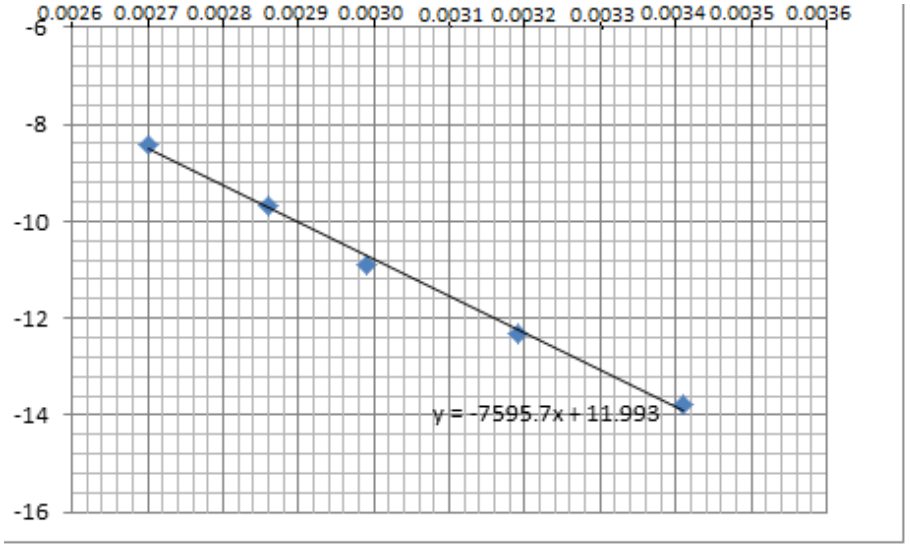
06.5	not feasible because ΔG is positive	1	
06.6	straight line with negative gradient	1	
	Total	**9**	

Question	Marking guidance	Mark	Comments
07.1	(test 1) add (hydrochloric acid and) barium chloride (solution) (observation) white precipitate (test 2) add aqueous sodium hydroxide (observations) brown precipitate result gas which turns damp red litmus blue formed	1 1 1 1 1	 allow use of aqueous ammonia or a named soluble carbonate Allow reference to pungent gas do not award this mark if aqueous ammonia or named soluble carbonate is used.
07.2	(dilute) sulfuric acid or H_2SO_4	1	allow nitric acid do not allow any other acid
07.3	colourless/(pale) green to (light) pink/purple caused by unreacted/excess MnO_4^-	1 1	

07.4	moles MnO_4^- (= 0.0151 x 13.25/1000) = 2.00(075) x 10^{-4}	1	
	moles Fe^{2+} (= 5 x 2.00075 x 10^{-4}) = 1.00(0375) x 10^{-3}	1	
	moles Fe^{2+} or Fe^{3+} in full 250 cm^3 = 1.00(0375)x 10^{-2}	1	
	M_r = 4.82 / 1.00(1) x 10^{-2} = 481(.819) OR 482	1	
	x = (482 – 266)/18 = 12	1	

	Total	**13**	

Question	Marking guidance	Mark	Comments
08.1	has not changed any concentration	1	allow only one experiment has been completed
08.2	Experiment with $[O_3]$ changed (but not $[NO_2]$) Experiment with $[NO_2]$ changed (but not $[O_3]$)	1	
08.3	(first step) $O_3 + NO_2 \rightarrow NO_5$ **OR** $O_3 + NO_2 \rightarrow O_2 + NO_3$ (second step) $NO_5 + NO_2 \rightarrow N_2O_5 + O_2$ **OR** $NO_3 + NO_2 \rightarrow N_2O_5$	1 1	Allow any equation with 1 O_3 and 1 NO_2 on left and balances If first mark not awarded then CE = 0 The second step, when added to the first step must give the correct overall equation
08.4	third/3	1	

08.5	all five points plotted correctly straight line of best fit drawn gradient of line drawn calculated correctly – this must have a negative sign.  	1 1 1	correct gradient is –7596.

08.6	gradient x (–8.31 /1000) correct evaluation to nearest whole number or better gradient of –7596 gives 63(.12) (kJ mol^{-1})	1 1	If –4500 is used answer = (+)37(.395) kJ mol^{-1}

	Total	**10**	