Version 1.1

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Chemistry 5421

CHM2 Foundation Physical and Inorganic Chemistry

Mark Scheme

2009 examination - January series

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Registered address: AQA, Devas Street, Manchester M15 6EX *Dr Michael Cresswell Director General*

Question	Part	Sub Part	Marking Guidance	Mark	Comments
1	(a)		X on the time axis under the H of H_2O;	1	
1	(b)		System at equilibrium opposes any change made to it;	1	
1	(c)		None; Same number of moles/molecules/particles on each side;	1 1	If this is wrong lose both marks in this section. Not atoms
1	(d)	(i)	Increase rate; More particles/collisions have $E>E_a$;	1 1	If this is wrong lose both marks in this section Allow sufficient/enough energy. Not more frequent/ forceful collisions or E_a lower.
1	(d)	(ii)	Increase; Finds an alternative route/ correct orientation/ surface to react on; Lower activation energy;	1 1 1	If this is wrong lose all marks in this section
1	(d)	(iii)	Exothermic/negative/-ve /heat (energy) given out;	1	
1	(e)		Increase; Opposes the change; Moves to right/replace CO_2;	1 1 1	If this is wrong lose all marks in this section Allow favours forward reaction

Question	Part	Sub Part	Marking Guidance	Mark	Comments
2	(a)	(i)	Al_2O_3;	1	
2	(a)	(ii)	Ions move	1	
2	(a)	(iii)	Lowers temp /mp bauxite too high;	1	Must be temp related, not energy.
2	(a)	(iv)	$Al^{3+} + 3e^- \rightarrow Al$; $2O^{2-} \rightarrow O_2 + 4e^-$;	1 1	
2	(b)		Conserves bauxite/ prevents mining / prevents landfill/ prevents eyesore on landscapes / saves energy or electricity / cost of purifying bauxite too high /reduces greenhouse gases;	2 max	Any 2
2	(c)	(i)	$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$; High temp/1500°C/ accept temp in range 1000-2000°C;	1 1	 Do not allow hot air
2	(c)	(ii)	Reducing agent/reductant/electron donor;	1	
2	(c)	(iii)	CO is a gas whereas C is a solid;	1	QWC Allow correct energy explanation.

Question	Part	Sub Part	Marking Guidance	Mark	Comments
3	(a)		Heat (energy) change/required/needed; At constant/fixed pressure;	1 1	 Lose 2nd mark if standard or a specified pressure.
3	(b)		$C(s) + 2S(s) \rightarrow CS_2(l)$;	2	Accept ¼ S_8 (not S_2). 1 mark for equation and 1 mark for state symbols. Conseq on first mark.
3	(c)		$-1076 = \sum\Delta H_f$ products - $\sum\Delta H_f$ reactants; $-1076 = -394 + (-297 \times 2) - \Delta H_f(CS_2)$ $-1076 = -988 - \Delta H_f(CS_2)$ $\Delta H_f(CS_2) = -988 + 1076$; = 88 $kJmol^{-1}$;	1 1 1	 -88 1 mark Ignore units even if incorrect.
3	(d)	(i)	$Q = mc\Delta T$; $= 75 \times 4.2 \times 8 = 2520$ J; Moles = 0.45/76.2 = 0.00591; Molar heat change = 2520 / 0.00591 = -427 (kJ or kJ mol^{-1});	1 1 1 1	Last mark must show the minus sign and the correct answer. Penalise wrong units. Accept range 424 – 427
3	(d)	(ii)	Heat loss / incomplete combustion;	1	

Question	Part	Sub Part	Marking Guidance	Mark	Comments
4	(a)		Gain of electrons; Donates/ gives / loses electrons;	1 1	Penalise pairs in both parts.
4	(b)		(+)5; (+)4; -3;	1 1 1	
4	(c)	(i)	$4H_2O + S \rightarrow H_2SO_4 + 6H^+ + 6e^-$;	1	
4	(c)	(ii)	$e^- + H^+ + HNO_3 \rightarrow NO_2 + H_2O$;	1	
4	(c)	(iii)	$6HNO_3 + S \rightarrow H_2SO_4 + 6NO_2 + 2H_2O$;	1	Allow uncancelled H^+ or H_2O
4	(c)	(iv)	Reducing agent/reductant/electron donor;	1	

Question	Part	Sub Part	Marking Guidance	Mark	Comments
5	(a)		$Cl_2 + H_2O \rightarrow HCl + HClO$;	1	Ionic allowed
			Green colour = Chlorine/Cl_2;	1	
			UI goes red/pink;	1	Not orange.
			With acid/H^+;	1	
			And white / loses colour / bleach;	1	
			Due to/because of HClO / ClO^- or names;	1	QWC mark here for reason following bleaching etc.
5	(b)		Brown solution/ black ppt or solid;	1	Not yellow or orange alone. Anything purple loses 1st mark.
			$Cl_2 + 2KI \rightarrow I_2 + 2KCl$;	1	Ionic allowed.
5	(c)		Ag NO_3 or correct name;	1	Needed for next 3 marks.
			KCl gives white ppt/solid;	1	
			KF gives colourless solution/no reaction/no change/no ppt;	1	
			Ag NO_3 + KCl → AgCl + KNO_3 / $Ag^+ + Cl^- \rightarrow AgCl$	1	
5	(d)		Sulphur dioxide/SO_2;	1	Lose mark if other product(s) given.
			$H_2SO_4 + 2H^+ + 2Br^- \rightarrow SO_2 + Br_2 + 2H_2O$;	2	1 mark for having Br_2 as a product
			OR		1 mark for any balanced equation
			$2KBr + H_2SO_4 + 2H^+ \rightarrow 2K^+ + Br_2 + SO_2 + 2H_2O$ and other balanced equation;		Not KOH or K_2O