Assessment Schedule – 2005

Chemistry: Describe oxidation-reduction processes (90696)

Evidence Statement

Q	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
1(a)	$3Co + Cr_2O_7^{2-} + 14H^+ \rightarrow 2Cr^{3+} + 7H_2O + 3Co^{2+}$	Correct equation.		
1(b)	$E^o_{cell} = E(Cr_2O_7^{2-}/Cr^{3+}) - E(Co^{2+}/Co)$ $= +1.64$ V	Correct answer.		
1(c)	Salt bridge drawn connecting half-cells. One half-cell: Co electrode, Co^{2+} solution Other half-cell: Inert electrode eg Pt electrode, $K_2Cr_2O_7$	Salt bridge shown **OR** ONE half cell correctly labelled.	ALL aspects of the cell correctly drawn and labelled.	
	• e^- flow from anode to cathode (Co to Pt) • anion movement toward anode (Co) • cation movement toward cathode (Pt)	Correct direction for electrons **OR** one of the ions.	ALL movement of charge correct.	
1(d)	$Co \mid Co^{2+} \parallel Cr_2O_7^{2-}, Cr^{3+} \mid Pt$ Any inert electrode acceptable. States may be included.	Answer correct.		
1(e)	From (a) spontaneous reaction produces Co^{2+} $E°$ for reaction between Co^{2+} and $Cr_2O_7^{2-}$ 1.36–1.82 < 0 V. Hence reaction for further oxidation is not spontaneous so oxidation to Co^{2+} not Co^{3+}.	Correct reaction recognised either by the actual reaction **OR** by inference using the E^o values **OR** by saying Co^{2+} formed.	Correct answer with partial explanation that includes calculations and comments on the feasibility, and also identifies that Co^{2+} is formed.	Correct answer with full explanation. May approach from the reverse direction.
1(f)	Co^{3+} Reaction (1) spontaneous so $E_{red} > E_{ox}$ $E°(Co^{3+}/Co^{2+}) > E°(U^{4+}/U^{3+})$ Reaction (2) not spontaneous so $E_{red} < E_{ox}$ $E°(U^{4+}/U^{3+}) < E°(Fe^{3+}/Fe^{2+})$ Reaction (3) spontaneous so $E°(Co^{3+}/Co^{2+}) > E°(Fe^{3+}/Fe^{2+})$ $E°(Co^{3+}/Co^{2+}) > E°(Fe^{3+}/Fe^{2+}) > E°(U^{4+}/U^{3+})$	**EITHER** strongest oxidant recognised **OR** correct sequence.	Correct answer for BOTH but incomplete explanation.	Correct answer for BOTH with full explanation.
2(a)	Pb 0 PbO_2 +4 $PbSO_4$ +2 Oxidant: PbO_2 oxidation no. reduced Reductant: Pb oxidation no. increased	Oxidant and reductant correctly identified due to change in oxidation number (without link to reaction) **OR one** of reductant **or** oxidant linked to the appropriate oxidation number change.	Answer identifies oxidant and reductant and links to oxidation numbers of elements involved	
2(b)	Anode: $Pb \rightarrow Pb^{2+} + 2e^-$ Cathode: $PbO_2 + 4H^+ + 2e^- \rightarrow Pb^{2+} + 2H_2O$ May write balanced equations using $PbSO_4$ or H_2SO_4 or SO_4^{2-}	BOTH equations correct. **OR** one equation correct and linked to correct electrode	Equations at correct electrodes.	
3(a)	Solution turns blue, brown fumes evolved, brass screw disappears, heat given out.	At least TWO observations correct including ONE colour change.		

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3(b)	$Cu \rightarrow Cu^{2+} + 2e^-$ $NO_3^- + 2H^+ + e^- \rightarrow NO_2 + H_2O$ **OR** $NO_3^- + 4H^+ + 3e^- \rightarrow NO + 2H_2O$ May write equations with HNO_3 instead of NO_3^-	ONE half-equation correct.	BOTH half-equations correct.	
3(c)	Step 2 Iodide oxidised to iodine (yellow-brown solution) and copper reduced to CuI (white solid). $2I^- \rightarrow I_2 + 2e^-$ $Cu^{2+} + I^- + e^- \rightarrow CuI$ (**OR** $Cu^{2+} + e^- \rightarrow Cu^+$ then recognition of CuI precipitate formed). **OR** $2Cu^{2+} + 4I^- \rightarrow 2CuI + 2I_2$ Step 3 Iodine reduced to I^- (colourless). $S_2O_3^{2-}$ oxidised to $S_4O_6^{2-}$. Both form colourless solutions. $I_2 + 2e^- \rightarrow 2I^-$ $2S_2O_3^{2-} \rightarrow S_4O_6^{2-} + 2e^-$ **OR** $I_2 + 2S_2O_3^{2-} \rightarrow S_4O_6^{2-} + 2I^-$	ONE observation linked to species involved (by name or formula).	Two observations linked to the appropriate half equations.	One redox reaction correctly identified and related to observations. Include appropriate balanced equation.

Judgement Statement

Achievement	Achievement with Merit	Achievement with Excellence
SEVEN opportunities answered at Achievement level or higher. 7 × A	EIGHT opportunities answered with at least FOUR at Merit level or higher. 4 × M *plus* 4 × A	NINE opportunities answered with at least TWO at Excellence level and FOUR at Merit level. 2 × E *plus* 4 × M *plus* 3 × A