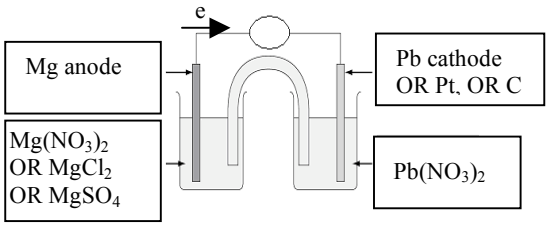
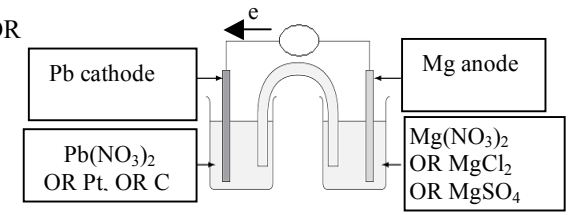
Assessment Schedule – 2008

Chemistry: Describe oxidation-reduction processes (90696)

Evidence Statement

Q	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
ONE (a)(i)	$S_2O_3^{2-}$ +2, S 0, SO_2 +4	All correct.		
(ii)	Oxidation $S_2O_3^{2-} + H_2O \rightarrow 2SO_2 + 2H^+ + 4e$ Reduction $S_2O_3^{2-} + 6H^+ + 4e \rightarrow 2S + 3H_2O$	Correct species on BOTH sides of BOTH equations OR one correctly balanced half-equation on correct line.	Oxidation and reduction reactants and products correctly identified and correctly balanced half-equations.	
(b)(i)	The purple permanganate solution is decolourised, AND bubbles of gas.	Correct observations.		
(ii)	Oxidation $H_2C_2O_4 \rightarrow 2CO_2 + 2H^+ + 2e$ OR $C_2O_4^{2-} \rightarrow 2CO_2 + 2e$ Reduction $MnO_4^- + 8H^+ + 5e \rightarrow Mn^{2+} + 4H_2O$ $5H_2C_2O_4 + 2MnO_4^- + 6H^+ \rightarrow 10CO_2 + 2Mn^{2+} + 8H_2O$ OR $5C_2O_4^{2-} + 2MnO_4^- + 16H^+ \rightarrow 10CO_2 + 2Mn^{2+} + 8H_2O$	Reactants and products correctly identified in BOTH half-equations AND ONE half-equation correctly balanced.	BOTH half-equations correctly balanced and balanced full equation.	
(c)	Oxidant: **IO_3^-** O.N. of I goes from +5 → 0. This is a decrease in ON showing IO_3^- is reduced/is the oxidant Reductant: **I^-** O.N of I goes from –1 to 0. This is an increase in ON showing I^- is oxidised/is the reductant. **I_2** O.N. is 0	Oxidant and reductant correctly identified. AND correct oxidation numbers for I in IO_3^-, I^-, and I_2 or oxidation number of I in I_2 clearly implied.	Evidence for Achieved AND correct identification of oxidant and reductant, linking the change to the process.	

Q	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
(d)	reduction ½ equation: $H_2O_2 + 2H^+ + 2e \rightarrow 2H_2O$ oxidation ½ equation: $H_2O_2 \rightarrow O_2 + 2H^+ + 2e$ Overall reaction: $2H_2O_2 \rightarrow 2H_2O + O_2$ $E°$ (cell) = $E°$ (red) – $E°$ (ox) (or = $E°$ (H_2O_2, H_2O) – $E°$ (O_2/ H_2O_2) = 1.77 – 0.68 = 1.09 V +ve spontaneous reaction is for H_2O_2 being reduced to H_2O and H_2O_2 being oxidised to O_2. Therefore the gas that is observed is O_2 / oxygen.	Correct identification of the gas AND correct cell voltage. Unit not required.	Correct identification of the gas and correct determination of the cell voltage with working shown linked to the equation. Units required. AND correct full balanced equation.	Evidence for Merit AND identification of the reaction as spontaneous and products from the reaction linked to the observation.
TWO (a) (b)	Reaction of MnO_4^- with Fe^{2+} E^o_{cell} = 0.74 V Reaction of MnO_4^- with Cl^- E^o_{cell} = 0.15 V Reaction of Cl_2 with Fe^{2+} E^o_{cell} = 0.59 V All E_{cell} are positive therefore all 3 reactions are possible • MnO_4^- will oxidise Cl^- to Cl_2 so more MnO_4^- is used than is needed to oxidise the Fe^{2+} alone. • Cl_2 produced may oxidise Fe^{2+} to Fe^{3+} changing the required amount of MnO_4^- • Some Cl_2 will escape as a gas and not react with Fe^{2+}.	Identification of ONE correct spontaneous reaction with appropriate E^o_{cell} calculation	Any TWO spontaneous reactions identified with correct E^o_{cell} calculations. AND linking the idea that this affects the amount of MnO_4^- needed for the titration/reaction.	Evidence for Merit, with no incorrect reactions or calculations included AND clear explanation and understanding of why the use of HCl will produce inaccurate results, including recognition of the reaction between Cl_2 and Fe^{2+}.
THREE (a) (i) (ii)	$Mg / Mg^{2+} // Pb^{2+} / Pb$ E_{cell} = $E°$ (Pb^{2+} / Pb) – $E°$ (Mg^{2+}/ Mg) = +2.24 V	Cell diagram correct OR cell voltage correct AND appropriate working shown. Unit required.	Cell diagram correct AND cell voltage correct. Unit required.	

Q	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
(b) (i) (ii) (iii)	 OR  • Anode and cathode linked to correct metal electrodes • Correct solutions (cations AND anions) • Correct electron flow direction.	One half-cell correctly labelled with metal plus correct solution AND correct electron flow direction OR anode and cathode correctly linked to appropriate electrodes AND correct electron flow direction OR all correct, but incorrect anions or missing anions.	Both half-cells correctly labelled with metal plus correct solution AND anode and cathode correctly linked to electrodes AND electron flow direction correct.	

Q	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
THREE (c)	**1) <u>Anode reactions and observations</u>** $Mg \rightarrow Mg^{2+} + 2e$ oxidation The electrode decreases in size as Mg is oxidised. **2) <u>Cathode reactions and observations</u>** $Pb^{2+} + 2e \rightarrow Pb$ reduction The electrode has a deposit of (grey/black) material building up as the Pb^{2+} is reduced. **3) <u>Identity and direction of movement of ions in the salt bridge</u>** K^+ ions travel to the cathode to balance the loss of Pb^{2+} ions. NO_3^- ions from the salt bridge travel to the anode to balance the formation of new Mg^{2+} ions. This keeps both half cells electrically neutral. OR The K^+ ions **in the salt bridge** will move from the Mg ½ cell to the Pb ½ cell and the NO_3^- ions **in the salt bridge** will move from the Pb ½ cell to the Mg ½ cell to balance the charges in each half cell. **4) <u>Flow of electrons</u>** Electrons are being produced at the Mg anode and will travel through the wire/external circuit to the Pb cathode.	Correct anode and cathode reactions but labels may be the wrong way round. OR Correct observations of what occurs at the anode and cathode. OR Correct movement of electrons **with reason.** OR Correct movement of named salt bridge anion, NO_3^- **AND** named cation, K^+.	Correctly identified anode and cathode reactions AND observations. AND **c**orrect movement of electrons with reason. OR Correct movement of named salt bridge anion NO_3^- AND named cation, K^+ with reason.	Full discussion of all four points.

Judgement Statement

Achievement	Achievement with Merit	Achievement with Excellence
Total of SIX opportunities answered at Achievement level or higher OR FIVE opportunities answered correctly including at least ONE at Excellence level or TWO at Merit level. $6 \times A$ OR $1 \times E + 4 \times A$ OR $2 \times M + 3 \times A$	Total of at least SEVEN opportunities answered with FIVE at Merit level or higher. $5 \times M + 2 \times A$	Total of at least EIGHT opportunities answered with TWO at Excellence level and FOUR at Merit level or higher. $2 \times E + 4 \times M + 2 \times A$