REDOX Core (SL & HL)

1. Consider the overall redox reaction:

$$CrO_4^{2-}(aq) + 3Fe(OH)_2(s) + 4H_2O(l) \rightarrow Cr(OH)_3(s) + 3Fe(OH)_3(s) + 2OH^-(aq)$$

(a) Determine the oxidation state for chromium (Cr) and iron (Fe) in the reactants and the products.

[2]

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(b) State what is oxidised and what is reduced.

[1]

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(c) Deduce, from the overall equation, the half equation for iron.

[1]

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2. Calcium chloride can be electrolysed. It is heated to a temperature of over 850°C. The melting point of calcium chloride is 772°C.

(a) Explain why the calcium chloride is heated to a molten state.

[1]

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(b) Deduce the half-equations for the reactions at each electrode, showing the state symbols of the products. The melting point of calcium is 842°C.

(i) Anode (positive electrode):

[1]

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(ii) Cathode (negative electrode):

[1]

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(c) Write an equation for the overall cell reaction.

[1]

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3. A student places pieces of copper metal in separate solutions of silver nitrate and lead (II) nitrate.

(a) Using **section 25** of the data booklet, state for each solution whether it will undergo a reaction.

[1]

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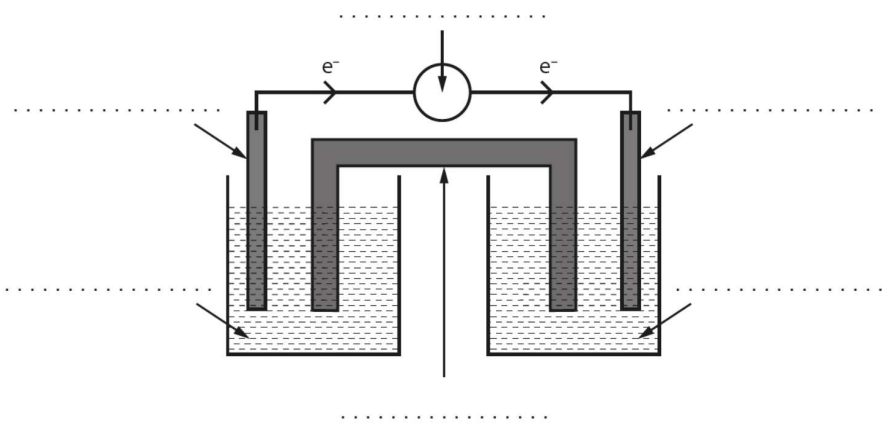
(b) The student decides to build a voltaic cell consisting of a copper electrode, a lead electrode, and solutions of copper sulfate and lead (II) nitrate, and measure the voltage of the cell. Label the diagram below, using **section 25** of the data booklet.

[4]



(c) Write an **ionic** equation for the expected overall cell reaction.

[1]

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4. (a) Tin ions will react with manganate (VII) ions in acid solution according to the follow equation:

$$\_\_\_ Sn^{2+} + \_\_\_MnO_4^- + \_\_\_ H^+ \rightarrow \_\_\_ Sn^{4+} + \_\_\_Mn^{2+} + \_\_\_ H_2O$$

(i) Rewrite and balance the equation above.

[1]

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(ii) Identify the oxidising agent and the reducing agent in this reaction.

[1]

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(b) Bromine can form the bromate (V) ion, BrO_3^-.

(i) Bromate (V) ions act as oxidising agents in acidic conditions to form bromide ions. Deduce the half-equation for this reduction reaction.

[2]

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(ii) Bromate(V) ions oxidise silver to silver ions, Ag^+. Deduce the equation for this redox reaction.

[1]

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5. Ethane-1,2-diol, CH_2OHCH_2OH, is used as anti-freeze.

(a) Deduce the oxidation state of carbon in ethane-1,2-diol.

[1]

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(b) Ethane-1,2-diol can be oxidised to ethandioic acid, CO_2HCO_2H. Deduce the oxidation state of carbon in ethandioic acid.

[1]

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(c) Other than a change in oxidation state, describe another way in which ethane-1,2-diol can be said to have been oxidised to ethandioic acid.

[1]

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(d) Construct a balanced chemical equation to show oxidation of ethane-1,2-diol to ethandioic acid. Use [O] to represent oxygen.

[1]

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(e) Using the half equation below, state how many moles of dichromate ions ($Cr_2O_7^{2-}$) would be needed to oxidise three moles of ethane-1,2-diol.

[1]

$$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$$

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Total Marks 24 (36 minutes)