Chemistry

Higher level

Paper 2

Practice paper

Topic: Redox Processes

Chemistry

Higher level

Paper 2

Specimen paper

2 hours 15 minutes

Instructions to candidates

- Answer all questions.
- Answers must be written within the answer boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination paper is [65 marks].

1. The following standard electrode potentials are provided at 298 K:

Half-equation	**E^θ / V**
$Fe^{3+}(aq) + e^- \rightleftharpoons Fe^{2+}(aq)$	+0.77
$I_2(aq) + 2e^- \rightleftharpoons 2I^-(aq)$	+0.54
$Cr_2O_7^{2-}(aq) + 14H^+(aq) + 6e^- \rightleftharpoons 2Cr^{3+}(aq) + 7H_2O(l)$	+1.33

(a) Calculate standard cell potential, E^θ_{cell}, for the reaction between acidified dichromate(VI) ions and iron(II) ions. **[2]**

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(b) Determine the standard Gibbs free energy change, delta G^θ, for this overall reaction. ($F = 96500\ C\ mol^{-1}$). **[3]**

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(c) Predict whether iron(III) ions will spontaneously oxidize iodide ions to iodine under standard conditions. Justify your answer using the E^θ values. **[3]**

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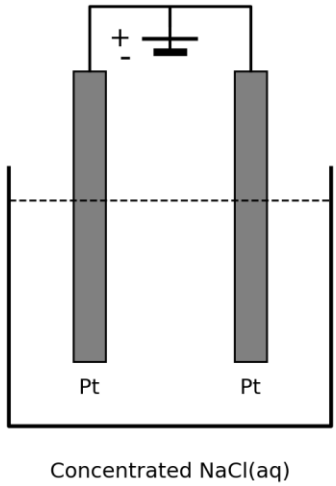
2. An electrolytic cell is constructed using inert platinum electrodes submerged in a concentrated solution of sodium chloride (brine).



(a) Identify all the ions present in the concentrated sodium chloride electrolyte. **[1]**

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(b) State the main products discharged at the cathode and the anode. Elaborate why sodium metal is not produced at the cathode. **[3]**

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(c) Write the overall balanced cell equation for this specific electrolysis of brine, including the new spectator ions remaining in solution. **[2]**

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3. Suppose the platinum electrodes in the previous electrolysis of NaCl(aq) were replaced entirely by copper electrodes.

(a) Explain how the product at the anode changes when an active (copper) electrode is used instead of inert platinum. Include the relevant half-equation. **[2]**

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(b) Outline how this active electrode process is heavily utilized in the industrial electro-refining of blister copper. **[2]**

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4. A standard voltaic cell is composed of a $Zn^{2+}(aq)/Zn(s)$ half cell (E^{θ} = -0.76 V) and a $Cu^{2+}(aq)/Cu(s)$ half cell (E^{θ} = +0.34 V).

(a) Formulate standard cell notation (line notation) for this voltaic cell. **[2]**

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(b) Explain the purpose and function of the standard hydrogen electrode (SHE) in establishing the -0.76 V value for the zinc half-cell. **[3]**

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5. A student decides to electroplate a medal with gold. They submerge the medal into an aqueous solution containing Au^{3+} ions and pass a current of 2.15 A for 2.50 hours.

(a) Calculate the mass of gold deposited on the medal (A_r Au = 196.97). **[3]**

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6. An uncharged lead-acid battery behaves as an electrolytic cell when being recharged, forcing the non-spontaneous reaction $PbSO_4(s) + H_2O(l) \rightarrow Pb(s) + PbO_2(s) + H_2SO_4(aq)$.

(a) Identify the oxidation state changes occurring for Lead during this recharging process. **[3]**

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7. In strongly acidic conditions, NO_3^- ions can oxidize Cu(s) to Cu^{2+}(aq) whilst evolving NO(g).

(a) Deduce the balanced full ionic equation. **[3]**

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