Chemistry

Standard level

Paper 2

Practice paper

Topic: Redox Processes

Chemistry

Standard level

Paper 2

Specimen paper

1 hour 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 [40 marks].

1. Redox reactions involve the transfer of electrons and changes in oxidation states.

(a) Deduce the oxidation state of sulfur in the following species: SO_2, SO_4^{2-}, and H_2S. **[3]**

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(b) The dichromate ion reacts with iron(II) ions in acidic solution to form chromium(III) ions and iron(III) ions. Formulate the two half-equations for this process. **[2]**

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(c) Combine the half-equations from (b) to deduce the overall balanced redox equation in acidic conditions. **[2]**

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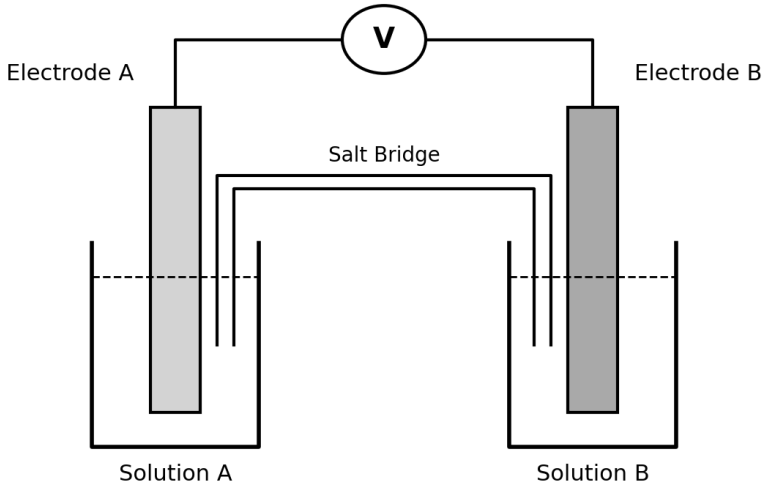
2. A voltaic cell is constructed using a zinc half-cell and a copper half-cell. The diagram below shows the basic setup. Zinc is a more reactive metal than copper.



(a) Identify Electrode A and Electrode B as either the zinc or copper electrode. Justify your choice based on reactivity. **[2]**

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(b) State the direction of electron flow in the external wire. **[1]**

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(c) Write the half-equation occurring at the cathode (positive electrode). **[1]**

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(d) The salt bridge often contains aqueous potassium nitrate, $KNO_3(aq)$. Explain how the movement of NO_3^- ions helps maintain electrical neutrality in the circuit. **[2]**

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3. Rusting is a common redox process that degrades iron structures over time.

(a) The initial step of rusting involves the oxidation of iron metal to iron(II) ions, and the reduction of oxygen gas to hydroxide ions in alkaline conditions. Formulate the two half-equations for this process. **[2]**

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(b) Deduce the overall balanced equation for this initial step. **[2]**

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(c) State the oxidation state of iron in rust, $Fe_2O_3 \cdot H_2O$. **[1]**

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(d) Explain how securely connecting a piece of magnesium to the iron structure prevents rusting. **[2]**

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4. A 25.0 cm^3 solution of iron(II) sulfate, $FeSO_4$, of unknown concentration was titrated with 0.0200 mol dm^{-3} potassium manganate(VII), $KMnO_4(aq)$, under acidic conditions.

(a) It required 18.2 cm^3 of the $KMnO_4$ solution to reach the end-point. Calculate the moles of MnO_4^- used. **[1]**

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(b) The mole ratio of MnO_4^- to Fe^{2+} is 1:5. Calculate the concentration of the iron(II) sulfate solution in mol dm^{-3}. **[2]**

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(c) State the color change observed at the end-point of this titration. **[1]**

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5. Halogens exhibit different oxidizing strengths down Group 17.

(a) Aqueous chlorine, $Cl_2(aq)$, is added to a test tube containing aqueous potassium bromide, KBr(aq). State the color change expected and formulate the ionic equation for the reaction. **[3]**

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(b) Aqueous iodine, $I_2(aq)$, is added to aqueous potassium chloride, KCl(aq). Predict if a reaction will occur, justifying your answer using the concept of oxidizing strength. **[2]**

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