Chemistry

Standard level

Paper 1B

Practice paper

Topic: Redox Processes

Chemistry

Standard level

Paper 1B

Specimen paper

45 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 paper 1B is [20 marks].

Section B

1. The Biochemical Oxygen Demand (BOD) of a water sample was determined using the Winkler method. A 100 cm^3 sample of water was treated to fix the dissolved oxygen, followed by titration of the liberated iodine with 0.050 mol dm^{-3} sodium thiosulfate ($Na_2S_2O_3$). The following titration results were recorded over 5 days.

Parameter	Day 0 Sample	Day 5 Sample
Volume of water sample / cm^3	100.0	100.0
Titre of $Na_2S_2O_3$ / cm^3	12.80	5.20

The overall stoichiometry of the Winkler method dictates that 1 mole of dissolved O_2 corresponds to 4 moles of $S_2O_3^{2-}$ used in the titration.

(a) Calculate the amount, in mol, of $S_2O_3^{2-}$ used in the titration of the Day 0 water sample. **[1]**

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(b) Determine the mass of dissolved oxygen, in mg, present in 1.00 dm^3 of the Day 0 water sample (which is equivalent to ppm). **[3]**

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(c) The initial dissolved oxygen concentration on Day 0 was 51.2 ppm. Use the titration data to calculate the dissolved oxygen on Day 5 and hence determine the BOD of the water sample. **[3]**

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(d) Evaluate the quality of this water sample based on your calculated BOD value. **[1]**

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2. A student investigates the relative reactivity of four unknown metals: W, X, Y, and Z. Strips of each metal are placed into 0.1 mol dm^{-3} aqueous solutions of the metal nitrates. The results are summarized in the data table below (✓ indicates a reaction occurred, ✗ indicates no reaction).

Metal / Solution	**$W(NO_3)_2$(aq)**	**XNO_3(aq)**	**$Y(NO_3)_2$(aq)**	**ZNO_3(aq)**
W(s)	-	✓	✗	✓
X(s)	✗	-	✗	✗
Y(s)	✓	✓	-	✓
Z(s)	✗	✓	✗	-

(a) Deduce the order of reactivity of the four metals, from most reactive to least reactive. **[2]**

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(b) Formulate the full balanced chemical equation for the reaction between metal W(s) and XNO_3(aq). **[2]**

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(c) Identify which metal acts as the strongest reducing agent and justify your choice using the tabulated data. **[2]**

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