Name ..... Class: .....

Start Time ..... End Time ..... Time Taken .....

Time allowed: 40 minutes

INSTRUCTIONS TO CANDIDATES

- This document is designed to be used as a practice test.
- Complete the test under exam conditions in one sitting.
- Optional: Before marking it, go through the paper with a set of notes and improve your answers.
- Mark the test using the mark scheme make corrections on the paper.
- Complete the table on the front page.
- Improve your notes so that they better reflect your weaknesses.
- Make a note of your strengths and weaknesses for future revision.

Success Criteria	**Questions in Paper**	**Mark**	**Out of**	**%**	**Rank Order**
Redox Calculations	1, 7c		7, 5		
Oxidation state	2, 5aii, 5aiii, 6cii		1, 2, 1, 1		
Definitions	3, 5ai, 6a		1, 1, 1		
Half equations	4, 5bi, 5bii, 6bii, 6ci, 6ciii		1, 1, 1, 1, 1, 1		
Full redox Half Equations	5biii, 6civ, 6di, 7b		1, 1, 1, 1		
Identifying agents	6bi, 6dii		2, 1		
General equations	7a		1		
Practical considerations	7d, 7e		2		
Total			36		

Q1.

A student carried out an experiment to find the mass of $FeSO_4.7H_2O$ in an impure sample, **X**.
The student recorded the mass of **X**. This sample was dissolved in water and made up to 250 cm^3 of solution.
The student found that, after an excess of acid had been added, 25.0 cm^3 of this solution reacted with 21.3 cm^3 of a 0.0150 mol dm^{-3} solution of $K_2Cr_2O_7$

(a) Use this information to calculate a value for the mass of $FeSO_4.7H_2O$ in the sample of **X**.

(5)

(b) The student found that the calculated mass of $FeSO_4.7H_2O$ was greater than the actual mass of the sample that had been weighed out. The student realised that this could be due to the nature of the impurity.

Suggest **one** property of an impurity that would cause the calculated mass of $FeSO_4.7H_2O$ in **X** to be greater than the actual mass of **X**.
Explain your answer.

(2)

(Total 7 marks)

Q2.

In which species is chlorine in its highest oxidation state?

A ClF_2^- ⬭

B ClO_4^- ⬭

C ClO_2 ⬭

D ClF_3 ⬭

(Total 1 mark)

Q3.

Which statement about this redox reaction is correct?

$3\ Sn^{2+}(aq) + Cr_2O_7^{2-}(aq) + 2\ H^+(aq) \rightarrow 2\ Cr^{3+}(aq) + 3\ SnO_2(s) + H_2O(l)$

A Sn^{2+} is the oxidising agent and it gains electrons. ⬭

B Sn^{2+} is the reducing agent and it gains electrons. ⬭

C $Cr_2O_7^{2-}$ is the oxidising agent and it gains electrons. ⬭

D $Cr_2O_7^{2-}$ is the reducing agent and it gains electrons. ⬭

(Total 1 mark)

Q4.

Which incomplete half-equation is balanced by adding two H^+ ions and one electron to the left-hand side?

A $CH_3CHO \rightarrow CH_3CH_2OH$ ⬭

B $VO^{2+} \rightarrow V^{3+} + H_2O$ ⬭

C $HNO_2 \rightarrow NO + H_2O$ ⬭

D $O_2 \rightarrow H_2O_2$ ⬭

(Total 1 mark)

Q5.

(a) The following is an equation for a redox reaction.

$2NO + 12H^+ + 10I^- \rightarrow 2NH_4^+ + 2H_2O + 5I_2$

(i) Define *oxidation* in terms of electrons.

_____

(ii) Deduce the oxidation state of nitrogen in NO and of nitrogen in NH_4^+

Oxidation state of nitrogen in NO _____

Oxidation state of nitrogen in NH_4^+ _____

(iii) Identify the species formed by oxidation in this reaction_____

(4)

(b) When chlorine gas is bubbled into an aqueous solution of sulphur dioxide, hydrogen ions, sulphate ions and chloride ions are formed.

(i) Write a half-equation for the formation of chloride ions from chlorine.

_____

(ii) Write a half-equation for the formation of hydrogen ions and sulphate ions from sulphur dioxide and water.

_____

(iii) Hence, deduce an overall equation for the reaction which occurs when chlorine is bubbled into aqueous sulphur dioxide.

_____

(3)

(Total 7 marks)

Q6.

(a) In terms of electrons, what happens to an oxidising agent during a redox reaction?

_____

(1)

(b) Consider the following redox reaction.

$SO_2(aq) + 2H_2O(l) + 2Ag^+(aq) \rightarrow 2Ag(s) + SO_4^{2-}(aq) + 4H^+(aq)$

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

Oxidising agent _____

Reducing agent _____

(ii) In a different reaction, sulfur dioxide is reduced to form hydrogen sulfide. Write a half equation for this equation.

_____

(3)

(c) Fe^{2+} ions are oxidised to Fe^{3+} ions by ClO_3^- ions in acidic conditions. The ClO_3^- ions are reduced to Cl^- ions.

(i) Write a half-equation for the oxidation of Fe^{2+} ions in this reaction.

_____

(ii) Deduce the oxidation state of chlorine in ClO_3^- ions.

_____

(iii) Write a half-equation for the reduction of ClO_3^- ions to Cl^- ions in acidic conditions.

_____

(iv) Hence, write an overall equation for the reaction.

_____

(4)

(d) Write an equation to show how sulphur is removed from impure iron using magnesium. Identify the oxidising agent in this reaction.

Equation _____

Oxidising agent _____

(2)

(Total 10 marks)

Q7.

Iron from the Blast Furnace contains carbon. In the steel-making process, oxygen is blown through molten impure iron. At stages during this process samples of iron are taken and analysed to determine the remaining carbon content. One method of analysis involves a redox titration.

At one stage a 1.27g sample of this impure iron was reacted with an excess of dilute sulphuric acid. All of the iron in the sample was converted into iron(II) sulfate, and hydrogen was evolved. The solution formed was made up to 250 cm^3. A 25.0 cm^3 sample of this solution reacted completely with exactly 19.6 cm^3 of a 0.0220 mol dm^{-1} solution of potassium manganate(VII).

(a) Write an equation for the reaction between iron and dilute sulphuric acid.

_____

(1)

(b) Write an equation for the reaction of iron(II) ions with manganate(VII) ions in acid solution.

(1)

(c) Assuming that carbon is the only impurity, calculate the percentage by mass of carbon in the 1.27g sample.

(5)

(d) How would you ensure the reliability of the result obtained in this experiment?

(1)

(e) Suggest one way in which the reliability of this analysis could be improved.

(1)

(Total 9 marks)