

Surname		Other Names	
Centre Number		Candidate Number	
Candidate Signature			

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General Certificate of Education
January 2001
Advanced Subsidiary Examination



CHEMISTRY **CHM2**
Unit 2 Foundation Physical and Inorganic Chemistry

Friday 12 January 2001 Morning Session

In addition to this paper you will require:

- a Periodic Table;
- a calculator.

For Examiner's Use			
Number	Mark	Number	Mark
1			
2			
3			
4			
5			
6			
7			
Total (Column 1)	→		
Total (Column 2)	→		
TOTAL			
Examiner's Initials			

Time allowed: 1 hour 30 minutes

Instructions

- Use blue or black ink or ball point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions in **Section A** and **Section B** in the spaces provided. All working must be shown.
- Do all rough work in this book. Cross through any work you do not want marked.

Information

- The maximum mark for this paper is 90.
- Mark allocations are shown in brackets.
- The paper carries 30 per cent of the total marks for AS. For Advanced Level this paper carries 15 per cent of the total marks.
- You are expected to use a calculator where appropriate.
- The following data may be required.
Gas constant $R = 8.31 \text{ J mol}^{-1} \text{ K}^{-1}$
- Your answers to questions in Section B should be written in continuous prose, where appropriate. You will be assessed on your ability to use an appropriate form and style of writing, to organise relevant information clearly and coherently, and to use specialist vocabulary, where appropriate.

Advice

- You are advised to spend about 1 hour on **Section A** and about 30 minutes on **Section B**.

NO QUESTIONS APPEAR ON THIS PAGE

SECTION A

Answer **all** questions in the spaces provided.

- 1 (a) State the trend in oxidising power of the halogens chlorine, bromine and iodine.

.....
(1 mark)

- (b) State what would be observed if aqueous bromine were to be added separately to samples of aqueous potassium chloride and aqueous potassium iodide. Write an ionic equation for any reaction occurring.

Observation with aqueous KCl

Observation with aqueous KI

Ionic equation

(3 marks)

- (c) When chlorine is dissolved in cold water a pale-green solution, chlorine water, is formed. A piece of universal indicator paper, dipped into chlorine water, first turns red and then becomes white.

- (i) Give the formula of the species responsible for the green colour of chlorine water.

.....

- (ii) Write an equation for the reaction between chlorine and cold water.

.....

- (iii) Explain the colour changes observed when universal indicator paper is dipped into chlorine water.

.....

.....

(4 marks)

- (d) Write an equation for the reaction that occurs when chlorine is bubbled into cold, dilute aqueous sodium hydroxide.

.....
(1 mark)

9

Turn over ►

2 Household bleach contains the ion ClO^- . The concentration of ClO^- ions can be determined by using their ability, under acid conditions, to oxidise iodide ions to iodine. The liberated iodine can then be estimated by titration with a standard solution of sodium thiosulphate, $\text{Na}_2\text{S}_2\text{O}_3$

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

.....

(ii) Give the oxidation state of chlorine in ClO^-

.....

(2 marks)

(b) Write an equation for the reaction between thiosulphate ions and iodine.

.....

(2 marks)

(c) An excess of solid potassium iodide was added to 25.0 cm^3 of a bleach solution and the resulting mixture was acidified with dilute sulphuric acid. The liberated iodine was then titrated with a sodium thiosulphate solution of concentration $0.100 \text{ mol dm}^{-3}$ and 24.4 cm^3 were required for complete reaction.

(i) Calculate the number of moles of $\text{S}_2\text{O}_3^{2-}$ present in 24.4 cm^3 of sodium thiosulphate solution.

.....

(ii) Calculate the number of moles of I_2 liberated in this reaction.

.....

(iii) Write an ionic equation for the reaction between ClO^- ions and I^- ions, in the presence of acid, to form I_2 and Cl^- ions.

.....

.....

- (iv) Calculate the concentration, in mol dm^{-3} , of ClO^- in the bleach solution.

.....
.....
.....
.....

- (v) Name the indicator used in this titration and state the colour change at the end-point.

Name

Colour change

(9 marks)

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TURN OVER FOR THE NEXT QUESTION

Turn over ►

- 3 (a) Define the terms *standard enthalpy of formation* and *standard enthalpy of combustion*.

Standard enthalpy of formation

.....

.....

Standard enthalpy of combustion

.....

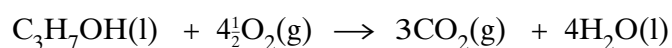
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(6 marks)

- (b) Use the standard enthalpies of formation, ΔH_f^\ominus , given below

Compound	$\Delta H_f^\ominus / \text{kJ mol}^{-1}$
$\text{CO}_2(\text{g})$	-394
$\text{C}_3\text{H}_7\text{OH}(\text{l})$	-304
$\text{H}_2\text{O}(\text{l})$	-286

to calculate the standard enthalpy of combustion of an alcohol $\text{C}_3\text{H}_7\text{OH}$, as shown by the equation:



.....

.....

.....

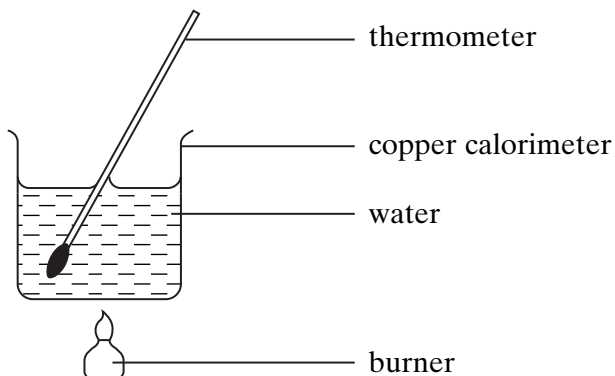
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(3 marks)

- (c) A value for the enthalpy of combustion of the alcohol C_3H_7OH was determined in the laboratory using the apparatus shown below. The following results were obtained.



Mass of water in the calorimeter	= 200 g
Initial temperature of water	= 15 °C
Final temperature of water	= 30 °C
Mass of alcohol burned	= 0.90 g

- (i) Calculate the heat energy required to raise the temperature of the water from 15 °C to 30 °C. The specific heat capacity of water is $4.2 \text{ J g}^{-1} \text{ K}^{-1}$.

.....

.....

.....

- (ii) Calculate the number of moles of the alcohol, C_3H_7OH , burned.

.....

.....

- (iii) Hence, calculate a value for the enthalpy of combustion of 1.0 mol of the alcohol.

.....

.....

- (iv) Give **two** reasons why you would expect your answer to part (c)(iii) to differ from that in part (b).

Reason 1

.....

Reason 2

.....

(8 marks)

Turn over ►

4 (a) Iron is extracted from the oxide Fe_2O_3 by reduction with carbon and carbon monoxide in a Blast Furnace.

(i) In the Blast Furnace, carbon monoxide is produced from carbon in a two-stage process. Write equations to show these two stages.

Stage 1

Stage 2

(ii) Write an equation for the reduction of Fe_2O_3 by carbon and an equation for the reduction of Fe_2O_3 by carbon monoxide.

Equation for carbon

Equation for carbon monoxide

(iii) Limestone is added to the Blast Furnace to remove impurities present in the iron ore. Identify the main impurity removed by limestone. Write an equation or equations to show how limestone acts to remove this impurity.

Impurity

Equation(s)

.....

(7 marks)

(b) State the main impurity in iron obtained from the Blast Furnace. Explain how this impurity is removed in the conversion of impure iron into steel.

Impurity

Explanation

.....

(3 marks)

- (c) Identify a gas which is released from the Blast Furnace which leads to environmental problems. State the environmental problem.

Gas

Environmental problem

(2 marks)

- (d) Identify another gas which leads to environmental problems when sulphide ores are used in the extraction of metals other than iron. State the environmental problem.

Gas

Environmental problem

(2 marks)

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TURN OVER FOR THE NEXT QUESTION

Turn over ►

5 Titanium is obtained by the reduction of titanium(IV) chloride.

(a) Write an equation to show how TiCl_4 is obtained from TiO_2 .

.....
(2 marks)

(b) Outline the method employed to obtain titanium from TiCl_4 by identifying a reducing agent, giving the conditions used and writing an equation for the reduction process.

Reducing agent

Conditions

.....

Equation

(4 marks)

(c) State why titanium cannot be extracted directly from the ore TiO_2 using carbon.

.....
(1 mark)

7

