Surname				Other	Names			
Centre Number				Candidate Number				
Candidate Signature								

I eave blank

General Certificate of Education June 2003 Advanced Subsidiary Examination



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

Wednesday 4 June 2003 Morning Session

In addition to this paper you will require: a calculator.

Time allowed: 1 hour

## 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.
- The Periodic Table/Data Sheet is provided on pages 3 and 4. Detach this perforated sheet at the start of the examination.

# **Information**

- The maximum mark for this paper is 60.
- Mark allocations are shown in brackets.
- This 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  $R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$
- Your answers to the question 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 45 minutes on **Section A** and about 15 minutes on **Section B**.

For Examiner's Use					
Number	Mark	Number	Mark		
1					
2					
3					
4					
5					
Total (Column	1)	<b>→</b>			
Total (Column	2)	<b>→</b>			
TOTAL					
Examine	r's Initials				

Copyright © 2003 AQA and its licensors. All rights reserved.

# **SECTION A**

Answer all questions in the spaces provided.

1	(a)	Iron is extracted in a Blast Furnace by a continuous reduction process. Identify <b>two</b> reducing agents present in the Blast Furnace. In each case, write an equation to show how the reducing agent reacts in the formation of iron.
		Reducing agent 1
		Equation
		Reducing agent 2
		Equation(4 marks)
	(b)	Titanium is extracted from ${\rm TiO_2}$ using two separate batch processes. For each of these processes, write an equation for the reaction occurring.
		Equation 1
		Equation 2 (4 marks)
	(c)	Suggest in general terms how metals can be extracted from sulphide ores. Explain how pollution problems can arise from such extractions.
		Extraction
		Pollution problems
		(4 marks)



# The Periodic Table of the Elements

APW/0203/CHM2

The atomic numbers and approximate relative atomic masses shown in the table are for use in the examination unless stated otherwise in an individual question.

						3						
0	4.0 <b>He</b> Helium 2	20.2 <b>Ne</b>			Argon 18			131.3 <b>Xe</b>		222.0 <b>Rn</b>	Radon 86	
<b>=</b>		O. L	-Iuorine	35.5 <b>C</b>	Chlorine 17	79.9 <b>Br</b>	Bromine 35	126.9 <b> </b>	lodine 53	210.0 <b>At</b>	Astatine 85	
5		16.0 <b>O</b>	Oxygen 8	32.1 <b>S</b>	Sulphur 16	79.0 <b>Se</b>	Selenium 34	127.6 <b>Te</b>	Tellurium 52	210.0 <b>Po</b>	Polonium 84	
>		0.4 <b>Z</b>	Carbon Nitrogen Oxygen F 6 7 8 9	31.0 <b>P</b>	Phosphorus 15	74.9 <b>As</b>	Arsenic 33	121.8 <b>Sb</b>	Antimony 51	209.0 <b>Bi</b>	Bismuth 83	
≥		15.0 C	Carbon 6	28.1 <b>Si</b>	Silicon 14	72.6 <b>Ge</b>	Germanium 32	118.7 <b>Sn</b>	Tin 50	207.2 <b>Pb</b>	Lead 82	
=		10.8 <b>B</b>	Boron 5	27.0 <b>AI</b>	Aluminium 13	69.7 <b>Ga</b>	Gallium 31	114.8 <b>n</b>	Indium 49	204.4 <b>T</b>	Thalliun 81	
						65.4 <b>Zn</b>		112.4 Cd	Cadmium 48	200.6 <b>Hg</b>	Mercury 80	
						63.5 <b>Cu</b>	Copper 29	107.9 <b>Ag</b>	Silver 47	197.0 <b>Au</b>	Gold 79	
						58.7 <b>N</b> i	Nickel 28	106.4 <b>Pd</b>	Palladium 46	195.1 <b>Pt</b>	Platinum 78	
						58.9 <b>S</b>	Cobalt 27	102.9 <b>Rh</b>	enum Technetium Ruthenium Rhodium Palladium 43 44 45 46	192.2 <b>"</b>	Iridium 77	
						55.8 <b>Fe</b>	Iron 26	101.1 <b>Ru</b>	Ruthenium 44	190.2 <b>Os</b>	Osmium 76	
		6.9 <b>Li</b>	Lithium 3			54.9 <b>Mn</b>	Manganese 25	98.9 <b>Tc</b>	Technetium 43	186.2 <b>Re</b>	Rhenium 75	
		3SS				52.0 <b>Ç</b>	Vanadium Chromium 23	95.9 <b>Z</b>	Molybd 42	183.9 <b>W</b>	Tungsten 74	
		relative atomic mass -	umber –			50.9 <b>V</b>	Vanadium 23	92.9 <b>Nb</b>	Niobium 41	180.9 <b>Ta</b>	Tantalum 73	
	Key	relative a	atomic number			47.9 <b>Ti</b>	Titanium 22	91.2 <b>Zr</b>	Zirconium 40	178.5 <b>Hf</b>	Hafnium 72	
						45.0 <b>Sc</b>	Scandium 21	<b>8</b> 8.9	Yttrium 39	138.9 <b>La</b>	Lanthanum 57 *	227 <b>Ac</b> Actinium 89 †
=		9.0 <b>Be</b>	Beryllium 4	24.3 <b>Mg</b>		40.1 <b>Ca</b>	Calcium 20	87.6 <b>Sr</b>	Strontium 38	137.3 <b>Ba</b>	Barium 56	226.0 <b>Ra</b> Radium 88
_	1.0 <b>H</b> Hydrogen 1	6.9 <b>Li</b>		23.0 <b>Na</b>		39.1 <b>K</b>	_	85.5 <b>Rb</b>	_	132.9 <b>Cs</b>	_	223.0 <b>Fr</b> Francium 87
			. \/	<b>L</b>			Π.					1

175.0	Lutetium	(260)	103
<b>Lu</b>	71	<b>Lr</b>	
173.0	Ytterbium	259)	102
<b>Yb</b>	70	<b>No</b>	
168.9	Thulium	(258)	101
<b>Tm</b>	69	<b>Mad</b>	
167.3 <b>Er</b>	Erbium 68	Fm (27)	0
164.9	Holmium	(252)	96
<b>H3</b>	67	<b>ES</b>	
162.5	Dysprosium	247.1 252.1 (252) (28	98
<b>Dy</b>	66	<b>Bk Cf Es</b>	
158.9	Terbium	247.1	97
<b>Tb</b>	65	<b>Bk</b>	
157.3	Gadolinium	239.1 243.1 247.1 247.1 25	96
<b>Gd</b>	64	<b>Pu Am Cm Bk</b>	
152.0	Europium	243.1	95
<b>Eu</b>	63	<b>Am</b>	
150.4	Samarium	239.1	94
<b>Sm</b>	62	<b>Pu</b>	
144.9 <b>Pm</b>	Promethium 61	232.0 231.0 238.0 237.0 239.1 243.1 247.1 The Pa U Np Pu Am Cm	93
144.2	Neodymium	238.0	92
<b>Nd</b>	60	<b>U</b>	
140.9 <b>Pr</b>	Praseodymium 59	231.0 <b>Pa</b>	91
	Cerium	232.0	06
<b>Ce</b>	58	<b>Th</b>	

www.xtremePapers.net

† 90 - 103 Actinides

\* 58 - 71 Lanthanides

Table 1 Proton n.m.r chemical shift data

Type of proton	δ/ррт
RCH <sub>3</sub>	0.7–1.2
$R_2CH_2$	1.2–1.4
$R_3$ CH	1.4–1.6
$RCOCH_3$	2.1–2.6
$ROCH_3$	3.1–3.9
RCOOCH <sub>3</sub>	3.7–4.1
ROH	0.5–5.0

Table 2 Infra-red absorption data

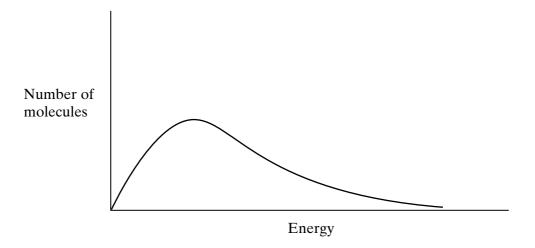
Bond	Wavenumber/cm <sup>-1</sup>
С—Н	2850-3300
С—С	750–1100
C=C	1620–1680
C=O	1680–1750
С—О	1000-1300
O—H (alcohols)	3230–3550
O—H (acids)	2500–3000

2	(a)	In te	In terms of electrons, what happens to an oxidising agent during a redox reaction?					
		•••••	(1 mark)					
	(b)	Cons	sider the following redox reaction.					
			$SO_2(aq) + 2H_2O(1) + 2Ag^+(aq) \rightarrow 2Ag(s) + SO_4^{2-}(aq) + 4H^+(aq)$					
		(i)	Identify the oxidising agent and the reducing agent in this reaction.					
			Oxidising agent					
			Reducing agent					
		(ii)	Write a half-equation to show how sulphur dioxide is converted into sulphate ions in aqueous solution.					
			(3 marks)					
	(c)		ions are oxidised to $Fe^{3+}$ ions by $ClO_3^-$ ions in acidic conditions. The $ClO_3^-$ ions are ced to $Cl^-$ ions.					
		(i)	Write a half-equation for the oxidation of Fe <sup>2+</sup> ions in this reaction.					
		(ii)	Deduce the oxidation state of chlorine in ClO <sub>3</sub> ions.					
		(iii)	Write a half-equation for the reduction of ClO <sub>3</sub> ions to Cl <sup>-</sup> ions in acidic conditions.					
		(iv)	Hence, write an overall equation for the reaction.					
			(4 marks)					
	(d)		e an equation to show how sulphur is removed from impure iron obtained from the t Furnace. Identify the oxidising agent in this reaction.					
		Equa	ation					
		Oxia	lising agent(2 marks)					
			(2 mans)					



Turn over ▶

A sample of a gas was sealed into a flask at temperature T and pressure P. The Maxwell-Boltzmann distribution of energies for the molecules in this sample is shown below.



- Using the axes above, sketch the curve that you would expect if this sample of gas at pressure P had been cooled. Label this curve X.
- Using the axes above, sketch the curve that you would expect if another sample of (ii) the same gas was sealed in the same flask at the original temperature, T, but at a higher pressure. Label this curve Y. (4 marks)
- Gas A decomposes slowly to form gases B and C. An equilibrium is established as shown by the following equation.

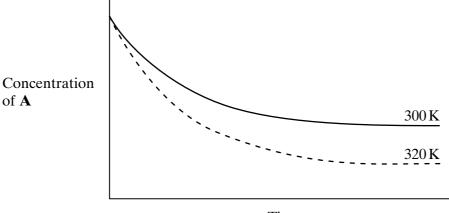
$$A(g) \Longrightarrow B(g) + C(g)$$
  $\Delta H$  is positive

In terms of the behaviour of molecules, state what must happen before molecules of **A** can react to form **B** and **C**.

(ii) Explain why the decomposition of A is faster at higher temperatures.

(4 marks)

The graphs below show how, starting from A alone, the concentration of A varies with time at temperatures of 300 K and 320 K for the reversible reaction given in part (b).



Time

Suggest why, as shown on the graphs, the concentration of A remains constant after a time.

Explain why, at 320 K, the concentration of A falls to a lower value compared with

ne reaction at 500 K.	
	(3 marks)

TURN OVER FOR THE NEXT QUESTION

Turn over

4

	(1 mark)
heat	laboratory experiment, 1.45 g of propanone were burned completely in oxygen. The from this combustion was used to raise the temperature of 100 g of water from K to 351.2 K.
(i)	Calculate the number of moles of propanone in the 1.45 g.
(ii)	Calculate the heat energy required to raise the temperature of $100\mathrm{g}$ of water from 293.1 K to 351.2 K. (The specific heat capacity of water is $4.18\mathrm{JK^{-1}g^{-1}}$ )
(iii)	Hence, calculate a value, in kJ mol <sup>-1</sup> , for the enthalpy of combustion of propanone.
	(5 marks)
	similar experiment, the enthalpy of combustion of butanone, $C_4H_8O$ , was found to $1290 \mathrm{kJ}\mathrm{mol}^{-1}$ . A data book value for the same reaction is $\Delta H_c^{\odot} = -2430 \mathrm{kJ}\mathrm{mol}^{-1}$ .
(i)	Suggest one reason why the experimental value is very different from the data book value.
<b>(**</b> )	
(ii)	This data book value of $\Delta H_c^{\bullet}$ for butanone (-2430 kJ mol <sup>-1</sup> ) refers to the formation of carbon dioxide gas and water in the gaseous state. How would this value differ if it referred to the formation of water in the liquid state? Explain your answer.
	Difference
	Explanation

(d) Calculate a value for the standard enthalpy of formation for liquid ethanethiol, C<sub>2</sub>H<sub>5</sub>SH. Use the equation given below and enthalpy of combustion data from the following table.

Substance	C <sub>2</sub> H <sub>5</sub> SH(l)	C(s)	$H_2(g)$	S(s)
$\Delta H_{\rm c}^{\Theta}/{\rm kJmol}^{-1}$	-1170	-394	-286	-297

$$2C(s) + 3H_2(g) + S(s) \rightarrow C_2H_5SH(l)$$

$$(3 marks)$$



TURN OVER FOR THE NEXT QUESTION

Turn over

# **SECTION B**

Answer the question below in the space provided on pages 10 to 12 of this booklet.

- 5 (a) Describe and explain the trend in the boiling points of the elements down Group VII from fluorine to iodine. (4 marks)
  - (b) Describe what you would observe when aqueous silver nitrate, followed by dilute aqueous ammonia, is added to separate aqueous solutions of sodium chloride and sodium bromide. (4 marks)
  - (c) State the trend in the oxidising abilities of the elements down Group VII from chlorine to iodine.

Explain how this trend can be shown by displacement reactions between halogens and halide ions in aqueous solutions.

Illustrate your answer with appropriate observations and equations. (*7 marks*)

# **END OF QUESTIONS**