

Surname		Other Names	
Centre Number		Candidate Number	
Candidate Signature			

For Examiner's Use

General Certificate of Education
January 2008
Advanced Subsidiary Examination



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

Thursday 10 January 2008 9.00 am to 10.00 am

For this paper you must have

- 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.
- Answer **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 to be 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.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- Write your answers to the question in **Section B** 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**.

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Question	Mark	Question	Mark
1			
2			
3			
4			
5			
6			
Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			

SECTION A

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

1 Aqueous bromide ions can be detected by using either aqueous silver nitrate or chlorine.

- (a) (i) State what is observed when aqueous silver nitrate is added to an aqueous solution containing bromide ions. Write an ionic equation for the reaction which occurs.

Observation

.....

Ionic equation

- (ii) State what is observed when an excess of concentrated aqueous ammonia is added to the products formed in part (a)(i).

.....

(3 marks)

- (b) (i) State what is observed when chlorine is added to an aqueous solution containing bromide ions. Write an ionic equation for the reaction which occurs.

Observation

.....

Ionic equation

.....

- (ii) Identify one halide ion, other than chloride, which will not react with chlorine and explain why a reaction does not take place.

Halide ion

Explanation

.....

(4 marks)

- (c) Bromine reacts with cold aqueous sodium hydroxide. The reaction is similar to the reaction of chlorine with cold aqueous sodium hydroxide.

Write an equation for the reaction of bromine with cold aqueous sodium hydroxide.

.....

(2 marks)

Gas constant $R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$

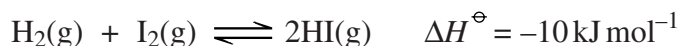
Table 1
Proton n.m.r chemical shift data

Type of proton	δ/ppm
RCH_3	0.7–1.2
R_2CH_2	1.2–1.4
R_3CH	1.4–1.6
RCOCH_3	2.1–2.6
ROCH_3	3.1–3.9
RCOOCH_3	3.7–4.1
ROH	0.5–5.0

Table 2
Infra-red absorption data

Bond	Wavenumber/ cm^{-1}
C—H	2850–3300
C—C	750–1100
C=C	1620–1680
C=O	1680–1750
C—O	1000–1300
O—H (alcohols)	3230–3550
O—H (acids)	2500–3000

- 2 When hydrogen and iodine gases are allowed to react, an equilibrium is established according to the following equation.



- (a) State and explain the effect of decreasing the temperature on the equilibrium yield of hydrogen iodide.

Effect on yield of hydrogen iodide

Explanation

.....

.....

(3 marks)

- (b) State and explain the effect of increasing the pressure on the equilibrium yield of hydrogen iodide.

Effect on yield of hydrogen iodide

Explanation

.....

(2 marks)

- (c) Explain why an increase in the concentration of hydrogen gas increases the equilibrium yield of hydrogen iodide.

Explanation

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(1 mark)

- (d) Explain why the addition of a catalyst does not alter the position of equilibrium.

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(2 marks)

- 3 (a) Define the term *standard enthalpy of combustion*.

.....

(3 marks)

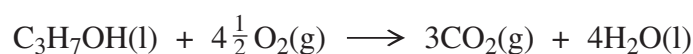
- (b) Write an equation for the complete combustion of ethanol, C₂H₅OH

.....
 (1 mark)

- (c) The following table gives some standard enthalpies of formation.

	C ₃ H ₇ OH(l)	O ₂ (g)	CO ₂ (g)	H ₂ O(l)
$\Delta H_f^\ominus / \text{kJ mol}^{-1}$	-315	0	-394	-286

Use these data to calculate a value for the enthalpy of combustion, ΔH_c^\ominus , of propan-1-ol, C₃H₇OH



.....

(3 marks)

- (d) State how you would expect the value obtained in part (c) to differ if gaseous water, rather than liquid water, is formed.

.....
 (1 mark)

- (e) In an experiment 0.92 g of propan-1-ol, C_3H_7OH , was burned and the heat given off used to raise the temperature of 250 g of water. The temperature rise was $16^\circ C$. The specific heat capacity of water is $4.2 J K^{-1} g^{-1}$.

Calculate a value for the enthalpy of combustion of one mole of propan-1-ol.

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.....

.....

(4 marks)

- (f) Suggest why the experimental value of the enthalpy of combustion obtained in part (e) is less reliable than the value obtained in part (c).

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(1 mark)

13

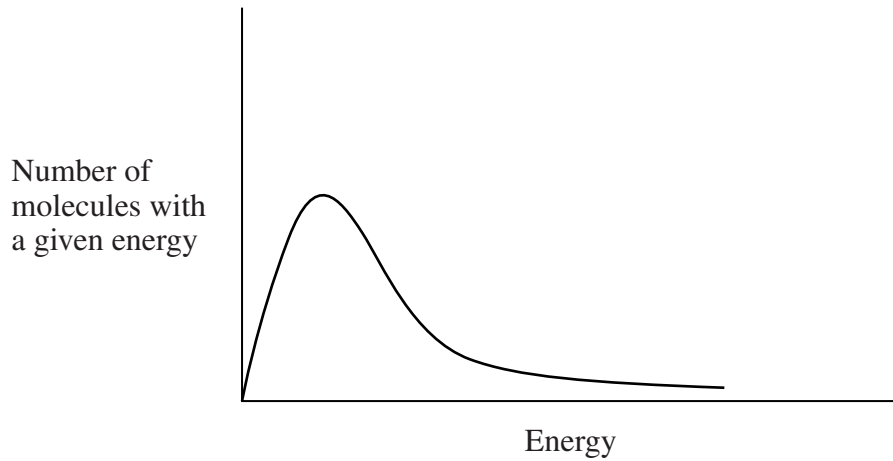
Turn over for the next question

Turn over ►

4 The Figures below represent the distribution of molecular energies for one mole of gas at 300 K.

- (a) On **Figure 1** below draw a curve to show the distribution of energies for one mole of gas at a higher temperature.

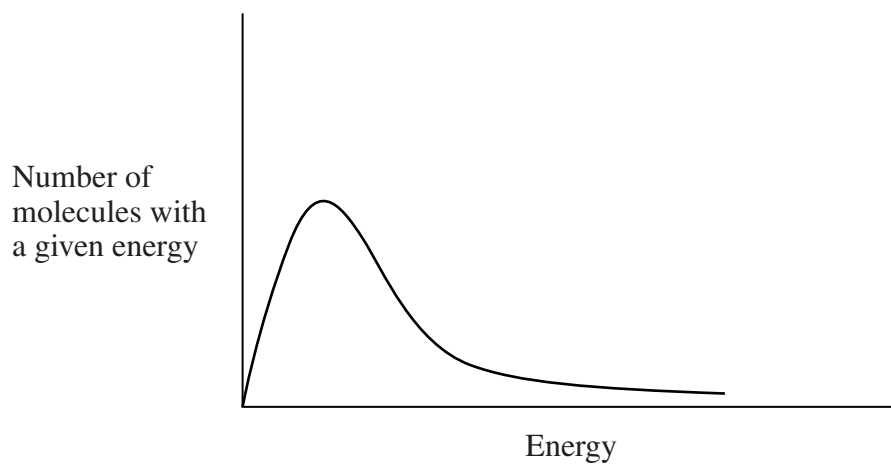
Figure 1



(2 marks)

- (b) On **Figure 2** below draw a curve to show the distribution of energies for two moles of gas at 300 K.

Figure 2



(2 marks)

(c) Gases **A** and **B** react together.

- (i) Explain why collisions between molecules of **A** and **B** do not always lead to a reaction.

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- (ii) Explain why increasing the temperature by a small amount has a much bigger effect on the rate of reaction than increasing the pressure by a small amount.

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.....

- (iii) Explain why adding a catalyst will increase the rate of reaction between gases **A** and **B**.

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

(5 marks)

9

Turn over for the next question

Turn over ►

- 5 (a) Deduce the oxidation state of S in SO_3^{2-} and in SO_4^{2-}

Oxidation state of S in SO_3^{2-}

Oxidation state of S in SO_4^{2-}

(2 marks)

- (b) A redox reaction occurs when Cl_2 reacts with SO_3^{2-} ions in aqueous solution.

- (i) Write a half-equation for the conversion of Cl_2 into Cl^- ions.

.....

- (ii) Write a half-equation for the conversion of aqueous SO_3^{2-} ions into SO_4^{2-} ions.

.....

- (iii) Hence, write an overall equation for the reaction between Cl_2 and SO_3^{2-} ions.

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- (iv) Deduce the role of SO_3^{2-} ions in this overall reaction.

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(4 marks)

