OCR
RECOGNISING ACHIEVEMENT

ADVANCED SUBSIDIARY GCE **2813/01**

CHEMISTRY

How Far, How Fast?

THURSDAY 11 JANUARY 2007 Morning

Time: 45 minutes

Additional materials: Scientific calculator
Data Sheet for Chemistry (Inserted)

Candidate Name

Centre Number

Candidate Number

INSTRUCTIONS TO CANDIDATES

- Write your name, Centre number and Candidate number in the boxes above.
- Answer **all** the questions.
- Use blue or black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure you know what you have to do before starting your answer.
- Do **not** write in the bar code.
- Do **not** write outside the box bordering each page.
- WRITE YOUR ANSWER TO EACH QUESTION IN THE SPACE PROVIDED. ANSWERS WRITTEN ELSEWHERE WILL NOT BE MARKED.

INFORMATION FOR CANDIDATES

- The number of marks for each question is given in brackets [ ] at the end of each question or part question.
- You may use a scientific calculator.
- A copy of the *Data Sheet for Chemistry* is provided as an insert with this question paper.
- You are advised to show all the steps in any calculations.

FOR EXAMINER'S USE		
Qu.	Max	Mark
1	10	
2	14	
3	10	
4	11	
TOTAL	45	

This document consists of **8** printed pages and a *Data Sheet for Chemistry*.

Registered Charity Number: 1066969
[Turn over

Answer **all** the questions.

1 A group of students investigated the effect of concentration on the rate of a reaction. They used the reaction between magnesium carbonate and dilute hydrochloric acid and measured the rate at which the gas was collected.

(a) (i) An incomplete equation for this reaction is given below. Complete the equation by balancing it and inserting state symbols.

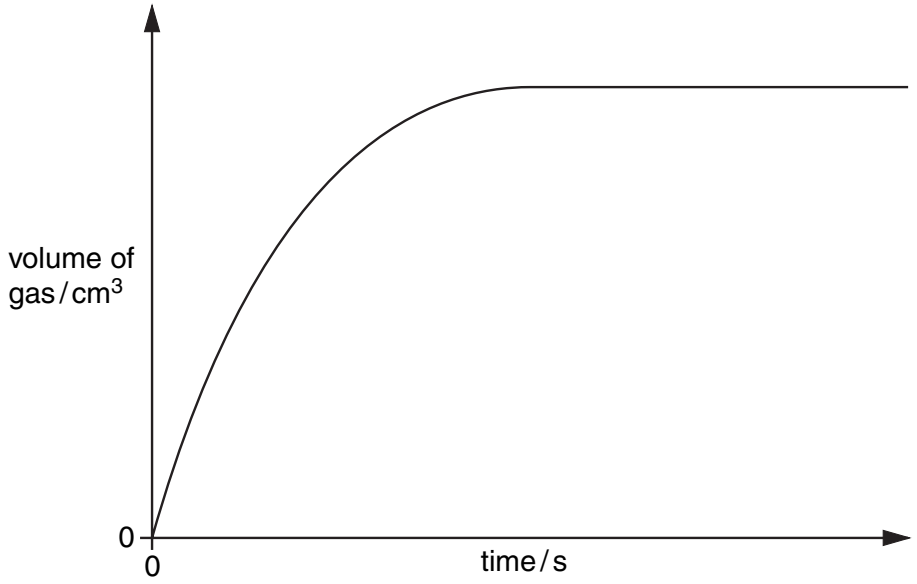
$MgCO_3$(.....) + HCl(.....) $\rightarrow$ $MgCl_2$(.....) + CO_2(.....) + H_2O(.....)

[2]

(ii) Write the ionic equation for this reaction.

[1]

(b) The students added dilute hydrochloric acid to some magnesium carbonate. The students collected the gas and measured the volume, at regular intervals, until after the reaction was complete. They then plotted a graph of their results.



Use collision theory to explain the changes in the rate of the reaction as it proceeds.

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..... [3]

(c) The students repeated the experiment using a weak acid instead of hydrochloric acid.

Assume the concentration of both acids and all other conditions are the same.

(i) On the axes in **(b)**, sketch the graph the students obtained from this experiment. [2]

(ii) State and explain what effect changing the acid has on the rate of the reaction.

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..... [2]

[Total: 10]

2 Propane, C_3H_8, is a gas at room temperature and pressure. It is used in blow torches to melt the bitumen needed to apply the felt to flat roofs.

(a) Write the equation for the complete combustion of propane.

[2]

(b) Define the term *standard enthalpy change of combustion*.

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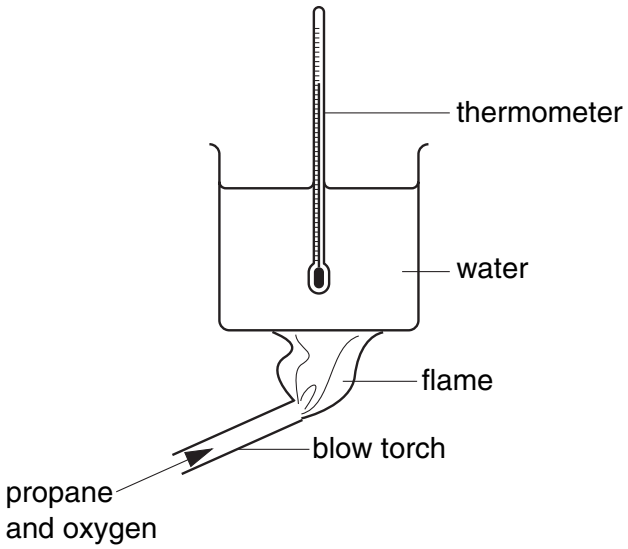
..... [3]

(c) A blow torch was used to determine the enthalpy change of combustion of propane. The apparatus is shown below.



In the experiment, 200 g of water were used. The temperature of the water changed from 18.0 °C to 68.3 °C when 1.00 g of propane was burnt.

(i) Calculate the energy produced in kJ. The specific heat capacity of water is 4.18 J g^{-1} K^{-1}.

energy = …… kJ [2]

(ii) Calculate the number of moles of C_3H_8 burnt during the experiment.

..... mol [1]

(iii) Deduce the enthalpy change of combustion, in kJ mol^{-1}, of C_3H_8.

enthalpy change of combustion = ... kJ mol^{-1} [2]

(d) Values of enthalpy changes of combustion can be used to calculate enthalpy changes of formation.

The enthalpy change for the reaction in **equation 2.1** is the enthalpy change of formation of propane.

$$3C(s) + 4H_2(g) \longrightarrow C_3H_8(g) \qquad \textbf{equation 2.1}$$

The table below shows the enthalpy changes of combustion of carbon, hydrogen and propane.

	enthalpy change of combustion / kJ mol^{-1}
carbon	−394
hydrogen	−286
propane	−2219

(i) Use these data to calculate the enthalpy change of formation of propane.

enthalpy change of formation = ... kJ mol^{-1} [3]

(ii) Suggest why the enthalpy change of formation of propane **cannot** be measured directly.

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..... [1]

[Total: 14]

3 Esters are used as flavourings. They are made by a reversible reaction between a carboxylic acid and an alcohol.

carboxylic acid + alcohol $\rightleftharpoons$ ester + water

(a) Give **two** features of a reversible reaction, when a dynamic equilibrium has been set up.

1 .....

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2 .....

..... [2]

(b) The production of esters is catalysed homogeneously by the presence of acids.

(i) What is meant by a catalyst?

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..... [1]

(ii) What is meant by homogeneous?

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..... [1]

(iii) Using the fact that acids are needed to catalyse this reaction, deduce the formula of the ion that acts as the catalyst.

..... [1]

(iv) Catalysts do **not** affect the position of an equilibrium. Explain why not.

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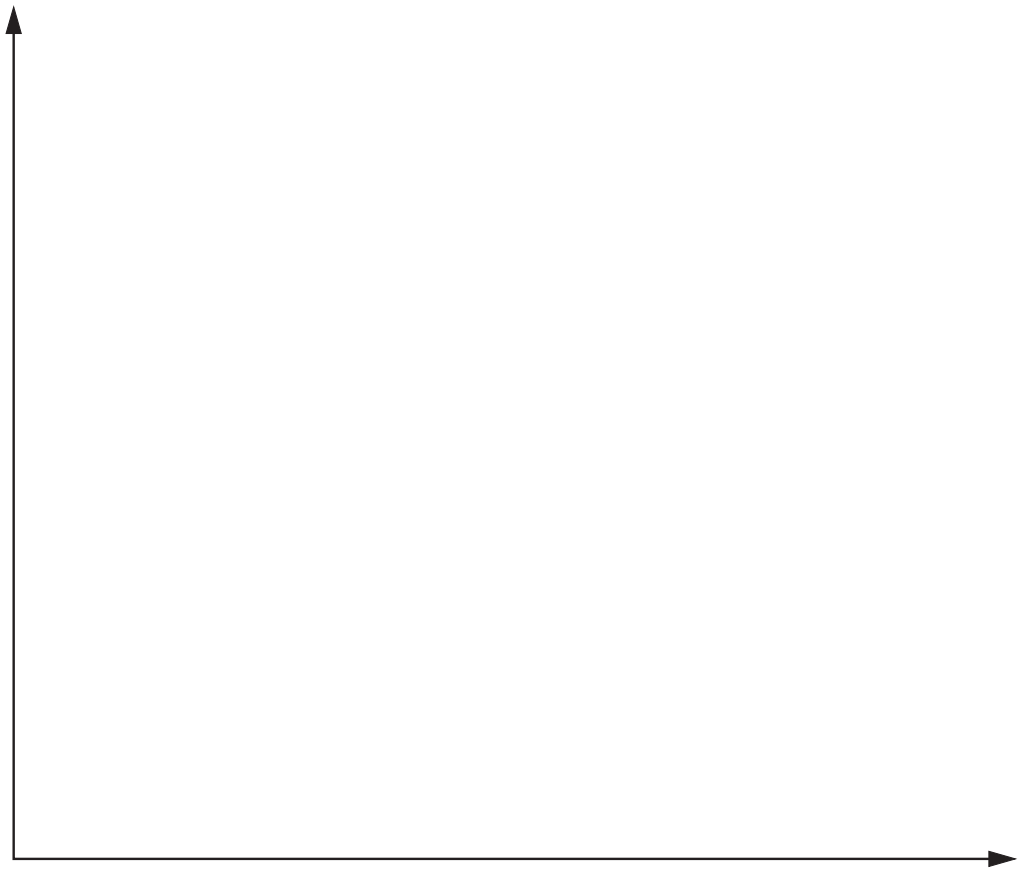
..... [1]

(c) (i) On the axes below, draw and label the Boltzmann distribution to show the energies of molecules in a gas at a fixed temperature.



[2]

(ii) Use the graph to explain the effect of a catalyst on the rate of a reaction.

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..... [2]

[Total: 10]

4 Ammonia, NH_3, is made industrially by the Haber process. This is an equilibrium reaction.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) \qquad \Delta H = -92\,kJ\,mol^{-1}$$

(a) State the pressure and temperature that are used in the Haber process.

pressure .....

temperature .....[2]

(b) Describe and explain why these conditions are a compromise between rate and equilibrium.

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.....[9]

[Total: 11]

END OF QUESTION PAPER