THIS IS A LEGACY SPECIFICATION

OCR
RECOGNISING ACHIEVEMENT

ADVANCED SUBSIDIARY GCE

CHEMISTRY

How Far, How Fast?

2813/01

Candidates answer on the question paper
A calculator may be used for this paper

OCR Supplied Materials:
- *Data Sheet for Chemistry* (Inserted)

Other Materials Required:
- Scientific calculator

Friday 9 January 2009
Afternoon

Duration: 45 minutes

CUP/T57245

2813011

Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **45**.
- 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.
- This document consists of **12** pages. Any blank pages are indicated.

FOR EXAMINER'S USE		
Qu.	**Max**	**Mark**
1	**5**	
2	**15**	
3	**15**	
4	**10**	
TOTAL	**45**	

OCR is an exempt Charity

Answer **all** the questions.

1 Students carried out an experiment to investigate the rate of a reaction.

The students added dilute hydrochloric acid to marble chips. They collected the gas and measured the volume, at regular intervals, until the reaction was complete.

They obtained the graph shown in **Fig. 1.1** below.

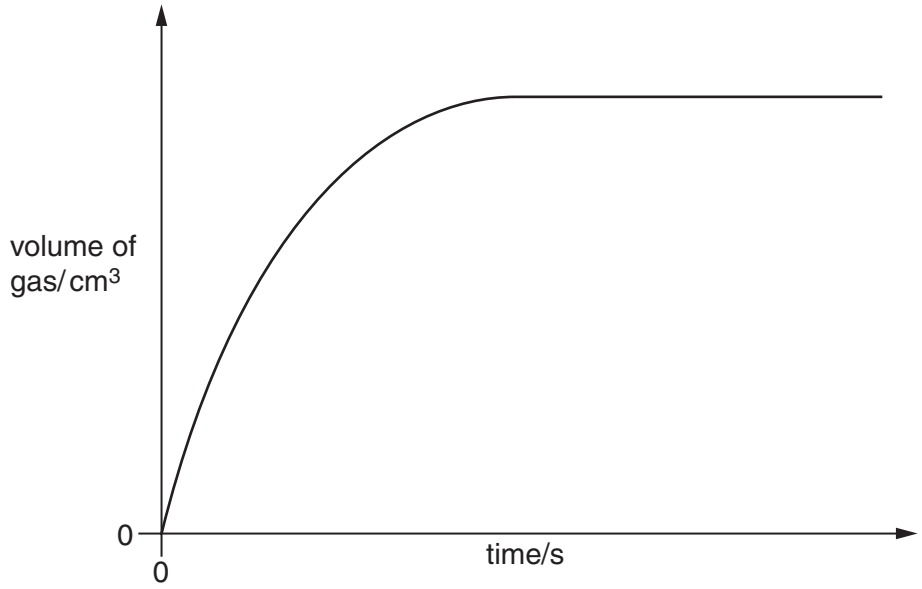

Fig. 1.1

(a) (i) How does the rate of reaction change as the reaction proceeds?

..... **[1]**

(ii) Explain the changes in the rate of the reaction in terms of collisions.

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.....

.....

..... **[2]**

(b) The experiment was repeated using crushed marble in place of the marble chips.

On **Fig. 1.1**, sketch the graph the students obtained from this experiment. The quantities and the temperature remain the same. **[2]**

[Total: 5]

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2 Bond enthalpies can be used to calculate enthalpy changes of reactions. Some bond enthalpies are given in **Table 2.1**.

bond	bond enthalpy / kJ mol^{-1}
C*l*–C*l*	+242
H–H	+436
H–F	+568
H–C*l*	+432

Table 2.1

(a) (i) Define the term *bond enthalpy*.

.....

.....

..... **[2]**

(ii) Why is the sign of bond enthalpy positive?

.....

..... **[1]**

(b) Hydrogen halides can be made from their elements.

Although the reaction between hydrogen and fluorine is explosive, the enthalpy change for the reaction can be found.

$$H_2(g) + F_2(g) \longrightarrow 2HF(g) \qquad \Delta H = -542\,kJ\,mol^{-1}$$

Use this value of the enthalpy change for the reaction, and the data in **Table 2.1**, to calculate the bond enthalpy of the F–F bond.

bond enthalpy of the F–F bond = ... kJ mol^{-1} **[3]**

(c) Use the data in **Table 2.1** to calculate the enthalpy change of formation of hydrogen chloride, HC*l*.

enthalpy change of formation of HC*l* = ... kJ mol^{-1} **[2]**

(d) Hydrogen fluoride and hydrogen chloride dissolve in water to give hydrofluoric acid and hydrochloric acid. Hydrofluoric acid is a weak acid but hydrochloric acid is a strong acid.

(i) What is meant by the term *weak acid*?

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.....

..... **[2]**

(ii) Use the data in **Table 2.1** to suggest why hydrofluoric acid is a weaker acid than hydrochloric acid.

.....

..... **[1]**

(iii) Write the equation for the reaction between hydrofluoric acid and solid sodium carbonate, Na_2CO_3.

..... **[1]**

(iv) Write the **ionic** equation for the reaction between hydrofluoric acid and solid sodium carbonate, Na_2CO_3.

..... **[1]**

(v) Describe how the reaction with Na_2CO_3 can be used to show that hydrochloric acid is strong and hydrofluoric acid is weak.

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..... **[2]**

[Total: 15]

3 Hydrogen is needed in large quantities for the manufacture of ammonia and margarine. Methane and steam can be used to manufacture hydrogen. This is a reversible reaction.

$$CH_4(g) + H_2O(g) \rightleftharpoons CO(g) + 3H_2(g) \qquad \Delta H = +210\,kJ\,mol^{-1}$$ **equation 3.1**

(a) Describe the conditions that would produce a high yield of hydrogen at equilibrium. Explain your answers.

temperature .....

.....

.....

pressure .....

.....

..... **[4]**

(b) Describe the conditions that would produce hydrogen at a fast rate. Explain your answers.

temperature .....

.....

.....

pressure .....

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..... **[4]**

(c) Use your answers to **(a)** and **(b)** to suggest why a temperature of 800 °C and a pressure of 30 atm might be used for the manufacture of hydrogen from methane and steam.

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..... **[3]**

(d) The carbon monoxide produced in the reaction can be used as a fuel.

Hess's Law can be used to calculate the enthalpy change of formation, ΔH_f, of carbon monoxide.

(i) State *Hess's Law*.

.....

.....

..... **[1]**

(ii) The table below shows some enthalpy changes of formation, ΔH_f.

substance	ΔH_f / kJ mol^{-1}
$CH_4(g)$	–75
$H_2O(g)$	–242

Use these data, and the enthalpy change of **equation 3.1**, to determine the enthalpy change of formation of carbon monoxide.

ΔH_f = ... kJ mol^{-1} **[3]**

[Total: 15]

4 Catalysts are often used to speed up chemical reactions.

(a) Explain how a catalyst increases the rate of a reaction.

Use an enthalpy profile diagram and a Boltzmann distribution in your answer.

Enthalpy profile diagram

Boltzmann distribution

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..... **[8]**

(b) Explain the effect that adding a catalyst has on the position of equilibrium in a reversible reaction.

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..... **[2]**

[Total: 10]

END OF QUESTION PAPER

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