

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
Advanced Subsidiary GCE

CHEMISTRY

2813/01

How Far, How Fast?

Friday

17 JANUARY 2003

Morning

45 minutes

Candidates answer on the question paper.

Additional materials:

Data Sheet for Chemistry

Scientific Calculator

Candidate Name	Centre Number	Candidate Number										
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TIME 45 minutes

INSTRUCTIONS TO CANDIDATES

- Write your name in the space above.
- Write your Centre number and Candidate number in the boxes above.
- Answer **all** the questions.
- Write your answers in the spaces provided on the question paper.
- Read each question carefully and make sure you know what you have to do before starting your answer.

INFORMATION FOR CANDIDATES

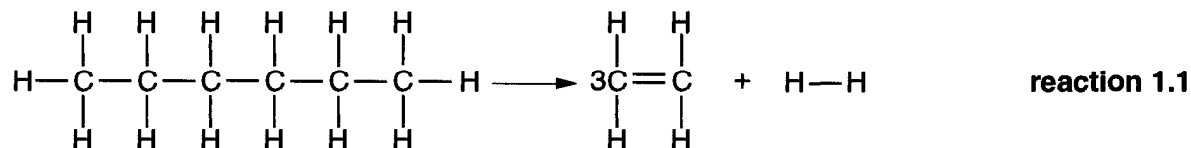
- The number of marks is given in brackets [] at the end of each question or part question.
- You may use a scientific calculator.
- You may use the *Data Sheet for Chemistry*.
- You are advised to show all the steps in any calculations.

FOR EXAMINER'S USE		
Qu.	Max.	Mark
1	8	
2	11	
3	6	
4	6	
5	7	
6	7	
TOTAL	45	

This question paper consists of 10 printed pages and 2 blank pages.

Answer all the questions.

- 1 Ethene is an important industrial chemical, used to make plastics, solvents and antifreeze. It is usually made by cracking larger alkanes. The equation for a cracking reaction is shown below.



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

.....

 [2]

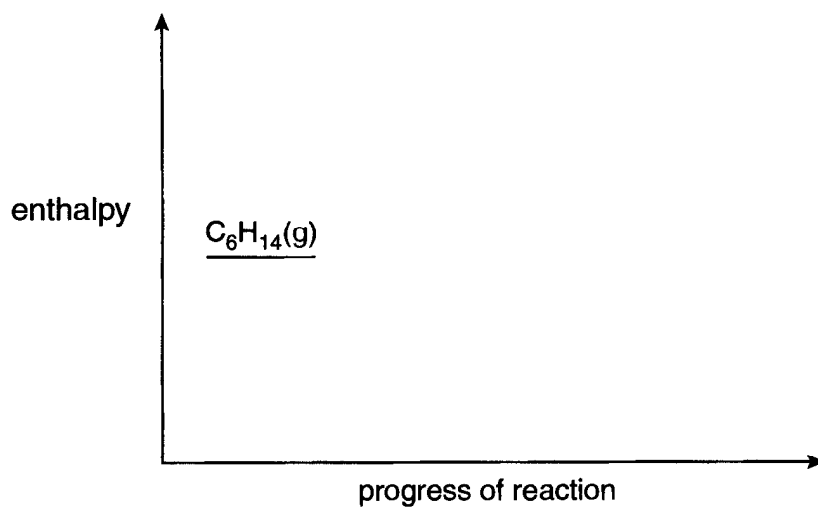
- (ii) Use the average bond enthalpies in Table 1.1 to calculate the standard enthalpy change, ΔH_r^\ominus , for reaction 1.1.

Table 1.1

bond	average bond enthalpy / kJ mol ⁻¹
H—H	436
C—H	410
C—C	350
C=C	610

$$\Delta H_r^\ominus = \dots\dots\dots \text{kJ mol}^{-1} \quad [3]$$

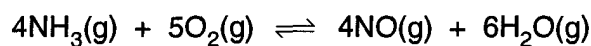
(b) Complete the enthalpy profile diagram for reaction 1.1.



[3]

[Total: 8]

- 2 The first stage in the industrial production of nitric acid from ammonia can be represented by the following equation.



- (a) Use the following standard enthalpy changes of formation to calculate the enthalpy change, ΔH_r^\ominus , for this reaction.

compound	$\Delta H_f^\ominus / \text{kJ mol}^{-1}$
$\text{NH}_3(\text{g})$	-46
$\text{NO}(\text{g})$	+90
$\text{H}_2\text{O}(\text{g})$	-242

$$\Delta H_r^\ominus = \dots\dots\dots \text{kJ mol}^{-1} \quad [3]$$

- (b) (i) State le Chatelier's principle.

.....

 [2]

- (ii) Predict and explain how the **equilibrium position** of this reaction is affected by increasing the pressure.

.....

 [2]

(c) This reaction takes place as the gases are passed slowly through a fine gauze made of a platinum-rhodium alloy.

(i) State the purpose of the platinum-rhodium gauze.

..... [1]

(ii) Suggest why the gases have to be passed through the gauze **slowly**.

..... [1]

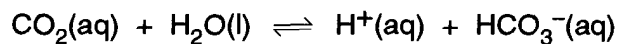
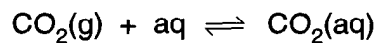
(d) The NO produced is reacted with oxygen and water to give nitric acid, HNO₃.

Construct a balanced equation for this reaction.

..... [2]

[Total: 11]

- 3 When carbon dioxide dissolves in water, the following dynamic equilibria are set up.



- (a) State **two** features of a dynamic equilibrium.

.....

 [2]

- (b) Use the above equations and your understanding of dynamic equilibrium to explain the following observations.

- (i) Bubbling carbon dioxide into an aqueous solution of universal indicator turns its colour from green to orange.

.....

 [2]

- (ii) A saturated solution of carbon dioxide effervesces when a small amount of concentrated sulphuric acid is added to it.

.....

 [2]

[Total: 6]

4 Reactions can be speeded up either by increasing the concentration of reagents or by increasing the temperature.

(a) Explain why an increase in concentration increases the rate of a reaction.

.....

.....

..... [2]

(b) The diagram in Fig. 4.1 shows the energy distribution of reactant molecules at a temperature T_1 . E_a represents the activation energy of the reaction.

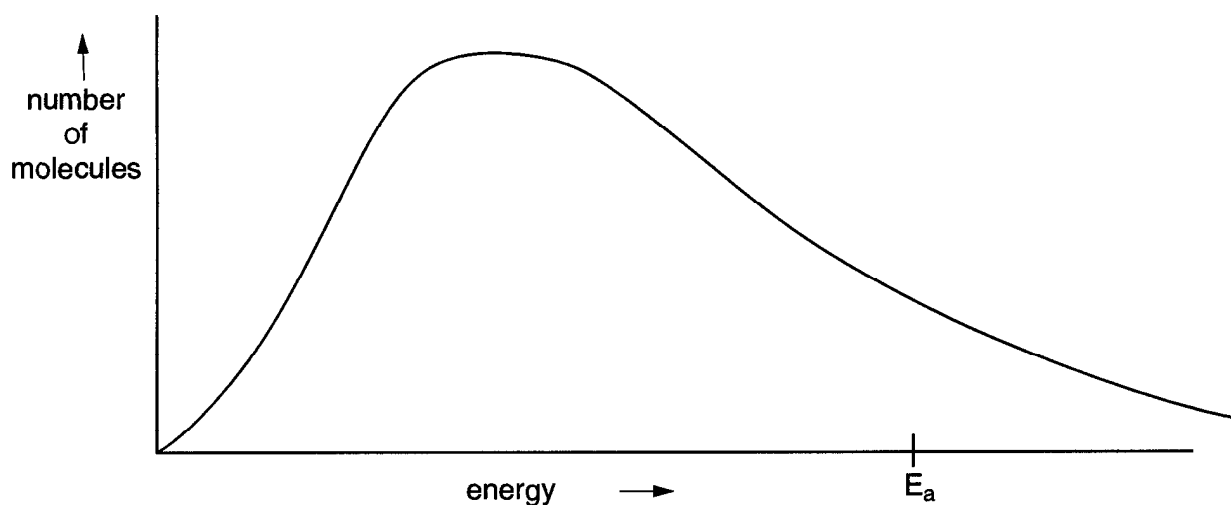


Fig. 4.1

(i) Draw a second curve on Fig. 4.1 to represent the energy distribution of the same number of molecules at a higher temperature. Label your curve T_2 . [2]

(ii) Use your curve to explain how an increase in temperature can cause an increase in the rate of a reaction.

.....

.....

.....

..... [2]

[Total: 6]

5 Sulphuric acid, H_2SO_4 , is a strong acid which is an important industrial and laboratory chemical.

(a) Spillages of sulphuric acid can be made harmless by neutralisation with sodium carbonate solution, $\text{Na}_2\text{CO}_3(\text{aq})$.

(i) State what you would see during this neutralisation reaction.

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

(ii) Write a balanced equation for this reaction.

..... [2]

(b) Sulphuric acid reacts with ammonia in the manufacture of the salt ammonium sulphate, $(\text{NH}_4)_2\text{SO}_4$.

(i) State the role of ammonia in this reaction.

..... [1]

(ii) Calculate the percentage by mass of nitrogen in ammonium sulphate.

[2]

(iii) State a **large scale** use of ammonium sulphate.

..... [1]

[Total: 7]

