OCR
RECOGNISING ACHIEVEMENT

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

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.

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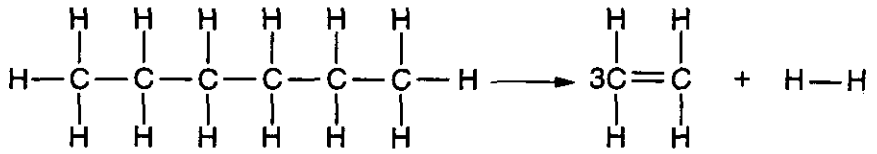
Answer **all** the questions.

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.



reaction 1.1

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

.....

.....

..... [2]

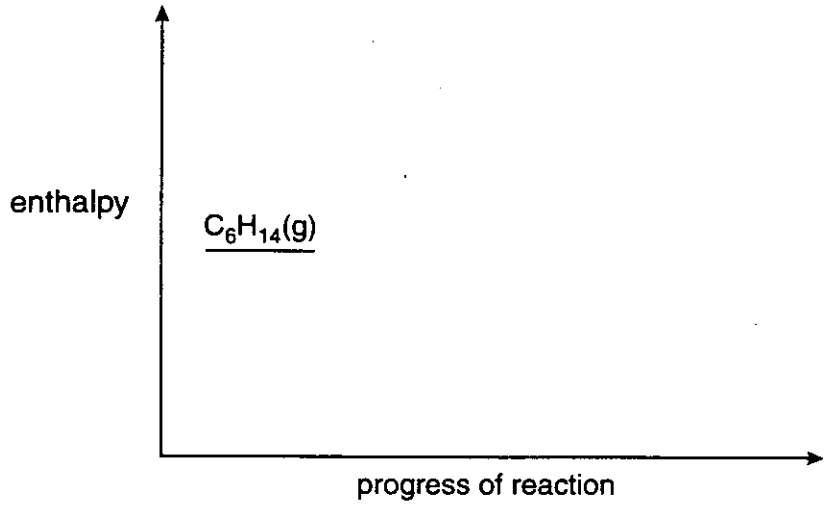
(ii) Use the average bond enthalpies in Table 1.1 to calculate the standard enthalpy change, $\Delta H_r^{\ominus}$, for reaction 1.1.

Table 1.1

bond	average bond enthalpy / kJ mol^{-1}
H—H	436
C—H	410
C—C	350
C=C	610

$\Delta H_r^{\ominus}$ = ... kJ mol^{-1} [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.

$$4NH_3(g) + 5O_2(g) \rightleftharpoons 4NO(g) + 6H_2O(g)$$

(a) Use the following standard enthalpy changes of formation to calculate the enthalpy change, $\Delta H_r^{\ominus}$, for this reaction.

compound	$\Delta H_f^{\ominus}$ / kJ mol^{-1}
$NH_3(g)$	–46
$NO(g)$	+90
$H_2O(g)$	–242

$\Delta H_r^{\ominus}$ = ... kJ mol^{-1} [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, HNO_3.

Construct a balanced equation for this reaction.

..... [2]

[Total: 11]

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

$$CO_2(g) + aq \rightleftharpoons CO_2(aq)$$

$$CO_2(aq) + H_2O(l) \rightleftharpoons H^+(aq) + HCO_3^-(aq)$$

(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.

.....

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..... [2]

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

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..... [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.

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..... [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.

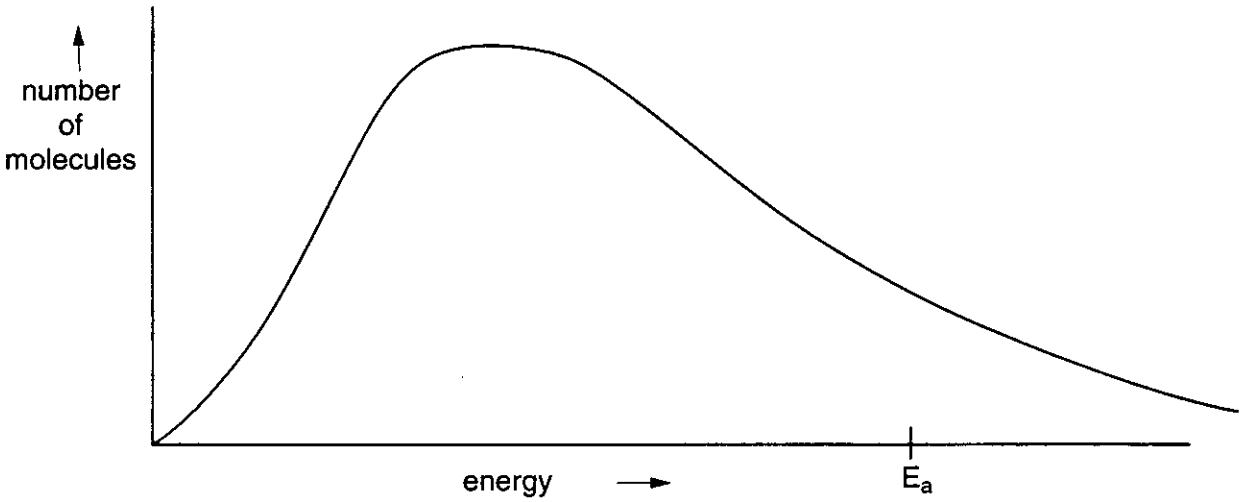

Fig. 4.1

(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.

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..... [2]

[Total: 6]

[Turn over

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, $Na_2CO_3(aq)$.

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

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..... [1]

(ii) Write a balanced equation for this reaction.

..... [2]

(b) Sulphuric acid reacts with ammonia in the manufacture of the salt ammonium sulphate, $(NH_4)_2SO_4$.

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

..... [1]

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

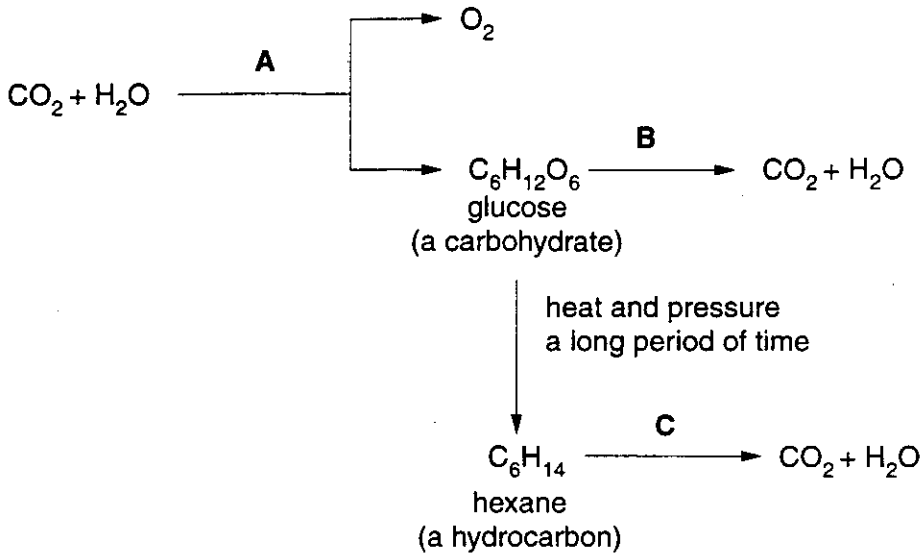
[2]

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

..... [1]

[Total: 7]

6 The following chart shows some processes involving carbohydrate and hydrocarbon fuels.



Discuss the processes **A**, **B** and **C** under the following headings. In your answer refer to:

- the name of each process
- the situations in which each occurs
- their endothermic or exothermic nature

How do these processes illustrate the statement that 'most fuels are solar fuels, since their energy has originally come from the sun'?

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..... [7]

[Total: 7]

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