

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced Subsidiary GCE

CHEMISTRY

How Far, How Fast?

2813/01

Tuesday

11 JANUARY 2005

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	13	
2	15	
3	7	
4	10	
TOTAL	45	

This question paper consists of 8 printed pages.

Answer **all** the questions.

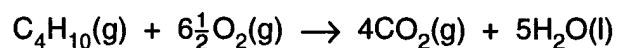
1 Butane, C_4H_{10} , is a gas at room temperature. It is used as a fuel for portable gas cookers.

(a) Give **two** properties of butane that make it suitable for its use as a fuel.

1

2[2]

(b) The combustion of butane is shown in the equation below.



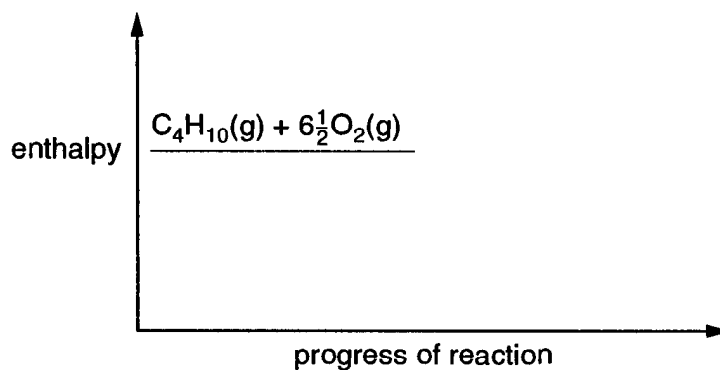
(i) The standard enthalpy change of combustion of butane is $-2877 \text{ kJ mol}^{-1}$.
What does *standard* mean in this context?

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

(ii) Define the term *enthalpy change of combustion*.

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

(iii) Complete the enthalpy profile diagram for the combustion of butane. Label the activation energy, E_a , and the enthalpy change, ΔH .



[3]

(c) Enthalpy changes of combustion can be used to determine enthalpy changes of formation.

(i) Write the equation for the standard enthalpy change of formation of butane, C_4H_{10} . Include state symbols in your answer.

.....[2]

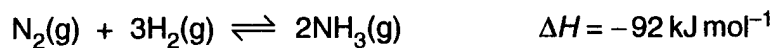
(ii) Use the following data to calculate the standard enthalpy change of formation of butane.

	standard enthalpy change of combustion / kJ mol^{-1}
carbon	-394
hydrogen	-286
butane	-2877

answer kJ mol^{-1} [3]

[Total: 13]

- 2 Part of the manufacture of ammonia involves the equilibrium below.



equilibrium 2.1

- (a) State le Chatelier's principle.

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

- (b) A mixture of N_2 and H_2 was made and left to reach equilibrium.

Explain how the following changes would affect the **time taken** to reach equilibrium.

- (i) use of a catalyst

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

- (ii) a higher temperature

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

- (iii) a lower pressure

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

(c) A mixture of N_2 and H_2 was left until it had reached equilibrium as shown in **equilibrium 2.1**. At that stage, N_2 , H_2 and NH_3 were present in the equilibrium mixture.

Explain how the following changes would affect the **amounts** of N_2 , H_2 and NH_3 present in the equilibrium mixture.

(i) use of a catalyst

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

(ii) a higher temperature

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

(iii) a lower pressure

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

(d) In the manufacture of ammonia, the reaction is generally carried out at a temperature of about $450\text{ }^\circ\text{C}$ and at a pressure approximately 200 times normal atmospheric pressure.

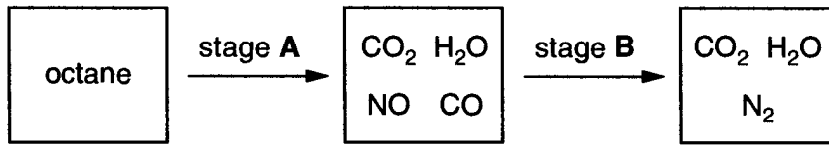
Suggest why these conditions are used industrially.

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

[Total: 15]

4 This question looks at some aspects of the use of petrol as a fuel for cars.

Petrol contains octane, C_8H_{18} . Two of the stages that occur when petrol, containing octane, is used in a car engine are shown below.



(a) Stage A includes the complete combustion of octane.

(i) Write the equation for this reaction.

.....[2]

(ii) Suggest how NO is produced.

.....[1]

(b) Stage B requires a catalyst.

(i) Name **two** metals generally present in the catalyst.

.....[1]

(ii) The catalyst is a heterogeneous catalyst. Describe how it works.

.....

[3]

(iii) Using the substances shown above, write the equation for the reaction that occurs in stage B.

.....[2]

(c) If stage B does not happen, further reactions occur and pollution levels rise.

Suggest **one** pollutant whose level in the atmosphere would rise.

..... [1]

[Total: 10]

END OF QUESTION PAPER