

OXFORD CAMBRIDGE AND RSA EXAMINATIONS**Advanced Subsidiary GCE****CHEMISTRY****2813/01**

How Far, How Fast?

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.

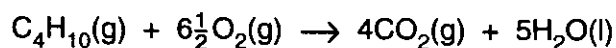
1 Butane, C_4H_{10} , is a gas at room temperature. It is used as a fuel for portable gas cookers.

(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]

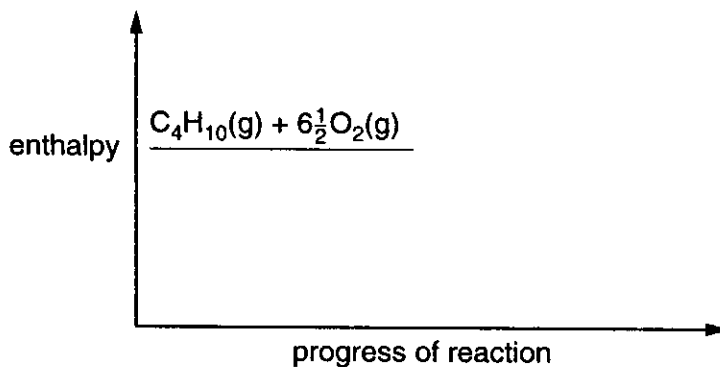
(ii) Define the term *enthalpy change of combustion*.

.....

.....

.....[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]

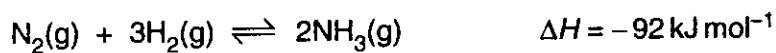
(ii) Use the following data to calculate the standard enthalpy change of formation of butane.

| | 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]

- 3 (a) Discuss what is meant by the terms *strong acid* and *weak acid*. Use hydrochloric acid, HCl, and ethanoic acid, CH₃COOH, as examples. Include relevant equations in your answer.

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.....[4]

- (b) Two students were provided with hydrochloric acid and ethanoic acid. They added the same amount of magnesium ribbon to each acid. Gas was produced at the same rate for each acid.

- (i) Identify the gas.

..... [1]

- (ii) One student said that the acids had the same concentration.

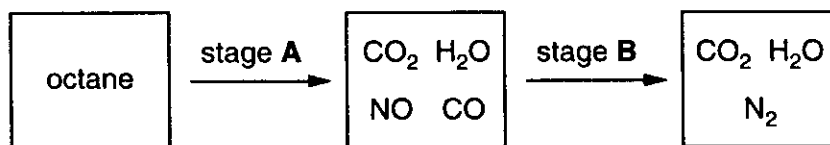
Comment, with a reason, on whether the student was correct.

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

[Total: 7]

- 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

