OCR
RECOGNISING ACHIEVEMENT

ADVANCED SUBSIDIARY GCE

CHEMISTRY

How Far, How Fast?

2813/01

WEDNESDAY 6 JUNE 2007

Morning

Time: 45 minutes

Additional materials: Scientific calculator
Data Sheet for Chemistry (Inserted)

Candidate Name

Centre Number

Candidate Number

INSTRUCTIONS TO CANDIDATES

- Write your name, Centre number and Candidate number in the boxes above.
- Answer **all** the questions.
- Use blue or black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure you know what you have to do before starting your answer.
- Do **not** write in the bar code.
- Do **not** write outside the box bordering each page.
- WRITE YOUR ANSWER TO EACH QUESTION IN THE SPACE PROVIDED. ANSWERS WRITTEN ELSEWHERE WILL NOT BE MARKED.

INFORMATION FOR CANDIDATES

- The number of marks for each question is given in brackets [ ] at the end of each question or part question.
- 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.

FOR EXAMINER'S USE		
Qu.	**Max.**	**Mark**
1	**6**	
2	**14**	
3	**13**	
4	**12**	
TOTAL	**45**	

This document consists of **7** printed pages, **1** blank page and a *Data Sheet for Chemistry*.

[Turn over

BLANK PAGE

PLEASE DO NOT WRITE ON THIS PAGE

Answer **all** the questions.

1 The equations below show some of the reactions that you may have studied in this unit.

$C_6H_{12}O_6 + 6O_2 \rightarrow 6H_2O + 6CO_2$ equation **A**

$C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$ equation **B**

$N_2 + 3H_2 \rightarrow 2NH_3$ equation **C**

$C + O_2 \rightarrow CO_2$ equation **D**

$2NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$ equation **E**

$6H_2O + 6CO_2 \rightarrow C_6H_{12}O_6 + 6O_2$ equation **F**

$2CO + 2NO \rightarrow N_2 + 2CO_2$ equation **G**

(a) Which equation represents photosynthesis?

..... [1]

(b) Which equation represents a neutralisation reaction?

..... [1]

(c) Which equation represents a reaction that is usually catalysed by a mixture of platinum, rhodium and palladium?

..... [1]

(d) Which two equations represent reactions that have ΔH values equal in value but opposite in sign?

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

(e) What conditions of temperature and pressure are generally used when the reaction represented by equation **C** is used industrially?

temperature .....

pressure ..... [2]

[Total: 6]

2 Alkanes are important hydrocarbons since they are used as fuels in homes and in industry. It is important that the enthalpy changes involved in alkane reactions are known.

(a) (i) Define the term *enthalpy change of formation of a compound*.

.....

.....

..... [2]

(ii) Write the equation, including state symbols, that accompanies the enthalpy change of formation of hexane, $C_6H_{14}(l)$.

[2]

(iii) What conditions of temperature and pressure are used when measuring the **standard** enthalpy change of formation?

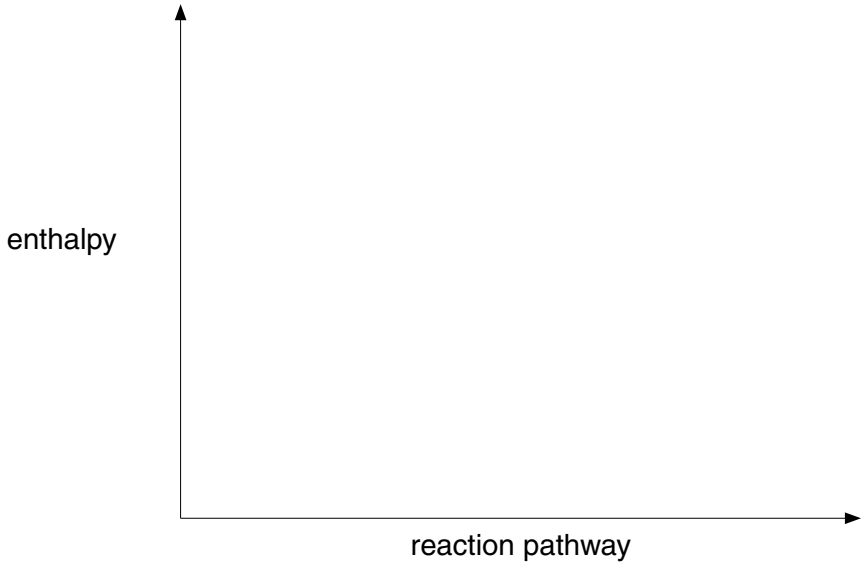
temperature .....

pressure ..... [1]

(b) The standard enthalpy change of formation of hexane is $-199\,kJ\,mol^{-1}$.

Using the axes below, show the enthalpy profile diagram for the formation of hexane.

On your diagram label the enthalpy change of reaction, ΔH, and the activation energy, E_a.



[3]

(c) Enthalpy changes can be calculated using enthalpy changes of combustion. The table below shows some values for standard enthalpy changes of combustion.

substance	$\Delta H_c^{\ominus}$ / kJ mol^{-1}
C(s)	–394
$H_2(g)$	–286
$CH_4(g)$	–890

Use these values to calculate the standard enthalpy change of the reaction below.

$$C(s) + 2H_2(g) \longrightarrow CH_4(g)$$

standard enthalpy change = ... kJ mol^{-1} [3]

(d) The equations for the combination of gaseous atoms of carbon and hydrogen to form methane, CH_4, and ethane, C_2H_6, are shown below.

$$C(g) + 4H(g) \longrightarrow CH_4(g) \qquad \Delta H = -1652\,\text{kJ mol}^{-1}$$

$$2C(g) + 6H(g) \longrightarrow C_2H_6(g) \qquad \Delta H = -2825\,\text{kJ mol}^{-1}$$

Use these data to calculate:

(i) the bond enthalpy of a C–H bond,

bond enthalpy = ... kJ mol^{-1} [1]

(ii) the bond enthalpy of a C–C bond.

bond enthalpy = ... kJ mol^{-1} [2]

[Total: 14]

3 Many industrial processes, used to manufacture important chemicals, involve equilibrium reactions. Chemists use their understanding of rates of reaction and of yields at equilibrium to find the most economic conditions for the reactions.

Chemists were investigating the production of a chemical, X_2Y, that could be formed from X_2 and Y_2 as shown in **equilibrium 3.1** below.

$$2X_2(g) + Y_2(g) \rightleftharpoons 2X_2Y(g) \qquad \textbf{equilibrium 3.1}$$

(a) State le Chatelier's principle.

.....

.....

..... [2]

(b) State and explain the effect on **equilibrium 3.1** of a **decrease** in pressure on:

(i) the equilibrium position of the reaction,

.....

.....

..... [2]

(ii) the rate of the reaction.

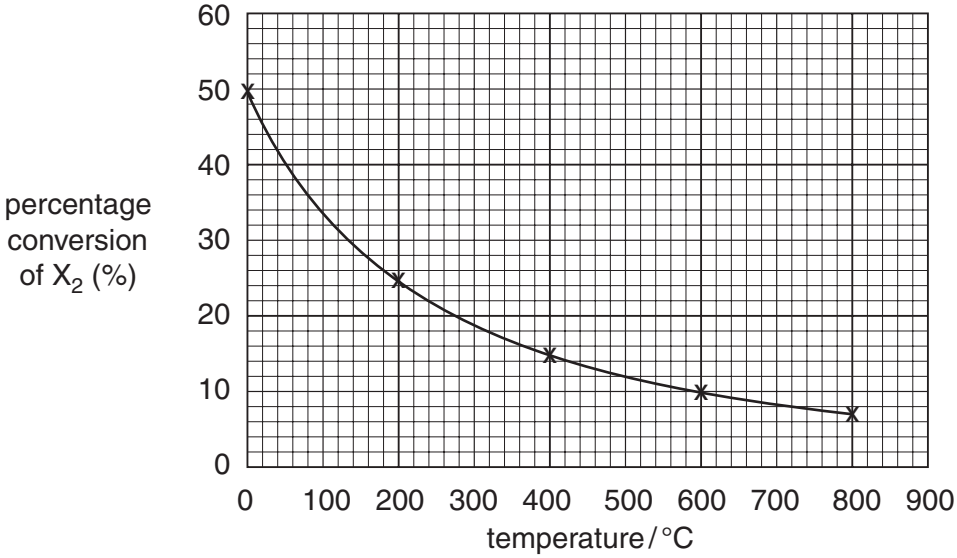
.....

.....

.....

..... [2]

(c) The chemists measured the percentage conversion of X_2 at various temperatures. The results are shown in the graph below.



(i) Use the graph to predict the percentage conversion at 350 °C.

answer = ... % [1]

(ii) The forward reaction in **equilibrium 3.1** is exothermic. Explain how the graph supports this statement.

.....

.....

.....

.....

..... [2]

(d) The chemists decided to use a catalyst in the process.
State, and explain, the effect of using a catalyst on:

(i) the rate of conversion of X_2 and Y_2 into X_2Y,

.....

..... [2]

(ii) the percentage conversion at equilibrium of X_2 and Y_2 into X_2Y.

.....

.....

..... [2]

[Total: 13]

TURN OVER FOR QUESTION 4

4 **(a)** Hydrochloric acid, HC*l*, is a strong acid and propanoic acid, C_2H_5COOH, is a weak acid.

Use these examples to give an account of the similarities and differences between strong and weak acids.

You should include in your account:

- the definition of an acid,
- equations to show the dissociation of both acids.

.....

.....

.....

.....

..... [4]

(b) Describe how you would use magnesium to distinguish between a strong and a weak acid of the same concentration. Include in your answer equations, observations and an explanation.

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.....

.....

..... [6]

(c) Acids also react with carbonates. Write the ionic equation for the reaction of hydrochloric acid with sodium carbonate solution.

[2]

[Total: 12]

END OF QUESTION PAPER