OCR
RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
Advanced Subsidiary GCE

CHEMISTRY 2813/01

How Far, How Fast?

Wednesday **8 JUNE 2005** 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	10	
2	15	
3	11	
4	9	
TOTAL	45	

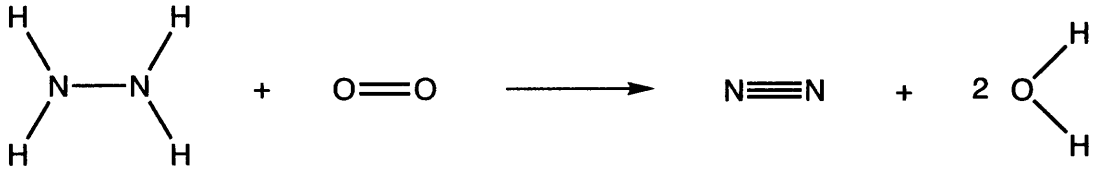
This question paper consists of 8 printed pages.

Registered Charity Number: 1066969
[Turn over

Answer **all** the questions.

1 This question is about hydrazine, N_2H_4, and ammonia, NH_3. These are both compounds of nitrogen and hydrogen.

(a) Hydrazine can be oxidised and used as a rocket fuel. The equation for one possible reaction taking place is shown below.



Some average bond enthalpies are given below.

bond	bond enthalpy / kJ mol^{-1}
N–N	+163
N≡N	+945
N–H	+390
O=O	+497
O–H	+463

Table 1.1

(i) Use these data to calculate the enthalpy change for the reaction of hydrazine with oxygen, as shown.

answer ..... kJ mol^{-1} [4]

(ii) Calculate the enthalpy change for one gram of hydrazine in this reaction.

answer ..... kJ [1]

(b) Ammonia reacts with oxygen in a very similar way to that shown for hydrazine. The enthalpy change for one gram of ammonia is approximately the same as that for one gram of hydrazine.

Using **Table 1.1**, suggest a reason why hydrazine is used as a rocket fuel and ammonia is not.

.....

.....[1]

(c) Ammonia reacts with sulphuric acid, as shown in the equation below.

$$2NH_3(g) + H_2SO_4(aq) \longrightarrow (NH_4)_2SO_4(aq)$$

(i) Complete the statement below to describe how ammonia is behaving in this reaction.

Ammonia is behaving as a ..... because

.....[2]

(ii) State **one** important use for the compound $(NH_4)_2SO_4$.

.....[1]

(iii) Apart from the manufacture of $(NH_4)_2SO_4$, state **one other** large-scale use of ammonia.

.....[1]

[Total: 10]

2 This question is concerned with equilibria that exist between oxides of nitrogen.

(a) State le Chatelier's principle.

.....

.....

.....[2]

(b) Nitrogen dioxide, NO_2, is a brown gas whilst dinitrogen tetroxide, N_2O_4, is a colourless gas. The following equilibrium between these two gases was set up.

$$2NO_2(g) \rightleftharpoons N_2O_4(g) \qquad \Delta H = -58\,kJ\,mol^{-1}$$

Describe, and explain, what you would **see** after the following changes have been made and the system allowed to reach equilibrium again.

(i) The temperature is increased.

.....

.....

.....

.....[3]

(ii) The pressure is increased.

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.....

.....

.....[3]

(c) NO_2 is an atmospheric pollutant that reacts with water according to the equation below.

$$2NO_2(g) + H_2O(l) \longrightarrow HNO_3(aq) + HNO_2(aq) \quad \textbf{equation 2.1}$$

(i) Use oxidation numbers of nitrogen to explain why equation **2.1** represents a redox reaction.

.....

.....

.....[2]

(ii) State a likely source of NO_2 as an atmospheric pollutant.

.....[1]

(d) The reaction of NO_2 with water, in equation **2.1**, occurs when rain falls through air containing NO_2.

Both HNO_3 and HNO_2 are acids.

Limestone contains calcium carbonate, $CaCO_3$.

(i) Which ion is responsible for the acid properties of HNO_3 and HNO_2?

..... [1]

(ii) Write the **ionic** equation for the reaction between calcium carbonate and HNO_3.

.....[2]

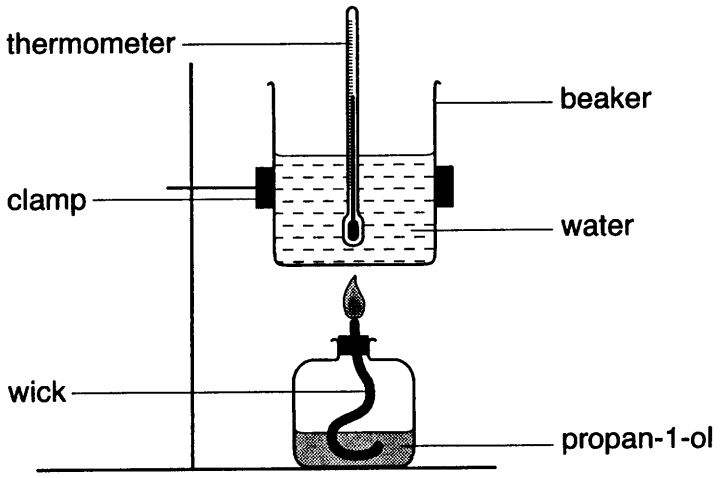
(iii) Norwich cathedral is built from limestone. What will happen to Norwich cathedral over a period of years if significant amounts of NO_2 are present in the atmosphere around Norwich?

.....

.....[1]

[Total: 15]

3 In an experiment to determine the standard enthalpy change of combustion of propan-1-ol, C_3H_7OH, a student used the apparatus shown below.



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

.....

.....

.....[2]

(b) Write the equation for the standard enthalpy change of combustion of propan-1-ol, C_3H_7OH.

.....[2]

(c) The student measured 50.0 cm^3 of water into the beaker and lit the burner. When the temperature of the water had gone up by 12.8 °C, he found that 0.100 g of propan-1-ol had been burnt.

(i) Calculate the energy, in kJ, produced by burning 0.100 g of propan-1-ol. The specific heat capacity of water is 4.18 $J\,g^{-1}\,K^{-1}$.

energy = ... kJ [2]

(ii) Calculate the number of moles of propan-1-ol in 0.100 g.

number of moles = ... [2]

(iii) Calculate the enthalpy change of combustion, in $kJ\,mol^{-1}$, of propan-1-ol.

enthalpy change ..... $kJ\,mol^{-1}$ [1]

(d) The student looked in a text book and found that the actual value for the standard enthalpy change of combustion of propan-1-ol was more exothermic than the experimental value.

Suggest **two** reasons for the difference between this value and the one he obtained experimentally.

1 .....

.....

2 .....

.....[2]

[Total: 11]

4 **(a)** What is a catalyst?

.....

.....[2]

(b) Explain the terms *heterogeneous catalyst* and *homogeneous catalyst.*
In your explanation you should

- include an example of a reaction for **each type** of catalyst
- include an equation for **one** of your reactions
- describe how a **heterogeneous** catalyst works.

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.....[7]

[Total: 9]

END OF QUESTION PAPER