Centre Number	Candidate Number	Name
0	067	

MINISTRY OF EDUCATION, BOTSWANA

in collaboration with

UNIVERSITY OF CAMBRIDGE LOCAL EXAMINATIONS SYNDICATE

Botswana General Certificate of Secondary Education

CHEMISTRY **0570/03**

Paper 3 October/November 2006

1 hour 15 minutes

Candidates answer on the Question Paper
No Additional Materials are required

Read the following carefully before you start.

Write your centre number, candidate number and name in the spaces provided at the top of this page.
Answer all questions.
Write your answers in the spaces provided on the question paper.
Show your working for any calculations.
Do not use staples, paper clips, highlighters, glue or correction fluid.
The number of marks is given in brackets [ ] at the end of each question or part question.
A copy of the Periodic Table is printed on page 12.

For Examiner's Use	
1	
2	
3	
4	
5	
6	
7	
Total	

This question paper consists of 12 printed pages.

For Examiner's Use

(a) A mixture contains the solids silicon(IV) oxide and sodium chloride. The following processes are needed to obtain pure samples of the two solids.

evaporation *filtration* *addition of water*

Put the separation processes in the correct order and explain the purpose of each.

first process .....

purpose .....

second process .....

purpose .....

third process .....

purpose .....[4]

(b) Silicon(IV) oxide is an acidic oxide.

What is meant by the term *acidic oxide*?

.....

.....[1]

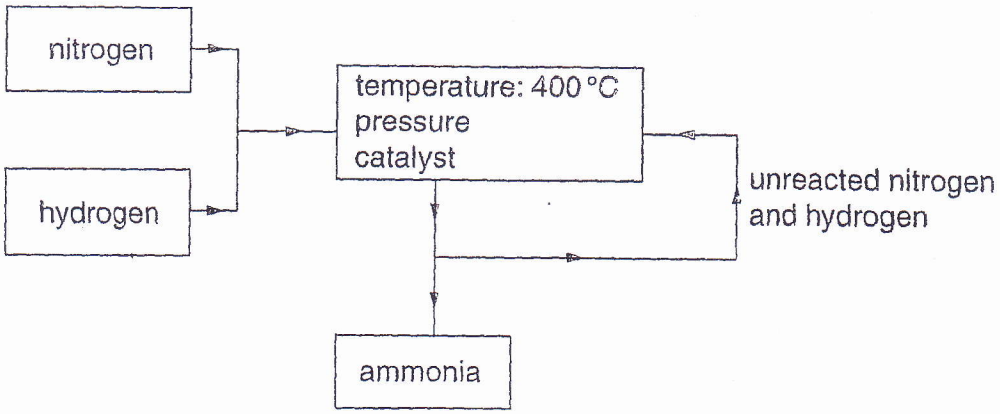
(c) Silicon(IV) oxide is similar in structure to diamond.

Describe the structure of silicon(IV) oxide and state one of its properties.

structure .....

property .....[2]

Ammonia is made from the reaction between nitrogen and hydrogen as shown.



For Examiner's Use

(a) Give a source of

(i) nitrogen, ...

(ii) hydrogen. .....[2]

(b) Name the catalyst used in this reaction.

.....[1]

(c) (i) The rate at which ammonia is formed from nitrogen and hydrogen can be increased by increasing the pressure.

Explain this in terms of the Kinetic Particle Theory.

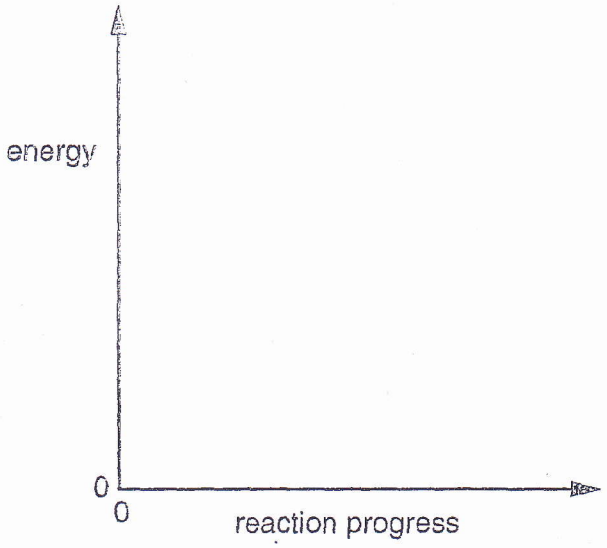
.....

.....[2]

(ii) State the pressure, in atmospheres, that is used in the industrial manufacture of ammonia.

.....atm [1]

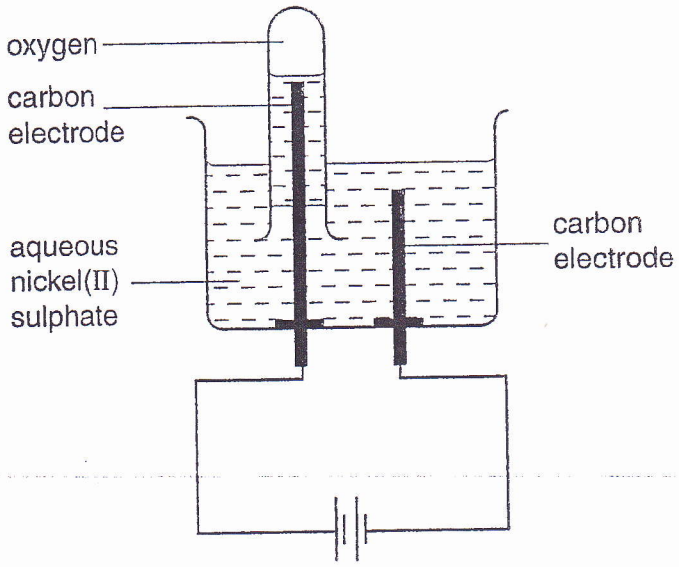
(iii) On the axis shown, sketch an energy level diagram to show the progress of the exothermic reaction for the production of ammonia. On your diagram, label reactants, products, ΔH and activation energy.



[4]

For Examiner's Use

3 The diagram shows how an experiment was set up to investigate the electrolysis of aqueous nickel(II) sulphate using carbon electrodes.



(a) (i) On the diagram, draw an arrow to show the direction of the movement of the electrons. [1]

(ii) What is meant by the term *electrolysis*?

.....

.....[1]

(iii) Name, or give the formula of, the ion that is discharged at the anode.

.....[1]

(iv) Write the ionic equation for the reaction at the cathode.

.....[1]

(v) State **two** changes to the set-up so that it can be used to electroplate a spoon with nickel.

1 .....

.....

2 .....

.....[2]

For Examiner's Use

(b) In the electrolysis experiment opposite, a current of 19.2 A was passed through the cell for 1 minute 40 seconds.

(i) How many coulombs were passed?

[2]

(ii) Calculate the number of faradays passed.
1 faraday = 96 500 coulombs

[1]

(iii) Calculate the number of moles of nickel produced.

[2]

(iv) The number of moles of oxygen, O_2, produced at the same time is half the answer to (b)(iii).

Calculate the volume of oxygen produced at room temperature and pressure.

.....dm^3 [2]

4 Tetrachloromethane, CCl_4, is a colourless liquid formed when a hydrocarbon Y reacts with chlorine.

(a) (i) Name the hydrocarbon Y.

.....[1]

(ii) State the type of reaction between hydrocarbon Y and chlorine.

.....[1]

(b) (i) Draw a dot-and-cross diagram to show the bonding in tetrachloromethane.

Show the outer electrons only.

[3]

(ii) Which element, carbon or chlorine, has a larger atomic radius?

.....

Suggest a reason for your answer.

.....[2]

(c) The boiling point of tetrachloromethane is 77 °C and that of water is 100 °C.

Explain why tetrachloromethane has a lower boiling point than water.

.....

.....

.....[2]

For Examiner's Use

5 Excess magnesium was added to 25.0 cm^3 of dilute hydrochloric acid.
The reaction is shown by the equation.

$$Mg(s) + 2HCl(aq) \longrightarrow MgCl_2(aq) + H_2(g)$$

The hydrogen produced was completely reacted with 2.0 g of copper(II) oxide as shown by the equation.

$$CuO(s) + H_2(g) \longrightarrow H_2O(l) + Cu(s)$$

(a) (i) Rewrite the first equation above as an ionic equation.

.....[1]

(ii) Calculate the number of moles in 2.0 g of copper(II) oxide.

[1]

(iii) Calculate the number of moles of hydrogen, H_2, that reacted with the copper(II) oxide.

[1]

(iv) Calculate the number of moles of hydrochloric acid used to make the amount of hydrogen in your answer to (iii).

[2]

(v) What is the concentration of the acid in g / cm^3?

[2]

For Examiner's Use

(b) A redox reaction occurs between copper(II) oxide and hydrogen.

(i) Explain why this is a redox reaction. Refer to the changes of oxidation number that take place.

.....

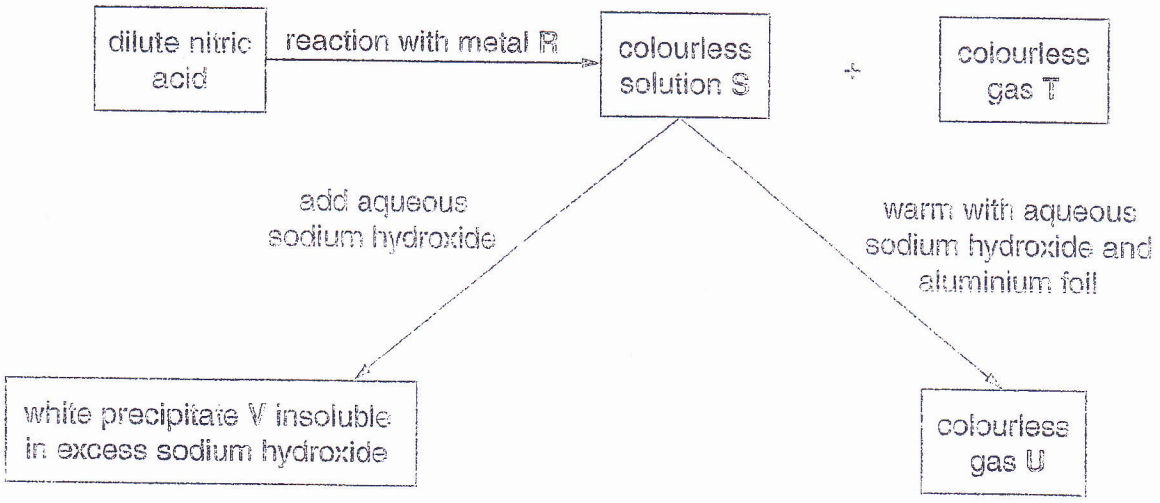
.....

.....[2]

(ii) Name the oxidising agent.

.....[1]

6 (a) Study the reaction scheme shown.



Name the

(i) metal R,

.....

(ii) colourless solution S,

.....

(iii) colourless gas T,

.....

(iv) colourless gas U,

.....

(v) white precipitate V.

For Examiner's Use

(b) Zinc carbonate reacts with dilute nitric acid to form zinc nitrate, carbon dioxide and water.

(i) Write a balanced chemical equation for the reaction.

.....[2]

Zinc nitrate crystals decompose on heating.

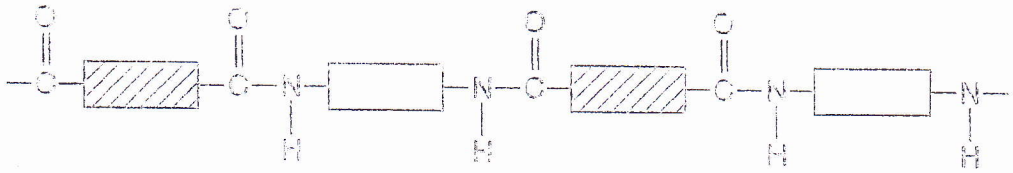
(ii) Give two of the products formed when zinc nitrate is heated.

1 .....

2 .....[2]

For Examiner's Use

7 The synthetic condensation polymer nylon can be represented by using the simplified structure shown.



(a) (i) Draw a simplified structure of one of the two molecules used in the formation of the nylon polymer shown.

[2]

(ii) Name one natural macromolecule similar in structure to nylon.

.....[1]

(iii) Name the linkage found in both structures.

.....[1]

(iv) State one environmental problem that can be caused by the use of nylon.

.....

Explain your answer.

.....[2]

(b) Butanol, $CH_3CH_2CH_2CH_2OH$, is produced from the catalytic addition of steam to an alkene.

(i) Name the alkene that would react with steam to produce butanol.

.....[1]

(ii) Name the catalyst for this reaction.

.....[1]

For Examiner's Use

(iii) Draw the other two isomers of butanol showing all the bonds between atoms.

[2]

(iv) Butanol has been proposed as a fuel for camping stoves.

Explain why it would be dangerous to burn butanol in a limited supply of oxygen.

.....

.....

.....[2]