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Centre Number 3	Candidate Number	Name
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MINISTRY OF EDUCATION, BOTSWANA  
in collaboration with  
UNIVERSITY OF CAMBRIDGE LOCAL EXAMINATIONS SYNDICATE  
**Botswana General Certificate of Secondary Education**

**CHEMISTRY**

Paper 3

**0570/03**

October/November 2005

**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	
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5	
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7	
8	
<b>TOTAL</b>	

This question paper consists of **12** printed pages.

- 1 (a) Choose **one** substance from the list that fits the given description. You may use each substance once, more than once or not at all.

barium sulphate  
carbon dioxide  
calcium oxide

copper  
hydrogen  
ammonium chloride

calcium hydroxide  
oxygen  
diamond

(i) an acidic oxide ..... [1]

(ii) used to dry ammonia ..... [1]

(iii) a salt prepared by precipitation ..... [1]

(iv) a macromolecule ..... [1]

- (b) Which **two** substances from the list would react to

(i) form ammonia when heated together,

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

(ii) only form a compound with a molar mass of 18 g?

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

- 2 (a) Chlorine exists as a diatomic molecule.

(i) What is meant by a *diatomic* molecule?

..... [1]

(ii) To which Period of the Periodic Table does chlorine belong?

..... [1]

- (b)  $^{35}_{17}\text{Cl}$  and  $^{37}_{17}\text{Cl}$  are two isotopes of chlorine.

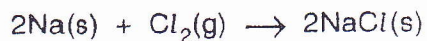
Give **one** similarity and **one** difference between the two isotopes.

similarity ..... [1]

difference ..... [1]

..... [2]

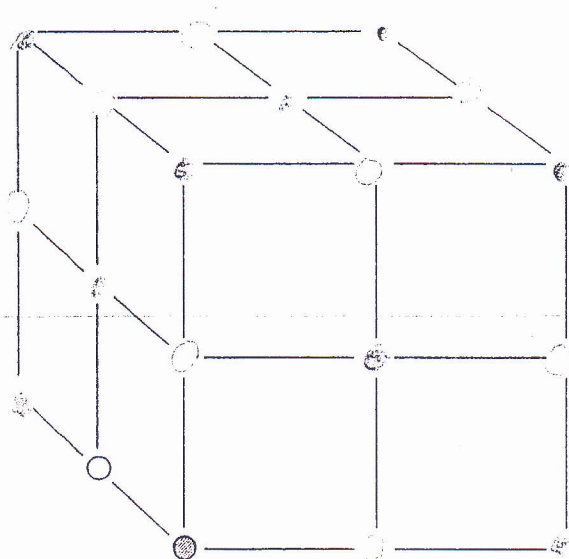
(c) Chlorine reacts with sodium as shown by the equation.



(i) What type of bonding is in sodium chloride, NaCl?

*ionic bonding* ..... [1]

The diagram shows part of the lattice structure of sodium chloride, NaCl.



key

○ sodium ion

● chloride ion

(ii) Complete the diagram to show the arrangement of the particles. [2]

(iii) Calcium oxide has the same type of lattice structure as sodium chloride. The melting point of calcium oxide is 2600 °C and that of sodium chloride is 808 °C.

Explain why the melting point of calcium oxide is higher than that of sodium chloride.

*Calcium oxide has a higher melting point than sodium chloride because calcium oxide has a higher charge of attraction.* ..... [2]

3 Ammonia is manufactured in the Haber process by the reversible reaction between nitrogen and hydrogen.

(a) Write the equation for this reaction including state symbols.

..... [3]

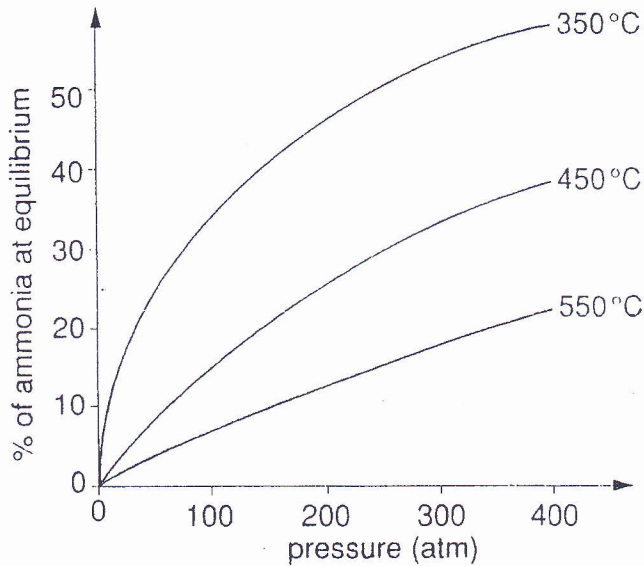
(b) State the conditions necessary for the Haber process.

**catalyst** .....

**temperature** ..... °C

**pressure** ..... atm [3]

(c) The graph shows the equilibrium percentage of ammonia at different temperatures and pressures.



Use the graph to deduce the relationship between the equilibrium percentage of ammonia and

(i) increasing temperature,

.....

(ii) increasing pressure.

.....

[2]

- (d) (i) Use your answer to (c)(i) to state whether the forward reaction is endothermic or exothermic and explain why.

The reaction is .....

because ..... [1]

- (ii) Explain why the continuous removal of ammonia from the equilibrium mixture increases the yield.

..... [1]

- 4 During the production of traditional beer, glucose is converted to ethanol and carbon dioxide as shown.



- (a) (i) Name this process.

..... [1]

- (ii) Explain why the temperature of the reaction is maintained around 40 °C.

..... [1]

- (b) (i) Calculate the mass of ethanol,  $\text{C}_2\text{H}_5\text{OH}$ , produced from 9.0 g of glucose,  $\text{C}_6\text{H}_{12}\text{O}_6$ .

mass = ..... g [2]

- (ii) Calculate the number of molecules of ethanol produced in (b)(i).  
(Avogadro's number =  $6.02 \times 10^{23}$ )

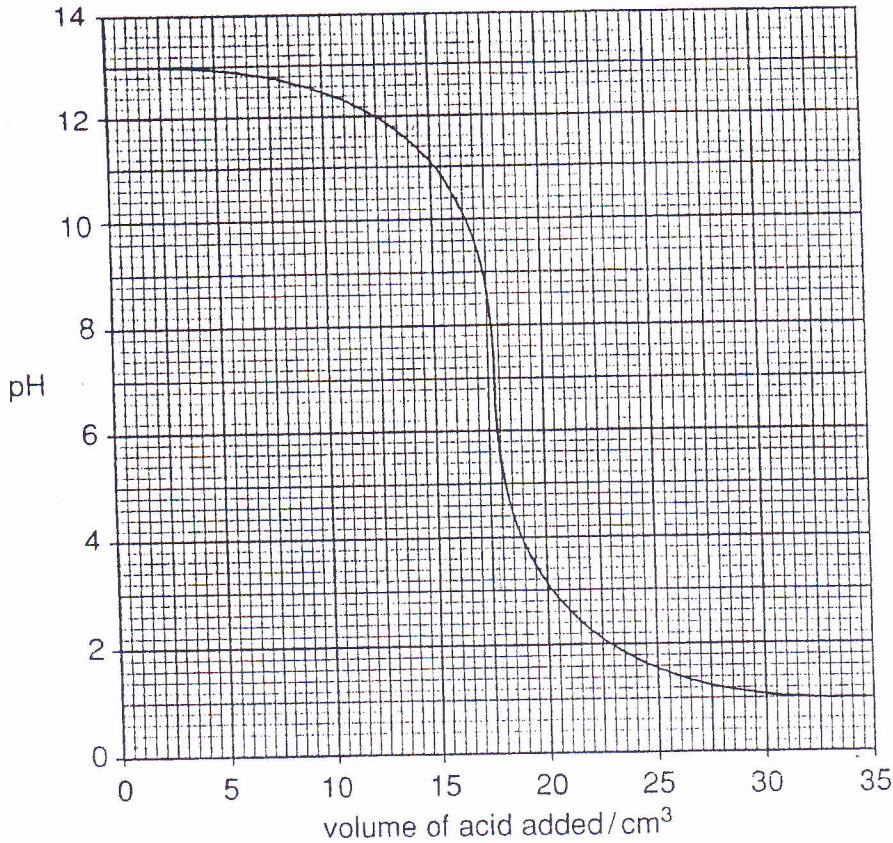
number of molecules = ..... [2]

- (c) Describe the chemical test to show that the gas produced is carbon dioxide.

test .....

result ..... [2]

5 Hydrochloric acid was added from a burette to 20 cm<sup>3</sup> of aqueous potassium hydroxide containing a few drops of Universal Indicator. The pH of the mixture was measured at intervals while the acid was being added. The graph shows the pH during the addition of the acid.



- (a) (i) What was the pH of the potassium hydroxide at first?  
 ..... 13 ..... [1]
- (ii) State the colour of the Universal Indicator when  
 10 cm<sup>3</sup> of acid had been added, ..... Purple .....  
 30 cm<sup>3</sup> of acid had been added. .... Yellow ..... [2]
- (iii) What volume of the acid was added to neutralise 20 cm<sup>3</sup> of the alkali?  
 ..... 17.5 ..... cm<sup>3</sup> [1]
- (iv) Comment on the relative concentrations of the acid and alkali.  
 ..... The acid is more concentrated than the alkali ..... [1]

(b) A student attempted to prepare potassium chloride crystals from the mixture of  $20 \text{ cm}^3$  potassium hydroxide and  $35 \text{ cm}^3$  hydrochloric acid. Small amounts of charcoal were added to the mixture and then removed.

(i) Explain the purpose of adding charcoal.

..... [1]

(ii) How was the charcoal removed?

..... [1]

(c) The solution was heated to dryness.

(i) What is the colour of the solid which remained?

..... [1]

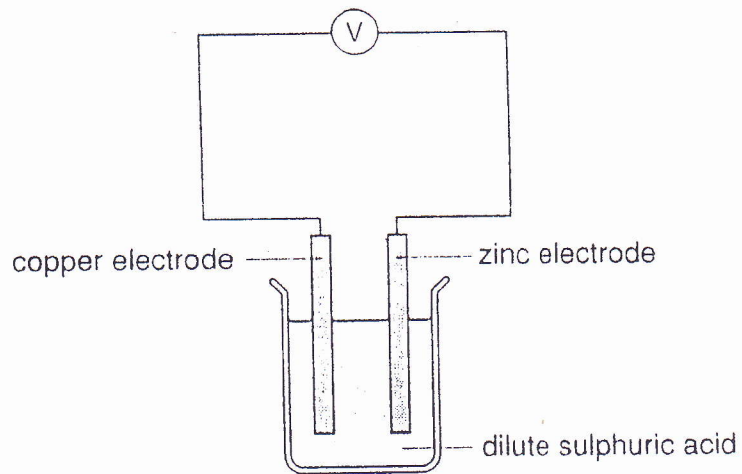
(ii) Were the crystals obtained pure? Explain.

..... [1]

(d) Give **one** application of acid-base reactions in daily life.

..... [1]

6 The diagram shows a simple cell.



(a) (i) Describe how the cell produces an electric current.

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

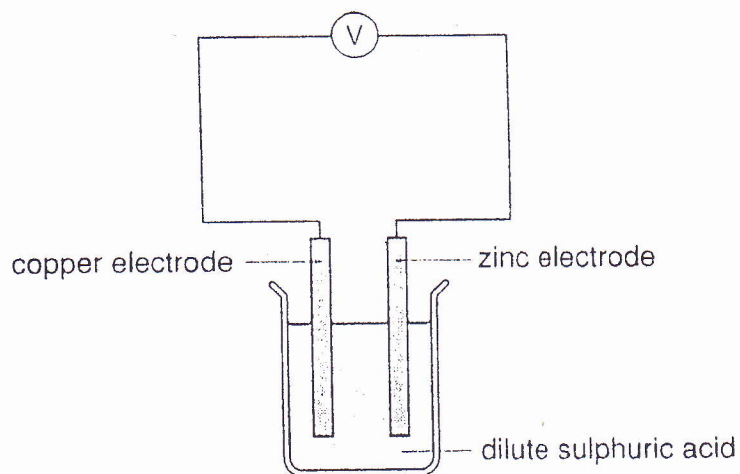
(ii) Which electrode is the cathode?

..... [1]

(iii) Write the equation for the reaction taking place at the zinc electrode.

..... [1]

6 The diagram shows a simple cell.



(a) (i) Describe how the cell produces an electric current.

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(ii) Which electrode is the cathode?

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(iii) Write the equation for the reaction taking place at the zinc electrode.

..... [1]

- (b) The experiment was repeated with different metals replacing the zinc electrode. The voltage across the electrodes was measured. The results are shown in the table.

electrode which replaced the zinc rod	voltage (V)
nickel	0.59
copper	0.00
zinc	1.10
tin	0.50
lead	0.47

- (i) Using the voltages of the metals, place the metals in order of their reactivity, starting with the most reactive.

most reactive .....

.....

.....

.....

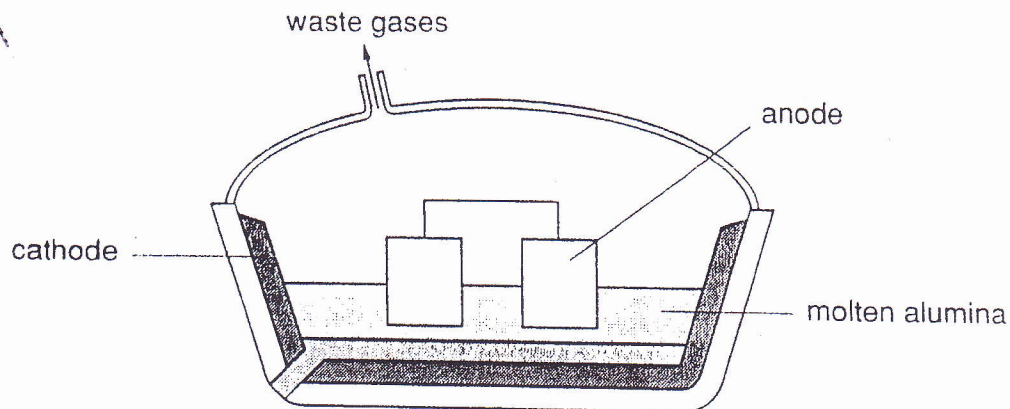
least reactive .....

[2]

- (ii) Calculate the voltage obtained if the copper electrode was replaced with lead and the zinc electrode replaced with tin.

..... V [1]

7 The diagram shows the electrolytic cell used for the extraction of aluminium from molten alumina.



- (a) (i) What are the electrodes made from?  
 ..... [1]
- (ii) Name the ore of aluminium from which alumina is extracted.  
 ..... [1]
- (iii) Write the chemical formula of alumina.  
 ..... [1]
- (b) Give **one** use of aluminium and state the property upon which this use depends.  
 use .....  
 property ..... [2]
- (c) The molten alumina is electrolysed for 2 hours using a current of 250 amps.
- (i) Write the equation for the formation of aluminium metal from the aluminium ion,  $Al^{3+}$ .  
 ..... [1]
- (ii) Calculate the quantity of electric charge used.  
 ..... [2]
- (iii) Calculate the number of moles of electrons used.  
 [1 Faraday = 96 500 C]  
 ..... [2]
- (iv) Calculate the mass of aluminium produced.  
 ..... [2]