



BOTSWANA EXAMINATIONS COUNCIL  
in collaboration with  
UNIVERSITY OF CAMBRIDGE LOCAL EXAMINATIONS SYNDICATE  
Botswana General Certificate of Secondary Education

CANDIDATE  
NAME

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CENTRE  
NUMBER

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CANDIDATE  
NUMBER

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**CHEMISTRY**

**0570/03**

Paper 3

**October/November 2012**

**1 hour 15 minutes**

Candidates answer on the Question Paper.

No Additional Materials are required.

**READ THESE INSTRUCTIONS FIRST**

Write your Centre number, candidate number and name in the spaces provided at the top of this page.

Write in dark blue or black pen.

You may use a soft pencil for any diagrams, graphs or rough working.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **all** questions.

Write your answers in the spaces provided on the question paper.

Show your working for any calculations.

You may use a calculator

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	
<b>Total</b>	

1 (a) Carbon is an element in group 4 of the Periodic Table.

(i) Suggest **one** reason why carbon is placed in group 4.

..... [1]

(ii) What type of element is carbon?

..... [1]

(b) Carbon reacts with oxygen to form carbon dioxide.

(i) Write a balanced chemical equation for this reaction and include state symbols.

..... [2]

(ii) What type of oxide is carbon dioxide?  
Give an explanation for your answer.

type of oxide .....

explanation ..... [2]

(iii) Draw a 'dot' and 'cross' diagram to show the bonding in a molecule of carbon dioxide.

[3]

(c) Explain why compounds with this type of bonding do **not** conduct electricity.

.....

..... [1]

[Total: 10]

2 Metals are extracted from their ores by chemical reduction.

(a) Complete the table.

metal	ore
iron	magnetite
zinc	
	bauxite
copper	

[3]

(b) Haematite is another ore of iron and contains a compound of formula  $Fe_2O_3$ . Name this compound.

..... [1]

(c) The reduction of  $Fe_2O_3$  by carbon monoxide, CO, forms iron. This is shown by the equation.



(i) Balance the equation and include state symbols. [2]

(ii) Describe the reactions that lead to the formation of carbon monoxide during the blast furnace process. You may write equations for the reactions.

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

(d) Iron, like other metals, can become more useful when converted to alloys.

(i) What is an alloy?

..... [1]

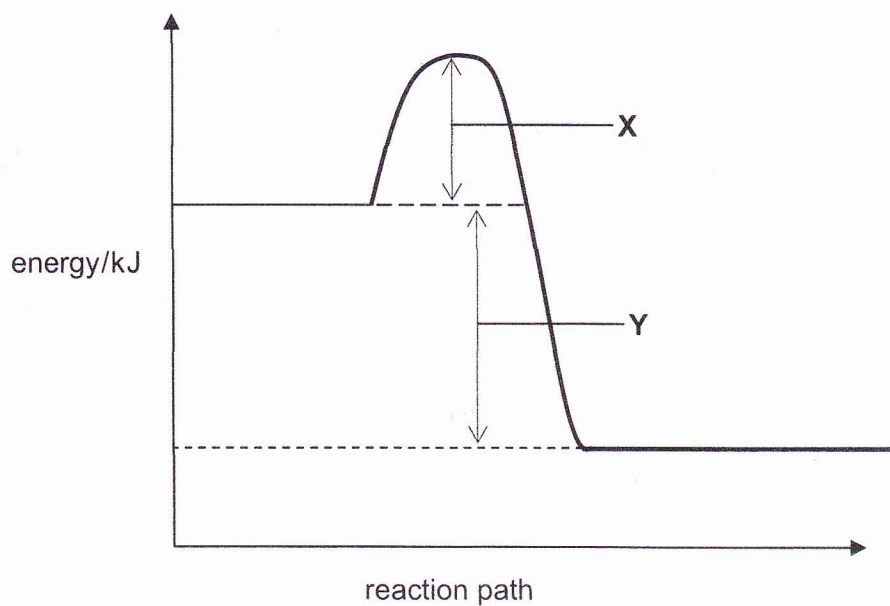
(ii) Name **one** alloy of iron and give one of its uses.

name of alloy .....  
 use ..... [2]

(iii) Give **two** reasons why an alloy may be more useful than the pure metal.

1 .....  
 2 ..... [2]

- 3 (a) An energy diagram for the production of ethanol by the addition of steam to ethane is shown.

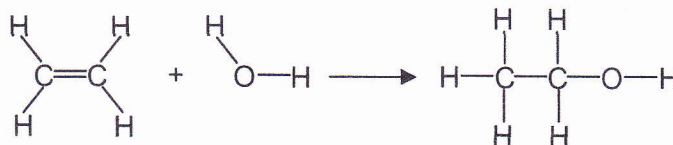


- (i) On the diagram, label the energy levels that represents the **reactants** and the **products**. [1]
- (ii) What do the letters **X** and **Y** in the diagram represent?

**X** .....

**Y** ..... [2]

- (b) The equation for the production of ethanol by the addition of steam to ethene is shown.



The bond energy of one mole of each type bond in the compounds in the equation is given in the table.

bond	bond energy (kJ/mol)
C—H	412
C=C	612
O—H	463
C—C	348
C—O	360

Use the information given to find the following energy changes.  
Each time, indicate the sign, – or +, of the total energy change.

- (i) Calculate the total energy change that takes place when all bonds in 1 mole of ethene are broken.

total energy change = ..... kJ/mol [2]

- (ii) Calculate the total energy change that takes place when all the bonds in 1 mole of steam are broken.

total energy change = ..... kJ/mol [1]

- (iii) Calculate the total energy change that takes place when all bonds in 1 mole of ethanol are formed.

total energy change = ..... kJ/mol [3]

- (iv) Calculate the total energy change,  $\Delta H$ , for the reaction shown by the equation.

total energy change = ..... kJ/mol [2]

- (v) Is the reaction endothermic or exothermic?

.....

Explain your answer.

..... [1]

- (c) State the conditions necessary for the production of ethanol by addition of steam to ethene.

.....

.....

..... [3]

[Total: 15]

4 Pollutant gases such as carbon monoxide and oxides of nitrogen are produced by a car engine and are emitted through the exhaust pipe.

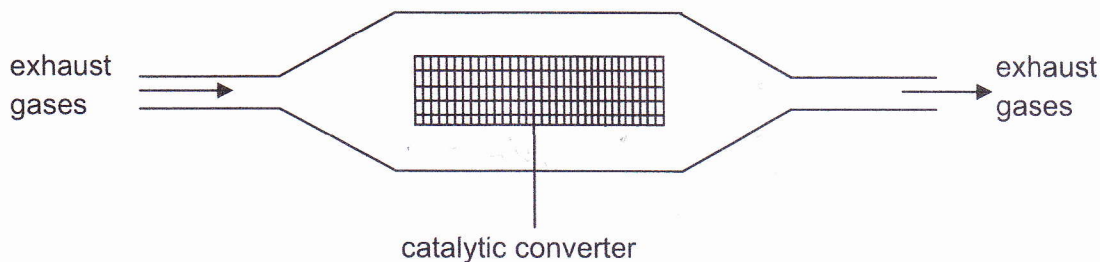
(a) Describe how oxides of nitrogen are formed in car engines.

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

(b) Explain how carbon monoxide affects human health.

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

(c) The diagram shows a car exhaust fitted with a catalytic converter.



(i) Why are catalytic converters fitted in car exhausts?

..... [1]

(ii) Suggest why catalytic converters contain a network of fine holes.

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

(d) The concentration of carbon dioxide in the atmosphere is increased by the burning of petrol in cars.  
State **one** type of environmental damage caused by this increase.

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

(e) Carbon dioxide, nitrogen and oxygen are all present in clean air.

(i) State the proportion of oxygen in clean air.

..... [1]

(ii) Give **two** uses of oxygen.

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

(iii) Name the process used to separate oxygen and nitrogen from air.

..... [1]

[Total: 12]

- 5 (a) Ethanoic acid,  $\text{CH}_3\text{COOH}$ , can be formed by the oxidation of ethanol,  $\text{C}_2\text{H}_5\text{OH}$ , using acidified potassium dichromate.

(i) State **two** chemical properties of ethanoic acid.

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

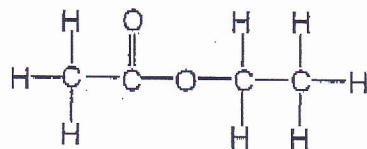
(ii) Draw the structural formula of ethanoic acid.

[2]

(iii) What colour change will be observed when acidified potassium dichromate reacts with ethanol?

from ..... to ..... [2]

- (b) Ethanol reacts with ethanoic acid to form an ester of the structure shown.



(i) Name the ester formed.

..... [1]

(ii) Circle the ester linkage on the structure.

..... [1]

(iii) Name a condensation polymer which has ester linkages.

..... [1]

- (c) Acidified potassium dichromate,  $\text{K}_2\text{Cr}_2\text{O}_7$ , also oxidises concentrated hydrochloric acid as shown by the equation.



(i) Calculate the oxidation number of chromium in

$\text{K}_2\text{Cr}_2\text{O}_7$ , ..... [1]

$\text{CrCl}_3$ , ..... [1]

- (ii) Use the change in the oxidation number of chromium atoms to show that potassium dichromate is reduced during the reaction.

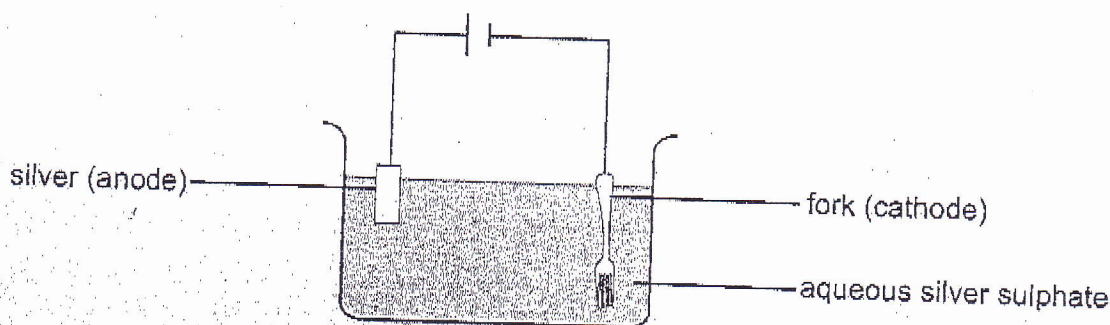
..... [1]

- (iii) Name another oxidising agent that can be used in the preparation of chlorine from hydrochloric acid.

..... [1]

[Total: 13]

- 6 The diagram shows a metallic fork electroplated using silver.



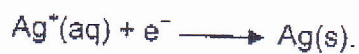
- (a) Explain the term electroplating.

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

- (b) Suggest one reason why many metallic objects used in the home are electroplated.

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

- (c) 0.54 g of silver was deposited on the surface of the fork.  
 The equation for the cathode reaction is



- (i) Calculate the charge in coulombs required to deposit 0.54 g of silver.  
 (1 Faraday = 96 500 C)

charge = ..... coulombs [2]

- (ii) If a current of 2.5 A was used in the electroplating process, calculate the time taken to deposit 0.54 g of silver.

time = ..... sec [2]

- (d) Write the equation for the reaction taking place at the anode.

..... [1]

[Total: 7]

