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Centre Number

Candidate  
Number

Candidate 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**

**0570/3**

Tuesday      **7 NOVEMBER 2000**      Afternoon      1 hour 15 minutes

Candidates answer on the question paper.  
No additional materials are required.

**TIME**      1 hour 15 minutes

**INSTRUCTIONS TO CANDIDATES**

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

Answer **all** questions.

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

**INFORMATION FOR CANDIDATES**

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

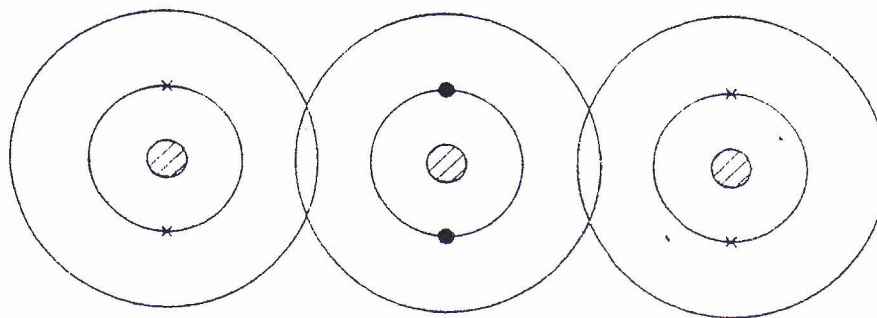
You may use a calculator.

A copy of the Periodic Table is printed on Page 12.

FOR EXAMINER'S USE	
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10	
TOTAL	

- 1 A carbon dioxide molecule is made up of one carbon atom bonded to two oxygen atoms.
- (a) Complete the diagram to show the arrangement of **all** the electrons in a molecule of carbon dioxide. Represent each electron by a dot, •, or a cross, x.

The inner shells have already been done.



[3]

- (b) Name the type of bond between the carbon and oxygen atoms.

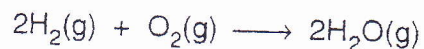
.....[1]

- 2 Energy is required to break bonds as shown in table 1 below. The bond energy is the amount of energy involved in breaking one mole of bonds.

Table 1

bond	bond energy kJ/mol
H - H	+ 436
O = O	+ 496
H - O	+ 463
C = O	+ 743

Hydrogen burns in air to form steam.  
The reaction equation is as follows.



Use the information given to find the following energy changes. You must show the sign, - or +, of the energy change.

- (a) What is the energy change when all the bonds in one mole of oxygen molecules,  $\text{O}_2$ , are broken?

..... kJ/mol [1]

- (b) Calculate the energy change when all the bonds in two moles of hydrogen,  $\text{H}_2$ , are broken.

..... kJ/mol [1]

- (c) Calculate the energy change when all the bonds are formed between the atoms in the two moles of steam,  $\text{H}_2\text{O}(\text{g})$ .

..... kJ/mol [3]

- (d) Use your answers in (a), (b) and (c) to calculate the total energy change for the reaction shown in the equation opposite.

..... kJ/mol [2]

3 The metals lithium, potassium and sodium belong to Group I of the Periodic Table.

A table of some of their physical properties is shown.

Table 2

metal	melting point/ $^{\circ}\text{C}$	boiling point/ $^{\circ}\text{C}$	density $\text{g}/\text{cm}^3$
lithium	180	1336	0.53
sodium	98	883	0.97
potassium	64	759	0.86

(a) What is the name of all the Group I elements?

.....[1]

(b) Use the information in the table to name the metal which

(i) is a gas at  $800^{\circ}\text{C}$ , .....

(ii) remains liquid over the widest range of temperature,

.....

(iii) will float in ethanol (density of ethanol is  $0.79\text{ g}/\text{cm}^3$ ).

.....[3]

(c) Which of the metals will react most vigorously with water?

.....[1]

(d) Why are these metals stored under oil or paraffin?

.....[1]

4 Aluminium is an important metal which has many uses. Aluminium is often recycled after use.

(a) (i) What property of aluminium makes it suitable for the manufacture of aeroplane bodies?

.....

(ii) Suggest a use for aluminium which depends on its good electrical properties.

.....

(iii) State a property of aluminium which makes it suitable for making drink cans.

.....

(iv) Some drink cans have a base made of steel and a top made from aluminium. Suggest why this may be a disadvantage.

.....

.....

[4]

(b) (i) Name an important ore of aluminium.

.....

(ii) Alumina, a white solid, is made from the ore. What is the chemical name of alumina?

.....

(iii) Alumina is mixed with cryolite and then the mixture is electrolysed. Why is cryolite added?

.....

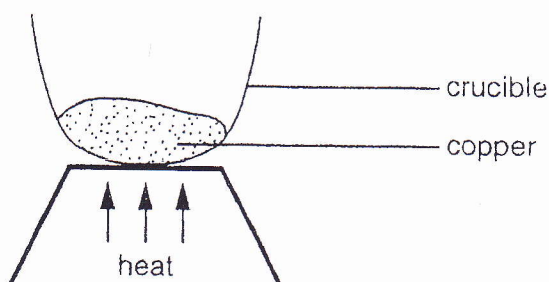
(iv) The anode is made of carbon. Why does the anode have to be regularly replaced?

.....

.....

[5]

- 5 The apparatus shown was used by a student to determine the empirical formula of an oxide of copper. The contents of the crucible were stirred during heating.



The crucible and contents were heated, cooled and weighed.

The process was repeated until there was no further change in mass.

The student obtained the following results:

Mass of crucible	=	35.0 g
Mass of crucible + contents before heating	=	47.8 g
Mass of crucible + contents after heating	=	51.0 g

- (a) What was the mass of copper used in the reaction?

..... g [1]

- (b) Calculate the number of moles of copper that reacted.  
(r.a.m. of copper is 64)

..... moles [1]

- (c) What mass of oxygen reacted?

..... [1]

- (d) Calculate the number of moles of oxygen atoms that reacted.  
(The  $A_r$  of oxygen is 16)

..... moles [1]

- (e) Write the empirical formula of the compound formed.

..... [1]

- (f) One oxide of copper is black like carbon.

Describe an experiment that you could do to distinguish between two samples of the black powders, carbon and copper oxide.

.....

.....

.....

.....

.....

.....[4]

- 6 Chlorine can be prepared by heating manganese(IV) oxide with concentrated hydrochloric acid. A redox reaction takes place, according to the following equation:



- (a) Which substance acts as the oxidising agent?

.....[1]

- (b) What is a test for chlorine?

test .....

result .....[2]

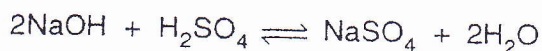
7 In an experiment to determine the concentration of a sample of dilute sulphuric acid,  $H_2SO_4$ , Kago titrated  $25.0\text{ cm}^3$  of the acid with a  $2.00\text{ mol/dm}^3$  solution of sodium hydroxide,  $NaOH$ . She used methyl orange indicator to mark the end-point of the reaction.

(a) What is the colour change of methyl orange?

colour in acid .....

colour in alkali ..... [2]

(b) The equation for the reaction is as follows.



(i) Kago found that the average titration was  $23.6\text{ cm}^3$  of sodium hydroxide. How many moles of sodium hydroxide are contained in  $23.6\text{ cm}^3$  of  $2.00\text{ mol/dm}^3$  solution?

..... moles [3]

(ii) How many moles of sulphuric acid reacted with this number of moles of sodium hydroxide?

..... moles [1]

(iii) The volume of acid was  $25\text{ cm}^3$ . Use your answer to (ii) to calculate the concentration of the acid in moles per  $\text{dm}^3$ .

.....  $\text{mol/dm}^3$  [2]

(c) Explain how Kago can use the results of the titration to prepare a pure sample of sodium sulphate crystals.

.....  
.....  
.....  
..... [3]

- 8 To improve the appearance of a bracelet, a jeweller coats it with silver. The bracelet was used as an electrode in an electrolysis reaction. The electrolyte was a solution of a silver salt.

A steady current of 0.5 A was allowed to flow for 32 minutes. A coating of silver was formed on the bracelet.

The Faraday constant = 96 000 coulombs per mole.

- (a) Name the electrode formed by the bracelet.

.....[1]

- (b) Calculate the total charge that flowed during the electrolysis, in coulombs.

..... coulombs [2]

- (c) Use your answer in (b) to calculate the number of moles of electrons that passed through the circuit.

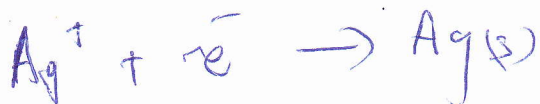
..... moles [2]

- (d) The formula of the silver ion is  $\text{Ag}^+$ . How many moles of silver were deposited during electrolysis?

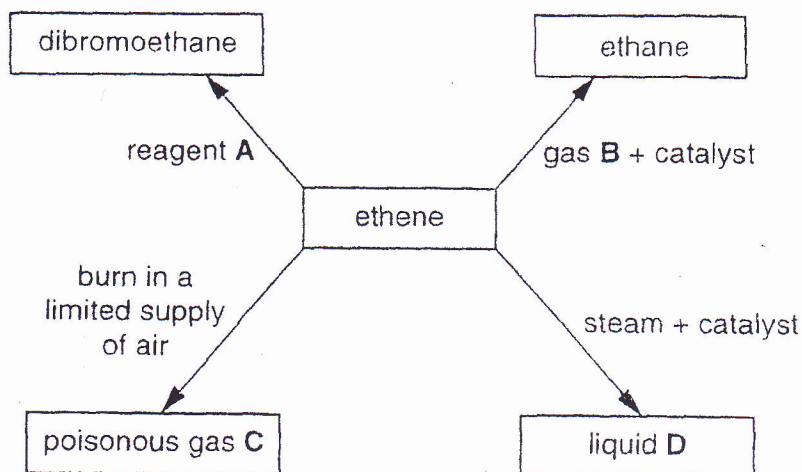
..... moles [1]

- (e) What mass of silver was deposited?

..... g [2]



9 The diagram shows some reactions of ethene.



(a) Identify the substances **A**, **B**, **C** and **D**.

reagent **A** .....

gas **B** .....

poisonous gas **C** .....

liquid **D** ..... [4]

(b) Ethene can be polymerised to poly(ethene).  
Give one use of poly(ethene).

..... [1]

(c) Explain why poly(ethene) can become a pollutant.

..... [1]

10 (a) Ethanol is used in some countries as a fuel. It is classified as a 'renewable' fuel.

(i) Explain why ethanol can be used as a fuel.

.....

(ii) Explain why it is classified as a renewable fuel.

.....

[2]

(b) The table shows data about three organic compounds.

Complete the table.

Table 3

name	formula	boiling point/ $^{\circ}\text{C}$
ethanol	$\text{C}_2\text{H}_5\text{OH}$	78
propanol	$\text{C}_3\text{H}_7\text{OH}$	
butanol		117

[2]

(c) These compounds belong to the same homologous series.

(i) State one characteristic of a 'homologous series'

.....

(ii) What is the name of the series?

.....

(iii) What is the general formula for the series?

.....

[3]

