

fiu



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

CANDIDATE
NAME

CENTRE
NUMBER

--	--	--	--	--

CANDIDATE
NUMBER

--	--	--	--



CHEMISTRY

0570/03

Paper 3

October/November 2011

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 16.

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

This document consists of **12** printed pages and **4** blank pages.

1 Water is a molecular compound. It has intermolecular forces and intramolecular forces.

(a) (i) Distinguish between intermolecular and intramolecular forces.

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

(ii) Draw a dot and cross diagram to show the bonding in a molecule of water.

[2]

(b) A student is given two samples of water. The samples are pure water, labelled Y and rain water containing dissolved calcium hydrogencarbonate labelled Z.

(i) Write the formula for calcium hydrogencarbonate.

.....[1]

(ii) Explain how calcium hydrogencarbonate is dissolved in the water.

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

(iii) State the observation that will be made when a few drops of soap solution are shaken with each sample.

Y

Z

Explain your observations.

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

(iv) State the observation that will be made when a portion of each sample of water is boiled.

Y

Z

Explain your observations.

.....

.....

.....[3]

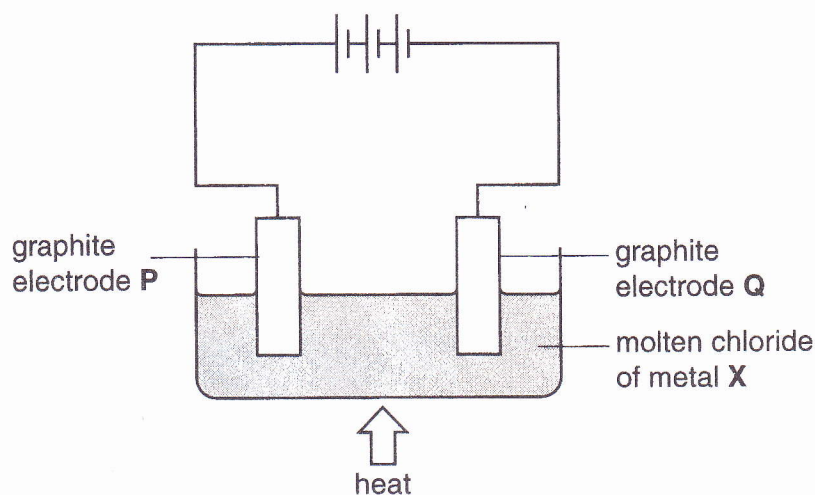
(c) State **two** properties which when determined can prove that sample Y is pure water.

.....

.....[2]

[Total: 15]

- 2 Molten chloride of a metal X is electrolysed as shown in the diagram.



- (a) (i) What is *electrolysis*?

.....
[1]

- (ii) Which electrode is the cathode, P or Q? Give a reason for your choice.

cathode

reason

.....[1]

- (b) Chlorine is formed at one of the electrodes.

- (i) State an observation that would be made at the electrode and write the equation for the formation of chlorine.

observation

.....[1]

equation[1]

- (ii) Explain why this electrolysis should be carried out in a fume cupboard.

.....
[1]

- (c) To determine the charge on the ion of metal **X**, a current of 1.0A was passed for 16 minutes 5 seconds through the molten chloride of metal **X**. 0.32g of metal **X** was deposited at the cathode.

Calculate the quantity of electricity in coulombs passed through the molten chloride of metal **X** to produce 0.32g of **X**.

quantity of electricity = coulombs [2]

- (d) (i) The relative atomic mass of metal **X** is 64.
Use your answer to (c) to calculate the quantity of electricity which will produce 1 mol of metal **X**.

quantity of electricity = coulombs [2]

- (ii) Use your answer to (d)(i) to calculate the number of faradays which are needed to produce 1 mole of metal **X**. (1F = 96 5000 C)

number of Faradays [2]

- (iii) What is the charge of the ion of metal **X**?

..... [1]

[Total: 12]

(c) Butanol may be oxidised by oxygen, forming butanoic acid.

(i) Suggest the name of another substance that will oxidise butanol.

.....[1]

(ii) Suggest a test to show that butanoic acid has been formed.

test

.....[1]

result

.....[1]

(iii) What type of substance is formed when butanol is reacted with butanoic acid under suitable conditions?

.....[1]

[Total: 13]

- 4 The elements listed are in order of decreasing reactivity. Use them to answer the questions that follow.

lithium	calcium	carbon	zinc	iron
hydrogen	copper	silver		

Which element(s)

- (a) must be kept in paraffin?

.....[1]

- (b) has a green carbonate which decomposes on heating to give a black solid?

.....[1]

- (c) is used in making steel?

.....[1]

- (d) forms ions that, when ammonia solution is added, give a white precipitate that re-dissolves on addition of more ammonia solution?

.....[1]

- (e) are components of brass?

..... and[1]

- (f) form a hydroxide which decomposes by gentle heating?

..... and[2]

- (g) completely reacts with oxygen to form an acidic oxide?

.....[1]

[Total: 8]

- 5 A mixture of solids at Sua pan contains anhydrous sodium carbonate. To determine the percentage purity of sodium carbonate in the mixture, 8 g of the mixture was dissolved in water and the solution was made to 500 cm³. 25 cm³ of this solution is neutralised by 40 cm³ of 0.1 mol/dm³ hydrochloric acid. Methyl orange indicator was used to show the end point.

The equation for reaction between sodium carbonate and hydrochloric acid is



- (a) Calculate the number of moles of the acid in 40 cm³ of 0.1 mol/dm³ hydrochloric acid.

number of moles of acid = [2]

- (b) Calculate the number of moles of sodium carbonate in 25.0 cm³ of the solution which was neutralised by 40 cm³ of 0.1 mol/dm³ hydrochloric acid.

number of moles of sodium carbonate = [1]

- (c) Use your answer to (b) to calculate the number of moles of sodium carbonate in 500 cm³ of solution.

number of moles of sodium carbonate = [2]

- (d) Calculate the mass of sodium carbonate in 8 g of the mixture.

mass of sodium carbonate = [1]

- (e) Calculate the percentage purity of sodium carbonate found in the mixture at Sua pan.

percentage purity = [1]

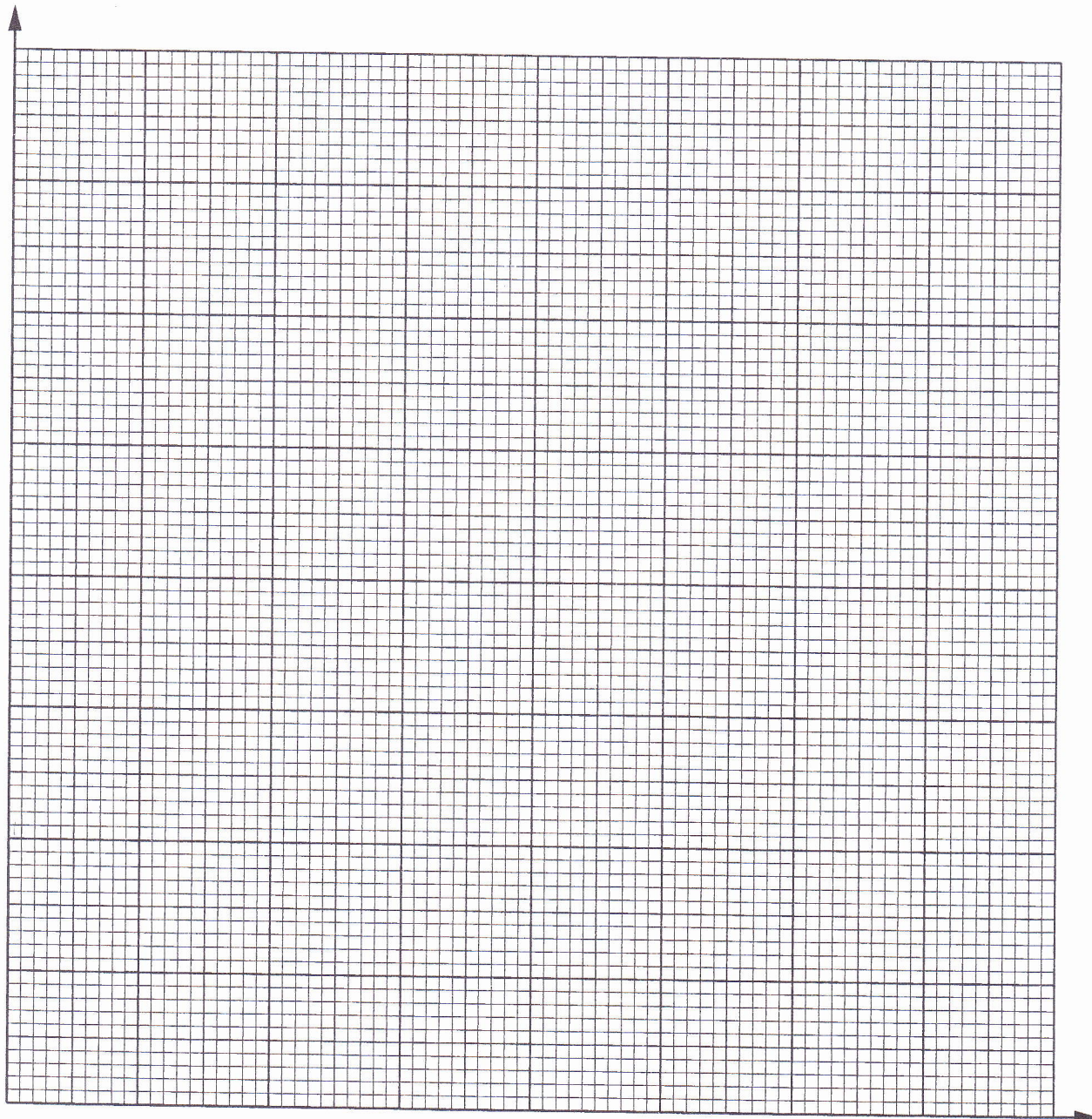
[Total: 7]

- 6 To determine the energy change of a reaction, 25.0cm^3 of sodium hydroxide solution was poured into a polystyrene cup. Different volumes of hydrochloric acid were added to the sodium hydroxide and the mixture was stirred. The maximum temperature reached was measured and recorded in table 6.1.

Table 6.1

volume of hydrochloric acid used/ cm^3	0.0	5.0	10.0	15.0	20.0	25.0	30.0	35.0	40.0
maximum temperature/ $^{\circ}\text{C}$	25	29	32.5		40	44	44.5	42.5	40

- (a) Plot the graphs of temperature of the mixture against volume of the acid. Draw **two** straight lines through the points.



- (b) Use your graph to find the temperature reached when 15.0 cm^3 of hydrochloric acid was added to the sodium hydroxide.

.....[1]

- (c) (i) What was the maximum temperature reached?

.....[1]

- (ii) Suggest a reason why the temperature began to drop after a maximum was reached.

.....[1]

- (d) What volume of hydrochloric acid was required to neutralise the 25.0 cm^3 of sodium hydroxide?

.....[1]

- (e) The equation for the reaction is



- (i) Write an ionic equation for the reaction.

.....[1]

- (ii) Suggest the pH of the mixture after the addition of 40 cm^3 of hydrochloric acid.

.....[1]

- (f) Is the reaction endothermic or exothermic?

.....

Explain your answer.

.....

.....[1]

- (g) Draw an energy level diagram for the reaction between sodium hydroxide and hydrochloric acid.

DATA SHEET
The Periodic Table of the Elements

		Group																					
I	II	III	IV	V	VI	VII	0																
7 Li Lithium 3	9 Be Beryllium 4	1 H Hydrogen 1	11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10	39 K Potassium 19	40 Ca Calcium 20	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36	133 Cs Caesium 55	137 Ba Barium 56	226 Ra Radium 88	227 Ac Actinium 89		
23 Na Sodium 11	24 Mg Magnesium 12	27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulphur 16	35.5 Cl Chlorine 17	35.5 Ar Argon 18	59 Co Cobalt 27	56 Fe Iron 26	55 Mn Manganese 25	59 Ni Nickel 28	64 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36	133 Cs Caesium 55	137 Ba Barium 56	226 Ra Radium 88	227 Ac Actinium 89
85 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	101 Ru Ruthenium 44	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	131 Xe Xenon 54	137 Cs Caesium 55	137 Ba Barium 56	226 Ra Radium 88	227 Ac Actinium 89	133 Cs Caesium 55	137 Ba Barium 56	226 Ra Radium 88	227 Ac Actinium 89	
137 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57	178 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	190 Os Osmium 76	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	210 Po Polonium 84	210 At Astatine 85	210 Rn Radon 86	210 Rn Radon 86	210 Rn Radon 86	210 Rn Radon 86	210 Rn Radon 86	210 Rn Radon 86	210 Rn Radon 86	210 Rn Radon 86	210 Rn Radon 86
140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	146 Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	162 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71	175 Lu Lutetium 71	175 Lu Lutetium 71	175 Lu Lutetium 71	175 Lu Lutetium 71	175 Lu Lutetium 71	175 Lu Lutetium 71	175 Lu Lutetium 71	175 Lu Lutetium 71	175 Lu Lutetium 71	175 Lu Lutetium 71	175 Lu Lutetium 71
232 Th Thorium 90	232 Pa Protactinium 91	238 U Uranium 92	238 Np Neptunium 93	238 Pu Plutonium 94	238 Am Americium 95	238 Cm Curium 96	238 Bk Berkelium 97	238 Cf Californium 98	238 Es Einsteinium 99	238 Fm Fermium 100	238 Md Mendelevium 101	238 No Nobelium 102	238 Lr Lawrencium 103	238 Lr Lawrencium 103	238 Lr Lawrencium 103	238 Lr Lawrencium 103	238 Lr Lawrencium 103	238 Lr Lawrencium 103	238 Lr Lawrencium 103	238 Lr Lawrencium 103	238 Lr Lawrencium 103	238 Lr Lawrencium 103	238 Lr Lawrencium 103

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).

*58-71 Lanthanoid series
†90-103 Actinoid series

Key

a	X
b	X

 a = relative atomic mass
 X = atomic symbol
 b = proton (atomic) number