

School Number	Candidate Number
Surname and Initials	

# CHEMISTRY

PAPER 2 3051/2

Tuesday **20 MAY 2014** 1:30–3:30 P.M.

**Additional materials:**  
None

<p><b>MINISTRY OF EDUCATION NATIONAL EXAMINATIONS</b></p>
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BAHAMAS GENERAL CERTIFICATE OF SECONDARY EDUCATION

## INSTRUCTIONS AND INFORMATION TO CANDIDATES

**Do not open this booklet until you are told to do so.**

Write your school number, candidate number, surname and initials in the spaces provided above.

Answer **ALL** the questions on this paper.

Read each question carefully and make sure you know what you have been asked to do before starting your answer.

The instruction **NAME . . .** requires an answer in words not chemical symbols.

Show **ALL** your working when answering numerical questions. Lines are provided on the question paper for your answers. You should write your answers on these lines only.

The mark for each part question is given in brackets [ ].

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This question paper consists of 17 printed pages and 3 blank pages.

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The Periodic Table of the Elements

		Group																																																													
I	II	III	IV	V	VI	VII	0					0																																																			
7 Li Lithium 3	9 Be Beryllium 4	<table border="1"> <tr> <td>1 H Hydrogen 1</td> <td colspan="10"></td> </tr> </table>										1 H Hydrogen 1											4 He Helium 2																																								
1 H Hydrogen 1																																																															
23 Na Sodium 11	24 Mg Magnesium 12	11 B Boron 5	12 C Carbon 6	13 Al Aluminum 13	14 Si Silicon 14	15 P Phosphorus 15	16 S Sulphur 16	17 Cl Chlorine 17	18 Ar Argon 18	19 K Potassium 19	20 Ca Calcium 20	21 Sc Scandium 21	22 Ti Titanium 22	23 V Vanadium 23	24 Cr Chromium 24	25 Mn Manganese 25	26 Fe Iron 26	27 Co Cobalt 27	28 Ni Nickel 28	29 Cu Copper 29	30 Zn Zinc 30	31 Ga Gallium 31	32 Ge Germanium 32	33 As Arsenic 33	34 Se Selenium 34	35 Br Bromine 35	36 Kr Krypton 36	37 Rb Rubidium 37	38 Sr Strontium 38	39 Y Yttrium 39	40 Zr Zirconium 40	41 Nb Niobium 41	42 Mo Molybdenum 42	43 Tc Technetium 43	44 Ru Ruthenium 44	45 Rh Rhodium 45	46 Pd Palladium 46	47 Ag Silver 47	48 Cd Cadmium 48	49 In Indium 49	50 Sn Tin 50	51 Sb Antimony 51	52 Te Tellurium 52	53 I Iodine 53	54 Xe Xenon 54	55 Cs Cesium 55	56 Ba Barium 56	57 La Lanthanum 57	72 Hf Hafnium 72	73 Ta Tantalum 73	74 W Tungsten 74	75 Re Rhenium 75	76 Os Osmium 76	77 Ir Iridium 77	78 Pt Platinum 78	79 Au Gold 79	80 Hg Mercury 80	81 Tl Thallium 81	82 Pb Lead 82	83 Bi Bismuth 83	84 Po Polonium 84	85 At Astatine 85	86 Rn Radon 86
133 Cs Cesium 55	137 Ba Barium 56	226 Ra Radium 88	227 Ac Actinium 89	140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	145 Pm Promethium 61	150 Sm Samarium 62	151 Eu Europium 63	152 Gd Gadolinium 64	157 Tb Terbium 65	162 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71	232 Th Thorium 90	238 U Uranium 92	238 Pa Protactinium 91	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																																

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

a	X	b
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Key

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

1. Use the Periodic Table to answer this question.

- (a) State the **TOTAL** number of elements found in the short Periods of the table. \_\_\_\_\_ [1]
- (b) Name the element found in Period 4, group II. \_\_\_\_\_ [1]
- (c) State the number of the Group that contains only elements having diatomic molecules. \_\_\_\_\_ [1]
- (d) Name the gas that is the third most abundant in normal air. \_\_\_\_\_ [1]
- (e) Write the symbol of **one** of the two transition elements that has the same relative atomic mass. \_\_\_\_\_ [1]
- (f) State the total number of electrons found in one atom of Zr. \_\_\_\_\_ [1]
- (g) State the number of neutrons in one atom of Zn. \_\_\_\_\_ [1]
- (h) State the r.m.m. of the compound formed when magnesium reacts with chlorine. \_\_\_\_\_ [1]
- (i) Draw diagrams of the ions formed when magnesium reacts with chlorine. Label each ion with its charge.

[2]

**TOTAL MARKS [10]**

2. Four containers labelled W, X, Y and Z were found in a chemistry laboratory. Preliminary tests determined that each contained a metal found in most high school laboratories. The results of additional tests using cold water, steam and dilute hydrochloric acid are shown in Table 1.

Table 1

element	reactions	
	water	dilute hydrochloric acid
W	- very slow reaction with cold water - vigorous reaction with steam	- vigorous reaction with acid - gas evolves
X	no reaction with cold water or steam	no reaction with acid
Y	- no reaction with cold water - very slow reaction with steam	- very slow reaction with acid - gas evolves
Z	- no reaction with cold water - slow reaction with steam	- slow reaction with acid - gas evolves

- (a) (i) Using the information shown in Table 1, list the metals in order of their reactivity starting with the least reactive.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

[2]

- (ii) Name the gas that evolves when one of the metals reacts with the acid.

\_\_\_\_\_

[1]

- (b) A small sample of each metal is heated in air (oxygen). The observations are recorded in **Table 2**.

**Table 2**

metal	observation
W	- burns with a bright white light - ash forms
X	- does not burn - a black layer forms on its surface
Y	- does not burn - a yellow layer forms on its surface initially - on cooling the layer turns white
Z	- burns with very strong heating - yellow sparks are given off - a black powder forms

- (i) Suggest the names of the metals **W** and **X**.

W \_\_\_\_\_

X \_\_\_\_\_ [2]

- (ii) Suggest what type of oxide is formed when these metals react with oxygen.

\_\_\_\_\_ [1]

Iron is the second most common metal found on Earth. It is often combined with other metals to form alloys like steel and stainless steel.

- (c) (i) Define the term **alloy**.

\_\_\_\_\_ [1]

- (ii) Identify **one** advantage the alloy steel has compared to iron.

\_\_\_\_\_ [1]

The rusting of iron requires oxygen and water. Rusting is an oxidation reaction.

- (d) (i) Give the full chemical name for rust including the oxidation number of the iron in this compound.

\_\_\_\_\_ [1]

- (ii) Name **ONE** method used to prevent rusting.

\_\_\_\_\_ [1]

**TOTAL MARKS [10]**

3. Carbon and nitrogen are non-metals. Graphite is an **allotrope** of carbon.

(a) (i) Define the term **allotrope**.

\_\_\_\_\_  
\_\_\_\_\_ [2]

(ii) Name another allotrope of carbon.

\_\_\_\_\_ [1]

(iii) Give a reason why graphite can be used as a lubricant.

\_\_\_\_\_  
\_\_\_\_\_ [2]

Nitrogen exists in nature as a colourless, odourless, tasteless gas. Nitrogen gas is reacted with hydrogen to make ammonia in the Haber process.

(b) (i) Fill in the blanks to balance the equation.



(ii) Calculate the molar mass of ammonia.

[1]

(iii) Calculate the mass of ammonia produced when 120 g of nitrogen reacts with hydrogen gas.

[2]

**TOTAL MARKS [10]**

4. Energy is derived by burning fuels such as the hydrogen gas propane,  $C_3H_8$ .

(a) (i) Write a word equation for the complete combustion of propane.

\_\_\_\_\_ [2]

(ii) Draw the structural formula of propane.

[1]

(iii) Calculate the r.m.m. of propane.

[2]

(iv) Suggest how the boiling point of liquid propane differs from the boiling point of liquid butane.

\_\_\_\_\_ [1]

(b) Butane is a fuel used in portable lighters. It is saturated and contains four carbon atoms. A molecule of butane contains four carbon atoms. Butane has two isomers, one straight-chained and one having a branched chain.

(i) Give the general formula for this type of saturated compound.

[1]

(ii) State how many moles of water would be produced from the complete combustion of each mole of this fuel.

\_\_\_\_\_ [1]

(iii) Draw the structure of the branched chain isomer of this compound.

[2]

**TOTAL MARKS [10]**



5. (a) Red cabbage juice varies from light red at pH 2, to purple at pH 7, to green and yellow at about pH 9 through 14. Red cabbage juice is added to four different solutions.

The table shows the colour of the juice and the pH of the solutions.

Use the information given to complete the table.

<b>solution</b>	<b>colour of juice</b>	<b>approximate pH</b>
white vinegar		3
drain cleaner	yellow	
table salt		7
soap		10–11

[4]

- (b) A student has dissolved the gas hydrogen chloride in water and in methylbenzene. He adds litmus to each of his solutions and then completes the table shown.

<b>hydrogen chloride gas</b>	<b>colour of litmus</b>	<b>electrical conductivity</b>
in water	changes from blue to red	yes
methylbenzene	no change	no

Based on the information given, state whether ionisation of hydrogen chloride takes place in

- (i) water                      yes/No \_\_\_\_\_  
methylbenzene    yes/No \_\_\_\_\_

- (ii) Give a reason for your answers to part (i).

\_\_\_\_\_  
\_\_\_\_\_ [2]

(c) Natural rainfall has a pH of approximately 5.5 and pure water a pH of 7.

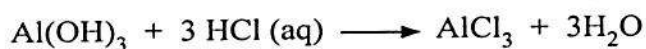
(i) State which has a greater hydrogen ion concentration.

\_\_\_\_\_ [1]

(ii) Write the formula of the ion that is responsible for aqueous ammonia being alkaline.

[1]

(d) Aluminium hydroxide is one of the compounds used in antacids to neutralise excess stomach acid. The equation represents this reaction.



(i) Find out how many moles of aluminium hydroxide are required to neutralise 12 moles of hydrochloric acid

[1]

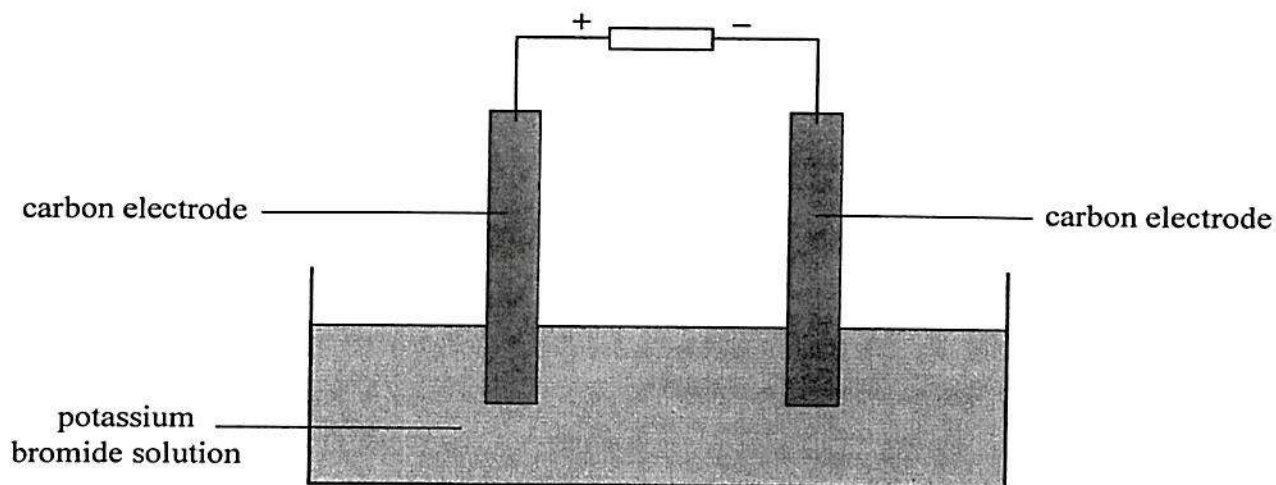
(ii) Another antacid treatment uses magnesium carbonate.

Name **two** products of the reaction between stomach acid and magnesium carbonate.

\_\_\_\_\_ [1]

**TOTAL MARKS [10]**

6. The diagram shows electrolysis of potassium bromide using carbon electrodes.



(a) (i) **On the diagram**, draw arrows to indicate the movement of electrons in the wires during electrolysis. [1]

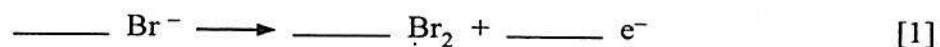
(ii) A solution of potassium bromide in water contains two other ions besides potassium ions and bromide ions.

Write the symbols for the other two ions.

1. \_\_\_\_\_

2. \_\_\_\_\_ [2]

(b) (i) Balance the anode reaction.



(ii) Name the product made at the cathode.

\_\_\_\_\_ [1]

(c) State the type of reaction taking place at the

cathode; \_\_\_\_\_

anode. \_\_\_\_\_ [1]

- (d) (i) Explain why the potassium bromide solution becomes progressively more alkaline during electrolysis.

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[2]

- (ii) Explain why solid potassium bromide does not conduct electricity whereas molten potassium bromide and potassium bromide solution conduct electricity.

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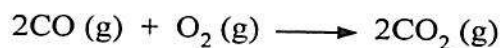
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[2]

**TOTAL MARKS [10]**

7. Carbon monoxide gas was burned in air. The carbon dioxide formed during the reaction was absorbed by bubbling the reacted gases through sodium hydroxide. The mass of carbon dioxide formed was 88 g.



- (a) (i) Calculate the molar mass of carbon monoxide.

[1]

- (ii) Calculate the mass of oxygen used up during the reaction.

[1]

- (iii) Calculate the mass of carbon monoxide that was burned.

[1]

- (b) The volume of 1 mole of gas, measured at r.p.t. is 24 dm<sup>3</sup>.

- (i) Using the equation given, calculate the volume of carbon monoxide that reacted.

[1]

- (ii) Explain why the volume of the gas formed was less than the total volume of the reacting gases. (All volumes measured at r.t.p.)

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[2]

- (iii) Explain the difference in behaviour of carbon dioxide molecules in the solid and the gas.

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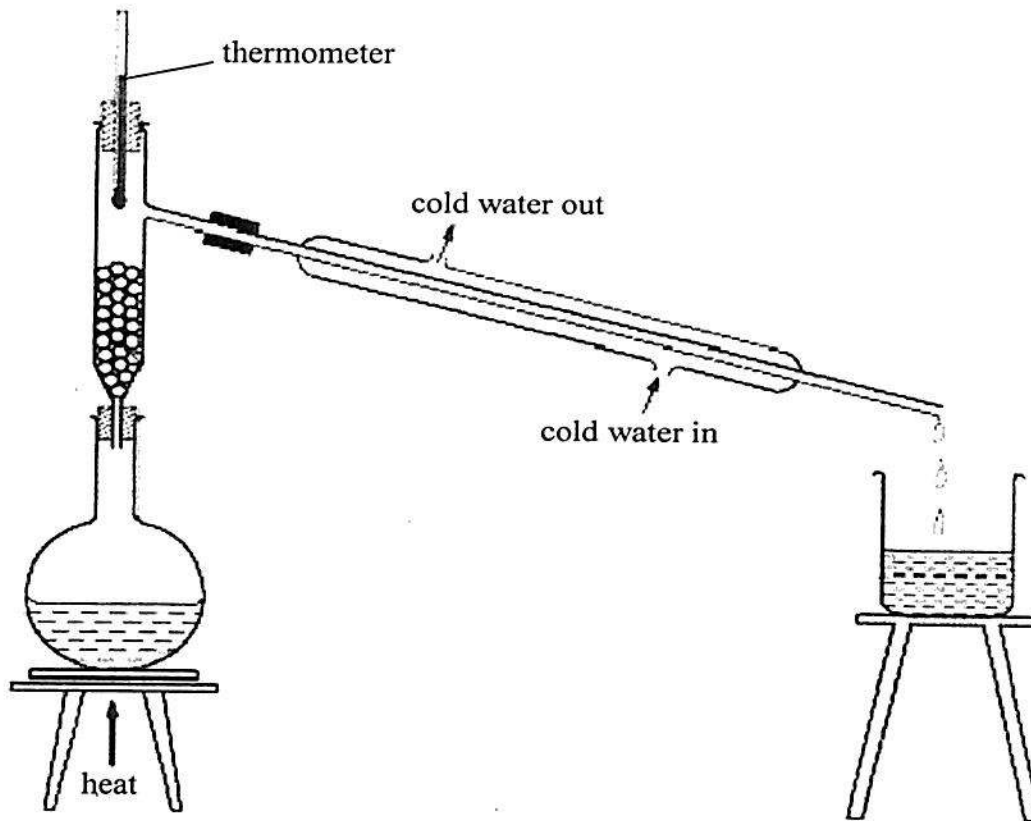
[2]

- (c) Using outer electrons only, draw the Lewis bonding diagram for carbon dioxide,  $\text{CO}_2$ .

[2]

**TOTAL MARKS [10]**

8. The diagram shows, apparatus for separating a mixture of liquids.



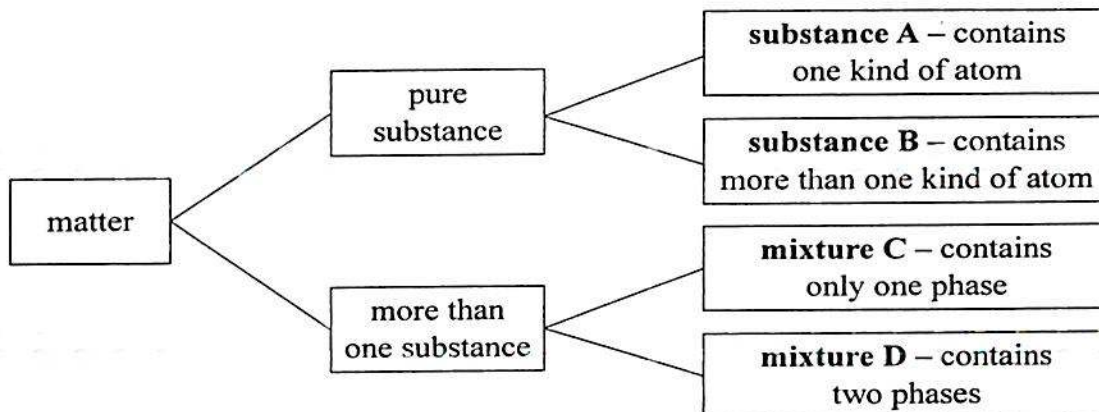
- (a) (i) Name the method of separation shown in the diagram.
- \_\_\_\_\_ [1]
- (ii) Suggest the names of **two** liquids that can be separated from a mixture using this technique.
- liquid 1 \_\_\_\_\_
- liquid 2 \_\_\_\_\_ [1]
- (iii) Explain how the person doing the experiment can tell when a different liquid is being collected in the conical flask.
- \_\_\_\_\_ [1]

- (iv) A similar technique is used on a large scale to separate petroleum into its different constituent parts.

Give the full name of this separation technique.

\_\_\_\_\_ [1]

The flow diagram shows some different kinds of matter.



- (b) (i) State one word that can be used to describe.

substance A \_\_\_\_\_

substance B \_\_\_\_\_

mixture C \_\_\_\_\_

mixture D \_\_\_\_\_ [4]

- (ii) **Mixture D** is composed of two phases, state the **MOST** suitable method of separation for this mixture.

\_\_\_\_\_ [1]



(iii) Sketch and label the apparatus to be used in (b)(ii).

[1]

**TOTAL MARKS [10]**

