



# GOZO COLLEGE

## Girls' Secondary

### Half Yearly Examinations

#### 2013-2014



**FORM 4** **CHEMISTRY** **TIME: 1h 30min**

Name: \_\_\_\_\_

Class: \_\_\_\_\_

**Useful Data:** Atomic numbers and relative atomic masses are shown in the Periodic table printed below.  
One Faraday is equivalent to 96500 C.

PERIODIC TABLE

1	2											3	4	5	6	7	0										
																1 <b>H</b> 1											4 <b>He</b> 2
7 <b>Li</b> 3	9 <b>Be</b> 4											11 <b>B</b> 5	12 <b>C</b> 6	14 <b>N</b> 7	16 <b>O</b> 8	19 <b>F</b> 9	20 <b>Ne</b> 10										
23 <b>Na</b> 11	24 <b>Mg</b> 12											27 <b>Al</b> 13	28 <b>Si</b> 14	31 <b>P</b> 15	32 <b>S</b> 16	35.5 <b>Cl</b> 17	40 <b>Ar</b> 18										
39 <b>K</b> 19	40 <b>Ca</b> 20	45 <b>Sc</b> 21	48 <b>Ti</b> 22	51 <b>V</b> 23	52 <b>Cr</b> 24	55 <b>Mn</b> 25	56 <b>Fe</b> 26	59 <b>Co</b> 27	59 <b>Ni</b> 28	63.5 <b>Cu</b> 29	65 <b>Zn</b> 30	70 <b>Ga</b> 31	73 <b>Ge</b> 32	75 <b>As</b> 33	79 <b>Se</b> 34	80 <b>Br</b> 35	84 <b>Kr</b> 36										
85 <b>Rb</b> 37	88 <b>Sr</b> 38	89 <b>Y</b> 39	91 <b>Zr</b> 40	93 <b>Nb</b> 41	96 <b>Mo</b> 42	99 <b>Tc</b> 43	101 <b>Ru</b> 44	103 <b>Rh</b> 45	106 <b>Pd</b> 46	108 <b>Ag</b> 47	112 <b>Cd</b> 48	115 <b>In</b> 49	119 <b>Sn</b> 50	122 <b>Sb</b> 51	128 <b>Te</b> 52	127 <b>I</b> 53	131 <b>Xe</b> 54										
133 <b>Cs</b> 55	137 <b>Ba</b> 56	139 <b>La</b> 57	178 <b>Hf</b> 72	181 <b>Ta</b> 73	184 <b>W</b> 74	186 <b>Re</b> 75	190 <b>Os</b> 76	192 <b>Ir</b> 77	195 <b>Pt</b> 78	197 <b>Au</b> 79	201 <b>Hg</b> 80	204 <b>Tl</b> 81	207 <b>Pb</b> 82	209 <b>Bi</b> 83	210 <b>Po</b> 84	210 <b>At</b> 85	222 <b>Rn</b> 86										
223 <b>Fr</b> 87																											

Key: 

<i>a</i>	relative atomic mass	
<b>X</b>		
<i>b</i>		symbol
		atomic number

**Marks Grid [ For Examiner's use only ]**

Question N <sup>o</sup> .	Section A						Section B			Theory Total
	1	2	3	4	5	6	7	8	9	
<b>Max Mark</b>	10	10	10	10	10	10	20	20	20	
<b>Actual Mark</b>										

Theory Paper: 85 %	Practical: 15 %	Final Score: 100 %

**SECTION A – Answer ALL questions. This section carries 60 marks.**

1 Francium, Fr, is found at the bottom of group 1. Chemists can predict some of its properties by looking at the properties of the other elements in group 1 and the trends down the group.

a. What kind of bonding is present in francium chloride? \_\_\_\_\_ [1]

b. Write the formula for this compound. \_\_\_\_\_ [1]

c. Potassium and lithium are elements in group 1. Potassium melts at 64 °C and lithium melts at 180 °C. Would francium melt at a higher or lower temperature than potassium?

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

d. Lithium reacts quite slowly with cold water but potassium reacts very quickly and gives out a lot of heat. Do you think that francium would be more or less reactive than potassium? Give a reason for your answer referring to their atomic structure.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ [3]

e. Write a balanced chemical equation including state symbols for the reaction between francium and water.

\_\_\_\_\_ [3]

f. If francium oxide is dissolved in water, would the solution be acidic or alkaline?

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

2 The element astatine, At, is a halogen.



a. How many electrons does astatine have in its outer shell? \_\_\_\_\_ [1]

b. What would be the physical state of astatine at room temperature? \_\_\_\_\_ [1]

c. Would you expect astatine to be more or less reactive than chlorine? Give a reason for your answer referring to their atomic structure.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ [3]

- d. Write down the formula of hydrogen astatide. \_\_\_\_\_ [1]
- e. Predict what would happen if bromine liquid is poured in a solution of sodium astatide.
- \_\_\_\_\_
  - \_\_\_\_\_ [2]
- f. Write the ionic equation omitting spectator ions for the above reaction.

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

3 Bromine reacts with calcium to form a white solid R. R dissolves in water to produce a colourless solution. When chlorine gas is bubbled through the solution a brown liquid, X, was produced and a new colourless solution, Y.

- a. What type of bonding is present in R? \_\_\_\_\_ [1]
- b. Give the chemical name and formula of R. \_\_\_\_\_ [1]
- c. What type of reaction is occurring when chlorine gas is bubbled through the solution of R?

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

- d. Write a balanced chemical equation including state symbols for the reaction between solution R and chlorine.

\_\_\_\_\_ [3]

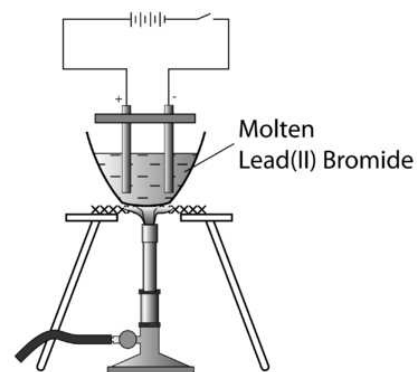
- e. Derive an ionic equation omitting spectator ions for this reaction.

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

- f. Identify X and Y: \_\_\_\_\_ [2]

4 An experiment was carried out by a student to investigate the effect of electricity on molten lead (II) bromide ( $\text{PbBr}_2$ ). Below is an extract from the results in the student's lab book:

*"I observed brown fumes coming from the positive electrode which formed a liquid on cooling. Solid metallic deposits were observed at the negative electrode."*



- a. i) What happens during electrolysis?

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

- ii) Why does solid lead (II) bromide **not** allow the passage of electricity through it?

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

iii) Explain the student's observations at the positive electrode.

---

---

[1]

b. i) Write down a half equation to represent what is occurring at the negative electrode.

---

[1]

ii) Is this a reduction or an oxidation? Explain your answer.

---

---

[2]

iii) Explain why this electrolysis should be carried out in a fume cupboard.

---

---

[2]

5 Electrolysis of a **concentrated** solution of sodium chloride is used for the manufacture of sodium hydroxide.

a. i) Name the gas produced at each electrode in the electrolysis of sodium chloride solution.

---

[2]

ii) Write balanced half equations to show the formation of these two gases.

---

---

[2]

iii) The sodium chloride solution is an **electrolyte**. What is the meaning of this term?

---

---

[1]

b. A solution of sodium chloride containing universal indicator is electrolysed. The indicator in the solution surrounding the cathode turned blue while the indicator in the solution surrounding the anode first turned red and finally it became colourless. Explain the changes in colour observed at each electrode giving a reason for each observation.

---

---

---

---

---

[3]

c. Explain why:

i) Pure water is a poor conductor of electricity

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

ii) Sodium chloride solution conducts electricity.

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

6 In an electrolytic cell, a current of 10 A passes through brine for 6 hours.

a. Calculate how much charge flows through this cell.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ [3]

b. Calculate how many Faradays flow through the cell.

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

c. Calculate the number of moles of chlorine produced in the cell.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ [3]

d. Calculate the mass of chlorine that was produced in this electrolytic cell.

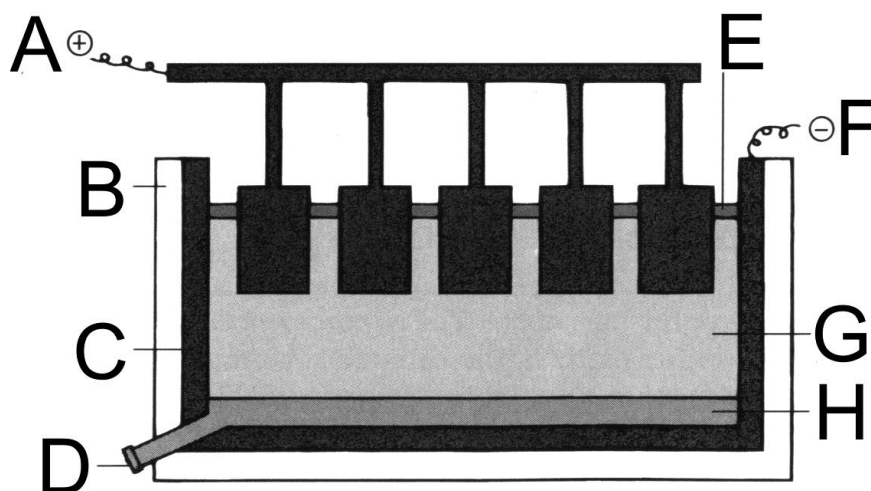
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ [2]

**SECTION B – Answer TWO questions only on the foolscap provided.**

**This section carries 40 marks.**

7 Aluminium is the most abundant metal in Earth's crust, yet it is more expensive than other common metals such as iron. These metals exist in the form of chemical substances called ores. The properties of aluminium make it a very important metal to humans.

- a. i) What is the name of the ore that is used in the industrial extraction of aluminium? [1]  
ii) What is the melting point of this ore? [1]  
iii) Cryolite is mixed with the aluminium ore to lower its melting point. Give two reasons for doing so. [1]  
iv) Why is aluminium more expensive than iron? [1]
- b. The following diagram shows the apparatus used in industry to extract aluminium. Label the parts A to H. [8]

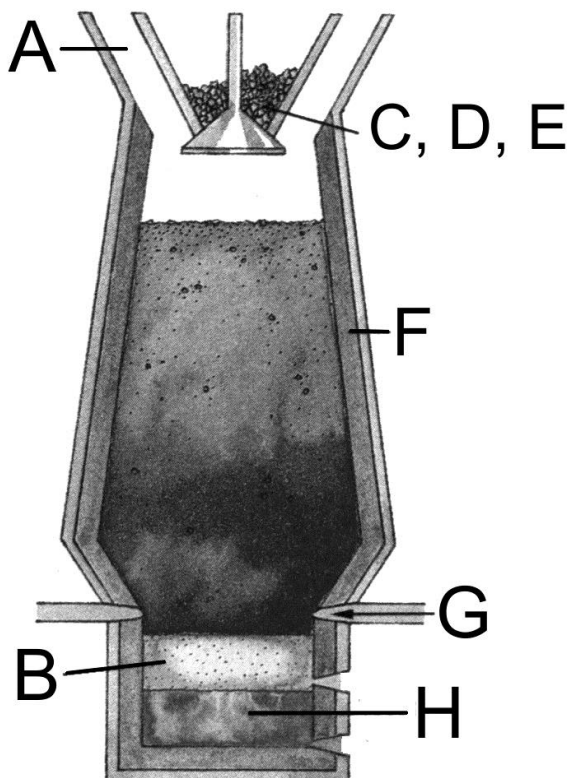


- c. During the electrolytic process, chemical reactions are happening at the cathode and at the anode. Give the balanced ionic half equations that is happening at both electrodes. [4]
- d. A side reaction happens at the anode which makes it corrode and so it needs to be replaced periodically.
- i) What effect does this have on the final price of aluminium? [1]  
ii) Give a balanced chemical equation including state symbols to show what happens at the anode because of this side reaction. [3]

8 Humans have used iron for thousands of years. The basic chemical process of producing iron has not changed much over time. It involves a redox reaction. Nowadays, the industrial production of iron is done in huge blast furnaces which operate continuously!

- a. i) Name the ore from which iron is extracted. [1]  
ii) Why do blast furnaces operate continuously? [1]

b. The following is a diagram of the blast furnace. Label the parts A to H. [8]



c. This industrial process involves several chemical processes which happen inside the furnace. [10]  
Give an account of these chemical processes with balanced chemical equations where appropriate. [Hint: Five chemical equations are expected!]

9a. Indicate which substances are oxidised and which substances are reduced in the following equations. Give a reason for each answer.



b. Copy the following table on the foolscap provided. In your table indicate with a cross (X) which metal would react with which solution.

	Copper	Magnesium	Zinc
Magnesium sulfate			
Zinc sulfate			
Copper (II) sulfate			

[3]

c. Write a balanced chemical equation for each instance where a chemical reaction happens. [6]

d. Put the three metals in order of decreasing reactivity. [1]

**End of paper**