JUNIOR LYCEUM AND SECONDARY SCHOOL
ANNUAL EXAMINATIONS 2010

Directorate for Quality and Standards in Education
Educational Assessment Unit

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 mole of any gas occupies 22.4 dm^3 at standard temperature and pressure
Faraday constant = 96500 C mol^{-1} Q =It

State symbols are expected to be included in all chemical equations.

PERIODIC TABLE

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

Key: *a* **X** *b* — relative atomic mass; symbol; atomic number

Marks Grid [For Examiners use only]

Question N°.	Section A							Section B			
	1	2	3	4	5	6	7	8	9	10	
Max Mark	5	10	10	5	10	10	10	20	20	20	Theory Total
Actual Mark											

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

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

1. Both calcium and magnesium are in Group 2 of the Periodic Table.

   a. Give **two** chemical properties of magnesium that resemble those of calcium.

   _____

   _____ **[2]**

   b. Describe a reaction to show that magnesium is lower than calcium in the reactivity series.

   _____

   _____ **[2]**

   c. Would you expect barium to be more or less reactive than magnesium and calcium?

   _____ **[1]**

2. This question refers to a 'tin' can that contains grapefruit. Although we often refer to 'tin' cans, they are not actually made of tin. The can is made of iron and there is just a thin coating of tin over the iron. This prevents the contents, like grapefruit juice, from corroding the iron.

   a. (i) What would you expect the pH of grapefruit juice to be? _____

   (ii) Why? _____ **[2]**

   b. What **type** of chemical reaction might occur between the iron and the grapefruit juice?

   _____ **[1]**

   c. Electroplating may be used to apply the thin layer of tin over the iron.
   In this process, the electrolyte is a soluble salt of tin. The iron can is used as one of the electrodes while a plate of pure tin is used as the other electrode.

   (i) Suggest the name of a suitable soluble salt of tin. _____

   (ii) Complete this statement by writing the correct names of the electrodes.

   The iron can must be used as the _____ of the electrolytic cell,

   whilst pure tin is made the _____ . **[3]**

   d. The reactions that take place at the electrodes are similar to what happens during the purification of copper. The symbol for tin is Sn and it has a valency of 2.
   (i) Use this information to write the ionic half equations that take place at each electrode.

   at the negative electrode _____

   at the positive electrode _____

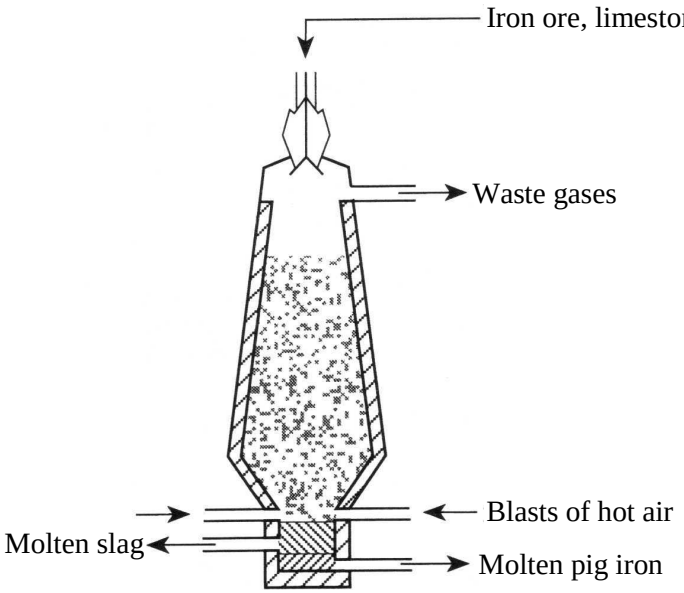
   (ii) State, giving a reason, which of these reactions is a reduction.

   _____ **[3]**

   e. Tin is good against corrosion. Suggest a reason why the entire can is not made out of tin.

   _____ **[1]**

3. The diagram below shows a simple outline diagram of a blast furnace which is used to obtain iron from iron ore by smelting. Iron ore is mainly iron (III) oxide.



a. The process occurs in three stages.

Stage 1: coke (carbon) burns to form carbon dioxide
Stage 2: carbon dioxide reacts with more coke to form carbon monoxide
Stage 3: iron (III) oxide is reduced to iron

(i) Why is the coke in Stage 1 considered to be a solid fuel for the process?

_____

(ii) Which oxide of carbon acts as the reducing agent?

_____

(iii) Write a balanced equation for Stage 3 of the process.

_____ **[4]**

b. Limestone has not been mentioned in Stages 1 to 3. What is the function of the limestone?

_____ **[1]**

c. The pig iron obtained from the furnace is of little use and most of it is converted into steel.

(i) Why is pig iron of little use? _____

(ii) Give one use of steel and state the property on which the use depends.

use: _____

property: _____ **[3]**

d. Iron forms two chlorides, iron (II) chloride and iron (III) chloride.

(i) If iron reacts with chlorine, which of these two chlorides is formed?

_____

(ii) Give one observation that you would expect to make during this reaction.

_____ **[2]**

4. This question is about ions and ionic equations.

a. Write the symbol/formula for the ions which are always present in:

(i) aqueous acids _____ (ii) aqueous alkalis _____

b. For reactions that follow the same pattern, we can write a 'general ionic equation'. Two such examples are:

carbonate + acid → salt + water + carbon dioxide

ammonium salt + alkali → salt + water + ammonia

Write the 'general ionic equation', omitting spectator ions, for these reactions:

(i) **any** acid on a carbonate _____

(ii) **any** alkali on an ammonium salt _____ **[4]**

5. a. Chlorine gas is prepared in a laboratory. State:

(i) one important safety precaution that must be taken.

_____

(ii) one physical property of chlorine _____

(iii) a simple test that confirms its presence. _____ **[3]**

b. Some chlorine gas is bubbled through a colourless solution of potassium iodide. The equation for the reaction is:

$Cl_{2\,(g)} + 2KI_{(aq)} \rightarrow 2KCl_{(aq)} + I_{2\,(s)}$

(i) What would be **seen** when this reaction takes place?

_____

(ii) Write the **ionic** equation, omitting spectator ions, for this reaction.

_____

(iii) State, in terms of electrons **or** in terms of oxidation number, why the iodide ions are oxidised to iodine.

_____ **[4]**

c. Fluorine, chlorine, bromine and iodine are in the same Group of the Periodic Table and so show **similar** properties.

Use this information to give:

(i) the number of electrons in the outer shell of an atom of iodine _____

(ii) the molecular formula of fluorine _____

(iii) one property of silver bromide _____ **[3]**

6. Nitrogen dioxide can be prepared in the laboratory by the thermal decomposition of ls of lead (II) nitrate. Besides nitrogen dioxide, a colourless gas is also liberated and a ye remains as residue.

   a. What would you **observe** when nitrogen dioxide is given off?

   _____ **[1]**

   b. Give the name of the

   (i) colourless gas _____ (ii) yellow residue _____ **[2]**

   c. Write a balanced equation for the thermal decomposition of lead (II) nitrate.

   _____ **[2]**

   d. Nitrogen dioxide is formed in everyday life. First nitrogen and oxygen combine to form nitrogen monoxide which then changes to nitrogen dioxide when exposed to the air.

   (i) Give one example where such reactions take place due to natural or human activities.

   _____

   (ii) Balance the following equation

   $$\_\_\_\ NO_{(g)} + O_{2\,(g)} \rightarrow \_\_\_\ NO_{2\,(g)}$$

   (iii) Use your answer to d. (ii) to calculate the volume of oxygen that is needed to convert 13 dm^3 of nitrogen monoxide to nitrogen dioxide.
   (Assume that all conditions of temperature and pressure remain constant.)

   _____ **[3]**

   e. Nitrogen dioxide dissolves in water to form a solution containing two acids.

   (i) Suggest the name of one of these acids. _____

   (ii) State one harmful effect that this solution may have in everyday life.

   _____ **[2]**

7. a. A student suspects that an aqueous solution of a salt contains Pb^{2+} or Al^{3+} ions.

   (i) To test for the presence of these ions the student adds aqueous sodium hydroxide, first dropwise then in excess. What will the student observe?

   _____

   (ii) In order to confirm which of the two ions is actually present, it is necessary to add another reagent to a fresh solution of the salt.

   Give the name of this reagent _____

   If Pb^{2+} is present, what would be **seen**? _____

   (iii) What **type** of reaction is taking place in the tests above? _____ **[5]**

b. After carrying out qualitative tests on a white solid, a student obtained the follow
The solid gave a yellow colour in a flame test. On warming the solid with dilute hy
acid, a colourless pungent gas was given off that turned acidified potassium dichroma
orange to green.

These results show that the cation is _____ and the anion is _____ . [

c. Sodium hydrogencarbonate (baking soda) is one of the ingredients used in making cakes. When the cake mixture is put in the oven, the sodium hydrogencarbonate decomposes to produce carbon dioxide that makes the cake rise.

(i) Fill in the missing formula in the following equation.

$$2NaHCO_{3\,(s)} \rightarrow \_\_\_\_\_{}_{(s)} + H_2O_{(g)} + CO_{2\,(g)}$$

(ii) Calculate the volume of carbon dioxide, that would be liberated at stp, if 8.4g of sodium hydrogencarbonate is decomposed
[Relative Atomic Masses Na = 23, H = 1, C = 12, O = 16]

_____

_____ **[3]**

SECTION B – Answer any TWO questions only on the foolscaps provided.
This section carries 40 marks.

8. a. In the chemistry laboratory, it is common practice to carry out a chemical reaction to produce a new substance and then to use this substance to obtain other products.
An example of such a series of reactions is given below.

Reaction 1: copper (II) carbonate (green solid) → **A** (black solid) + **B** (colourless gas)

Reaction 2: **A** (black solid) + dilute sulfuric acid → **C** (blue solution) + water

Reaction 3: **C** (blue solution) + sodium hydroxide solution → **D** (blue precipitate) + sodium sulfate solution

(i) Identify A, B, C and D.
(ii) Write balanced equations for Reactions 1, 2 and 3 **[10]**

b. In industry, it is common practice to obtain substances from raw materials and then to use these substances to manufacture other chemicals. An example of this is the isolation of nitrogen and hydrogen from raw materials which are then used to synthesise ammonia.

(i) Name the **raw materials** from which nitrogen and hydrogen can be obtained and the name of the **process** by which each is isolated.

(ii) Write the equation for the synthesis of ammonia, name the catalyst used and give **one** important physical condition for the reaction to be successful.

(iii) Give **two** large scale uses of ammonia. **[10]**

9. a. (i) Explain why solid lead iodide does not conduct electricity but molten lead (II) [illegible] electrolyte

(ii) Calculate the mass of lead that would be deposited if a current of 1.8 amperes flows [illegible] 45 mins.

b. Explain the following observations, giving equations in each case.

(i) The addition of concentrated sulfuric acid to sugar [sucrose ($C_{12}H_{22}O_{11}$)] results in the formation of a black residue.

(ii) When concentrated sulfuric acid is reacted with potassium chloride, misty fumes of an acidic gas are liberated.

(iii) There is no reaction when dilute sulfuric acid is added to some copper metal, but when dilute sulfuric acid is added to iron, there is effervescence and a green solution is formed.

[14]

10. A solution of hydrochloric acid was titrated against a standard solution of sodium carbonate of molar concentration 0.1 mol dm^{-3} (0.1M) using a suitable indicator.

a. For this titration procedure, give:

(i) a labelled diagram of the titration set up,

(ii) the names of two other items of **apparatus** (not included in the diagram above) that are needed during the titration,

(iii) the name of a suitable indicator and its colour change at the end point (assuming that the indicator is initially in the sodium carbonate solution),

(iv) three precautions or practical steps necessary to obtain accurate titre values. **[12]**

b. It was found that 25 cm^3 of the standard sodium carbonate solution was exactly neutralized by 30 cm^3 of the hydrochloric acid solution.

The equation for the reaction is:

$$Na_2CO_{3\,(aq)} + 2HCl_{\,(aq)} \rightarrow 2NaCl_{\,(aq)} + H_2O_{\,(l)} + CO_{2\,(g)}$$

(i) Calculate the number of moles of sodium carbonate present in the 25 cm^3 solution.

(ii) Use the carbonate : acid mole ratio of the equation to find the number of moles of hydrochloric acid solution that reacted with the number of moles of sodium carbonate solution found in your answer to b.(i).

(iii) Use your answer to b.(ii) to find the molarity (M) of the hydrochloric acid solution. **[8]**