# ST. FRANCIS SECONDARY SCHOOL
## YEARLY EXAMINATION
## CHEMISTRY SPECIMEN PAPER

NAME:_____          CLASS: _____

FORM 4                                                          TIME: 2 hrs

Directions to Candidates:

- **Answer all questions** in **Section A** and **two questions** in **Section B**. Write your answers in the spaces provided for Section A and write your answers for Section B on the lined papers provided. Each question in Section B should be started on a separate sheet. **Always use ink to write your final answer.** Markings in pencil are considered as rough work.

- The mark allocation is indicated at the end of each question. Marks allocated to parts of questions are also indicated. Section A carries 60 marks and Section B carries 40 marks.

- You are reminded for the necessity of **good English** and orderly presentation in your answers.

- **Electronic Calculators** may be used in any part of the examination. In calculations you are advised to show <u>all the steps</u> in your working.

- A **Periodic Table** is provided during the exam.

Useful Data:

<u>Relative Atomic Masses may be taken as:</u>

| | | |
|---|---|---|
| **Magnesium = 24** | **Hydrogen = 1** | **Chlorine = 35.5** |
| **Calcium = 40** | **Carbon = 12** | **Oxygen = 16** |
| **Copper = 64** | **Sulfur = 32** | |

Q=It

Molar volume of gases = 22.4 $dm^3$ at s.t.p

S.t.p conditions are taken at 1atm and and $0^oC$

Faraday's Constant = 96500 $Cmol^{-1}$

Avogadro's Constant  L= 6 x $10^{23}$

**GOOD LUCK!**

1. a) The outline diagram below shows different areas of the Periodic Table.
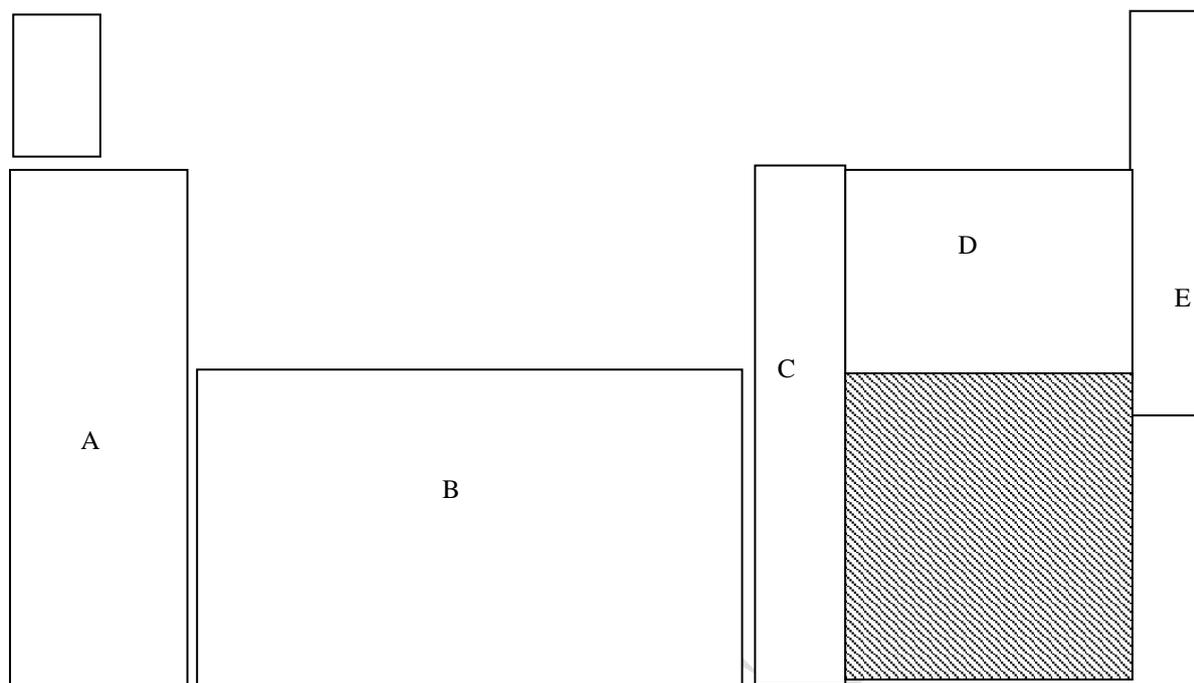


Give the **letter** of **the area** in which you would find – (1 mark each)

   i)    elements that do not tend to form compounds  _____

   ii)   the most reactive metals   _____

   iii)  a metal which is borderline with non-metals and whose oxide is

         amphoteric        _____

   iv)   a solid non-metal that burns in air to form an acidic oxide     _____

   v)    a metal that has a variable valency and forms coloured ions    _____

   vi)   a halogen          _____

   vii)  an element that reacts with water to form an alkaline solution _____

**(Total: 7 marks)**

2.    Fill in the spaces below using words from the list. Each word may be used once or not at all.

> Three    tetrahedral    upward    calcium carbonate
>
> Allotropes    calcium hydroxide solution    pyramidal
>
> electrons    carbon dioxide    carbon monoxide
>
> downward    carbonic acid    insoluble    reducing
>
> oxidising    potassium hydroxide solution    denser
>
> conductor    lighter

Carbon occurs in two different _____. These are graphite and diamond. In graphite each Carbon atom is bonded to _____ other carbons while in diamond the bonding is stronger and each carbon forms a _____structure with a very strong lattice. Graphite is a _____ of electricity since there are free _____ in the planar sheet structure. Carbon can react with oxygen producing two different gases. When oxygen is abundant _____ _____ gas is formed. This can be collected in the lab in the dry form using _____ delivery since the gas is _____ than air. This gas can be tested using limewater. When bubbled through limewater _____ _____ is formed leading to a cloudy appearance. When dissolved in water, this gas forms _____ _____ which turns blue litmus red. When limited oxygen is present and excess coke (carbon) is present like in the blast furnace, a poisonous gas _____ _____ is produced. This gas is used as a _____ agent as the iron ore is reduced to iron. This gas is a neutral oxide and is _____

in water.  To separate a mixture of these two gases _____ can be used.

**(Total 7 marks)**

3.  Give the general **ionic equation** (omitting spectator ions) for the following

    reactions. (Include state symbols) (4)

    (i)    $K_2CO_3$ + 2HCl → 2KCl + $H_2O$ + $CO_2$

_____

(ii)    NaOH + $HNO_3$ → $NaNO_3$ + $H_2O$

_____
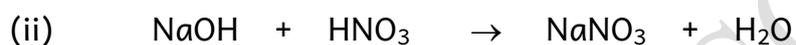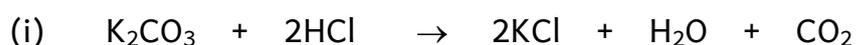
**(Total: 4 marks)**

4.  The questions below refer to the reactions of copper metal with different

    acids.

i)   Copper does not react with dilute hydrochloric acid or dilute sulphuric acid.

    Give a reason for this observation.

_____(1 )

ii)    Copper reacts with concentrated nitric acid to give a brown gas.  Give

the **name** of the gas given out.

Name: _____ (1)

iii)    Is **copper** in this reaction acting as an oxidising or reducing agent?

_____  (1)


b)    Copper reacts directly with chlorine to form copper (II) chloride.

$$Cu + Cl_2 \rightarrow CuCl_2$$


(i)    Name this type of reaction in which the two elements combine to

form one compound.  _____  (1)


(ii)   Write the balanced ionic **half** equations for this reaction in (b) above

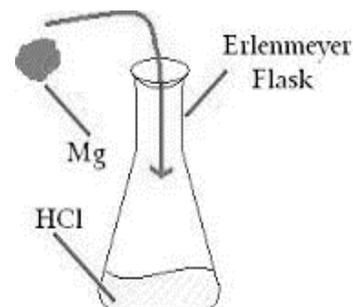and use them to explain why this is a **redox** reaction. (3)

_____

_____

_____

_____


(b) Identify the **reducing agent** in the following redox reactions: (2)

(i) $C_{(s)} + H_2O_{(l)} \longrightarrow CO_{(g)} + H_{2(g)}$


_____


(ii) $SO_{2(g)} + KMnO_{4(g))} \longrightarrow MnO_{2(aq)} + K_2SO_{4(aq)}$


(Total: 9 marks)

_____

5

5. 3 g of magnesium granules were added to excess dilute hydrochloric acid.

(i) Write **one** observation for this reaction.

_____(1)

(ii) Write a balanced chemical equation (**including state symbols**) to represent this reaction.

_____ (2)

b. (i) Calculate the **number of moles** of magnesium that reacted with the acid.

(Show working and give answer to **3 decimal places**)  (2)




(ii) How many moles of hydrochloric acid were used? (Answer to **2 decimal places**)

_____

_____ (1)


(iii) Find the volume of hydrogen produced from this reaction at **standard temperature and pressure**. (Answer to **two decimal places**)
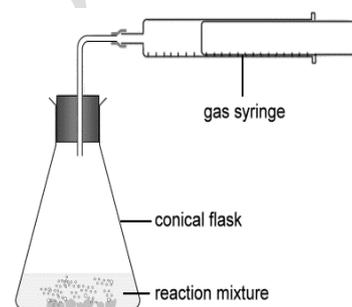
_____

_____ (2)


6

c. If all the hydrogen given off from this reaction were collected and the temperature changed from 0°C (standard temperature) to 20 °C (room temperature), calculate **the new volume of gas**, given that **there was no change in pressure**. (Give answer to **two decimal places**)

_____

_____(2)

(**Total-10 marks**)

6. An experiment was carried out in a water lab in order to find **the percentage of calcium carbonate by mass in limestone**. 4.5 g of crushed limestone were placed in a flask and 30 cm$^3$ of 2 moldm$^{-3}$ hydrochloric acid solution were added to it. The contents were swirled till there was no more effervescence. 1.2 cm$^3$ of the acid **remained unreacted** after the reaction stopped completely.


gas syringe

conical flask

reaction mixture

a. (i) What volume of **acid solution reacted** with the calcium carbonate in the limestone?

_____ (1)

(ii)    Find **the number of moles of hydrochloric acid** present in the volume found in question a (i) above, given that the molar concentration of the acid was 2 moldm$^{-3}$ (2M). Give answer up to **3 decimal places**.

_____

_____(2)

b.  Using the equation:

$$2HCl\ (aq) + CaCO_3\ (s) \rightarrow CaCl_2\ (aq) + H_2O\ (l) + CO_2(g)$$

(i) Find the number of moles of calcium carbonate that reacted with the acid. Give answer to **three decimal places**.

_____

_____(1)

(ii)     Calculate the mass in g of calcium carbonate that reacted with the acid. (Useful relative atomic masses: Ca = 40, C=12, O=16) Give answer to **two decimal places**.

_____

_____(2)

c.  (i) Limestone (calcium carbonate) is the raw material used to produce a white caustic solid known as **quicklime.** Write a **balanced chemical equation to show this process**.

_____ (2)

ii)     What is this type of reaction called? _____

       (1)

**(Total 9 marks)**

7. The diagram below shows the electrolytic process which is used to extract aluminium from its ore.
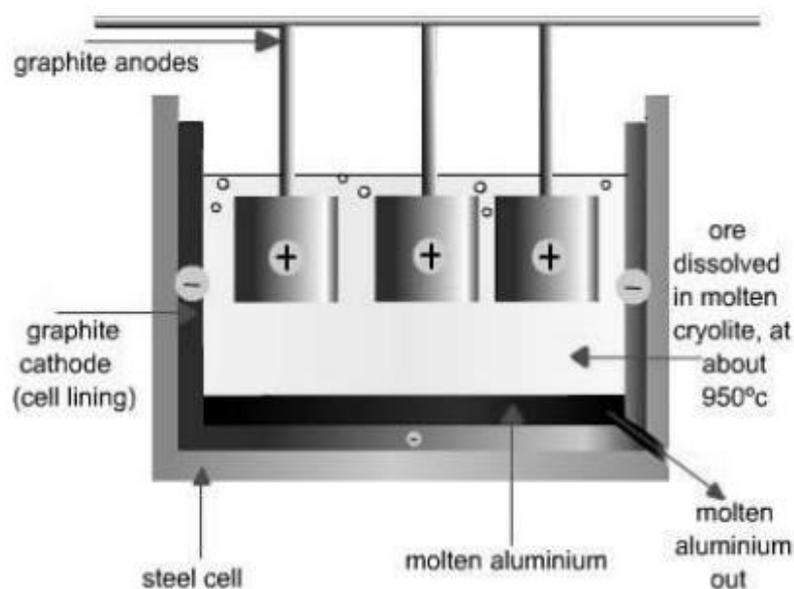


a. (i) Give the common **name** of the **ore** that is mined in order to extract aluminium from it.

_____ (1)

b. Write half equations to represent the processes taking place at the anode and cathode.

Anode: _____ (1)

Cathode:_____ (1)

c. (i) Aluminium production is a very costly process for a number of reasons. One of these is that the positive electrode needs frequent replacement. Why?

_____(1)

(ii) Another reason why aluminium extraction is costly is the amount of electricity needed to convert ions into the metal.  3 moles of electrons are needed to deposit one mole of aluminium leading to a huge amount of electricity. Calculate the **mass of aluminium deposited** when a current of 200 Amps is passed for 5 hours. (2)

**(Total : 7 marks)**

8. Materials behave differently when they are heated. What are the products formed, when they are heated using a blue Bunsen flame: (1)

i) Magnesium:

_____

ii) Sodium hydrogencarbonate:

_____
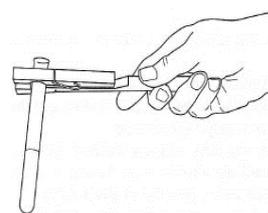
b. Roberto was given a task to distinguish between **three unknown substances**. For each substance, the student performed tests and recorded the observations.

Your task is to identify the unknown substances A, B and C.

i) **Substance A** was a green, insoluble material. A flame test gave a blue-green flame. It decomposed on heating to form a black powder. When the black powder was dissolved in dilute HCl and the resulting solution was tested with NaOH solution, a blue precipitate insoluble in excess was obtained. When dilute HCl was added to substance A, effervescence was observed and the gas produced turned limewater milky.

Substance A is:

_____ (2)

ii) **Substance B** was a transparent crystalline solid. On heating, it decomposed to produce a white solid and a brown gas which relighted a glowing splint. Also, after heating a sample of substance B with dilute NaOH and some aluminium powder, a smell of ammonia was detected. A flame test on substance B gave a brick red flame. When NaOH solution was added d to a solution of substance B, a white precipitate was produced. This precipitate was insoluble in excess NaOH.

Substance B is:

_____(2)

**Substance C** was a white crystalline solid. On performing a flame test, a golden yellow colour was observed. Adding acidified silver nitrate to a solution of the salt resulted in a white precipitate.
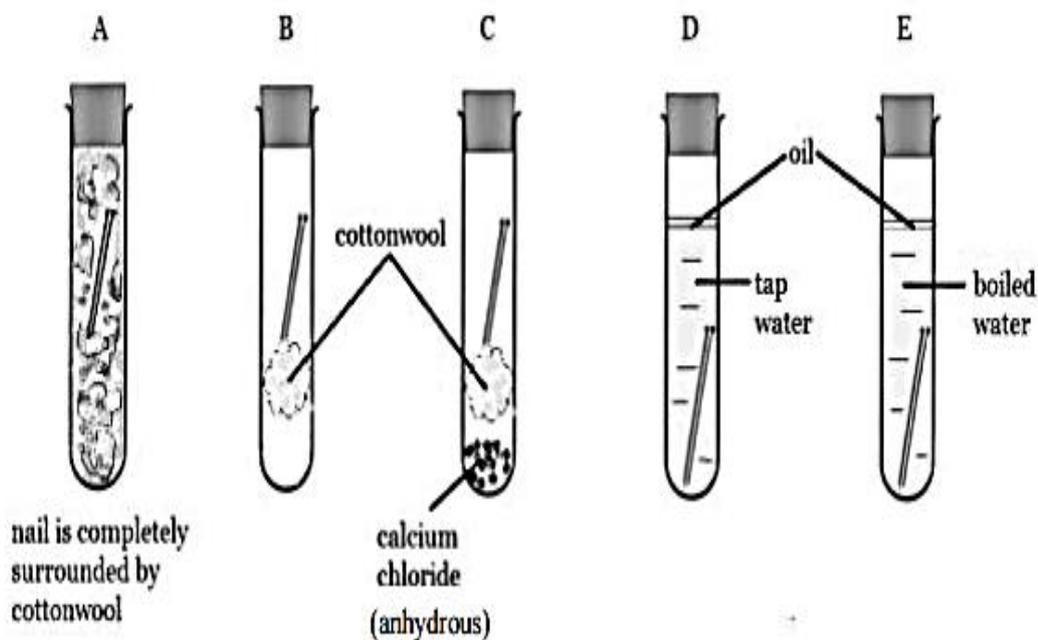
Substance C is:

_____ (2)

(Total : 7 marks)

Choose any two questions. Each question carries 20 marks. Be careful to answer ALL parts in the questions and to write the question number in the margin.
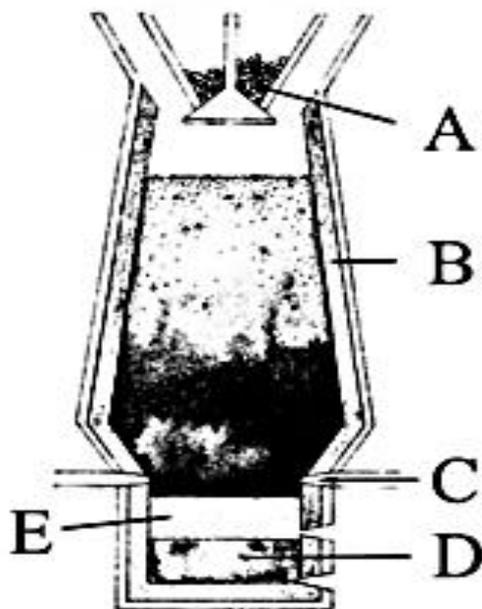
**Question 1: This question is about reactions of iron and the blast furnace.**

During an experiment to study the rusting of iron, a student sets up the apparatus shown below. He places an iron nail in each of the boiling tubes and leaves them standing for a week. Then he checks each nail for any sign of rusting.

a. State, **giving reasons**, whether you expect the iron nail in each of the 5 boiling tubes shown above to rust or not. (7)



| A | B | C | D | E |

nail is completely
surrounded by
cottonwool

cottonwool

calcium
chloride
(anhydrous)

oil

tap
water

boiled
water

b.  Label the **blast furnace** below. (A-E) (5 marks)



c.  Explain how iron is produced from its ore in the blast furnace. You need to give *a* **detailed description** of the name of the ore, other raw materials used and all the reactions taking place.  Include ALL balanced reactions (including state symbols) in your account as well as details of the process involved and the chemical details of the ore. (8)

 Total- 20 marks

Question 2: This question is about qualitative analysis of compounds.

A mixture consisted of two white powders A and B, which had been accidentally put in the same container. Michelle, a lab supervisor, wanted to determine what the white powders in the mixture were made of. She needed to **separate them and analyse them**. So she carried out the following steps:

### Step 1

She heated the solid mixture. **Substance A** sublimed to form a white cloud. This vapour formed a white solid crust as it hit a cool inverted funnel. The crust was scraped off with a spatula and dissolved in a small amount of water to form a colourless solution.

### Step 2

Some of the solution of A was heated with sodium hydroxide solution. It gave out a **pungent gas X** that turned moist red litmus paper blue.

### Step 3

Another sample of solution A gave a white precipitate when tested with acidified silver nitrate solution.

### Step 4

A flame test was carried out on the remaining **powder B**. It gave the flame a golden yellow colour.

### Step 5

Powder B quickly dissolved in water to form a colourless solution. It gave a persistent white precipitate when acidified barium chloride solution was added to it.

(i) Draw a **labelled diagram** of the apparatus the analyst needed for step 1 in which the two solids were separated. (4)

(ii) Identify the gas X which was produced in step 2 and briefly describe another chemical test that can be used to test for it instead of the litmus paper. (2)

(iii) What does the result of step 2 prove about substance A? (1)

(iv) What does the result of step 3 prove about substance A? (1)

(v) Give the full chemical name of substance A. (1)

(vi) Write 2 ionic equations to represent the reactions in step 2 and step 3 (one for each step). (4)

b. (i) What does the test in step 4 show about substance B? (1)

(ii) Describe briefly how a flame test should be carried out on a powder sample. (2)

(iii) What does the test in step 5 show about substance B? (1)

(iv) Give the full chemical name of substance B. (1)

(v)    Write an ionic equation to represent the reaction in step 5. (2)

**Total- 20 marks**

## Question 3: This question is about molarities and solutions.

A pharmacy analyst prepared a solution of sulfuric acid by mixing distilled water with an amount of concentrated sulfuric acid ($H_2SO_4$). His target was to have a 1mol dm$^{-3}$ (1M) solution.

   i)    Name one piece of equipment which is necessary to make a solution of known concentration. [1]

   ii)   What is the name of a solution whose concentration is known? [1]

   iii)  Calculate the RFM of sulfuric acid. [1]

   iv)   Calculate the amount of sulfuric acid in grams that would be required to produce 500 cm$^3$ of this 1 mol dm$^{-3}$ solution. [2]

b. In reality the amount of acid in concentrated sulfuric acid varies due to its ability to absorb water vapour from the air. When the technician produced the solution he was not sure what its concentration might be. He needed to measure the concentration of the sulfuric acid solution.

i) When sulfuric acid absorbs water from the air, we say that it is…….… (1)

ii) What is the name of the process by which the concentration of a solution can be measured? (1)

iii) Name typical items of glassware that are necessary to carry out this process

(3)

iv) Comment on the precautions necessary to make this process a reliable one.

(2)

    c.  The technician used a 1 mol dm$^{-3}$ solution of sodium carbonate ($Na_2CO_3$) so that it reacted with the acid. What is this kind of reaction called? (1)

    d.  On performing the above process, the technician concluded that 31 cm$^3$ of sulfuric acid were required to react completely with 25 cm$^3$ of sodium carbonate.

i) What is the name of the point where all of the acid reacted with the carbonate? (1)

ii) **Methyl orange** was used as an indicator. Give its colour when it is present in the acid. (1)

  ii)  Give a balanced chemical equation for the reaction between sodium carbonate and sulfuric acid. (2)

   iii) Give an overall **ionic equation** for the reaction stating the **spectator ions**. (1)

  iv)  From the information gathered so far, calculate the actual concentration of the sulfuric acid solution. (2)

**Total -20 marks**

--------------------------------END OF PAPER----------------------------------------

# PERIODIC TABLE



Periodic Table of the Elements

Student name: _____ **Form 3- Chemistry Yearly Exam**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | TOT SEC 1 / 60 | Q1 | Q2 | TOT SEC 2 / 40 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 7 | 7 | 4 | 9 | 10 | 9 | 7 | 7 | | 20 | 20 | |
| | | | | | | | | | | | |

**Section A: (no choice in questions)**

Q1: Periodic table

Q2: Carbon

Q3: Ionic equations

Q4: Copper chemistry

Q5: Moles and gases

Q6: Titration and volumetric analysis

Q7: Electrolysis and Aluminium extraction

Q8: Action of heat on substances and qualitative analysis

**Section B. (from 3 to choose 2)**

1. Iron and the Blast Furnace (memory and analysis area)
2. Qualitaitve analysis: Anion and Cation tests (analytical area)
3. Titration and quantitative analysis (lab and mathematical area)

Comments:_____

_____

_____

Revision summer work for <u>all students</u> – to be brought to school after the summer holidays. Enjoy your holidays and have a good rest. Most of you truly deserve it☺

- May 2015 Paper I no.1, 2, 3, 4, 5, 6, 7, 8, 11, 12

**Extra work for those students obtaining <50 %:**

- May 2015 Paper 2 B: no 1, 2, 3, 7,11, 12
- Sept 2015 Paper 1: no. 1, 2, 5, 6, 7

   <u>To be handed in at school during September</u>. Ms. K. Mizzi.