ST. FRANCIS SECONDARY SCHOOL

HALF YEARLY EXAMINATION

CHEMISTRY SPECIMEN PAPER

NAME:_____ CLASS: _____

FORM 4 TIME: 2 hrs

Directions to Candidates:

- **Answer ALL Questions** in **Section A** and **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 2 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.
- 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 **all the steps** in your working.
- A **Periodic Table** is provided during the exam.

Useful Data:

Relative Atomic Masses may be taken as:

Hydrogen (H) = 1.0 Carbon (C) = 12.0 Chlorine (Cl) = 35.5

Magnesium (Mg) = 24.0 Zinc (Zn) = 65

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

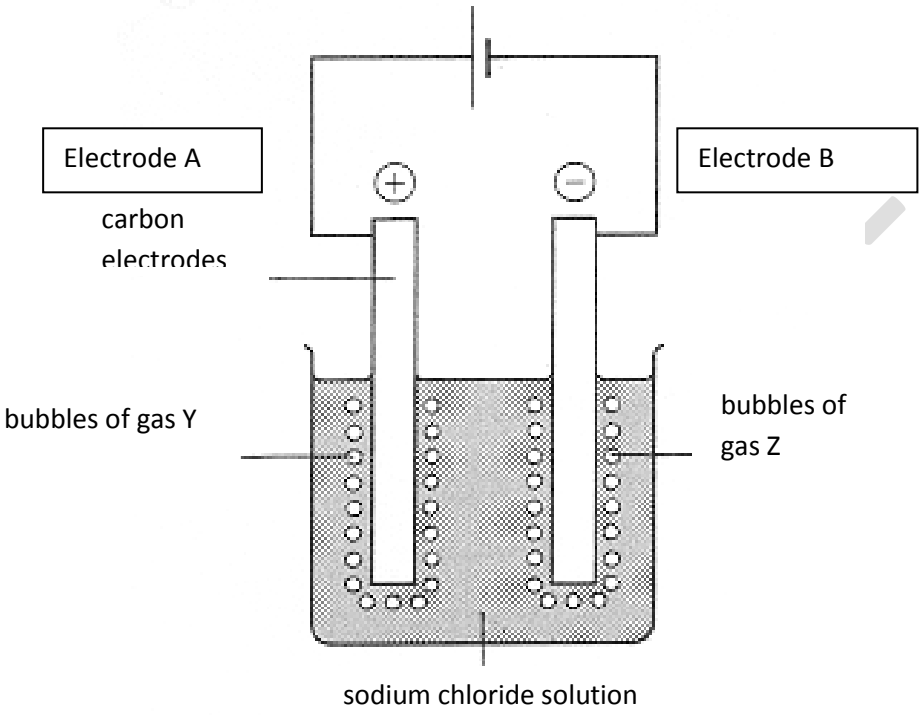
Faraday's Constant = 96500 $Cmol^{-1}$

Avogadro's Constant L= 6×10^{23}

GOOD LUCK!

Question 1

The diagram below shows the electrolysis of ***concentrated*** sodium chloride solution (Brine) in the laboratory.



(a) In the electrolysis cell there are two electrodes. A positive and a negative electrode. State which is electrode A and B. (2 marks)

Cathode: _____ Anode: _____

b) Name the ions present at the cathode and the anode: (2)

Anode: _____ Cathode: _____

c) Name the gases Y and Z. (2 marks)

Y= _____

Z= _____

d) How would you identify the gas Z: (1)

_____

TOTAL: 7 marks

Please Turn Over

Question 2:

Sometimes simple tests are used to identify the gases produced at the electrodes. This is what is done in a school laboratory, to test the products of the electrolysis of ***concentrated brine solution*** mentioned in question 1. If a few drops of universal indicator are added to the solution before electrolysis starts, the indicator is green (neutral solution). As electrolysis happens, the indicator turns blue around the cathode while around the anode first it turns red, then colourless.

a. Explain, in terms of the ions present in solution, what causes the indicator to go blue at the cathode.

_____

_____

_____(2 marks)

b. Suggest a reason for the colour changes at the anode. Give the half equation taking place at the anode.

_____

_____

_____(2 marks)

c) Name a **compound** produced on an **industrial scale** by the electrolysis of sodium chloride solution. (1)

_____

d) The electrolysis of brine is an important industrial process. The gas produced at the anode is used for various day-to-day activities.

Mention one way where the gas is used in everyday life. (1 mark)

_____

e) What is an ***electrolyte***? What is the electrolyte in the electrolysis of brine? (2)

_____

_____

f) How would you change the electrolyte to have preferential discharge of the metal (sodium)? Give the half-equation showing formation of the metal sodium.(3)

_____

_____

_____

g) Carbon electrodes are chosen for this lab experiment. Comment on the use of these electrodes when compared to other inert electrodes (like Platinum electrodes) (2 marks)

_____

_____

TOTAL – 13 marks

Question 3:

(a) Rewrite the following equations as an ionic equation, (omitting spectator ions). (Show all necessary working)

Equation 1: $Ca\ (s) + 2HCl\ (aq) \rightarrow CaCl_2\ (aq) + H_2\ (g)$

_____

Equation 2: Cl_2 (g) + 2NaBr (aq) → 2NaCl (aq) + Br_2 (g)

_____

(4 marks)

From the reactions above- equation 1 and 2 which reaction shows a displacement reaction? (1)

_____

(b) Explain, in terms of electrons, why

(i) calcium is oxidised in equation 1 above.

_____

(ii) chlorine is reduced in equation 2 above

_____

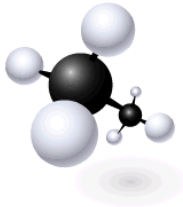
(2 marks)

(iii) What is the reducing agent in equation 1? (1)

_____

TOTAL- 8 marks

Question 4:



A compound, composed of carbon and hydrogen only, contains 80% of carbon and 20% of hydrogen. (***SHOW ALL WORKING***)

(a) Calculate the **empirical** (simplest) formula of this compound (3 marks)

(b) If the relative molecular mass of the compound is 30, find its molecular formula. (2 marks)

TOTAL- 5 marks

Question 5:

Magnesium is a metal found in group 2 of the periodic table. Mark uses magnesium in an experiment. He weighed 19.2 grams of the element and needed to work out the number of moles.

a. Calculate the number of moles in 19.2g of Magnesium (2)

b. Calculate the number of atoms in the 19.2g of Magnesium. (2)

Mark wanted to react the magnesium with chlorine gas. Magnesium reacts in a ***synthesis reaction*** with chlorine.

c. Give ONE property of chlorine. (1)

_____

d. Define the term in italics. (1)

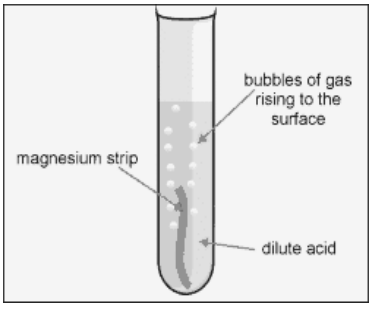
_____

e. Give a balanced reaction ***using state symbols*** of the reaction done by Mark. (2)

_____

f. Find the mass of product obtained. (3)

g. Magnesium can also react with acids. What gas is produced in the reaction between magnesium and hydrochloric acid. (1)



_____

TOTAL- 12 marks

Question 6

Redox reactions occur everywhere around us. In the browning of apples polyphenyls are ***oxidised*** to o-quinones which are responsible for the brown colour. This reaction can be prevented by the addition of lemon or pineapple juices which contain natural anti-oxidants.

a. The **loss of electrons** from a substance during a chemical reaction is called _____. (1)

b. Mention one **other** way how the polyphenols in apples are oxidised to o-quinones. (1)

_____

c. In the reaction $H_2 + F_2 \rightarrow 2HF$ (**Underline** the correct answer) (1)

i. H_2 and F_2 are both reduced.

ii. H_2 and F_2 are both oxidised.

iii. H_2 is reduced and F_2 is oxidised.

iv. H_2 is oxidised and F_2 is reduced.

d. Give the **oxidation number** of : (3)

i. Mn in $KMnO_4$ _____

ii. Fe in Fe_2O_3 _____

iii. Mg metal _____

TOTAL- 6 marks

Question 7

a. Given the reaction: $Ca + NiCl_2 \rightarrow CaCl_2 + Ni$

The oxidation number of chlorine (**Underline** the correct answer in INK) (1)

- decreases
- increases
- remains the same

b. Calcium is a metal found in group 2 of the periodic table. Is Calcium more or less reactive than Magnesium? Why? (2)

_____

_____

_____

Transition metals have ***multiple valencies***.

a. Give one other property of transition metals. (1)

_____

b. In this reaction iron oxide reacts with a gas to form iron. This reaction is often used in the blast furnace to produce iron.:

Fe_2O_3 (s) + 3CO (g) ⟶ 2Fe (s) + $3CO_2$ (g)

Carbon monoxide is the: (**Underline one answer** in INK) (1)

- Spectator ion
- Reducing agent
- Oxidising agent

a. Write the ***half equation*** showing what is happening to iron oxide in forming iron metal.

Half Equation: _____ (1)

Explain if iron is oxidised/reduced in terms of electrons, oxidation numbers, loss/gain of oxygen. (3)

_____

_____

_____

_____

Total: 9 marks

Section B.- Answer **BOTH questions** in this section on separate sheets. Write your name and question number (including sub-sections) on each sheet. Each question carries 20 marks. **It is important to show all necessary working**.

QUESTION 1 (Total: 20 marks)

This question is about redox reactions and electrolysis.

$$C_6H_{12}O_6 + 6O_2 \rightarrow 6H_20 + 6CO_2 + \text{energy}$$

(glucose + oxygen → water + carbon dioxide + energy)

a. The reaction above shows how every living organism respires. It is a common redox reaction occurring all the time around you. Copy this equation showing how the redox reaction is taking place commenting on which substance is oxidised and reduced and what made you come to this conclusion. (4)

b. Read the article below and then answer the questions.

The FRTA (Free Radical theory of Aging)

*The **free radical theory of aging**(**FRTA**) states that organisms age cells accumulate free radical damage over time. A free radical is any atom or molecule that has a single unpaired electron in an outer shell. While a few free radicals such as melanin are not chemically reactive, most biologically-relevant free radicals are highly reactive. For most biological structures, free radical damage is closely associated with oxidative damage. Antioxidants are reducing agents and limit oxidative damage to biological structures by passivating them from free radicals. Such examples in fruits are lemons, grapes and blueberries.*

Denham Harman first proposed the free radical theory of aging in the 1950s and in the 1970s extended the idea to implicate mitochondrial production of reactive oxygen species. In some model organisms, such as yeast and the Drosophila fly, there is evidence that reducing oxidative damage can extend lifespan. Whether reducing oxidative damage below normal levels is sufficient to extend lifespan remains an open and controversial question.

Free radicals are atoms or molecules containing unpaired electrons. Electrons normally exist in pairs in specific orbitals in atoms or molecules. Free radicals, which contain only a single electron in any orbital, are usually unstable. They tend to lose or pick up an extra electron, so that all electrons in the atom or molecule will be paired.

Damage occurs when the free radical encounters another molecule and seeks to find another electron to pair its unpaired electron. The free radical often pulls an electron off a neighboring molecule, causing the affected molecule to become a free radical itself. The new free radical can then pull an electron off the next molecule, and a chemical chain reaction of radical production occurs. The free radicals produced in such reactions often terminate by removing an electron from a molecule which becomes changed or cannot function without it, especially in biology. Such an event causes damage to the molecule, and thus to the cell that contains it. The DNA of the cell is effected and this in turn leads to various effects of aging

especially cancer, wrinkles (as fats and proteins become linked) or oxidise LDL (important in taking fat around the body) leading to strokes and heart disease.

Free radicals that are thought to be involved in the process of aging include superoxide and nitric oxide. Specifically, an increase in superoxide affects aging whereas a decrease in nitric oxide formation does the same.

Antioxidants are helpful in reducing and preventing damage from free radical reactions because of their ability to donate electrons which neutralize the radical without forming another. Ascorbic acid, for example, can lose an electron to a free radical and remain stable itself by passing its unstable electron around the antioxidant molecule. This has led to the hypothesis that large amounts of antioxidants, with their ability to decrease the numbers of free radicals, might lessen the radical damage causing chronic diseases, and even radical damage responsible for aging.

i. Name two effects associated with aging mentioned in the passage above. (1)

ii. Name two free radicals involved in the aging process. (1)

iii. What are free radicles? How do these contribute to the aging process? (2)

iv. Draw a diagram of an atom showing free radicles, orbitals with electrons and nucleus. (3)

v. Name an antioxidant. Explain how antioxidants prevent or help in the aging process according to this theory. (2)

vi. Are antioxidants oxidising or reducing agents? Why? (2)

c. Aluminium is the ***third*** most abundant element and the ***most abundant metal***, however it is still very expensive. Comment on why it is very expensive by referring to its extraction from the ore. Give a detailed description of how aluminium is obtained from its ore, including a diagram (No details of temperatures are required) listing two factors contributing to its very costly price in industry. (5)

Question 2. (Total- 20 marks)

This question is about reactivity and reacting masses.

a. Different substances are arranged in the periodic table in terms of reactivity.

i) Arrange the following metals in order of their chemical reactivity, placing the most reactive metal first: (1)

Copper , sodium , iron , zinc, magnesium

ii) How would you test chemically in a lab for this classification in reactivity. (2)

ii) Zinc is used in ***galvanising***. Explain what this means and how/why it is done. (3)

iii) Arrange the following ***halogens*** in order of their chemical reactivity, placing the most reactive first. bromine, chlorine, fluorine, iodine. State one reason why you arranged the elements in this way. (2)

iv) Give ONE physical property that shows that halogens are non-metals. (1)

b. One of the metals, Zinc, is reacted with hydrochloric acid to produce a salt and hydrogen gas. In this experiment, 32.5g of zinc were reacted with hydrochloric acid and the hydrogen gas was collected. What is the **mass of zinc chloride** produced? (2)

c. Hydrogen can also be produced from the electrolysis of acidified water, better known as the electrolysis of dilute sulfuric acid. What **volume** of

Hydrogen is produced if a current of 0.192A flows for 50 minutes at room temperature. (Molar volume at rtp = 24dm^3) (4)

d. The following chemical equations represent different types of reactions:

A $AgNO_{3(aq)} + NaCl_{(aq)} \rightarrow AgCl_{(s)} + NaNO_{3(aq)}$

B $2Cu(NO_3)_{2(s)} \xrightarrow{heat} 2CuO_{(s)} + 4NO_{2(g)} + O_{2(g)}$

C $2H_{2(g)} + O_{2(g)} \rightarrow 2H_2O_{(g)}$

D $Cl_{2(g)} + 2KBr_{(aq)} \rightarrow 2KCl_{(aq)} + Br_{2(aq)}$

Select from the equations given above, an example of each of the following types of reaction mentioned. In each case give the letter of the equation selected, and ***a reason for your choice***. Each equation may be used once, more than once or not at all. (5)

I. Thermal decomposition
II. Combustion
III. Precipitation
IV. Direct Synthesis or Direct Combination
V. Displacement

---------END OF PAPER----------Go back and check your work

Student name: _____ **FORM 4- Half Yearly Exam**

1	2	3	4	5	6	7	TOT SEC 1 / 60	Q1	Q2	TOT SEC 2 / 40
7	13	8	5	12	6	9		20	20	

Section 1:

Q1: Electrodes and ionic equations

Q2: Electrolysis of Brine and Ionic equations

Q3: Oxidation and reduction in terms of ionic equations

Q4: Empirical Formula

Q5: Moles

Q6: Redox Reactions and Oxidation numbers

Q7: The Periodic Table and Half-equations

Section 2.

1. Ionic Theory and Electrolysis
2. Periodicity, Reactivity, Reactions and Volumes

Expert (75-100 marks)	Worker (55-74 marks)	Apprentice (< 55 marks)
Shows an excellent understanding of the basic concepts addressed in the questions and ability to apply knowledge in different areas	**Shows a good understanding of the basic concepts addressed in the questions and ability to apply knowledge in different areas**	**Basic understanding of the areas tested still needs to be developed perhaps through better and frequent revision and more attention in homework**
		

Comments:_____

_____

K. Mizzi- Chemistry teacher