

# Chemistry I

## 002

14 Nov. 2016

08.30AM – 11.30AM

# YEAR 2016

## ORDINARY LEVEL NATIONAL EXAMINATIONS, 2016

SUBJECT: CHEMISTRY I

DURATION : 3 HOURS

### INSTRUCTIONS TO CANDIDATES:

- 1) Write your names and index number on the answer booklet as they appear on your registration form and **DO NOT** write your names and index number on additional answer sheets of paper if provided.
- 2) Do not open this question paper until you are told to do so.
- 3) This paper consists of three sections: **A, B** and **C**.
  - **SECTION A:** Attempt all questions. (55 marks)
  - **SECTION B:** Attempt any **THREE** questions (30 marks)
  - **SECTION C:** Attempt **ONLY ONE** question. (15 marks)
- 4) You do not need the Periodic Table.
- 5) Silent non-programmable calculators may be used.
- 6) Use only blue or black pen.

**SECTION A: ATTEMPT ALL THE QUESTIONS. (55 MARKS)**

- 1) Iron metal undergoes rusting when it is exposed to air for a long period of time.
- (a) Indicate names of 2 chemical substances that are necessary for causing rusting of iron, Fe. (2 marks)
- (b) Mention 2 means that are used to prevent rusting of objects which are made of iron (Fe) metal. (2 marks)
- 2) Water is used for various domestic purposes.
- a) State 2 natural sources of water. (2 marks)
- b) Briefly describe one method used to treat unclean drinking water to be ready for cooking food. (2 marks)
- 3) A student uses 100cm<sup>3</sup> of a 0.5 mol dm<sup>-3</sup> sodium hydroxide solution to react with excess sulphuric acid.
- a) Calculate the number of moles of NaOH contained in 100 cm<sup>3</sup> of solution. (2 marks)
- b) Calculate the mass of sodium sulphate crystals that are formed after evaporation of the resultant solution. (2 marks)
- Equation:  
$$\text{H}_2\text{SO}_{4(\text{aq})} + 2\text{NaOH}_{(\text{aq})} \longrightarrow \text{Na}_2\text{SO}_{4(\text{aq})} + 2\text{H}_2\text{O}_{(\text{aq})}$$
  
(Atomic mass Na = 23, S = 32, O = 16, H = 1)
- 4) (a) When hydrated sodium sulphate crystals are heated gently, water is given off. State the name of the reagent used to test the presence of water and the expected observation for a positive test. (2 marks)
- (b) Pure oxygen for industrial use can be obtained from atmospheric air. State the percentage composition of oxygen gas by volume in air. (1 mark)
- 5) In the upper atmosphere, there is a layer of zone surrounding the earth.
- (a) Explain the importance of this layer in terms of human health. (2 marks)
- (b) State the type of chemical substances that destroy the ozone layer. (1 mark)
- 6) Calcium is a metal of group IIa of the periodic table.
- (a) Using Bohr model of the representation of electrons on shells, draw the structure of calcium atom. (2 marks)
- (b) Write a balanced equation of the reaction that takes place when calcium reacts with oxygen (O<sub>2</sub>). (2 marks)
- (Atomic number of Ca = 20).
- 7) Sodium atom loses 1 electron and sulphur accepts 2 electrons to form ions.
- (a) Deduce the chemical formula of the compound formed between sodium and sulphur. (2 marks)
- (b) State one physical and one chemical property of the compound formed when sodium reacts with sulphur. (Atomic number: Na = 11, S = 16) (2 marks)
- 8) When calcium reacts with water, hydrogen gas is evolved and an alkaline solution is formed.
- a) State two observable changes that take place when calcium reacts with water. (2 marks)
- b) Write the equation of reaction between calcium and water; include state symbols. (2 marks)
- 9) Magnesium is an alkaline earth metal; copper is a transition element. State one difference between these two metals in terms of:
- a) Melting point. (1 mark)
- b) Density. (1 mark)
- c) Color. (1 mark)

- 10) In an experiment, SO<sub>2</sub> gas was dissolved in a test tube of cold water; blue and red litmus papers were put in the resultant mixture.
- a) Indicate the litmus paper that changed color. (1 mark)
- b) Write down the chemical equation for the reaction which took place between SO<sub>2</sub> and H<sub>2</sub>O. (2 marks)
- 11) State the reagent that you would use to differentiate between each of the pair of compounds and give the observable change for a positive test:
- a) Sulphur dioxide, SO<sub>2</sub> and hydrogen sulphide H<sub>2</sub>S. (2 marks)
- b) Copper II nitrate Cu(NO<sub>3</sub>)<sub>2</sub> and iron II nitrate Fe(NO<sub>3</sub>)<sub>2</sub>
- 12) Alkanes are members of a homologous series of saturated hydrocarbons with the general formula C<sub>n</sub>H<sub>2n+2</sub>.
- a) Write the chemical equation of reaction for the combustion of an alkane with 4 carbon atoms. (2 marks)
- b) State 2 uses of hydrocarbon compounds. (2 marks)
- 13) Silicon dioxide has a similar structure to that of diamond. Suggest the reason why silicon dioxide:
- a) does not conduct electricity. (2 marks)
- b) is solid at 25°C. (2 marks)
- 14) A student added 3.0g of magnesium to an excess sulphuric acid solution of 0.5 mol dm<sup>-3</sup> by concentration to react in a container.
- a) Calculate the number of moles contained in 3.0g of magnesium. (2 marks)
- b) Calculate the maximum volume of sulphuric acid that reacted with all the 3.0g of magnesium. (2 marks)
- (Atomic mass, Mg = 24).  
Equation of reaction: Mg<sub>(s)</sub> + H<sub>2</sub>SO<sub>4(aq)</sub> → MgSO<sub>4(aq)</sub> + H<sub>2(g)</sub>
- 15) (a) Write the chemical formula of 1 weak base. (1 mark)
- (b) Describe the difference between a strong acid and a weak acid. (2 marks)

**SECTION B: ATTEMPT ANY THREE QUESTIONS ONLY. (30 MARKS)**

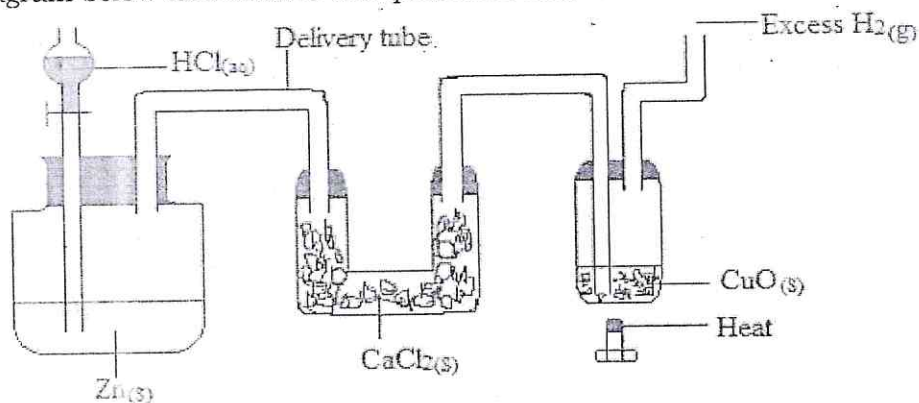
- 16) A mixture of Zinc and Zinc oxide were reacted with excess sulphuric acid. 400 cm<sup>3</sup> of hydrogen gas were produced (measured at room temperature and pressure). If the mixture had a mass of 2g and only Zinc reacted with the acid to produce H<sub>2</sub> gas, determine:
- a) The number of moles of H<sub>2</sub> gas produced. (2 marks)
- b) The number of moles of Zn that reacted with the acid. (2 marks)
- c) The mass of zinc in the mixture. (2 marks)
- d) The mass of zinc oxide in the mixture. (2 marks)
- e) The percentage composition of Zinc oxide by mass in the mixture. (2 marks)

Equation:

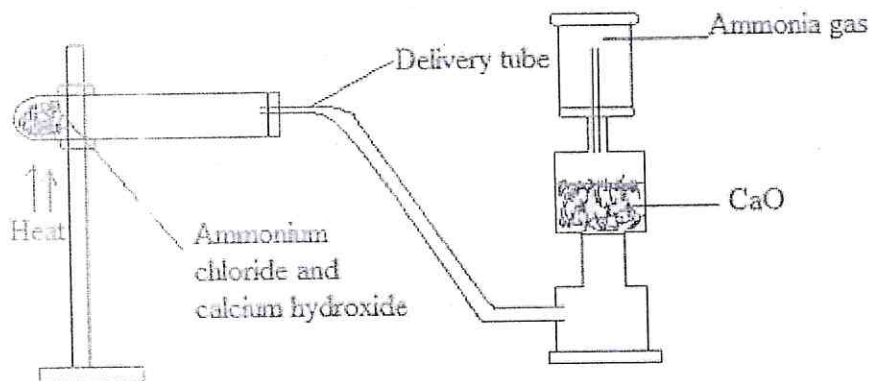


(Atomic mass: Zn = 65, O = 16; 1 mole of gas occupies 24000 cm<sup>3</sup> at room temperature and pressure)

- 17) Copper II oxide, CuO can be reduced by hydrogen gas H<sub>2</sub>. Study the set up diagram below and answer the questions that follow:



- Write the equation of the reaction that takes place when copper II oxide reacts with hydrogen gas. **(2 marks)**
  - State the observable color change when copper II oxide has completely been reduced by hydrogen. **(2 marks)**
  - State the role of CaCl<sub>2</sub> in the tube. **(1 mark)**
  - Zn reacts with dilute HCl to produce H<sub>2</sub>,
    - Indicate 1 physical property of H<sub>2</sub> gas. **(1 mark)**
    - Mention 1 test for H<sub>2</sub> gas and give the observation of the test. **(2 marks)**
  - Copper II oxide can be reduced by carbon on heating. Write the equation of reaction between CuO and C. **(2 marks)**
- 18) The set-up apparatus below is for the preparation of ammonia gas in the laboratory.



Equation for the reaction:



- State the role of calcium oxide (CaO) in the apparatus. **(1 mark)**
  - State the type of method used for the collection of the gas NH<sub>3</sub> in the setup. **(1 mark)**
  - Write a balanced equation of reaction between NH<sub>3</sub> and H<sub>2</sub>SO<sub>4</sub>. **(2 marks)**
  - State two uses of ammonia on a large scale. **(2 marks)**
- Nitric acid is used to prepare fertilizers.
  - Write a balanced equation of the reaction between HNO<sub>3</sub> and Ca(OH)<sub>2</sub>. **(2 marks)**
  - State 1 danger of using chemical fertilizers. **(1 mark)**
- Nitrogen gas from the atmosphere is absorbed by plants via root nodules to

form nitrate fertilizers. State the percentage composition of nitrogen gas in the atmosphere. (1 mark)

- 19) The table below shows some symbols of elements of the periodic table: Study the table and answer the questions that follow:

Element symbol	Group of element	Period of element	Atomic number
Li	I	2	3
O	VI	2	8
Ca	II	4	20
Cl	VII	3	17
Al	III	3	13
N	V	2	7

- a) Write the electronic configuration of the oxygen atom (O). (1 mark)
- b) Write a chemical equation that represents the ionization (ion formation) of Li. (2 marks)
- c) Deduce the formula of the compound formed by the reaction of Al and Cl. (2 marks)
- d) State 2 physical properties of a compound formed between N and O. (2 marks)
- e) Indicate 1 important use of compounds formed between N and O. (2 marks)
- f) Give 2 reasons to suggest why Al is the best of the above elements at being used as electric cables. (2 marks)
- 20) (a) Draw a well labeled diagram for the preparation of chlorine gas in the laboratory. (3 marks)
- (b) A red litmus paper is placed in chlorine gas for 5 minutes, state 2 observable changes on the red litmus paper during the exposure in chlorine gas. (2 marks)
- (c) Chlorine gas dissolves in cold water.
- i) Write a chemical equation of the reaction that takes place between  $\text{Cl}_2$  and  $\text{H}_2\text{O}$ . (2 marks)
- ii) State 1 use of chlorine. (1 mark)

**SECTION C: ATTEMPT ONLY ONE QUESTION. (15 MARKS)**

- 21) Graphite and diamond are allotropes of carbon with different physical properties.

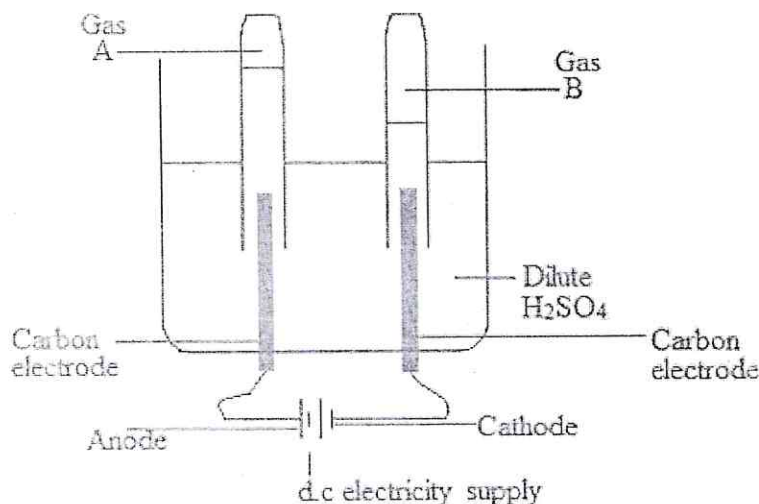
- a) Write 1 physical property of:
- i) Graphite. (1 mark)
- ii) Diamond. (1 mark)
- b) Write a chemical equation of the reaction between carbon (C) and iron oxide ( $\text{Fe}_2\text{O}_3$ ) (2 marks)
- c) State 1 use of:
- i) Graphite
- ii) Diamond
- d) Carbon reacts with oxygen during combustion according to the equation:



In insufficient oxygen, the reaction shown below takes place:



- i) Mention 2 important uses of CO<sub>2</sub> in nature. (2 marks)
- ii) State 1 important use and 1 danger of CO gas. (2 marks)
- e) Carbon dioxide (CO<sub>2</sub>) causes global warming. Describe 2 means of reducing CO<sub>2</sub> from the atmosphere. (2 marks)
- f) Marble rock that is formed of carbohydrates can be degraded by acid rain.
- i) Write the equation of reaction between calcium carbonate, CaCO<sub>3</sub>, and hydrochloric acid, HCl. (2marks)
- ii) Temporary hard water contains hydrogen carbonates, HCO<sub>3</sub><sup>-</sup>. Indicate 1 means that is used to soften (eliminate) HCO<sub>3</sub><sup>-</sup> from hard water. (1 mark)
- 22) (a) Describe the term “**electrolyte**” substance. (2 marks)
- (b) Write the chemical formula of 1 electrolyte substance. (1 mark)
- (c) Study the diagram below and answer the questions that follow:



- i) Write the chemical equation of the reaction that takes place at the “**anode**” and at the “**cathode**”. (4 marks)
- ii) Describe a simple test for gas B and the observation for this test. (2 marks)
- d) When **carbon** electrodes are replaced with copper electrodes using **copper** sulphate solution (CuSO<sub>4</sub>) instead of H<sub>2</sub>SO<sub>4</sub>; the following reactions take place:
- $$\text{Anode: Cu}_{(s)} \longrightarrow \text{Cu}_{(aq)}^{2+} + 2e$$
- $$\text{Cathode: Cu}_{(aq)}^{2+} + 2e \longrightarrow \text{Cu}_{(s)}$$
- i) Indicate 1 observable change in the mixture when the reaction is almost complete. (1 mark)
- ii) State 2 important applications of electrolysis on a large scale. (2 marks)
- e) Zinc metal is put in a solution of copper sulphate. The following reaction takes place:
- $$\text{Zn}_{(s)} + \text{CuSO}_{4(aq)} \longrightarrow \text{Cu}_{(s)} + \text{ZnSO}_{4(aq)}$$
- i) If Zn and Cu metals are connected in an electrochemical cell; which of the two metals can act as the “**anode**”? (1 mark)
- ii) Indicate a reagent substance that can be used to distinguish ZnSO<sub>4(aq)</sub> solution and CuSO<sub>4</sub> solution and the observable change when the reagent reacts in each case. (2 marks)

**END**