

Chemistry I

002

14 Nov. 2016 08.30am - 11.30am



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 written 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. **(55marks)**
 - **Section B:** Attempt any **THREE** questions. **(30marks)**
 - **Section C:** Attempt **ONLY ONE** question. **(15marks)**
- 4) You do not need the Periodic Table.
- 5) Silent non-programmable calculator 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. **(2marks)**
- (b) Mention 2 means that are used to prevent rusting of objects which are made of iron (Fe) metal. **(2marks)**
- 2) Water is used for various domestic purposes. **(2marks)**
- (a) State 2 natural sources of water. **(2marks)**
- (b) Briefly describe one method used to treat unclean drinking water to be ready for cooking food. **(2marks)**
- 3) A student uses 100 cm³ of a 0.5 mol dm⁻³ sodium hydroxide solution to react with excess sulphuric acid.
- (a) Calculate the number of moles of NaOH contained in 100 cm³ of solution. **(2marks)**
- (b) Calculate the mass of sodium sulphate crystals that are formed after evaporation of the resultant solution. **(2marks)**
- 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. **(2marks)**
- (b) Pure oxygen for industrial use can be obtained from atmospheric air.
State the percentage composition of oxygen gas by volume in air. **(1mark)**
- 5) In the upper atmosphere, there is a layer of ozone surrounding the earth. **(2marks)**
- (a) Explain the importance of this layer in terms of human health. **(2marks)**
- (b) State the type of chemical substances that destroy the ozone layer. **(1mark)**
- 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. **(2marks)**
- (b) Write a balanced equation of the reaction that takes place when calcium reacts with oxygen (O₂).
(Atomic number of Ca=20). **(2marks)**

- 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. **(2marks)**
- (b) State one physical and one chemical property of the compound formed when sodium reacts with sulphur. **(2marks)**
(Atomic number: Na=11, S=16)
- 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. **(2marks)**
- (b) Write the equation of reaction between calcium and water; include state symbols. **(2marks)**
- 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. **(1mark)**
(b) density. **(1mark)**
(c) colour. **(1mark)**
- 10) In an experiment, SO₂ 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 colour. **(1mark)**
- (b) Write down the chemical equation for the reaction which took place between SO₂ and H₂O. **(2marks)**
- 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, SO₂ and hydrogen sulphide H₂S. **(2marks)**
- (b) Copper II nitrate Cu(NO₃)₂ and Iron II nitrate Fe(NO₃)₂. **(2marks)**
- 12) Alkanes are members of a homologous series of saturated hydrocarbons with the general formula C_nH_{2n+2}.
- (a) Write the chemical equation of reaction for the combustion of an alkane with 4 carbon atoms. **(2marks)**
- (b) State 2 uses of hydrocarbon compounds. **(2marks)**
- 13) Silicon dioxide has a similar structure to that of diamond. Suggest the reason why silicon dioxide:
- (a) does not conduct electricity. **(2marks)**
- (b) is solid at 25°C. **(2marks)**

14) A student added 3.0 g of magnesium to an excess sulphuric acid solution of 0.5 mol dm^{-3} by concentration to react in a container.

(a) Calculate the number of moles contained in 3.0 g of magnesium. **(2marks)**

(b) Calculate the maximum volume of sulphuric acid that reacted with all the 3.0 g of magnesium. **(2marks)**

(Atomic mass, Mg = 24).

Equation of reaction:



15) (a) Write the chemical formula of 1 weak base. **(1mark)**

(b) Describe the difference between a strong acid and a weak acid. **(2marks)**

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^3 of hydrogen gas were produced (measured at room temperature and pressure). If the mixture had a mass of 2 g and only Zinc reacted with the acid to produce H_2 gas, determine:

(a) the number of moles of H_2 gas produced. *$n = \frac{V}{V_m}$ $n = \frac{M}{M_r}$* **(2marks)**

(b) the number of moles of Zn that reacted with the acid. **(2marks)**

(c) the mass of zinc in the mixture. **(2marks)**

(d) the mass of zinc oxide in the mixture. **(2marks)**

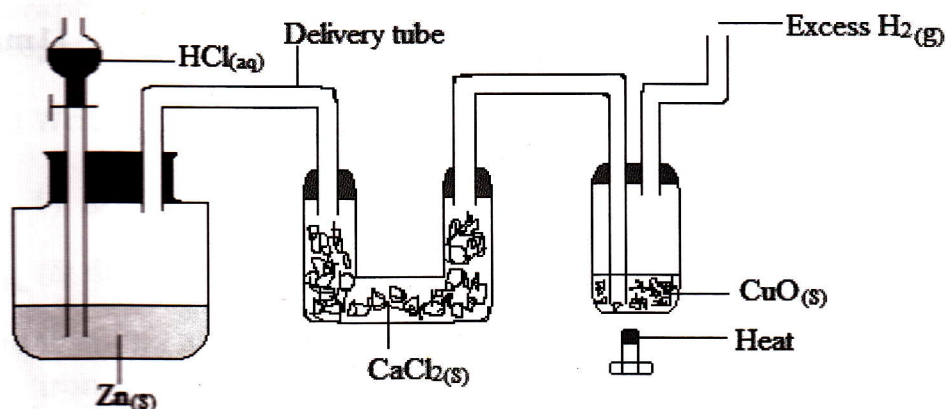
(e) the percentage composition of Zinc oxide by mass in the mixture. **(2marks)**

Equation:



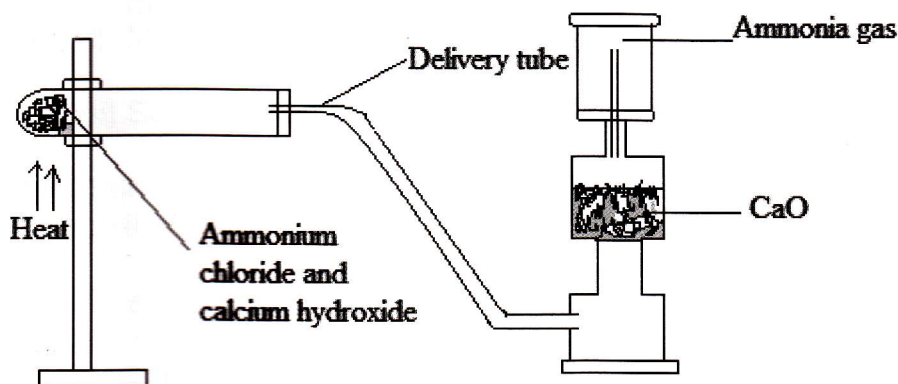
(Atomic mass: Zn = 65, O=16; 1 mole of a gas occupies 24000 cm^3 at room temperature and pressure)

17) Copper II oxide, CuO can be reduced by hydrogen gas H₂. 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. **(2marks)**
- State the observable colour change when copper II oxide has completely been reduced by hydrogen. **(2marks)**
- State the role of CaCl₂ in the tube. **(1mark)**
- Zn reacts with dilute HCl to produce H₂ ,
 - Indicate 1 physical property of H₂ gas. **(1mark)**
 - Mention 1 test for H₂ gas and give the observation of the test. **(2marks)**
- Copper II oxide can also be reduced by carbon on heating. Write the equation of reaction between CuO and C. **(2marks)**

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. **(1mark)**
 - State the type of method used for the collection of the gas NH₃ in the set up. **(1mark)**
 - Write a balanced equation of reaction between NH₃ and H₂SO₄. **(2marks)**
 - State 2 uses of ammonia on a large scale. **(2marks)**
- Nitric acid is used to prepare fertilizers.
 - Write a balanced equation of the reaction between HNO₃ and Ca(OH)₂. **(2marks)**
 - State 1 danger of using chemical fertilizers. **(1mark)**

- (c) 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. **(1mark)**

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). **(1mark)**
- (b) Write a chemical equation that represents the ionization (ion formation) of Li. **(2marks)**
- (c) Deduce the formula of the compound formed by reaction of Al and Cl. **(2marks)**
- (d) State 2 physical properties of a compound formed between N and O. **(2marks)**
- (e) Indicate 1 important use of compounds of N element. **(1mark)**
- (f) Give 2 reasons to suggest why Al is the best of the above elements at being used as electric cables. **(2marks)**
- 20) (a) Draw a well labeled diagram for the preparation of chlorine gas in the laboratory. **(3marks)**
- (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. **(2marks)**
- (c) Chlorine gas dissolves in cold water.
- (i) Write a chemical equation of the reaction that takes place between Cl_2 and H_2O . **(2marks)**
- (ii) Describe the observation seen when AgNO_3 solution is added to the solution of Cl_2 . **(2marks)**
- (d) State 1 use of chlorine. **(1mark)**

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. (1mark)

(ii) diamond. (1mark)

(b) Write a chemical equation of the reaction between carbon (C) and iron oxide (Fe_2O_3). (2marks)

(c) State 1 use of:

(i) graphite. *tetrahedral* (1mark)

(ii) diamond. *hexagonal* (1mark)

(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_2 in nature. (2marks)

(ii) State 1 important use and 1 danger of CO gas. (2marks)

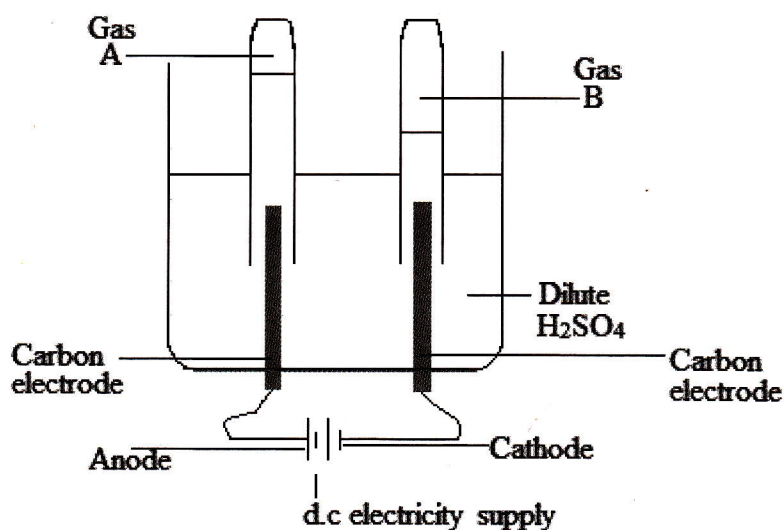
(e) Carbon dioxide (CO_2) causes global warming. Describe 2 means of reducing CO_2 from the atmosphere. (2marks)

(f) Marble rock that is formed of carbonates can be degraded by acid rain.

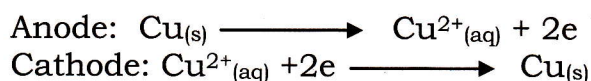
(i) Write the equation of the reaction between calcium carbonate, CaCO_3 , and hydrochloric acid, HCl. (2marks)

(ii) Temporary hard water contains hydrogen carbonates, HCO_3^- . Indicate 1 means that is used to soften (eliminate) HCO_3^- from hard water. *Heating* (1mark)

- 22) (a) Describe the term "**electrolyte**" substance. (2marks)
 (b) Write the chemical formula of 1 electrolyte substance. (1mark)
- (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**". (4marks)
- (ii) Describe a simple test for gas B and the observation for this test. (2marks)
- (d) When **carbon** electrodes are replaced with **copper** electrodes using copper sulphate solution (CuSO_4) instead of H_2SO_4 ; the following reactions take place:



- (i) Indicate 1 observable change in the mixture when the reaction is almost complete. (1mark)
- (ii) State 2 important applications of electrolysis on a large scale. (2marks)
- (d) 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 "**anode**"? (1mark)
- (ii) Indicate a reagent substance that can be used to distinguish ZnSO_4 solution and CuSO_4 solution and the observable change when the reagent reacts in each case. (2marks)