

Chemistry I

002

04/11/ 2014

8.30AM– 11.30AM



ORDINARY LEVEL NATIONAL EXAMINATIONS, 2014

SUBJECT: CHEMISTRY I

DURATION: 3 HOURS

INSTRUCTIONS:

- 1) Do not open this question paper until you are told to do so.
- 2) 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)
- 3) You do not need the Periodic Table.
- 4) Silent non-programmable calculators may be used.

SECTION A: ATTEMPT ALL QUESTIONS. (55 marks)

1. One of the types of bonding is “metallic”.
 - a) Draw a labeled diagram to illustrate “metallic bonding”. (2 marks)
 - b) By using ideas about the structure of metals, state 2 physical properties of metals. (2 marks)
2. Give a brief description of the following terms :
 - a) Melting point b) Fluid. (4 marks)
3. The equation for the reaction between aqueous lead II nitrate and aqueous potassium iodide is shown below :
$$\text{Pb}(\text{NO}_3)_2 (\text{aq}) + 2\text{KI} (\text{aq}) \longrightarrow \text{PbI}_{2(\text{s})} + 2\text{KNO}_3 (\text{aq})$$

Lead II iodide is a yellow precipitate.

Briefly describe a method that could be used to separate the precipitate from the mixture. (2 marks)
4. Bromine is an element of group VII. It has two naturally occurring isotopes.
 - a) Describe the term “isotopes”. (2 marks)
 - b) One isotope of bromine has the symbol below:
$$\begin{array}{c} 81 \\ \text{Br} \\ 35 \end{array}$$

State the number of protons and neutrons in this isotope of bromine. (2 marks)
5. When sodium (Na) reacts with cold water (H_2O), hydrogen gas H_2 is given off and an alkaline solution is formed.
 - a) Mention one observation that can be made when sodium reacts with cold water. (1 mark)
 - b) Write a balanced equation for the reaction of sodium with water. (2 marks)
 - c) State the colour of phenolphthalein indicator in the alkaline solution mentioned above. (1 mark)
6. Nitrogen gas makes up 78% of atmospheric air.
 - a) State one importance of nitrogen gas in air. (1 mark)
 - b) Most substances burn in air by reaction with oxygen and not with nitrogen. Give a brief explanation of these occurrences. (2 marks)

7. When 8g of a metal oxide were reduced using hydrogen gas; 6.4g of metal M were obtained.
- a) Given that the relative atomic mass of the metal is 64, and that of oxygen is 16, determine the empirical formula of the metal oxide. **(3 marks)**
- b) Write an equation for the reaction which occurred between the metal oxide and hydrogen gas. **(2 marks)**
8. Limestone consists mainly of calcium carbonate compound.
- a) Write the names or chemical formula of the compounds obtained when calcium carbonate decomposes on heating. **(2 marks)**
- b) Write a balanced equation of reaction between sodium oxide (Na_2O) and water (H_2O). **(2 marks)**
9. Draw the conventional representation according to Bohr (show circumferences which represent the shells with electrons on them) of the following elements: **(2 marks)**
- a) Sodium.
- b) Oxygen. (Atomic number: Na=11, O=8).
10. a) Solid sulphur in crystalline state consists of rings of Sulphur molecules of formula S_8 .
- State names of 2 allotropes of sulphur that exist in crystalline form. **(2 marks)**
- b) Sulphur is a non-metal; indicate 2 properties of non-metals. **(2 marks)**
11. a) Write the chemical equation that represents the reaction between iron sulphide (FeS) and dilute hydrochloric acid (HCl). **(2 marks)**
- b) Write a chemical equation or give names of 2 substances that can react in a displacement reaction. **(1 mark)**
12. Write chemical symbols of ions or formulae of radicals which migrate to each of the following electrodes during the electrolysis of dilute sulphuric acid (H_2SO_4).
- a) Anode. **(2 marks)**
- b) Cathode. **(1 mark)**
13. Ammonia is manufactured by the Haber-Bosch process.
- a) Write a balanced equation of reaction for the formation of ammonia from nitrogen and hydrogen gases in the Haber-Bosch process. **(2 marks)**

- b) State the name of the catalyst used to speed up the reaction between nitrogen and hydrogen gases in this process. **(1 mark)**
14. a) A salt solution contains 12g of NaCl per 100 cm³ of solution. Calculate the molarity (molar concentration) of the solution. **(3 marks)**
(Atomic mass: Na = 23, Cl = 35.5)
- b) Calculate the number of moles of HCl in 20 cm³ of a 2M HCl (2 moles per litre) solution. **(3 marks)**
15. Calculate the volume of nitrogen dioxide gas (NO₂) produced when 42g of copper nitrate completely decomposes at room temperature and pressure. **(4 marks)**
- $$2 \text{ Cu(NO}_3)_2(\text{s}) \longrightarrow 2 \text{ CuO}(\text{s}) + 4 \text{ NO}_{2(\text{g})} + \text{O}_{2(\text{g})}$$
- (1 mole of a gas occupies 24 dm³ at room temperature and pressure;
Atomic mass: Cu = 63.5, N = 14, O = 16).

SECTION B: ATTEMPT ANY THREE QUESTIONS. (30 marks)

16. A student pours (titrates) 30ml of a 0.1M aqueous sodium hydroxide from a burette into a beaker containing 25cm³ of a 0.1M sulphuric acid solution. The student measures the pH of the mixture in the beaker using a pH meter during the addition of sodium hydroxide.
- a) Describe how pH values change in the mixture of the beaker during addition of the base. **(2 marks)**
- b) Establish an ionic equation to represent the neutralisation reaction between sodium hydroxide (NaOH) and sulphuric acid H₂SO₄. **(2 marks)**
- c) Sulphuric acid is a strong acid.
- (i) What is meant by the term "acid"? **(2 marks)**
- (ii) Explain the difference between a "strong" acid and a "weak" acid. **(2 marks)**
- d) Dilute sulphuric acid reacts with magnesium (Mg) to give off hydrogen gas.
- Write an equation for the reaction between Mg and H₂SO₄. **(2 marks)**
17. a) Draw a labeled diagram for the preparation of ammonia gas in the laboratory. **(4 marks)**

- b) Write a balanced equation of reaction between ammonium chloride and calcium hydroxide. **(2 marks)**
- c) By giving an appropriate equation of reaction, explain how temporary hardness of water is treated to get soft water. **(2 marks)**
- d) Briefly explain how permanent hard water containing MgSO_4 is treated to get soft water. **(2 marks)**

18.a) Methane is a member of the homologous series of hydrocarbons called alkanes. Describe the meaning of the term :

- (i) Homologous series. **(2 marks)**
- (ii) Alkane. **(2 marks)**

b) Write a balanced equation of reaction that takes place when butane burns in oxygen gas. **(2 marks)**

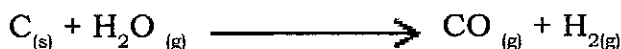
c) Ethene reacts with hydrogen chloride.

- (i) Write the equation of reaction that takes place between ethene and hydrogen chloride. **(2 marks)**
- (ii) State the type of reaction taking place in c) (i) above and draw the structural formula of the organic product obtained. **(2 marks)**

19.a) A compound constituted of carbon, hydrogen and oxygen contains 40% carbon, 6.67% hydrogen and 53.33% oxygen by mass. The molar mass of the compound is 60 g mol^{-1} .

Determine:

- (i) The empirical formula of the compound. **(2 marks)**
- (ii) The molecular formula of the compound. **(2 marks)**
- c) When very hot carbon reacts with steam and they form carbon monoxide and hydrogen gas according to the equation below:



- (i) Calculate the mass of steam required to react completely with 40g of carbon. **(2 marks)**
- (ii) What volume of carbon monoxide, measured at room temperature and pressure will be produced? **(2 marks)**

(Atomic mass: $\text{C}=12$, $\text{H}=1$, $\text{O}=16$; 1 mole of a gas occupies 24 dm^3 at

room temperature and pressure.)

- d) Hydrogen gas is used as a fuel; write an equation of reaction between hydrogen gas and oxygen.

(2 marks)

20. a) Samples of iron were placed in aqueous solutions having different pH values. The table below shows how the speed of corrosion of iron varies with the pH of the solution.

Speed of corrosion/ cm per year	0.043	0.029	0.012	0.010	0.010	0.010	0.009	0.006
pH	2	3	4	5	6	8	10	12

Describe how pH affects the speed of corrosion of iron.

(2 marks)

- b) Mention a material that can be coated on iron metal or mixed with it so that you avoid it being degraded by corrosion.

(1 mark)

- c) Two gases are unlabeled. It is known that one is chlorine and the other is hydrogen chloride.

Mention a reagent that can be used to test one gas so as to distinguish it from another. State the observable change for each gas.

(i) Chlorine gas.

(2 marks)

(ii) Hydrogen chloride gas.

(2 marks)

- e) (i) Write an equation of the reaction observed when chlorine gas (Cl_2) is passed in a solution of potassium iodide (KI).

(2 marks)

(ii) State the type of reaction that has taken place when chlorine gas (Cl_2) is passed in a solution of potassium iodide (KI).

(1 mark)

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

21. a) 25 cm³ of a 0.12 M sodium hydroxide solution was neutralized by 30 cm³ of a solution of a dibasic acid H₂X, containing 6.3 g of acid per litre.

Calculate :

- (i) The number of moles of NaOH that was used in the reaction. **(2 marks)**
- (ii) The molarity of the acid. **(2 marks)**
- (iii) The relative molecular mass of the acid. **(2 marks)**

Equation :

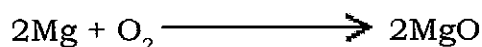


- b) Mention 2 uses of Sulphur. **(2 marks)**
- c) Write an equation of reaction between chlorine gas and phosphorous. **(2 marks)**
- d) Briefly explain the reason why a mixture of chlorine and hydrogen gas explodes once it is exposed to bright light. **(1 mark)**
- e) Chlorine is a powerful bleaching agent in the presence of water. Briefly, describe how chlorine bleaches materials. **(2 marks)**
- f) Chlorine gas (Cl₂) was passed over heated iron powder (Fe) in a combustion tube. Write down the observable changes and the equation of reaction that took place. **(2 marks)**

22. a) Petroleum is a complex mixture of hydrocarbons and is also a source of many useful fuels.

- (i) Describe the meaning of the term “functional group” and give two examples of substances with different functional groups. **(3 marks)**
- (ii) Name 3 fractions (products) obtained from petroleum. **(3 marks)**
- (iii) Write the structural formula of an unsaturated hydrocarbon that contains 4 carbon atoms. **(1 mark)**

- (b) Magnesium reacts with oxygen in air to form magnesium oxide.



If the yield (MgO produced) of the reaction is 100%, calculate the mass of magnesium oxide formed when 6 g of magnesium burns in excess oxygen. **(3 marks)**

(Atomic mass: Mg=24, O=16)

c) Using pentane as an example,

(i) Write the molecular formula and structural formula of pentane. **(2 marks)**

(ii) Mention two uses of pentane on a large scale. **(2 marks)**

d) Write the name of a hydrocarbon derivative that can cause environmental hazard in the atmospheric ozone layer. **(1 mark)**