

**THE UNITED REPUBLIC OF TANZANIA  
NATIONAL EXAMINATIONS COUNCIL  
CERTIFICATE OF SECONDARY EDUCATION EXAMINATION**

**032/1**

**CHEMISTRY 1  
(For both School and Private Candidates)**

**TIME: 3 Hours**

**Tuesday November 04, 2003 p.m.**

**Instructions**

1. This paper consists of sections A, B and C.
2. Answer ALL questions in sections A and B, and TWO (2) questions from section C.
3. Cellular phones are **not** allowed in the examination room.
4. Electronic calculators are **not** allowed in the examination room.
5. Write your Examination Number on every page of your answer booklet(s).
6. The following constants and atomic masses may be used:

H = 1, C = 12, O = 16, Cu = 64, Ca = 40

N = 14, Na = 23, Cl = 35.5, Fe = 56, S = 32.

Avogadro's Number =  $6.02 \times 10^{23}$

GMV at STP =  $22.4 \text{ dm}^3$

1 Faraday = 96500 coulombs.

This paper consists of 8 printed pages

# SECTION A (20 marks)

Answer ALL questions in this section.

1. For each of the items (i) – (x) choose the correct answer from among the given alternatives and write its letter beside the item number.

(i) The molarity of 5.3 g of  $\text{Na}_2\text{CO}_3$  in 100 ml of solution is

- A 0.20 M    B 0.50 M    C 0.05 M    D 0.005 M    E 0.01 M.

(ii) Two faradays (2 F) were required to deposit one mole of a metallic element M from an aqueous solution of its salt. If element M has no variable valency, the empirical formula of its phosphate is

- A  $\text{M}(\text{PO}_4)_3$     B  $\text{MPO}_4$     C  $\text{M}_3(\text{PO}_4)_2$   
D  $\text{M}_2(\text{PO}_4)_3$     E  $\text{M}_3(\text{PO}_4)$ .

(iii) Nitrogen, which constitutes about 79% by volume of the gases in the atmosphere, is a gas which is inert at

- A ordinary conditions, colourless, and has no any positive test  
B all conditions, colourless and has no positive test  
C all conditions, colourless and burns with a blue flame  
D ordinary conditions, colourless and burns with a blue flame  
E all conditions, colourless and burns with a pale yellow flame.

(iv) The problem of acid rains is now a reality in industrialized countries. The gases which escape from industries into the atmosphere and cause acid rains include

- A nitrogen, carbon dioxide and chlorine  
B chlorine, nitrogen monoxide and ammonia  
C chlorine, carbon dioxide and sulphur dioxide  
D nitrogen dioxide, carbon dioxide and sulphur dioxide  
E chlorine, nitrogen and nitrogen monoxide.

(v) Dilute acids combine with metals to produce hydrogen except

- A  $\text{CH}_3\text{COOH}$     B  $\text{HCl}$     C  $\text{H}_2\text{SO}_4$     D  $\text{H}_2\text{CO}_3$     E  $\text{HNO}_3$ .

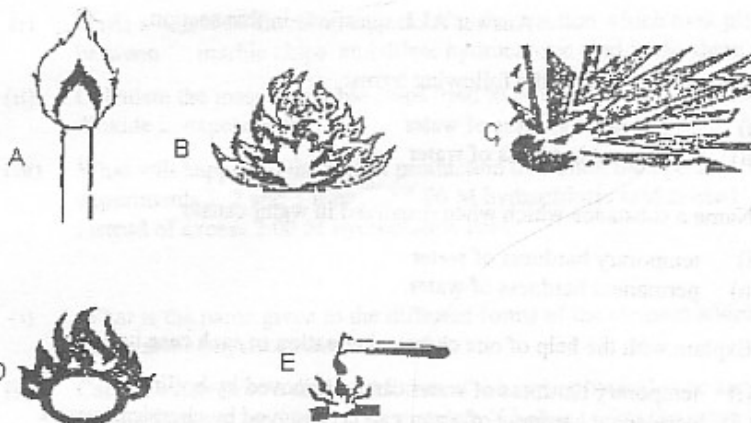
(vi) Which of the following substances increase the biological oxygen demand (BOD) of river water?

- A Heavy metals    B Radioactive wastes    C Industrial effluents  
D Nitrogenous fertilizers.    E Polymers.

(vii) An iron spoon can be electroplated with copper if the spoon is

- A the anode, platinum the cathode and copper (II) sulphate solution the electrolyte  
B the anode, copper the cathode and copper (II) sulphate solution the electrolyte  
C the cathode, copper the anode and copper (II) sulphate solution the electrolyte  
D the anode, carbon the cathode and copper (II) sulphate the electrolyte  
E the anode, Iron the cathode and copper (II) sulphate solution the electrolyte.

(viii) Which of the following warning signs stand for flammable chemicals?



(ix) The IUPAC name of  $\text{H}_2\text{SO}_4$  is

- A sulphuric (IV) acid      B sulphuric acid      C sulphuric (V) acid  
D sulphurous acid.      E sulphuric (VI) acid.

(x) The correct chemical equation for the combustion of ethanol is

- A  $\text{CH}_3\text{CH}_2\text{OH} + \frac{1}{2}\text{O}_2 \rightarrow \text{CH}_3\text{CHO} + \text{H}_2\text{O}$   
B  $\text{CH}_3\text{CH}_2\text{OH} + 3\text{O}_2 \rightarrow 2\text{CO}_2 + 3\text{H}_2\text{O}$   
C  $\text{CH}_3\text{CH}_2\text{OH} + \text{O}_2 \rightarrow \text{CH}_3\text{COOH} + \text{H}_2\text{O}$   
D  $\text{CH}_3\text{CH}_2\text{OH} + 2\text{O}_2 \rightarrow 2\text{CO} + 3\text{H}_2\text{O}$   
E  $\text{CH}_3\text{CH}_2\text{OH} + 2\text{O}_2 \rightarrow \text{HCHO} + \text{CO}_2 + \text{H}_2\text{O} + \text{H}_2$

2. Match the items in List A with the responses in list B by writing the letter of the corresponding response beside the item number.

#### List A

- (i) Solvent extraction  
(ii) Alcohol-organic acid reaction  
(iii) Producer gas  
(iv) Exothermic reaction  
(v) Deliquescent substances  
(vi) Descicator  
(vii) Graphite  
(viii) Biodegradable material  
(ix)  $\text{KMnO}_4$   
(x) Dry - ice.

#### List B

- A. Keeps substances constantly dry  
B. Substances which decay easily  
C. A non-metal which conducts electricity  
D. Substances which do not decay easily e.g. plastic bags  
E. Used to obtain oil from groundnuts  
F. Esterification  
G. Favoured by high temperature  
H. Favoured by low temperature  
I. Used to distinguish saturated from unsaturated hydrocarbons  
J.  $\text{NaOH}$ ,  $\text{KOH}$   
K. One use of carbondioxide gas  
L. Method used to separate two solvents  
M. Neutralization reaction  
N. Mixture of carbonmonoxide and hydrogen gas  
O. Mixture of carbonmonoxide and nitrogen gas  
P. Evaporated liquid carbondioxide  
Q. Carbon isotope which is the hardest element known  
R.  $\text{Ca}(\text{NO}_3)_2$   
S. Hydrogenation  
T. Nitrogen fixation process.

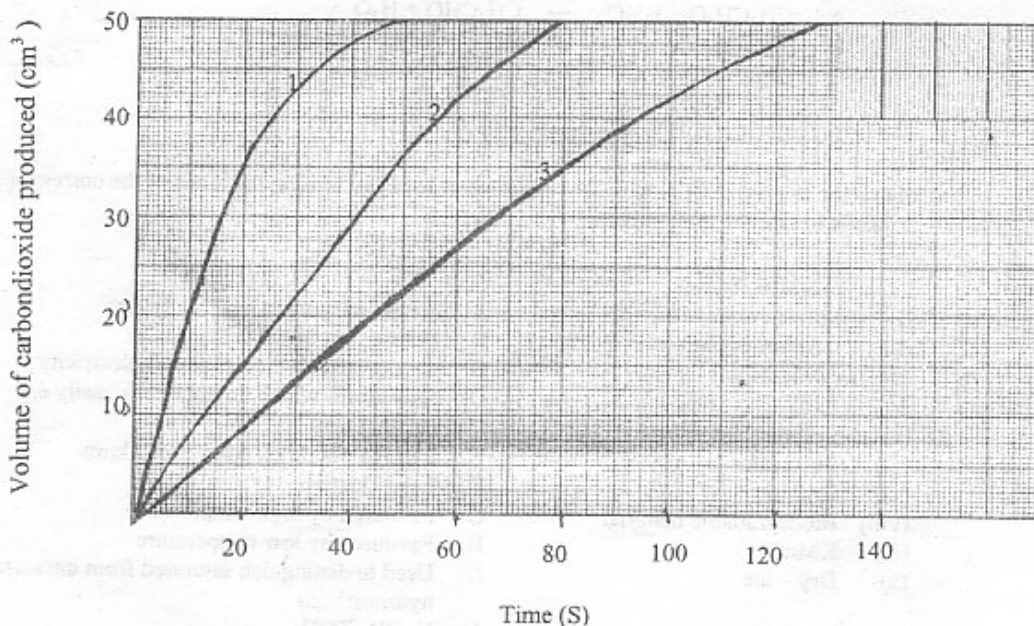


### SECTION B (60 marks)

Answer ALL questions in this section.

3. (a) Give the meaning of the following terms:
- (i) Temporary hardness of water
  - (ii) Permanent hardness of water
- (2 marks)
- (b) Name a substance which when dissolved in water causes
- (i) temporary hardness of water
  - (ii) permanent hardness of water.
- (2 marks)
- (c) Explain with the help of one chemical equation in each case how
- (i) temporary hardness of water can be removed by boiling
  - (ii) permanent hardness of water can be removed by chemical means.
- (6 marks)
4. A pupil has carried out three experiments at 20 °C to study the rate of reaction between marble chips and hydrochloric acid by observing the rate of evolution of carbon dioxide. In each case marble chips of equal masses but different sizes were used with excess 2.00 M hydrochloric acid. Finally the pupil presented the results of the experiment graphically as shown below:

The influence of surface area on the rate of chemical reaction of HCl and  $\text{CaCO}_3$



Curves 1, 2 and 3 represent experiments 1, 2 and 3 respectively.

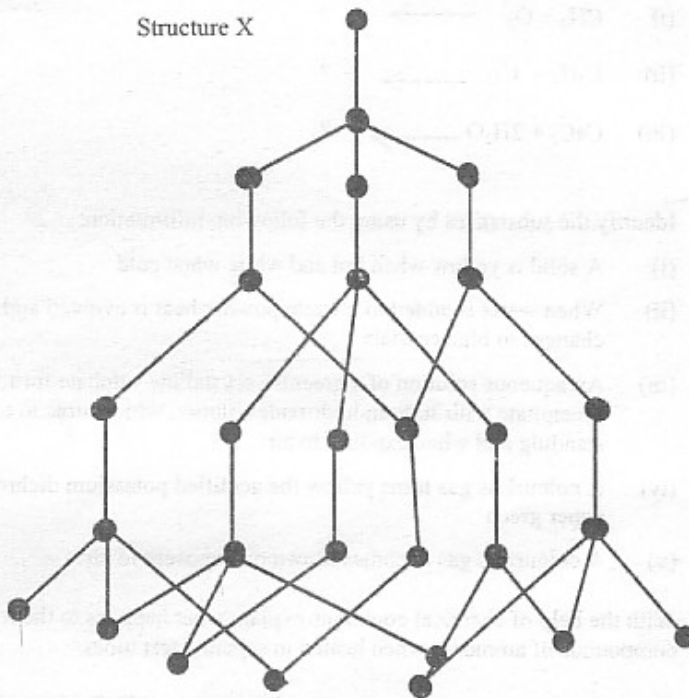
- (a) Use the graph above to answer the following questions:
- (i) Which experiment gave the fastest reaction?
  - (ii) In which experiment did the pupil use the largest size marble chips?
  - (iii) At what time did experiment 2 produce the largest volume of carbon dioxide?
  - (iv) What was the volume of carbon dioxide produced at the 30<sup>th</sup> second in experiment 1?
  - (v) Why did the volume of carbon dioxide not increase any further after 130 seconds in experiment 3?
- (5 marks)

(b) Answer the following questions, using the above graph or otherwise.

- (i) Write a balanced chemical equation for the reaction which took place between marble chips and dilute hydrochloric acid in the three experiments
  - (ii) Calculate the mass of marble chips used to produce 50 cm<sup>3</sup> of carbon dioxide in experiment 1.
  - (iii) What will happen to the rate of production of carbon dioxide in experiments 1, 2 and 3 if excess 3.00 M hydrochloric acid is used instead of excess 2.00 M hydrochloric acid?
- (5 marks)

5. (a) (i) What is the name given to the different forms of the element which exists in the same physical state?
- (ii) Carbon exists in two different forms of the same physical state and one of those carbon forms is represented by structure X below. Give the name of the carbon form with structure X.

Structure X



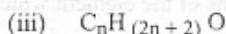
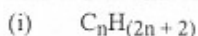
- (iii) Name the second form of carbon.
  - (iv) State one property and one use which depends on the property you have stated for each form of carbon.
- (4 ½ marks)
- (b) (i) Carbon can be used to convert copper (II) oxide to copper as shown in the equation below:
- $$\text{C}_{(s)} + 2\text{CuO}_{(s)} \longrightarrow 2\text{Cu}_{(s)} + \text{CO}_{2(g)}$$
- What is the function of carbon in this equation?
- (ii) Calculate the mass of CuO which can react with 12 g of carbon in the equation given in 5. b (i) above.
  - (iii) What is the effect of carbon monoxide in the blood?
- (5½ marks)



6. (a) (i) Define isomerism. (½ mark)

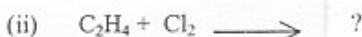
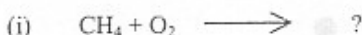
(ii) Write down the molecular structures and IUPAC names of the isomers whose molecular formula is  $C_4H_{10}$ . (03 marks)

(b) Name the homologous series of organic compounds which are represented by the molecular formulae:



(In each case  $n = 1, 2, 3, \dots$ ) (1½ marks)

(c) Complete the following equations of chemical reactions and give the IUPAC names of each organic compound which appears in each equation.



7. (a) Identify the substances by using the following information:

- (i) A solid is yellow when hot and white when cold
- (ii) When water is added to a white powder heat is evolved and the white powder changes to blue crystals
- (iii) An aqueous solution of a greenish crystalline sulphate forms a pale-green precipitate with sodium hydroxide solution which turns to brown on standing and when exposed to air
- (iv) A colourless gas turns yellow the acidified potassium dichromate paper green
- (v) A colourless gas becomes brown on exposure to air. (2½ marks)

(b) With the help of chemical equations explain what happens to the following compounds of ammonia when heated in separate test tubes:

- (i) A mixture of ammonium chloride and sodium hydroxide solution
- (ii) Ammonium chloride crystals
- (iii) Ammonium nitrate crystals
- (iv) Ammonium sulphate crystals
- (v) Ammonium nitrite crystals. (7½ marks)

8. (a) Define the following terms:

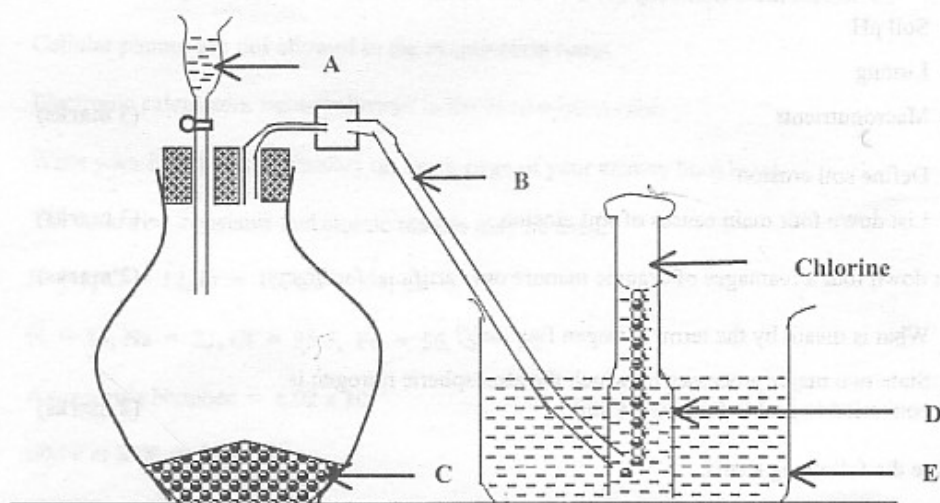
- (i) Valency
- (ii) Molar solution. (1 mark)

- (b) Metal M has variable valences of values 2 and 3. Write down the formulae of its oxides when its valency is
- 2
  - 3.
- (1 mark)
- (c) 8.48 g of sodium carbonate crystals were made up to 250 cm<sup>3</sup> of solution. 25 cm<sup>3</sup> of this solution neutralized 30 cm<sup>3</sup> of 0.20 M hydrochloric acid. Calculate the number of moles of water of crystallization in sodium carbonate crystals.
- (8 marks)

### SECTION C (20 Marks)

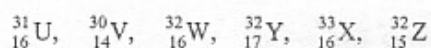
Answer TWO (2) questions from this section.

9. The diagram below shows the preparation of chlorine gas in a laboratory fume-chamber. Study the diagram and answer the questions that follow.



- (a) What do letters A, B, C, D and E represent? (2½ marks)
- (b)
- Why is the gas prepared in the fume-chamber?
  - Can the gas be collected over water? Why?
  - What will happen to a damp blue litmus paper if it is introduced into a gas jar full of chlorine gas?
  - What will happen if a gas jar of hydrogen sulphide is inverted over a gas jar of chlorine such that the two gases get mixed? Write a balanced equation for the reaction which will take place between hydrogen sulphide gas and chlorine gas.
- (5 marks)
- (c)
- List down two uses of chlorine gas.
  - Give a balanced chemical equation for the method of preparation of chlorine used in this question.
- (2½ marks)

10. (a) Which of the following are isotopes of the same element?



(1 mark)

(b) Element Q has 17 electrons and 18 neutrons.

(i) What is the atomic number of element Q?

(ii) What is the mass number of element Q?

(iii) Write down the electronic configuration of element Q.

(iv) Which group and period in the periodic table does element Q occupy? (2 marks)

(c)  ${}^{204}_{\text{J}}$ ,  ${}^{206}_{\text{K}}$ ,  ${}^{207}_{\text{L}}$  and  ${}^{\text{A}}_{\text{M}}$  are isotopes of element H whose abundancies are 2%, 24%, 22% and X% respectively. Calculate the abundancy X% and mass number A of isotope M given that the relative atomic mass of element H is 207.

(7 marks)

11. (a) Give the meaning of the following terms:

(i) Soil pH

(ii) Liming

(iii) Macronutrients

(3 marks)

(b) (i) Define soil erosion.

(ii) List down four main causes of soil erosion.

(3 marks)

(c) List down four advantages of organic manure over artificial fertilizers.

(2 marks)

(d) (i) What is meant by the term "nitrogen fixation"?

(ii) State two major processes by which the atmospheric nitrogen is converted to usable form in the soil.

(2 marks)

12. (a) Define the following terms:

(i) Pollution

(ii) Pollutant

(3 marks)

(b) List down the three main types of pollution.

(1½ marks)

(c) (i) Define "green house effect"

(ii) Why does the increase of the concentration of carbon dioxide gas in the atmosphere results into large increase of the earth's surface temperature?

(iii) What is the function of ozone layer at the top of earth's atmosphere?

(iv) List down any two gases produced by industries that destroy the ozone layer.

(5½ marks)