

NATIONAL EXAMINATIONS COUNCIL
P.O.BOX 3817 KIGALI

Chemistry III
025
06th Nov 2002 8.30am-11.30am

ORDINARY LEVEL NATIONAL EXAMINATION 2002/2003

SUBJECT : CHEMISTRY III

LEVEL : ORDINARY LEVEL

TIME : 3 HOURS

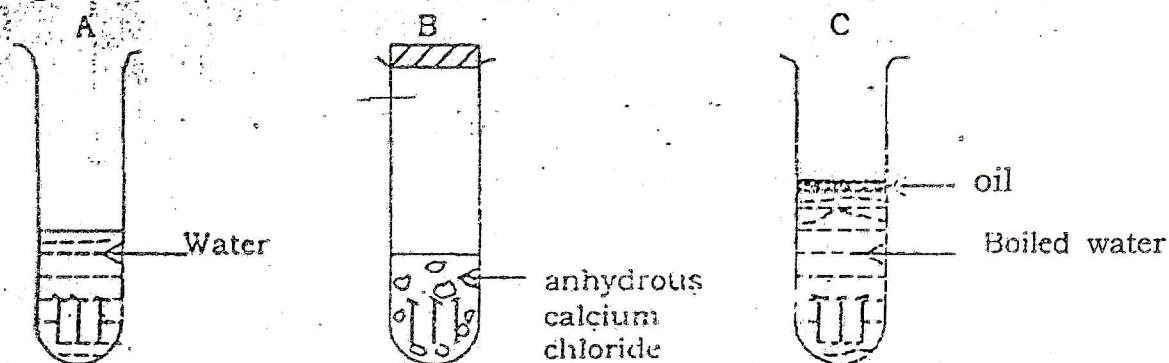
INSTRUCTIONS:

- This paper consists of **THREE** Sections A, B and C.
- Answer **ALL** the questions in section A. (55 marks)
- Answer **THREE** questions in section B. (30 marks)
- Answer only **ONE** question in section C. (15 marks)
- Calculators may be used.

SECTION A: Answer ALL questions in this section.

- Air is a mixture of several different gases.
 - Name a gas in air that supports combustion. (1 mark)
 - Name a gas that causes global warming. (1 mark)
 - Name a gas that is chemically inactive. (1 mark)
 - Name a gas that makes the biggest part of air. (1 mark)

- The iron nails were placed in test tubes under different conditions. Study the diagrams carefully and answer the questions that follow.



- In which of the test tubes will the nails rust? (1 mark)
- What is the purpose of anhydrous calcium chloride in tube B? (1 mark)
- Why is boiled water used in tube C? (1 mark)

- The table below shows the melting points and boiling points in degrees centigrade of substance A to C. Study the table and answer the questions that follow.

Substance	Melting point	Boiling point
A	1009	2506
B	-256	-248
C	-10	63

- What do you understand by melting point? (2 marks)
- Which substance is a gas at room temperature of 20°C? (1 mark)
- Which substance is a metal? (1 mark)

- Write the chemical formula for the following compounds.

- Sulphuric acid (1 mark)
- Sodium Phosphate. (1 mark)

- Complete the following equation.



- Study the following equation and answer the questions that follow.



- Name the oxidizing agent in the above reaction. (1 mark)
- Calculate the mass of Fe_2O_3 that would be required to produce 112grams of Fe. Atomic masses are: Fe = 56, O = 16, C = 12. (2½ marks)

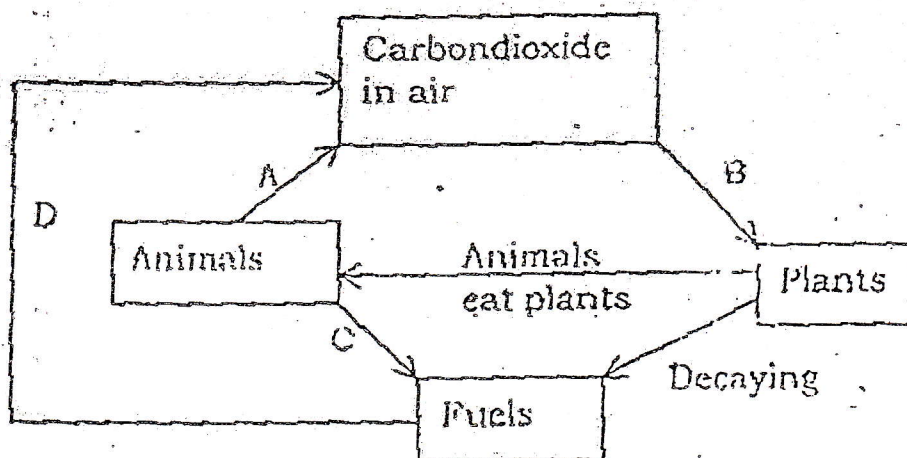
- Copy and complete the table below about electrolysis of 2 electrolytes. (2 marks)

Electrolyte	Product at anode	Product at cathode
Dilute H_2SO_4		
CuSO_4 solution using copper electrodes		

c) For both electrolytes in the above table, write ionic equations to show the reactions taking place at the Cathode.

(2 marks)

7. The diagram below shows a carbon cycle.



a) Name the processes A, B, C and D.

(2 marks)

b) What does the word fuel mean?

(1 mark)

c) Give one example of a fuel that is used in your home.

(1 1/2 mark)

8. a) What do you understand by the word catalyst?

(2 marks)

b) Give the name of the catalysts used in the following reactions:

i) Decomposition of hydrogen peroxide (H_2O_2).

(1/2 mark)

ii) Reaction between Zinc (Zn) and dilute Sulphuric acid (H_2SO_4).

(1/2 mark)

iii) Contact process.

(1/2 mark)

9. Hydrogen contains 82.8% by mass of carbon and the rest is hydrogen.

a) Calculate the empirical formula of the hydrocarbon.

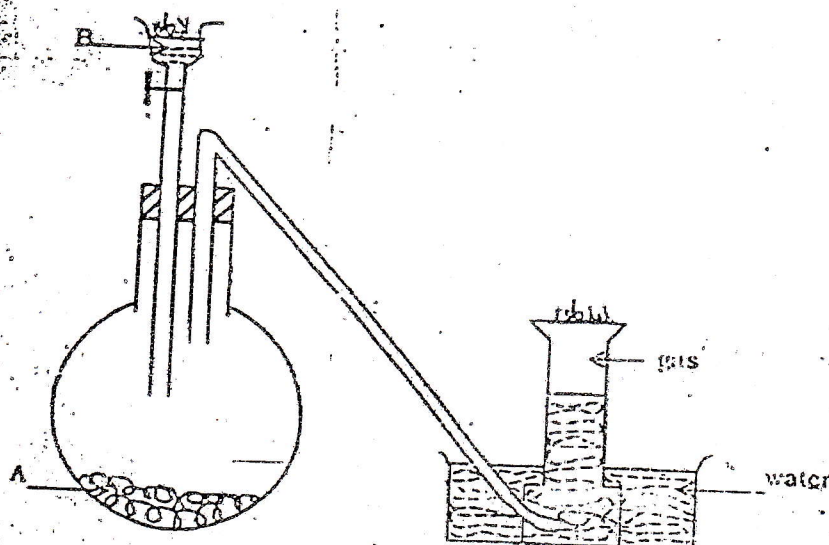
(2 marks)

b) If the relative molecular mass of the hydrocarbon is 58, calculate its molecular formula. (Relative atomic masses are: C = 12, H = 1)

(2 marks)

10. The apparatus below is used to prepare only one of the two gases mentioned below.

Hydrogen, Ammonia



a) Which of the mentioned gases can be prepared in the laboratory using the apparatus (diagram) shown?

(1 mark)

- b) State the names of the substances A and B indicated in the diagram. (2 marks)
 c) Give a reason why the other gas cannot be prepared using the apparatus shown. (1 mark)

11. When most nitrates are heated, one or two gases may be given off from the nitrates of the metals Potassium, Zinc, Sodium and Copper

- a) Choose two nitrates that give off 2 gases on heating. (2 marks)
 b) Choose one nitrate that gives off one gas on heating and write a balanced equation for the reaction. (1 mark)

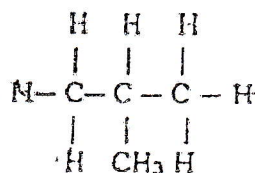
12. The table below shows the periodic table. Use it to answer the following questions.

H						He
			C	N	O	
Na						Cl
K						Br

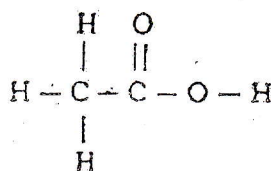
- a) Which of the elements Na and K is more reactive? (1 mark)
 b) Which of the elements Cl and Br is more reactive? (1 mark)
 c) Select one element that will form an ionic bond (electrovalent bond) with O. (1 mark)
 d) Write the electronic configuration of K. (1 mark)

13. Name the following organic substances.

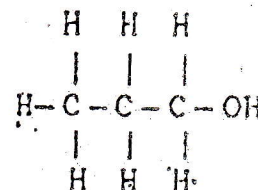
a)



b)



c)



14. Complete the following table. (4 marks)

Experiment	Observation	Inference (conclusion)
Add NaOH solution to solution X	A blue precipitate	
Add NaOH solution to solution Y		Solution Y contains Fe
Add NaOH solution to solution Z	A white precipitate that dissolves in excess NaOH	
Add NaOH solution to solution W		Solution W contains CO ₃

15. Balance the following equations.

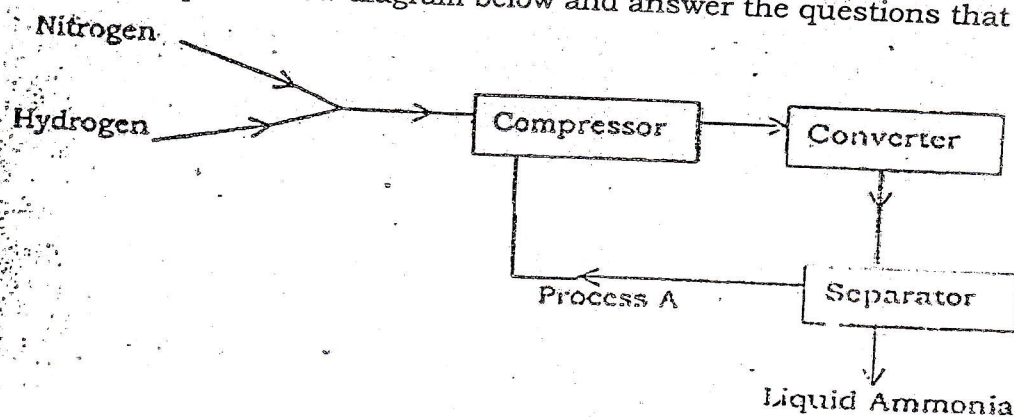


SECTION B. Choose THREE questions from this section.

16. a) State one anion that causes permanent hardness of water and one anion that causes temporary hardness of water. (2 marks)

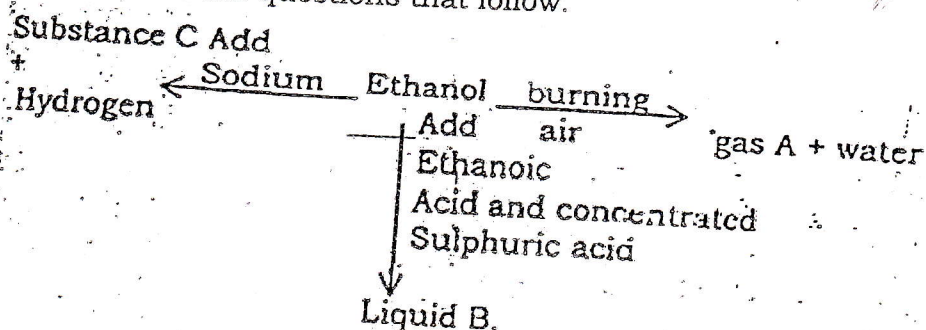
- b) State a simple chemical test that can be carried out to distinguish the anion in temporary hard water from the anion in permanent hard water. You must clearly state the observations that would be made. (2 marks)
- c) With help of balanced equations, state the observations made when carbon dioxide is bubbled into lime water for a long time and the solution is then boiled. (6 marks)

17. Study the simplified flow diagram below and answer the questions that follow.



- a) Name the source of nitrogen and hydrogen. (2 marks)
- b) The reaction that takes place in the converter under certain conditions of temperature in presence of a catalyst. (1 mark)
- i) What is the name of the catalyst used? (2 marks)
- ii) State the optimum temperatures and pressure used in the converter. (2 marks)
- iii) Name process A and give a reason why it is important. (2 marks)
- c) Write balanced equations to show how Ammonia reacts with:
- i) HCl ii) CuO iii) H₂O (3 marks)

18. The following question is about some of the reactions of Ethanol. Study the chart below and answer the questions that follow.



- a) Write the structural formula of Ethanol. (1 mark)
- b) Write an equation to show how Ethanol reacts with ethanoic acid. (2 marks)
- c) Give the names of substances or compounds A, B and C. (3 marks)
- d) Describe the steps taken during fermentation of alcohol. (4 marks)
19. a) With the help of relevant equations, describe how Copper can be extracted and purified. (7 marks)
- b) State three similarities between copper and aluminium. You may consider uses as similarities also. (2 marks)
20. a) What is Polymerization? (2 marks)
- b) By choosing only two polymers you are familiar with: (2 marks)
- i) Write an equation to show how each polymer is prepared from the monomer. (4 marks)

ii) State two uses of each polymer. (4 marks)

c) Explain why exposing some polymer products is an environmental hazard. (2 marks)

SECTION C

21. If you are given only distilled water (H_2O), dilute hydrochloric acid (HCl), solid sodium carbonate (Na_2CO_3), Zinc metal (Zn) and Magnesium Sulphate solid ($MgSO_4$)

N.B: The order of reactivity series is sodium, Magnesium, Zinc and Hydrogen.

By use of equations, outline how you would prepare pure samples of:

a) Zinc Carbonate (7½ marks)

b) Magnesium chloride. (7½ marks)

22. Read the following passage and answer the questions that follow. To a black powder, A was added dilute H_2SO_4 and a blue solution B, was formed. When $NaOH$ solution was added to B, a blue precipitate C was formed. When C was strongly heated the black powder A was formed. When Na_2CO_3 solution was added to B, a green blue precipitate D was formed. When D was strongly heated, the black powder A was formed.

a) Name and write the formula of substances A, B, C and D. (8 marks)

b) Write balanced equations for the reactions mentioned in the passage. (7 marks)

23. a) With the aid of a well labeled diagram, describe an experiment to prepare chlorine gas from Manganese IV oxide (MnO_2). (9 marks)

b) Write equations to show how Cl_2 reacts with:

i) Iron (Fe)

ii) Iron II chloride ($FeCl_2$)

iii) H_2O

iv) $NaOH$ (4 marks)

c) State two uses of Chlorine. (2 marks)

END.

CHEMISTRY III 2002/2003

SECTION A

Answer to question 1.	Answer to question 2.	Answer to question 3.
a) Oxygen, O_2 b) CO_2 c) Nitrogen, N_2 d) Nitrogen	a) In test tube A b) To absorb any moisture in the test tube: c) It is air free	a) Melting point is the temperature at which a substance changes from solid to liquid state. b) Substance B. c) Metal is A
Answer to question 4. a) i) H_2SO_4 ii) Na_3PO_4	b) Sulphuric Acid + Sodium carbonate \rightarrow Sodium sulphate + water + carbon dioxide	

Answer to question 14.

Experiment	Observation	Inference (conclusion)
Add NaOH solution to solution X	A blue precipitate	Cu^{2+} may be present
Add NaOH solution to solution Y	A green precipitate	Solution Y contains Fe^{2+}
Add NaOH solution to solution Z	A white precipitate that dissolves in excess NaOH	Pb^{2+} , Zn^{2+} or Al^{3+} may be present
Add NaOH solution to solution W	A gas which turns lime water milky	Solution W contains CO_3^{2-}

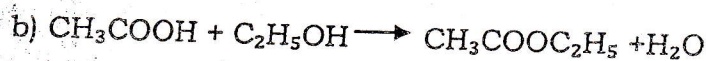
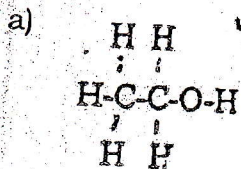
Answer to question 15.



SECTION B.

<p>Answer to question 16.</p> <p>a) SO_4^{2-} of Ca/Mg HCO_3^- of Ca/Mg</p> <p>b) Use BaCl_2 solution:</p> <ul style="list-style-type: none"> ➤ With SO_4^{2-}, a white precipitate is observed ➤ With HCO_3^-, no observable reaction. 	<p>c) When CO_2 is bubbled through lime water, immediately a milky precipitate is observed. i.e $\text{Ca}(\text{OH})_2 + \text{CO}_2 \longrightarrow \text{CaCO}_3 + \text{H}_2\text{O}$---- milky precipitate.</p> <p>When excess CO_2 is bubbled, the milky precipitate disappears and a colorless solution is observed. i.e $\text{CaCO}_3 + \text{H}_2\text{O} + \text{CO}_2 \longrightarrow \text{Ca}(\text{HCO}_3)_2(\text{aq})$</p> <p>When the solution is boiled, $\text{Ca}(\text{HCO}_3)_2$ decomposes into a milky precipitate again i.e $\text{Ca}(\text{HCO}_3)_2 \longrightarrow \text{CaCO}_3 + \text{CO}_2 + \text{H}_2\text{O}$</p>
<p>Answer to question 17.</p> <p>a) $\text{N}_2 \longrightarrow$ Atmospheric air $\text{H}_2 \longrightarrow$ from natural gas (methane)</p> <p>b) i) Finely divided iron. ii) Temperature 450 - 500°C. iii) Recycling, it takes back in reacted nitrogen and hydrogen in the compressor so that they can react.</p>	<p>c) i) $\text{NH}_3 + \text{HCl} \longrightarrow \text{NH}_4\text{Cl}$.</p> <p>ii) $2\text{NH}_3 + 3\text{CuO} \longrightarrow 2\text{Cu} + 3\text{H}_2\text{O} + \text{N}_2$</p> <p>iii) $\text{NH}_3 + \text{H}_2\text{O} \longrightarrow \text{NH}_4\text{OH}$</p>

Answer to question 18.

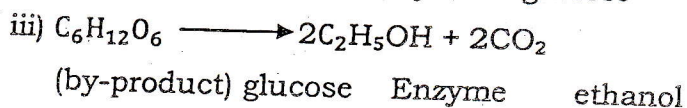
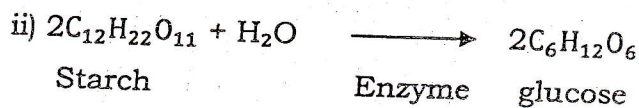
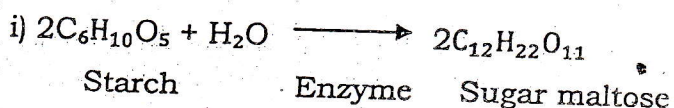


c) A - $\text{CO}_2 \rightarrow$ Carbon dioxide.

B - $\text{CH}_3\text{COOC}_2\text{H}_5 \rightarrow$ Ethyl ethanoate

C - $\text{C}_2\text{H}_5\text{ONa} \rightarrow$ Sodium ethoxide

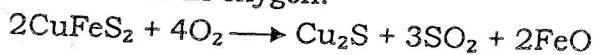
d)



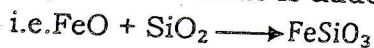
Answer to question 19.

a) Principle one is CuFeS_2

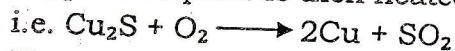
- It is heated in oxygen:



12) Silicon dioxide is added to the mixture to remove FeO



- Copper I sulphite is then heated in air

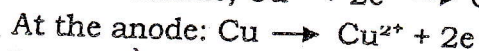
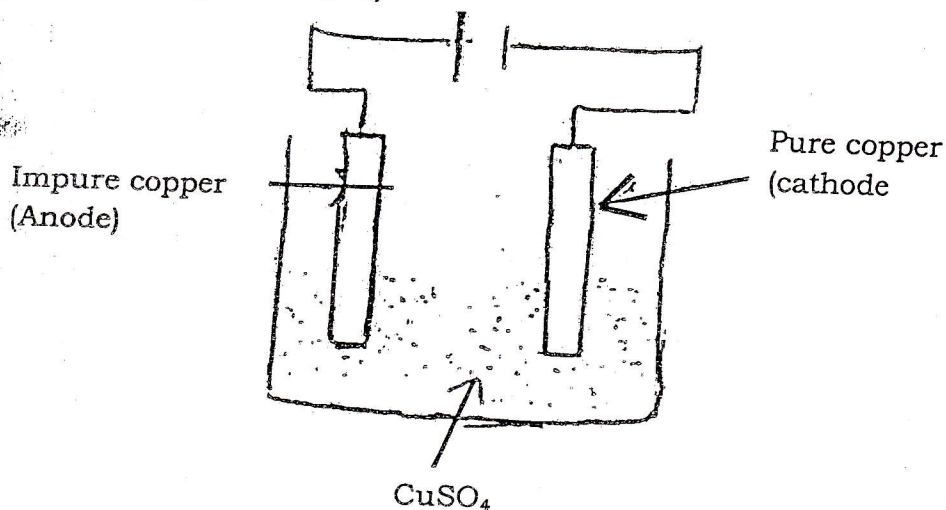


The copper obtained is not pure, it is purified by electrolysis.

Here, impure copper is made anode.

Pure copper is made cathode.

Electrolyte is CuSO_4



I.e. the anode dissolves and goes in solution as Cu^{2+} , Cu^{2+} ions are then discharged at the cathode; $\text{Cu}^{2+} + 2e \rightarrow \text{Cu}$. The impurities are left in the solution.

b) Three similarities between copper and Aluminium.

- > They are used in making electric cables since they are all good conductors of electricity.
- > They are all used in making Alloys e.g bronze \rightarrow copper + tin
 duralumin (al + Cu + Mg + Mn)
- > Both do not react with dilute H_2SO_4 .

Answer to question 20.

a) Polymerization is a process whereby a large organic molecule is built from hundreds or thousands of small molecules called monomers joined together.

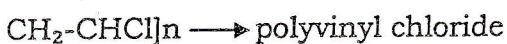
b) i) Monomer, $\text{CH}_2 = \text{CH}_2$

For monomers



Monomer, $\text{CH}_2 = \text{CHCl}$

For monomers



ii) Two uses of each polymer:

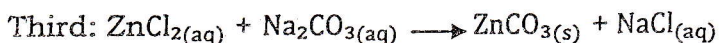
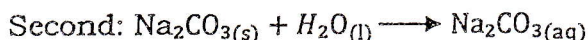
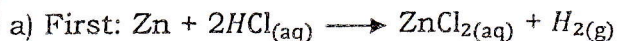
- uses of polythene for making; crates, cable insulation
- uses of PVC: imitation leather, corrugated roofing material

c) Polymer products do not decompose.

Polymer products do not allow water to penetrate through them.

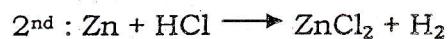
SECTION C.

Answer to question 21.

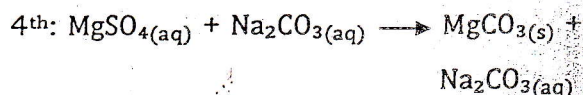


Then filter off to remain with ZnCO_3

b) 1st : Dissolve MgSO_4 in water to get MgSO_4 solution



3rd : Dissolve Na_2CO_3 also in water.



Filter to get MgCO_3



Then warm to evaporate the water and crystallize.

Answer to question 22.

a) A - $\text{CuO} \rightarrow$ Copper II oxide.

B - $\text{CuSO}_4 \rightarrow$ Copper II sulphate.

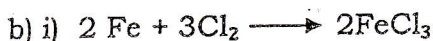
C - $\text{Cu}(\text{OH})_2 \rightarrow$ copper II hydroxide

D - $\text{CuCO}_3 \rightarrow$ copper II carbonate.



Answer to question 23.

a) Teacher's guidance.



c) Uses of Cl_2

❖ Used in the manufacture of plastics e.g. polyvinyl chloride, PVC.

❖ Used in the sterilization of water (purification of water).

END