

Chemistry III

003

05 Nov. 2007

8h30-11h30

RWANDA NATIONAL EXAMINATIONS COUNCIL



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ORDINARY LEVEL NATIONAL EXAMINATION 2007

SUBJECT : CHEMISTRY III

TIME : 3 HOURS

INSTRUCTIONS :

This paper consists of three Sections : A, B and C.

- Answer all questions in Section A. **(55 marks)**
- Answer three questions in Section B. **(30 marks)**
- Answer one question in Section C. **(15 marks)**
- You do not need the Periodic Table.

Section A : Answer all questions. (55 marks)

1. A compound contains 40 % carbon, 6.67 % hydrogen and the rest is oxygen. If the molecular mass of the compound is 180, calculate the:

i) Empirical formula.

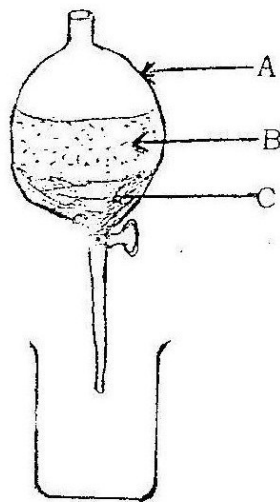
(2 marks)

ii) Molecular formula.

(1.5 marks)

(Relative atomic masses: H: 1, O: 16, C: 12).

2. Study the diagram below and answer the questions that follow :



a) What method of separating mixtures does the above diagram represent?

(1/2 mark)

b) Name the principle of this method.

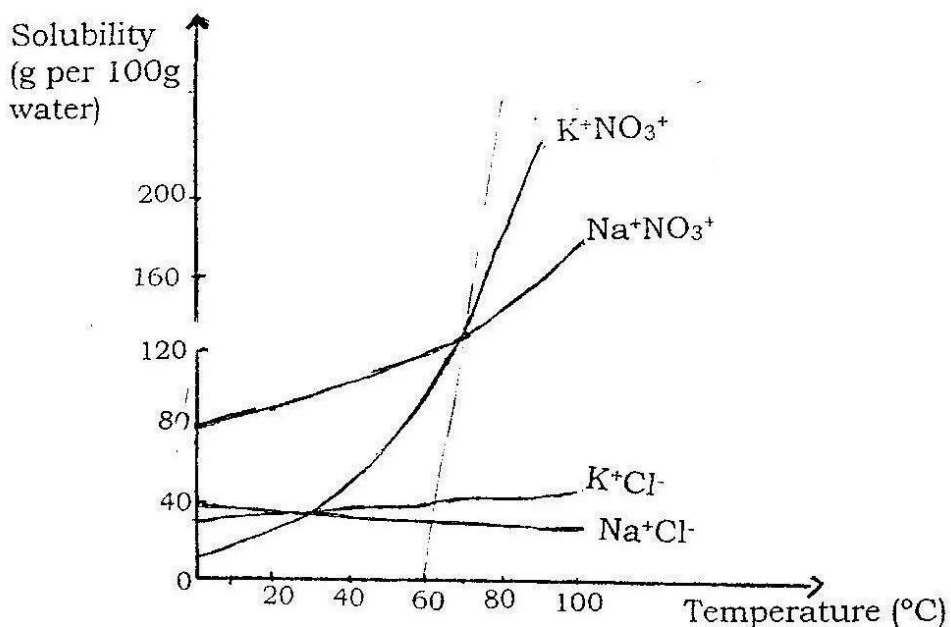
(2 marks)

c) When are you going to use this method?

(1/2 mark)

3. a) Name two ways in which atmospheric nitrogen is fixed in the soil. **(1 mark)**
- b) Name two artificial fertilizers containing nitrogen. **(1 mark)**
- c) Which important nitrogen-containing compound is produced by the Huber process ? **(1 mark)**
- d) Name the complex process by means of which plants build up carbohydrates from carbon dioxide. **(1 mark)**

4. The following graph shows the solubility curves for potassium nitrate, sodium nitrate, potassium chloride and sodium chloride.



Potassium nitrate can be prepared by mixing hot saturated solutions of potassium chloride and sodium nitrate. Use the solubility curves to answer the following questions :

- b) Which salt crystallizes first from solution at 10°C ? **(1 mark)**
- c) At which temperature are the solubilities of potassium nitrate and sodium nitrate the same ? **(1 mark)**

d) If a saturated solution of sodium nitrate, at 80°C, containing 150g sodium nitrate in 100g water was cooled to 0°C, how much sodium nitrate would crystallize? **(1 mark)**

5. Insert the following oxides in their appropriate position in the table below: zinc oxide (ZnO), carbon monoxide (CO), sodium oxide (Na₂O), carbon dioxide (CO₂).

Classification	Oxide
Acidic	
Basic	
Amphoteric	
Neutral	

(4 marks)

6. State whether the following are physical or chemical changes:

- Alcoholic fermentation
- Dilation of a solid
- Sublimation of iodine.

(3 marks)

7. Aluminium reacts with oxygen to give aluminium oxide.

a) Write a balanced equation for this reaction. **(1 mark)**

b) What mass of aluminium will burn in 1.6g of oxygen?
(Atomic masses: Al = 27, O = 16). **(3 marks)**

8. For each of the following pairs of ions, identify the chemical test that can be used to distinguish them, stating clearly the observations.

a) $Cl^{-}(aq)$ and $NO_3^{-}(aq)$ **(1.5 marks)**

b) $Fe^{2+}(aq)$ and $Cu^{2+}(aq)$ **(1.5 marks)**

9. Give 3 reactions (equations) involved in the contact process. **(3 marks)**

10. Complete the following table:

Radical	Name	Valence
NO ₂		
PO ₄		

(3 marks)

11. This question refers to the elements of the periodic table with atomic number from 3 to 18. Some of the elements are shown by letters but the letters are not the symbols of the elements:

3 A	4	5	6	7	8 E	9	10 G
11 B	12 C	13	14 D	15	16	17 F	18

- a) Which of the elements lettered A to G :

- i) Is a noble gas ?
- ii) Is a halogen ?
- iii) Would react most readily with chlorine?

- b) Give i) the formula of the hydride of D.

(1 mark)

- ii) the formula of the oxide of C.

(1 mark)

- c) Indicate whether the bonding in the oxide of C will be ionic or covalent.

(1/2mark)

12. Iron nails were placed in test tubes under different conditions.

Show that both air and water are necessary for rusting.

(4 marks)

13. Complete the following table :

Particle	Mass	Charge
Proton		
		0
	$\frac{1}{1836}$	-1

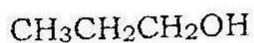
(4 marks)

14. When solutions of potassium chloride, KCl and silver nitrate, AgNO₃, are mixed together, a precipitate of silver chloride forms.

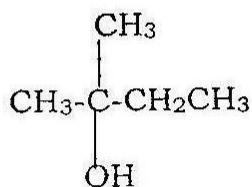
- a) Write down a balanced equation for this reaction.

- b) Deduce from this the ionic equation.

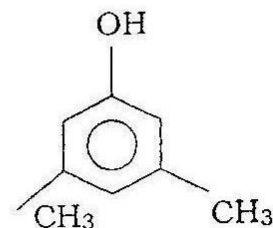
15. The compounds A to E are alcohols, phenols or ethers.



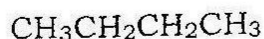
A



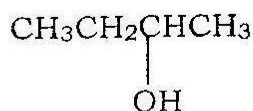
B



C



D



E

a) Which of these is:

(3 marks)

- i) A primary alcohol?
- ii) A phenol?
- iii) An ether?

b) Name the compound A.

(1 mark)

c) Which compound may be oxidised to form an aldehyde?

(1 mark)

SECTION B : Answer any three questions only. (30 marks)

16. a) Write the name and formula of the principal ore of copper.

(2 marks)

b) Suggest one method by which the ore you have named may be concentrated.

(1 mark)

c) i) Outline, giving equations, the process by which impure copper is obtained from the concentrated ore.

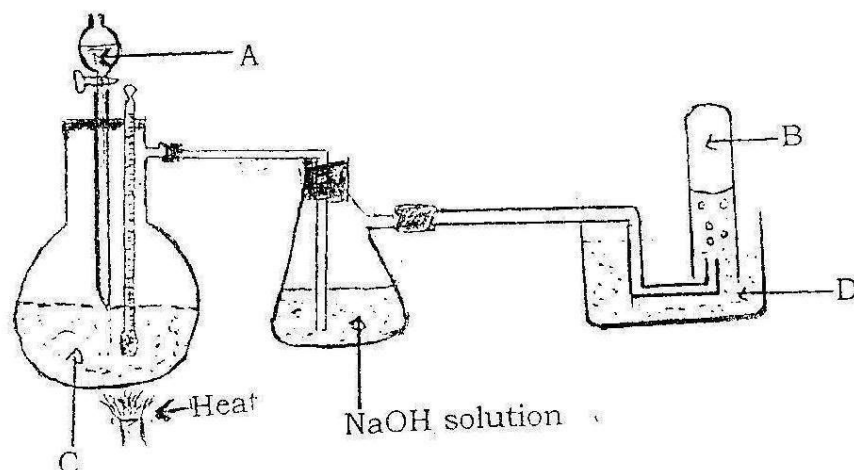
(4.5 marks)

d) Give the formula of compounds that are obtained when copper reacts with concentrated HNO_3 .

(1.5 marks)

17. a) Give 3 differences between ionic and covalent bonds. **(3 mark**
- b) i) Compare the properties of ionic and covalent compounds. **(5 mark**
- ii) Give two examples of each type of compounds. **(2 mark**
18. The electronic configuration of an element X is $1s^2 2s^2 2p^6 3s^2$.
- a) Find out the atomic number, the number of protons and the number of electrons for X. **(3 mark**
- b) How many electrons are in
- i) K-shell
 - ii) L-shell
 - iii) M-shell
 - iv) N-shell ?
- c) i) To which group does the element belong? **(1 mark**
- ii) Give any one reason for your answer. **(1 mark**
- d) What is the valence of X? **(1 mark**
- e) Give the formula of the compound formed between X and
- i) Hydrogen **(1 mark**
 - ii) Sulphur. **(1 mark**
19. 20cm^3 of sodium hydroxide was pipetted into a conical flask and titrated against 0.1 M hydrochloric acid using phenolphthalein as indicator. The indicator changed colour when 15.6cm^3 of acid had been added.
- a) Define titration. **(1 mark**
- b) State two basic pieces of apparatus that would be used in this experiment. **(2 mark**
- c) What is the role of indicator in this experiment? **(1 mark**
- d) i) Write the equation for this neutralisation. **(1 mark**
- ii) Calculate the percentage composition of sodium in one mole of sodium hydroxide. **(2 ma**

20. Study the diagram below and answer the questions that follow.
Dehydration of ethanol (=preparation of ethane from ethanol).



- a) Name the substances labelled A, B, C and D. (4 marks)
- b) What is the role of NaOH solution? (2 marks)
- c) Write the name of a compound obtained after polymerization of C_2H_4 . (1 mark)
- d) What is the molar volume at room temperature and atmospheric pressure (r.t.p). (1 mark)
- e) What is the volume of 2 moles of C_2H_4 gas at r.t.p? (2 marks)

SECTION C : Answer only one question. (15 marks)

21. a) The following tests were carried out on some unknown organic compounds :

- Compound A was shaken with bromine (in tetrachloromethane). There was an immediate decolorization of the red bromine solution.
- Compound B was shaken with bromine (in tetrachloromethane). There was only a very SLOW decolorization of the red bromine solution, and after a while pungent acid fumes could be detected.
- A small piece of freshly cut sodium was added to the non-acidic compound A. A gas was liberated which formed an explosive mixture with air.

- On warming compound D with ethanol and a few drops of concentrated sulphuric acid, a pleasant fruity smell could be detected when the mixture was poured into water.

i) Assign the following formulas to compounds A, B, C and D:
 $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$, $\text{CH}_3\text{CH}_2\text{CH}_3$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$, $\text{CH}_2=\text{CHCH}_2\text{COOH}$.
(4 marks)

ii) Write the equation for each observation.
(4 marks)

b) i) What are the basic raw materials used in the production of soap? (2 marks)

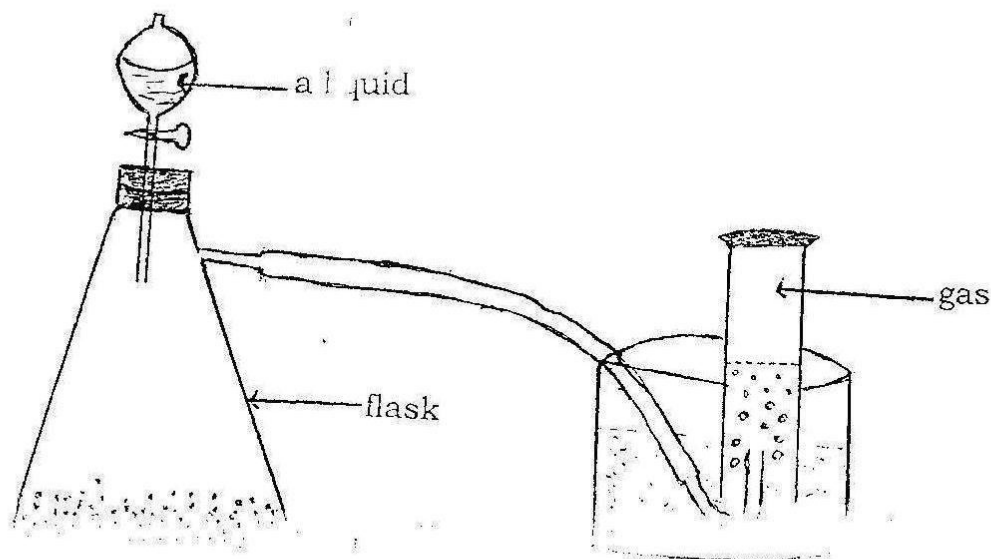
ii) Write the equation for the reaction involved in the production of soap.
(1 mark)

iii) Which type of compound is used to separate soap from the reaction mixture?
(1 mark)

iv) What other substances are used in the manufacture of soap? (2 marks)

v) State any use of the byproducts of the manufacture of soap. (1 mark)

22. Gases are always made from the reaction between a solid and a liquid. The volume of gas made is controlled by the amount of liquid run into the flask holding the solid reactant.



Complete the following table :

	Liquid	Solid	Reaction
Sulphur dioxide (SO ₂)	Dilute hydrochloric acid	Sodium sulphite	$2\text{HCl} + \text{Na}_2\text{SO}_3 \rightarrow \text{SO}_2 + 2\text{NaCl} + \text{H}_2\text{O}$
Hydrogen (H ₂)			
Oxygen (O ₂)			
Carbon dioxide (CO ₂)			
Hydrogen chloride (HCl)			
Ammonia (NH ₃)			
Chlorine (Cl ₂)			
Nitrogen dioxide (NO ₂)			

(3 marks)

(2 marks)

(2 marks)

(2 marks)

(2 marks)

(2 marks)

(2 marks)