

Chemistry III

003

10 Nov. 2008

8.30am-11.30am

RWANDA NATIONAL EXAMINATIONS COUNCIL



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ORDINARY LEVEL NATIONAL EXAMINATION 2008

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) Name two types of hardness of water. (2marks)
(b) (i) Give the causes of hardness of water. (2marks)
(ii) Briefly explain how one of the types of hardness can be removed. (1mark)
2. Methane burns in oxygen to give carbon dioxide and water vapour only.
(a) Write a balanced equation for this reaction. (1mark)
(b) Calculate the volume of oxygen needed for the complete combustion of 100cm^3 of methane. (All volumes of gases were measured at the same temperature and pressure). (2marks)
3. The following techniques are used for the separation of mixtures: evaporation, chromatography, filtration, fractional distillation and sublimation. Which of these is the most suitable technique for obtaining:
(a) Sodium chloride from a solution of sodium chloride?
(b) Ammonium chloride from a white powder composed of ammonium chloride and sodium chloride?
(c) Small pieces of metal from the engine oil of a car?
(d) The different pigments from an extract of flower petals? (4marks)
4. Calculate the number of water molecules in 900g of water (H_2O). (Relative atomic masses : H : 1, O: 16. Avogadro's number = 6.0×10^{23} per mole). (3marks)
5. Sodium is manufactured by the electrolysis of molten sodium chloride containing calcium chloride in the Downs cell.
(a) Why is calcium chloride added? (1mark)
(b) (i) Name the product at the anode. (1mark)
(ii) Write an equation showing the discharge at the anode. (1mark)

6. In an experiment concerning the displacement of one metal from an aqueous solution of its salt by another metal, the results were tabulated as follows:

	Metal A	Metal B	Metal C	Metal D
Solution of Salt A	-	W	Reaction	X
Solution of Salt B	Reaction	-	Reaction	Reaction
Solution of Salt C	No Reaction	No Reaction	-	Y
Solution of Salt D	Reaction	No Reaction	Z	-

The table shows whether or not reaction occurs between the metal and a solution of another metal salt.

- (a) Arrange the metals in order of reactivity, giving the most reactive one first. **(2marks)**
- (b) State whether reaction will take place in the spaces labeled W, X, Y and Z. **(2marks)**
7. Solutions may be classified as basic, neutral or acidic. The information below shows the solutions and their pH values. Study the table and classify solutions A, B and C. **(3marks)**

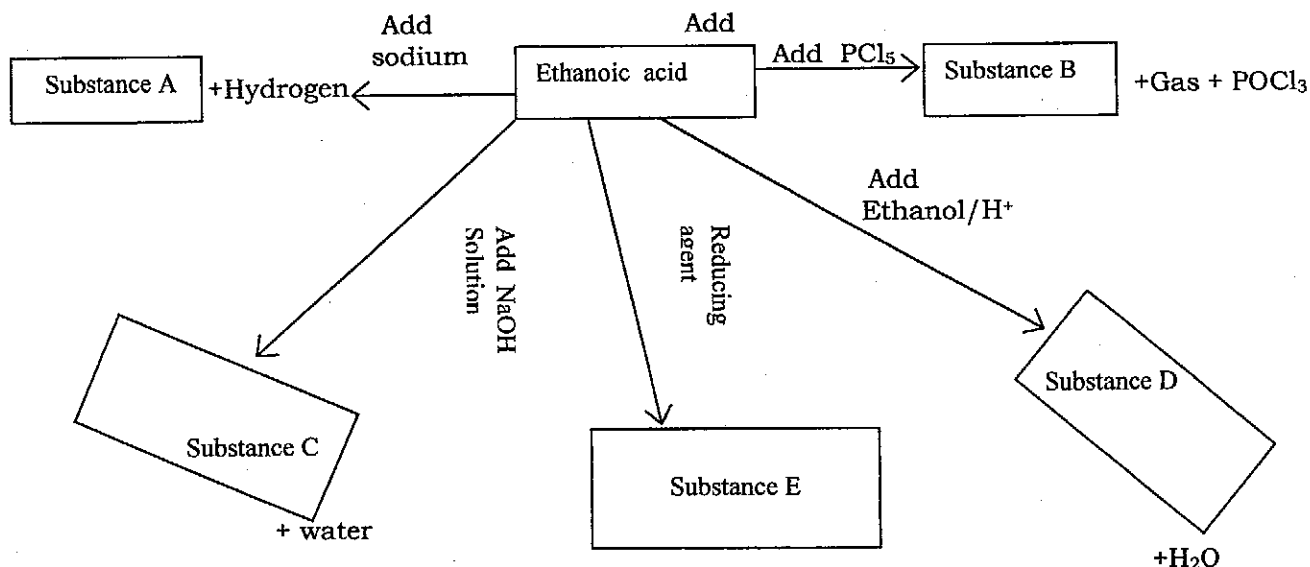
Solution	pH value
A	7
B	3
C	10

8. (a) Which method can be used to separate the components of air? **(1mark)**
- (b) What is meant by air pollution? **(1mark)**
- (c) Name two sources of air pollution. **(2marks)**
9. (a) What is the cause of inertness of nitrogen? **(1mark)**
- (b) The following reaction: $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g})$ takes place during Haber process. Give the optimum conditions used in the process (temperature, pressure, catalyst) for this reaction. **(3marks)**
- (c) What feature of the catalyst in (b) makes it efficient? **(1mark)**

10. (a) Give one example of (i) a reaction which shows effervescence.
(ii) an exothermic reaction. **(2marks)**
- (b) Complete the following equations:
(i) $\text{SO}_2 + \text{H}_2\text{O} \rightarrow$
(ii) $\text{Na} + \text{H}_2\text{O} \rightarrow$ **(2marks)**
11. (a) Write an equation for the reaction that takes place when hydrogen reacts with copper (II) oxide. **(1mark)**
- (b) (i) State which of the species is a reducing agent. Give a reason for your answer. **(2marks)**
- (ii) Which is an oxidizing agent? **(1mark)**
12. Give three means of preventing the rusting of iron. **(3marks)**
13. Write the formula of:
(a) Ammonium phosphate
(b) Potassium chlorate
(c) Pentanol
(d) Butene. **(4marks)**
14. An organic compound contains 40% by mass of carbon, 13.3% hydrogen and 46.7% nitrogen.
- (a) Calculate the empirical formula of the compound. **(2marks)**
- (b) If the relative molecular mass of the compound is 60, determine its molecular formula.
(Relative atomic masses : C:12, H :1, N :14) **(1mark)**
15. Give one example of: (a) weak electrolyte
(b) Non-electrolyte
(c) Conductor. **(3marks)**

Section B: Answer any THREE questions (30 marks)

16. (a) The following question is about some of the reactions of ethanoic acid. Study the chart below and answer the questions that follow.



- (i) Write the structural or molecular formula of ethanoic acid. **(1mark)**
- (ii) Write an equation to show how ethanoic acid reacts with sodium carbonate. **(1mark)**
- (iii) Give the formula of substances A, B, C, D and E. **(5marks)**
- (b) Name one natural polymer and give its monomers. **(2marks)**
- (c) Write the structural formula of octane. **(1mark)**
17. Answer the following questions about the extraction of iron. (no diagrams are required).
- (a) Give the name and formula of one mineral from which iron is extracted. **(2marks)**
- (b) Explain how carbon monoxide is formed in the blast furnace. **(3marks)**
- (c) Write the equation for the reaction by which iron is formed in the furnace from its ore. **(1mark)**

- (d) Name two impurities likely to be present in the "Pig iron" formed in the blast furnace. (2marks)
- (e) Explain clearly why limestone (calcium carbonate) is used in the blast furnace. (2marks)
18. Sulphuric acid is manufactured by converting sulphur dioxide to sulphur trioxide and dissolving this in 95-98 per cent sulphuric acid, whilst adding an appropriate amount of water.
- (a) How is the sulphur dioxide obtained? (2 different methods) (2marks)
- (b) (i) Name one catalyst commonly used in this process. (1mark)
- (ii) Name another catalyst not commonly used and explain why? (2marks)
- (c) Why is the sulphur trioxide not dissolved in water directly? (1mark)
- (d) Give two uses of sulphuric acid. (2marks)
- (e) Complete the following equations: (2marks)
- (i) $\text{H}_2\text{SO}_4 + \text{NaCl} \rightarrow$
- (ii) $\text{Zn} + \text{H}_2\text{SO}_{4(\text{aq})} \rightarrow$
19. What volume of 0.1M sodium hydroxide solution:
- (a) Contains 0.0025 mol of sodium hydroxide? (3marks)
- (b) Neutralizes 25cm³ of 0.05M sulphuric acid solution? (4marks)
- (c) Reacts exactly with 0.5mole of hydrochloric acid? (3marks)
- (Relative atomic mass: Na: 23, H: 1, O:16, S: 32, Cl: 35.5)
20. (a) Write down the electronic configuration of chlorine. (1mark)
- (Atomic number of chlorine = 17)
- (b) Explain why chlorine forms an ion Cl⁻. (2marks)
- (c) Write the symbol for the magnesium ion. (1mark)
- (Atomic number of magnesium = 12)
- (d) Write the formula and the name for the compound formed when these two elements combine. (2marks)
- (e) Would you expect this compound to have a high or low melting point? Give a reason. (2marks)
- (f) Indicate whether the bonding in the compound will be ionic or covalent. Give a reason for your answer. (Atomic number: Mg: 12, Cl: 17). (2marks)

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

21. In an experiment to determine the volume of hydrogen produced when magnesium powder reacts with dilute hydrochloric acid, the volume of hydrogen produced was measured at different intervals of time. The following results were obtained.

Time (seconds)	0	5	10	20	30	40	50	60
Volume of H ₂ (cm ³)	0	32	52	78	93	95	95	95

- (a) Write down the equation for the reaction. **(1mark)**
- (b) Suggest three ways of speeding up this reaction. **(3marks)**
- (c) Plot a graph of volume of H₂ produced (on-y-axis) versus time (x-axis). **(8marks)**
- (d) Why is the volume of H₂ constant in the last three results? **(1mark)**
- (e) Why is the volume of H₂ = 0 cm³ when the time = 0 seconds? **(1mark)**
- (f) Suggest one use of hydrogen gas. **(1mark)**
22. With the help of equations where possible, state the chemical test that would be used to distinguish each pair of the following substances and state the observation in each case.
- (a) Fe²⁺(aq) and Cu²⁺(aq)
- (b) Cl⁻(aq) and CO₃²⁻(aq)
- (c) SO₂(g) and Cl₂(g)
- (d) C₂H₄(g) and C₂H₆(g)
- (e) C₅H₁₂(l) and C₂H₅OH (l).

(3marks each)

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