



NATIONAL EXAMINATIONS COUNCIL  
P.O. BOX 3817 KIGALI

Chemistry I  
003  
08<sup>th</sup> Nov 2010 8.30am-11.30am

ORDINARY LEVEL NATIONAL EXAMINATION 2010

SUBJECT : CHEMISTRY I

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.
- You do not need the periodic table.

**SECTION A: Attempt all questions. (55 marks)**

1. The stomach secretes gastric juice, which contains hydrochloric acid. The gastric juice helps with digestion. Sometimes there is an overproduction of acid, leading to indigestion. Antacids, such as milk of magnesia, can be taken to neutralize the excess acid. Milk of magnesia is only slightly soluble in water and has the chemical formula  $Mg(OH)_2$ .
- Write a balanced chemical equation to show how the antacid reacts with the acid. (1 mark)
  - The directions on the bottle recommended that children under the age of 12 years take one teaspoon of milk of magnesia, whereas adults can take two teaspoons of the antacid. Briefly explain why the dosages are different. (1 mark)
  - Why is it not advisable to take an overdose of the antacid in the stomach? Refer to the hydrochloric acid concentration in the stomach in your answer. (1 mark)
2. An unknown substance has a molar mass of  $62.2 \text{ g mol}^{-1}$  and consists of the following elements: 74.07% CARBON, 17.28% nitrogen and 8.65% hydrogen.
- Determine the empirical formula of the substance. (2.5 marks)
  - What is the molecular formula of the substance? (Atomic mass: H = 1, C = 12, N = 14) (1.5 marks)
3. Two test tubes, A and B, both contain HCl at a concentration of 1M. One gram of calcium carbonate powder is added to test tube A. In test B, one gram of calcium carbonate chunks is added. The reaction that takes place in the two test tubes is:  
 $CaCO_3 + 2HCl \longrightarrow CaCl_2 + H_2O + CO_{2(g)}$
- In which test tube (A or B) will the formation of  $CO_{2(g)}$  take place at a higher rate? (0.5 marks)
    - Give a reason for your answer. (1 mark)
  - Will the rate at which  $CO_{2(g)}$  is formed in test tube A be influenced (yes or no) if more of the HCl solution of the same concentration is poured into the test tube? (0.5 marks)
  - Name two ways in which the rate of  $CO_{2(g)}$  formation in both test tubes can be increased, excluding the option of adding more  $CaCO_3$ . (1 mark)
4. 0.72 g of  $O_3$  reacts with 0.66g NO according to the following equation:  
 $O_{3(g)} + NO_{(g)} \longrightarrow O_{2(g)} + NO_{2(g)}$
- Calculate the number of moles of  $O_3$  and NO present at the start of the reaction. (2 marks)
  - Identify the limiting reagent (reactant) in the reaction and justify your answer. (Atomic mass: O = 16, N = 14) (2 marks)
5. Research has shown that the temperature on Earth is gradually rising.
- What term has been given to this phenomenon? (1 mark)
  - What is the likely cause of this phenomenon? (1 mark)
  - What are the consequences of this phenomenon? (1 mark)
  - What can be done about it? (1 mark)
6. Study the formula of the compound: crystalline magnesium, sulphate:  $(MgSO_4 \cdot 7H_2O)$
- Determine the percentage of sulphur present in the compound. (2 marks)
  - If we have 5g of this substance available, what mass will comprise of water? (Atomic mass: H = 1, O = 16, S = 32, Mg = 24) (2 marks)
7. Write only the word/term for each of the following descriptions:
- The distance between two atoms in a molecule. (0.5 marks)
  - A chemical reaction during which electrons are transferred. (0.5 marks)
  - A measure of how much solute is dissolved in a solvent. (0.5 marks)

d) An ionic solution that conducts electricity.

(0.5 marks)

8. a) Hydrogen is not a metal, but it is classified in 1A group (alkali metals), why? (1 mark)

b)  $15\text{cm}^3 \text{N}_2$  reacts with  $30\text{cm}^3$  of  $\text{H}_2$  to produce ammonia gas ( $\text{NH}_3(\text{g})$ ). Determine the total volume of gas left in the container if the reaction runs to completion and if the volumes are measured at the same temperature and pressure before and after the reaction. (3 marks)

9. Read the following statements and then choose the best answer(s) from the column marked possible answers. There could be more than one correct answer and the possible answers may be used more than once.

Statement	Possible answers
1. The extent to which a salt dissolves in water is known as the.....of salt	A. Element
2. Sand and water is an example of a .....	B. Compound
3. In the case of a cup of black coffee, the coffee is the .....	C. Solution
4. A homogenous mixture can also be called a.....	D. Homogenous mixture
5. Salt dissolved in water is an example of a .....	E. Heterogeneous mixture
6. When $\text{AgNO}_3$ and $\text{NaCl}$ are mixed, a .....is formed	F. Solvent
	G. Precipitate
	H. Solubility
	I. Solute
	J. Mixture

10. a) Name the following compounds:

i)  $\text{NaHCO}_3$

ii)  $\text{CS}_2$

(1 mark)

(1 mark)

b) write down the chemical formulae for the following compounds:

i) Ammonium sulphate

ii) Aluminium hydroxide.

(1 mark)

(1 mark)

11. a) What an element?

(1 mark)

b) Write down the name of seven elements on the periodic table which always occur as diatomic molecules in nature.

(3 marks)

12. a) Define dilution.

(1 mark)

b) What volume of 15M of sulphuric acid must be used to prepare 1.5L of a 0.1M  $\text{H}_2\text{SO}_4$  solution?

(1 mark)

13. a) Name the type of chemical bond that occurs between the atoms in a water molecule.

(1 mark)

b) Comment on the following table: Boiling points of the hydrides of VIA group elements against molecular weights.

(3 marks)

Compound	$\text{H}_2\text{O}$	$\text{H}_2\text{S}$	$\text{H}_2\text{Se}$	$\text{H}_2\text{Te}$
Molecular weight	18	34	81	130
Boiling point (K)	373	213	231	271

14. Sketch a diagram showing a water cycle.

(4 marks)

15. a) The atomic number of phosphorous is 15. What does this mean?

(1 mark)

b) Phosphorus is also classified as a non-metal. Name four physical properties phosphorus should have because of its non-metallic status. (2 marks)

c) Phosphorus has only one naturally occurring isotope. The isotope has 16 neutrons. The two radioactive isotopes of phosphorus have 17 and 18 neutrons respectively.

Represent the two radioactive isotopes of phosphorus according to the notation  $\frac{A}{Z}X$

**SECTION B: Attempt any three questions from this section. (30 marks)**

16. Study the following reaction:  $Fe_2O_3(s) + 3CO(g) \longrightarrow 2Fe(s) + 3CO_2(g)$  Carbon monoxide is added to 500kg of iron (III) oxide at STD. Determine:

a) The mass of iron formed. (4 marks)

b) The volume of carbon dioxide released. (2 marks)

c) The number of iron atoms formed. (2 marks)

d) The number of atoms present in 500kg of  $Fe_2O_3$ . (Atomic mass: Fe = 56, O = 16, C = 12, Number of Avogadro,  $N_A = 6.023 \times 10^{23}$ ; molar volume =  $22.41 \text{ mol}^{-1}$ ) (2 marks)

17. A student wants to test sea water for the presence of chloride ions.

a) Make a list of the chemicals and apparatus that will be needed to conduct his test (2 marks)

b) Suggest a method (procedure) to test sea water for the presence of chloride ions. (4 marks)

c) Write balanced equations for all reactions that take place. (2 marks)

d) If chloride ions are present, a precipitate forms. What is the color of the precipitate? (1 mark)

e) Do you think the precipitate will contain other ions as well? Give a reason for your answer. (1 mark)

18. Bauxite is the principal ore of aluminium.

a) Describe briefly how bauxite is purified. (2 marks)

b) Explain why cryolite is added to the purified ore before it is electrolyzed. (1 mark)

c) Write equations to show the reactions that take place at the electrodes during the electrolysis of the purified ore ( $Al_2O_3$ ) (2 marks)

d) Explain why the anode is replaced from time to time. (1 mark)

e) State two reasons why aluminium is not obtained from bauxite by heating the purified ore with carbon. (2 marks)

f) What is the reason why certain metals (such as gold) are more expensive than others (such as aluminium, copper etc)? (2 marks)

19. Because the world population is increasing so rapidly, the demand for food is increasingly high. The largest percentage of the world's soil is used for cultivation of crops, but large shortages of nutrients and minerals to allow good growth exist. The solution is the use of fertilizers.

a) Where do plants get the elements carbon, hydrogen and oxygen from? (1 mark)

b) The fertilizer: NPK is sold as NPK 14-26-16. What does this mean? (2 marks)

c) Why are liquid fertilizers used more and more in agriculture? (3 marks)

d) Write two paragraphs in which you address the impact of fertilizers on the environment. (4 marks)

20. a) Hydrocarbons are obtained from crude oil through fractional distillation.

i) Which physical property is used to separate the various hydrocarbons from crude oil? (1 mark)

ii) Which of the hydrocarbons, ethane or butane, will be removed first during distillation? Give a reason for your answer. (1.5 marks)

- b) Consider the following organic compound:  $\text{CH}_3\text{-CO-O-CH}_3$
- Write down the name of this compound. (1 mark)
  - Write down the names of the two organic compounds that were used to prepare this compound. (2 marks)
  - Write down the structural formula and name of one isomer of this compound. (2 marks)
  - Write the functional group of an amine, a ketone. (2 marks)
  - Is butane saturated or unsaturated hydrocarbon? (Give a reason for your answer. (1.5 marks)

**SECTION C: Attempt only one question from this section. (15 marks)**

21. A chemist conducts an investigation and makes use of the following:

- |                              |                    |
|------------------------------|--------------------|
| - mol. $\text{dm}^{-3}$ NaOH | - Burette          |
| - Unknown concentration HCl  | - Stand            |
| - Bromothymol blue indicator | - Erlenmeyer flask |

20 $\text{cm}^3$  of HCl and a few drops of the indicator are placed in the Erlenmeyer flask. The burette is filled with NaOH. The latter is added to an acid solution until a permanent color change occurs. The reaction mixture heats up slightly. The whole process is repeated three times. Results:

Volume acid	20	20	20
Volume base	15.3	15.5	15.2

- Supply a possible hypothesis for the investigation. (2 marks)
  - Name the dependant and independent variables in this investigation. (2 marks)
  - Write the ionic equation for the unknown value. (3 marks)
    - Use a calculation to determine the unknown value. (3 marks)
    - Give the common name of salt formed. (1 mark)
  - What will happen to the pH of the acid during this reaction? (2 marks)
  - Is the reaction endothermic or exothermic? Explain. (2 marks)
  - Give the name of the method used for neutralizing the reaction. (1 mark)
  - Define acid-base indicator. (1 mark)
22. A group of learners was asked to investigate the reactivity of alkanes and alkenes. They chose ethane and ethene as examples. They then carried out the following experiments.

Experiments A: the learners poured a few drops of ethane and ethene onto two separate watch glasses and lit the liquids in a fume cupboard. Their observations are indicated in the table below:

Compound	Color of flame	Sootiness
Ethane	Orange and blue flame	No soot observed
Ethene	Orange and blue flame	Slightly sooty

Experiments B: The learners perform the reaction of ethane and ethene firstly in a darkened room. They poured 2 $\text{cm}^3$  of ethane and 2 $\text{cm}^3$  of ethene into two separate test tubes and then added a few drops of bromine to the contents of each test tube. They then repeated the experiment in sunlight. Their observations are indicated in the table below.

Compound	Action of liquid bromine in the dark.	Action of the liquid bromine in sunlight.
Ethane	No visible reaction	Liquids mix and decolorize after a long time. A gas evolves
Ethene	Bromine decolorizes slowly	Liquids mix and decolorize rapidly. No gas evolves.

- a) Write down for safety precautions that the learners took during the experiment. (2 marks)
- b) Write down a possible hypothesis for the investigation. (2 marks)
- c) What conclusion should the learners reach about the reactivity of the compounds as a result of:
- the experiment A? (1 mark)
  - the experiment B? (1 mark)
- d) i) Write down the balanced equations for the combustion reactions involved in the experiment A. (2 marks)
- ii) Write down the balanced equations for the bromation reactions involved in the experiment B. (2 marks)
- e) Ethene molecules bond with one another to form long polymer chains. What are these units known as? (1 mark)
- f) Give the general molecular formula of the alkenes. (1 mark)
- g) Calculate the mass of gas evolved in experiment B. (3 marks)  
(Atomic mass: H = 1, C = 12, Br = 80, density of ethane = 1.212g/l).

END

CHEMISTRY III 2010

SECTION A

<p>1 a) <math>\text{Mg}(\text{OH})_2(\text{s}) + 2\text{HCl}(\text{aq}) \rightarrow \text{MgCl}_2(\text{aq}) + 2\text{H}_2\text{O}(\text{l})</math></p> <p>b) Adults have a bigger mass and generally produce more acid than children. Adults will therefore need more antacid to neutralize the excess acid.</p>	<p>c) A low acid concentration, the stomach may slow down food digestion or may cause further stomach upset.</p>
<p>2 a) <math>\text{C} : \text{mole} = \frac{74.07}{12} = 6.17</math></p> <p><math>\text{N} : \text{mole} = \frac{17.28}{14} = 1.23</math></p> <p><math>\text{H} : \text{mole} = \frac{8.65}{1} = 8.65</math></p> <p><math>\text{C} : \frac{6.17}{1.23} = 5</math></p> <p><math>\text{N} : \frac{1.23}{1.23} = 1</math></p> <p><math>\text{H} : \frac{8.65}{1.23} = 7</math></p> <p>} ratio of elements.</p> <p>The empirical formula <math>\Rightarrow \text{C}_5\text{NH}_7</math></p>	<p>b) Molar mass of <math>\text{C}_5\text{NH}_7 = (5 \times 12) + 14 + (7 \times 1) = 81 \text{g/mol}</math></p> <p>But it should be 162.2g/mole</p> <p><math>\frac{162.2}{81} = 2</math></p> <p>Thus molecular formula is <math>\text{C}_{10}\text{N}_2\text{H}_{14}</math></p>
<p>4 a) <math>\text{MmO}_3 = 48 \text{g/mol}</math></p> <p><math>\text{Mm No} = 30 \text{g/mol}</math></p> <p><math>n\text{O}_3 = \frac{0.74}{48} = 0.015 \text{ mol}</math></p> <p><math>n\text{NO} = \frac{0.67}{30} = 0.0223 \text{ mol}</math></p>	<p>3 a) i) Test tube A</p> <p>ii) Powdered has greater reaction surface than the pieces of <math>\text{CaCO}_3</math></p> <p>b) No</p> <p>c) - Add more concentrated HCl to each test-tube.</p> <p>- Heat the test tube</p> <p>4. b) From the equation: 1 mol of <math>\text{O}_3</math> combines with 1 mol of NO</p> <p>Hence 0.0154 mol of NO</p> <p>The <math>\text{O}_3</math> yields the smaller product hence it is the limiting agent</p> <p>Or Needed Ration = <math>\frac{1}{1}</math></p> <p>Actual ration = <math>\frac{03}{\text{NO}} = \frac{0.0154}{0.0223} = 0.69 \text{L } 1</math></p> <p><math>\text{O}_3</math> is thus the limiting reagent</p>

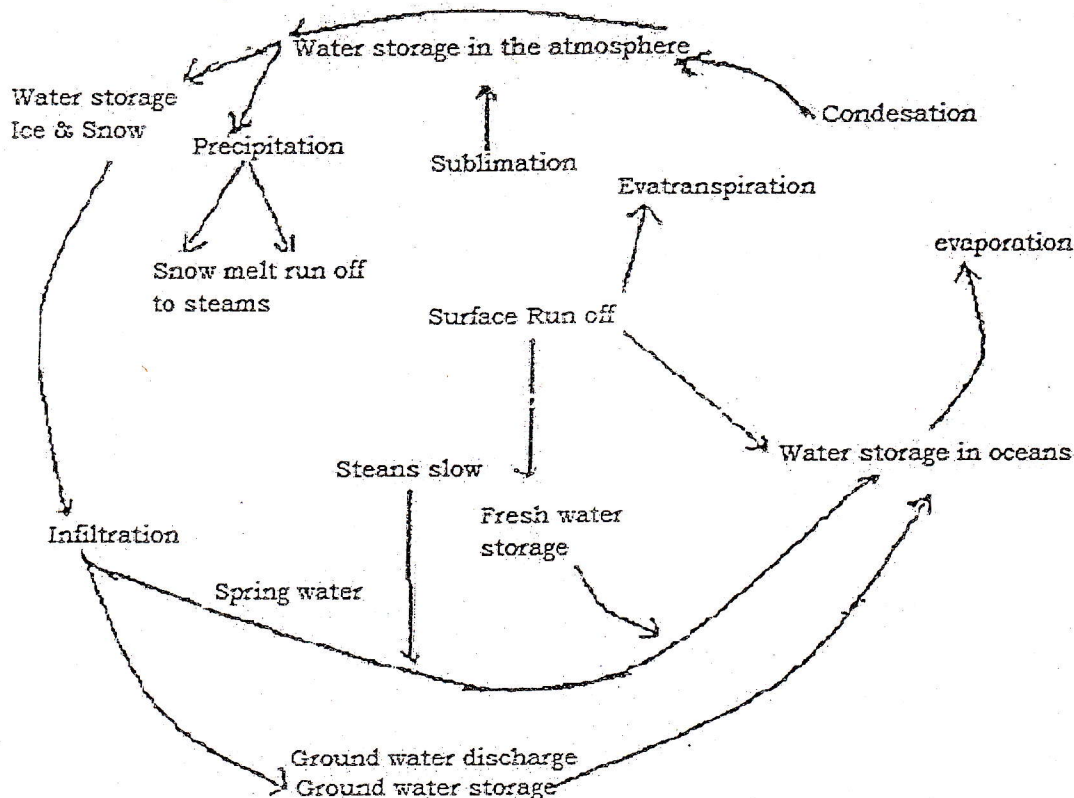
<p>5 a) Global warming</p> <p>b) The rise in carbon dioxide levels in the atmosphere as a result of the growing population and technological progress</p>	<p>5. c) - Rise in sea level, Floods, Droughts, More heat-waves, Spreading of diseases and insects (malaria), Melting of icebergs</p> <p>d) - Limited use of fossil fuels - Delay damage to the ozone layer by reducing CFCS</p>															
<p>6. a) Total molar mass (<math>MgSO_4 \cdot 7H_2O</math>)</p> $24+32+(16 \times 4)+7 \times [(2 \times 1)+(16 \times 1)]$ $120+126$ $246g/mol$ $\% = \frac{32}{240} \times 100 = 13.01\%$	<p>b) <math>\% H_2O = \frac{126}{246} \times 100 = 51.22\%</math></p> <p>Thus <math>\frac{51.22}{100} \times 5g = 2.56g</math></p>															
<p>7 a) Bond length</p> <p>b) Redox reaction or oxido-reduction reaction</p>	<p>c) Concentration</p> <p>d) Electrolyte</p>															
<p>8 a) Because hydrogen has one electron in the outer shell like alkali metals it can lose it and form monovalent in like alkali</p>	<table border="1"> <thead> <tr> <th>b) <math>N_2</math> needed</th> <th><math>H_2</math> needed</th> <th>To form <math>NH_3</math></th> </tr> </thead> <tbody> <tr> <td>1 <math>cm^3</math></td> <td>3 <math>cm^3</math></td> <td>2 <math>cm^3</math></td> </tr> <tr> <td>15 <math>cm^3</math></td> <td>45 <math>cm^3</math> (only one have 30<math>cm^3</math>)</td> <td></td> </tr> <tr> <td>impossible</td> <td></td> <td></td> </tr> <tr> <td>10 <math>cm^3</math></td> <td>30 <math>cm^3</math></td> <td>20 <math>cm^3</math></td> </tr> </tbody> </table> <p>Thus, (15 - 10) = 5<math>cm^3</math> remains; and 20<math>cm^3</math> <math>NH_3</math> is formed</p> <p>Final volume of gas = 5 + 20 = 25<math>cm^3</math> gas.</p>	b) $N_2$ needed	$H_2$ needed	To form $NH_3$	1 $cm^3$	3 $cm^3$	2 $cm^3$	15 $cm^3$	45 $cm^3$ (only one have 30 $cm^3$ )		impossible			10 $cm^3$	30 $cm^3$	20 $cm^3$
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<p>9. 1. H</p> <p>2. E, J</p> <p>3. I</p> <p>4. C</p> <p>5. C, D</p> <p>6. G</p>	<p>10.</p> <p>a) i) Sodium bicarbonate (1 mark) sodium hydrogen carbonate</p> <p>ii) Carbonate sulphite</p> <p>b) i) <math>(NH_4)_2SO_4</math></p> <p>ii) <math>Al(OH)_3</math></p>															
<p>12 a) Is a technique used to diminish the concentration of sodium</p> <p>b) <math>C_i = 15M</math></p> <p><math>V_i = ?</math></p> <p><math>C_f = 0.1M</math></p> <p><math>V_f = 1.5L</math></p> <p><math>C_i V_i = C_f V_f</math></p> <p><math>V_i = \frac{C_f V_f}{C_i}</math></p> <p><math>V_i = \frac{0.1M \times 1.5L}{15M} = 0.01L</math></p>	<p>11 a) Elements are the basic units of material; they are pure substances that cannot be broken down into simpler substances by chemical methods.</p> <p>b) Hydrogen - Gas</p> <p>Nitrogen - Gas</p> <p>Oxygen - Gas</p> <p>Fluorine - Gas</p> <p>Chlorine - Gas</p> <p>Bromine - Gas</p> <p>Iodine - Gas</p>															

13 a) Covalent bond

b) There is a trend of decrease of boiling points with decrease of molecular weight from  $H_2Te$  to  $H_2S$ .

But there is a share increase in case of  $H_2O$ , although it has the smallest molecular weight. The reason is that the molecules of water are associated by hydrogen bonds between them, while  $H_2Te$ ,  $H_2Se$  and  $H_2S$  exist as single molecules since they are incapable of forming hydrogen bonds. Therefore, more energy is required to separate the molecules of water as they enter the gaseous state or the liquid.

14.



15 a) Number of protons

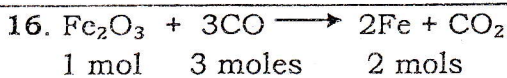
b) Brittle

i. Dull

ii. Does not conduct electricity

c)  ${}_{15}^{32}X$  and  ${}_{15}^{33}X$

SECTION B:

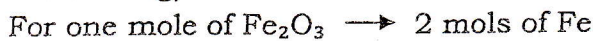


a)  $Fe_2O_3 = 500kg = 500,000g$

$Mm_{Fe_2O_3} = (56 \times 2) + 16 \times 3 = 160g/mol$

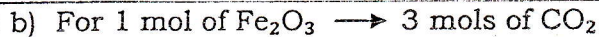
$Fe_2O_3 = \frac{M}{Mm} = \frac{500,000}{160} = 3125 \text{ moles}$

$Fe = 56g/mol$

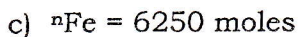


$m_{Fe} = Fe \times Mm_{fe}$

$6250 \times 56g = 3350.000g$



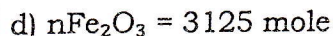
$V_{CO_2} = n_{CO_2} V_m = 9375 \times 22.41 = 210.000 \text{ L}$



number of atoms =  $n \times N_A$

$= 6250 \times 6.023 \times 10^{23}$

$= 3.76 \times 10^{27} \text{ Fe atoms.}$



Number of atoms =  $n \times N_A \times 5$

$= 3125 \times 6.023 \times 10^{23} \times 5$

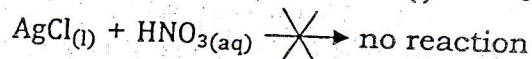
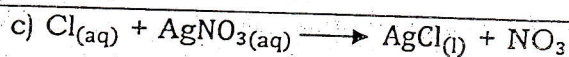
$= 9.41 \times 10^{27} \text{ atoms}$



17. a) - Test tube, Ag NO<sub>3</sub>, Sea water, Concentrated HNO<sub>3</sub>.

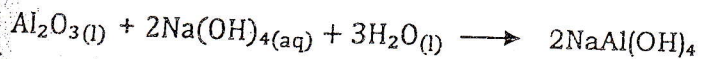
b) Method:

- Pour a small amount of sea water into the test tube
- Add AgNO<sub>3(aq)</sub> to the test tube and observe if a white precipitate forms
- If a precipitate forms, add a few drops of conc. HNO<sub>3</sub>.
- If the precipitate does not react with the acid, it is possibly AgCl, and the sea water contained chloride ions.



- d) The precipitate is white
- e) Yes, because sea water contains dissolved ions and it is possible that the sample will contain some bromide and iodide ions as well. AgBr and AgI are both insoluble in HNO<sub>3</sub>

18. a) The ore is dissolved in conc sodium hydroxide solution to form sodium aluminate.

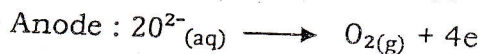
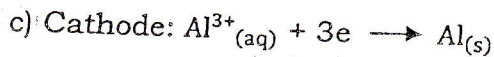


The solution is filtered and the filtrate diluted then carbon dioxide is blown through it, Aluminium hydroxide is the precipitate as a result.

The aluminium hydroxide is then heated to produce Aluminium oxide.



b) To lower the melting point of Aluminium oxide



d) Because it is burnt to carbon dioxide in the oxygen produced.

e) - Because aluminium is a stronger reducing agent than carbon, hence Al<sub>2</sub>O<sub>3</sub> cannot be reduced. (i.e Al is above C in the electrochemical series)

- Because Al reacts with carbon to form aluminium carbide (Al<sub>4</sub>C<sub>3</sub>)

f) The cost of the mining and processing, as well as the availability of the metal play an important role.

19. a) From the CO<sub>2</sub> and H<sub>2</sub>O absorbed through their leaves and roots from the soil and air.

b) N : Nitrogen, P: Phosphorous, K : Potassium

The numbers indicate the percentage per mass of the substance

c) - They cause least environmental problems

- Substances are wasted minimally

- Insecticides can be added

- Nutrients are spread evenly

d) The leaching of too many nitrates and phosphates (in fertilizers) into natural water resources may lead to eutrophication. This can take place during heavy rains or when too much fertilizers are administered. When there is an excess of nutrients in the water, blue-green algae thrive. The algae contain waste products, which taint the water and make it unsuitable for drinking.

When the algae die, the excessive decomposing matter uses up oxygen in the water. Lack of oxygen then leads to the death of animals living in the water. Diseases spread through use of the water due to the contamination. Excess nitrates can decrease the ability of blood to carry oxygen. The wind can carry fertilizers (administered by earphones) to nearby lakes.

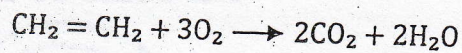
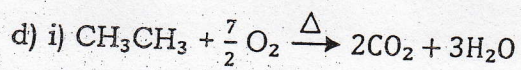
20. a) i) Different boiling points  
 ii) Ethane, because Ethane has a lower boiling point than butane or Ethane's mass is smaller than that of butane.
- b) i) Methylmethanoate  
 ii) - Methanol, Ethanoic acid  
 iii)
- $$\text{CH}_3 - \text{CH}_2 - \overset{\text{O}}{\parallel} \text{C} - \text{OH} \quad (\text{Propanoic acid})$$
- c) Amine:  $-\overset{|}{\underset{|}{\text{C}}}-\text{N} \begin{matrix} / \\ \backslash \end{matrix}$       Ketone:  $-\text{C}-\overset{\text{O}}{\parallel}{\text{C}}-\overset{|}{\text{C}}$
- d) Saturated hydrocarbon due to lack of double or triple bonds.

### SECTION C

21. a) The concentration of an acid solution can be determined by means of a titration process, By knowing the quantity of a base required to neutralize a certain quantity of acid.
- b) Independent = volume acid  
 Dependant = volume base
- c) i)  $\text{HCl} + \text{NaOH} \rightarrow \text{H}_2\text{O} + \text{NaCl}$   
 $\text{H}^+ + \text{Cl}^- + \text{Na}^+ + \text{OH}^- \rightarrow \text{H}_2\text{O} + \text{Na}^+ + \text{Cl}^-$   
 $\text{H}^+ + \text{OH}^- \rightarrow \text{H}_2\text{O}$
- ii)  $\text{CaV}_a = \text{CbV}_b$   

$$\text{V}_b = \frac{15.3 + 15.15 + 15.2}{3} = 15.22 \text{ cm}$$
  

$$\text{C}_a = \frac{\text{C}_b \text{V}_b}{\text{V}_a} = \frac{0.1 \text{ M} \times 15.22}{20} = 0.076 \text{ M}$$
- iii) Caustic soda
- d) The Ph will rise to approximately seven
- e) Exothermic (The energy of the products is lower than the energy of the reagents)
- f) Titration
- g) An indicator is a substance which changes color in aqueous solution when the Ph is changed color in aqueous solution when the PH is changed.
22. a) - Wear gloves, Wear goggles, Wear a gas mask, Perform the experiment in fume cupboard or outside the lab or in a well ventilated room.
- b) Alkenes are more reactive than alkanes under identical conditions.
- c) i) Under the same conditions alkenes are more reactive than alkanes  
 ii) Alkenes react more readily in bromine than alkanes.



e) Monomies

f)  $\text{C}_1\text{H}_2\text{n}$



For 1 mol of  $\text{CH}_3\text{CH}_3 \longrightarrow 1$  mol of  $\text{HBr}_{(g)}$

$$M_{m(\text{HBr})} = 1 + 80 = 81 \text{ g mol}^{-1}$$

$$\left. \begin{array}{l} V\text{CH}_3\text{CH}_3 = 2 \text{ cm}^3 = 2 \times 10^{-3} \\ \text{CH}_3\text{CH}_3 = 1.212 \text{ g} \end{array} \right\} \longrightarrow m = V \cdot d = 1.212 \times 2 \times 10^{-3} = 2.424 \times 10^{-3} \text{ g}$$

$$M_{n\text{CH}_3\text{CH}_3} = 30 \text{ g/mol} \quad n\text{CH}_3\text{CH}_3 = \frac{m}{M_m} = \frac{2.424 \times 10^{-3}}{30} = 8.08 \times 10^{-5} \text{ mole}$$

$$m\text{HBr} = n \times M_m = 8.08 \times 10^{-5} \times 81 \text{ g} = 654.48 \times 10^{-5} \text{ g}$$

**END.**