INDUSTRIAL PROCESSES DETAILED NOTES AND SAMPLE QUESTIONS

(I regret for any mistake if noted)

S4 TERM ONE TOPIC

NEW LOWER SECONDARY CURRICULUM

(CHEMISTRY)

BY

TR. KISULE JOSEPH
(0751339538-0786570990)
kisjo19961@gmail.com

DEDICATED TO YOU

The attached questions are almost enough for a student to have a general idea/concept about this region(**content/subtopic**) in chemistry, however, I advise a student to search for more related questions about this content area for **better results**.

CONTENT:

1. ***Industrial processes***
2. ***Some sample questions on the above topic***
3. ***Try so hard to answer the sample questions and look for more qns.***

Don't say tomorrow, it will be too late for chemistry revision, and yesterday is gone forever, you have got today to revise your chemistry!

"Revise as if tomorrow is not there"

May god bless you

Industrial processes

These are the procedures involved in manufacturing of items.

Or;

An industrial process is a set of procedures that convert material resources into finished commodities.

Industries do a great work of processing raw materials into finished products ready for use by the final consumer.

There is a variety of natural resources in Uganda, ranging from minerals, stones, plants and animals.

These act as a starting point for many manufacturing industries within your locality.

Examples of some industries, their products and uses

Industry	Product	Name of product	Use of some products
Textile industry		clothes	Covering the body
Steel making industry		Steel bars, iron nails, iron sheets	Construction
Battery industry		Battery	Providing electric energy
Mining industry		Cement	Building houses
Plastics industry		Plastic chairs, plastic buckets, plastic cups, jerrycans etc	Sitting on, carrying water, taking water/tea, fetching water.
Fertilisers industry		Fertilisers	Restoring soil fertility
Beverage's industry/Soda drinks industry/food industry		soda	Human consumption
Water industry/food industry		water	Human consumption
Sugar industry/food industry		sugar	Human consumption

Soap making industry.		Soaps and detergents	Washing
Soap making industry		Sanitizer	Killing micro-organisms
Cosmetics industry		Jelly	Human beautification

Describe how industries relate to each other

Industries are interdependent on the other so that the economy as a whole function properly and efficiently. The primary sector is where the materials for the secondary industry are gathered. In the secondary sector, the product is then made into consumable product which is then distributed by the tertiary industry.

Types/Classification of industries.

Industries can be classified as;

- Primary
- Secondary
- Tertiary

Primary industries

These are industries that produce or create products that are sold to the public.

Examples of primary industries.

- Lumbering
- Mining
- Farming
- fishing

Secondary industries

These are industries that process raw materials from the primary sector into finished products.

The products manufactured under secondary sector are either consumed by the consumers or used as raw materials for other processing industries.

Examples of secondary industries.

- Oil refinery
- Cement industry

Tertiary industries

These are industries that provide services and facilitate a smooth flow of goods and services in the market.

Examples of tertiary industries.

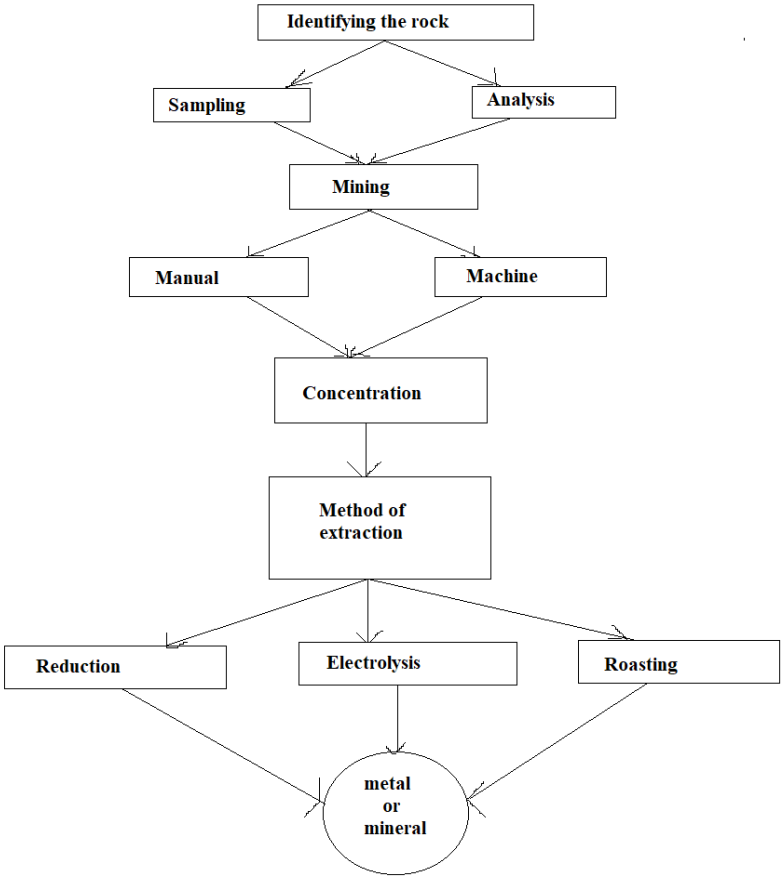
- Warehousing
- Insurance
- Banking
- Transport
- Advertising

Some industries, corresponding products their products

Industry	Product	Class of industry
Mining	Limestone	Primary
Processing	Cars	Secondary
Service	telecommunication	Tertiary

Processes of obtaining useful chemicals from rocks

Summary of the processes



Sample questions and answers

1. Why are sampling and analysis of the rock necessary before mining?
   - Sampling helps in obtaining information which is necessary for the economic assessment of the ores.
   - Analysis gives information about the ore before massive mining can begin
2. State at least two ways in which sampling is done.
   - Hand sampling
   - Machine sampling or excavation
3. Compare manual and excavation (machinery) methods of mining.
   - The manual method consumes more time than the excavation method
   - The manual method is also risker in terms of accidents than the excavation method.
4. State three properties of the ore considered before concentration of the ore is done.
   - Chemical composition of the ore
   - Conductivity of the ore

- Solubility of the ore
- Density of the ore

5. Outline three ways in which the ore is concentrated.
   - Froth flotation
   - Roasting
   - Gravity separation
6. Complete the table by giving examples of metals extracted by each of the methods indicated.

Method of extraction	**Examples of metals extracted**
Electrolysis	Sodium, potassium
Chemical reduction	Iron, aluminium
Roasting in air	Zinc, copper
No extraction process method needed	Gold, silver

Useful chemicals from rocks

Most rocks are made up of naturally occurring inorganic solids that have a crystalline structure and a distinct chemical composition.

These are known as minerals and are chemical in nature.

Examples of elements that make up the minerals (and their uses) found in the Earth's rocks

Note (research about the image of each mineral element from baroque**)**

Mineral	Chemical Symbol/ formula	Image	Use
Silver	Ag		➢ Making jewellery ➢ Making trophies ➢ Making mirrors
Copper	Cu		➢ Making electric wires ➢ Used in construction such as roofing ➢ Making jewellery
Graphite	C		➢ Making lead pencils ➢ Making electronic products, such as electrodes. ➢ Making lubricants
Cinnabar	HgS		➢ Making colouring paints

			➢ Providing mercury
Galena	PbS		➢ Manufacturing lead ➢ Making lead pipes and sheets
Pyrite	FeS_2		➢ Used in the production of sulphur dioxide. ➢ Used in the production of sulphuric acid.
Halite or rock salt	NaCl		➢ It is added in food to make it tasty. ➢ Used to preserve food such as fish. ➢ It maintains blood pressure.
Corundum	Al_2O_3		➢ Used as an abrasive ➢ Grinding optical metals ➢ Polishing metals
Cuprite	Cu_2O		➢ Making jewellery
Haematite	Fe_2O_3		➢ Producing pigments. ➢ Radiation shielding
Calcite	$CaCO_3$		➢ Used as a construction material ➢ For agricultural soil treatment.
Dolomite	$CaMg(CO_3)_2$		➢ As an ingredient in the production of glass, bricks, and ceramics.
Gypsum	$CaSO_4.2H_2O$		➢ Manufacture of wallboard, cement.
Anhydrite	$CaSO_4$		➢ Used as a drying agent ➢ in plaster, pant, and varnish.
Albite	$NaAlSi_3O_3$		➢ Manufacture of glass and ceramics.
Olivine	$(Mg,Fe)_2SiO_4$		➢ Added to blast furnaces to remove impurities from steel and to form a slag
Orthoclase	$KAlSi_2O_8$		➢ Manufacture of glass and ceramics.

Quartz	SiO_2		➢ Used to make oscillators for watches, clocks, radios, televisions, electronic games, computers.

Extraction and purification of metals

Metals are electropositive, they ionize by loss of electrons to form positively charged ions. They are therefore reducing agents.

Occurrence of metals.

Metals occur in the earth's crust as **ores.**

An ore is a rock which contains metal compounds from which metals can be extracted. Therefore, ores are the major source of metals on earth.

General idea on extraction of metals

For a metal to be extracted, its concentration in a given ore must be high.

Therefore, it is necessary to concentrate (purify) the ore before extracting the metal.

The method of metal extraction normally depends on the position of the metal in the electrochemical/reactivity series.

K, Na, Ca, Mg, Al — These are very reactive metals according to their order and therefore form very stable compounds. They are not found as free elements and can only be extracted from thier compounds by electrolysis

Zn, Fe, Pb — These are moderately reactive metals. They usually occur as ores in form of oxides, sulphides, carbonates and more other forms. They are extracted by reduction of the ores using either carbon or carbon monoxide

Cu, Hg, Ag, Au — These are not very reactive. They are therefore found as free elements. They are the easiest to extract since they form unstable compounds. They can be extracted by mere heating of the ore

Note;

We only look at the extraction of only three metals, one metal from each category, that is to say;

- Aluminium, Al
- Iron, Fe
- Copper, Cu

The processes involved in extracting and purifying metals especially intermediate metals in Uganda.

The metals are extracted by reduction and there have four basic stages in the process after obtaining the ore/mining;

1. Concentration of the ore
2. Roasting of the ore to convert the carbonates and sulphides to oxides and remove water vapour. It is easier to reduce the oxide than the carbonate, that's why ores are heated directly in air before electrolysis.
3. Reduction of the ore
4. Purification/refining of the metal extracted

Concentration of the ore

This process involves removing impurities.

Impurities can be separated by physical means like, picking by hand, washing, using a magnet or solvent extraction.

In the case of copper, the ore is first crushed and then mixed with water.

Air is then blown through the mixture and the clean ore separates and collects at the surface as froth. This is referred to as froth floatation.

Roasting

The concentrated (pure) ore is roasted in air at high temperatures to produce oxides which are easier to reduce than carbonates or sulphides.

Sulphur is removed as sulphur dioxide and carbon dioxide driven off from the carbonates.

e.g.,

zinc sulphide + oxygen ⟶ sulphur dioxide + zinc oxide

Reduction of the ore

The ore is usually heated in a furnace in the presence of a suitable reducing agent, usually coke (carbon) or carbon monoxide which converts the ore into the required metal.

e.g.,

Iron(III) oxide + carbon dioxide ⟶ iron + carbon dioxide

Purification/refining of the metal

The metal obtained is often impure. Purification is normally done by electrolysis in the case of copper and zinc. In other cases, the impure metal is heated in a hearth open to air where the impurities oxidize and rise to the surface as a scum and can be removed.

COPPER

The principle/ chief ores of copper are:

- copper pyrites ($CuFeS_2$);
- cuprite (Cu_2O);
- copper (I) sulphide (Cu_2S) or glance and
- malachite ($CuCO_3$, $Cu(OH)_2$).

Extraction of copper from copper pyrites

The ore obtained from mining is first concentrated by a process of froth floatation and then it is roasted in air to produce copper(I) sulphide.

$$2CuFeS_2(s) + 4O_2(g) \longrightarrow Cu_2S(s) + 3SO_2(g) + 2FeO(s)$$

By adding silicon dioxide (sand) and heating the mixture in the absence of air, the solid iron (II) oxide impurity is converted into slag which is poured off with the reaction mixture leaving behind only copper (II) sulphide.

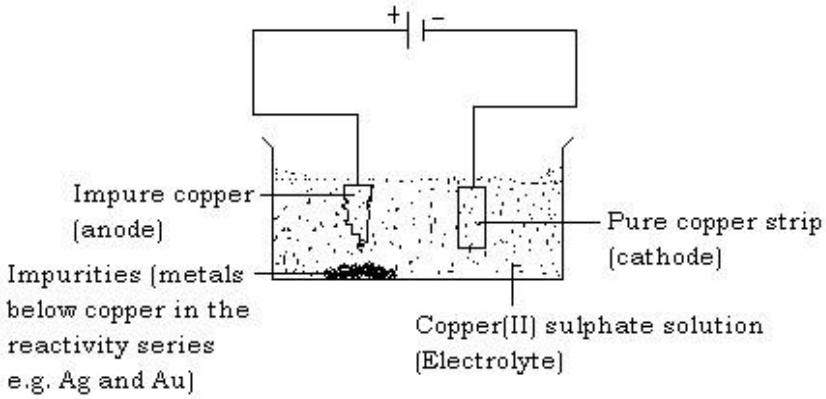
The copper (II) sulphide is reduced to metallic copper by heating in a regulated supply of air (oxygen).

$$Cu_2S(s) + O_2(g) \longrightarrow 2Cu(s) + SO_2(g)$$

(Impure copper)

The metallic copper produced is impure copper (blister copper) and has to be purified. Purification of the copper is done by the process of electrolysis.

Purification of blister copper



The impure copper/blister copper is made the anode and strip of pure copper serves as the cathode.

The electrolyte is acidified solution of copper (II) sulphate.

During electrolysis, pure copper is transferred from the impure copper anode to the pure copper cathode.

Therefore, the anode dissolves and decreases in size as the cathode grows bigger.

At the anode (impure)

$Cu(s) - 2e \longrightarrow Cu^{2+}(aq)$

At the cathode (pure)

$Cu^{2+}(aq) + 2e \longrightarrow Cu(s)$

(Pure copper)

Ions above copper in the reactivity series remain in the solution.

Uses of copper

- For wiring electrical circuits since it is a good conductor of electricity and is relatively cheap. The copper used for this purpose must be very pure since impurities increase electrical resistance.
- It is used for making ornaments like ear rings and pins, bungles e.t.c. being little attacked by air.
- It is used for making alloys like bronze (copper and tin) and brass (copper and zinc), copper coinage (copper and tin), German silver (copper, zinc and nickel) - Used for making water pipes and boilers.
- Copper is used as a roofing material because it weathers to acquire a coating of green basic copper carbonate, $CuCO_3.Cu(OH)_2.\ nH_2O$, which lends a colourful touch to the building.

Sample Questions on copper extraction

(kindly look for more questions from the library books **#dont wait for tomorrow**)

1. Identify the principle ores of copper

Diagram	Name
	Copper pyrites
	Copper glance
	Malachite
	Cuprite

2. Mention where in Uganda can such ores be found
   - Kilembe mines in Kasese
3. State the main steps involved in extracting copper from its ores
   - Mining,
   - Concentration,
   - Roasting, and
   - Purification.
4. Describe how copper mining affects the environment
   - Erosion
   - Formation of sink holes
   - Destruction of ecosystems and habitats
   - Contamination of soil and water by chemicals from mining processes
5. State the uses of copper in everyday life.
   - Check the notes above

IRON

The principle/chief ores of iron are:

Structure	Name
	Haematite, Fe_2O_3
	Magnetite, Fe_3O_4
	Iron pyrite, FeS_2

	Siderite or Spathic iron ore ($FeCO_3$)
	Limonite ($Fe_2O_3.xH_2O$).

These ores in Uganda can be found in

- Muko in Kabale district
- Kisoro district
- Sukulu and Bukusu in Tororo district

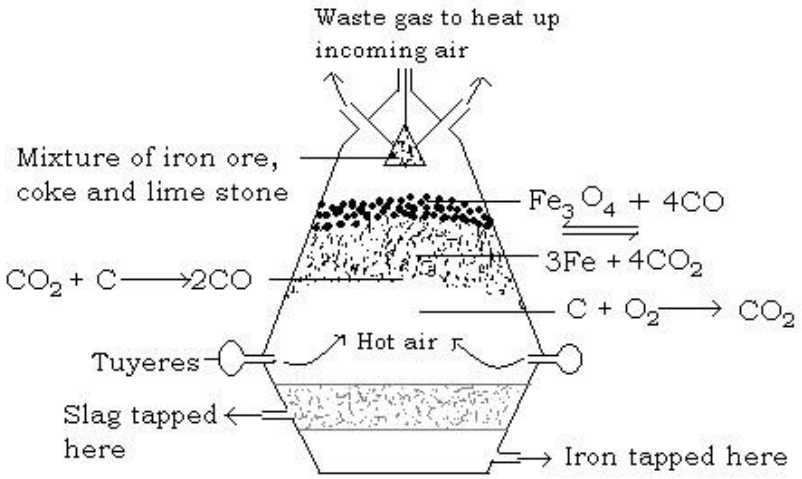
Extraction process (iron from magnetite, Fe_3O_4).

The iron ore is crushed and roasted in air to remove water and other non-metallic impurities especially sulphur and phosphorus which are oxidized away as gaseous oxides.

The roasted ore is now mainly Fe_3O_4. When an ore is roasted in air and Fe_3O_4 is the main product, it is known as sintering

The roasted ore is mixed with coke (carbon) and limestone (calcium carbonate) and introduced into the blast furnace where the reduction of the ore takes place.

The blast furnace



Very hot air is introduced from low down into the blast furnace.

As the hot air passes through the mixture of roasted ore, coke and limestone, the coke burns to form carbon dioxide (is oxidized) in an exothermic process.

$C(s) + O_2(g) \longrightarrow CO_2(g)$

As the carbon dioxide produced rises through the furnace, it is reduced by the excess hot coke to produce carbon monoxide.

$CO_2(g) + C(s) \longrightarrow 2CO(g)$

The carbon monoxide formed reduces the iron ore at a high temperature (about 1000°C) to form iron metal.

$4CO(g) + Fe_3O_4(s) \longrightarrow 3Fe(s) + 4CO_2(g)$

The molten iron formed sinks to the bottom of the blast furnace where it is tapped and solidified into blocks of pig iron.

Note; The procedures are the same when using Haematite ore (Fe_2O_3)

The role of limestone

Limestone removes Silicon (IV) oxide which is the main impurity in the iron ore. Limestone at high temperature decomposes to form calcium oxide and carbon dioxide. The calcium oxide formed combines with silicon (IV) oxide (impurity) to form molten calcium silicate (slag).

$CaCO_3(s) \longrightarrow CaO(s) + CO_2(g)$

$CaO(s) + SiO_2(s) \longrightarrow CaSiO_3(s)$

The slag being less dense than iron forms a separate layer above iron and thus are tapped separately.

The slag protects the molten iron against any further oxidation by oxygen in the hot air in the blast furnace.

The carbon dioxide produced as a bi-product in the furnace is quickly reduced by hot coke to carbon monoxide which is required as a reducing agent.

By products from the blast furnace include:

- Calcium silicate/slag (used for making roads, manufacturing cement, manufacturing glass);
- Waste gases like Carbon dioxide, carbon monoxide, steam and unreacted nitrogen;
- Calcium phosphate (used as an in organic fertilizer).

Types of Iron

There are three types of iron which are classified based on their percentage purity. The percentage purity also determines the strength and use of the iron.

The types of iron are;

- Cast iron (pig iron)
- Wrought iron
- Steel.

Cast iron

This is an impure iron which contains relatively high proportions of carbon (4%) and small proportions of other substances such as silicon, phosphorus and sulphur.

Such impurities make cast iron to be hard, brittle and to have a lower melting point than pure iron. It cannot be welded and has little tensile strength.

Cast iron can be used to make hot water pipes, Bunsen burner bases, cookers, in railings and other purposes where little strain is imposed.

Wrought iron

This is the purest form of iron (contains about 0.3% carbon) and is obtained from cast iron by heating it with iron (III) oxide in a furnace by a process known as ―puddling‖.

The oxygen of the iron oxide oxidizes carbon and sulphur to their respective gaseous oxides, phosphorus to Phosphates(V) and silicon to silicates which form slag.

The semi molten mass is then hammered and rolled so that the slag is squeezed out and a mass of almost pure iron remains.

It is very tough, malleable and ductile and is therefore used to make iron nails, sheeting, ornamental work, horse shoes and agricultural implements.

Wrought iron is sometimes referred to as low carbon steel.

Steel

Steel is an alloy of mainly iron with carbon and other elements like manganese, chromium, silicon, cobalt and sometime tungsten.

The quality of steel depends on the amount of carbon present and this in turn determines its intended use.

Steel is generally used in the construction of buildings, bridges, ships, car bodies, cutting and boring tools, crushing machines and stainless cutlery such as knives, forks e.t.c.

Uses of iron

- Used in the manufacture of steel
- Used as a medical supplement
- Used to make bridges, bicycles, chains and cutting tools.

- Iron catalysts are used in the industrial production of ammonia

ALUMINIUM

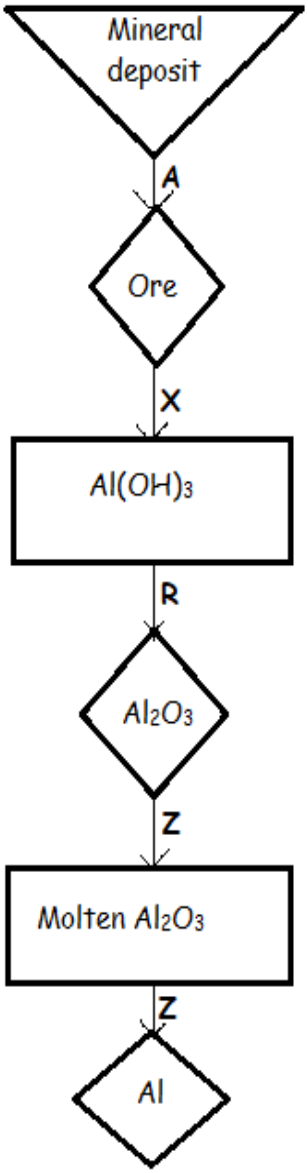
The principle ore of aluminium is; bauxite.

Sample questions on Aluminium extraction.

Study the figure below and answer the questions that follow

1. Name the processes taking place at;
   - **A**-Mining
   - **X**-Concentration
   - **R**- Roasting
   - **Z**-Melting
   - **M**- Electrolysis
2. Describe what takes place in the processes X, Z, M, and R.
   - At X, the ore is crushed and mixed with concentrated sodium hydroxide solution.
   - At R, pure aluminium hydroxide is heated to form pure aluminium oxide.
   - At Z, aluminium oxide is dissolved in molten cryolite to lower its melting point.
   - At M, the mixture of aluminium oxide in molten cryolite is electrolyzed between graphite electrodes.
3. Mention the uses of aluminium.
   - Aluminium is used in the manufacture of food packing materials, aircrafts, source plans and cars.

Note; aluminium is a widely used metal because of its light weight.



FERTILISERS

A fertilizer is a substance containing essential elements for the healthy growth of plants. When added to the soil, fertilisers normally improve soil fertility.

The most important elements are nitrogen, potassium, and phosphorus and sometimes sulphur.

These elements are absorbed by plants as compounds especially as nitrates phosphates.

Nitrates as fertilisers

Nitrates are obtained from nitrogen as one the major elements to form nitrate fertilisers.

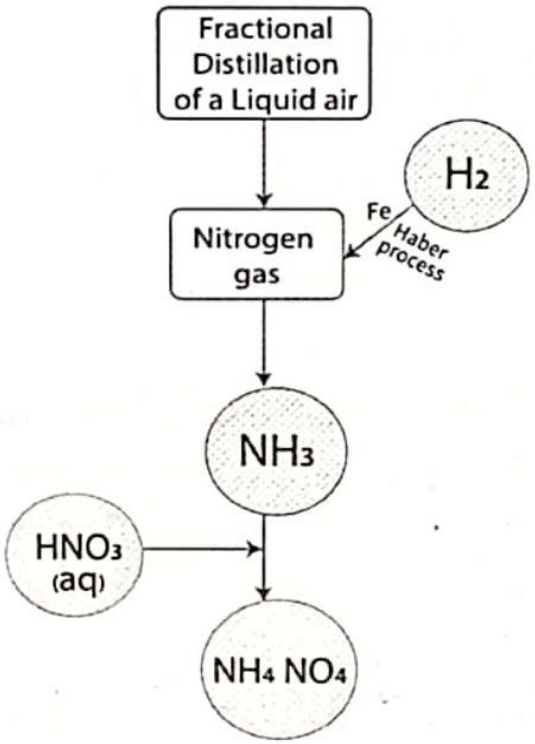
Uses of nitrogen

- Used in the manufacture of fertilisers
- Used in the manufacture of ammonia

Obtaining nitrates from nitrogen starting from atmospheric air

- The atmospheric air is trapped and condensed to form liquid air.
- The liquid air is pumped into the plant where it goes through various stages until it reaches the fractionating column where it is slowly warmed up and the air components(gases) boil off one by one according to their boiling point. Nitrogen having the lowest boiling point (-196^0C), it is obtained first.
- Hydrogen gas is then mixed with nitrogen in the presence of finely divided iron catalyst and the mixture is heated to form ammonia gas.
  $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) + heat$
- The ammonia gas is then mixed with nitric acid to form ammonium nitrate
  $HNO_3(aq) + NH_3(g) \longrightarrow NH_4NO_3(aq)$
- The ammonium nitrate obtained acts as the fertilizer containing nitrogen.

Summary using a flow chat



Conversion of nitrates into fertilisers

Ammonia.

On daily basis, our bodies produce urine on daily basis.

The smell of the urine is due to ammonia vapour residues in urea.

Ammonia naturally occurs in many parts of the environment like in soil, air, and vegetation.

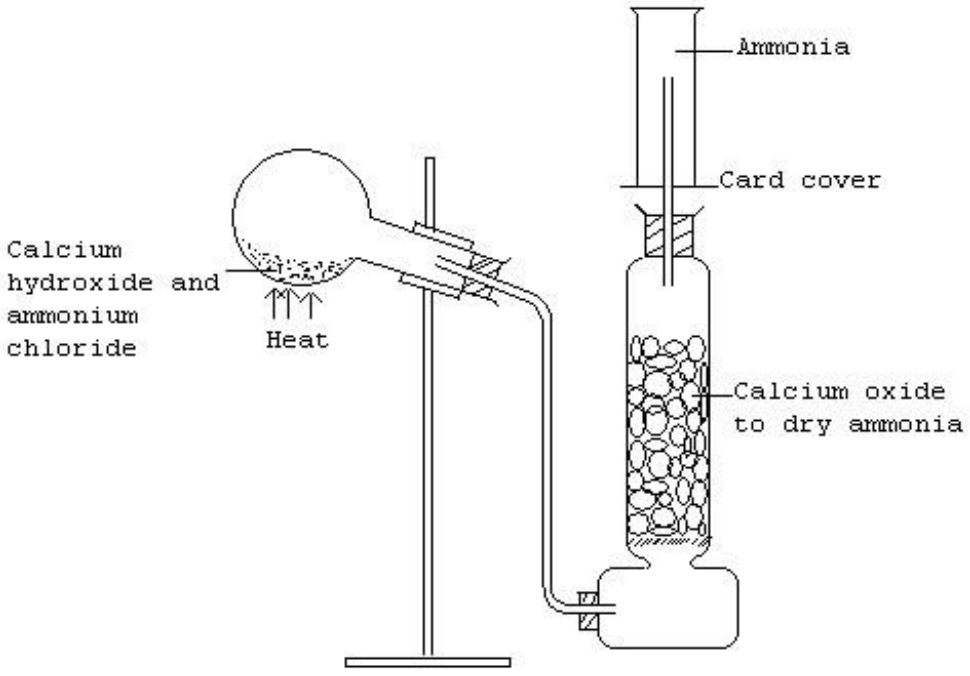
Ammonia is an essential compound of nitrogen and hydrogen.

Ammonia can be prepared in the laboratory.

Laboratory preparation of ammonia gas

- Round bottomed flask
- Gas jar
- Source of heat
- Cork
- Retort stands and clamps
- Delivery tube
- Ammonium chloride
- Calcium hydroxide
- Calcium oxide (quick lime) to dry ammonia
- Litmus paper

Setup of apparatus



Procedure

- Assemble the apparatus as shown in the diagram above
- Grind a mixture of ammonium chloride and calcium hydroxide and place it in a round bottom flask of a hard glass

NB. The neck of the flask should bend down wards and the flask should be in a slanting position because the formed water vapour will condense and if allowed to run back on the hot flask causes breakage

- Heat the mixture in the flask to evolve ammonia gas

Equation

$Ca(OH)_2(aq) + 2NH_4Cl(aq) \longrightarrow 2NH_3(g) + CaCl_2(aq) + 2H_2O(l)$

- The gas is then dried by passing it over lumps of calcium oxide.

Haber process (industrial manufacture of ammonia)

Most of the ammonia used today is manufactured by reacting nitrogen and hydrogen at the temperatures of 400-500°C and a pressure of 200 atmospheres.

Finely divided iron is used as a catalyst in the industrial manufacture of ammonia.

Sample questions and answers

1. On testing ammonia with moist litmus paper, what did you observe?
   - The red litmus paper turned blue and the blue litmus paper remained blue.
2. Write an equation for the formation of ammonia from calcium hydroxide and ammonium chloride.
   $Ca(OH)_2(aq) + 2NH_4Cl(aq) \longrightarrow 2NH_3(g) + CaCl_2(aq) + 2H_2O(l)$
3. Explain the role of calcium oxide in the preparation of ammonia.
   - To dry ammonia gas
4. Why is ammonia gas collected by upward delivery?
   - Ammonia gas is less dense than air.
5. How important is ammonia gas?
   - Used as a refrigerant gas.
   - Usec in the manufacture of fertilisers.
   - Used in the manufacture of plastics, pesticides, dyes and other chemicals.
   - Used as an ingredient in many cleaning products.

Fertilisers from ammonia gas

Ammonia is converted into a variety of fertilisers, such as potassium nitrate, ammonium nitrate, ammonium sulphate and diammonium phosphate (DAP), calcium ammonium nitrate (CAN).

These fertilisers are better than each other depending on the nitrogen composition.

The best fertiliser is the one with the highest composition of nitrogen.

Structure/photo of the above fertilisers

These fertilisers are known as **inorganic fertilisers**
Inorganic fertilisers are therefore synthetic fertilisers that contain a high percentage of essential elements like nitrogen, phosphorus and potassium. They are relatively cheap and soluble in water.

Sample questions and answers
Consider the fertilisers in the table below

Fertiliser	Chemical formula
Ammonium nitrate	NH_4NO_3
Potassium nitrate	KNO_3
Urea	NH_2CONH_2

a) Calculate the molar mass of each compound in the table above. (RAM; N=14, H=1, O=16, K=39.1, C=12).
Molar mass of NH_4NO_3
= (2X14) +(4X1) +(3X16)
=80
Molar mass of KNO_3
= (1X39.1) + (1X14) + (3X16)
= 101.1
Molar mass of NH_2CONH_2
= (2X14) + (4X1) + (1X12) + (1X16)
= 60

b) Calculate the percentage composition of nitrogen in each of the compounds.
Ammonium nitrate
Mass of nitrogen in NH_4NO_3
= (2X14)
= 28g
Percentage composition of nitrogen in NH_4NO_3
= $(\frac{28}{80}X100)\%$
= 35%
Potassium nitrate
Mass of nitrogen in KNO_3
= (1X14)
= 14g
Percentage composition of nitrogen in KNO_3
= $(\frac{14}{101.1}X100)\%$
= 13.8477%
Urea

Mass of nitrogen in NH_2CONH_2

= (2X14)

= 28g

Percentage composition of nitrogen NH_2CONH_2

= $(\frac{28}{60}X100)\%$

= 46.667%

c) Write the compounds in descending order, with respect to the percentage compositions of nitrogen.
   - Urea, Ammonium nitrate, Potassium nitrate

d) Identify the best fertiliser out of the three fertilisers. Give a reason for your answer.
   - The best fertiliser is urea, since it has the highest percentage of nitrogen.

Preparation of ammonium nitrate fertiliser

- Ammonium nitrate is produced by reacting nitic acid with ammonia
- The resulting solution is concentrated to 97.5% - 98% in the final concentrator.
- The concentrated solution is fed to a prilling tower, and some part of the solution is fed to a slurry tank.
- In the slurry tank, the filter is dispersed, the oversize and small fines are melted.
- The 97.5% ammonium nitrate solution from the concentrator is discharged and the moisture content of the mixture is adjusted by the addition of scrubbing liquor.

Health awareness

Nitrates and nitrites are widespread contaminants of vegetables, fruits, and waters. Fertilisers applied to crops can be washed into rivers and leached into soil and ground water.

The levels of these compounds are increased as a result of wastes from chemical industries, effluents, nitrogenous fertilisers, and herbicides in agriculture.

Therefore, determining the nitrate and nitrite levels in biological food and food samples in important for human health and the environment.

Organic fertilisers such as cow dung, plant materials (humus) and human waste have less harm to the environment, and therefore can be used in preference to inorganic fertilisers.

Industrial processes that make use of natural resources

- Power generation
- Fish processing
- Turning wind turbines
- Cement manufacturing
- Textile production

- Processes in the oil and gas industry

Industries that use natural resources

Natural resource	Processes that make use of the natural resource	Industry in which the resource is used
Lakes	Fishing	Fish processing industry
Rivers	Generation of hydro-electric energy.	Hydropower industry
Swamps	Disposal of wastes from the industries.	Water purifying industries
Forests	Carpentry	Wood and pulp industry
Air	Signal transfer	communication

Technology and environment.

Technology has improved transport, industry, and communications in everyday life.

Technology has also improved the quality of the environment. For example, energy used at home can be generated from different sources, such as the sun, water and biomass.

Explain how technology has improved the use of natural resources in the industrial sector.

-

Importance of industrial processes in utilizing natural resources to make useful chemicals

- H

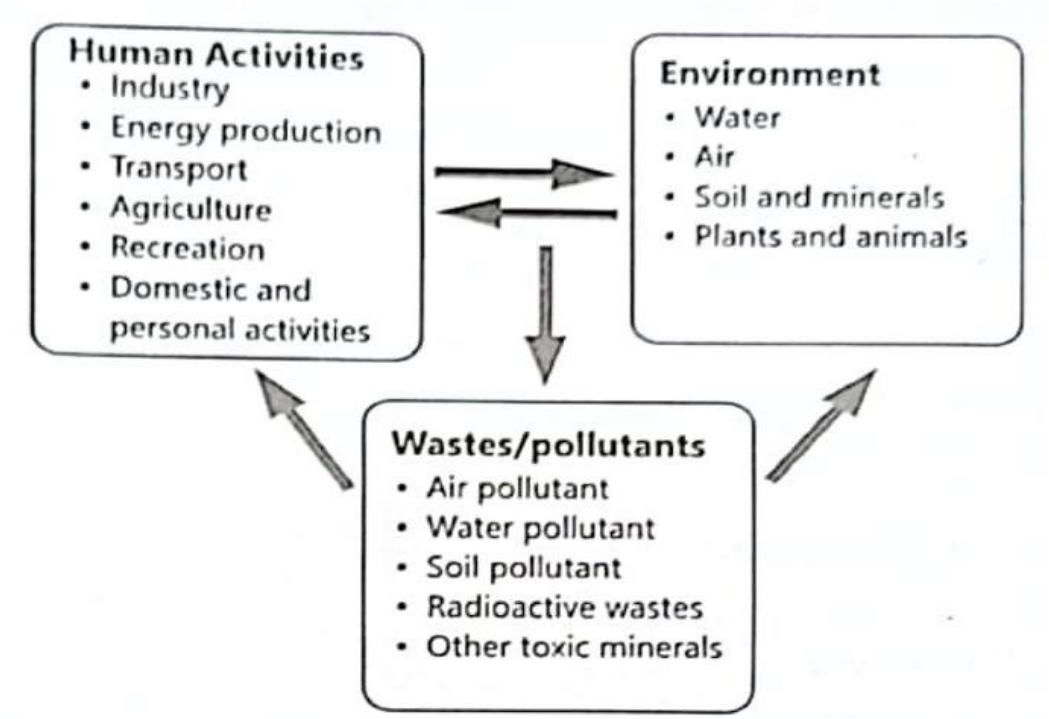
Dangers arising from industrial processes

- Water pollution
- Global warming
- Degradation of land quality

Ways of minimizing/reducing the dangers of industrial processes

- Proper treatment of industrial wastes before disposal.
- Recycling
- Planting more trees to absorb harmful gases like carbon-dioxide.
- Etc (look for more)

The relationship between human activities, the environment and wastes



Recycling, reusing and reducing.

Importance of recycling, reusing and reducing.

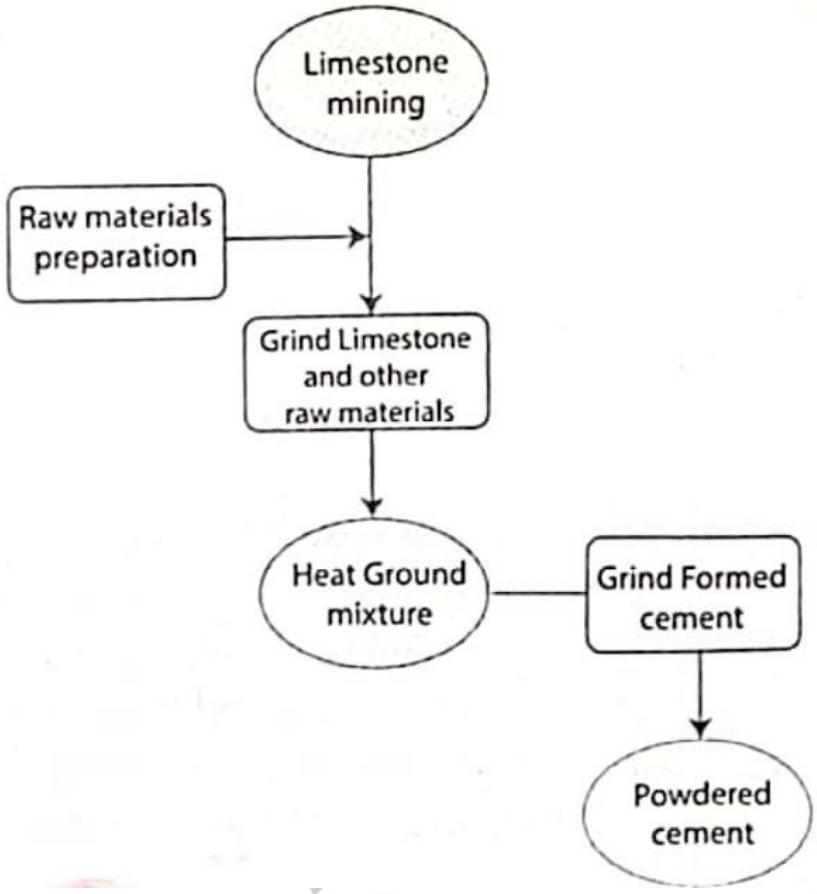
-

Manufacture of lime and cement

The process of cement manufacture occurs in the following stages;

- Mining of limestone.
- Other raw materials (alumina and clay) are added to limestone and grinded.
- The mixture is then heated to form cement.
- The formed cement is then grinded again after cooling to form powdered cement.

Summary of the process



Benefits of manufacturing lime and cement

- Provides employment opportunities.
- Construction of safer structures for shelters.
- Earns foreign exchange for the government.
- It's for study purposes.

Dangers arising from manufacture of lime and cement.

Please, explain the following points and add on if you can;

- Air pollution
- Water pollution
- Global warming
- Accidents
- Difficulty in breathing.

How to minimizing dangers arising from manufacture of lime and cement.

- Using suitable respiratory gears like nose masks, etc
- Wearing suitable eye protection wear like safety glasses.
- Using alternatives like fly ash instead of cement.
- Using better alternatives to make cement.

Production of sodium hydroxide and chlorine gas by electrolysis of sodium chloride solution/brine.

What you need.

- Batteries
- Electrical wires
- Carbon rods
- Spatula
- Glass beaker
- 10M sodium chloride solution
- Distilled water
- Test tube
- Burning splint
- Measuring cylinder.

Safety precautions

- Chlorine gas is poisonous; therefore, the experiment should be carried out in a fume cupboard or be carried out by the teacher in small amounts.
- Sometimes alkali solution is corrosive and it should be handled with care.

What to do/steps taken.

- Measure 100cm^3 of distilled water using a measuring cylinder and pour into a glass beaker.
- Measure 4 spatula endful of sodium chloride and add them to the water in the beaker.
- Stir the mixture to form a solution.
- Introduce the carbon rods in the solution and attach them to the wires from the battery.
- Insert the test tubes at each carbon rod.

Observation.

- When tested with moist blue litmus paper, it turned red and got bleached.
- The gas discharged burnt with a pop sound when tested, indicating hydrogen gas.

Products, conclusion and application.

Chlorine gas is produced at the anode.

Hydrogen gas is produced at the cathode.

Equation at the anode.

$2Cl^-(aq) \longrightarrow Cl_2(g) + 2e^-$

Equation at the cathode.

$2H^+(aq) + 2e^- \longrightarrow H_2(g)$

Overall equation for the electrolysis of brine

$2NaCl(aq) + 2H_2O(l) \longrightarrow 2NaOH(aq) + Cl_2(g) + H_2(g)$

Uses of the products from electrolysis of brine.

Product	Use
Chlorine	➢ Used for making paints and dye stuffs ➢ Used for making solvents for degreasing and dry cleaning ➢ Used in the manufacture of hydrochloric acid. ➢ Used for making medical drugs, pesticides and weed killers.
Hydrogen	➢ Used to harden vegetable oils ➢ Used as a fuel in hydrogen fuel cells ➢ Used in making nylon.

Uses of sodium hydroxide solution as a product also;

➢

Polymers

A polymer is a complex molecule with a large molecular mass formed by the combination of many small molecules with relatively small molecular mass.

Types of polymers

There are mainly two types of polymers;

- Natural polymers
- Synthetic polymers

Uses of polymers

Natural polymers

Polymer	Monomer	Use
Starch	Glucose	Source of energy
Proteins	Amino acids	Repair of worn-out tissues
Cellulose	Glucose	Cell walls
Glycogen	Glucose	Source of energy
Lipids (fats and oil)	Fatty acids and glycerol	Source of energy,
Natural rubber	Isoprene	Making foot wears
Nylon (was first produced by an American chemist Wallace Hume Carothers at the DuPont on 28th February, 1935)		Manufacture of car tyres
Cotton		Used in making textiles.

Synthetic (artificial) polymers

Polymer	Monomer	Use
Polyethene	ethene	➢ Making containers, eg plastics bowls and dust bins ➢ used as wrapping materials ➢ manufacture of polythene bags
Polyvinyl chloride (PVC)	Chloro ethene	➢ Making rain coats ➢ Electrical insulation ➢ making pipes and films
Polystyrene	styrene	➢ making packing materials ➢ making house hold items such as combs, plastic cups and a common lining in refrigerators
Artificial rubber		➢ making of shoes
Melamine		➢ making of melamine glasses
Teflon		➢ used in insulation of wirings in aerospace and computer applications

Dangers of synthetic polymers

- They prevent water from penetrating into the soil hence reducing soil fertility.
- They cause air pollution due to the emission of gases(outgassing) resulting from exposure of the polymer to heat.
- They also contribute to global warming when burnt to produce greenhouse gases like carbon-monoxide.

Important chapter summary concepts

- Uganda has a large number of natural resources, which can be used in various industrial processes.
- Metals can be extracted from their ores.
- The method used to extract a metal from an ore depends on the reactivity of the metal.
- Metals which are high in the reactivity series are extracted by electrolysis but those averagely reactive are extracted by chemical reduction.
- In the extraction of sodium, molten sodium chloride is used as the electrolyte. Calcium chloride is added to lower its melting point.
- The main ore of aluminium is bauxite.
- Iron is extracted by heating a mixture of the ore, limestone and coke in a blast furnace.
- Copper is extracted from cuprite or malachite. It can be refined by electrolysis of copper(II) sulphate using a copper cathode.
- Ammonia is a useful gas, especially in the manufacture of fertilisers and is obtained on a large scale by the haber process.
- Ammonium sulphate, ammonium nitrate, urea and DAP are some of the fertilisers from ammonia.
- Fertilisers have many advantages but also some disadvantages.
- Organic fertilisers are useful substitutes for industrial (inorganic) fertilisers but may lack sufficient quantities of key elements for plant growth.
- Cement is made by heating a mixture of limestone, alumina and clay. It is a useful material in construction.
- Sodium hydroxide and chlorine are prepared by electrolysis of concentrated sodium chloride (brine).

Sample activity of integration

Over time, Ugandans have used risky processes in mining expensive minerals like iron, tin and gold. It was reported by investigative journalists of different media houses in Uganda that people in the gold mining business in Mubende district and Karamoja region were using mercury, a hard metal, to separate gold from earthly materials.

Task

As a chemistry learner, write a short message to the leaders in the aforementioned regions, stating the precautions that people can employ for safe mining.

End of chapter questions

1. a) Write the names and locations of three important chemical industries in Uganda.
   b) What are the major sources of metals on Earth?
2. a) List the physical and chemical methods employed to concentrate an ore.
   b) Describe the electromagnetic separation method of ore concentration.
3. a) Write four reducing agents used in the reduction of metal oxides to metals.
   b) What are the three common purification procedures for metal extraction?
4. a) Describe how sodium metal is extracted from sodium chloride.
   b) Explain why metals cannot be extracted from the electrolysis of sodium chloride solution.
5. a) What is the role of nitrogen in food packaging?
   b) Write a balanced chemical equation for thew laboratory preparation of ammonia.
6. a) Explain why drying agents like concentrated sulphuric acid and calcium chloride cannot be used to dry ammonia.
   b) Explain how sulphur dioxide is converted to sulphur trioxide in the industrial manufacture of sulphuric acid.
7. a) Give two examples of fertilisers manufactured from ammonia.
   b) Explain the environmental impact of fertilisers.
   c) Write some examples of naturally occurring organic fertilisers.
   d) What are the advantages of organic fertilisers over chemical fertilisers? Explain.
8. Describe the process of manufacturing cement.