APPROACH TO THE NEW LOWER SECONDARY CURRICULUM

CHEMISTRY PAPER 1

FIRST EDITION 2024

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Preface

My objective in writing this chemistry book was to prepare O'level students for the UCE examinations which compressively covers the modern approach to the new lower secondary curriculum.
The content in this book has been extended considerably to make it suitable for all students at ordinary level.

This workbook has been written in line with the revised chemistry syllabus for the new Lower Secondary Curriculum. The knowledge and skills which have been incorporated are what is partly required to produce a learner who has the competences that are required in the 21st century.

This book provides summary notes on assessable areas for each of the four elements of construct for the chemistry paper 1.
This book also contains a variety of sample examination papers for the learner to widen his/her subject knowledge.

The learner is expected to be able to work as an individual, in pairs and groups according to the nature of the item in order to be able to share learning experiences with their colleagues.

SSEKYANZI RONALD

Acknowledgement

I would like to express my sincere appreciation to all those who worked tirelessly towards the production of this book.

My sincere gratitude goes to my family and friends for supporting all my initiatives both financially and spiritually. Many thanks go to my parents Mr. Kaliisa John Musisi and Mrs. Joan Kaliisa for educating me.

My task has been made possible through my being able to draw on the counsel of the staff of chemistry department of Nakaseke Christian Secondary School. I am indebted to Mr. Mabiike Deo the head of science department Kololo High School and Mr. Otiya Muhammad head of science department NCSS and head chemistry department Mbogo College School Kawempe.

I have been fortunate in receiving once again the guidance from my former teachers Mr. Mulisa Brian and Mr. Basingura Fredrick.
My work has benefited from advise on content and presentation which I received from Mr. Ofwono and Mr. Otiya Muhammad.

I welcome any suggestions for improvement to continue making my service delivery better.
Please get to me through ssekyanzironaldjr123@gmail.com or contact 0708540273/0768240566

RONALD SSEKYANZI

INTRODUCTION TO CHEMISTRY PAPER 1 (545/1)

The revised new lower secondary curriculum requires a learner to do **two** papers ie theory and practical compared to the old curriculum which had three papers.

In this book we shall concentrate on the theory paper 545/1.

The entire content of theory was grouped into four elements of construct to avoid duplicating/ multiple testing of competences.

The paper has **two** sections; section **A** that has **two** compulsory items and section **B** has **two** parts ie part **I** having **two** items and **part II** also having **two** items and the learner is requested to attempt only **one** item from each of the two parts. The learner will be required to attempt a total **four** examination items **two** from section A and **two** from section B from the four elements of construct which we are going to explore in details.

THE LISTS OF ALL TOPICS IN THE THEORY PAPER ARE AS FOLLOWS

SENIOR 1	**THEME**	**TOPIC**
Term 1	Introduction to chemistry and experimental	Chemistry and society
		Experimental chemistry
	Particle nature of matter	States and changes of states of matter
		Using materials
Term 2	Temporary and permanent changes to materials	Temporary and permanent changes
		Mixtures, elements and compounds
Term 3	Air and environment	Air
		Water
	Earth and space	Rocks and minerals

SENIOR 2	THEME	TOPIC
Term 1	Acids and alkalis	Acids and alkalis
		Salts
	The periodic table	The periodic table
Term 2	Carbon in the environment	Carbon in the environment
Term 3	Order of reactivity of metals	The reactivity series

SENIOR 3	THEME	TOPIC
Term 1	Carbon in life	Carbon in life
	Structures and Bonds	Structures and Bonds
Term 2	Using equations in Chemistry	Formulae, stoichiometry and mole concept
	Structures and substances	Properties and structures of substances
Term 3	Fuels and energy	Fossil Fuels
	Reactants and products	Chemical reactions

SENIOR 4	THEME	TOPIC
Term 1	Redox reactions	Oxidation and reduction reactions
		Industrial processes
Term 2	Periodicity	Trends in the periodic table
	Thermochemistry	Energy changes during chemical reactions
Term 3	Consumable chemicals	Chemical for consumers Nuclear processes.

A breakdown of the first four elements of construct

FIRST ELEMENT OF CONSTRUCT

The learner appreciates the contribution of chemistry to our economy. (For items 3 and 4 in part one of section B)

Topics

- Air (oxygen)
- Industrial processes
- Chemistry and society
- Carbon in life (mainly on crude oil, fermentation and saponification)
- Chemical reactions (contact and haber processes)
- Oxidation and reduction. (in iron extraction and for the concepts of electrolysis in extraction of aluminum, copper, manufacture of sodium hydroxide and chlorine)

ASSESSABLE AREAS

(a) Manufacture of oxygen gas (b) Manufacture of chlorine gas (c) Extraction of metals(Na, Al, Fe, Cu, Zn) (d) Manufacture of fertilizers (e) Manufacture of detergents	(f) Manufacture of sodium hydroxide (g) Manufacture of sulphuric acid (h) Manufacture of cement (i) Manufacture of Ethanol (j) Manufacture of bio gas	Each Process involves **V – vessel** **Cp – chemical processes** **Cd – conversion to desired product** **Ch – coherence** **Pr -purification**

BASIS OF ASSESSMENT

BASIS OF ASSESSMENT		CRITERIA OF ASSESSMENT	SCORE
A	Raw materials Rm 02	All raw material	
		any one raw material	
		no raw material	
B	Process of production Pp 3	Process of production with all V, Cp, Ch, Pr	
		Process of production with any three of V, Cp, Ch, Pr	
		Process of production with any one of V, Cp, Ch, Pr	
		No process of production	
C	Side effects of the process of production and mitigation Se 2	Any one danger identified, explained and mitigated	
		Any one danger identified and explained OR identified and mitigated OR explained and mitigated	
		Any one danger identified OR explained OR mitigated	
		No danger identified, explained or mitigated	
D	Social benefits of the process of production Sb 2	Any one social benefit identified, effect of the benefit and impact of the benefit	
		Any one social benefit identified and effect of the benefit OR identified and impact of the benefit OR effect of the benefit and impact of the benefit	
		Any one social benefit identified OR effect of the benefit OR impact of the benefit	
		No social benefit identified	

LET'S EXPLORE THE SUMMARY NOTES ON THE ASSESSABLE AREAS FOR THIS ELEMENT OF CONSTRUCT

MANUFACTURE OF OXYGEN

Air is a mixture of different components contains 21% oxygen. Due to respiratory illnesses caused by COVID-19, there was an increased demand for oxygen by patients in hospitals. The government supply of oxygen is not enough and is planning to set up an oxygen production plant with minimal environmental impact.

However, the science club members in your school would like to know how the process of production of oxygen will be carried out.

Task:

As a chemistry student, make a summary you will use during the presentation.

Expected responses following the basis of assessment

Raw materials

Liquid air/air

Process of production

Air is passed through air filters to remove dust and smoke particles.

Air is passed through concentrated sodium hydroxide solution to absorb/ remove carbon dioxide which is acidic.

$$2NaOH_{(aq)} + CO_{2(g)} \longrightarrow Na_2CO_{3(aq)} + H_2O_{(l)}$$

Air is free from Carbon dioxide is now passed through Silicon (IV) oxide/silica get to absorb water vapor. Carbon dioxide and water vapor are removed from air before it is liquefied because they solidify and block the apparatus.

The air is now compressed at 200 atmospheres and allowed to cool by making it escape into a large space through a jet. The process of cooling is repeated several times to obtain liquid air at about -200^0C. The liquid air is fractionally distilled using a fractionating column/tower. Nitrogen boils off first because it has a lower boiling point (-196^0C) leaving behind Oxygen with a higher boing point (-183^0C). Both nitrogen and Oxygen collected contain traces of noble gases. Pure oxygen is then stored under pressure in steel cylinders.

Side effects of the production and mitigation

(a) Explosion of oxygen cylinders due to high pressure. This can cause other materials to ignite spontaneously/ catch fire. The resulting fire can cause damage to equipment and injury to people.

Mitigation

- ✓ Regular maintenance and monitoring of cylinders
- ✓ Keeping cylinders in a cool area/ avoid exposure to heat.

(b) Exposure to liquid oxygen can cause severe skins and eye irritation and burns. This may cause loss of vision and cancer.

Mitigation

- ✓ Posting hazard and warning information in the working area.
- ✓ Communicating all information on the health and safety hazards of oxygen to potentially exposed workers; for example submerging the affected body in warm water.

(c) Air pollution by waste gases. Acidic gases can cause acidic rain which leads to crumbling of buildings, lowering the soil PH and corrosion of roofs made of iron.

Mitigation

- ✓ Fitting catalytic converters in exhaust pipes of machines to convert oxides of nitrogen into nitrogen and Carbon monoxide to Carbon dioxide.
- ✓ Neutralize the acidic gases before releasing waste gases into the atmosphere.

Social benefits of the process of production

- ✓ Employment opportunity; improved income thus better standard of living.
- ✓ Development of infrastructure eg electricity lines, roads, hospitals and schools. Etc., improved road network will facilitate trade hence improved income and better standards of living.

MANUFACTURE OF CHLORINE (INDUSTRIAL)

Sample scenario

One of the large scale uses of chlorine is treating water, to ensure that chlorine is readily available and at a cheaper cost, Government has cleared a local investor to set up a chlorine production plant near Lake Katwe in Kasese district. However, the community is concerned about its environmental effects and how the environmental process will occur

The class teacher has appointed you to sensitize the other learners.

Task:

Prepare a presentation you will deliver during the meeting

Expected responses following the basis of assessment

Raw materials (RM)

Concentrated sodium chloride solution (brine) or sodium chloride crystals (Rock salt)

Process of production (pp) (FROM BRINE)

Brine is electrolyzed in a cell made up of mercury cathode and graphite anode. Brine contains Na^+, Cl^-, OH^- and H^+. The ions migrate to oppositely charged electrodes.

Na^+ are discharged at the cathode by electron gain in presence of H^+ since Na^+ are more concentrated.

$Na^+_{(aq)} + e^- \longrightarrow Na_{(s)}$

At the anode chloride ions are discharged, in preference to hydroxide ions; being in higher concentration than the hydroxyl ions and chlorine gas is formed.

$2Cl^-_{(aq)} - 2e^- \longrightarrow Cl_{2\,(g)}$

The chlorine formed is collected and stored in tightly closed tanks. The chlorine is dried, liquefied and stored.

ALTERNATIVE USING ROCK SALT

Solid sodium chloride (rock salt0 and little calcium Chloride are fed into Down's cell. The mixture is electrolyzed using titanium or graphite anode and steel or iron cathode. The ions migrate to oppositely charged electrodes. At the cathode Na^+ are discharged by reduction being the only ions present.

$Na^+_{(aq)} + e^- \longrightarrow Na_{(s)}$

At the anode Cl^- are discharged by electron loss forming chlorine gas.

$2Cl^-_{(aq)} - 2e^- \longrightarrow Cl_{2\,(g)}$

The chlorine formed is collected and stored in tightly closed tanks. The chlorine is dried, liquefied and stored.

Side effects of the process of production and mitigations

(a) Air pollution by waste gases. Acidic gases can cause acidic rain which leads to crumbling of buildings, lowering the soil PH and corrosion of roofs made of iron.

Mitigation: -Fitting catalytic converters in exhaust pipes of machines to convert oxides of nitrogen into nitrogen and Carbon monoxide to Carbon dioxide.

- ✓ Neutralize the acidic gases before releasing waste gases into the atmosphere.

(b) Exposure of mercury due to linkage in the cell which is highly toxic and may cause damage to nervous and reproductive systems on long exposure to the workers.

Mitigation: Proper use of required personal protective equipment

(c) Land degradation

Social benefits

- ✓ Employment opportunity; improved income thus better standards of living.
- ✓ Development of infrastructure e.g. electricity lines, roads etc.

MANUFACTURE OF SODIUM HYDROXIDE

Sample scenario

People of Kalangala have got limited supply of soap yet they grow a lot of palm oil plants. They have knowledge about the manufacture of soap but they have a limited supply of sodium hydroxide which is a raw material for the manufacture of soap.

An organization wants to set up a sodium hydroxide manufacturing factory in the area but they have little knowledge about the process and its impact on the environment.

The organization chairperson has contacted you to give advice on how to manufacture sodium hydroxide and its impact to the people and the environment.

Task:

Prepare a write up you will use upon invitation.

Expected responses following the basis assessment

Raw materials

- ✓ Concentrated sodium chloride solution or Brine or Rock salt
- ✓ Graphite

Process of production

Sodium hydroxide is manufactured by electrolysis of concentrated sodium Chloride using a mercury cell made up of graphite anode and mercury cathode. Concentrated sodium chloride solution contains sodium ions and chloride ions.

The sodium ions migrate to the mercury cathode, forming sodium amalgam. Liquid sodium amalgam flows by gravity from the electrolyte to the carbon filled decomposers, where deionized water is added forming sodium hydroxide, hydrogen gas and mercury. The mercury is then pumped back to the cell inlet and the process of electrolysis is repeated. Sodium hydroxide solution is then evaporated to saturation and then cooled to form pure pellets of sodium hydroxide and stored in a tight plastic container.

While chloride ions migrate to the graphite anode producing chlorine gas which is collected in tight closed tanks.

Side effects of the process of production and mitigations.

(a) Suffocation of workers due to release of hydrogen in confined space which results into death.

Mitigation: Installing effective exhaust ventilation to ensure fresh air supply.

(b) Burns caused by contact with hot surfaces such as hot solutions and electrolysis cells.

Mitigation: Use of appropriate personal protective equipment by the workers.

(c) Exposure to chlorine by the workers and the residents as well causes burning of eyes, nose and mouth.

Mitigation : Install effective exhaust ventilation

Use of appropriate PPE

(d) Poisonous fumes by waste gases which when inhaled can cause respiratory disorders.

Mitigation: Fitting catalytic converters in exhaust pipes of the machines to convert toxic chlorine to other non-toxic compounds.

Social benefits of the process of production

- ✓ Source of employment opportunity to the residents, earn salary hence improved standard of living.

EXTRACTION OF IRON

Sample Scenario

Due to rapid infrastructural development in most of the towns in the country, the demand for iron has increased since it gives buildings a good artistic impression. The government has recently discovered the presence of iron ore deposits in Sikulu hills in Eastern Uganda. The government was to set up a factory to extract iron in its impure form for s continuous supply.

However, the residents are worried about the environmental effects due to the iron extraction and have put a lot of resistance to frustrate the project.

You have been selected as a chemistry student by the Chairperson L.C.1 of Sikulu village to comfort the residents that the factory is necessary.

Task:

Make a write up you will use

Expected responses following the basis of assessment

Raw materials

- Coke
- Limestone or Calcium Carbonate
- Iron ore or Iron(III)Oxide or Haematite

Process of production

Haematite, Coke and Calcium Carbonate are fed into the blast furnace from the top. Hot air is blown in the furnace from the bottom. Coke is oxidized by the hot air to carbon dioxide gas. The carbon Dioxide gas formed is then reacted with excess coke or carbon to produce Carbon monoxide gas. Carbon monoxide gas produced then reacted with haemitite, iron (III) Oxide to produce molten iron and Carbon dioxide.

$3CO_{(g)} + Fe_2O_{3(s)} \longrightarrow 3CO_{2(g)} + 2Fe_{(s)}$

Molten iron then flows to the bottom of the furnace. Calcium oxide from thermal decomposition of calcium carbonate reacts with acidic impurities, from the ore with silicon (IV) oxide and aluminium, oxide to produce calcium silicate and calcium aluminate respectively, which is collected as slag. Molten iron is then tapped off and cooled then solidify into metal iron, which is further processed to iron containing materials like iron bars.

Impact of the process of production to the environment and mitigations

(a) Carbon dioxide gas released from the furnace is a greenhouse gas whose accumulation in the atmosphere destroys the ozone layer therefore resulting to global warming.

Mitigation: Through carrying out re-afforestation since the plants are trees absorb carbon dioxide during photosynthesis, reducing its concentration in the atmosphere.

(b) Hot surface burns causing wounds hence pain to workers.

Mitigation: Proper use of required personal protective equipment.

Social benefits of the process of production

- ✓ Employment opportunities; increased income among residents hence improved standards of living

MANUFACTURE OF AMMONIA GAS

Raw materials

- Nitrogen and hydrogen gases

Process of production

Nitrogen and hydrogen gases are reacted in a reactor at high pressure (200 atmospheres) and low temperature (450^0C) in a ratio of 1:3 in presence of finely divided iron catalyst to form ammonia gas.

$$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$$

Ammonia is the purified by methanation process.

Side effects of the process of production and mitigations

(a) Noise pollution from compressors that may cause discomfort and hearing problems to the residents.

Mitigation: use of sound proof in production rooms.

Social benefits of the process of production

- Source of employment opportunities leading to increased income among residents hence improved standard of living
- Development of infrastructure eg electricity lines, roads, hospitals and schools. Etc., improved road network will facilitate trade hence improved income and better standards of living.

MANUFACTURE OF AMMONIUM FERTILIZERS

Ammonium fertilizers include the following

- ✓ *Ammonium nitrate*
- ✓ *Urea*
- ✓ *Ammonium sulphate*
- ✓ *Ammonium phosphate*

AMMONIUM NITRATE

Sample scenario

In some districts of Uganda like Tororo district, farmers get very low crop yields due to poor soils that has led to persistence famine in the area. Ammonium nitrate is one of the effective fertilizers used to improve crop yields. The ministry of agriculture and animal husbandry has entrusted an investor to put up an ammonium nitrate production plant in Tororo district such that the fertilizer is got at a cheap cost. However, the community near the site is worried about its effects on environment and how the environmental process will occur.

The head of department has appointed you to sensitize the community.

Task:

Prepare a presentation you will use during the meeting

Expected responses following the basis of assessment

Raw materials

- Nitrogen, hydrogen

Process of production

- Nitrogen from distillation of liquid air is reacted with hydrogen from natural gas in a ratio of 1:3 respectively to form ammonia by labour process. The reaction requires low temperature (450-500^0C), high pressure (200atm) and finally divided iron as catalyst.

  $N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$

- Ammonia produced is heated in air in presence of platinum catalyst forming nitrogen monoxide and water

  $4NH_{3(g)} + 5O_{2(g)} \longrightarrow 4NO_{(g)} + 6H_2O_{(l)}$

- Nitrogen monoxide is further oxidized to nitrogen dioxide.

  $2NO_{(g)} + O_{2(g)} \longrightarrow 2NO_{2(g)}$

- Nitrogen dioxide is dissolved in water in presence of oxygen in a tank forming Nitric acid. Nitric acid is heated with ammonia gas to form ammonium nitrate.

$NH_{3(g)} + HNO_{3(g)} \longrightarrow NH_4NO_{3(aq)}$

The fertilizer is further concentrated and converted to solid form.

Side effects of the process of production and mitigations

(a) Run off into water bodies increases algae growth, thus oxygen supply is cut off leading to suffocation of aquatic animals.

(b) Some fertilizers when dissolved in water form acidic solutions that alter the soil pH, hence low crop production.

Mitigations

All these can be mitigated by using organic fertilizers and also proper disposal of these fertilizers in places which are a far from water bodies.

Social benefits of the process of production

- ✓ Source of government revenue since the production plant is taxed and that revenue collected is used to improve on other sectors such as the medical sector.
- ✓ Source of employment opportunities to some people since some residents get salaries hence improving on the standard of living.

UREA

Raw material

- Liquid ammonia and Carbon dioxide gas

Process of production

Liquid ammonia (concentrated ammonia solution) is put in an air tight cylinder (reactor) at low temperatures of about 200^0C and high pressure of 100atmospheres to form Urea crystals. Urea crystals are then washed and dried to remove impurities. The crystals are ground into fine powder that is packed for storage.

$2NH_{3(aq)} + CO_{2(g)} \longrightarrow CO(NH_2)_{2(aq)} + H_2O_{(l)}$

Side effects of the process of production and mitigation

- Leakage of pipes leading to air pollution. This is inhaled can cause stomach and respiratory disorders.

Mitigation: regular maintenance and monitoring cylinders.

Note: Other ammonium fertilizers can also manufactured as below

AMMONIUM SULPHATE

Cleary indicate how sulphuric acid is prepared from the contact process.

Obtained by reacting sulphuric acid with ammonia gas

$2NH_{3(g)} + H_2SO_{4(aq)} \longrightarrow (NH_4)_2SO_{4(aq)}$

The respective fertilizers are further concentrated and converted to solid form and packed for storage

MANUFACTURE OF CEMENT

Sample scenario

Builders in Uganda have been experiencing collapsing structures due to poor cement quality. To improve their situation, they requested the government to build local cement manufacturing plant since there are required raw materials in Uganda to avoid relying on its importation. The idea is to produce cement of good quality at subsidized prices. Although the government approved the plans, local residents are concerned about manufacturing process and potential environmental impacts from the cement plant. To avoid resistance from the locals, it is essential to provide them with clear information about the production process, environmental **safeguards and benefits.**

Task:

Write down all the necessary information that is needed by the local residents.

Expected responses following the basis of assessment

Raw materials

- Limestone
- Clay
- Sand

Process of production

- ✓ A mixture of limestone and clay and sand is crushed into fine powder. The fine powder is then mixed with water and allow a rotating drum (cylinder) in which it is strongly heated to about 1500^0C to form a hard substance called clinker. Limestone decomposes forming calcium oxide and carbon dioxide.

  $CaCO_{3(s)} \longrightarrow CaO_{(s)} + CO_{2(g)}$

- ✓ Calcium oxide reacts with sand forming lumps calcium silicate. Aluminium oxide reacts with sand to form lumps of aluminium silicate. Calcium silicate and Aluminium silicate form a mixture called clinker.

  $2CaO_{(s)} + SiO_{2(s)} \longrightarrow Ca_2SiO_{4(s)}$

  $3SiO_{2(s)} + 2Al_2O_{3(s)} \longrightarrow Al_4(SiO_4)_{3(s)}$

- ✓ The lumps are crushed to form cement as a fine powder. Gypsum is added during the grinding process to moderate the setting of cement.
  Clinker + $CaSO_4.2H_2O$ $\longrightarrow$ Cement
  Cement is packed in bags and ready for use

Side effects of the process of production and mitigation

(a) Effluent discharge from cement plants can contaminate water bodies, affecting aquatic life and water quality.

Mitigation: Treating wastewater through sedimentation and filtration before discharge, recycling water within the plant, and implementing strict monitoring and control measures to prevent contaminations.

(b) Dust particles during the crushing process that cause air pollution leading to respiratory disorders to workers.

Mitigation: Proper use of personal protective equipment.

Social benefits of the process of production

- ✓ Source of revenue to the government through taxes hence improved infrastructures eg healthy facilities, roads hence development of the society.
- ✓ Source of employment opportunities, improved income hence better standard of living.

MANUFACTURE OF BIO GAS

Sample scenario

Biogas is one of the modern fuel sources used by many Ugandans now days in the name of minimizing environmental pollution. As a result the government has contracted a foreign investor to set up a bio gas product plant to meet the increased demand of the gas. However the villagers are worried about the effects of the plant to their well-being. The LC1 chairperson has approached you for guidance before he meets the residents.

Task: As a chemistry student prepare a leaflet of message to advise the villagers.

Expected responses following the basis of assessment

Raw material

- Organic waste
- Water

Process of production

- Organic wastes are put in a tank and mixed with some little water.
- The tank is covered to prevent aerial oxidation. The tank and contents are maintained at room temperature for about 2 weeks. Anaerobic bacteria breakdown the organic matter (fermentation) to produce biogas. The biogas compressed and collected in gas cylinder by means of pipes.

Side effects of the process of production and mitigation

(a) Explosion of biogas cylinders due to high pressure. This can cause other materials to ignite spontaneously/ catch fire.

Mitigation: Keeping cylinders in cool areas.

(b) Air pollution by waste gases (such as hydrogen sulphide and ammonia) in case of any linkage. This may cause stomach and respiratory disorders.

Mitigation: Regular maintenance and monitoring of cylinders.

(c) Linkage of hydrogen sulphide as a waste gas that can cause acid rain which leads to crumbling of buildings.

Mitigated: Regular maintenance and monitoring of cylinders.

Social benefits of the process of production

- ✓ Source of employment opportunities, improved income hence better standard of living.

EXTRACTION OF COPPER

Sample scenario

Electricity connectivity in most parts of Uganda is still very low and rural communities have continued to cut down trees for fuel which is affecting the environment and likely to cause climate change. Kilembe mines can be revived to extract the metal for making electric cables which would benefit the communities despite the impact of the extraction process.

Task:

Using your knowledge of chemistry, write a presentation explaining how the pure metal can be produced including the impact and benefits of the process.

Expected responses following the basis of assessment.

Raw materials

- ✓ Copper pyrites, ore, water, special oils, silicon (IV) oxide.

Process of production

- ✓ The extraction of copper from its ore requires concentration of the ore by froth floatation method.

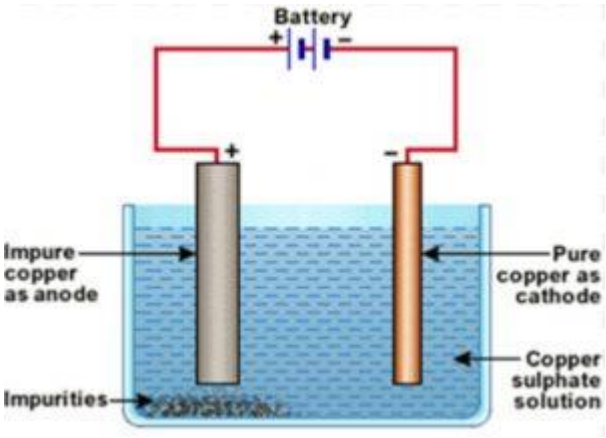
- ✓ Roast in air to obtain copper (II) sulphide
- ✓ Removal of impurities and purification of blister/ impure copper by electrolysis.
- ✓ Copper pyrites are crushed and added into a tank containing water which is mixed with some oils.
- ✓ Air is blown into the mixture to separate out copper ore to the oil layer on the surface while the useless rock materials dropped to the bottom of the tank.
- ✓ The copper ore is skimmed away dried and then roasted in a large supply of air.

$2CuFeS_{2(s)} + 4O_{2(g)} \longrightarrow Cu_2S_{(s)} + 2FeO_{(s)} + 3SO_{2(g)}$

The mixture of iron oxide and copper (II) is mixed with silicon (IV)oxide heated in supply of air. Iron oxide reacts with silicon (IV) to form iron (II) silicate/ slag which is separated out.

Copper (I) sulphide is heated in a regulated supply of air to obtain blister copper.

Finally the impure copper is purified by electrolysis using a pure copper strip as the cathode while the impure copper is the anode and copper (II) sulphate is used as the electrolyte. The anode dissolves and gets coated on the cathode as the impurities drop to the bottom



At the anode

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

At the cathode $Cu^{2+}_{(aq)} + 2e \longrightarrow Cu_{(s)}$

Side effects of the process of production and mitigation

(a) Air pollution by the sulphur dioxide evolved can cause acidic rain which can corrode roofs of iron buildings

Mitigation: Fitting catalytic converters in exhaust pipes of machines to convert sulphur dioxide to sulphur that is harmless.

Social benefits of the process of production

- ✓ Source of employment opportunities, improved income hence better standard of living.
- ✓ Improved infrastructures eg healthy facilities, roads hence development of the society.

EXTRACTION OF OIL FROM CRUDE OIL

Sample scenario

The discovery of crude oil and natural gas in Bunyoro region has caused excitement to people while the neighboring communities are worried about the impact of the extraction process on the environment. The National Oil company (UNOC) officials have organized a sensitization meeting with the residents to address their worries.

Task:

Using your knowledge of chemistry, make a write up of what the officials would present to the residents.

Expected responses following the basis of assessment

Raw materials

- ✓ Oil is extracted from crude oil/petroleum

Process of production

Crude oil processed into oil in a refinery

- ✓ The process of production requires heating the oil and separating it into various components or fractions such as gasoline diesel and lubricants based on their boiling points.
- ✓ Refining crude oil usually is carried out in the ocean to evade its impacts on the environment. This refining crude oil transforms oil into usable products like gasoline naphtha, kerosene, diesel lubricating oil and bitumen used for surfacing roads.

Side effects of the process of production and mitigation

Various environmental effects including air and water pollution, habitant destruction plus production of greenhouse gases that contribute to climate change through reflection of heat back to the earth causing global warming. The fossil burn to form pollutant gases that cause acid rain like carbon monoxide. The acis **rain corrodes roofs made of iron.**

Mitigation: use catalyst converters to convert pollutants into harmless substances. Plant trees to avoid accumulation of carbon dioxide to harmful levels in the atmosphere.

Social benefits of the process of production

Improve road infrastructure so transport of products to market is simplified.

MANUFACTURE OF ETHANOL/SANITIZER

Sample scenario

Ethanol is a major component in sanitizers' production. Following an increased demand for hand sanitizer country wide due to corona virus and red eyes recently in the country. The Government has hired a local investor to set up an ethanol brewing plant in Kitgum industrial area to make more ethanol to be used in sanitizers. The kitgum municipal council would like to know the production process and how the plant will impact on the environment of their town.

Task:

Make a write up you will deliver answering their concerns upon invitation

Expected responses following the basis of assessment

Raw materials

- ✓ Ripe bananas, sorghum and millet

Process of production

- ✓ Ripe bananas are peeled and put in a boat/canoe things squeezed into juice using spear grass.
- ✓ The juice is filtered out, mixed with little water and roasted sorghum.
- ✓ It is put in an air tight container such as a pot in a hole dug underground.
- ✓ Germinated millet flour/ yeast is added to the mixture before it is covered and buried for a period of 24-48 hours for it to fully ferment.
- ✓ Crude alcohol is formed.
- ✓ The alcohol is removed and distilled to obtain ethanol solution which can be refined better through fractional distillation.
- ✓ The pure ethanol is an antibiotic as it kills most bacteria hence used as a sanitizer to disinfect surfaces.

Side effects of the process of production and mitigation

(a) Ethanol is highly inflammable and can cause fires.

Mitigation: installation of fire extinguishers to put off fires

(b) Pollutant emission of machines that can cause greenhouse effect like global warming.

Mitigation: Plant trees and vegetation to remove carbon dioxide for photosynthesis in order to reduce the greenhouse effect.

Social benefits of the process of production

- ✓ Source of employment opportunities, improved income hence better standard of living.
- ✓ Improved infrastructures eg healthy facilities, roads hence development of the society.

EXTRACTION OF ALUMINIUM

Sample scenario

Aluminium is used in a huge variety of products including foils, kitchen utensils and others. Recently, there was shortage of aluminium products and also production of poor-quality aluminium products especially kitchen utensils. The government got an investor to extract aluminium from its ore on large scale.

However the science club members in your school would like to know how the process of production will be carried out.

Task:

As a chemistry student, write a presentation you will deliver to the rest of the science club members.

Expected responses following the basis of assessment

Raw material

Ore bauxite

Process of production

- ✓ The ore is first roasted in air to drive off any water from it.
- ✓ The ore is then crushed into fine powder and concentrated with hot concentrated sodium hydroxide solution in a container to form pure aluminium hydroxide by Bayer's process.
- ✓ The aluminium hydroxide is heated to form pure aluminium oxide. The aluminium oxide is dissolved in molten cryolite to lower its melting point to about 800^0C.
- ✓ The molten aluminium oxide is electrolyzed between graphite electrodes.

At the Anode $Al^{3+}_{(l)} + 3e \longrightarrow Al_{(s)}$

Side effects of the process of production and mitigation

(a) Hot surface burns causing wounds hence pain to workers.

Mitigation: Proper use of personal protective equipment.

(b) Acid rain formation which lowers soil pH, causing rocks like limestone to crumble and iron roofs to corrode.

Mitigation: Install catalytic converters to convert the greenhouse emissions into harmless products.

Social benefits of the process of production

- ✓ Source of employment opportunities, improved income hence better standard of living.
- ✓ Improved infrastructures eg healthy facilities, roads hence development of the society.

MANUFACTURE OF SULPHURIC ACID

Sample scenario

One of the large scale uses of sulphuric acid is to manufacture fertilizers for high crop yields. To ensure that sulphuric acid is available at a cheaper cost, government has cleared a local investor to set up a sulphuric acid production plant in kilembe mines in Kasese district. However the community members are worried about its impact on the environment and would like to know how the production process will be carried out. The chair person has called for a village meeting and you're invited.

Task:

Make a write up you will deliver in the meeting.

Expected responses following the basis of assessment

Raw materials

- Sulphur
- Vanadium(V)Oxide
- Oxygen and water

Process of production

- ✓ Sulphur is heated in a closed cylinder to produce sulphur dioxide gas.
  $S_{(s)} + O_{2(g)} \longrightarrow SO_{2(g)}$
- ✓ Sulphur dioxide gas is further reacted with excess oxygen in presence of Vanadium(V)Oxide at high pressure and low temperature in a closed cylinder to produce sulphur trioxide gas
  $2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)}$
- ✓ The sulphur trioxide gas produced is bubbled in concentrated sulphuric acid to produce oleum, which is then diluted with approximate amounts or volumes of water to produce 98% sulphuric acid which is stored in storage tanks.
  $SO_{3(g)} + H_2SO_{4(l)} \longrightarrow H_2S_2O_{7(l)}$
  $H_2S_2O_{7(l)} + H_2O_{(l)} \longrightarrow 2H_2SO_{4(l)}$

Side effects of the process of production and mitigation

(a) Air pollution due to waste gases eg sulphur dioxide and sulphur trioxide which are acidic gases, thus react to produce acid rain which damages buildings and lower the pH of the soil and water.

Mitigation: fitting catalytic converters in the exhaust pipes of the production plant thus giving out less acidic fumes

(b) Destruction of the area vegetation covers since the trees and other vegetation covers are cleared to create space to install machines for production this results in accumulation of carbon dioxide gas in the atmosphere hence global warming.

Mitigation: planting fast growing trees that use carbon dioxide during photosynthesis.

(c) Hot surface burns causing wounds hence pain to workers.

Mitigation: Proper use of personal protective equipment.

Social benefits of the process of production

- ✓ Source of employment opportunities to the residents, improved income hence better standard of living.
- ✓ Improved infrastructures eg healthy facilities, roads hence development of the society.

MANUFACTURE OF SOAPLESS DETERGENTS

Sample scenario

Bukenya is a well-known local investor in Kalot village use borehole water for washing clothes. He has planned to set up a soapless manufacturing plant in the village with high hopes of maximizing his annual profits. He has assured the LC1 chairperson that his plant will have a minimal impact to the village environment.

However the locals would like to know how the production process will be carried out and how the plant will impact their village. You have been entrusted by the LC1 chairperson to sensitize the locals about plant during a village meeting.

Task: prepare a write up that you will deliver during the village meeting.

Expected responses following the basis of assessment

Raw materials

- Benzene

- Concentrated sulphuric acid
- Concentrated sodium hydroxide

Process production

- ✓ Benzene is reacted with a long chain alkene in presence of concentrated sulphuric acid in a plastic container forming alkylbenzene.
- ✓ The alkylbenzene is heated with concentrated sulphuric acid and then concentrated sodium hydroxide solution added to the resultant solution forming a detergent.
- ✓ This mixture can be added to minimum volumes of water to form liquid from detergents.
- ✓ Some additives such as whitening agents, biological enzymes, fragrances, stabilizers may be added during the process.

Side effects of the process of production

(a) Acids pills on surface that may cause falls/ accidents leading to injuries on workers.

Mitigation: Careful handling of the acid or posting hazard and warning information in the working area.

(b) Burns from acids when in contact with the skin causing wounds.

Mitigation: careful handling of the acid

MANUFACTURE OF SOAPY DETERGENT

Sample scenario

Soap is the chief material commonly used to facilitate washing. Of recent, there have been countrywide outcries to the government about the high costs of soap for domestic use. This is partly because of the few industries producing soap in the country. To ensure efficient supply of soap, recently the government secured some land for the local investors to set up another soap production plant in one of the village in Tororo District. However, the local people are concerned about to be taken by the investor. The community members are also wondering how the process

of soap production will take place. As a result, the District Chairperson has called for a meeting with the investor and the local representatives.

Task:

As a chemistry learner, make a write up you will use during the present upon invitation.

Expected responses following the basis of assessment

Raw material

- Vegetable oil (animal fat) and concentrated sodium hydroxide
- Dyes and perfumes
- Sodium chloride

Process of production

- ✓ A mixture of vegetable oil or animal fat and concentrated sodium hydroxide solution is boiled while stirring until no more reaction occurs in a boiler (plastic container). The resultant soap solution is cooled. Concentrated sodium chloride is added to soap solution to precipitate out soap.
- ✓ Soap floats and it is skimmed off.
- ✓ Additives like perfumes and dyes may be added.
- ✓ Soap is baked into desired bars and it is stores.

Side effects of the process of production and mitigation

(a) Hot surface burns during the boiling process causing wounds hence pain to workers.

Mitigation: proper use of required personal protective equipment.

Social benefits of the process of production

- ✓ Employment opportunities increased income among residents hence improving standards of living.

SECOND ELEMENT OF CONSTRUCT

THE LEARNER APPRECIATES THE APPLICATION OF CHEMISTRY IN DAILY LIFE.

(For item 1)

Topics

- ✓ Chemicals for consumers. (mainly food additives, medicine and drugs and soapy and soapless detergents)
- ✓ Nuclear processes.

BASIS OF ASSESSMENT

BASIS OF ASSESSMENT		CRITERIA OF ASSESSMENT	SCORE
A	Category/type of product 1	Any one product and category/type of product identified	
		Any one product or category/type of product identified	
		no product nor category/type of product identified	
B	Function(s) of product(s) 1	Anyone function of product(s)	
		No function of the product(s)	
C	Dangers or Side effects of the product and mitigation 3	Any one danger/side effect identified explained and mitigated	
		Any one danger/side effect identified explained and mitigated	
		Any one danger/side effect identified and explained OR explained and mitigated	
		No danger/side effect identified OR mitigated	
D	Evaluation of products/processes 2	Evaluation of products/processes basing on both similarities and differences	
		Evaluation of products/processes basing on either similarities OR differences	
		No evaluation of products/processes	

ASSESSABLE AREAS

FOOD ADDITIVES		*DRUGS AND MEDICINE*	*NUCLEAR PROCESSES*	*DETERGENTS*
Flavour enhances Preservatives Glazing agents Gelling agents Glazing agents Anti-oxidants Bulking agents	Beverages Dyes(food colours) Stabilizers Thickeners Biological enzymes Whitening agents Firming agents	Antibiotics (penicillin & streptrine) Herbal medicine (Trachtroul medicine) Analgesics (aspirin, paracetamol codeine)	Nuclear fission Nuclear fusion Nuclear decay and half life	Soapy detergents Soapless detergent

Summary notes about this element of construct

NUCLEAR PROCESSES.

Sample scenario

Due to increasing demand for power in Uganda, agencies predict that Uganda can adopt the use of nuclear power for the smooth running of increasing number of industries. Discussions in the ministry of energy are underway to build a nuclear power plant. However, there is little knowledge about the use of nuclear energy by most people in Uganda and others fear of its dangers.

Task:

You have been invited by the minister of energy and mineral development in Uganda at the ministry headquarters as a student who has studied about nuclear processes; help the minister to acquire knowledge of the following

(a) Category of the process involved.

The process is nuclear reactions categorized into;

Nuclear fission

Nuclear fusion

(b) How the process will help to solve the problem

Nuclear fission:

- ✓ Will involve the splitting of a heavy nucleus when it is bombarded by a fast moving neutron to produce light nucleus with release of energy. In a nuclear reactor which is used to heat water to produce steam at high pressure, which drives turbines that produce electricity.
- ✓ Used in atomic bombs

Nuclear fusion: it is used as a fuel

(c) Impact of the process on the environment

- ✓ The energy emitted can cause cancer resulting into death.

Mitigation: Wearing protective gears such as lead coats or by posting warning information in the working area.

- ✓ Environmental pollution due to disposal of radioactive wastes which affect different ecosystems like plants and animals.

Mitigation: proper disposal of radioactive wastes for example in underground bankers.

- ✓ Radiations may lead to mutation in DNA leading to hereditary defects like leukemia.
- ✓ Reduced fertility

Mitigation: proper use of personal protective equipment such as lead coats.

(d) Make an evaluation on the process.

Differences

- ✓ Nuclear fission can be controlled while nuclear fusion cannot be controlled.
- ✓ Nuclear fission involves splitting of heavy nuclei to lighter nuclei while Nuclear fusion involves joining lighter nuclei to form heavy nuclei

- ✓ Nuclear fission releases high energy while nuclear fusion releases relatively low energy.

Similarity

- ✓ Both involve a large release of energy
- ✓ Both are initiated by energy

Item 2

Due to increasing demand of power in Uganda, the government wants to adopt use of nuclear power. However, there is little knowledge among the natives about how nuclear energy works. The ministry of energy and mineral development is interested in a knowledgeable person to sensitize the natives about the matter.

Task:

As a chemistry student

(a) Advise the natives on the types of processes that can be used by the government.

The process is nuclear reactions categorized into;
Nuclear fission
Nuclear fusion

(b) Educate them on how the energy can be produced and caution them on the possible dangers associated with their process.

When Uranium is bombarded with fast moving neutrons its atomic mass increases and the nucleus becomes unstable. Therefore it spontaneously splits into two lighter nuclei, three neutrons and energy. The three neutrons cause more successive disintegration, amplifying the energy given out. This can be used to boil water to steam which can eventually drive turbines and produce electricity.

Equation

$$^{235}_{92}U + {}^{1}_{0}n \rightarrow {}^{141}_{56}Ba + {}^{92}_{36}Kr + 3{}^{1}_{0}n + energy$$

However the process has the following challenges.

- ✓ The energy emitted can cause cancer resulting into death.

Mitigation: Wearing protective gears such as lead coats or by posting warning information in the working area.

- ✓ Environmental pollution due to disposal of radioactive wastes which affect different ecosystems like plants and animals.

Mitigation: proper disposal of radioactive wastes for example in underground bankers.

- ✓ Radiations may lead to mutation in DNA leading to hereditary defects like leukemia.
- ✓ Reduced fertility

Mitigation: proper use of personal protective equipment such as lead coats.

(c) Suggest to the residents on the most effective process.

- ✓ Both produce energy, but nuclear fission produces more energy than nuclear fusion.
- ✓ Both are initiated by energy but nuclear fusion requires a lot of energy to start while nuclear fission requires little energy to start.

CHEMICALS FOR CONSUMERS

MEDICINE AND DRUGS

Sample scenario

In a remote village with limited access to modern medicinal facilities, the nearest clinic is very far away and transportation options are scarce. The villagers rely on each other for medicinal advice. Recently, the bacterial infections have been increasing but there is lack of awareness about proper medication to use.

This raises concerns about misuse and development of drug resistance. As a chemistry student, you have an opportunity to meet them in one of their village meetings.

Task:

(a) **What are the possible types of drugs or medicine you can advise them to treat the infections.**

Drugs and medicine that can treat bacterial infections are known as antibiotics. Antibiotics can be natural because they are God made for instance aloe Vera extract and can be artificial or synthetic because they are manmade for example penicillin & streptomycin.

(b) **Carefully educate them on what the drugs exactly do**

Antibiotics work by inhibiting the growth of bacteria, interferes with the bacteria's ability to build their cell walls, leading to their eventual death or making it easier for immune system to fight the bacteria. Generally they cure diseases caused by bacteria infections like gonorrhea, syphilis, anthrax, pneumonia, meningitis.

(c) **Advise them on the challenges associated with the drugs and medicine use and consequently how to select the medicine to use.**

Overdose or excessive use of antibiotics can cause dizziness and headache, hearing loss, kidney damage, allergic reactions and eventually drug resistance.

Mitigation: Ensure controlled use of the drugs following doctor's guidance, getting plenty of rest, enough water as well as avoiding activity that needs alertness such as driving.

Item 2

Two students, peter and James were suffering from the same illness. They were both diagnosed with a bacterial infection from the nearby healthy center. They both later bought medicine from different pharmacies in their villages. Peter after using the medicine, the illness was cured while as for peter the headache was cured but the infection persisted.

As a chemistry student,

Task:

(a) Help to categorize the medicine the students bought.

James bought an antibiotic drug while peter bought an analgesic or pain killer which are modern medicines.

(b) State the function of the drugs the students bought.

Antibiotics kill or slow down the growth of bacteria or treat infections caused by bacteria

Analgesics relieve pain / pain killers

(c) Explain the side effects of the drugs.

Antibiotics cause allergic reactions and diarrhea because they are easily broken down by the acid in the stomach.

Mitigation:

- Avoid self-medication
- Take upon prescription by a trained medical practitioner.

(d) Evaluate the two drugs

Similarity: Both antibiotics and analgesics are modern medicines.

Difference: Antibiotics treat infections caused by bacteria while analgesics relieve pain.

Herbal medicines have few side effects than modern.

DETERGENTS

Onyera, living in an area where they use bore hole water, slid, fell and his white shirt became dirty. He decided to use a detergent to clean his shirt. The shirt remained with some brown spots yet he had rinsed it several times.

Task: As a chemistry learner;

(a) Point out the problem Onyera made when choosing a product.

Onyera used a soapy detergent (or soap) instead of a soapless detergent

(b) Help Onyera understand how the product works.

The dirt is held on the cloth by a layer of oil. - Detergents (soaps) facilitate the emulsification and removal of grease.

Alternatively

- Detergents facilitate breakdown of fats into small parts.
- A soap molecule contains two parts; namely; the water-soluble /polar carboxylate head / hydrophilic end and non-polar tail/fatsoluble part / hydrophobic part.
-During washing, soap acts by lowering the surface tension between water and oil/grease/other water insoluble materials and also emulsifies them. The hydro-carbon tail becomes attached to dirt /oil /fat while the polar head dissolves in water. With constant agitation, the dirt is pulled off the cloth and gets dispersed in water as tiny droplets which are then poured away. The cloth is then rinsed several times and dried.

(c) Advice Onyera on the challenges associated with the long term use of the product.

SOAP contains chemicals that can cause:

- Skin burns / blisters / irritation and hence pain or cancer.
- Eye redness and pain; hence loss of vision.

Mitigation: By thoroughly washing the affected areas (or irrigation of the affected areas) like skin or eyes.

SOAPLESS DETERGENTS contain phosphates which cause algae bloom/alagalbloom and hence water pollution. N.B. Algae/algal bloom already means accumulation.

(d) Evaluation of the product

SIMILARITIES:

- Both soapy detergents and soapless detergents are salts of Organic acids of long carbon chain.
- Both soapy detergents and soapless detergents are effective cleansing agents in soft water / rain water.

DIFFERENCES;

Soapy detergents:

- Forms scum with hard water.
- Gentle on skin during cleansing.

- Sodium salts of carboxylic acid of long chains and cannot be used in strongly acidic solutions.
- Biodegradable

Soapless detergents:

- Does not form scum with any form of water.
- Not gentle on skin during washing.
- Sodium salts of long chain benzene sulphonic acids and can be used in strongly acidic solutions.
- Non-biodegradable

Item 2

Parents of Nakaseeta Secondary School complained about how fast the shirts of their s3 students got stained brown. The wardens when contacted by the parents about the issue advised the parents to buy their children the best detergents that would help them to remove the brown stains from their uniforms.

Task: As a chemistry student guide the parents;

(a) The categories of products on the market

Soapy detergents (soap) and soapless detergent

(b) How the product works

A soap molecule contains two parts; namely; the water-soluble /polar carboxylate head / hydrophilic end or and non-polar tail/fatsoluble part / hydrophobic part.

During washing, soap acts by lowering the surface tension between water and oil/grease/other water insoluble materials and also emulsifies them. The hydro-carbon tail becomes attached to dirt /oil /fat while the polar head dissolves in water. With constant agitation, the dirt is pulled off the cloth and gets dispersed in water as tiny droplets which are then poured away. The cloth is then rinsed several times and dried.

(c) Dangers of long time use of the product

SOAPY DETERGENTS contains chemicals that can cause:

- Skin burns / blisters / irritation and hence pain or cancer.

• Eye redness and pain; hence loss of vision.

MITIGATION: By thoroughly washing the affected areas (or irrigation of the affected areas) like skin or eyes.

SOAPLESS DETERGENTS contain phosphates which cause algae bloom/alagalbloom and hence water pollution. N.B. Algae/algal bloom already means accumulation.

MITIGATION: Proper disposal of detergents

(d) Evaluation of the product

Check the previous example

FOOD ADDITIVES

Sample scenario

Ms Sanyu has a restaurant in Iganga Town. The customers have these days abandoned her restaurant because of poor taste of food, unpleasant scent and food gets spoilt after a very short time. The appearance of cooked food is also not attractive and the soup is always too dilute. She wishes to acquire different substances which would be added to her food to produce meals attractive to her customers. She has contacted you as a chemistry student well knowing that you can advise her on the right products/ substances to buy.

Task:

Write a piece of advice to her on;

(a) Category of the product/substance

Food additives like flavor enhancers, food color, food preservatives are classified as;

Natural food additive

Artificial/synthetic food additives

(b) Uses of different product/ substances

- Preservatives slow down or prevent the growth of microorganism by retarding their growth and extending food storage life.

Or

Salt draws waters from the cells of the microorganisms and retard their growth

Or

Vinegar lowers PH to inhibit the growth of microorganisms

- Flavoring gives taste/ smell of particular foods.
- Stabilizers work by stabilizing emulsions through inhibition of reactants between chemicals in food.
- Food colouring restore the colour in food in order to enhance its visual appeal to match customers' expectations
- Antioxidants prevent fats and oils from oxidation when fats stay for long.
- Thickness increases viscosity of food without significantly altering other physical properties and give the food a dense smooth and uniform texture.

(c) Side effects of using different products on customers

- Preservatives cause asthma, allegies, carcinogen, increase risks of cardiovascular diseases.
- Some antioxidants are carcinogenic
- Salt increases blood pressure
- Flavours cause headache, allergy, thirsty, chest pain and increase the risks of leukemia.
- Food colouring causes; allergy, hyperactivity, carcinogenic
- Thickness cause allergic reactions.

(d) Evaluation of the product

Similarities

- Both make food delicious
- Both can preserve food
- Both restore the food colour

Differences

- Natural additives are chemical compounds extracted from plants, animals, minerals while synthetic additives are not extracts but are result of chemical or enzymatic reaction. ie (not plant or animal)
- Natural food additives are less effective in action than synthetic
- Natural additives have fewer side effects than synthetic.

THIRD ELEMENT OF CONSTRUCT

THE LEARNER APPRECIATES DIVERSITY AND INTERACTIONS OF SUBSTANCES AND THEIR IMPORTANCE IN LIFE.

For items 2

ASSESSABLE AREAS

(a) Elements, compounds and mixtures (b) The periodic table (c) Trends in the periodic table (d) Reactivity series	(e) Structure and bonds (f) The mole concept (g) Materials other than plastics (h) Polymers and Plastics

BASIS OF ASSESSMENT

BASIS OF ASSESSMENT		CRITERIA OF ASSESSMENT	SCORE
A	Category of element, compound, substance or material with a reason 3	Identified category of element, compound, substance or material with a reason and example	
		Identified category of element, compound, substance or material with either example OR reason	
		Identified category of element, compound, substance OR material OR reason only OR example only	
		No identified category of element, compound, substance OR material OR reason OR example	
B	Properties or prediction of properties of element, compound, substance OR material 3	At least four properties or characteristics or predictions of trends	
		At least two properties or characteristics or predictions of trends	
		Any one property or characteristic or prediction of trends	
		No property or characteristic or prediction of trends	
C	Uses of element, compound, substance or	Any one use/application	

	material/applications/ quantity of matter i.e moles	No use/ application	
D	Impact/ pollution of environment by element, compound, substance or material and mitigation 2	Identified impact and mitigation	
		Identified impact OR mitigation	
		No Identified impact OR mitigation	

Topics

- polymers
- Using materials
- The periodic table
- Trends in the periodic table
- Structure and bonds
- Structure and properties of substances
- Formulae, stoichiometry and mole concept.

Summary notes about this element of construct

USING MATERIALS

Sample scenario

Steven is in the process of constructing his store for his coffee without affecting the environment. He wants to build a good strong store; there are various building materials of different quality and properties on the market. However, he does not know the quality of materials to use.

James knows that choosing quality materials depends on the nature of the material and has come to you for advice.

Task:

Use your chemistry knowledge to:

(a) Explain

(i) Categories of materials

A material is a substance or a mixture of substances that constitute an object. It can be Natural or Artificial. Natural material is God made / exists in nature and its formation is not influenced by man e.g. rocks, sand, wood, water, soil etc. Artificial material is man-made / synthetic manufactured by man e.g. iron bars, plastics, paint, composites

(ii) The suitability of the materials.

Materials to be used for constructing a good strong house have different qualities based on their nature. A house is made up of the following:

(a) Iron;

- Very strong (can support heavy load.)
- has high tensile strength (resists breakage).
- Its ductile and malleable (easy to mould.)
- Has high melting point (resists fires.)
- Galvanised iron resists rusting.
- Steel has improved properties, making it suitable for many users.

(b) **Aluminium;**

-
Low density(used on top of buildings).
- Strong, not easy to break / durable.
- Has high melting points (resists fires).
- Has bright appearance (used for doors, roofing, and window frames.)
- High electrical/ heat conductivity (making utensils.)

(c) **Wood;**

- Readily available so easy to get cheaply.
- Strong, so it can support heavy load.
- Light when dry so good for roofing.
- Easy to smoothen to give nice appearance.
- can rot or be eaten by termites when not treated.

(d) Mortar;

Composite made of cement, sand and water,

- Hard so reacts deformation.
-It is adhesive so can join bricks.
-Cushioning to spread the vertical load

(e) Glass;

- Ordinary glass is transparent so good for windows to see through.
- Tinted glass allows light to pass through it in only one direction so good for windows (visual security.)
- Double-glazed glass (tampered glass) is strong, resistant to fire attack and it is not brittle.
- Glass is reflective, attractive and it adds value when put in doors and windows.

(f) Paint

This is a liquid composite made of pigment, resin, solvent and additives.

- Weather guard resists bad weather (water proof). So good for outside walls.
- Silk vinyl paint does not burn, so good for interior purposes.
- Paint can be insect repelling, light sensitive to beautify, protect walls.

(g) Plastic

- These are man-made polymers which can undergo permanent deformation without breaking when subjected to a strong force. E.g. PVC, Polyethene, Nylon, Polyesters.
- They are flexible so can be bent easily.
- They are water prone so a good for Plumbing and roofing.
- They are light and strong, so good for shuttering purposes.
- They have low melting points so can be attacked by fires easily.

(h) Clay and Ceramics;

- They are brittle so break easily.
- They are water proof so good for flooring.
- They are good looking, so nice for finishing purpose like floors, walls.
- They cannot be attacked by chemicals.

(i) Bricks and blocks:

- Resistant to fire so good for wall construction.
- They are strong, so can support heavy loads.

(b) **Advise peter on the choice of materials**.

The choice of material for construction is dependent on the purpose it is meant to do and its impact to the environment.

(a) Iron

- Making shutters for doors, windows.
- Making frames for doors windows.
- Reinforcing concrete.
- Irons used to fix / join objects like timber, iron sheets.
- Used for plumbing.

(b) Aluminium

- Making shutters for doors, and windows.
- Making frames for doors and windows.
- Reinforcing concrete.
- Making roofing materials (struts and ties).
- Electrical installations, wires.

(c) Wood

- Used to make shutters for windows, doors.
- Making frames for doors, windows.
- Making struts and ties during roofing.
- Making poles, pillars and beams.

(d) Mortar;

- Joining and binding bricks.
- Making concrete for floors.
- Plastering walls.

(e) Glass;

- Making shutters for doors, windows.

(f) Paint;

- Beautifying (better appearance) of buildings.
- Protecting materials, from rusting.
- Enhancing durability.

(f) Plastics;

- Making pipes (water pipes) for plumbing.
- Making door and window stutters.

(h) Clay and Ceramics;

- Making bricks.
- Making Tiles (floor tiles).
- Making roofing tiles.

(i) Bricks and blocks;

- Constructing walls.

(c) Impact on the materials on the environment

Material used in construction of a house have impact to the environment.

(a) Iron;

- Depletes soil fertility when it accumulates
- Being a heavy metal can cause cancer.
- Non biodegradable.

(b) Aluminium;

- Depletes soil fertility when it accumulates.

(c) Plastics;

- Non biodegradable spoils the soil.

(d) Mortar;

- Bulky, takes long to decompose and so spoils the soil.

Mitigation

-Proper disposal of iron materials

-Recycling plastic materials

STRUCTURE AND PROPERTIES OF SUBSTANCES

Sample scenario

A group of boys at Namilyango boy's school are considering a project to develop a device combining electronic performances, heat management and durability. The have learned that graphite has unique properties that they could be utilized.

They would want to understand it better so that they can make high-performance electronic devices.

Task:

(a) **Write down what can help them know its nature**.
Graphite is an element since it consists of one type of atom, carbon. It has a giant atomic structure in which each carbon atom is bonded to three other by covalent bonds leaving one valence electron unused(mobile)

(b) Point out how suitable it is to their project.
Graphite has the following properties which make it suitable to the project.

- Conducts electricity
- Has high density
- Has high melting point
- It is soft and slippery

It may be used in the following ways;

- As a lubricant
- As electrodes
- In the production of refractory materials
- In thermal management such as heat sinks in electronics.

(c) Caution them on its environmental concerns.
Graphite manufacturing is characterized by energy intense production processes with greenhouse gas emission.
Mitigation: By graphite recycling and alternative manufacturing methods with no greenhouse gas emissions.

THE PERIODIC TABLE

Sample scenario

A donation to the school of sports and games equipment comprised of balls, nets, flags, javelin short put and pressure pumps. Caleb a games and sports prefect realized the equipment's were made of different materials and that their nature and properties influenced their purpose. However the games master was disappointed when he asked the prefects to sort the equipment for storage and he couldn't.

Task:

As a chemistry student,

(a) Help the prefect with reason categorize the materials

The sports equipment donated can be grouped into two types of materials; metallic and non-metallic

Metallic materials include pressure pumps, short put and javelin because metals are generally hard and strong.

Non-metallic materials include balls, nets and flags. These are flexible and not hard.

(b) **State the properties of the materials that influenced their suitability**.

Javelin is made up of aluminium metal

Aluminium has got the following properties.

- Is light/ has low density
- Is hard and strong
- Is malleable and ductile
- Does not rust
- Durable
- Good conductor of heat and electricity

Iron/steel

- Is hard
- Has high density
- Resistant to rusting
- Non-biodegradable

Plastic such as nylon

- Flexible
- Non-biodegradable
- Resistant to harsh weather conditions
- Light and quick dries up
- Easy to clean

Synthetic rubber

- Strong
- Elastic
- Non sticky
- Insoluble in water
- Easy to sharpen
- Non-biodegradable
- Durable

Cotton

- Soft polymer
- Easy to clean
- Strong
- Is biodegradable
- Relatively light/can be sweed by wind

(c) Advise the prefect on the choice of materials for the different equipment.

The choice of materials to serve the purpose it is meant to serve is dependent on its properties and impact on the environment.

- Aluminium is used to make javelin due to its low density and strength can be thrown a long distance without breaking.
- Aluminium is also used to make pressure pumps. It is strong, light and easy to carry poor move.
- Pressure valves are made of plastic materials such as synthetic rubber. It is strong and less elastic.
- Balls are made of synthetic rubber which can expand and retain high pressure without bursting. It is also light and easy to move/kick or throw.
- Short put is made of steel due to its high density and resistance to rusting.

- Flags are made of plastic polymers such as nylon due to their strength and non-wettability or from natural polymers like cotton with wooden stands.
- Nets are made of nylon which is a strong synthetic polymer durable and resistant to harsh weather.

(d) What is the impact of the materials on the environment

- Iron depletes soil nutrients and makes the soil infertile or is non-biodegradable and spoils the soils or being a heavy metal can cause cancer.
- Aluminium depletes soil fertility when it accumulates.
- Plastics are non-biodegradable
- Cotton is biodegradable but takes long to decompose.

Mitigation:

Proper disposal of materials

Recycling of materials

ELEMENTS

A friend in S.1 found you reading about $^{23}_{11}Na$ and wanted to know the relevance and its application in the daily life. As a student of chemistry

Task:

(a) Explain to him the category of the element

Metal

Reason: Loses outermost electron to form a cation

(b) Explain to him the properties of the element

- Low melting point
- Ductile
- Light weight
- Conducts electricity
- Soft
- Shinny appearances

(c) Give him the uses of the element

- Used as a coolant in nuclear reactor.

- Used to make alloys like sodium amalgam
- Used as a reducing agent in extraction

(d) Help him understand the impact of the element to the environment and its mitigation

- High level of sodium can disrupt natural ecosystems in area where plants and animals are adapted to salty conditions leading to change in biodiversity

  Mitigation:

  Reduced use of sodium based fertilizers

OTHER ELEMENTS

ELEMENT	CATEGORY OF ELEMENT WITH REASON	PROPERTIES OF ELEMENTS	USES OF ELEMENTS	IMPACT ON THE ENVIRONMENT AND MITIGATION
Magnesium	Metal: Loses electrons to form a cation	• High melting point • Conducts electricity • strong	• Used as a fertilizer to replenish soil nutrients and promote plant growth • Used to make alloys like duralumin • Used in electronic devices such as laptops and cameras	• Over application of magnesium-containing fertilizers can lead to soil contamination and nutrient imbalances, affecting plant growth and soil health **Mitigation:** Adopt nutrient management practices
Aluminium	Metal: Loses electrons to form a cation	• Conducts electricity • Malleable • Strong • Sonorous • Corrosion resistant	• Used in packaging materials such as foil wraps • Used in construction ie roofing, window frames and doors • Used in electrical transmission	• Aluminium products such as packaging materials contribute to landfill waste Mitigation: Recycling

			• Making cookware, furniture and electronic casing	
Phosphorus	Non- metal Gains electrons to form anion	• Soft • Waxy solid that glows in the dark	• Used to make match heads • Used to make alloys • Used in production of phosphoric acid which is used to make fertilizers.	• Excess phosphorous runoff causes eutrophication in water bodies which leads to algal blooms, oxygen depletion, fish kills and degradation of aquatic habitants. Mitigation

MOLE CONCEPT

Sample scenario

A group of Learners were faced with a unique solid substance, X, which they suspected to be an element.

0.3g of the element could burn in air to form 0.5g of the solid product. One of them picked interest in what could be the chemical formula of the oxide of the element. However, he did not know how to determine the formula. When they contacted the laboratory technician he gave them the atomic number and mass number of X as 12 and 24 respectively, and the symbolic representation of Oxygen as ${}^{16}_{8}O$.

Task:

As a student of chemistry help the learners to;

(a) Understand the nature of substance X

X is a metal since it forms ions by loss of electrons for example Calcium

(b) Determine the formula of the Oxide of X

Mass of oxygen in the oxide = 0.5-0.3 = 0.2g

Symbols Elements present in the Oxide	X	O
Composition by mass	0.3	0.2
Number of moles (mass$\div Mass\ number$)	$\frac{0.3}{24} = 0.0125$	$\frac{0.2}{16} = 0.0125$

Simplest ratio (mole ratio)	$\frac{0.0125}{0.0125}$	$\frac{0.0125}{0.0125}$
	1	1

Hence the formula of the oxide is X0

(c) Know the environmental consequences of the element

- When in contact with drinking water, especially in large amounts can cause cancer leading to death.

  Mitigation: by purifying water
- Their accumulation in soil can be absorbed by plants which are consumed by human causing cancer and then death.

  Mitigation: Consuming plant materials with the right amount of mineral content.
- When contaminated in air can be inhaled, hence causing respiratory diseases.

  Mitigation: by purifying the air

Item 2

Charcoal is a common fuel in many homes in Uganda. During its combustion in excess oxygen supply, it produces Carbon dioxide. Your friend is using 80.5g of charcoal to cook food in a busy evening for guests. It burns completely as shown in the equation below.

$$C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)}$$

Task:

As a learner of chemistry

(a) Assess the product formed

The product is a covalent compound, because it is formed by sharing of electrons between non-metal atoms. Examples include sulphur dioxide, ammonia etc

(b) Advise the friend on the appropriateness of the product formed.

- Does not dissolve in water
- Does not conduct electricity
- Has a giant covalent structure

- Exists as a molecule
- Is not made up of ions
- The product is used in
    - Fire extinguishers to put out fire
    - Manufacture of fizzy drinks to improve on the taste and to preserve them

(c) Calculate the volume of the gas produced every busy evening.

(1 mole of a gas occupies 22.4*l* at s.t.p, $C = 12$)

From 1 mole of a gas occupies 22.4 l at s.t.p

And 1 mole is equivalent to the RAM (12g)

Then 12g of charcoal produces 22.4l of the product at s.t.p

80.5g of charcoal used will produce $\frac{80.5 \times 22.4}{12}\ l$ of the product

$= 150.3\ l$ of the product at s.t.p

(d) Help the friend understand the impact of the product in the environment

- Its accumulation in the atmosphere causes an increase in the temperature of the earth that causes discomfort to people and other animals, death of plants due to increased transpiration.
  Mitigation: By planting trees to absorb it
- Its accumulation in the atmosphere causes acid rains that cause crumbling of buildings and change in soil pH.
  Mitigation: by planting trees to absorb it

POLYMERS

Sample scenario

A shop attendant wants to use environmentally friendly and sustainable packing materials. He is not having enough information about which packaging material to use

He has decided to seek for advise from a person with good knowledge of chemistry.

Task:

(a) Help him appreciate that the packing materials are of different types.

He should realize that packaging materials may be;

Synthetic/ artificial because they are man-made eg polythene bags or

Natural because they are God made eg cellulose in paper bags.

(b) Advise him on the suitability of the materials

- Polythene is tough
- It is insoluble in water
- Water proof
- Durable

Suitable for making packing bags for wet products

Alternatively

- Paper can easily be decomposed by fungi and bacteria (biodegradable)
- It is affordable
- Absorbs moisture
- It is stiff
- Strong
  Suitable for making packing boxes for dry products

Impacts to the environment and mitigation

- Polythene is non-biodegradable, hence pollutes the soil environment, limiting free circulation of water and air in the soil.
  Mitigation: Reduce on its use, dispose it off properly, reuse or recycle.
- Paper easily catches fire, so can lead to fire out breaks and damage.
  Mitigation: Do not use it near fire

MIXTURE

Sample scenario

A businessman was selling salt mixed with particles of sand, tricking people who couldn't notice the difference between the salt and its mixture with sand. This made it difficult for residents to use the salt. They need your help to prevent future problems and avoid any chemical dangers.

They trust your chemistry knowledge to clarify the situation and prevent further suffering.

Task:

Help the residents know

(a) Know the behavior of the substances in the mixture
Salt (NaCl) is an ionic compound because it is formed by complete transfer of electrons from a metal to a non-metal atom, eg Calcium Chloride.

It has the following characteristics

- It dissolves in water readily
- It is a crystalline solid at room temperature
- Has a high melting and boiling point
- Composed of particles called ions
- Conduct electricity in molten and aqueous state

Alternatively

Sand (SiO_2) is a covalent compound because it is formed as a result of sharing electron between non-metal atoms

It has the following characteristics

- Does not conduct electricity
- Does not dissolve in water
- Has a giant covalent structure
- Exists as a molecule
- Is not made up of ions

Uses

Sand is used during construction, used as an electrical insulator

(b) Evaluate the problems associated with the use of one of the component in the mixture.

- Over use of salt can lead to high blood pressure that may result into death.
  Mitigation: by using regulated amounts
- Lead to kidney disorders causing illness.
  Mitigation: By using regulated amounts

TRENDS IN PERIODIC TABLE

Sample scenario

A group of S3 learners came across data on melting points of elements whose identities they forgot to capture. They brought it to S4 learners to help them analyze and interpret the data for them.

Element	X	Y	Z	W	A	Q	M
Atomic number	11	12	13	14	15	16	17
M.P/^0C	98	650	660	1410	44	119	-101

Task:

As a senior four learner with good knowledge about periodic trends

(a) help them;

i) understand the classes of elements

X, Y and Z are metals, since they form ions by loss of electrons for example Calcium and Potassium

Q, A and M are non-metals since they form ions by gaining electrons, for example Oxygen.

W is a metalloid because it has both metallic and non-metallic properties, for example Silicon, Carbon.

ii) on how to interpret the data

There is a sharp increase in melting points from A to Y because decrease in atomic radius and increase in the number of electrons each metal atom contributes towards metallic bond formation resulting into stronger metallic bonds.

Melting point increased slightly from Y to Z because of the slight increase in the strength of the metallic bond due to the decrease in the atomic radius.

W has the highest melting point because it adopts a giant atomic structure with many strong covalent bonds that requires a lot of heat energy to break.

A, Q and M are non-metals which exist as molecules with simple molecular structures and the melting point decreases with decrease in the strength of the Vander Waals forces due to decreasing molecular mass.

(b) Suggest to them the uses and environmental impacts of the elements.

- Metals are used in electronic devices, in construction, manufacture of aeroplanes.

- Non-metals are used as electrical insulators, manufacture of drugs and fertilizers.
- Metalloids used in production of alloys, as flame retardant as semiconductors in the manufacture of dry cells and batteries.

Environmental impacts

Metals

- When in contact with drinking water, especially in large amounts can cause cancer leading to death.
  Mitigation: By purifying water
- Their accumulation in soil can be absorbed by plants which are consumed by human causing cancer and then death.
  Mitigation: Consuming plant materials with the right amount of mineral content.
- When contaminated in air can be inhaled, hence causing respiratory diseases.
  Mitigation: by purifying the air

Non-metals

- When burnt in air produce acidic gases which pollute the atmosphere causing respiratory diseases.

Mitigation: By burning them cautiously

Metalloids

- During mining, smelting and industrial process they can get in contact with water and soil polluting them and causing harm to organisms.
  Mitigation: Handling them carefully during the above process.

FOURTH ELEMENT OF CONSTRUCT

THE LEARNER APPRECIATES THE EXISTENCE OF NATURAL RESOURCES IN THE ENVIRONMENT AND THEIR IMPORTANCE IN EVERYDAY LIFE

For item 5 and 6 in part II of section B

ASSESSABLE AREAS

(a) Air (b) Water (c) Rocks and mineral resources	(d) Carbon based fuels (e) Fossil fuels (oil) (f) Trees

BASIS OF ASSESSMENT

BASIS OF ASSESSMENT		CRITERIA OF ASSESSMENT	SCORE
A	Identity of category of natural resource, reason and example	Identified category of natural resource with a reason and example	
		Identified category of natural resource with a reason OR Identified category of natural resource with example	
		Identified category of natural resource OR example	
		No identified category of natural resource	
B	Composition of natural resource	Any two components of natural resource	
		Any one component of natural resource	
		No component of natural resource	
C	Impact of human activities on the natural resource, how it occurs, and mitigation	Anyone Impact of the natural resource on the environment, how it occurs, and its mitigation	
		Anyone Impact of the natural resource on the environment and how it occurs OR Anyone Impact of the natural resource on the environment, and its mitigation	
		Anyone Impact of the natural resource on the environment OR how it occurs OR its mitigation	
		No Impact of the natural resource on the environment, how it occurs, and its mitigation	
D	Benefit/importance of natural resource	Any one benefit/importance of natural resource	
		No benefit/importance of natural resource	

NATURAL RESOURCES

Sample scenario

Natural resources have been destroyed as a result of increasing population and human activities. This has attracted the attention of the officials from the National Environment Management Authority (NEMA).

The officials are planning to create awareness to the people of the country through sensitization workshops organized in different district communities.

Task:

As a chemistry student, prepare a short presentation you will deliver during the workshop upon invitation.

Expected responses following the basis of assessment

Category of natural resource

They are classified as: Renewable and Non-renewable.

Renewable Natural resources can be replenished e.g. Air, water vapour, dust etc.

Non-renewable resources cannot be replenished (get used up) e.g. fossil fuels, rocks/ minerals.

Composition of natural resources.

- Air contains Nitrogen, Oxygen Carbon dioxide, rare gases, water contains; Hydrogen and oxygen.
- Fossil fuels contain Carbon, Hydrogen, and Oxygen.
- Rocks contain Iron, copper, calcium carbonate, and other minerals like Gold, Cobalt, etc.

Impact of human activities on the natural resources and mitigation.

AIR

- Some components of Air pollute environment and cause global warming, and carbon dioxide because it's a greenhouse gas thus traps heat in the atmosphere.

$$C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)}.$$

- Carbon monoxide is a poisonous gas and causes suffocation; carbon monoxide can also be converted to carbon dioxide e.g.

$$2CO_{(g)} + O_{2(g)} \rightarrow 2CO_{2(g)}.$$

Mitigation:

- Increased Afforestation to replace the cut trees which absorb CO2 from the atmosphere to reduce global warming.
- Carbon monoxide effects and production can be reduced by using catalytic converters on exhaust pipes of cars and other fuel engines to reduce the poison in the environment.

Water impact and how it occurs.

Water contains dissolved gases like O_2 and CO_2. The CO_2 in it forms carbonic acid.

$$H_2O_{(l)} + CO_{2(g)} \rightleftharpoons H_2CO_{3(aq)}.$$

The carbonic acid makes water acidic. The acid rains dissolve or deplete rocks.

$$H_2CO_{3(aq)} + CaCO_{3(s)} \rightarrow Ca(HCO_3)_{2(aq)}.$$

- Water has dissolved oxygen which facilitates rusting of iron containing materials according to the following equation:

$$2Fe(s) + xH_2O_{(l)} + \frac{3}{2}O_{2(g)} \rightarrow Fe_2O_3 \bullet xH_2O_{(l)}$$

- Hot water as an effluent from industries when introduced into the water bodies, increase the temperature of the water bodies affecting the life of aquatic organisms.

- Water pollution caused by farming and Agriculture. So the use of fertilizers results in Eutrophication of nearby water bodies and Algae blooms/algal bloom.

- Re-afforestation to reduce the impact of acid rains.

- Use of Alloys, painting, galvanizing to reduce the effect of rusting.

- Hot water reservoirs and effluent deposit points from factories to cool the exhaust water before introduction into the water bodies.

- Use of organic fertilizers e.g. manures from both animal and plant waste which are Biodegradable and reduce on use of synthetic fertilizers.

- Vehicles and machines burn fossil fuels leading to reduction of gaseous pollutants into the atmosphere.

$$2C_{(s)} + O_{2(g)} \rightarrow 2CO_{2(g)}.$$

$$CH_{4(g)} + 2O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O_{(l)}$$

$$S_{(s)} + O_{2(g)} \rightarrow SO_{2(g)}.$$

$$2SO_{2(g)} + O_{2(g)} \rightarrow 2SO_{3(g)}$$

Mitigation:

• Use of alternative fuel and energy sources like solar and Hydroelectric Power (HEP) from the sun and water respectively reduce on depletion of Fossils and also the decrease in gaseous pollutants.

Benefits of the natural resource

• Air facilitates respiration, during respiration carbohydrates combine with oxygen in order to release energy and carbon dioxide used for proper body functioning.

- Air facilitates photosynthesis. During photosynthesis, carbon dioxide from air combines with water in presence of sunlight trapped by chlorophyll to form glucose, carbohydrates and oxygen.

Fossil fuels are used as fuels; fossil fuels when burnt produce heat energy used to run engines and machines and for cooking.

•Water is a habitat for many aquatic organisms; water bodies like lakes, rivers, swamps, dams, pools contain necessary conditions for survival of animals like fish, snails, snakes, worms, bacteria and plants e.g. blue green algae planktons which are fish foods etc.

•Water bodies like; lakes, rivers, pools, as well as water vapour from plants crucial role in rain formation.

Water from the water bodies evaporates and eventually cools and condenses on the clouds, these results into precipitation.

Water bodies like rivers can be used to generate electricity, fast moving waters to the rivers drives turbines at waterfalls which produce kinetic energy into electrical energy.

Item 2

Osukuru village in Tororo district is at the foot of Tororo rock. People of this village for a long time have practiced charcoal burning , animal husbandry , crop husbandry and stone quarrying, recently the animals have started dying and wells are drying up yet the little water available is not fresh. The locals are now wondering why all these are happening.

A sensitization workshop is to be organized to explain the existing situation in the village.

The theme of the work shop is **MY ENVIRONMENT MY RESPONSIBILITY**.

Task:

As chemistry student, write a massage you will deliver upon invitation

Expected responses following the basis of assessment

Theme '**MY ENVIRONMENT MY RESPONSIBILITY**'

Category of the natural resource

Resources in our environment which we use to satisfy our needs; water, air, trees, grass, rocks. They are classified as renewable and non-renewable.

Renewable resources can be sustained e.g. air, water, grass.

Non-renewable resources can be exhausted and not replaceable e.g. fossil fuels, rocks etc.

Composition of natural resources.

- Air: is composed of Nitrogen, Oxygen, Carbon dioxide, rare gases, water vapour and dust in different proportions.

- Water: is a compound made up of hydrogen and oxygen. It has dissolved minerals, micro-organisms and living things.

- Rocks: are of different types of example igneous, sedimentary metamorphic. They contain minerals for example limestone, iron, gold, copper, quartz etc.

- Trees and natural vegetation is made up of important elements like carbon, hydrogen, magnesium etc. (depending on the soil composition).

Impact of human activities on natural resources. How it occurs and mitigation/chemicals and physical reactions

Impact to the Environment:

Several activities impact negatively on natural resources for example

Charcoal burning involves cutting down of trees which leads to deforestation and loss of habitat for wild animals.

It leads to increased amount of carbon dioxide in the atmosphere which contributes to climate change and global warming.

Mitigation:

Ensure sustainable fuel production using soft wood which is renewable. (Afforestation) Use charcoal briquettes made from waste organic materials.

Stone quarrying:

Involves breaking of rocks into small stones and gravel for construction purposes. This disrupts the underground water cycle and sources hence reduced water quality, air pollution from dust, destruction of vegetation cover.

Mitigation:

Strict government policies and laws against stone quarrying. Filling up holes made during the process of quarrying, encourage population to use alternative construction materials like tiles and clay bricks..

Farming:

Involves the use of fertilizers and manure which pollutes water bodies and makes the water unsafe for use.

Mitigation:

Sensitize farmers to use controlled doses of fertilizers and manure in gardens.

Animal Husbandry:

Causes water pollution through their excreta.

Mitigation:

People should ensure proper disposal of animal excreta and also convert it into other useful products for example biogas, organic fertilizers and briquettes.

Benefit / importance of natural resource

Air is used for respiration. During respiration carbohydrate combine with oxygen in air to release energy and carbon dioxide used for proper body functioning.

Air facilitates photosynthesis, during photosynthesis carbon dioxide from air combines with water in presence of sunlight trapped by chlorophyll to form glucose and oxygen.

Fossil fuels are used as fuels: Fossil fuels when burnt produce heat energy used to run engines and machines, even for cooking.

ROCKS AND MINERALS

In Uganda there are many mineral reserves and rocks. Due to the rapid population growth, their exploitation is causing proportional environmental degradation. The government through media houses wants to make public awareness on the matter.

Your school has been chosen to lead the environmental conservation campaign in your district. You have been chosen to present on one of the radio talk shows trusting your chemistry knowledge on natural resources.

Task:

Write down the information that can be conveyed.

Expected responses following the basis of assessment

Category of the natural resource

Rocks and minerals are non-renewable natural resources because they cannot be replenished/ replaced by natural processes in man's life time.

Composition of the natural resource

They are classified as igneous, sedimentary and metamorphic rocks

Igneous rocks comprising of minerals like Quartz, Feldspar and Olivine.

Sedimentary rocks comprising of minerals like Calcite, Clay materials and Gypsum.

Metamorphic rocks composed of minerals like Garnet, Mica (biotite) and feldspar

Impact of the human activities on the natural resource

- Stone quarrying produces dust particles which erode into water bodies, hence reducing on its quality.
  Mitigation: Extracting carefully and use of personal protective equipments.
- Stone quarrying and mineral extraction removes top soil and ditches which degrades the soil environment hence affecting growth of plants and destruction of vegetation covers.
- Mineral extraction results into breaking rocks into smaller stones and gravels which depreciates the rocks.
  Mitigation: Careful extraction

Importance of the natural resources

- Rocks are broken into hard cores, gravel or panels used as materials for construction of roads, bridges and houses.
- They are usefully in formation of soil by a process of weathering

WATER

Urbanization and industrialization have caused freshwater bodies to suffer from severe pollution. The Uganda government aims to create public awareness regarding the natural resource through various initiatives.

One of the initiatives is to involve students with good knowledge of chemistry in radio talk shows.

Task

Write a presentation you can use.

Expected responses following the basis of assessment

Category of the natural resource

Water is a renewable natural resource because it be replaced/replenished by natural processes in man's life time.

Composition of the natural resource

Dissolved Oxygen, mineral salts, aquatic plants and big animals as well as micro-organisms and pollutants from man's activities.

Impact of human activities on the natural resource

- Release of hot water as an effluent from industries into the water bodies, increase the temperature of the water bodies hence endangering like aquatic organisms.

Mitigation: By cooling the water before discharge and use of hot water reservoirs

- Excessive use of fertilizers during crop farming which infiltrate into water bodies, hence polluting water, resulting eutrophication of nearby water bodies.

Mitigation: use of organic fertilizers eg Manure from both animals and plants waste which are biodegradable and reduce on use of synthetic fertilizers.

Benefits/importance of the natural resource

- Water bodies are very useful in rain formation which is useful for proper plant growth.

AIR

Sample scenario

"Residents of Kampala are facing severe health risks due to poor air quality," was headline in one of the recent editions of the New Vision new paper. With the city's reputation tarnished and residents' health hanging in the balance, urgent action to raise awareness and clean the natural resource is needed, the paper continued to state.

The Kampala Capital City Authority (KCCA) is getting ready to improve the situation following the alarming revelation.

As a student of Chemistry who has learned about air as a natural resources.

Task:

Write an article KCCA would use in response to the paper to sensitize the community of Kampala.

Expected responses following the basis of assessment

Category of the natural resource

Air is a renewable natural resource because it can be replenished in man's life time.

Composition of the natural resource

Nitrogen gas, oxygen gas, carbon dioxide, rare gases, water vapour and dust.

Impact of human activities on the natural resource

- Burning of fossil fuels increases amount of carbon dioxide gas thus trapping a lot of heat in the atmosphere thereby causing global warming and consequently desertification.

  Mitigation: By increasing afforestation to absorb carbon dioxide from the atmosphere as quickly as it is formed.

- Air contains gases like oxygen which supports burning, cooking in limited air leads to incomplete combustion of carbon- based fuels which adds carbon monoxide to air polluting it.

Mitigation: use clean energy such as electricity to avoid greenhouse gas emissions.

Importances of the natural resource

- Air contains oxygen which is used for respiration and carbon dioxide which is used for photosynthesis.

TREES

Sample scenario

Uganda's forests are under pressure from illegal logging, agricultural expansion, and urban growth. Despite government attempts to advocate for sustainable forest management, these efforts have failed due to citizens' lack of awareness regarding the benefits and consequences.


Task:

Use your chemistry knowledge to create awareness on the matter.

Expected responses following the basis of assessment

Category of the natural resource

Trees and natural vegetation are renewable natural resources because they can be replenished/ replaced by natural processes in man's life time.

Composition of the natural resource

Trees and natural vegetation are made up of cellulose which is a carbohydrate (made up of important elements like Carbon, hydrogen and Oxygen) and other minerals such as magnesium, nitrogen etc.

Impact of human activities on the natural resource

- Charcoal burning involves cutting down of trees which leads to deforestation and loss of habitat for wild animals.

Mitigation: Use of charcoal briquettes made from waste organic materials and carrying out afforestation.

- Massive cutting down of trees leads to increased amount of carbon dioxide in the atmosphere resulting into increasing temperatures on earth since it's a greenhouse gas.

Mitigation: Planting more tree which can absorb carbon dioxide

Benefits of the natural resource

- Trees provide herbal medicine, provide food and purify air by adding oxygen and removing carbon dioxide.

CARBON BASED FUELS

Sample scenario

In Uganda, people are voicing concerns about prolonged drought and unpredictable rain seasons, leading to difficulties in farming planning. The officer in charge of agriculture attributes these issues to the use of charcoal and kerosene for cooking, citing their environmental implications. However, many natives deem to struggle to grasp the connection between their energy consumption habits and the broader environmental impact.

You are expected to close a gap in understanding between the officer's perspective and the community's perception of the situation.

Task:

Help the natives understand this connection.

Expected responses following the basis of assessment

Category of natural resource

Renewable Natural resources can be replenished e.g. Air, water vapour, dust etc.

Non-renewable resources cannot be replenished (get used up) e.g. fossil fuels, rocks/ minerals.

Composition of the natural resource

They are made up of Carbon hydrogen etc

Impact of human activities on the natural resource

- Burning carbon-based fuels releases harmful pollutants like particulate matter, nitrogen oxides, sulfur dioxide, and volatile organic compounds, contributing to poor air quality and negative health effects.

Mitigation: Implement emission controls like scrubbers, electrostatic precipitators, and fabric filters; promote cleaner fuels like natural gas or renewable energy

- Burning carbon-based fuels releases sulfur dioxide and nitrogen oxides, which combine with water and oxygen to form acid rain, damaging ecosystems and infrastructure.

Mitigation: Implement emission controls like scrubbers; switch to cleaner fuels like natural gas or renewable energy; add alkaline substances to neutralize acidity

- Burning carbon-based fuels can contaminate water sources through wastewater disposal or cooling system discharges.

Mitigation: Implement proper wastewater treatment and disposal; use dry cooling systems or hybrid cooling towers; promote water conservation

Benefits/importances of the natural resource

- Charcoal & kerosene are used for cooking

SAMPLE EXAMINATION PAPERS

SET 1

SECTION A

Answer all items from this section

Item1

Whenever Alexa falls sick, she resisted going to the hospital and chewed leaves of mangoes, eucalyptus plus a cup full of hot water in which she dissolved seeds of Dutchman's pipe. This time she presented with cough, flu and fever with convulsions and was rushed to a nearby health facility. Her body temperature was high and was given some tablets then an injection. Alexa's condition improved tremendously.

Task:

(a) Point out why Alexa was rushed to a healthy facility.

_____
_____
_____

(b) Help Alexa to understand how the tablets she received and injection work.

_____
_____
_____
_____
_____

(c) Advise Alexa on the long term use of medicine

_____
_____
_____
_____
_____

Item 2

Constructors abandoned some materials at the construction site which Vincent discovered while leveling the compound. They included some metal pieces, polythene and cloth. Some cloth broke into tiny pieces while others remained intact. Vincent was disturbed on how best to dispose off the materials that remained intact seeking for advice from the owner of the building.

Task:

Using your knowledge of chemistry;

(a) Help Vincent;

(i) Categorize with reasons the abandoned materials

_____
_____
_____

(iii) Advise him on the suitability of the materials he found abandoned

_____
_____
_____
_____
_____
_____

(b) In what ways were the materials suitable for the uses they served?

_____
_____
_____
_____
_____

(c) Advise Vincent on the impact of the materials on the environment

_____
_____
_____
_____
_____

SECTION B

PART I

Answer **one** item from this part

Item 3

Electricity connectivity in most parts of Uganda is still very low and rural communities have continued to cut down trees for fuel which is affecting the environment and likely to cause climate change. Kilembe mines can be revived to extract the metal for making electric cables which would benefit the communities despite the impact of the extraction process.

Task:

Using your knowledge of chemistry, write a presentation explaining how the pure metal can be produced including the impact and benefits of the process.

Item 4

The collapse of tall buildings and bridges has partly been blamed on low grade materials used in construction. The ores for extraction of Iron are abundant in Kiwembe. A company intends to build an industry in the areas and the officials want to meet the residents for an educative talk.

Task:

As a chemistry learner, make a write up of what the company officials would present to the residents.

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

PART II

Attempt only one item from this part

Item 5

Walusimbi a compound cleaner advised students not to burn rubbish on the school compound but seek other means of disposal. This resulted into accumulation of garbage which made the deputy head teacher to intervene and ordered for the rubbish to be burnt. This activity did not go well with the learners in the adjacent classrooms. The lessons were abandoned as the students and teachers sought for safer places.

Task:

Make a write up of why Walusimbi could be right in his advice to the students.

Item 6

Kasambya residents practice stone quarrying to earn a living. The quarry is on school land. The board of governors of the school have deemed it necessary to stop this activity because of its associated challenges. The community feels it is not right for the school authorities to stop them from using the natural resource and have organized through the LC 1 chairperson for a meeting with the school authorities.

Task:

As a student of chemistry, prepare a write up of the presentation you expect the school authorities to deliver to the community covering the identity of the natural resource.

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

SET 2

SECTION A

Answer **all** items in this section

Item 1

A man from the village is not used to brushing his teeth with a tooth paste after a meal every evening and requested to be educated about underlying facts behind this practice. He felt just washing his mouth with water was sufficient enough to stay clean.

Task:

Using your knowledge of chemistry

(a) State why it was necessary to use a tooth paste

_____
_____
_____

(b) Help the man understand how it works

_____
_____
_____
_____
_____

(c) Advise the man on the challenges associated with long term use of the paste.

_____
_____
_____
_____
_____

(d) How does the method compare with the man's way of maintaining clean and healthy teeth?

_____
_____
_____
_____
_____

Item 2

A rich man was in the process of connecting water to his newly constructed residential building. There are various materials he could use for constructing a water tank stand whose nature and properties determine their suitability. However he needs to be advised before buying the materials and has asked a local builder to educate him. The builder decides to come to you for advise.

Task:

(a) Use your knowledge of chemistry to explain;
(i) The nature of materials.

_____
_____
_____

(ii) The suitability of materials.

_____
_____
_____
_____
_____

(b) Advise the rich man on the choice of materials for use and their impact on the environment.

_____
_____
_____
_____
_____

SECTION B

PART I

Answer only **one** item from this section

Item 3

Kimbagaya is a well-known local investor in Kalot village whose locals use borehole water for washing clothes. He has planned to set up a soapless detergent manufacturing plant in the village with high hopes of maximizing his annual profits. He has assured the LC1 chairman that his plant will have a minimal impact to the village environment.

However the locals would like to know how the production process will be carried out and how the plant will impact their village.

You have been entrusted by the LC1 chairman to sensitize the locals about plant during a village meeting

Task:

Prepare a write up that you will deliver during the village meeting.

Item 4

Iron is used to make steel bars that reinforce the strength of concrete in building. Due to increased demand for steel bars countrywide, the government has hired an investor to setup an iron manufacturing plant in Gangu town which has large quantities of iron rich rocky ores. The investor has assured the government will have a minimal impact to the town environment.

The chemistry club members at your school would like to know how the production process will be carried out and how the plant will impact their town. The chemistry club president has appointed you to sensitize the club members.

Task:

Prepare a brief message you will deliver during your presentation.

_____

_____

_____

_____

_____

_____

_____

PART II

Answer **one** item from this section

Item 5

Lwera is a big wet land that has of late been heavily encroached on for sand mining by some investors. The wet land is next to Lake Victoria. The investors use heavy caterpillar graders and trucks and have constructed temporary settlement, fenced off the area from local residents who felt cheated. Besides this, the activity was impacting on the environment. The parliament of Uganda debated the matter and a decision was made to stop the activity.

Task:

As a student of chemistry make a write up of the presentation the residents must have forwarded to their member of parliament on the natural resource for consideration.

Item 6

In most urban centers, waste management and disposal is a big challenge that has kept the local authorities seeking for solutions. In one slum, some residents pass stool into polythene papers and dispose off in the nearby water channel. Garbage and plastic materials are scattered almost everywhere. This has prompted the local authorities to organize sensitization workshops to address the challenge.

Task:

As a student of chemistry, write a presentation of the message you would expect the local authorities to use to sensitize the residents.

END

SET 3

SECTION A

Answer **all** items in this section

Item 1

Josephine, a popular food vendor has been using a new ingredient in her dishes, to enhance the food flavor and stomach texture. However complaints related to issues and allergic reactions have been reported to her by customers. She is considering using an alternative but needs guidance.

Task:

As a learner of chemistry

(a) Point out the best alternative product she can use.

_____
_____
_____
_____
_____

(b) Explain the function of the product you have chosen

_____
_____
_____
_____
_____

(c) Evaluate the impacts associated with long-term use of the product.

_____
_____
_____

(d) Help her evaluate the product

Item 2

The government wants to construct a new strong dam in Isimba region along River Nile in order to increase on hydroelectric power production. It has hired a Chinese dam construction company to execute this exercise using different building materials on market that have minimal impact to the environment.

The chief engineer of the company has promised the government that he will select suitable materials to be used basing on their qualities and properties.

Task:

Use your chemistry knowledge to;

(a)Explain

(i) Categories of materials to be used.

(ii) The suitability of the materials.

(b) Advice the chief engineer about the impacts of the materials to the environment.

_____
_____
_____
_____

SECTION B

PART I

Answer **one** item from this section

Item 3

Ethanol is a major component in sanitizers. Following an increased demand for sanitizers countrywide due to covid-19 spike. The government has hired a local investor to set up an ethanol brewing plant in Jinja industrial area to make more ethanol to be used in sanitizers. The Jinja city council would like to know how ethanol will be produced and how the plant will impact the environment of their city.

Task:

Make a write up you will deliver to Jinja city council answering their concerns.

Item 4

A large chemical plant in a rural area is considering producing ammonia to be used in making fertilizers in order to meet the growing demand for fertilizers in the agricultural industry. However, many residents in the area lack knowledge on how the production process can be affected with less impact to the environment.

Your fellow students also wish to understand the same. You have been selected to make a presentation to them by your teacher.

Task

As a learner of chemistry, make a write up of the message that you will deliver to them.

PART II

Answer **one** item from this part

Item 5

With the increasing demand of charcoal and fire wood among the residents Of Mpigi district, a large part of Mpanga forest was cleared. Consequently the area started experiencing little rainfall and flooding. This has attracted the attention of the district chairman and thus organized sensitization workshops to address the challenges in the community.

Your school has been invited and you have been selected among the speakers since you have enough chemistry knowledge.

Task:

As a learner of chemistry make a write up of what you would deliver in the

Item 6

Following the recent discovery of some of the natural resources in the Albertine region, many people have started encroaching onto the land of this region by clearing trees to create space for settlement and charcoal burning and also the water of Lake Albert is exponentially deteriorating. This has attracted the officials of Hoima district environment management authority.

The officials want to sensitize people in the Albertine region about environment conservation through a workshop.

Task:

As a chemistry learner, prepare a short message you will deliver upon invitation to the workshop.

SET 4

SECTION A

Answer **all** items in this section

Item 1

One of the most important salts in human life is mined from Lake Katwe. This salt is a household chemical compound hence it is given a name common salt. Most of the people in the community have insufficient knowledge on the nature of this salt and its importance in their life. One of the community members has identified you as a knowledgeable person and he is seeking for guidance.

Task:

(a) Take him through on;

(i) The category of its chemical compound

_____

_____

_____

(ii) The suitability of the chemical compound

_____

_____

_____

_____

_____

(iii) How the compound is beneficial to the people in the community

_____

_____

_____

_____

_____

(b) Does the compound have any effect on the environment

_____
_____
_____
_____
_____

Item 2

A new juice company in Soroti district is in need of plastic bottles for packaging their juice. The production manager is in need of good quality bottles that are environmentally friendly. There are various plastics available on market. The manager is seeking for more clarity on the different plastic brands.

He is aware that selecting quality plastic depends on the nature of the material.

Task:

As a learner of chemistry

(a) Explain the;

(i) Category of the product

_____
_____
_____

(ii) The suitability of the material for the selected product.

_____
_____
_____
_____
_____

(b) Advise the manager on the choice of the products

_____
_____
_____

SECTION B

PART I

Answer only **one** item from this part

Item 3

Agriculture is the backbone of Uganda, in some districts of Uganda like Kasese and Tororo, farmers get very low yields due to exhausted soils this has led to famine outbreak in the areas. Ammonium nitrate is one of the effective fertilizers used to improve crop yields.

The ministry of agriculture through the government of Uganda has cleared a local invertor to set up an ammonium nitrate production plant Mukono industrial area such that the fertilizer is got at a cheaper cost.

However, the community near the production plant is worried about its effects on the environment and how the process will occur. The head of chemistry department at your school has appointed you to sensitize other learners.

Task:

Prepare a presentation you will make during the meeting.

Item 4

Due to increased population growth in Uganda, the electrical engineering forum has raised a concern of reduced copper wires in the country. In response, the government has contracted an investor to set a new copper extraction plant in Kasese district.

However, the community near the production plant is worried about its effects on the environment and how the process will occur. The head of science department at your school has appointed you to sensitize other learners during the science club meeting

Task:

Prepare a presentation you will make during the meeting.

PART II

Answer only **one** item in this part

Item 5

With the increasing demand of charcoal and firewood among the residents of Mpigi district, a large part of Mpanga forest was cleared. Consequently, the area started experiencing little rainfall and flooding. This has attracted the attention of the district chairman and thus organized sensitization workshops to address the challenges in the community.

Your school has been invited and you have been selected among the speakers with enough knowledge of chemistry knowledge.

Task

As a learner of chemistry make a write up of what you expect to be delivered in the meeting

Item 6

The collapse of Masaka Highway in Busega was attributed to the heavy rainfall that led to flooding, weakening the road foundation. Additionally, the many human activities taking place in the swamp surrounding it such as industrialization and human settlement contributed to its swallowing hence erosion.

The environmental experts have embarked on the sensitizing the community with the goal of finding a solution to the current challenges and those likely to occur.

Task

As a learner of chemistry, make a write up of your expectations in the meeting.

SET 5

SECTION A

Answer **all** items in this section

Item 1

In Butemula town, Nakaseke district, residents are facing an unexpected challenge of water wasting soap. The locals are frustrated as they do not understand the cause and what to do. However they have heard of another detergent on the market that work better but they need more advice on this.

A resident has sought your assistance, confident that you can use your knowledge of chemistry to provide help.

Task:

As a chemistry student;

(a) Advise the residents on the category of that detergent.

_____
_____
_____
_____
_____

(b) Help the residents understand how that detergent works

_____
_____
_____
_____
_____

(c) Advise the residents on the challenges associated with the long term use of the detergent.

(d) Elaborate to the members how the two detergents differ and relate in terms of their properties.

Item 2

A group of Learners were faced with a unique solid substance, X, which they suspected to be an element. 0.3g of the element could burn in air to form 0.5g of the solid product. One of them picked interest in what could be the chemical formula of the oxide of the element.

However, he did not know how to determine the formula. When they contacted the laboratory technician he gave them the atomic number and mass number of X as 12 and 24 respectively, and the symbolic representation of oxygen as $^{16}_{8}O$

As a student of chemistry help the learners to;

(a) Understand the nature of substance X

(b) Determine the formula of the oxide of X

_____

_____

(c) Know the environmental consequences of the element

_____

_____

_____

_____

SECTION B

PART I

Answer only **one** item from this part

Item 3

Ammonia is used on a large scale for the manufacture of laundry detergents for removing temporary hardness. It's used on a large scale refrigeration plant and in the production of Nitrogenous fertilizers which are highly needed by the farmers. In an attempt to continue supporting the country's agricultural sector among other sectors, the government is seeking to ensure a steady availability of ammonia and thus has hired an investor to set up an ammonia production plant with minimal environmental impact in Kasambya town.

However, the community in Kasambya would like to know how the production process will be carried out and how they will benefit from this plant.

Task:

As a chemistry student, make a write up you will use during this presentation.

Item 4

With the need to overcome the financial constraints in Buwanuka village, the women councilor has organized women groups and wishes to support them start up a soap making project.

However, many residents lack knowledge on the production process. They are also wondering how this will be effected without endangering the ecosystem.

Task:

Use your knowledge of chemistry to make a useful write up to them.

PART II

Answer only **one** item in this part

Item 5

People have encroached on wetlands in search for land for settlement and setting up industries. This has caused major problems to the country and prompted government to come up with a campaign to conserve the wetland. Your school has been selected to champion this campaign in the district.

Task:

As a member of this campaign team in your school, make a write up of the message you will be presenting to people when you are called upon.

Item 6

In the village of Lukese which is on lake shores in Kamuli District, people are found washing near the lake, practicing agriculture and setting up industries. They are now facing with a challenge of low water quality.

The chairperson of Lukese village has organized an emergency meeting with a theme **"WATER CONSERVATION IS EVERYONE RESPONSIBILITY"**

Task:

As a student of chemistry who is a member of the village make a written document about the theme that you will present in the village meeting upon invitation.

SET 6

SECTION A

Answer **all** items in this section

Item 1

Enid owns a laundry shop in Busia border town. Being a new person in the area, she sent one of the water sellers to collect for her water for use. While cleaning some of her client's white clothes, using the available detergents, she realized that some brown spots remained on them yet she had rinsed it severally. This has left Enid wondering and has approached you for some piece of advise.

Task:

As chemistry learner;

(a) Explain to Enid the mistake she made why choosing the product

_____
_____
_____
_____

(b) Guide Enid to understand how the product works

_____
_____
_____
_____
_____
_____
_____
_____

(c) Advise her on the challenges associated with the long term use of the product.

_____
_____
_____
_____
_____
_____
_____
_____

Item 2

Mayuge district local Government has planned to create Jobs for Jobless youth by setting up an industry that makes Kitchen Utensils. However they do not know the various materials and their properties that can be used to make the items. The district has contacted the chemistry department of your school to advise them on what elements/substances to be used as raw materials.

Task:

As a chemistry student who has learnt about periodic table, write a presentation you would give upon invitation being selected by the head of department

(a) On the category of elements /substance.

_____
_____
_____

(b) Suitability of the elements/substances

_____
_____
_____
_____

(c) Choice of elements/ substances

_____
_____

_____

_____

(d) Impact of the elements/ substances on the environment

_____

_____

_____

_____

SECTION B

PART I

Answer only **one** item from this part

Item 3

Kaliisa an investor dealing in paper recycling is facing a challenge of high cost of sodium hydroxide which is so crucial to come up with high quality papers. He is planning to set up sodium hydroxide production plant to cut the costa. However the residents are protesting against the establishment of this plant and their concern is about its impact on the environment and how they will benefit from the plant. The investor has contacted you to guide him on what to tell the residents.

Task:

As a chemistry student, prepare a report that will guide him on his presentation.

Item 4

The use of acid containing materials is on the rise in Uganda and around the globe due to their wide applications. Tiwana chemical industry wants to establish a sulphuric acid plant in Namanve to cater for the increasing demands of the acids.

However, the municipality has to approve it. The authorities have requested Tiwana Company to represent a detailed write up which can help in approval process but the Chief Executive Office has limited knowledge about the production process of Sulphuric acid.

You are a chemist staying in Namanve and the CEO has approached you for help.

Task:

Make a write up that Tiwana Company will submit to the municipality.

PART II

Answer only **one** item from this part

Item 5

Uganda is blessed with rocks and minerals. However, their exploitation is causing more harm than good to the environment. The Government wants to raise public awareness about this issue through school debating competitions on the theme **"EXPLOIT NATURAL RESOURCES RESPONSIBLY"**

Task:

Write down the chemistry information which can be extended to the public in these debates.

Item 6

The government plans to build a new oil refinery in Kadam-Moroto Basin to exploit the natural resource and reduce on fuel prices. However, there is need to educate local residents about the natural resource, its environmental impact and importance first.

The science club at your school has volunteered to do the sensitization during holidays.

Task:

Write the chemistry you would need to pass over to the residents.

END

SET 7

SECTION A

Answer **all** items in this section

Item 1

A man was looking at a label on the bottle of soda which showed ingredients such as citric acid, carbonated water, sugar and flavoring, he then wondered whether this was a trade mark of the company that produces soda.

As a student of chemistry

Task:

(a) Help the man understand the type of product

_____
_____
_____

(b) Explain to the man the functions of the product

_____
_____
_____
_____

(c) Explain to him the dangers of the product

_____
_____
_____
_____

(d) Help him evaluate the product

_____
_____

_____

_____

Item 2

The Uganda Civil Aviation Authority has hired an engineering company to reconstruct the recently damaged bombardier aircraft body. The chief engineer of the company wants to reconstruct a new, good and strong bombardier aircraft body.

However the chief engineer knows that he has to choose the right material to be used with suitable qualities and properties and thus he has come to you for advice.

Task:

Use your chemistry knowledge to;

(a) Explain

(i) The category of the material the engineering company will use

_____

_____

_____

_____

(ii) The suitability of the material

_____

_____

_____

_____

_____

_____

(b)The impact of the material to the environment.

_____

_____

_____

_____

SECTION B

PART I

Answer only **one** item from this part

Item 3

There is high demand of oxygen in referral hospitals in Uganda. An investor was contacted by government to set up an oxygen manufacturing plant at Namanve, one of the swamps near Kampala to tap into the opportunity. However, the residents seem not to understand how the process will occur plus its consequences and are resisting the project.

As a senior four candidate with the knowledge of chemistry, you are required to create awareness to the members and provide the necessary information.

Task

Write a presentation you will use upon meeting them

Item 4

People in Kisinza village only have access to borehole water which is not effective in cleaning clothes when soap is used. A local investor has been cleared by government to set up an industry that makes soapless detergents in the area however he is facing resistance from the community members about the issue of starting up the factory and he is equally lacking knowledge about the manufacturing process.

The head teacher has appointed you to go and represent the school in the meeting organized by the chairperson of the area to settle the wrangles between the investor and the citizens of the area.

Task

Write a message you would deliver in this meeting.

PART II

Answer only **one** item from this part

Item 5

The setup of crude oil mine in Hoima district resulted in displacing of residents to other places but the displaced people are still not contented. This has made the government to intervene.

The government is planning to sensitize the residents through workshops in the district.

Task:

As a chemistry student prepare a short presentation you will deliver during the workshop upon invitation

Item 6

In Masese Division Jinja city some residents near the lake are involved in certain activities like raring animals, growing crops, distillation of ethanol and washing clothes from lake banks.

Recently it has been discovered that the fish has started dying and people who use the water for bathing develop rashes. This has attracted the attention of officials of the ministry of health and have been invited for discussion to try and discover the causes of what is happening.

A sensitization workshop is to be conducted to explain the existing situation in the area. The theme of the workshop is **MY ENVIRONMENT MY RESPONSIBILITY**

Task:

As a chemistry student, write a presentation.

END

SET 8

SECTION A

Answer **all** items in this section

Item 1

On a wedding party guests were wondering and excited by the aroma and taste of the food served that it so delicious. The Master of Ceremony (MC) kept on notifying the people that the food had been prepared with knowledge of chemistry and some of the guests wanted to know what the Master of Ceremony meant

Task:

As a chemistry learner, basing on the MC's communication advise the guests on:

(a) The variety of the ingredients used.

_____
_____
_____
_____

(b) The suitability of the ingredients

_____
_____
_____
_____

(c) The possible problems associated with, and choice of the ingredients used.

_____
_____
_____
_____
_____
_____

Item 2

The government wants to construct a new strong dam in Isimba region along River Nile in order to increase on hydroelectric power production. It has hired a Chinese dam construction company to execute this exercise using different building materials on market that have minimal impact to the environment.

The chief engineer of the company has promised the government that he will select suitable materials to be used basing on their qualities and properties.

Task:

Use your chemistry knowledge to;

(a) Explain

(i) Categories of materials to be used.

_____

_____

_____

_____

(ii) The suitability of the materials.

_____

_____

_____

_____

_____

_____

_____

_____

_____

(b) Advice the engineer on the uses of materials.

_____

_____

_____

_____

_____

(c) Advise the chief engineer about the impacts of the materials to the environment.

_____

_____

_____

_____

SECTION B

PART I

Answer only **one** item from this part

Item 3

A parent of a senior four candidate in one of the villages in Kaberamaido District belongs to a "women's development group". The members of the group have come up with a project idea of making soap which they think they can sell to the nearby shops and obtain revenue. However, none of the members has knowledge about soap making. But the parent suggested a name of an s.4 candidate to the executive committee of the group as a rescuer and the committee has approached him/her for guidance.

As a chemistry learner.

Task

Write a brief message that candidate will deliver to the group members

Item 4

At Lake Katwe in Kasese District, Uganda, there are significant rock salt deposits. Discussions are underway in your class regarding the operations of a proposed chlorine plant. Students are unclear about how chlorine is manufactured from raw materials and its advantages.

They need guidance on the production process, emphasizing safety and environmental concerns.

Task

Write down your presentation in the discussion.

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

PART II

Answer only **one** item from this part

Item 5

A technical team from National Environmental Authority (NEMA) is making research about the **air** quality in Namanve industrial Park in Mukono District. The area has many industries that release waste gases to the atmosphere. The authority has engaged stake holders including your school to make a detailed research report.

Task:

As the chairperson of the Environment club at your school, prepare a detailed report for them to use as a research tool.

Item 6

A non-government organization dealing with the impact of refugees on the hosting communities in west Nile region, observed a number of challenges that impacted negatively on the natural resources. The refugees carried out activities such as grazing, cultivation, cutting down trees for firewood and charcoal, brick making, molding soil for houses, cutting grass for mud and wattle houses, brewing alcohol and many others. The environment was noisy, dusty with generally poor sanitation, malaria was quite common and poor harvest as the soils are left bear and eroded.

The poor handling of natural resources has caused total environmental degradation and the NGO has organized awareness talk shows to solve the challenges.

Task:

As a student of chemistry make a write up of the awareness the NGO officials are expected to present to the refugees and the hosting population.

END

SET 9

SECTION A

Answer **all** items in this section

Item 1

In one of the societies in Kampala, there is an outbreak of bacterial diseases such as typhoid. The society members rely on each other for medical advice. Recently, a resident complained about persistent stomach ache followed by diarrhoea, but there was no one to advise on proper medication the society members should use.

Task:

As a learner of chemistry;

(a) Advise society members on the possible types of products to use

_____
_____
_____
_____

(b) Carefully educate them on what the products exactly do.

_____
_____
_____
_____

(c) Advise them on the challenges associated with the product use and consequently how to select the products to use

_____
_____
_____
_____

Item 2

Ruzindana a businessman who runs a shoe boutique in Kampala city has received numerous complaints from customers regarding the poor quality of the shoe soles. As a result, he is looking to find high quality environmentally friendly shoe soles. Despite the availability of various shoe soles of different qualities and compositions in the global market, he does not know which ones to stock.

The businessman is aware that the quality of shoe soles depend on the nature of the material used and he is now seeking advise from you on this matter.

Task:

As a student of chemistry, explain the;

(a) Category of the materials used

_____
_____
_____
_____

(b) Suitability of the materials

_____
_____
_____
_____

(c) Advise him on the choice of the material he should opt for.

_____
_____
_____
_____

SECTION B

PART I

Answer only **one** item from this part

Item 3

The price of cement in Uganda is so high. However, the people in authority are attributing this to the limited amount of cement in the country because of the few manufacturing industries. A resolution was made to set up another cement factory in your village in Tororo District.

The village members are wondering how this will be done. But the chairman has called for a meeting and has requested you to give a talk to the members. As a chemistry learner,

Task

Make a write up of your communication to the village members.

Item 4

Many people in villages make a living by manufacturing local waragi (ethanol). However, the government is against the business due to associated challenges. The area Member of Parliament wants to sensitize the community about the large-scale production process and its impact to enable them understand the government position.

The area Member of Parliament has contacted you as a student with the knowledge of chemistry in your village to provide relevant information.

Task:

Make a write-up to use upon meeting the community.

PART II

Answer only **one** item from this part

Item 5

Recently there has been a rapid climate change for the past years leading to increased temperature changes of the earth and extinction of some species of organisms.

Government through the National Environmental Management Authority is planning to organize environmental awareness workshop on the effect of climate change.

You have been invited at one of the local FM radio to talk about the issue.

Task:

As a chemistry student who has studied about climate change, prepare your presentation for the talk show.

Item 6

Some people living in rocky area are poor because crops cannot grow well. They have decided to relocate to another area but the area Member of Paliament has organized a sensitization workshop on the other ways they could make use of the rocks.

Task:

As a student of chemistry, you have been selected to advise the people of the area. Make a write up you would present to the people.

END

SET 10

SECTION A

Answer **all** items in this section

Item 1

Sanyu participated in serving guests at a S.4 promo party. She discovered that the life style of the elderly and youths was completely different basing on their choices of menu. The elderly guests preferred boiled foods, a fruit and water whereas the youths preferred fried foods and bottled soft drinks of different colours tastes and flavors.

Sanyu was bothered and wanted to know why the youths had preferences quite unique and similar.

Task:

As a learner of chemistry help Sanyu;

(a) Categorize the preferences made by the guests.

_____
_____
_____
_____

(b) To explain how the materials that influenced the youth's choice work.

_____
_____
_____
_____

(c) To advise the youths on the long term consumption of the foods and drinks they preferred compared to that of the elders.

_____
_____

_____

_____

Item 2

In Buwanuka ward, Kyenjojo district, modern buildings have been completed but several huge cracks have developed and the buildings are about to collapse. Residents are planning to arrest and beat the construction workers, accusing them of using substandard materials. The Chairperson LC1 together with the community development officer have organized a community meeting to talk to the residents and discuss the other possible alternatives to rebuild the society's houses without affecting the environment.

Task:

As a student of chemistry, explain the;

(a) Category of the materials used

_____

_____

_____

_____

(b) Suitability of the materials

_____

_____

_____

_____

_____

_____

_____

_____

(c) Advise him on the choice of the material he should opt for.

_____

_____

_____
_____
_____
_____
_____
_____

SECTION B

PART I

Answer only **one** item from this part

Item 3

Agriculture is very difficult in a certain part of Uganda due to acidic soils because of Sulphur deposits beneath the soil layers. As a student with knowledge of chemistry you notice that there is need to convince the community members to abandon Agriculture but use the available mineral present in the soil to manufacture a very useful acid from it.

Task:

Explain to them how the acid can be obtained from this type of soil.

Item 4

Bugiri sugar factory which has just been set up is disposing off molasses which would be used to make ethanol. Ethanol is at a high demand and it's used to make essential substances like sanitizer. The locals around are making ethanol on small scale and it cannot meet the demands. However, the government is planning to set up an industry to produce ethanol with minimum environmental impacts.

However the community would like to know the process of production and how it would be carried out.

Task:

As a chemistry student, prepare a presentation you will make upon invitation.

PART II

Answer only **one** item from this part

Item 5

In Hima village, Kasese District, most people survive on charcoal burning, animal husbandry, crop husbandry, stone quarrying among others. Some have small mills to process rice, maize, and millet among others. Currently the crops are drying up, animals are dying and wells are drying up.

Yet the little water that is available is also not fresh. These happenings have left many of the villages wondering why.

A sensitization workshop is to be organized to explain the existing situation in the village. The theme for the workshop is "**BECOME PART OF YOUR ENVIRONMENT"**

Task:

As a learner of chemistry, prepare a message you will deliver during the meeting upon invitation.

Item 6

River Kafu is located in Western Uganda. People living around this river survive on sand mining, crop husbandry, animal husbandry and brick making. Of recent, the water levels have seripously reduced and sadly, even the little water available is polluted. The fish are dying. These existing situations have left the local authorities very worried. The town mayor has called for a workshop to sensitize the local community on the existing situations around the river. The theme for the workshop is **"SAVE RIVER KAFU"**

Task:

As a chemistry student, write a message you will deliver upon invitation for the workshop.

END

SET 11

SECTION A

Answer **all** items in this section

Where necessary; (Ca = 40, C = 12, O =16, 1 mole of a gas occupies 22.4 dm^3 at s.t.p)

Item 1

During the Second World War, the cities of Hiroshima and Nagashaki in Japan were bombed using the most lethal weapon of the time, which caused massive destruction as shown below. However, the energy that was used can be useful in the treatment of cancerous growths in humans. Up to now the impact of the bombing is still being felt in Japan.

Task:

As a learner of Chemistry;

(a) Identify the type of bomb used.

_____
_____
_____
_____

(b) Suggest any other use of the form of energy that was used in the bomb.

_____
_____
_____
_____

(c) Explain the other danger associated with the form of energy in the bomb and give its mitigation.

_____
_____

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_____

Item 2

An industry wanted to produce lime for treatment of acidic soils. The production of lime involves heating limestone strongly which results into its decomposition according to the equation.

$$CaCO_{3\,(s)} \longrightarrow CaO_{\,(s)} + CO_{2(g)}$$

The industry is also interested to know how much gas is evolved during the process since the gas is useful.

Before the production, an experiment was performed where 25g of limestone were heated until there was no further change. You have been contacted for help.

Task:

As a learner of chemistry;

(a) Explain the categories of the product.

_____

_____

_____

Suggest the properties of the gaseous product that make it useful in daily life.

_____

_____

_____

_____

_____

_____

(b) Calculate the volume of the gaseous product measured at s.t.p that was formed.

_____
_____
_____
_____
_____
_____
_____
_____

(c) Explain the impact of one of the products on the environment.

_____
_____
_____
_____

SECTION B

PART I

Answer **one** item from this part

Item 3

In Uganda, copper wires are used mainly for transmitting electric power. To ensure the availability of wires, the government is considering setting up a copper production plant in a certain area. However, the residents of the area need to be sensitized about the industrial processes, social benefits, side effects and how they can be overcome.

Your head teacher has been identified to sensitize the residents.

Task:

As a learner of chemistry, prepare a write up that your head teacher will use to sensitize the residents.

Item 4

Cement is one of the most commonly used building materials. In order to meet the high demand of cement in Uganda, many cement factories have been set up across the country, one of which is shown in the figure below.

You are part of the chemistry class that visited one of the factories and the process of producing cement was explained to the class. You have been invited to a radio talk show to explain how cement is produced.

After your presentation one of the callers wants to know whether there is any impact associated with the process you have talked about.

Task:

Make a write up of the sensitization message up to the end of the talk show.

_____
_____
_____
_____
_____
_____
_____
_____
_____

PART II

Answer **one** item from this part

Item 5

Peter, the cattle keeper, grazes his cattle on a community land. During the dry season, he practices bush burning and also takes his cattle to drink water from the community water source. Peter's practices have raised concern in the community.

The area chairperson has organized a meeting to create awareness for peter and the community

Task:

As a learner of Chemistry make a write up of the message the chairperson will present to the community.

Item 6

During her school holiday's, **Tracy** visited her aunt who works at a stone quarry. She noticed that explosives were being used to blast big rocks to form small stones (aggregates) and there was a lot of dust rising into the air as shown.

Besides the social benefits, Tracy was concerned about what would happen to the site and community if the activity continued over time.

Task:

As a learner of chemistry, make a write-up to respond to Tracy's concern.

END