GRAND 'O' LEVEL

CHEMISTRY SEMINAR

AT

MITYANA MODERN S.S.S

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CHEMISTRY; PAPER 1; 545/1

SAMPLE THEORY ITEMS

SECTION A

ITEM 1

APPLICATION OF CHEMISTRY IN DAILY LIFE

(Food additives, Drugs and medicines, Nuclear processes, Soapy and soapless detergents)

ITEM 2

DIVERSITY AND INTERACTIONS OF SUBSTANCES AND THEIR IMPORTANCE IN LIFE

(Trends in the periodic table, polymers, periodic table, structure and bonds)

SECTION B

PART I:

ITEMS 3 AND 4

CONTRIBUTION OF CHEMISTRY TO OUR ECONOMY

(Extraction of Copper, iron, Aluminum, manufacture of nitric acid, sulphuric acid, fertilizers, ethanol, detergents, sodium hydroxide, chlorine gas, oxygen gas and cement)

PART II:

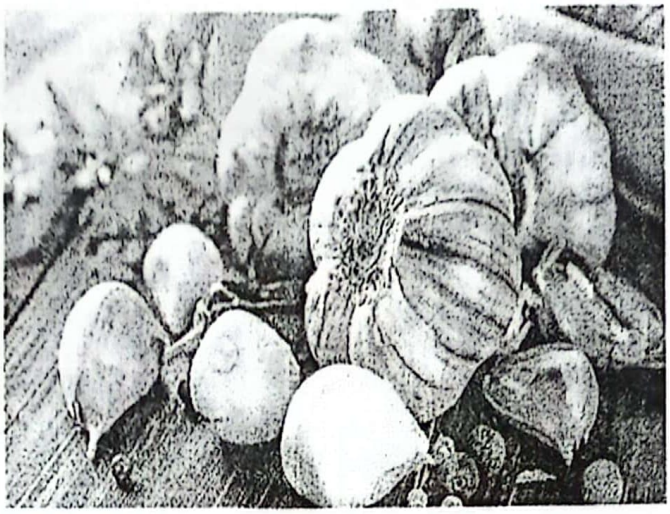
ITEMS 5 AND 6

EXISTENCE OF NATURAL RESOURCES IN THE ENVIRONMENT AND THEIR IMPORTANCE IN EVERY DAY LIFE

SET 1

ITEM 1

In a newly established restaurant in Mityana town, the customers are excited about the quality of food served. The food served has a very sweet aroma, nice looking, and a fine taste, making it so delicious. One of the nearby traders is wondering how this is possible because it has been quite long since they enjoyed such a delicacy.



Task

As a chemistry learner, help the trader understand the:

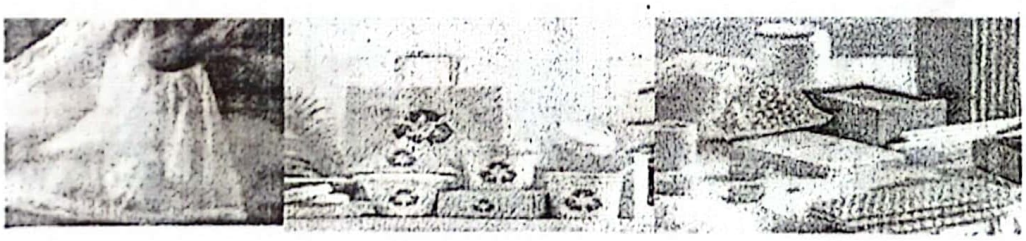
(a) categories of the ingredients used.

(b) suitability of the ingredients

(c) possible challenges associated with the long term use and choice of the ingredients to be used.

ITEM 2

The local authority is advising all traders to use environmentally friendly and sustainable packing materials. The traders had no problems with the packing materials used previously and are now puzzled by the information given to them. The traders have decided to seek for advice from a person with good knowledge of chemistry about packing materials.



TASK

As a chemistry student,

a) help the traders appreciate the categories of packing materials.

b) help the traders appreciate the suitability of packing materials

c) advise them about these packing materials

SECTION B

PART I

ITEM 3

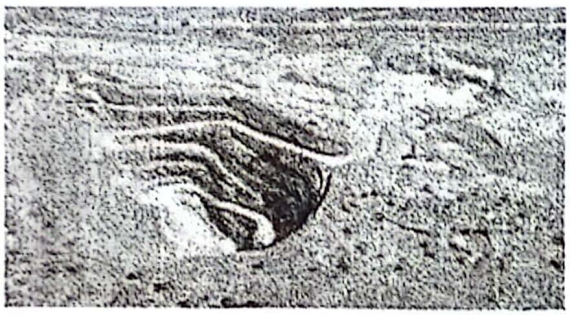
In a given State of the country, the price of cement is so high, and no longer affordable. However, the State authority is attributing this to the trade restrictions imposed to them. A resolution was made to set up their own cement factory in one of the Districts with large deposits of limestone. The people in the districts are wondering how this will be done. You have been chosen to have a talk show on one of the radio stations to educate the people about this process.

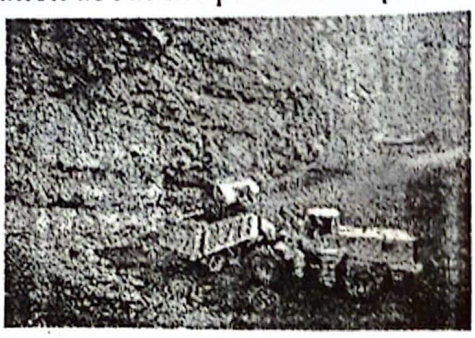
TASK

As a chemistry learner, make a write up of your communication.

ITEM 4

Electrical engineers have raised a concern of reduced copper quality wires in the country. In response, the government has contracted an investor to set up a new copper extraction plant in Kasese, a copper ore rich district. However, the locals are bothered that the factory to be set up may affect their environment and demand scientific explanation about the production process.





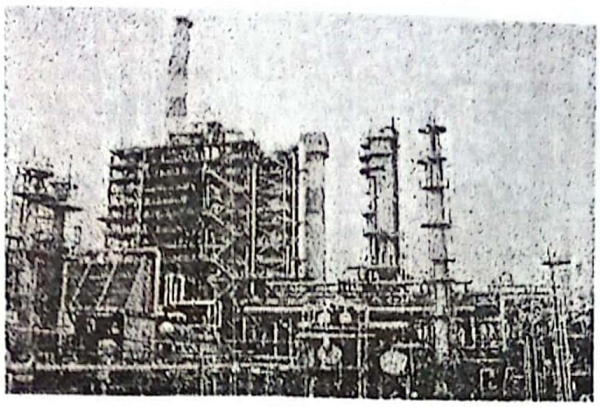
Task

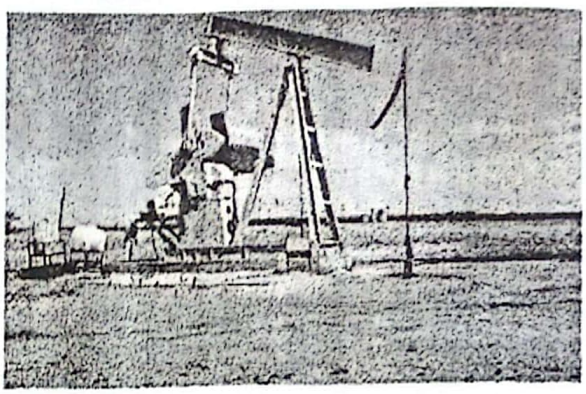
As a chemistry learner, write a speech you would deliver to the residents of Kasese.

PART II

ITEM 5

Recently, oil deposits were discovered in Western Uganda. A Chinese investor has been contracted by the government to extract the oil but the people around are scared of the outcomes. You have been invited by the ministry of government of Uganda as a knowledgeable person about natural resources to talk to the people about this issue.





Task

As a chemistry learner, make a write up of your speech.

ITEM 6

In Tanda-Mityana District, there are many rocks. The locals are heavily engaged in quarrying to generate income. This is causing serious environmental degradation. The local leaders want to raise the public awareness about the matter. You have been chosen to give a speech in one of the meetings as a knowledgeable person on natural resources.

TASK

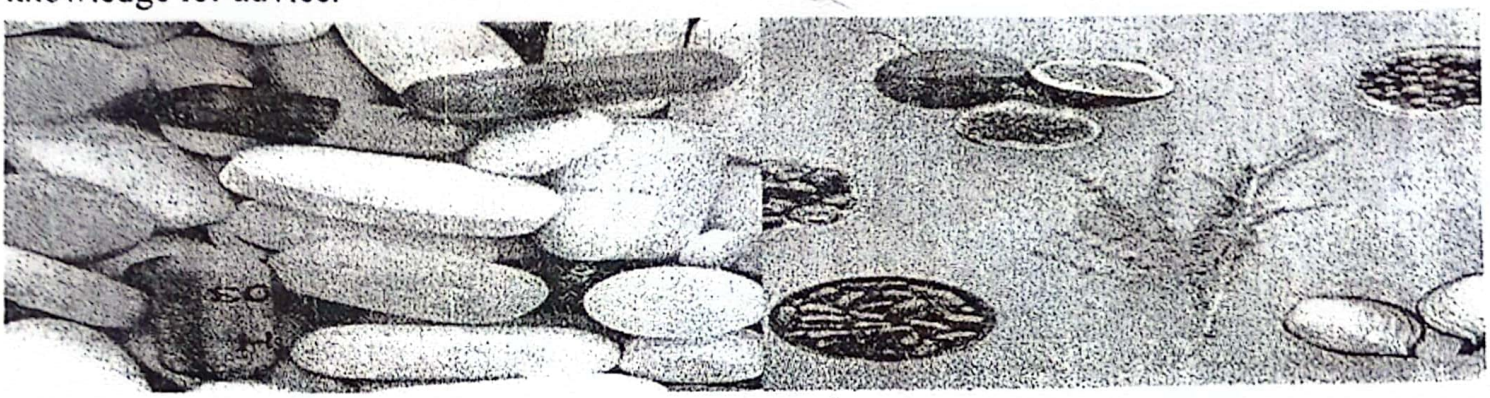
As a learner of chemistry, write a speech that you could give.

SET 2

SECTION A

ITEM 1

In one of the ghettos, there is an outbreak of typhoid which is a bacterial disease. One of the residents is complaining about persistent stomach ache, fevers and diarrhea, which seem to be some of the signs and symptoms of the typhoid. A local herbalist has advised the patient to take a concoction of herbs that is claimed to cure typhoid. The patient has also been advised by the friend to use chloramphenicol tablets to treat the condition. The friend alleges that he took the same medicine when she was sick and got cured. The patient has contacted you with chemistry knowledge for advice.



Task:

As a learner of chemistry;

(a) Advise the patient on the possible categories of medicines to use?

(b) educate the patient on how the products work.

(c) Advise the patient about the products to use

ITEM 2

During a scientific investigation, members of S3 heated 2.52g of calcium in excess oxygen to form 3.52g of substance. However, the learners found challenges establishing the formula of substance formed.

When they contacted the laboratory technician he gave them a copy of the period table from which they established that the atomic masses of calcium and oxygen as 40 and 16 respectively. The molecular mass of calcium oxide is 56g.

As a student of chemistry help the learners to;

(a) understand the nature of product

(b) understand the properties of the product

(c) explain the use of the product

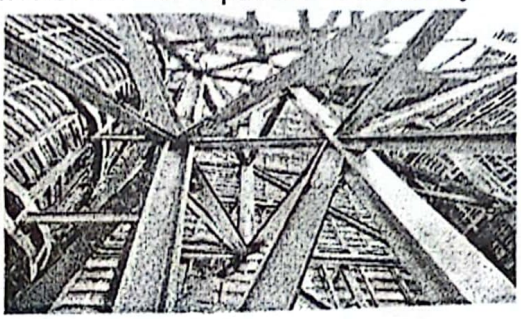
(d)

SECTION B

PART I

ITEM 3

Rushekye hills in Kisoro district Uganda are found to contain significant iron deposits. An investor wants to set up an iron and steel rolling factory to tap into the opportunity. The local leaders need to understand the process of production and the environmental impacts of the factory.



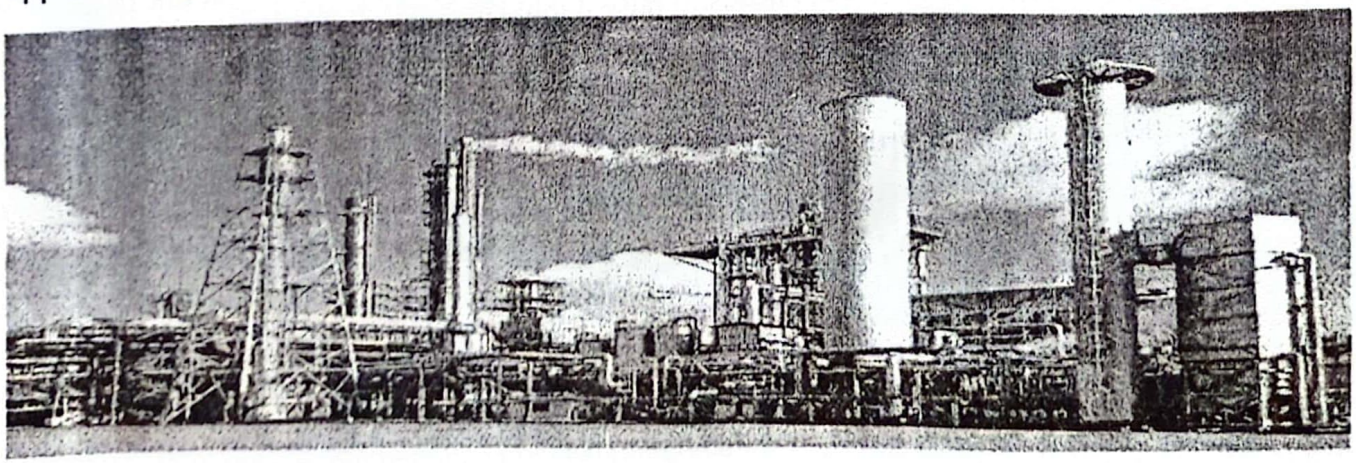
As a chemistry student, the residents are confident that you can provide the necessary information.

TASK

Prepare a presentation which you will use upon invitation.

ITEM 4

In a given district most of the citizens survive on farming that involves growing of crops every season. For the last three seasons, farmers are registering a great decrease in the amount of the harvest, which is being associated with decline in soil fertility. The government has cleared a local investor to startup a fertilizer production plant in the district. However, the citizens are very much worried about the effects of the plant to the environment. The chairperson LC5 of the district has approached you to sensitize the citizens of the area.

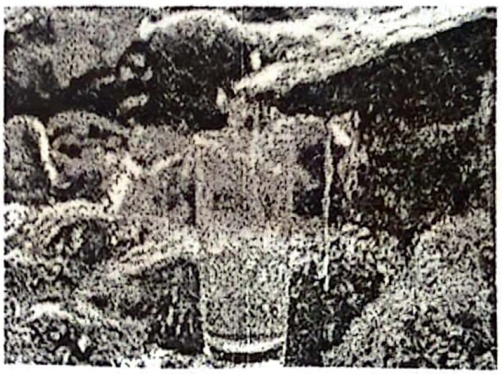


Task

As a chemistry student, prepare a presentation you will make during the meeting.

ITEM 5

Due to great increase in industrialization in an industrial park, untreated sewage is being disposed off into freshwater bodies leading to severe water pollution. The Ugandan government through NEMA is aiming at creating public awareness regarding this natural resource through various initiatives. One of the initiatives is to use radio talk shows.



TASK:

Write the presentation you can use.

ITEM 6

In one of the recently published reports about the air quality in Kampala indicated that air quality is in a very poor state, putting residents at a high risk of acquiring respiratory diseases.
This report tarnished the city's reputation and left residents so bothered about their health. In an urgent meeting, it was resolved that KCCA needs to raise public awareness so as to clean up the air.

TASK

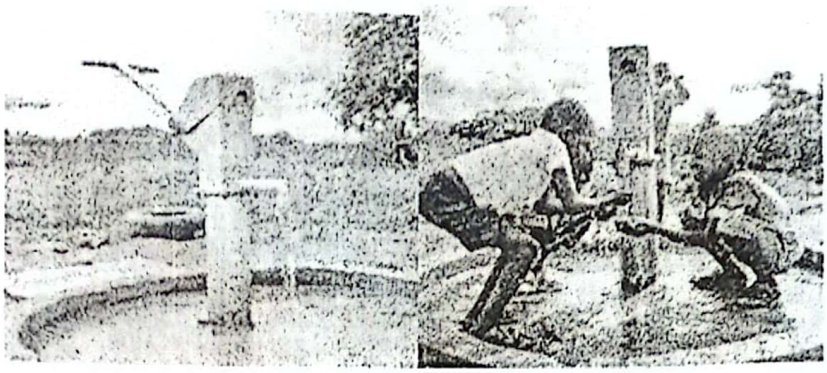
As a student of Chemistry write an article about this issue.

SET 3

ITEM 1

In one of the towns in Uganda, residents are facing an unexpected challenge of water wasting detergents. There are two different categories of detergents that are sold in the markets. The locals are frustrated and do not know which one is best for laundry work. They have been

advised to try other alternatives on the market to overcome the challenge but they need more advice on this



\As a concerned chemistry student in the town,

Task:

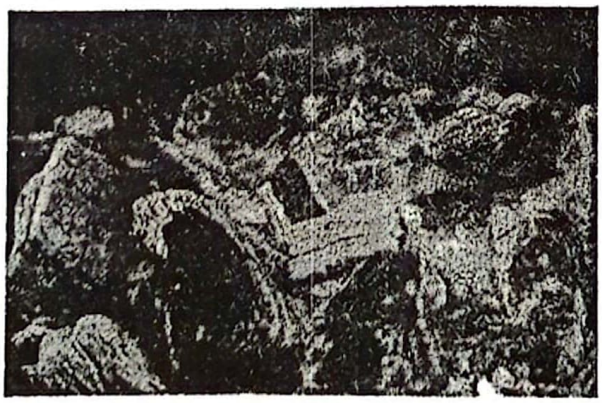
Help the residents,

a) understand the types
b) mode of action of the detergents
c) the consequences of the detergent

ITEM 2

Charcoal is a common fuel used 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.

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



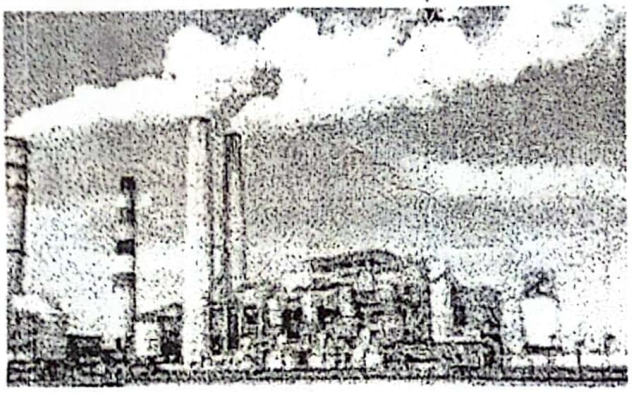
Task

As a learner of chemistry

a) Assess the product formed
b) Advise the friend on the appropriateness of the product formed.

ITEM 3

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.

ITEM 4

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 5

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.

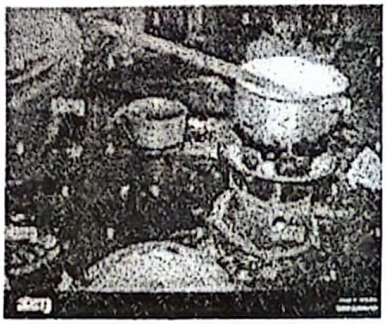
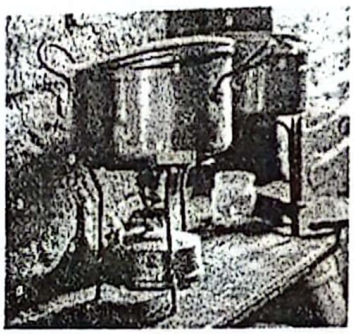

Use your chemistry knowledge to create awareness on the matter.

TASK.

Make a write-up you can use upon meeting the citizens.

Item 6

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 overuse of charcoal and kerosene for cooking, citing their environmental implications. However, many natives seem to struggle to grasp the connection between their energy consumption habits and the broader environmental impact.

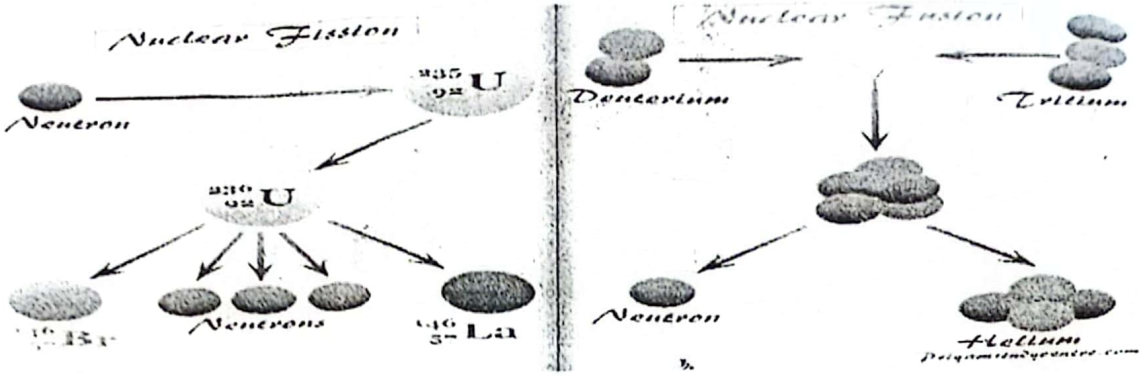
TASK

Help the natives understand this connection better.

SET 4

ITEM 1:

Many countries have resorted to using nuclear power in order to meet energy demands for domestic and industrial purposes. But they need guidance on the nuclear processes that is convenient to use



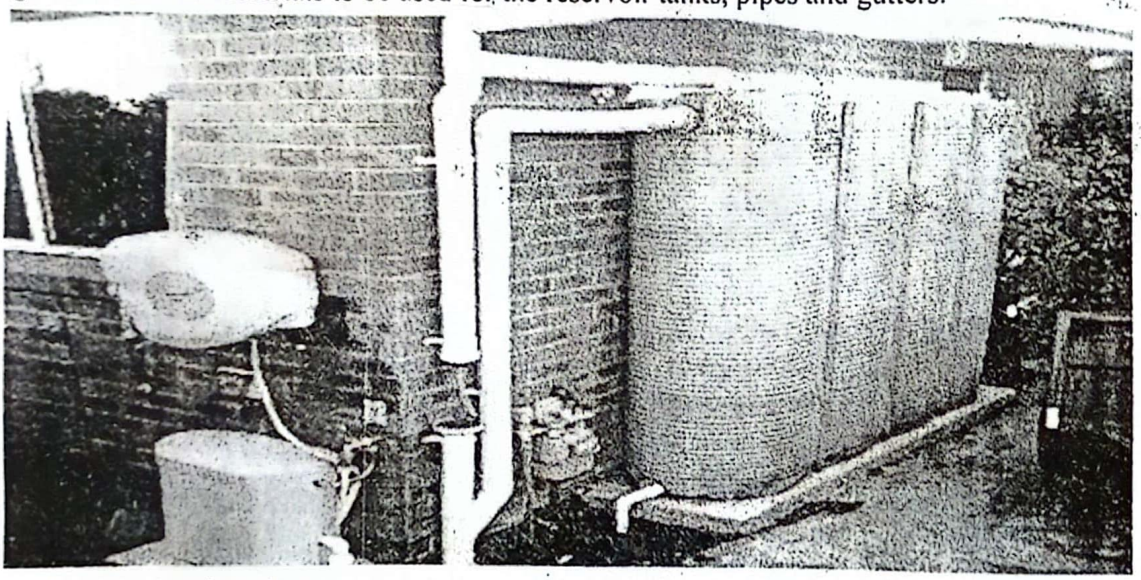
Task:

As a chemistry learner:

a) State categories of nuclear processes.
b) Explain how the process works.
c) What are the dangers associated with the process.
d) Advise on the process which is better to use.

ITEM 2:

Paul wants to invest rain water from his house roof so as to reduce on his water bills. He needs guidance on the materials to be used for the reservoir tanks, pipes and gutters.



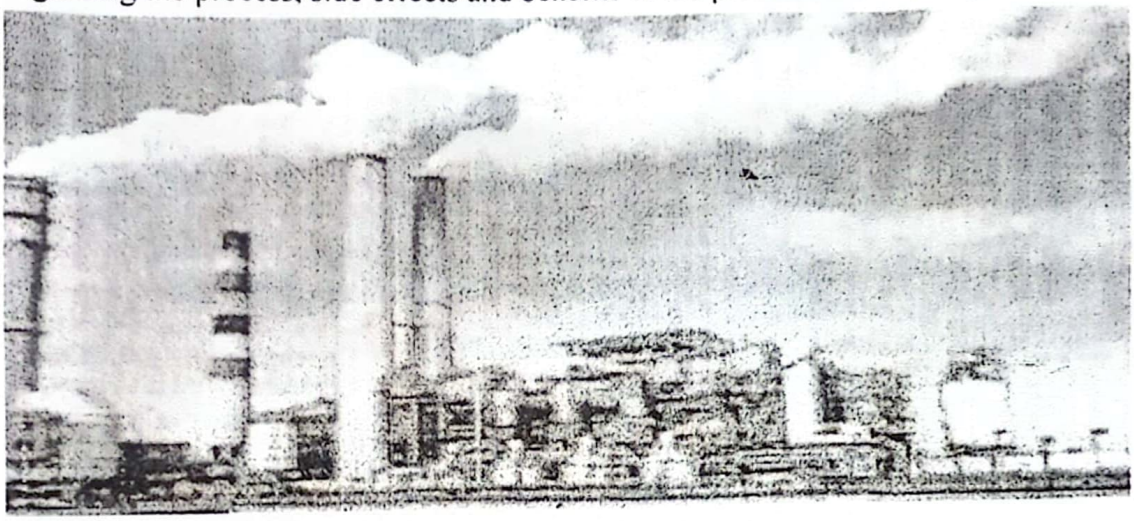
Task: As a chemistry learner:

a) Identify the possible categories of materials that Paul can use.
b) Explain how suitable the materials you have identified are.
c) State for what other purposes can the materials be used.

d) Advise Paul on the side effects of the materials and how to avoid them.

ITEM 3:

Ronald wants to establish a soapless detergent factory in his area but he requires an input from someone with chemistry knowledge. You have been chosen to give guidance to Ronald regarding the process, side effects and benefits of the process to the society.

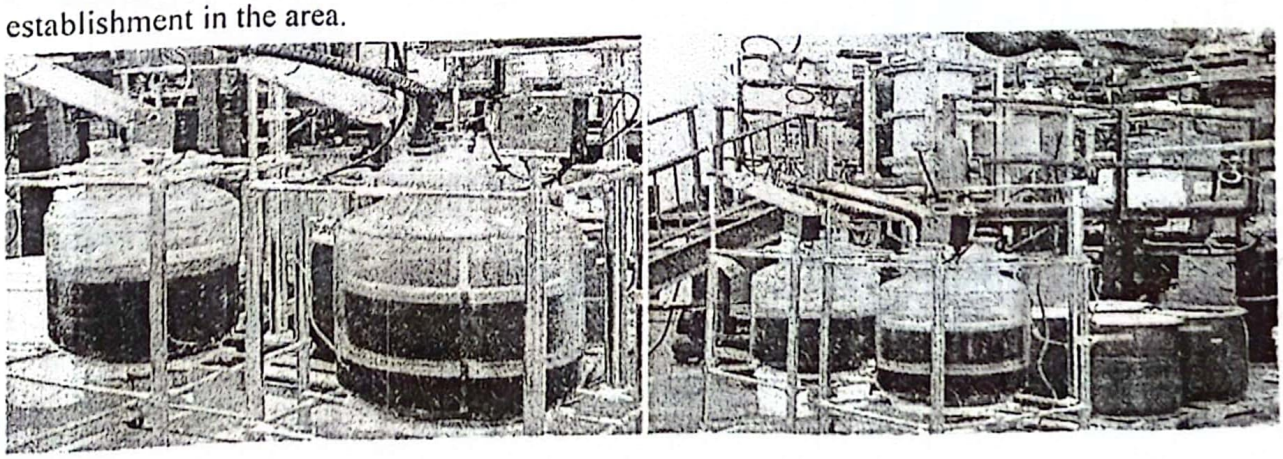


Task:

As a chemistry learner, write a message to guide Ronald.

ITEM 4:

In recent times, there is an increased demand of solar and car batteries, that has resulted subsequent increased demand of battery acid. An investor wants to set up an industry manufacturing the acid that car and solar owners need for their batteries. However, the community needs to understand the process of production and the impacts of this factory establishment in the area.



Task:

As a chemistry learner, write a speech that you would give at the gathering of members of this community.

PART II

ITEM 5:

In a given village, meals are all prepared using firewood, wood charcoal and liquid petroleum gases (LPGs). However, recently, environmental concerns of using these materials have forced them to seek guidance from you.

Task:

As a chemistry learner, make a write up you would use to address the concern.

CHEMISTRY; PAPER 2; 545/2

SAMPLE PRACTICAL ITEMS

PRACTICAL ITEMS

Item 1

A company is investigating an appropriate chemical method to generate heat for portable stoves. The idea involves using Iron scrap to displace copper (II) ions in a chemical reaction, offering an eco-friendly alternative to fossil fuel stoves. The company aims to determine how much heat is produced by the reaction for every 25cm^3 of copper II sulphate solution used, so that they make it a viable option for outdoor cooking.

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

You are provided with:

- Solid P which is sample of Iron fillings from scrap
- BA1 which is Copper (II) sulphate solution

TASKS

(a) Design an experiment that can be used to determine the amount of heat evolved
(b) Carry out the experiment and determine the amount of heat involved
(c) Analyze the results
(d) draw a conclusion

Item 2

A company is planning to use metal X and hydrochloric acid to produce hydrogen gas to be used in fuel cells for generating electricity. Heat generated or absorbed influences both the reaction speed and hydrogen quality. The company wants to determine the heat change for a reaction between the metal (X) and dilute hydrochloric acid to be able to make a decision on whether to use it or not.

Metal **X** reacts with hydrochloric acid according to the following equations;

$X(s) + 2HCl(aq) \longrightarrow XCl_2(aq) + H_2(g) + \text{Heat}$

You are provided with:

- Solid P which is sample of metal X
- BA1 which is a dilute solution of hydrochloric acid

TASK:

(a) Design an experiment that can be used to determine the amount of heat involved during the reaction

(b) Carry out the experiment and obtain data to determine the amount of heat involved during the reaction.

(c) Analyze the data and draw your conclusion

Item 3

A healthcare company is developing a new chewable antacid tablet and is evaluating the potential use of a specific alkali, represented as XOH, as the active ingredient. The company wants to confirm if heat produced varies with the volume of acid added to the alkali and how much heat is produced by the reaction, so that they are able to work on dosage.

The alkali reacts with hydrochloric acid according to the following equation.

$\mathbf{XOH_{(aq)} + HCl_{(aq)} \longrightarrow XCl_{(aq)} + H_2O_{(l)} + Heat}$

You are provided with:

- BA1 which is a sample solution of the alkali
- BA2 which is dilute hydrochloric acid

TASK:

As a learner of chemistry;

a) Design an experiment to determine the heat produced

b) Carry out the experiment and record your results appropriately

c) Analyse and interprete your data

d) Make a conclusion and recommendation to the company?

Item 4

A laundry service provider in one of the urban centers in Uganda has to choose the best water for effective washing with soap. He requested the men who supply to bring him samples from the two different water sources. He would want to discover which type of water minimizes soap wastage hence more effective in cleaning. You are provided with:

BA1: which a soap solution

BA2: which is water sample from supplier A

BA3: which water sample from supplier B

Task:

As a learner of chemistry;

a) Design and plan an experiment to help a laundry service provider make choice
b) Carry out the experiment and record your findings.
c) Make analysis and interpret the data
d) Draw a conclusion from your findings

SET 1

ITEM 1

(a) The ingredients used are **food additives** which are either:

Natural, these are food additives that naturally exist without man's intervention eg onions

Artificial/synthetic, these are food additives that man-made eg royco

(b) The food additives maintain or improve flavour, safety, freshness, texture and appearance of food.

(c) Excessive use of Artificial/synthetic food additives increases risk of lifestyle diseases like high blood pressure

Mitigation; by using controlled amounts of artificial food additives should be used, using more of natural food additivities.

Similarity

Both natural and artificial food additives have chemical compounds that are useful and some of which are harmful to the body.

Difference

Natural food additives have these chemical compounds in lower concentrations chemical compounds that are useful and some of which are harmful to the body.

It is, therefore, advisable to use more of the natural food additives than the synthetic additives.

ITEM 2

a) He should realize that packaging materials may be;

Synthetic/artificial because they are man-made e.g. polyethene bags

Natural, because they naturally exist without man's intervention e.g. paper bags.

b) **Polyethene bag**

- It is insoluble in water, Water proof, Durable, Elastic, strong, flexible, moldable.

Alternatively,

Paper bag

biodegradable, foldable, absorbs moisture, stiff

c) **Polyethene bag**

use - Suitable for making packing bags for wet products.

Impact to the environment

Polyethene is non- biodegradable, hence pollutes the soil, limiting free circulation of water and air in the soil, leading to decrease in soil fertility.

Mitigation; Reduce or stop use of Polyethene bag, dispose it off properly, reuse or recycle.

Alternatively

Paper bag

Used for making packing boxes/bags for dry products.

Impact to the environment

Paper easily catches fires, so can lead to fire outbreaks and damage of property.

Mitigation; keep paper away from fire

Item 3

Raw materials; lime stone, sand and clay

Process of production;

The lime stone obtained from the quarry is mixed with sand and clay in the correct proportions and crushed into a fine powder.

The powder is then mixed with water and allowed to flow down a rotating tank (or cylinder or cement kiln) where it is strongly heated at about 1500°C

Limestone decomposes into calcium oxide and carbon dioxide

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

Calcium oxide reacts with sand forming calcium silicate and also reacts with aluminium oxide forming calcium aluminate.

$2CaO(s) + SiO_2 \rightarrow Ca_2SiO_3$

$3CaO(s) + Al_2O_3 \longrightarrow Ca_3Al_2O_6$

Calcium silicate and calcium aluminate form a mixture called clinker

Gypsum (2-5%) is added to clinker to moderate the setting of the cement and the lumps are then crushed by machine to obtain the fine cement powder

Side effects of the process of production

- Effluent discharge from the cement plant can contaminate water bodies, affecting aquatic life and quality of water, mitigated by treatment of waste water through sedimentation and filtration before discharge / recycling the treated water with in the plant.
- Carbon dioxide emissions to the atmosphere, pollutes air and can cause global warming, this is mitigated by using carbon dioxide for other purposes.
- Inhalation of air contaminated with cement dust causes respiratory diseases, mitigated by wearing personal protective equipment like masks.

Social benefits

- Source of employment opportunities, hence improved income and therefore better standards of living
- Increased government revenue through taxes hence improvement of infrastructure such as roads, schools, health facilities leading development of the society.
- Provision of market for goods of the community members, hence generating income, leading to better lives
- Production of cement for use during construction by the community members, hence acquiring better houses

ITEM 4

Raw materials used; Copper pyrites ($CuFeS_2$), air

Process of production;

The ore is crushed into powder and mixed with water containing special oils called frothing agents.

Compressed air is blown into the mixture, causing agitation, leading to froth formation. Earthly impurities in the ore are wetted with water, become denser and sink to the bottom of the flotation tank while the copper pyrites particles float on the surface, trapped in the froth.

The froth is skimmed off, and an acid added to it to break it.

The ore is filtered off, dried and roasted in limited air to convert it to copper (I) sulphide, sulphur dioxide and iron (II) oxide

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

Silica is then added and the mixture heated in absence of air to convert iron (II) oxide to iron (II) silicate liquid.

$$FeO(s) + SiO_2 \rightarrow FeSiO_3(l)$$

The copper (I) sulphide is then heated in a controlled amount of air to produce copper (I) oxide and sulphur dioxide;

$$2Cu_2S(s) + 3O_2(g) \rightarrow Cu_2O(s) + 2SO_2(g)$$

The formed copper (I) oxide reacts with unreacted copper (I) sulphide to form impure copper and sulphurdioxide

$$Cu_2S(s) + 2Cu_2O(s) \rightarrow 6Cu(s) + SO_2(g)$$

The copper produced is then purified by electrolysis. Aqueous copper (II) sulphate solution electrolyte is put in an electrolytic cell. The produced impure copper is made the anode and a pure strip of copper is made the cathode. The cathode and anode are connected to an electric current source or battery. When electric current is passed through the electrolyte, impure copper anode dissolves in the electrolyte producing copper (II) ions which move to the cathode where they are reduced or discharged to form pure copper.

Anode: $Cu(s) \rightarrow Cu^{2+}(aq) + 2e$

Cathode: $Cu^{2+}(aq) + 2e \rightarrow Cu(s)$

Side effects of the process of extraction of copper

- Release of sulphur dioxide causes air pollution resulting into acid rains that affect plant growth and also causes global warming, mitigated by installing catalytic converters in the exhaust pipes
- Exposure to copper fumes or dust can cause copper poisoning which may lead to death, mitigated by using personal protective equipment like masks.

Social benefits

- Source of employment opportunities, hence improved income and therefore better standards of living

- Increased government revenue through taxes hence improvement of infrastructure such as roads, schools, facilities leading development of the society improving standards of living
- Provision of market for goods of the community members, hence generating income, leading to better lives

ITEM 5

Category of the natural resource: Oil is a **non renewable natural resource** because it cannot be replenished replaced by natural processes in man's life time or it gets used up.

Composition: bitumen, natural gas, paraffins, petrol and diesel.

Impact of the human activities on the natural resource

- combustion of oil, releases carbon dioxide which can results into acid rain that interferes with the soil pH, hence affecting plant growth, also leads to global warming; Mitigated by increased afforestation such that the trees absorb carbon dioxide.
- Oil spills by humans in to water bodies cutting off oxygen supply causing suffocation of aquatic animals. Mitigated by proper waste management routines

Importance of the natural resource

When purified it produces various chemicals like motor fuels, lubricants, paints, detergents, drugs, etc, these can improve the wellbeing of man.

ITEM 6

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. **Or** they get used up.

They are categorized as: **Igneous rocks, Sedimentary rocks** and **Metamorphic rocks**

- **Igneous rocks,** composed of minerals like **Quartz, Feldspar,** and **Olivine**
- **Sedimentary rocks,** composed of minerals like **Calcite, Quartz, Clay materials, Gypsum**
- **Metamorphic rocks,** composed of minerals like **Garnet, Mica (biotite** and **muscovite), Quartz** and **Feldspar (Marble** or **Gneiss)**

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 equipment like face masks.
- Stone quarrying and mineral extraction removes top soil and ditches which degrades the soil environment, hence affecting growth of plants, hence destruction of vegetation cover
- Mineral extraction results into breaking of rocks into smaller stones and gravels which depreciates the rocks
  Mitigation, careful extraction

Importance of the natural resource

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

SET 2

ITEM 1

(a) The products are **antibiotics,** which are categorized as
Herbal/traditional, because they are locally made from parts of plants called herbs or whole plant eg onions
or **modern/synthetic,** because they are highly processed in industry eg chloramphenicol

(b) Inhibits growth of bacteria / kills bacteria

(c) Impacts and mitigation

Excessive use of the antibiotics causes dizziness, headache, hearing loss, body organ damage hence health complications. Mitigated by controlled use or following doctor's prescription

Similarities

Both herbal and modern medicines are used to kill bacteria

Differences

Modern medicines are needed in smaller amounts and take a shorter time to cure the disease, implying that they are more effective.

Herbal medicines have a shorter shelve life than the modern medicines.

ITEM 2

(a) Mass of oxygen in the oxide = 3.52 – 2.52 = 1g

Symbols of elements in the oxide	Ca	O
Composition by mass	2.52	1
Number of moles	$\frac{2.52}{40}$	$\frac{1}{16}$
Mole ratio	0.063	0.0625
Simplest ratio	$\frac{0.063}{0.0625}$	$\frac{0.0625}{0.0625}$
Simplest ratio	1	1

Hence the empirical formula of the oxide is **CaO**

$(CaO)_n = 56$

$(40 + 16)n = 56$

$56n = 56$

$n = 1$

Molecular formula is **CaO**

The nature product is ionic, because in molten state, it conducts electricity

The product is basic, because it reacts with dilute acids to form a salt and water only

(b) - product has high melting point, has high density, conducts electricity, slightly soluble in water

(c) Used to remove the silica when extracting iron to form a slag.

Impact and mitigation

When contaminated in air can be **inhaled**, hence **causing respiratory diseases Mitigated** by purifying the air

ITEM 3

Raw materials: Iron ore e.g. Haematite, Coke, Lime stone and air

Process of production;

The ore is crushed to form small partices.

The ore, coke and limestone are mixed together and introduced into the **blast furnace** from the top up. Hot air is blown from the bottom of the furnace through pipes called tuyeres. As the hot air rises up the furnace it reacts with the coke to form carbon dioxide.

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

As the carbon dioxide formed rises up the furnace it is reduced by the unburnt coke to carbon monoxide

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

The lime stone decomposes into calcium oxide and carbo dioxide. Calcium oxide reacts with the silica to form slag of calcium silicate which flows to the bottom of the furnace.

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

$$CaO(s) + SiO_2(g) \rightarrow CaSiO_3(l)$$

The carbon monoxide then reduces the haematite to molten iron;

$$2Fe_2O_3(s) + 3CO(g) \longrightarrow 4Fe(s) + 3CO_2(g)$$

The molten iron then sinks to the bottom of the furnace where it is tapped off. The slag floats on top of molten iron. The iron obtained is impure and can be purified by converting it onto wrought iron, by blowing air through it, oxidizing the impurities to gaseous oxides that escape in the atmosphere.

Side effects of the process of extraction

- Emission of poisonous gases leading to air pollution that may cause suffocation hence illness or death, mitigated by catalytic treatment of these gases before emission to the atmosphere
- The un reacted carbon dioxide can escape into the atmosphere causing global warming, mitigated by recycling the carbon dioxide

- Emission of heat from the furnace causing rise of temperature of the surrounding environment, which affects the people, mitigated by installing heat absorbers around the furnace

Social benefits of process of extraction of iron

- Source of employment opportunities in the factory, hence improved income and therefore better standards of living
- Increased government revenue through taxes hence improvement of infrastructure such as roads, schools, health facilities leading development of the society and better lives
- Provision of market for local goods of the community members, hence generating income, leading to better lives

ITEM 4

The local investor could produce ammonium nitrate fertilizer and the production will be as follows

Raw materials; ammonia and air

Process of production;

Ammonia gas from the Haber process is burnt in dry pure oxygen of the air, in the presence of platinum catalyst, to form nitrogen monoxide gas with in a **reaction vessel**

$$4NH_3(g) + 5O_2(g) \longrightarrow 4NO(g) + 6H_2O(l)$$

Nitrogen monoxide formed is then reacted with oxygen to form nitrogen dioxide gas;

$$2NO(g) + O_2(g) \longrightarrow 2NO_2(g)$$

Nitrogen dioxide gas is then mixed with oxygen and the mixture absorbed in water to form nitric acid

$$4NO_2(g) + O_2(g) + 2H_2O(l) \rightarrow 4HNO_3(aq)$$

The nitric acid formed is then reacted with ammonia to form ammonium nitrate fertilizer which is concentrated by crystallization

$$NH_3(g) + HNO_3(aq) \rightarrow NH_4NO_3(s)$$

Side effects of the process of production of fertilizers

Emission of ammonia, nitrogen oxides and sulphur oxides can pollute the air, causing respiratory problems and environmental issues, mitigated by installing catalytic converters to convert them to less toxic substances.

Social benefits

- Source of employment opportunities, hence improved income and therefore better standards of living
- Increased government revenue through taxes hence improvement of infrastructure such as roads, schools, health facilities leading development of the society.
- Development of small scale businesses, hence generating income, leading to better lives
- Availability of fertilizers, hence better plant growth in the community leading increased crop yields.

ITEM 5

- **Category:** Water is a renewable natural resource because it can be replaced/replenished by natural processes in man's life time.
- **Composition:** Dissolved oxygen, mineral salts, aquatic plants and big animals as well as microorganisms and pollutants from man's activities.

Impact

- Release of hot water as an effluent from industries into the water bodies, increase the temperature of the water bodies killing aquatic organisms. Mitigated 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 into eutrophication of nearby water bodies
- Mitigated by use of organic fertilizers e.g. manure from both animal and plant waste which are biodegradable and reduce on use of synthetic fertilizers

Importance

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

ITEM 6

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

Composition: Nitrogen gas, oxygen gas, carbon dioxide gas, rare gases, water vapour and dust. **Impact**

- **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.
Mitigated by increased afforestation to absorb carbon dioxide from the atmosphere as quickly as it is formed

Importance

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

SET 3

ITEM 1

(a) The products are **detergents**, which are either;
Soapy detergents, because they are sodium salts of alkylbenzene sulphonic acid e.g ~~omo~~
or **soapless detergents**, because they are salts of long chain carboxylic acids eg ~~white star soap~~

(b) The detergents facilitate the emulsification and removal of grease /oil / dirt.

Mode of action:

A soap molecule contains two parts; namely; the water-soluble /polar carboxylate head / hydrophilic end and non-polar tail/fat soluble 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 hydrocarbon 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) Soapy detergents contain chemicals that can cause:

- Skin burns / blisters / skin irritation and hence pain mitigated by thoroughly washing the affected areas or by use of gloves during washing
- Eye redness and pain; hence loss of vision mitigated by thoroughly washing the eyes with plenty of water.
- Soapless detergents contain phosphates which cause algae bloom and hence polluting water that kills the aquatic organisms

ITEM 2

(a) The product is a **covalent compound**, because **it is formed by sharing of electron between non-metal atoms**, examples include sulphur dioxide, ammonia, etc

(b) It has the following properties

- does not dissolves in water, does not conduct electricity, has a giant covalent structure, exists as a molecule

The product is used in;

- fire extinguishers to put out fire
- the manufacture of fizzy drink to improve on the taste and to preserve them

Impacts of the product

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.
This is mitigated by planting trees to absorb it.
Its accumulation in the atmosphere causes acid rains that cause crumbling of buildings and change in soil pH.
Mitigated **by planting trees** to absorb it.

ITEM 3

NOTE: This item requires manufacture of chlorine, but the solution also gives room for manufacture of sodium hydroxide

Raw materials used; Brine (concentrated sodium chloride solution)

Process of production;

Sodium hydroxide and chlorine are manufactured by electrolysis of brine
Brine which mainly contains sodium ions, chloride ions, is placed in a **diaphragm cell** that consists of a graphite anode and a steel cathode.
Brine ionizes according to the equation;

$NaCl(aq) \rightarrow Na^+(aq) + Cl^-(aq)$

The sodium ions migrate to the cathode where they are preferentially discharged to form sodium which reacts with water to form **sodium hydroxide** solution that can be **purified by evaporation to dryness** to form solid sodium hydroxide,

$Na^+(aq) + e \rightarrow Na(s)$

$2Na(s) + 2H_2O(l) \rightarrow 2NaOH(aq) + H_2(g)$

Chloride ions migrate to the anode where they are preferentially discharged to form chlorine gas which is then packed in strong cylinders.

i.e. $2Cl^-(aq) \rightarrow Cl_2(g) + 2e$

Side effects of the process of production;

- Contact with sodium hydroxide causes severe burns to the eyes, skin, digestive system resulting into permanent damage of the body organs and even death, mitigated by wearing personal protective gears
- Repeated inhalation of sodium hydroxide vapor causes lung damage, mitigated by wearing protective gears
- Inhalation of chlorine can cause death as it is a poisonous gas, mitigated by wearing protective gears
- Escape of chlorine into the surrounding atmosphere can pollute the resulting into acid rain which leads to crumbling of buildings, lowering soil pH and corrosion of roofs made of iron, mitigated by regular maintenance of the plant.

Social benefits

- Source of employment opportunities, hence improved income and therefore better standards of living
- Increased government revenue from taxes hence improvement of infrastructure such as roads, schools, health facilities leading development of the society.
- Provision of market for goods of the community members, hence generating income, leading to better lives

ITEM 4

Raw material; liquid air / air.

Process of production;

Air is passed through **air filters** to remove dust and smoke particles. It is then passed through concentrated sodium hydroxide solution to remove carbon dioxide,

$2NaOH(aq) + CO_2(g) \longrightarrow Na_2CO_3(aq) + H_2O(l)$.

Air free from carbon dioxide is now passed through silicon (IV) oxide to absorb water vapour. Carbon dioxide and water vapour are removed from air before it is liquefied because they would solidify and block the apparatus.

The air is then 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°C. The liquid air is fractionally distilled using a fractionating column / tower.

Nitrogen boils off first because it has a lower boiling point (–196°C) leaving behind oxygen with a higher boiling point (-183°C). Pure oxygen is then stored under pressure in steel cylinders.

Side effects of the process of production

- Explosion of oxygen cylinders due to high pressure causing injuries and fire outbreaks also resulting into damage to equipment, mitigated by regular maintenance and monitoring of cylinders, keeping cylinders in cool areas to avoid exposure to heat.
- Exposure to liquid oxygen can cause severe skin and eye irritations and burns, loss of vision, mitigated by 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 parts in warm water.

Social benefits

- **Source of employment opportunities,** hence **improved income** and therefore **better standards of living**
- **Increased government revenue** from taxes hence **improvement of infrastructure** such as roads, schools, health facilities leading **development of the society.**
- **Development of small scale businesses,** hence **generating income,** leading to **better life**

ITEM 5

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

Composition 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.

Impacts

the atmosphere thereby causing global warming and consequently desertification.
Mitigated by increased afforestation to absorb carbon dioxide from the atmosphere as quickly as it is formed

Importance

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

SET 3

ITEM 1

(a) The products are **detergents**, which are either;
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A soap molecule contains two parts; namely; the water-soluble /polar carboxylate head / hydrophilic end and non-polar tail/fat soluble 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 hydrocarbon 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.

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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.
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- Emission of heat from the furnace causing rise of temperature of the surrounding environment, which affects the people, mitigated by installing heat absorbers around the furnace

Social benefits of process of extraction of iron

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Nitrogen monoxide formed is then reacted with oxygen to form nitrogen dioxide gas;

$$2NO(g) + O_2(g) \longrightarrow 2NO_2(g)$$

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$$4NO_2(g) + O_2(g) + 2H_2O(l) \rightarrow 4HNO_3(aq)$$

The nitric acid formed is then reacted with ammonia to form ammonium nitrate fertilizer which is concentrated by crystallization

$$NH_3(g) + HNO_3(aq) \rightarrow NH_4NO_3(s)$$

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- **Composition:** Dissolved oxygen, mineral salts, aquatic plants and big animals as well as microorganisms and pollutants from man's activities.

Impact

- Release of hot water as an effluent from industries into the water bodies, increase the temperature of the water bodies killing aquatic organisms. Mitigated 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 into eutrophication of nearby water bodies
- Mitigated by use of organic fertilizers e.g. manure from both animal and plant waste which are biodegradable and reduce on use of synthetic fertilizers

Importance

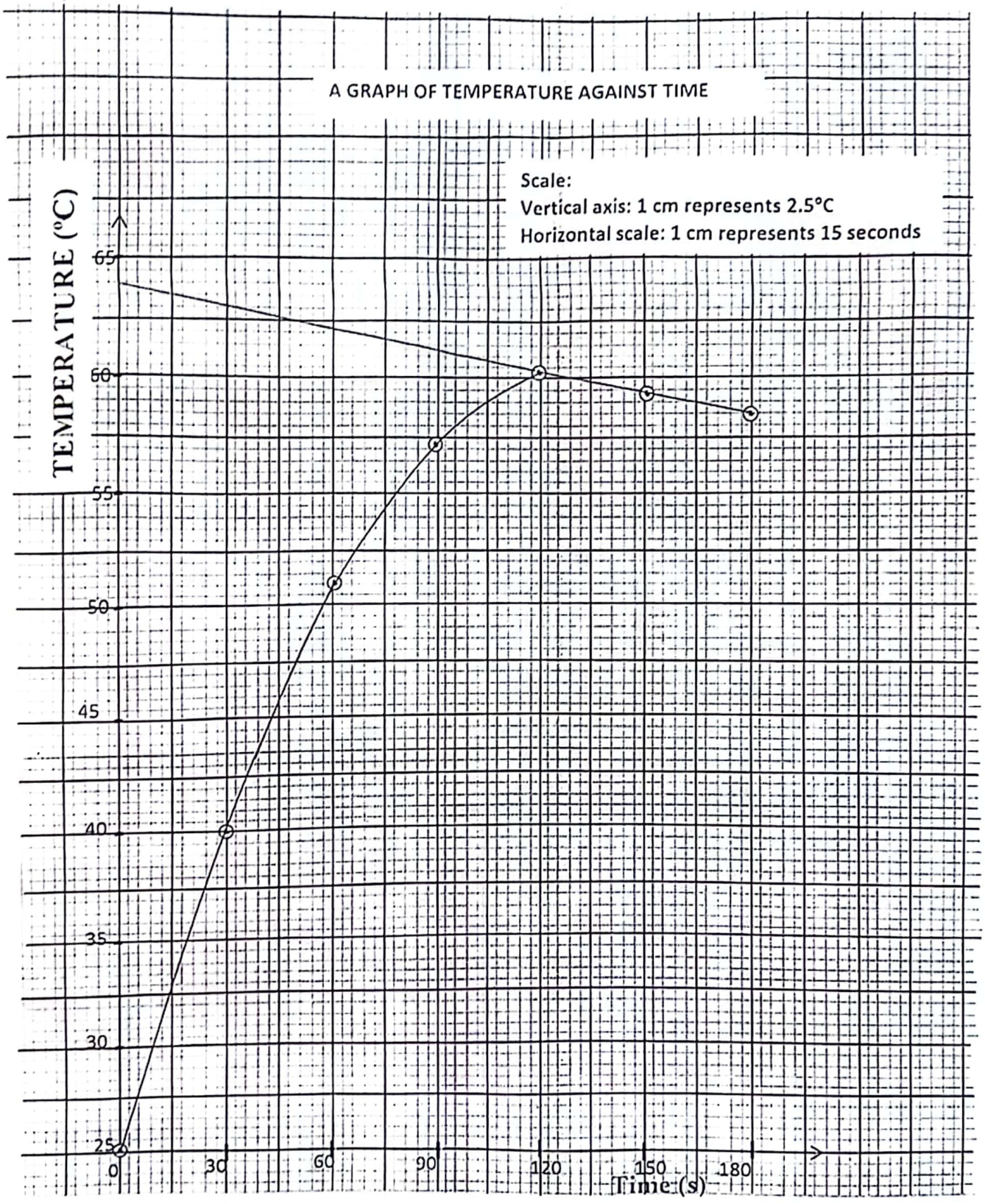
- Water bodies are very useful in rain formation which is useful for proper plant growth

ITEM 6

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

Composition: Nitrogen gas, oxygen gas, carbon dioxide gas, rare gases, water vapour and dust. **Impact**

- **Burning of fossil fuels, increases amount of carbon dioxide gas thus trapping a lot of heat in**


A GRAPH OF TEMPERATURE AGAINST TIME
Scale:
Vertical axis: 1 cm represents 2.5°C
Horizontal scale: 1 cm represents 15 seconds
TEMPERATURE (°C)
65
60
55
50
45
40
35
30
25
0
30
60
90
120
150
180
Time (s)

PRACTICALS

Item 2

(a)

Aim of the experiment	To determine the heat change of the reaction between metal X and hydrochloric acid
Hypothesis	The reaction between metal X and hydrochloric acid liberates heat energy
Variables	Dependent variable – temperatures Independent variable – time Controlled variable – volume of hydrochloric acid
Risk and mitigation	- Breaking of the thermometer hence causing injuries to the body. Mitigated by putting the thermometer in its casing immediately after use - Acid pouring on the skin hence causing burns. Mitigated by wearing a laboratory coat, gloves and closed shoes
Procedure	(a) Using a measuring cylinder, 30 cm^3 of hydrochloric acid was measured and transferred into a plastic beaker. (b) The initial temperature of the solution was read using a thermometer and recorded (c) 0.5g of metal X is weighed using a digital scale and added at once to the acid in the plastic beaker and the stop watch is simultaneously stated. (d) The mixture was stirred using a thermometer and the temperature of the solution mixture was read and recorded every after 30 seconds for 3 minutes (e) The results were entered in the table.

(b) Volume of BA I used = $30.0cm^3$

Time(s)	0.0	30.0	60.0	90.0	120.0	150.0	180.0
Temperature of mixture of BA I and metal X(°C)	25.0	40.0	51.0	57.0	60.0	59.0	58.0

From the graph;

Maximum temperature attained by the mixture = 64°C

Temperature change of the mixture = $64 - 25$ = 39°C

Heat change of reaction = $mc\Delta t$

$= 30 \times 4.2 \times 39$

$= -4,914J$

Or; $-4.914KJ$

c) Conclusion;

The reaction between metal X and hydrochloric acid liberates = 4.914KJ of heat energy.

Item 4

(a) (i)

Aim of the experiment	To discover which type of water is more effective in cleaning and minimizing soap wastage
Hypothesis	Water sample BA3 or BA2 is more effective in cleaning and minimizing soap wastage
Variables	Dependent variable – volume of soap solution used Independent variable – type of water sample Controlled variable – volume of water sample used
Risk and mitigation	Soap solution pouring on the skin causing irritations and burns **Mitigated by** wearing gloves.
Procedure	(a) 25.0cm^3 of water sample BA2 was pipetted into a clean conical flask. (b) Soap solution was poured into a burette and initial burette reading recorded. (c) BA2 in the conical flask was then titrated with BA1 until a permanent lather is formed. (d) The final burette reading is recorded. (e) The titration was repeated two more times to obtain consistent results. (f) The results were then entered in a suitable table (g) The procedures (a) to (f) are repeated with water sample BA3.

(ii) Results for BA2

Experiment number	1	2	3
Final burette reading (cm^3)	25.10	25.00	25.00
Initial burette reading (cm^3)	0.00	0.00	0.00
Volume of BA2 used (cm^3)	25.10	25.00	25.00

Results for BA3

Experiment number	1	2	3
Final burette reading (cm^3)	10.20	10.00	10.00
Initial burette reading (cm^3)	0.00	0.00	0.00
Volume of BA3 used (cm^3)	10.20	10.00	10.00

(b) Average volume of soap required to form permanent lather with;

(i) Water sample BA2 $= \frac{25.10+25.00+25.00}{3} = 25.03\text{cm}^3$

(ii) Water sample BA3 $= \frac{10.20+10.00+10.00}{3} = 10.07\ \text{cm}^3$

Water sample; BA3 required less soap solution to form permanent lather than water sample BA2. Hence, BA3 is the effective water sample the laundry service provider should use.

END