BWERA SECONDARY SCHOOL

APPROACH TO ANSWERING CHEMISTRY PAPER I (S.4)

- Chemistry examination will consist of two papers. Paper one is theory and paper two is practical
- Paper one will have two sections A and B
- Section A will have only two questions and all are compulsory. The question requires short answers (filling in)
- Section B will have 4 questions and candidate will chose only two
- NB the term item means question. All items will be in scenario form

SECTION A

Topics where question 1 (item 1) will be set from

- Chemistry and society
- Chemicals for consumers
- Nuclear processes
- Carbon in life (only detergents will be considered)

Chemicals for consumers will consider the following areas

i) Food additives

Under this the following will be considered

Flavour enhances	Anti-oxidants	Thickeners
Preservatives	Bulking agents	Biological enzymes
Glazing agents	Beverages	Whitening agents
Gelling agents	Dyes(food colours)	Firming agents
Glazing agents	Stabilizers	

ii) Drugs and medicine

Under this the following will be considered

Antibiotics (penicillin & streptrine)

Herbal medicine

Analgesics (aspirin, paracetamol, codeine)

Nuclear processes will consider the following areas

Nuclear fission

Nuclear fusion

Nuclear decay and half life

Detergents will consider the following areas

Soapy detergents

Soapless detergent

What question/item 1 will require

	What the Qn will require	Expected response will require to;	Score
A	Student to state the category or identify	Type of product identified	2

	the type of product		
B	To state the function(s) of the product	Anyone function of product(s)	1
		No function of the product(s)	0
C	Dangers or Side effects of the product and mitigation	Any one danger/side effect identified explained and mitigated	3
D	Evaluation of products/processes *NB here its upon the student to evaluate but UNEB will not set Qn on evaluation*	Evaluation of products/processes basing on both similarities and differences	2
		No evaluation of products/processes	0

Sample question

Item 1.

James, living in an area where they use borehole 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 James made when choosing a product.

Answer

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

Alternatively

James used bar soap instead of powdered soap like omo and nomi

NB the answer mentions the category or type of product used.

(b) Help James understand how the product works.

Answer

- The dirt is held on the cloth by a layer of oil.

- Detergents (soaps) facilitate the emulsification and removal of grease

Alternatively

- A soap molecule contains two parts; namely; the hydrophilic head which is water solute and hydrophobic tail which is dirt or fat/oil soluble

-During washing, soap acts by lowering the surface tension between water and oil/grease/other water insoluble materials and also emulsifies them

- With continuous squeezing of the cloth in water, the dirt is pulled off from the cloth and gets dispersed in water as tiny droplets which are then poured away.

- The cloth is then rinsed several times and dried

NB the answer brings out the function of the product

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

Answer

Soap contains chemicals that can cause:

- *Skin burns / blisters / irritation and hence pain or cancer*
- *Eye redness and pain; hence loss of vision*
  - Mitigation can be done 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*

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*

(i) 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*

(ii) 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*

Topics where question 2 (item 2) will be set from

- Periodic table
- Trends in the period table
- Structures and bonds
- Structures and properties of substances
- Air
- Carbon in life
- Using materials
- Elements, compounds and mixtures
- Reactivity series
- Polymers and plastics

What question/item 1 will require

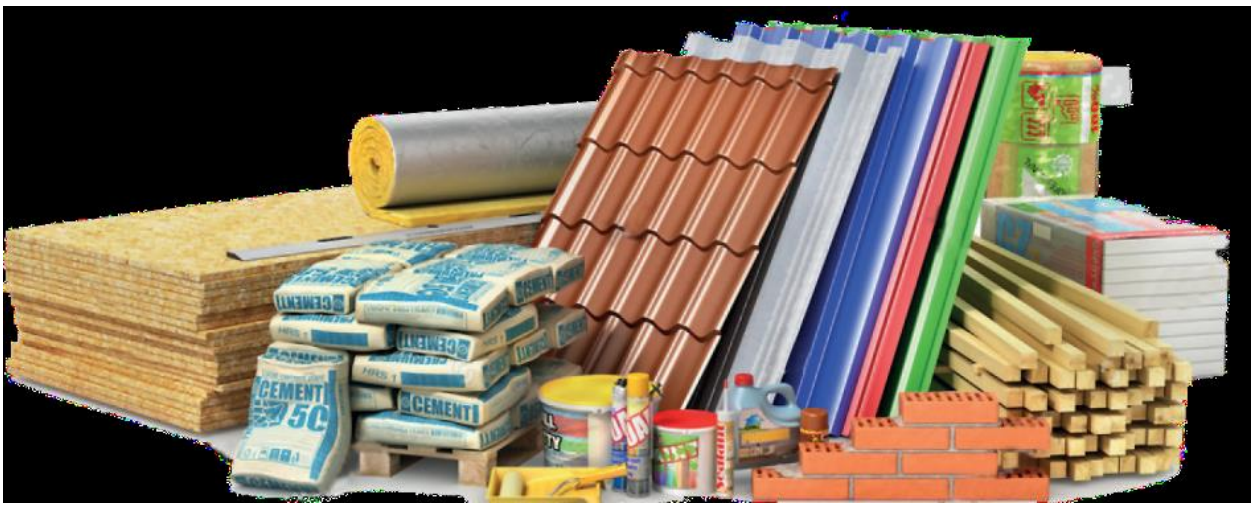
	What the Qn will require	Expected response will require to;	Score
A	Student to state the category of element, compound, substance or material with a reason	Identified category of element, compound, substance or material with a reason and example	3
		No identified category of element,	0

		ompound, substance OR material OR reason OR example	
B	Properties or prediction of properties of element, compound, substance OR material	At least four properties or characteristics or predictions of trends	3
		No property or characteristic or prediction of trends	0
C	Uses of element, compound, substance or material/applications/quantity of matter i.e moles	Any one use/application No use/application	1 0
D	Impact/ pollution of environment by element, compound, substance or material and mitigation *NB here its upon the student to state the impact and UNEB will not set Qn on this*	Identified impact and mitigation	2
		No identified impact and mitigation	0

Sample question

Item 2.

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



Peter 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.

Answer
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

Answer
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
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.
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, window frames.)
- High electrical/ heat conductivity (making utensils.)

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

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

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 rittle.

- Glass is reflective, attractive and it adds value when put in doors and windows

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

Plastics;

- 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.

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

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

Answer

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

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

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

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

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

Glass;
- *Making shutters for doors, windows*

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

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

Clay and Ceramics;
- *Making bricks.*
- *Making Tiles (floor tiles).*
- *Making roofing tiles.*

Bricks and blocks;
- *Constructing walls.*

Impact of the materials to the environment

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

Aluminium;
- *Depletes soil fertility when it accumulates*

Plastics;
- *Non biodegradable spoils the soil*

Mortar;
- *Bulky, takes long to decompose and so spoils the soil*

SECTION B

Topics where question 3 & 4 (item 3 & 4) will be set from

- Carbon in life (ethanol and biogas mainly)
- Air
- Industrial processes

These questions will be set from the following areas under these topics

- Manufacture of oxygen gas
- Manufacture of chlorine gas
- Extraction of metals(Na, Al, Fe, Cu, Zn)
- Manufacture of fertilizers (only NH_4NO_3 and $(NH_4)_2SO_4$)
- Manufacture of detergents
- Manufacture of sodium hydroxide
- Manufacture of sulphuric acid
- Manufacture of cement
- Manufacture of Ethanol
- Manufacture of bio gas

Approach when answering question from this section

- List raw materials used in the manufacture of the product …….. 2mks
- Describe process of production or chemical process or procedure ……3mks
  NB: under this stage consider to;
  - put a vessel (what is being used to produce the material) if necessary
  - Be coherent in your procedures
  - Conversion to the desired product
  - Purification
- Side effects of the process of production and mitigation i.e state the effect, cause and how it can be controlled …….3mks
- Identify the social benefit the activity, effect of the benefit and impact of the benefit ……...3mks

Sample question

Air which is a mixture of different components contains 21% oxygen. Due to a wide spread of 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 will be carried out.

Task:
As chemistry student, make a write up you will use during the presentation

Solution
Raw materials *: Liquid air or Air*

Process of production

- *Air is passed through air filters to remove dust and smoke particles.*
- *Air is then 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 gel to absorb water vapour.*
- *Carbon dioxide and water vapour 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^{o}C. The liquid air is fractionally distilled using a fractionating column / tower.*
- *Nitrogen boils off first because it has a lower boiling point (–196 oC) leaving behind oxygen with a higher boiling point (-183 oC).*
- *Both nitrogen and oxygen collected obtained contain traces of noble gases. Pure oxygen is then stored under pressure in steel cylinders*

Side effect of the process of production and mitigation
(i) 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 can be done by:
- Regular maintaince and monitoring of cylinders.
- keeping cylinders in cool areas / avoid exposure to heat

(ii) Exposure to liquid oxygen can cause severe skin and eye irritations and burns. This may cause loss of vision and cancer.
Mitigation can be done 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.
(iii) Air pollution by waste gases. Acidic gases can cause acid rain which leads to crumbling of buildings, lowering of soil pH and corrosion of roofs made of iron.
Mitigation can be done by:
- fitting catalytic converters in exhaust pipes of machines to convert oxides of nitrogen into nitrogen and carbon monoxide to carbon dioxide.
- neutralise the acidic gases before releasing waste gases into the atmosphere

Social benefits
- Employment opportunity; improved income thus better standards of living.
- Development of infrastructure e.g. electricity lines, roads, hospitals schools etc., Improved road network will facilitate trade hence improved income and better standards of living

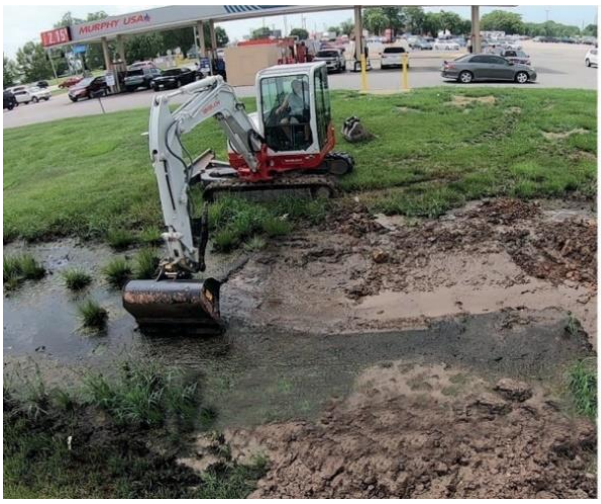
Topics where question 5 & 6 (item 5 & 6) will be set from

- Air
- Water
- Rocks and minerals
- Fossil fuels
- Carbon based fuels

Approach when answering question from this section

- Identify the category of natural resource, reason and example …….3mks
- Mention the composition of the natural resource ……2mks
- Impact of the natural resource on the environment, how it occurs, and mitigation ….3mk
- Benefit/importance of natural resource …….1mk

Sample question
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

Solution

They are classified as: (i.e category of natural resource)

- *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/ mineral*

Composition of natural resource

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

Impact of the natural resource

Air

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

$C(s) + O2\ (g) \longrightarrow CO2(g).$

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

$2CO(g) + O2(g) \longrightarrow 2CO2(g).$

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

Impact of water and how it occurs

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

$H_2O\ (l) + CO_2(g) \longrightarrow H_2CO_3(aq)$.

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

$H_2CO_3(aq) + CaCO3(s) \longrightarrow Ca(HCO_3)_2\ (aq)$.

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

$2Fe(s) + xH2O(l) + \frac{3}{2}O_2(g) \longrightarrow Fe_2O_3 \cdot xH_2O(l)$

- 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

Mitigation:

-Re-afforestation to reduce the impact of acid rains

-Use of Alloys, painting, galvanising 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. manure from both animal and plant waste which are biodegradable and reduce on use of synthetic fertilizers.

-Use of vehicles and machines in good working conditions to burn fossil fuels leading to reduction of gaseous pollutants into the atmosphere

-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 resources

-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

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