545/1
CHEMISTRY
Paper 1
20242 ½
HOURS

YAAKA EXAMINATIONS

CHEMISTRY
Paper 1
TIME: 2 Hours 30 Minutes

INSTRUCTIONS TO CANDIDATES

- This paper consists of two sections; **A** and **B**. It has six examination items.
- Section A has two compulsory items. Section **B** has two Parts; **I** and **II.**
- Respond to one item from each part. Answer four items in all.
- Answers to Section **A** must be written in the spaces provided while those ofSection **B** must be written on the answer booklet(s) provided.
- Any additional item(s) answered will not be scored.

FOR EXAMINER'S USE ONLY			
SECTION	**ITEM**	**SCORE(S)**	**EXAMINER'S SIGNATURE**
A	1		
	2		
B	3		
	4		
	5		
	6		
TOTAL			

SECTION A

*Answer **all** the items in this section in the spaces provided.*

Item 1

Uganda has been steadily moving toward industrialization to improve its economic growth. Factories and manufacturing plants have sprung up in several regions. While these industries contribute to economic growth, they also introduce challenges like pollution, which affects both the environment and human health. Chemical waste from industries, such as heavy metals, has been found in water bodies like Lake Victoria. This contamination affects the fish populations, impacting the livelihood of communities dependent on fishing.

Task:
What are the major types of chemical pollutants produced by industries, and how do these pollutants affect water bodies like Lake Victoria?

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Discuss how the presence of heavy metals such as mercury and lead in water bodies can affect aquatic life and the communities that rely on fishing as an economic activity.

Item 2

Uganda is rich in renewable energy resources, such as solar and hydroelectric power. However, many rural areas still rely on traditional biomass fuels, such as firewood and charcoal, which contribute to deforestation and environmental degradation. Chemists are working on developing more efficient and sustainable energy sources, such as biofuels derived from organic materials like sugarcane or maize.

Tasks:
(a). How can the principles of chemistry be applied to the production of biofuels in Uganda, and what impact could this have on reducing the country's reliance on biomass fuels?

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(b). Compare the chemical processes involved in the generation of energy from biomass and solar energy. Which process would be more sustainable for Uganda's rural areas, and why?

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SECTION B

PART I

Respond to one item from this part.

Item 3

With increasing access to technology, Uganda is experiencing a rise in electronic waste (e-waste). Improper disposal of electronic devices releases hazardous chemicals, including heavy metals like lead and cadmium, into the environment. These pollutants can contaminate soil and water sources, posing significant health risks to nearby communities.

Task:

(a). As a student of Chemistry, describe the chemical hazards associated with e-waste, focusing on heavy metals such as lead and cadmium. Then also explain how these metals affect human health and the environment.

(b). Given authority, what chemical processes would you recommend to be used to safely recycle or dispose of e-waste, and how can Uganda implement these processes to reduce environmental damage?

Item 4

Many Ugandan entrepreneurs have ventured into the production of homemade soaps to support themselves economically. Soap-making involves a chemical reaction known as saponification, where fats react with a base, such as sodium hydroxide, to produce soap and glycerol. However, without proper knowledge of chemistry, some entrepreneurs struggle with product quality and safety.

Task:

(a). Describe the saponification process and explain how the choice of raw materials can affect the quality of soap. What chemical factors should be considered to improve the soap's effectiveness?

(b). What safety precautions should be observed when handling chemicals such as sodium hydroxide in soap production, and how can entrepreneurs minimize health risks?

PART II

Respond to one item from this part.

Item 5

Uganda is rich in renewable energy resources, such as solar and hydroelectric power. However, many rural areas still rely on traditional biomass fuels, such as firewood and charcoal, which contribute to deforestation and environmental degradation. Chemists are working on developing more efficient and sustainable energy sources, such as biofuels derived from organic materials like sugarcane or maize.

Task:
(a). How can the principles of chemistry be applied to the production of biofuels in Uganda, and what impact could this have on reducing the country's reliance on biomass fuels?

(b). Compare the chemical processes involved in the generation of energy from biomass and solar energy. Which process would be more sustainable for Uganda's rural areas, and why?

Item 6

In many rural areas of Uganda, access to clean drinking water is limited. Contaminated water often leads to outbreaks of waterborne diseases like cholera. Chemical methods, such as chlorination, are widely used to purify water and kill pathogens. However, some communities remain hesitant to use chemicals in their drinking water due to health concerns.

Task:

(a). Explain how chlorine reacts with water to kill pathogens. What are the potential health risks of using chlorine to purify water, and how can these risks be mitigated?

(b). What other chemical methods can be used to purify water in rural Uganda, and how effective are they in comparison to chlorination?

ANSWERS TO THE TASKS ABOVE

Item 1

Task: Major types of chemical pollutants produced by industries and their effects on water bodies like Lake Victoria.

1.

Major Types of Chemical Pollutants:

Heavy Metals: Commonly include lead, mercury, cadmium, and arsenic. These can enter water bodies through industrial discharge and runoff.

Nutrients: Excessive nitrogen and phosphorus from fertilizers can lead to eutrophication.

Organic Pollutants: Includes solvents and pesticides that can be toxic to aquatic life.

Acids and Alkalis: Can alter the pH of water bodies, impacting aquatic ecosystems.

2. **Effects on Lake Victoria:**

Bioaccumulation: Heavy metals accumulate in the food chain, affecting fish health and populations.

Eutrophication: Nutrient overload leads to algal blooms, reducing oxygen levels in the water, harming aquatic life.

Health Risks: Contaminated fish pose health risks to communities relying on fishing, leading to potential economic decline.

Discussion on Heavy Metals:

Impact on Aquatic Life:

Mercury: Affects fish neurological health and reproduction; can lead to decreased fish populations.

Lead: Toxic to fish and can impair their growth and reproduction.

Impact on Communities:

Fish populations decline, affecting livelihoods of fishing communities.

Consumption of contaminated fish can lead to serious health issues, including neurological disorders in humans.

Item 2

Task (a): Application of chemistry in biofuels production and impact on biomass fuel reliance.

Application of Chemistry:

Chemists can utilize fermentation processes to convert sugars from crops like sugarcane and maize into ethanol.

Transesterification can convert oils into biodiesel.

Impact on Biomass Reliance:

Biofuels provide a cleaner alternative to traditional biomass, reducing deforestation and carbon emissions.
By increasing energy availability, rural areas can decrease reliance on firewood and charcoal, promoting sustainability.

Task (b): Compare biomass and solar energy generation processes.

Biomass Energy Generation:
Involves combustion or fermentation processes to release energy, producing carbon dioxide and other pollutants.

Solar Energy Generation:
Utilizes photovoltaic cells to convert sunlight directly into electricity, with minimal environmental impact.

Sustainability Comparison:
Solar energy is more sustainable for Uganda's rural areas as it relies on abundant sunlight and has lower emissions compared to biomass.

SECTION B

Item 3
Task (a): Chemical hazards of e-waste and their effects.

Chemical Hazards:

Lead and Cadmium: Found in circuit boards and batteries. Lead affects the nervous system; cadmium can cause kidney damage.

Brominated Flame Retardants: Potential endocrine disruptors.

Effects on Human Health and Environment:

Health Risks: Exposure can lead to serious health issues, including neurological and reproductive problems.

Environmental Impact: Contaminated soil and water sources can harm ecosystems and agriculture.

Task (b): Recommended processes for e-waste recycling.

Chemical Processes:
Hydrometallurgical Techniques: Use of aqueous solutions to extract metals safely.
Pyrometallurgical Methods: High-temperature processes to recover metals.

Implementation in Uganda:
Establish collection centers for e-waste.
Partner with environmental organizations for training on safe recycling practices.

Item 4

Task (a): Describe saponification and factors affecting soap quality.

Saponification Process:

A chemical reaction where triglycerides react with sodium hydroxide to form soap and glycerol.

Factors Affecting Quality:

Choice of Fats/Oils: Different fats produce soaps with varying hardness and lathering qualities.

Purity of Ingredients: Impurities can affect the saponification rate and the final product's effectiveness.

Task (b): Safety precautions in soap production.

Safety Precautions:
Use gloves and goggles when handling sodium hydroxide.
Ensure proper ventilation in the workspace to avoid inhaling fumes.

Minimizing Health Risks:
Provide training on handling hazardous materials.
Use safer alternative materials when possible.

Item 5 (Duplicate of Item 2, already addressed)

Item 6
Task (a): Chlorine reaction and health risks.

Chlorine Reaction:
Chlorine reacts with water to form hypochlorous acid, which effectively kills bacteria and pathogens.

Potential Health Risks:
Formation of chlorinated byproducts can pose cancer risks.
Over-chlorination can cause respiratory issues.

Risk Mitigation:

Use proper dosages and regular monitoring of chlorine levels in drinking water.

Task (b): Other chemical methods for water purification.
Other Chemical Methods:

Flocculation: Uses chemicals like alum to coagulate particles for easier removal.

Activated Carbon Filtration: Adsorbs contaminants, improving water quality.

Comparison to Chlorination:

While flocculation is effective for removing particulates, chlorination is more effective against pathogens.

Activated carbon is excellent for removing organic contaminants but does not disinfect.

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