

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 of Section **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

Item 1

A new cement factory has been set up in Tororo District. However, dust from the factory is affecting the health of nearby residents, causing respiratory problems. The local council is concerned about the environmental and health impacts of the factory.



Task:

Use your chemistry knowledge to:

- Explain the chemical processes involved in cement production and the sources of dust.
- Suggest measures that can be taken to reduce dust pollution from the factory.
- Advise the local council on how to monitor and control air pollution from the factory.

Item 2

A student performing an experiment in the lab accidentally spills sulfuric acid on the bench. The teacher quickly uses sodium carbonate to neutralize the acid and clean up the spill.



Task:

As a chemistry learner:

- (a). Explain why sodium carbonate was used to neutralize the sulfuric acid.
- (b). Write the balanced chemical equation for the neutralization reaction.
- (c). Discuss the importance of using appropriate chemicals for cleaning up acid spills.

SECTION B

PART I

Item 3

A local soap manufacturer in Jinja is looking to expand their production to meet the growing demand for soap in the region. However, the manufacturer is facing challenges with sourcing raw materials and dealing with waste from the production process.



Task:

As a chemistry learner, write a presentation you would make to the manufacturer. Your presentation should include:

- (a). The chemical process of soap production, including the raw materials used.
- (b). The environmental challenges associated with soap production.
- (c). Suggestions for managing waste and reducing the environmental impact of soap production.

Item 4

A new sugar factory is being built in Hoima District to process sugarcane grown by local farmers. However, the residents are concerned about the environmental impact of the factory, especially regarding water pollution from the factory's waste products.



Task:

As a chemistry learner, prepare a presentation for a community meeting. Your presentation should include:

- (a). The chemical processes involved in sugar production.
- (b). The potential environmental impacts of sugar factories, particularly on water bodies.
- (c). Strategies that the factory can use to minimize pollution and protect the environment.

PART II

Item 5

In Nakasongola District, charcoal production is a major economic activity. However, excessive charcoal burning has led to deforestation, and the land is becoming barren.



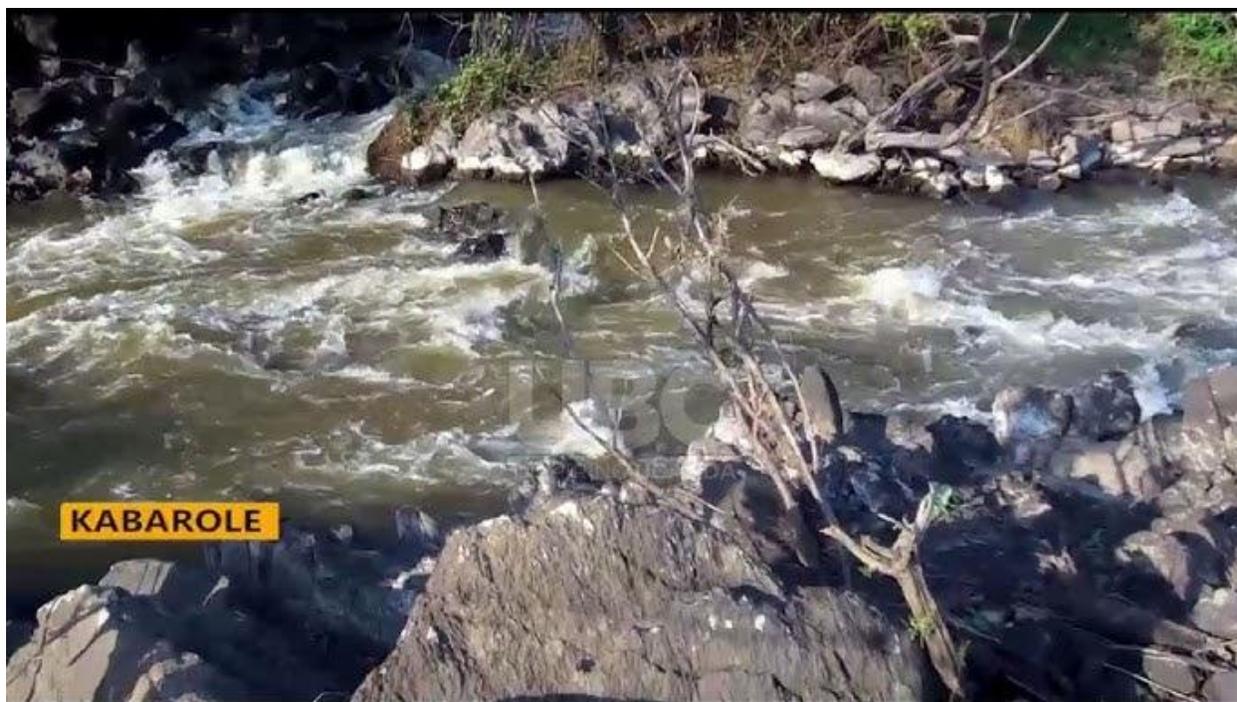
Task:

As a learner of Chemistry, prepare a message for a sensitization workshop on sustainable charcoal production. Your message should address:

- (a). The environmental impact of uncontrolled charcoal burning.
- (b). The chemical processes involved in the conversion of wood to charcoal.
- (c). Sustainable practices that can be adopted to reduce deforestation while maintaining charcoal production.

Item 6

River Mpanga is a vital water source for the people of Fort Portal. However, the river is now heavily polluted due to industrial waste, and the water is unsafe for drinking.



Task:

As a Chemistry student, prepare a message you would deliver during a workshop on cleaning up River Mpanga. Your message should include:

- (a). The causes of pollution in River Mpanga.
- (b). The impact of polluted water on human health and the ecosystem.
- (c). Measures that can be taken to clean up the river and prevent future pollution.

MARKING GUIDE TO THE ABOVE TASKS

Item 1:

(a) Cement Production and Dust Pollution:

- Cement is produced through a process called **calcination**, where **limestone (CaCO_3)** is heated in a rotary kiln to produce **calcium oxide (CaO)** and **carbon dioxide (CO_2)**. This process involves burning **fossil fuels**, which generates a significant amount of dust particles and CO_2 emissions. The dust primarily consists of fine **particulate matter (PM)**, which is hazardous when inhaled and can lead to **respiratory issues** such as asthma and bronchitis.

(b) Measures to Reduce Dust Pollution:

- The factory can install **baghouse filters** or **electrostatic precipitators** to capture dust before it is released into the atmosphere.
- Implementing **wet scrubbers**, which use water to trap dust particles, can also reduce airborne dust levels.
- Ensuring that **covered conveyors** and **closed systems** are used during cement grinding and transportation will help minimize dust escape.

(c) Monitoring and Controlling Pollution:

- The local council can establish **ambient air quality monitoring stations** around the factory to track particulate matter levels.
- Implementing **strict regulations** and requiring the factory to conduct regular **emissions audits** will ensure compliance with environmental standards.
- Encouraging the use of **green technologies**, such as **alternative fuels** (biomass) or **low-emission processes**, will further reduce the factory's environmental footprint.

Item 2:

(a) Why Sodium Carbonate Neutralizes Sulfuric Acid:

- Sodium carbonate (Na_2CO_3) is a **basic substance** that reacts with sulfuric acid (H_2SO_4), a strong acid, to produce **sodium sulfate (Na_2SO_4)**, **carbon dioxide (CO_2)**, and **water (H_2O)**. The reaction neutralizes the acid, making the spill safe for cleaning.

(b) Balanced Chemical Equation for the Reaction:

(b) Balanced Chemical Equation for the Reaction: $H_2SO_4 + Na_2CO_3 \rightarrow Na_2SO_4 + CO_2 + H_2O$

(c) Importance of Using Appropriate Chemicals for Acid Spills:

- **Neutralizing acids** with appropriate bases, such as sodium carbonate, ensures that the reaction is controlled and prevents further hazards. Improper neutralization may produce harmful gases or violent reactions.
- Sodium carbonate is safe, cost-effective, and non-corrosive, making it ideal for handling acid spills in laboratories or industrial settings.

Item 3:

(a) Chemical Process of Soap Production:

- Soap is produced via **saponification**, where a fat or oil (usually a triglyceride) reacts with a **strong alkali** like sodium hydroxide (NaOH). The process produces **glycerol** and **soap** (sodium salts of fatty acids). Common raw materials include **animal fats** or **vegetable oils** (e.g., palm oil, coconut oil).

- **Example:** $Fat + NaOH \rightarrow Glycerol + Soap$

(b) Environmental Challenges in Soap Production:

- **Wastewater** from soap production can contain high levels of **alkali** and **organic matter**, contributing to **water pollution**.
- The sourcing of oils, particularly palm oil, can lead to **deforestation** and **loss of biodiversity**.

(c) Managing Waste and Reducing Environmental Impact:

- Treating wastewater using **biological treatment** systems like **constructed wetlands** or **anaerobic digesters** can help reduce organic waste.

- Encouraging **sustainable sourcing** of oils, such as **certified palm oil**, can reduce deforestation.
- **Recycling by-products** like glycerol can reduce waste and provide additional revenue streams.

Item 4:

(a) Chemical Process of Sugar Production:

- Sugar production involves the **extraction** of juice from sugarcane, followed by **clarification, evaporation, and crystallization**. The juice is heated with lime (CaO) to remove impurities, and the water is evaporated to concentrate the sugar, which then crystallizes.

(b) Environmental Impacts of Sugar Factories:

- Sugar production generates large amounts of **wastewater** containing organic matter and chemicals like lime. This wastewater, if not treated, can cause **eutrophication** in water bodies, leading to oxygen depletion and harm to aquatic life.
- **Bagasse**, a by-product of sugarcane, can either be beneficial (as biofuel) or harmful (if improperly managed and burnt, causing air pollution).

(c) Strategies to Minimize Pollution:

- Using **biofilters** or **constructed wetlands** to treat wastewater before discharge.
- Recycling **bagasse** as a fuel source for generating electricity within the factory (biomass energy) can reduce reliance on fossil fuels.
- Implementing **closed-loop water systems** to minimize water consumption and pollution.

Item 5:

(a) Environmental Impact of Charcoal Production:

- Charcoal production contributes to **deforestation**, as large amounts of wood are burned to produce small amounts of charcoal.
- The **smoke** produced during the burning process contains harmful pollutants like **carbon monoxide (CO)**, **methane (CH₄)**, and **particulate matter**, which contribute to **air pollution** and **greenhouse gas emissions**.

(b) Chemical Process in Charcoal Production:

- Charcoal is produced through **pyrolysis**, where wood is burned in a low-oxygen environment. The **carbonization** process breaks down the cellulose in the wood, leaving behind **carbon-rich charcoal**.

(c) Sustainable Practices for Charcoal Production:

- **Sustainable tree harvesting**, including **selective cutting** and **reforestation**, can help replenish forests.
- Using **improved kilns** with better insulation can increase the efficiency of charcoal production, reducing the amount of wood needed.
- Promoting the use of **alternative energy sources** like **biogas** and **solar cookers** can reduce dependence on charcoal.

Item 6:

(a) Causes of Pollution in River Mpanga:

- **Industrial discharge**, **sewage**, and **agricultural runoff** introduce pollutants such as heavy metals, **nitrates**, **phosphates**, and **pesticides** into the river. These contaminants harm aquatic life and make the water unsafe for human use.

(b) Impact on Human Health and Ecosystem:

- Polluted water can cause **waterborne diseases** like cholera and dysentery in humans. In the ecosystem, pollutants can lead to **eutrophication**, causing **algal blooms** that deplete oxygen and kill fish and other aquatic organisms.

(c). Measures to Clean Up the River:

- **Installing wastewater treatment plants** at industrial sites can prevent untreated water from entering the river.
- Encouraging **sustainable agriculture**, such as **buffer strips** and **organic farming**, can reduce nutrient runoff.
- Conducting regular **water quality monitoring** and **community clean-up initiatives** can maintain long-term water quality improvements.



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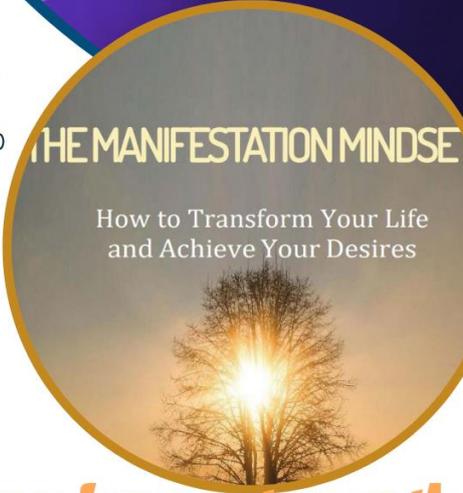
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