Candidate's Name PROPOSED GUIDE BY KYEYI JOSHUA 0776835529

Signature.....

Random No.						Personal No.		

(*Do not write your School/Centre Name or Number anywhere in this booklet*)

545/1

CHEMISTRY

Paper 1

April, 2025

2 hours

ASSURED EXCELLENCE IN CHEMISTRY EXAMINATIONS

Uganda Certificate of Education

CHEMISTRY

Paper 1

2 hours

INSTRUCTIONS TO CANDIDATES:

The 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:** answer **one** item from each part

Answers to Section **A must** be written in the spaces provided while those of Section B must be written in answer booklet(s) provided.

Answer **four** items in all. Any additional item(s) answered shall not be scored.

Use where necessary: C = 12, O = 16, 1 mole of a gas occupies 22.4L at s.t.p

SECTION A

Answer **both** *items in this section in the spaces provided*

Item 1

Arnold and James bought white table-towels on the same day. Both Arnold and James use spring-water to clean their table towels. Arnold uses only White-star Laundry bar soap but James uses Magic Laundry powder also, while washing their table-towels. Arnold's table-towels have developed many brown spots unlike James', after a very short period of time. Arnold also complains that it is hard to form lather while washing. Arnold is worried.

Task:

As a chemistry learner;

a) Help the gentlemen understand;

(i) why Arnold is facing that challenge while James is not.

Arnold uses a soapy [C] detergent which reacts with dissolved magnesium and calcium ions in the hard [T] spring-water to form insoluble scum [I] which adhere on clothes as dirty-white spots. Soapy detergents do not easily form lather with hard water.

James uses soapless [C] detergent which easily forms lather and does not form scum with hard spring-water.

2C + I + T = 04 scores

(ii) how the products work.

A detergent molecule consists of the hydrophilic [S] (polar end) and hydrophobic [S] (non-polar end) part. The hydrophilic part dissolves in water but insoluble in dirt while the hydrophobic part dissolves in the dirt but insoluble in water [Ie]. During washing, the surface tension between water and dirt is lowered exposing dirt [Ii]. On constant agitation [A], the dirt is removed.

2S + Ie + Ii + A = 04 Scores

b) Guide Arnold on the choice of the product.

Detergents contain chemicals that can cause skin burns hence pain (or eye irritation, redness and pain hence loss of vision) [Di]. This can be mitigated by thorough washing of the affected area with plenty of clean water [De].

Both are effective cleansing agents in soft water [Es].

Soapless detergent is more effective because it does not form scum with hard water [Ed]

Di + De + Es + Ed = 04 scores

- Accept correct alternative responses
- Deny scores for missing or wrong BOA

Subtotal I =12 scores

Item 2

Three students who live in the same room use 161g of charcoal while cooking their evening meal, using their charcoal stove, in their enclosed room. Charcoal undergoes incomplete combustion in limited supply of oxygen according to the following equation.

$2C(s) + O_2(g) \longrightarrow 2CO(g)$

Task:

As a learner of chemistry;

a) Explain the

(i) Category of the product formed

Carbon monoxide is a covalent compound [C] ***because it is formed when carbon and oxygen, which are non-metals, share valence electrons to form a covalent bond*** [R].

C + R = 02 Scores

(ii) suitability of the product formed

Carbon monoxide is a colourless [P], ***odourless*** [P], ***and tasteless gas*** [P], ***less dense than air*** [P], ***highly flammable*** [P], ***highly poisonous*** [P], ***soluble in some organic solvent*** [P], ***insoluble in water above 70ºC*** [P].

Carbon monoxide used:

to form syngas fuel [U] ***when it is combined with other gases like methane, hydrogen and nitrogen, because it is highly flammable; as raw material for manufacturing various organic and inorganic chemicals including methanol and metal carbonyls; in production of chemical intermediates like toluene and diisocyanatos which are used to produce polyurethane; as a reducing agent in metal refining, helping to extract metals from their oxides; in atmosphere of packaging for fresh meat, poultry, and fish to help in maintaining their colour; to remove rust from the surfaces of metals; in certain types of lasers like infrared laser.***

3p + U = 03 scores Accept correct alternatives

(iii) Possible danger they expose themselves to every evening and how the danger can be mitigated.

Carbon monoxide can be fatal [Di] ***because it binds irreversibly to haemoglobin in the blood more readily than oxygen, when inhaled, reducing the body's ability to carry oxygen, leading to organ damage and death*** [De]***. This is called suffocation. This can be mitigated by ensuring proper ventilation, and avoid using fuel-burning appliances in enclosed spaces*** [Dm]***.***

Di + De + Dm = 03 scores

b) Calculate the volume of the product formed every week, at s.t.p.

From the equation, mole ratio of C:CO = 1:1 [W]

12g of charcoal produces 22.4L of carbon monoxide gas at s.t.p [W]

161g 0f charcoal produce $\frac{22.4L \times 161g}{12} \times 7$ [W]

$= 2103.7L$ [W]

- Accept correct working

4W = 04 scores

Subtotal score-II= 12 scores

SECTION B

Part I

*Answer **one** item from this part in the answer booklet(s) provided*

Item 3

In its continuous support to the agricultural sector, the government of Uganda has cleared an investor to set-up an Ammonium nitrate fertilizer production plant in Busoga sub-region.

You have been invited to a radio talk show to a local radio station in Busoga sub-region, to sensitise the citizens about industrial processes, social benefit, side effects and how they can be overcome.

Task:

As a learner of chemistry, make a write-up that you shall use to sensitise the citizens

Nitrogen gas [Rm] ***is reacted*** [Pp] ***with hydrogen*** [Rm] ***gas in the ratio of 1:3 in a tank*** [V] ***to form ammonia gas*** [Cd]***. The reaction takes place at a temperature of 450°C, pressure of 200 atmospheres and in presence of finely divided iron catalyst*** [Pc]***.***

$N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g)$

Ammonia produced is reacted [Pp] with nitric acid [Rm] to form aqueous ammonium nitrate [Cd].

$NH_3(g) + HNO_3(aq) \longrightarrow NH_4NO_3(aq)$

Aqueous ammonium nitrate is then passed into a cyclone separator to separate ammonium nitrate liquid from steam [Pr]. Air is blown through the liquid [Pp].

The liquid is then directly prilled [Pp] in short tower [V] to obtain uniform sized prills [Cd] which are dried, coated and taken to packing plant for packing and stored [Ch].

3Rm + 2V + 3Pp + 1Pr + 2Cd + 1Ch = 06 scores

- Deny a score for missing or wrong basis of assessment;

Air pollution [Di] by waste gases/fumes. Waste acidic gases or fumes can cause acid rain which leads to crumbling of buildings, bridges, lowering of soil pH/low crop production [De]. This can be mitigated by encouraging the production and use of renewable energy instead of fossil fuels/fitting scrubbers in exhaust pipes of machines to neutralize the acidic fumes/fitting catalytic converters to convert oxides of nitrogen [Dm]

Di + De + Dm = 03 scores

Accept correct alternative response; Deny a score for missing basis of assessment; Deny all scores for wrong or no side effect identified.

It is a source of employment opportunity [Sb], leading to improved income [Se] of the people working there thus improving their standards of living [Si].

Sb + Se + Si = 03 scores

- Accept correct alternative side effects and social benefit.
- Deny a score for wrong or missing basis of assessment

Subtotal III = 12 scores

Item 4

Ethanol is an important solvent in hospitals, schools and other sectors.

The government of Uganda is planning to clear an investor to set-up an ethanol production plant in Namwendwa village to enhance its continuous supply.

The locals are worried of the likely outcome.

The village leader has invited you in the village meeting to sensitise the citizens about industrial processes, social benefit, side effects and how they can be overcome.

Task:

As a learner of chemistry, make a write-up that you shall use to sensitise the citizen

The starch containing material ^{Rm} ***(can be specified) is crushed*** ^{Pp} ***(or some are first roasted) to extract starch. Malt*** ^{Rm} ***is then added to starch in a container*** ^{V} ***and it is then covered. Malt contains an enzyme, diastase that catalyses hydrolysis of starch to maltose*** ^{Pc}***. Yeast*** ^{Rm} ***is then added*** ^{Pp} ***to maltose after about three days at room temperature*** ^{Pc}***. The maltase in yeast catalyses the hydrolysis of maltose to glucose. Zymase enzyme in yeast catalyses the decomposition of glucose to Crude ethanol and carbon dioxide*** ^{Cd}***.***

$$C_6H_{12}O_6(aq) \longrightarrow 2C_2H_5O(l) + 2CO_2(g)$$

Crude ethanol is converted to pure ethanol by fractional distillation ^{Pr} ***in a fractionating column*** ^{V}

- Follow student's logic. Accept specific starch containing material.

3Pp + 2V + Pr + 3Rm + Cd + 2Pc = 06 scores

Hot surface burns from distillation tanks ^{De} ***that cause wounds hence pain to workers*** ^{Di}***. This can be mitigated by proper use of required personal protective equipment*** ^{Dm}***.***

Di + De + Dm = 03 scores

- Accept correct alternative response; Deny a score for missing basis of assessment; Deny all scores for wrong or no side effect identified.

Provision of market for goods of the community members ^{Sb}***, hence generating income*** ^{Se}***, leading to better lives*** ^{Si}

Sb + Se + Si = 03 scores

- Should be well explained
- Accept correct alternative side effects and social benefit.
- Deny a score for wrong or missing basis of assessment

Subtotal III = 12 scores

Part II

*Answer **one** item from this part in the answer booklet(s) provided*

Item 5

In 2007, the government proposed to convert Mabira forest into a sugarcane plantation. This was aimed at expanding the industrial sector, improving exports and

creating more jobs for Ugandan population. However, the proposal faced strong opposition from environmental groups and public.

On the World Environment Day, celebrated every 5th June, the Science Club in your school has selected you to sensitise the entire school community why the strong opposition to the proposal was necessary.

Task:

As a learner of chemistry, make a write-up you shall use during your presentation.

Mabira forest is made up of trees and vegetation [E], which are renewable [Ci] natural resources. This is because trees and vegetation can be replenished by natural processes in man's life-time [R]. Trees and vegetation are composed of hydrogen [Co], oxygen [Co], carbon [Co], nitrogen [Co] and magnesium [Co].

Ci + R + E + 3Co = 06 scores

- Deny a score for any missing or wrong BOA
- Deny all if composition is wrong or not given

Converting Mabira forest into a sugarcane plantation would involve deforestation [Di]. Trees and vegetation are a carbon sink and their destruction would result into accumulation of carbon dioxide gas in the atmosphere. Being a greenhouse gas, it destroys the ozone layer resulting into global warming, prolonged draught and hence low crop productivity/famine [De]. Mitigation is by putting strict raw against deforestation [Dm]

Di + De + Dm = 03 scores

Accept correct alternative response; Deny a score for missing basis of assessment; Deny all scores for wrong or no side effect identified.

Trees are champions in absorbing carbon dioxide from the atmosphere through the process of photosynthesis. (forests are called carbon sinks) [Bi]. This helps to reduce greenhouse gas emission hence combating/reducing climate impacts [Be]

Bi + Be = 02 scores

- Should be well explained
- Accept correct alternative side effects and social benefit.
- Deny a score for wrong or missing basis of assessment

Subtotal = 11 scores

Item 6

The Albertine Graben, a rift valley basin in Western Uganda, is the most promising area for the petroleum exploration in Uganda (https://www.pau.go.ug). Besides the importances of petroleum, the citizens are concerned about what would happen to the community if exploration process fully commences.

Task:

As a learner of chemistry, make a write-up you will use, to respond to the citizen's concern.

Petroleum is a non-renewable ^{Ci} ***natural resource because petroleum cannot be replenished by natural processes in man's life-time*** ^{R}***. Petroleum is composed of carbon*** ^{Co}***, hydrogen*** ^{Co}***, some oxygen*** ^{Co}***, nitrogen*** ^{Co} ***and sulphur*** ^{Co}***.***

Ci + R + E + 3Co = 06 scores

- Deny a score for any missing or wrong BOA

Deny all if composition is wrong or not given

Use of machines during the exploration process lead to air pollution ^{Di} ***by waste gases/fumes. Waste acidic gases or fumes can cause acid rain which leads to crumbling of buildings, bridges, lowering of soil pH/low crop production*** ^{De}***. This can be mitigated by encouraging the production and use of renewable energy instead of fossil fuels/fitting scrubbers in exhaust pipes of machines to neutralize the acidic fumes/fitting catalytic converters to convert oxides of nitrogen*** ^{Dm}***.***

Di + De + Dm = 03 scores

Accept correct alternative response; Deny a score for missing basis of assessment; Deny all scores for wrong or no side effect identified.

Petroleum is a key feedstock for the petrochemical industry, used to produce a wide range of chemicals, plastics, including those used in packaging, containers and various consumer goods, like cosmetics.

Bi + Be = 02 scores

- Should be well explained
- Accept correct alternative side effects and social benefit.
- Deny a score for wrong or missing basis of assessment

Subtotal = 11 scores

TOTAL 12 + 12 + 12 + 11 = 47 scores

END