MARKING GUIDE OF 545/1 CHEMISTRY

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Signature	Stream

545/1

CHEMISTRY

Paper 1

2 Hours

2025 Feb/March

Uganda Certificate of Education

S.4 CHEMISTRY

BOT I 2025

Paper 1

2 hours

INSTRUCTIONS:

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, Part I and II. Answer **only one** item from each part.
Answer four items in all.
Answer to section **A must** be written in the spaces provided while those of Section **B must** be written in the answer sheets provided. Any additional item(s) answered will **not** be scored.

Scoring guide for the Scorer's Use Only					Total
Item 1	(a)**C** = 02	(b)**F**(04)	(c)D_3 = 06		12 Scores
Item 2	(a)C_2 =04	(b)P_4 = 04	(c) U_1 = 01	(d)I_2 = 03	12 Scores
Item 3/4	(a)P_3 = 06	(b)D_3 = 06	(c)B_3 = 06		18Scores
Item 5/6	(a)N_2 =06	(b)D_3 = 04	(c)B_2 = 05		15Scores
TOTAL					57Scores

SECTION A

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

Item 1:

Mr Okwelle, relocated into Busia town, being new in the area, resorted in buying water from one of the local water supplier for his home laundry activity. While washing, his wife realized that all the white clothes she hanged on a wire, were stained brown even after several rinse with the detergent. This left the new family frustrated with what was wrong with the water, and they have approached you for some advice.

Task:

As a chemistry student

a) Explain the mistake his wife made while choosing the product.

His wife used soapy detergent: √C

Accp: Soap; Soap detergent

Deny: Soapless detergent; Detergent; Surfactants

b) Guide Mr Okwelle to understand how the product works.

Both soapy and Soapless detergents, possess the hydrophilic head and hydrophobic tail of long chain hydrocarbons√ F_1. The head being polar, gets attracted to water molecules, and lowers the surface tension of water molecules√ F_1 to form lather easily with the detergent. The tail being non – polar, moves away from water and gets attracted to stain. The mechanical movement between soap and water causes breaking of stains molecules into emulsion of small droplets that settle on water as stains leaving the cloth material clean. C + F = T_2 = 06Scores

c) Advice Mr Okwelle on the challenges associated with the long – term use of the product.

Soapy/Soapless detergents cause skin, eye irritations, burning sensations; √D(i) causing discomforts, bruises √D(e) to the

affected body parts due to the chemicals in them. This can be mitigated by wearing personal protective equipment/washing the affected body part with plenty of water. √D(m)

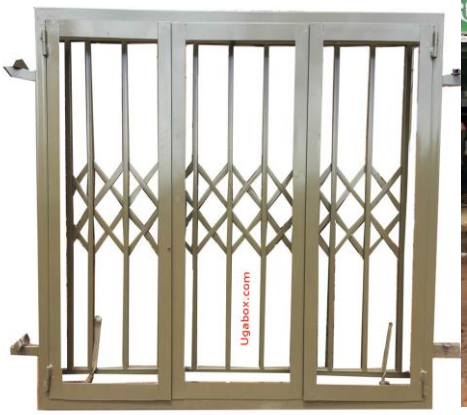
Alternative response

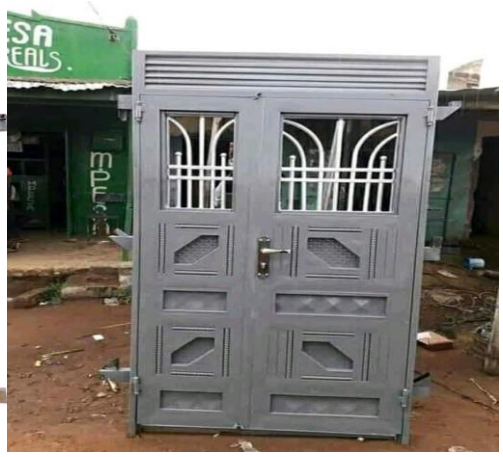
Soapless detergents contain non – biodegradable surfactants such as phosphates/Sulphates√D(i) which cause water pollution leading to excessive growth of algae√D(e). This can be mitigated encouraging all surfactant users to avoid pouring the dirty water containing the detergents directly into water body√D(m). D(i) + D(e) + D(m) = D_3 = 06 Scores

TOTAL = T_2 + D_3 = 06+ 06 = 12 Scores

Item 2:

Mr Kamuntu, is in the process of entering in his newly constructed house, but the house lacks metal doors, window frames and electrical wires. He wants to buy these materials from the market. He has lit knowledge about their structural suitability in the house. He wants to be guided well to make the right choice, and has come to you for advice






Task:

As a chemistry student,

a) Help Mr Kamuntu to know the category of the materials:

The materials which is window, door metallic frames and electrical wires are metal elements; √C(i) because they can

easily lose electrons to form positive ions √C(r). Examples include iron and copper. C(i) + C(r) = C_2 = 04Scores

b) Guide him on the suitability of the materials.

Iron and copper materials

- **Have high tensile strength. √P_1**
- **Malleable√P_1**
- **Ductile √P_1**
- **Have high melting points√P_1 P_1 = P_4 = 04Scores**

Alternative response

- **Resistant to corrosion√**

c) Advise him on the choice of the material chosen for use.

Iron materials are malleable, have high tensile strength, with high melting point, thus can be used to frames. √U_1 = 01Score

Alternative response:

Copper material is ductile, and has ability to conduct heat and electricity, thus can be used to make electric wires.√

d) Advise him the impact of the materials to the environment.

Iron materials readily rust; contaminating both soil and water, altering their pH, thus pollution. √M(i) This can be mitigated by encouraging recycling/re – using the metal materials. √M(m)

M(i) + M(m) = I_2 = 03Scores

TOTAL = C_2 + P_4 + U_1 + I_2 = (04+ 04+ 01+03) = 12Scores

SECTION B

Part I

Answer any **one** item from this part in the answer sheets provided.

Item 3:

Due to increased costs and demand of copper in the markets needed for making electrical vehicles across the Country, the government of Uganda through the ministry of energy and power has contracted an investor with the aim to revive the copper production in Kilembe mine, in Kasese District Uganda. However,

some local residents are worried whether the environment would not be affected.

They also have no idea on how the production process of copper will be conducted. This attracted the attention of the Local Council Chairperson (LC1) to organize a sensitization workshop where the management of the plant and some local representatives have been invited.

Task

As chemistry learner, write a brief presentation that you will deliver on this day's invitation.

Raw materials and process of production of copper	Copper pyrites ($CuFeS_2$) √Rm is main ore from which pure copper is extracted, containing impurities such as silicon dioxide, (SiO_2); is crushed; √Pp into fine powder; water added with a frothing agent; √Pp to remove impurities in a purifier√V, where copper pyrite is skimmed off from the oily layer, dried, and roasted in a blast furnace√V to obtain copper (I) sulphide, iron (II) oxide and sulphur dioxide gas. $2CuFeS_2(s) + 4O_2(g) \longrightarrow Cu_2S(s) + 2FeO(s) + 3SO_2(g)$ The above mixture is then heated with silicon dioxide√Rm in a purifier tank, √V to remove iron (II) oxide as impurities of iron (II) silicate called slag. $FeO(s) + SiO_2(s) \longrightarrow FeSiO_3(l)$ The copper (I) sulphide, is then heated in limited air√Rm to form blister copper and sulphur dioxide gas.

	$Cu_2S(s) + O_2(g) \longrightarrow 2Cu(s) + SO_2(g)$ Blister/impure copper formed is purified, √Chp by electrolysis by making blister copper an anode and pure copper as a cathode, placed in an electrolyte of copper (II) sulphate solution in an electrolytic cell√V. The anode dissolves out in the electrolyte and undergoes oxidation reaction√Chp by loss of electrons to form copper (II) ions, Cu^{2+} which migrates to the cathode where it undergoes reduction reaction√Chp by gains of electrons and get deposited as pure copper metal, as shown in the equations below. Anode: $Cu(s) \longrightarrow Cu^{2+}(aq) + 2e$ Cathode: $Cu^{2+}(aq) + 2e \longrightarrow Cu(s)$ The pure copper is then molded into desired shapes, packed and transported for use/sale. 3Rm + 1V+ 3Pp+ 3Chp + 1Co + 1Pr = P_3 06Scores
Side effects/ dangers from the process of production of copper	There's high emission of sulphur dioxide gas, causes air pollution; √D(i) leading to formation of acid rain that corrodes iron roofing materials, plant leaves, soil pH and its agent of global warming√D(e). This can be mitigated by encouraging the plant to install catalytic convertors in the exhaust pipes to remove the gas√D(m). D(i) + D(e) + D(m) = D_3 = 06Scores Alternative response: Prolong exposure to dust particles emitted from the activities of grinding, √ causes potential health risk to respiratory illnesses such cancer, coughs and flu or even death to the workers √. This can be mitigated by encouraging the workers to wear personal protective equipment, and also to go for regular routine – health checkup √.
Social benefit(s) of the plant	Employment opportunity to the workers; √Sb improves their income earnings; √Se thus improved standard of living √Si Sb+ Se+ Si = S_3 = 06Scores Alternative response:

	Government revenue through taxes; √ improves infrastructres such as roads, schools and health facilities; √thus improved societal development and standard of living of people; √ Creation of ready markets for the products to the society; √ improves income generation; √ thus improved standard of living; √ Sb + Se+ Si = S_3 = 06Scores TOTAL = P_3 +S_3 + B_3 = 06+ 06+ 06 = 18Scores

Item 4:

Kibambuli village has been hit hard by red eye outbreak. The village is best known for growing cassava and millets, which are used to make local drinks called "Maruwa". But because the outbreak has worsened in the area, the ministry of Health has locked down the village. An investor from the nearby town wants to set – up a production process for plant to produce ethanol on large scale. This attracted the attention of the people in this area and they are wondering how this project will work, while benefiting the community without affecting the environment.

You have been invited by the local leaders to sensitize the villagers.

Task:

Prepare a presentation you will use during the meeting.

Raw materials and process of production	The source of ethanol is starch obtained from millets, sorghum, maize corn, cassava or ripped banana and yeast √Rm. Starch is grounded and mixed with water causing it to undergo hydrolysis to form malt √Pp. Malt contains an enzyme *diastase* which catalyzes the hydrolysis of starch to maltose √Chp. $2C_6H_{10}O_{5(aq)} + H_2O_{(l)} \xrightarrow{\text{Diastase enzyme}} C_{12}H_{22}O_{11(aq)}$ Yeast √Rm is added to the *maltose* at room temperature and left to ferment for 5 days. *Maltase* in yeast, catalyzes √Chp the hydrolysis of maltose to glucose as below. $C_{12}H_{22}O_{11(aq)} + H_2O_{(l)} \xrightarrow{\text{Maltase enzyme}} 2C_6H_{12}O_{6(aq)}$ (Maltose) +(Water) (Glucose) *Zymase* in yeast, catalyzes √Chp the breakdown of glucose into ethanol, carbon dioxide, with evolution of heat in the process √Chp. $C_6H_{12}O_{6(aq)} \xrightarrow{\text{Zymase enzyme}} 2C_2H_5OH_{(l)} + 2CO_{2(g)} + \text{Heat}$ Glucose*(aq)* ⟶ Ethanol*(l)* + Carbon dioxide*(g)* + Heat Crude ethanol √Rm is distilled into pure ethanol by fractional distillation √Pp in a distillation tank √V collected, and packed. 3Rm + 3Pp + 1V + 1Chp + Co +1Pr = P_3 = 06Scores
Danger/side effect and mitigation	There may be risk of hot Surface burns√S(i) from the distillation tanks; causing wounds and boils hence pain to workers √S(e). This can be mitigated by use of proper personal protective equipment√S(m). S(i) + S(e) + S(m) = S_3 = 06Scores **Alternative response:** There is high risk of explosion from the flammable chemicals from distillation tank; √ Causing severe burns to the workers, loss of properties and lives√. This can be mitigated by carrying out routine check – up on the equipment used, and wearing personal protective equipment√.
	Employment opportunity to the workers; √Sb improves their income earnings; √Se thus improved standard of living √Si Sb+ Se+ Si = S_3 = 06Scores

	Alternative response: Government revenue through taxes; √ improves infrastructres such as roads, schools and health facilities; √thus improved societal development and standard of living of people; √

Part II

Answer any **one** item from this part in the answer sheets provided..

Item 5:

Galabuzi, the cattle keeper, grazes his cows on community land. During the dry season, he practices bush burning and also takes his cows to drink water from the nearby community water source. His practices have raised concern from the community. The area chairperson has organized a meeting to create awareness for Galabuzi and others who perform such practices.

Task:

As a learner of Chemistry, prepare a write – up message that will be delivered during the meeting.

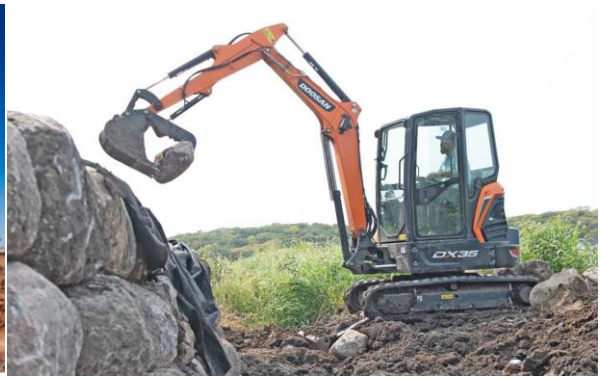
Category, reason and examples of the N.R	Forests, air and water are; renewable natural resources; √C(i) since the use of their materials does not deplete the resources, and are infinite since they can be replaced naturally within man's life time √C(r). Air is composed of a mixture of gases such as (nitrogen, oxygen, water vapour, carbon dioxide and noble gases) √Co Water is a compound composed of elements such as hydrogen and oxygen √Co. Forests are composed of different tree species made up of elements such as carbon, hydrogen and oxygen √Co. 1C(i) + 1C(r) + 3Co = N_2 = 06Scores
Danger of human's activities on N.R	Activities of man such cutting down trees for timbers/charcoal burning, bush burning for farming, poor animal husbandry, poor farming methods, dumping of untreated effluent from industries, oil spills from broken pipes into water bodies, accumulation of plastic wastes,

	and fiscal wastes affect the resources such as (Air, water and forests) directly√D(i); by causing air pollution, acid rain formation that corrodes iron roofing materials and plant leaves and thus global warming√D(e). This can be mitigated by encouraging community team spirit through planting tree species which take shorter time to grow to replace those already cut, encouraging proper treatment of industrial effluents, avoiding irresponsible dumping of acidic fertilizers, non – biodegradable plastics and surfactants directly into the water bodies√D(m). **Alternative response** Excessive cutting down of trees by man for making charcoals, firewood, timbers, leads to increased carbon dioxide level in the atmosphere; √ causing global warming, lowering precipitation level hence prolong drought; √ This can be mitigated by encouraging community team spirit through planting tree species which take shorter time to grow to replace those already cut; √ Di + De + Dm = D_3 = 04Scores
Social benefits	Air contains oxygen √B(i) which is used by animals during cellular respiration to generate energy; this supports normal body functioning √B(e). Air contains carbon dioxide√B(i) used as raw materials during photosynthesis by green plants to make their own food in the presence of sunlight and chlorophyll. This facilitates the flow of energy in a food chain√B(e). **Alternative response** Forests support biodiversity of different species both plants and animals√, facilitates conservation of ecosystem /habitats for terrestrial wildlife, thus attracting tourism industry√. Water supports biodiversity of aquatic life, conservation of aquatic ecosystem and homes for aquatic wildlife√, thus attracting tourism industry√.

	Water is source of hydro – electric power; √ which can be used to run most industries and home electrical appliances. Thus creating jobs and stimulating economic growth of the Country√. B(i) + B(e) = B_2 = 05scores TOTAL = N_2+D_3+ B_2 = 06+04+ 05 = 15Scores

Item 6:

In her school holidays, Suzan visited her aunt who works in one of the stone quarries in the area. Suzan noted that explosives were being used to blast the big lumps of rocks to form small stones (aggregates) and there was a lot of dust rising into the atmosphere as shown below.



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Besides the social benefits, Suzan was much concerned about what would happen to the site and community at large, if the activity continued over time.

Task:

As a learner of Chemistry, prepare a write – up to respond to Suzan's concern.

Category, reason and examples of the N.R	Rocks and minerals are non – renewable natural resources; √C(i) because the use of their materials deplete the resources and are finite since they cannot be replace within man's life time. √C(r) Rocks are mainly igneous, metamorphic and sedimentary rocks√Co composed of minerals such as quartz, sandstone, limestone, marbles√Co, metals (iron, copper, aluminium) √Co 1C(i) + 1C(r) + 3Co = N_2 = 06Scores

Danger of human's activities on N.R	Man's activities on rocks such as quarrying, mining process greatly degrade the soil environment; √S(i) causing soil erosion, soil destruction/exhaustion, water pollution, loss of plant nutrients, and emission of dust particles in the air hence air pollution√S(e). This is mitigated by encouraging the use of hybrid equipment that when used, leave no harm to the environment√S(m). **Alternative response:** Prolong exposure to dust particles emitted from the activities of quarrying, √ causes potential health risk to respiratory illnesses such cancer, coughs and flu or even death to the workers √. This can be mitigated by encouraging the workers to wear personal protective equipment, and also to go for regular routine – health checkup √.
Social benefits	Rocks provide minerals such as metals (iron, aluminium, copper) quartz, limestone, and gold √Bi. Their extraction has supported the growth and development of metal and chemical industry in the Country √Be. **Alternative response:** Rocks provide the construction materials for infrastructure such as roads, schools, hospitals, bridges, buildings and industries √Bi. This leads to economic development of the Country √Be. Bi + Be = B_2 = 05Scores TOTAL = N_2+D_3+ B_2 = 06+04+ 05 = 15Scores

MARKING GUIDE PREPARED BY Dr KENNETH OPIO OJOK

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