S.5 CHEMISTRY- 2025

GROUP ASSIGNMENT C003

GROUP NAME: ……STREAM:……

GROUP CHAIRPERSON:……EXPECTED SCORE:……

💣 ITEM 1: RADIOACTIVITY AND ITS APPLICATIONS.

During a mineral exploration survey in the Karamoja sub-region, geologists discovered naturally occurring deposits of Uranium-238 (^{238}U) in certain rock formations. The Ministry of Energy plans to study its potential for peaceful purposes, such as generating electricity or producing medical isotopes.

However, members of the surrounding community were concerned when they heard that Uranium is radioactive. A local chemistry teacher explained that U-238 undergoes a series of nuclear decays, during which the nucleus emits alpha (α), beta (β), and gamma (γ) radiations at different stages of the decay chain.

The teacher also highlighted that the half-life of U-238 is about 4.5 billion years, which makes it relatively stable in the short term, but also poses long-term environmental risks.

A student science team was asked to assist in preparing a community sensitization report to resolve unfamiliar terms such as half-life and radioactivity, explain the nature of each radiation, effect of each radiation on the uranium nucleus with aid of nuclear equations, applications as well as health, environmental, ethical and safety implications of radioactivity.

❓Task:

(a) As a learner of Advanced Chemistry, prepare a write-up that the team shall use to sensitize the community residents.

❓Computation tasks: ***(b) A rock sample is found to contain 6.25 g of U-238. How many half-lives would have passed for this to reduce from an original 100 g?***

(c) A certain mass of U-238 was found to have decayed to a quarter of its original mass, M_o after t years. Determine the value of t.

(20 scores)

ITEM 2: PERIODICITY I.

A group of chemistry students from CMoS and PEARSON schools have partnered to create, respectively, locally-made water filters and fertilizer coatings that use nanoparticles of compounds of Period 3 elements.

However, the CMoS team runs into a challenge: the particle sizes are inconsistent, and the filter efficiency is affected. An NBS science show interviews them, The CMoS group explains:

"We're using the cations Na^{+}, Mg^{2+}, and Al^{3+} to form oxide layers. They are all derived from corresponding atoms (Na, Mg, Al), but surprisingly, their ionic radii are smaller than the radii of the corresponding atoms, which affects the expected final particle size in the filters."

Meanwhile, the PEARSON group working on phosphates, sulphides, and chlorides for fertilizer coatings is facing a different issue — their anions (P^{3-}, S^{2-}, Cl^{-}) are too large, causing instability in coating layers though the levels of instability increase with increase in anionic radii.

During the interview, both teams added that "Beyond just ionic size, there are other reasons why some elements work better in filters, and others in fertilizer coatings i.e variations in first ionization energy and first electron affinity of instead the corresponding atoms."

After that addition, the interviewer wants to know;

(i) How atomic radius and hence first ionization energy varies in the corresponding atoms of the ions used by the CMoS group. ***(Explain)***
(ii) Why the CMoS group is facing that challenge.
(iii) Which is the most stable anion in the coating layers that the PEARSON group should recommend for use and why is it the most stable?
(iv) ***Why*** the first electron affinity of sulphur differs from that of chlorine.

? Task:

As a Chemistry student, help both teams respond to the interviewer.

(20 scores)

ITEM 3: THERMOCHEMISTRY.

A local engineering firm is exploring the use of Aluminium Oxide (Al_2O_3) in the development of solid-state batteries and sustainable energy storage systems for off-grid communities in Uganda.

Before implementing their plan, they want to understand whether Al_2O_3 is a suitable compound based on its thermochemical properties, particularly: Its stability, especially under high temperatures and humid conditions, the energy involved in forming its crystal lattice and how it behaves if exposed to water.

The firm asks your team to assist with:

- ✓ Calculating the lattice energy of Al_2O_3
- ✓ Commenting on the stability of Al_2O_3
- ✓ Explaining whether MgO would be more stable than Al_2O_3, under high temperatures, as one of the firm-members suggested.
- ✓ Determining the enthalpy of solution of Al_2O_3
- ✓ Commenting on the solubility of Al_2O_3 and how temperature affects its solubility.

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The firm provides to the following thermochemical Data (All values in $kJmol^{-1}$).

Enthalpy of formation of Al_2O_3	-1676
Enthalpy of atomization of Al	+314
Bond dissociation energy of Oxygen	+498
First ionisation energy of Aluminium	+577
Second ionisation energy of Aluminium	+1820
Third ionisation energy of Aluminium	+2740
First electron affinity of O	-141
Second electron affinity of O^-	+844
Hydration enthalpy of Al^{3+}	-4690
Hydration enthalpy of O^{2-}	-885

? Task:

As a learner of Chemistry, work with the team and respond to the firm.

(20 scores)

ITEM 4: HYDROCARBONS- ALKANES.

The engineering team at Gulu District Hospital is working on a project to upgrade their fuel system to a cleaner, more efficient alkane-based system. They are evaluating four potential fuel candidates:

- Ethane
- Butane
- 2-Methylpropane (isomer of butane)
- Hexane

During one of their meetings, their chemical engineer advised that the solubility and boiling points of the fuels needed to be studied before decision making and ,as well as, cautioned the team against use of chlorinated solvents in cleaning the fuel tanks as this may cause chemical modifications of the fuels under U.V light.

The team then tasked the chemical engineer to help them;

- Explain the comparison between the boiling point of ethane and hexane.
- Explain how the boiling point of butane differs from that 2-methylpropane despite of the two being isomeric.
- Explain the difference in solubility of ethane and hexane.
- Illustrate how chlorine in the solvents may attack the fuels under U.V light, using ethane in the outline of the reaction mechanism that occurs.
- Recommend the best fuel candidate in terms of energy production.

? Task:

As a learner of Organic Chemistry, make a write-up that the chemical engineer will present to the team.

(20 scores)

❁ ITEM 5: PERIOD 3 ELEMENTS.

In Luweero District, a solar battery recycling company is facing chemical waste management challenges. During disassembly, residual compounds of sodium, magnesium, aluminium, and sulphur are found in varying forms — some as oxides, others as chlorides.

The National Environmental Management Authority (NEMA) assigned a profound chemist, ·PaulTutor, to evaluate:

- With aid of equations, ***how*** each of these elements and oxides react with water, dilute acids and dilute alkalis.
- Which oxides are acidic, basic, or amphoteric in nature.
- How to safely separate magnesium ions and aluminium ions from the waste stream.
- With reasons, whether beryllium-based alternatives would chemically behave differently from aluminium if adopted in Uganda's hot, acidic environments.

? Task:

As a learner of Chemistry, assist ·PaulTutor with the evaluation.

(20 scores)

END!!!

TAKE NOTE:

1). CMoS SCENARIOS ARE BULKY AND HEAVILY AWARDED BECAUSE THEY CONCENTRATE ON ACHIEVING A GOOD NUMBER OF LEARNING OUTCOMES IN A SINGLE PROBLEM-BASED ITEM (And that's why we call them, "GROUP ASSIGNMENTS" so endeavor to attempt the work in groups such that you don't feel overwhelmed individually)__ PRECISE AND UP-TO-STANDARD SCENARIOS SHALL COME IN AFTER UNEB RELEASES THE NEW A-LEVEL CBC SAMPLE PAPERS IN EARLY 2026___SO, KINDLY STAY TUNED!!!

2). LASTLY, VIDEOS HAVE BEEN RECORDED WHERE OUR SCENARIOS HAVE BEEN EXPLAINED FROM FIRST PRINCIPLES AND THE EXAMINED CONTENT WELL-MASTERED WITH ALL COMPETENCIES WELL-ACHIEVED✍_____TO ACCESS THE VIDEOS, WHATSAPP PAULTUTOR AT 0753279592 BY A CALL/MESSAGE/BOTH.

3). JUST A QUICK REMINDER, VIDEO-LESSONS OF SENIOR FIVE WORK AND SENIOR SIX WORK IN LINE WITH THE NEW CURRICULUM ARE ALSO AVAILABLE, DON'T FORGET THAT THE GOAL IS TO COMPLETE THE SYLLABUS BY JANUARY 2026 (S.5 THIRD-TERM HOLIDAY) WITH CMoS 📌! SUCH THAT WE USE THE REST OF THE YEAR 2026 TO REPEAT EVERYTHING IN REVISION FORMAT AS THIS WILL HELP US ACHIEVE OUR TARGET POINTS IN THE FINAL NATIONAL EXAMS (UNEB-UACE 2026).

4). TO ACCESS THE SCORING (MARKING) GUIDES FOR ALL CMoS ASSIGNMENTS, KINDLY CONTACT PAUL TUTOR STILL. (WHATSAPP- 0753279592)

CMoS Assignments,

Set by PaulTutor,

0753279592.

CMoS.

Don't watch the clock, do what it does, keep going!

"CMoS- CREATING COMPETENT CHEMISTRY AND MATH STUDENTS IN UGANDA"