THE UNITED REPUBLIC OF TANZANIA
NATIONAL EXAMINATIONS COUNCIL OF TANZANIA
DIPLOMA IN SECONDARY EDUCATTION EXAMINATION

732/1 **CHEMISTRY**

Time: 3 Hours **ANSWERS** **Year: 2021**

Instructions.

1. This paper consists of sections A, B and C with a total of **Sixteen (16)** questions.
2. Answer **all** questions from section A and **two (2)** questions from section B and C.
3. Section A carries **forty (40)** marks and section B and C carries **sixty (60)** marks.
4. Cellular phones are **note** allowed in the examination room.
5. Write your **examination Number** on every page of your answer booklet(s).

SECTION A (40 Marks)

Answer all questions from this section. Each question carries 4 marks.

1. Explain the importance of the chemistry syllabus in four points.

- The chemistry syllabus guides the teacher to teach appropriate content to specific learner levels, ensuring curriculum coverage is accurate and relevant.
- It helps the teacher in preparing teaching materials such as lesson plans, schemes of work, and lesson notes.
- It assists the teacher in constructing internal assessments such as tests and terminal exams aligned with national standards.
- It also guides examination bodies like NECTA in developing national examinations based on expected learning outcomes.

2. Identify four features of micro-teaching that differentiate it from other teaching practices.

- It is conducted within teacher training colleges rather than in actual school environments.
- The lessons are taught among student teachers, with some acting as learners and others evaluating.
- It involves a shorter teaching session, usually focused on practicing specific teaching skills.
- It includes immediate feedback and reflection from peers and instructors, helping student teachers improve rapidly.

3. (a) Explain the difference between homogeneous and heterogeneous equilibria.
(b) For the equilibrium: $2NO(g) + O_2(g) \rightleftharpoons 2NO_2(g)$,
(i) Write the expression for the equilibrium constant Kc.
(ii) Explain what will happen to the equilibrium if NO_2 is removed.

(a) **Homogeneous equilibrium** occurs when all reactants and products are in the same phase (e.g., all gases).
Heterogeneous equilibrium involves reactants and/or products in different phases (e.g., gas and solid).

(b) (i) $K_c = [NO_2]^2 / ([NO]^2 \times [O_2])$
(ii) According to Le Chatelier's Principle, removing NO_2 shifts the equilibrium to the right (forward direction) to produce more NO_2 and restore balance.

4. (a) Why are alkenes slightly more soluble in water than their corresponding alkanes?
(b) Why is the major product of the reaction between 1-butene and hydrogen bromide secondary bromobutane, not primary?

(a) Alkenes are slightly more soluble due to the presence of a π-bond which introduces slight polarity, allowing weak interaction with polar water molecules. Alkanes are completely non-polar.

(b) The major product is secondary bromobutane due to **Markovnikov's Rule** — in addition of HX to asymmetrical alkenes, the hydrogen attaches to the carbon with more hydrogen atoms, making the bromine attach to the more substituted carbon, forming a more stable secondary carbocation.

5. State four merits of classroom tests.

- They help the teacher assess learners' academic progress and understanding of the subject content.
- They allow the teacher to evaluate the effectiveness of their teaching methods and adjust accordingly.
- They assist in identifying individual learner differences and learning needs for targeted support.
- They motivate students to study consistently and prepare well, thus enhancing academic discipline.

6. (a) Explain the concept of soil reaction.
(b) Describe two sources of acid in the soil.

(a) **Soil reaction** refers to the chemical nature of the soil in terms of its acidity, alkalinity, or neutrality. It is influenced by the interaction of water with minerals, acids, bases, and salts in the soil.

(b) Describe two sources of acid in the soil.

- **Acidic rain:** When rain combines with industrial emissions like SO_2 and NOx, it forms acids that lower soil pH.
- **Application of chemical fertilizers and pesticides:** Some fertilizers, such as ammonium-based compounds, release hydrogen ions into the soil, increasing acidity.

7. Given the following half-cell reactions:

$MnO_4^-(aq) + 5e^- + 8H^+ \rightarrow Mn^{2+}(aq) + 4H_2O(l)$ $\quad E° = +1.51V$
$ClO^-(aq) + 2H^+ + 2e^- \rightarrow ClO_2^-(aq) + H_2O(l)$ $\quad E° = +1.19V$

(a) Give the overall balanced cell reaction.
(b) Calculate the standard electrode potential (E°cell) of the cell.

(a) First, balance the number of electrons:

- Multiply the first equation by 2
- Multiply the second equation by 5

Overall balanced reaction:

$2MnO_4^- + 10e^- + 16H^+ \rightarrow 2Mn^{2+} + 8H_2O$
$5ClO^- + 10H^+ + 10e^- \rightarrow 5ClO_2^- + 5H_2O$

Combined:
$2MnO_4^- + 5ClO^- + 6H^+ \rightarrow 2Mn^{2+} + 5ClO_2^- + 3H_2O$

(b) E°cell = E°(reduction) - E°(oxidation)
E°cell = 1.51V - 1.19V = **0.32V**

8. (a) Write electronic configurations of the following:
(i) Copper (29Cu)
(ii) Calcium ion (Ca^{2+})
(iii) Chloride ion (Cl^-)
(b) Explain why atoms undergo hybridization.

(a)
(i) 29Cu: [Ar] $4s^1$ $3d^{10}$
(ii) Ca^{2+}: [Ar]
(iii) Cl^-: [Ne] $3s^2$ $3p^6$ (or [Ar])

(b) Atoms undergo **hybridization** to achieve stable configurations and form stronger, more directed covalent bonds. It allows the mixing of orbitals (e.g., s and p) to form new hybrid orbitals suited for bonding.

9. (a) Find the oxidation state of iron in the complexes $[Fe(CN)_6]^{4-}$ and $[Fe(CN)_6]^{3-}$.
(b) Identify the property of the cyanide ligand CN^- that allows it to form complexes with transition metals.

(a)
Let oxidation state of Fe be x:
For $[Fe(CN)_6]^{4-}$: x + 6(-1) = -4 → x = +2
For $[Fe(CN)_6]^{3-}$: x + 6(-1) = -3 → x = +3

(b) CN^- has a lone pair of electrons on nitrogen which it donates to the metal ion to form a coordinate (dative) bond, allowing complex formation.

10. State four uses of a lesson plan.

- It enables the teacher to deliver the lesson in a logical, well-organized, and time-conscious manner.
- It guides the teacher in preparing appropriate teaching aids and learning materials.
- It helps the teacher to assess their own teaching effectiveness and learners' understanding.
- It provides a reference for future teaching and assists substitutes in case the main teacher is absent.

SECTION B (30 Marks)

Answer two questions from this section. Each question carries 15 marks.

11. A solution of 1 dm^3 was made by dissolving 28.6 g of impure sodium carbonate in distilled water. A 25 cm^3 of this solution was completely neutralized by 24.9 cm^3 of 3.65 g of hydrochloric acid in 1 dm^3 solution.

(a) Calculate the concentration of pure sodium carbonate in g/dm^3.
(b) If the impurity in sodium carbonate is water of crystallization, calculate the value of Z in the formula $Na_2CO_3 \cdot ZH_2O$.

- Molar mass of HCl = 1 + 35.5 = 36.5 g/mol
- Moles of HCl = 3.65 g / 36.5 g/mol = 0.1 mol
- Since this is in 1 dm^3, concentration of HCl = 0.1 mol/dm^3
- Volume used = 24.9 cm^3 = 0.0249 dm^3
- Moles of HCl used = 0.1 × 0.0249 = 0.00249 mol

From the neutralization equation:
$Na_2CO_3 + 2HCl \rightarrow 2NaCl + CO_2 + H_2O$
Mole ratio: Na_2CO_3 : HCl = 1 : 2
So, moles of Na_2CO_3 = 0.00249 / 2 = 0.001245 mol

This is in 25 cm^3 = 0.025 dm^3
So, concentration of Na_2CO_3 = 0.001245 / 0.025 = **0.0498 mol/dm^3**
Mass concentration = 0.0498 mol/dm^3 × molar mass (106 g/mol) = **5.28 g/dm^3**

(b)
Mass of impure Na_2CO_3 = 28.6 g
Mass of pure Na_2CO_3 = 5.28 × 1 dm^3 = 5.28 g
Mass of water of crystallization = 28.6 – 5.28 = 23.32 g

Let molar mass of $Na_2CO_3 \cdot ZH_2O$ = 106 + 18Z
(106 / (106 + 18Z)) × 28.6 = 5.28
→ 106 × 28.6 = 5.28 × (106 + 18Z)
→ 3031.6 = 560.4 + 95.04Z

→ 2471.2 = 95.04Z
→ Z ≈ 26

So, **Z ≈ 26 molecules of water of crystallization**.

12. Calculate the wavelength in meters of a bulb light radiated by energy of 2.76×10^5 J.

Use the formula:
$E = hc / \lambda \rightarrow \lambda = hc / E$
Where:
h = Planck's constant = 6.626×10^{-34} Js
c = speed of light = 3.0×10^8 m/s
E = 2.76×10^5 J

$\lambda = (6.626 \times 10^{-34} \times 3.0 \times 10^8) / (2.76 \times 10^5)$
$\lambda = 1.9878 \times 10^{-25} / 2.76 \times 10^5$
$\lambda \approx$ **7.2×10^{-31} meters**

13. (a) Using a relevant example in each case, describe five characteristics of homologous series. (b) Hydrocarbon R contains 84% carbon by mass and the rest hydrogen. If its molecular mass is 60 g, find: (i) Empirical formula (ii) Molecular formula.

(a)

- Same general formula: e.g., Alkanes CnH2n+2
- Differ by CH_2 group: e.g., CH_4, C_2H_6, C_3H_8
- Same functional group: e.g., -OH in alcohols
- Gradual change in physical properties: boiling point increases with molecular size
- Similar chemical properties: undergo same types of reactions

(b)
Assume 100 g of compound:
C = 84 g → 84 / 12 = 7 mol
H = 16 g → 16 / 1 = 16 mol
Mole ratio = 7 : 16 → Divide by 7: C = 1, H = 2.29 → ≈ C_3H_8 (empirical)

Empirical formula mass = 12×3 + 1×8 = 44
Molecular mass = 60
Molecular formula = (60 / 44) ≈ 1.36 → closest whole multiple = **C_4H_8**

SECTION C (30 Marks)

Answer two questions from this section. Each question carries 15 marks.

14. Suggest five safety precautions for storage of chemicals in the chemistry laboratory.

- Label all chemical containers clearly with names and hazard symbols.
- Store acids and bases in separate, ventilated areas to avoid reactions.
- Keep flammable substances in fireproof cabinets or away from heat sources.
- Use corrosion-resistant shelves and avoid storing chemicals above eye level.
- Inspect containers regularly for leaks, corrosion, or expiry.

15. Elaborate five principles of teaching and learning chemistry.

- **From simple to complex:** Teach basic concepts first before moving to advanced topics.
- **Learning by doing:** Engage students in experiments to foster practical understanding.
- **Use of models and visuals:** Helps in explaining abstract chemical concepts.
- **Inquiry-based learning:** Encourage students to ask questions and explore chemical phenomena.
- **Safe and supportive environment:** Promotes free discussion and participation during lessons.

16. Describe five procedures to be followed when moderating chemistry test items.

- Review the alignment of test items with syllabus objectives and learning outcomes.
- Ensure a balance in difficulty level, covering various cognitive domains (knowledge, application, analysis).
- Check for clarity, accuracy, and relevance in the language and content of each item.
- Pilot test or peer review the items with qualified educators or subject specialists.
- Revise or replace poorly constructed or ambiguous items before final administration.