THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL OF TANZANIA

DIPLOMA IN SECONDARY EDUCATION EXAMINATION

732/1 **CHEMISTRY 1**

Time: 3 Hours **ANSWERS** **Year: 2020**

Instructions

1. This paper consists of section A, B and C.

2. Answer all questions in section A and two questions from section B and C.

1. (a) 0.2M hydrochloric acid is stronger than 0.2M ethanoic acid.
Hydrochloric acid is a strong acid and completely ionizes in water to release hydrogen ions. Ethanoic acid is a weak acid and only partially ionizes in water, thus releasing fewer hydrogen ions in the solution.

(b) Ammonia is a weak base while sodium hydroxide is strong.
Sodium hydroxide completely dissociates in water to release hydroxide ions, making it a strong base. Ammonia only partially reacts with water to form ammonium and hydroxide ions, hence it's a weak base.

2. The following reaction takes place in a vessel of a fixed volume:
$A(g) + 3B(g) \rightleftharpoons 5C(g)$

(a) How many moles of gas are there on the right and left-hand sides of the equation?
Left-hand side: 1 + 3 = 4 moles
Right-hand side: 5 moles

(b) Identify the high-pressure side and the low-pressure side.
Since pressure is directly proportional to the number of moles of gas, the right-hand side with 5 moles is the high-pressure side and the left-hand side with 4 moles is the low-pressure side.

(c) To what direction will the equilibrium shift if:
(i) the pressure is increased?
The equilibrium will shift to the left-hand side (low-pressure side) to reduce pressure.

(ii) the pressure is decreased?
The equilibrium will shift to the right-hand side (high-pressure side) to increase pressure.

3. (a) One of the isotopes of uranium has atomic number 92 and atomic mass 238. Give its number of electrons, protons, and neutrons.
Number of protons = 92
Number of electrons = 92
Number of neutrons = 238 - 92 = 146

(b) Given the following electronic configurations of elements, identify the elements and their corresponding valencies.
(i) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2$ → Calcium, valency is 2
(ii) $1s^2\ 2s^2\ 2p^6$ → Neon, valency is 0 (noble gas)
(iii) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5$ → Chlorine, valency is 1
(iv) $1s^2\ 2s^2\ 2p^6\ 3s^1$ → Sodium, valency is 1

4. Outline four functions of a chemistry logbook.
- Recording experimental procedures and observations.
- Keeping data and results for reference.
- Providing evidence of work done in practicals.

- Helping in preparation of lab reports and analysis.

5. Why during the electrolysis of dilute NaCl solution, O_2 gas is produced at the anode; while in the electrolysis of concentrated hydrochloric acid the gas evolved at the anode is Cl_2?
In dilute NaCl solution, water is preferentially discharged at the anode over chloride ions, producing oxygen gas. In concentrated hydrochloric acid, the concentration of chloride ions is high, hence they are discharged at the anode to produce chlorine gas.

6. (a) Name each of the following complex compounds:
(i) $[CrCl_2(H_2O)_4]^+$ → Tetraaquadichlorochromium(III) ion
(ii) $K_3[CoF_6]$ → Potassium hexafluorocobaltate(III)
(iii) $[Co(NH_3)_5Cl]Cl_2$ → Pentaamminechlorocobalt(III) chloride

(b) Identify ligands of each complex compound.
(i) Ligands: H_2O and Cl^-
(ii) Ligand: F^-
(iii) Ligands: NH_3 and Cl^-

7. Name the instruments used to measure specific volume of liquid and give one example of a liquid measured by each instrument.
- Burette: used to measure accurate volumes of acid or base in titrations.
- Pipette: used to measure fixed volumes of solutions like sodium hydroxide.
- Measuring cylinder: used for measuring approximate volumes of liquids like water.
- Volumetric flask: used for preparing standard solutions like 0.5M HCl.

8. Identify the two general properties of each of the following:
(a) Sandy soil
- Has large particle size
- Drains water quickly

(b) Clay soil
- Has small particle size
- Retains water for long

9. Briefly describe four principles of teaching and learning chemistry.
- Learner-centered approach: students are actively involved.
- Use of real-life examples and practicals to enhance understanding.
- Integration of theory and experiments.
- Continuous assessment and feedback to monitor progress.

10. State four relevant assessment tools used when teaching the topic "Periodic classification".
- Written tests
- Oral questioning

- Group discussions
- Practical assignments

11. (a) Define standard solution.
A standard solution is a solution of known concentration prepared by dissolving a known amount of solute in a known volume of solvent.

(b) The specific gravity of concentrated nitric acid solution are as follows:
Nitric acid is redistilled
70% w/w HNO_3 in water
Density is 1.490 g/cm³
Molecular weight of HNO_3 is 63.01g
Chloride Cl^- = 0.0005%
Sulphate SO_4^{2-} = 0.002%

(i) Calculate the concentration of HNO_3 in g/dm³.
70% w/w means 70g in 100g solution
Volume of 100g solution = mass/density = 100g / 1.490g/cm³ = 67.11 cm³ = 0.06711 dm³
Concentration = 70g / 0.06711 dm³ = 1043.2 g/dm³

(ii) Find the number of moles of the concentrated acid in 1 dm³
Moles = mass / molar mass = 1043.2 g / 63.01 g/mol = 16.56 mol

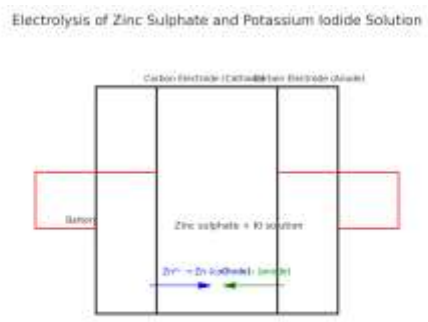
(iii) Determine the volume of concentrated HNO_3 acid required to prepare 500cm³ of a 0.5M aqueous solution.
Using $M_1V_1 = M_2V_2$
16.56 x V_1 = 0.5 x 0.5
V_1 = 0.25 / 16.56 = 0.0151 dm³ = 15.1 cm³

12. (a) (i) Define galvanization.
Galvanization is the process of coating iron or steel with a layer of zinc to protect it from rusting.

(ii) Give three significances of galvanization.
- Prevents corrosion and rusting of iron.
- Extends the lifespan of metal items.
- Enhances durability of metallic structures.

(b) Equal amounts of zinc sulphate and potassium iodide were dissolved in water. A potential difference of 6 volts and current of 12 amperes was passed for 2 hours and carbon electrodes used.

(i) Draw a well labeled diagram representing the above experiment.



(ii) Calculate mass of zinc deposited on cathode.
Zinc ion charge = 2+
t = 2 hours = 7200 seconds
Q = It = 12 x 7200 = 86400 C
n = Q / (z x F) = 86400 / (2 x 96500) = 0.447 mol
Mass = moles x molar mass = 0.447 x 65.4 = 29.26g

(iii) Calculate the volume of iodine gas liberated at s.t.p.
At anode, $2I^- \text{----> } I_2 + 2e^-$
n of I_2 = Q / (2 x F) = 86400 / (2 x 96500) = 0.447 mol
Volume at s.t.p = n x 22.4 = 0.447 x 22.4 = 10.02 dm^3

13. (a) Define each of the following types of organic reactants:

(i) Electrophiles
Electrophiles are chemical species that seek electrons. They are electron-deficient and are attracted to regions of high electron density such as double bonds or lone pairs in a molecule. Electrophiles accept a pair of electrons to form a covalent bond. Examples include H^+, NO_2^+, and Br_2.

(ii) Free radicals
Free radicals are atoms or molecules that contain an unpaired electron in their outer shell. They are highly reactive and can initiate chain reactions in organic reactions. Free radicals are formed during homolytic bond cleavage, such as in the presence of heat or ultraviolet light. An example is the methyl radical, $CH_3\bullet$.

(b) State five characteristics of homologous series.

Homologous series is a group of organic compounds having the same functional group and similar chemical properties but differ by a CH_2 group in molecular formula from one member to the next.

All members of a homologous series exhibit similar chemical behavior due to the presence of the same functional group in each compound.

Physical properties such as boiling point, melting point, and solubility change gradually with increase in molecular mass as the chain length increases.

Each successive member differs by a constant molecular unit of CH_2 or 14 atomic mass units.

Members of a homologous series can be represented by a general molecular formula, such as CnH2n+2 for alkanes.

(c) For each of the following hydrocarbons, give the IUPAC name and identify the functional group:

(i) $CH_3CH(CH_3)CH_2CH_3$
IUPAC name: 2-Methylbutane
Functional group: Alkane

(ii) $CH_3C{\equiv}CCH_3$ with a CH_3 attached to the second carbon
IUPAC name: 3-Methylbut-1-yne
Functional group: Alkyne

(iii) $CH_3CH{=}C(C{\equiv}CH)CH_3$
IUPAC name: 3-Methylpent-1-yne
Functional group: Alkyne and Alkene (contains both double and triple bonds)

14. Ability to improvise teaching and learning resources is an important skill a chemistry teacher ought to possess. Analyse five qualities of a well improvised teaching and learning resource.

A well improvised teaching and learning resource must be relevant to the topic being taught. It should effectively demonstrate the scientific concept or principle intended and connect with learners' prior knowledge to promote better understanding.

The improvised resource should be simple in design and easy to use. It must not require complex interpretation or handling. Simplicity ensures that students concentrate on the concept rather than struggling with the apparatus.

Durability is another quality of a well improvised teaching and learning resource. It should be made from materials that can withstand repeated use over time without wearing out quickly or breaking.

The cost-effectiveness of the resource is also important. A good improvised resource should be affordable and made from locally available materials to reduce the financial burden on the school and allow teachers to produce more resources as needed.

A well improvised resource must be safe for use in the classroom or laboratory. It should not pose any health hazard to students or teachers and should comply with the basic safety guidelines for educational materials.

15. Explain the importance of providing first aid to a person who got whatever type of accident in a chemistry laboratory. Give five points.

Providing first aid ensures immediate response to an injury, which helps in reducing the severity of the damage. Early action can prevent a minor accident from becoming a major health issue.

First aid is crucial in stabilizing the injured person before professional medical help arrives. This is especially important in severe injuries such as chemical burns, electric shocks, or deep cuts which may lead to shock or unconsciousness if not managed initially.

First aid helps to control bleeding in case of cuts or wounds caused by broken glass or sharp instruments. Proper application of pressure or dressing can prevent excessive blood loss and reduce the risk of infection.

In cases of chemical spills on the skin or eyes, first aid ensures immediate flushing or neutralization of the chemical to prevent tissue damage. Timely washing with water or specific neutralizers can protect the victim from long-term effects.

Administering first aid promotes confidence and responsibility among students and staff in the laboratory. It cultivates a safety-conscious environment where individuals are prepared to act promptly during emergencies.

16. Describe five criteria for selecting a project method in teaching and learning chemistry.

The relevance of the project to the chemistry curriculum is the first criterion. The project should be aligned with the learning objectives and concepts intended in the syllabus so that students gain meaningful understanding and application of scientific knowledge.

The availability of required materials and equipment is another important factor. The selected project should utilize accessible resources to allow students to perform the tasks without unnecessary limitations or costs.

The project method should match the learners' level of understanding and competence. It should not be too complex or too simple, but rather stimulate learners' critical thinking and encourage them to apply theoretical knowledge practically.

Time availability must be considered when selecting a project method. The project should be achievable within the given timeframe in the school calendar or chemistry lesson plan without compromising other learning activities.

The project should offer opportunities for evaluation and assessment. It should be measurable in terms of outcomes, allowing the teacher to assess students' knowledge, skills, creativity, and problem-solving abilities.