THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL OF TANZANIA

DIPLOMA IN SECONDARY EDUCATION EXAMINATION

732/1 **CHEMISTRY 1**

Time: 3 Hours **ANSWERS** **Year: 2009**

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. Outline the four steps you will follow in deducing the formula of copper (II) chloride.

First, determine the mass of copper that reacts with chlorine by performing an experiment.

Second, calculate the moles of copper used by dividing the mass by its molar mass.

Third, calculate the moles of chlorine that have reacted by finding the mass difference and using the molar mass of chlorine.

Lastly, find the simplest mole ratio between copper and chlorine and write the empirical formula based on the ratio.

2. (a) What is meant by order of reaction?

Order of reaction refers to the sum of the powers of the concentration terms in the rate equation. It indicates how the rate of reaction depends on the concentration of the reactants.

(b) Derive an expression for the 1st order chemical reaction A → Products with initial concentration $[A]_0$. After time t, its concentration becomes [A].

For a first-order reaction, rate = k[A]

Integrating the equation:

$\ln[A] = -kt + \ln[A]_0$

Rearranged form:

$\ln([A]_0/[A]) = kt$

3. (a) What is a molar solution?

A molar solution is a solution that contains one mole of solute dissolved in one litre (1 dm^3) of solution.

(b) Study the table below and answer the questions that follow:

| Burette readings in (cm^3) | Pilot | I | 2 | 3 |

|---|---|---|---|---|

| Final reading (cm^3) | 24.80 | 49.00 | 24.70 | 48.95 |

| Initial reading (cm^3) | 0.40 | 24.60 | 0.50 | 24.70 |

| Titre Volume (cm^3) | 24.40 | 24.40 | 24.20 | 24.25 |

(i) What is the volume of the acid used in the titration?

Average titre volume = (24.40 + 24.20 + 24.25)/3 = 24.28 cm^3

(ii) If the molar concentration of the acid is 0.1 M, calculate the concentration of the base solution during titration if the pipette used was 25 cm^3. Consider the molar ratio of the acid to base to be one to one (1:1).

Using the formula:

$C_1V_1 = C_2V_2$

$(0.1 \times 24.28) = C_2 \times 25$

$2.428 = 25 \times C_2$

$C_2 = 2.428 / 25 = 0.0971$ M

4. (a) Why do atoms bond?

Atoms bond in order to attain stable electronic configurations, often resembling that of noble gases. Bonding allows atoms to achieve lower energy states and complete their outermost electron shells through transfer, sharing, or pooling of electrons.

(b) Write electronic configuration of the following:

(i) $_{11}Na$ ----> 2, 8, 1

(ii) $_{20}Ca$ ----> 2, 8, 8, 2

(iii) $_{17}Cl$ ---> 2, 8, 7

5. (a) What do you understand by the term fractional distillation?

Fractional distillation is a method used to separate a mixture of liquids with different boiling points into individual components. It works by heating the mixture so that each component vaporizes at its boiling point, rises through a fractionating column, and then condenses at different levels according to their boiling points.

(b) Study Figure 1 and answer the questions which follow:

(i) What is the name of the process above?

The name of the process is fractional distillation of crude oil.

(ii) Mention products which are collected at A, B, C, and D.

A – Petrol

B – Kerosene (Paraffin)

C – Diesel

D – Lubricating oil

(iii) What property guides the collection of specific products above?

The products are collected based on their differences in boiling points. Substances with lower boiling points condense at the top of the column, while those with higher boiling points condense lower in the column.

(iv) Mention conditions which should be fulfilled for the reaction to occur in the above process.

Crude oil must be heated to high temperatures so that components can vaporize. The column should be maintained with a temperature gradient, hot at the bottom and cooler at the top. The column should also contain trays or surfaces for condensation of products at different levels.

6. (a) What is a standard solution?

A standard solution is a solution whose concentration is accurately known. It is prepared by dissolving a known amount of solute in a known volume of solvent.

(b) Show clearly the calculations by which you may carry out to dilute 96% pure sample of commercial concentrated sulphuric acid of density 1.82 g/cm³ to get 1 litre of 0.1 M H_2SO_4 acid.

First, calculate the number of moles needed in 1 litre of 0.1 M H_2SO_4:

Moles = molarity × volume = 0.1 × 1 = 0.1 mol

Molar mass of H_2SO_4 = 2(1) + 32 + 4(16) = 98 g/mol

Mass needed = moles × molar mass = 0.1 × 98 = 9.8 g

Now calculate the volume of concentrated acid required to get 9.8 g:

In 100 g of 96% sulphuric acid, there is 96 g of pure acid.

So, to get 9.8 g of pure acid:

(96/100) × x = 9.8

x = 9.8 × 100 / 96 = 10.21 g

Now convert this mass into volume using density:

Volume = mass / density = 10.21 / 1.82 = 5.61 cm³

Therefore, measure 5.61 cm³ of the concentrated sulphuric acid and dilute it with distilled water to make up a total volume of 1 litre to obtain a 0.1 M H_2SO_4 solution.

7. (a) State Faraday's first law of electrolysis.

Faraday's first law of electrolysis states that the mass of a substance deposited or liberated at an electrode during electrolysis is directly proportional to the quantity of electricity passed through the electrolyte.

(b) If 1.542 g of silver is liberated when 0.65 A electric current is passed through the electrolyte for 30 minutes, determine the chemical equivalent of silver.

Charge Q = I × t

Q = 0.65 × (30 × 60) = 1170 C

Using Faraday's first law:

Mass = (Equivalent weight × Q) / 96500

1.542 = (E × 1170) / 96500

E = (1.542 × 96500) / 1170

E = 127.06

8. (a) What is hydrogen bond?

A hydrogen bond is a weak electrostatic force of attraction between a hydrogen atom that is covalently bonded to a highly electronegative atom (such as oxygen, nitrogen, or fluorine) and another electronegative atom from a nearby molecule or group.

(b) Describe briefly the position of hydrogen in the periodic table.

Hydrogen is placed at the top of group I in the periodic table because it has one electron in its outermost shell like alkali metals. However, it also shares characteristics with group VII elements because it can gain one electron to form a hydride ion. Due to these dual properties, hydrogen has a unique position and is often considered separately.

9. (a) What is Chemical Kinetics?

Chemical kinetics is the study of the rate at which chemical reactions occur and the factors that influence these rates. It focuses on how fast a reaction proceeds and what affects the speed of the reaction.

(b) Explain briefly three (3) factors which can affect the rate of a chemical reaction.

Temperature: Increasing temperature increases the kinetic energy of particles, resulting in more frequent and effective collisions, hence speeding up the reaction rate.

Concentration: Increasing the concentration of reactants increases the number of particles per unit volume, leading to more collisions and a faster reaction.

Catalyst: A catalyst lowers the activation energy required for a reaction to occur, thereby increasing the rate without being consumed in the reaction.

10. What quantity of electricity will be required to liberate 1 kg of aluminium from a solution by electrolysis?

Mass of aluminium = 1000 g

Molar mass of aluminium = 27 g/mol

Number of moles = 1000 / 27 = 37.04 mol

Since aluminium has a valency of 3, each mole of aluminium requires 3 moles of electrons.

Total moles of electrons = 3 × 37.04 = 111.12 mol

Charge Q = 111.12 × 96500 = 10723680 C

11. Discuss the importance of lesson plan to administrators, teachers and students.

Lesson plans help administrators monitor the implementation of the curriculum. Through lesson plans, they can verify whether the teacher is following the syllabus, allocating time appropriately, and using effective teaching strategies to meet educational goals.

For teachers, a lesson plan serves as a roadmap that guides classroom instruction. It helps the teacher organize content, plan teaching aids, allocate time for each activity, and identify the objectives to be achieved during the lesson. This enhances teaching effectiveness and confidence.

For students, lesson plans promote a structured and coherent learning process. When a teacher follows a plan, students receive content in a logical sequence, making it easier for them to understand, follow and retain the information. Lesson plans also create opportunities for meaningful student engagement.

12. (a) Prepare a Table of Specification for testing ten (10) questions from five (5) topics of O-level Chemistry.

Topic	Knowledge	Comprehension	Application	Total Questions
Acids and Bases	1	1	1	3
Electrolysis	1	0	1	2
Chemical Equations	0	1	1	2
Atomic Structure	1	1	0	2
Chemical Kinetics	1	0	0	1

(b) Describe briefly three (3) advantages of using a Table of Specification.

A table of specification ensures a balanced distribution of questions across topics and cognitive levels. It prevents the overemphasis or neglect of certain areas of the syllabus.

It helps teachers in planning and aligning test items with instructional objectives. This promotes fairness and objectivity in assessment.

It provides a basis for constructing valid and reliable tests by ensuring that test content matches what was taught during instruction.

13. The Management of Mtukwao Secondary School has appointed you to be the head of Chemistry Department. Prove to them that their appointment was not accidental by preparing rules which will ensure safety in the Chemistry laboratory.

All students must wear lab coats, safety goggles, and closed shoes when working in the laboratory.

No eating, drinking, or playing is allowed in the laboratory to prevent contamination and accidents.

All chemicals must be properly labeled and stored in designated cabinets, particularly flammable or corrosive substances.

Students must follow instructions carefully and report all breakages, spills, or injuries immediately to the teacher.

All laboratory equipment must be handled with care and returned to the appropriate place after use.

Emergency equipment such as fire extinguishers, eye wash stations, and first aid kits must be kept accessible and in working condition.

14. The following are scores of form two students in one of the secondary schools.
88, 54, 60, 56, 68, 52, 88, 94, 72, 80, 86
Assume the national average is 50 and 11 is standard mark. Calculate the standardized score for each student.

Standardized score = ((Student Score – Mean) / Standard Deviation) × 10 + 50

Mean = 50, Standard deviation = 11

For score 88: ((88 - 50)/11) × 10 + 50 = 84.55
For score 54: ((54 - 50)/11) × 10 + 50 = 53.64
For score 60: ((60 - 50)/11) × 10 + 50 = 59.09
For score 56: ((56 - 50)/11) × 10 + 50 = 54.55
For score 68: ((68 - 50)/11) × 10 + 50 = 66.36
For score 52: ((52 - 50)/11) × 10 + 50 = 51.82
For score 88: Already calculated = 84.55
For score 94: ((94 - 50)/11) × 10 + 50 = 90.91
For score 72: ((72 - 50)/11) × 10 + 50 = 70.91
For score 80: ((80 - 50)/11) × 10 + 50 = 77.27
For score 86: ((86 - 50)/11) × 10 + 50 = 82.73

15. (a) What do you understand by the term curriculum materials?

Curriculum materials are the teaching and learning resources designed to support the implementation of the curriculum. They include everything used to facilitate the delivery of content and achievement of learning objectives.

(b) Explain clearly the types of curriculum materials. Give examples in each type.

Print materials include textbooks, teacher's guides, charts, and reference books. They are used for reading, reference, and instructional planning.

Non-print materials include audiovisual aids like videos, audio tapes, and models. These materials help in visualizing abstract concepts and enhancing understanding.

Electronic materials include digital resources such as e-books, educational software, and simulations. They promote interactive and self-directed learning.

Manipulative materials include laboratory apparatus, specimens, and models. They help in hands-on learning and practical skill development.

16. Explain five (5) principles that can be used in the teaching and learning of Chemistry.

Teaching should be based on practical work. Chemistry is an experimental science and learners understand better through hands-on activities and demonstrations.

Teaching should be learner-centered. Students should be actively involved in the learning process through discussions, group work, and problem-solving activities.

The use of relevant teaching aids and real-life examples is essential. Visual aids and linking concepts to daily life help learners relate better to what is being taught.

Content should be presented logically and progressively. Complex topics should be built from simple foundational concepts to enhance understanding.

Assessment and feedback must be continuous. Regular evaluation helps to identify learning gaps and improve both teaching and learning.

17. Suppose you are the only Chemistry teacher at your school. How will you advise the school administration on the qualities of a Chemistry laboratory?

The laboratory should be spacious and well ventilated to ensure safety and comfort for students during practicals.

It should be equipped with essential apparatus, reagents, and storage facilities for chemicals and glassware.

Proper safety equipment such as fire extinguishers, first aid kits, and eye wash stations must be installed.

There should be adequate water and electricity supply to facilitate experiments.

Storage cabinets and shelves should be clearly labeled and arranged to enhance organization and prevent accidents.

18. Describe necessary procedures required to prepare a specified concentration of dilute mineral acid from a commercial concentrated acid in the laboratory.

Determine the required volume of concentrated acid using the dilution formula $C_1V_1 = C_2V_2$.

Carefully measure the calculated volume of concentrated acid using a measuring cylinder or pipette.

Add the acid slowly into a large volume of distilled water in a beaker while stirring continuously. Never add water to acid to avoid splashing.

Transfer the mixture into a volumetric flask and make up to the desired volume with distilled water.

Mix the solution thoroughly, label it properly, and store it safely in an appropriate container.