THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL OF TANZANIA

FORM TWO NATIONAL ASSESSMENT

032 **CHEMISTRY**

Time: 2:30 Hours **ANSWERS** **YEAR: 2023**

Instructions

1. This paper consists of sections A and B with a total of **ten (10)** questions.
2. Answer **all** questions in the spaces provided.
3. Section A and C carry **fifteen (15)** marks each and section B carries **seventy (70)** mark s.
4. All writings must be in **blue** or **black** ink.
5. Communication devices and any unauthorized materials are **not** allowed in the assessment room .
6. Write your **Assessment Number** at the top right hand corner of every page.
7. The following atomic masses may be used: H = 1. C = 12, O = 16

maktaba.tetea.org

Find this and other free resources at: http://maktaba.tetea.org

Prepared by: Maria marco for TETEA

(i) . What are the common activities done in the chemistry laboratory?

A. Marking exercises

B. Reading newspapers

C. Storing books

D. Experiments

Answer: D. Experiments

Reason: Chemistry laboratories are designed for conducting experiments to study chemical reactions and their properties. Activities like marking exercises and reading newspapers do not belong in a lab environment.

(ii). The following substances are constituents of a First Aid Kit in the chemistry laboratory, except:

A. Spirit

B. Bandages

C. Cotton wool

D. Plaster of Paris

Answer: D. Plaster of Paris

Reason: A First Aid Kit typically contains items for treating injuries, such as spirit, bandages, and cotton wool. Plaster of Paris is used for construction and crafting, not for first aid.

(iii). What is the suitable method for separating a mixture of sand and ammonium chloride?

A. Filtration

B. Decantation

C. Sublimation

D. Fractional distillation

Answer: C. Sublimation

Reason: Ammonium chloride sublimates directly from solid to gas when heated, leaving behind the sand, which does not undergo sublimation.

Find this and other free resources at: http://maktaba.tetea.org

Prepared by: Maria marco for TETEA

(iv). Which one is an example of liquid solutions?

A. Oxygen in water

B. Mercury in silver

C. Carbon dioxide in water

D. Vinegar

Answer: D. Vinegar

Reason: Vinegar is a liquid solution of acetic acid dissolved in water, making it an example of a liquid-liquid homogeneous mixture.

(v). Why do ships often have blocks of magnesium attached to their hull?

A. To strengthen the hull

B. To weaken the hull

C. To give sacrificial protection to the hull

D. To react with salty water

Answer: C. To give sacrificial protection to the hull

Reason: Magnesium acts as a sacrificial anode. It corrodes instead of the ship's hull, protecting it from rust and degradation in salty water.

(vi). Given a task of preparing hydrogen gas in the laboratory, which complete set of apparatuses will you use?

A. Funnel, water trough, gas jar, delivery tube

B. Test tube, gas jar, thistle funnel, trough

C. Thistle funnel, flat-bottomed flask, delivery tube, water trough, beehive stand, gas jar

D. Flat-bottomed flask, trough, test tube, gas jar, beehive stand

Answer: C. Thistle funnel, flat-bottomed flask, delivery tube, water trough, beehive stand, gas jar

Reason: This set contains all the necessary apparatus to safely generate and collect hydrogen gas through water displacement.

Find this and other free resources at: http://maktaba.tetea.org

Prepared by: Maria marco for TETEA

(vii). What is the role of charcoal in filter elements?

A. To increase taste

B. To trap dust particles

C. To reduce noise

D. To improve color

Answer: B. To trap dust particles

Reason: Charcoal is used in filters to trap impurities, including dust particles, improving the purity of air or water.

(viii). Why is wind considered a promising source of energy for the future?

A. It produces harmful gases

B. It does not produce harmful gases

C. It is hard to harness

D. It is expensive to maintain

Answer: B. It does not produce harmful gases

Reason: Wind energy is a clean, renewable resource that does not release pollutants into the atmosphere, making it environmentally friendly.

(ix). Given that the amount of heat gained by water after a complete combustion of 46 g of ethanol (C_2H_5OH) is 8.4 kJ, what is the energy value of ethanol in J/g?

A. 182.6 J/g

B. 185.6 J/g

C. 184.7 J/g

D. 183.6 J/g

Answer: A. 182.6 J/g

Reason: The energy value is calculated by dividing the total energy by the mass: 8.4 kJ ÷ 46 g = 182.6 J/g.

Find this and other free resources at: http://maktaba.tetea.org

Prepared by: Maria marco for TETEA

(x). The following sets of radicals have oxidation states of either -1 or -2, except:

A. Chloride, hydroxide, sulphide, and bromide

B. Hydroxide, sulphate, carbonate, nitrate, nitrite, chlorate, and sulphite

C. Fluoride, oxide, sulphide, bromide, chloride, and iodide

D. Bromide, sulphide, iodide, chloride, and fluoride

Answer: B. Hydroxide, sulphate, carbonate, nitrate, nitrite, chlorate, and sulphite

Reason: This set includes radicals with varying oxidation states. For instance, sulphate has a -2 charge, while nitrate has a -1 charge, showing that this group is mixed.

2. Match the chemical constituents in List A with the corresponding types of fire extinguisher in List B by writing the letter of a correct response below the item number in the table provided.

List A

(i) Bromochloro-difluoro-methane

(ii) Sodium bicarbonate and urea complex

(iii) Potassium acetate

(iv) Mono ammonium phosphate with nitrogen carrier

(v) Proteins and fluoro proteins

List B

A. Dry powder

B. Wet chemical

C. Foam

D. CO_2

E. Sand

F. Halon

G. ABC

Find this and other free resources at: http://maktaba.tetea.org

Prepared by: Maria marco for TETEA

Answers:

(i) Bromochloro-difluoro-methane - F. Halon

(ii) Sodium bicarbonate and urea complex - A. Dry powder

(iii) Potassium acetate - B. Wet chemical

(iv) Mono ammonium phosphate with nitrogen carrier - G. ABC

(v) Proteins and fluoro proteins - C. Foam

3. Compare the properties of gaseous and solid states of matter based on the following aspects:

(a) Shapes of particles

- Gaseous State: The particles in a gas are not fixed in shape. They move freely in all directions.

- Solid State: The particles in a solid are closely packed and have a fixed shape.

(b) Volume

- Gaseous State: Gases do not have a fixed volume and expand to fill the container they are in.

- Solid State: Solids have a fixed volume and maintain their shape.

(c) Compressibility

- Gaseous State: Gases are highly compressible because the particles are far apart.

- Solid State: Solids are not compressible as the particles are tightly packed.

(d) Ability to flow

- Gaseous State: Gases flow easily because their particles are free to move.

- Solid State: Solids do not flow, as the particles are fixed in place.

(e) Arrangement of particles

- Gaseous State: The particles are spread out and move freely in all directions, with weak intermolecular forces.

- Solid State: The particles are tightly packed in a regular pattern and vibrate in place, with strong intermolecular forces.

Find this and other free resources at: http://maktaba.tetea.org

Prepared by: Maria marco for TETEA

4. (a) A laboratory technician instructed Form Two students to dissolve sodium chloride in distilled water. Giving two reasons, state whether a mixture or a compound was formed in the process.

Answer

The process forms a mixture, not a compound, for the following reasons:

- Physical Change: The dissolving of sodium chloride (NaCl) in water is a physical change, not a chemical reaction. The sodium chloride retains its individual properties.

- No New Substance: No new substance is formed. The sodium chloride particles remain intact and can be separated from the water by evaporation.

- Component Retain Their Properties: In a mixture, the individual components retain their original properties. Sodium chloride still has the properties of salt, and water retains its properties as a solvent.

- No Fixed Proportions: In a mixture, the components are not combined in fixed proportions. The amount of sodium chloride dissolved in the water can vary depending on the amount of water and salt used, unlike a compound, which has a fixed chemical formula.

(b) Which method can be useful in separating each of the following components from their mixtures?

(i) Pure water from tea

- Method: Distillation. - explanation: Distillation involves heating the tea to evaporate the water, which is then condensed back into liquid form, leaving impurities behind.

(ii) Oil from a mixture of oil and water

- Method: Separating funnel.

- Explanation: A separating funnel allows the denser water to be drained from the bottom, leaving the less dense oil on top.

(iii) Ethanol from a mixture of water and ethanol

- Method: Fractional distillation.

- Explanation: Fractional distillation separates components based on their boiling points; ethanol and water have different boiling points, allowing them to be separated.

(iv) Nail from a mixture of nail and flour

- Method. Magnetism.

- Explanation. A magnet can attract the iron nail, separating it from the non-magnetic flour.

Find this and other free resources at: http://maktaba.tetea.org

Prepared by: Maria marco for TETEA

(v) Salt from sea water

- Method: Evaporation.

- Explanation. Heating sea water causes the water to evaporate, leaving the salt behind.

(c) Which change of state of matter is applied in the following processes?

(i) Metallurgy

- Change of State: Melting.

- Explanation: In metallurgy, metals are often heated to their melting points to separate impurities or to cast them into desired shapes.

(ii) Drying of material

- Change of State. Evaporation.

- Explanation: Drying involves the removal of water or other solvents from materials, typically through evaporation, where the liquid turns into vapor.

5. (a) Differentiate oxidation state from valency

- Oxidation State. The oxidation state (or number) of an element in a compound indicates the degree of oxidation of the element, representing the hypothetical charge that would result if all bonds to atoms of different elements were 100% ionic.

- Valency: Valency refers to the number of bonds an atom can form with other atoms, indicating its combining capacity. It is determined by the number of electrons an atom can lose, gain, or share to achieve a stable electron configuration.

Find this and other free resources at: http://maktaba.tetea.org

Prepared by: Maria marco for TETEA

(b)For each of the radicals given in the following table, write its chemical formula, valency and oxidation state.

Radical	Formula	Valency	Oxidation State
Nitrate	NO_3^-	1	-1
Hydrogen Sulphate	HSO_4^-	1	-1
Phosphate	PO_4^{3-}	3	-3
Carbonate	CO_3^{2-}	2	-2
Sulphite	SO_3^{2-}	2	-2

6 (a) (i) One gram of hydrogen atom mixes with 35.5 g of chlorine atom to give 36.5 g of hydrogen chloride. Use this experimental fact to prove the Dalton atomic theory.

Answer: This observation supports Dalton's atomic theory, particularly the law of definite proportions, which states that a chemical compound always contains the same elements in the same proportion by mass. In this case, hydrogen and chlorine combine in a fixed mass ratio to form hydrogen chloride. The mass ratio of hydrogen to chlorine is 1:35.5, indicating a consistent proportion in the compound.

(ii) With reasons, give two statements of the Dalton atomic theory that were later corrected.

Answer

- Atoms are indivisible: Later discoveries revealed that atoms are divisible into subatomic particles—protons, neutrons, and electrons.
- Atoms of a given element are identical in size, mass, and other properties: The existence of isotopes—atoms of the same element with different masses—shows that atoms of the same element can have different masses.

(iii) Why is the nuclide notation '^{12}C' allowed, but '^{12}C' is not allowed?

Answer: The notation '^{12}C' is allowed because it correctly represents the isotope of carbon with an atomic mass of 12. The superscript indicates the mass number, and the subscript (which is often omitted) indicates the atomic number. The notation '^{12}C' is not allowed because it lacks the subscript, which is necessary to distinguish between different elements. Without the subscript, the notation is ambiguous and does not conform to standard chemical notation.

Find this and other free resources at: http://maktaba.tetea.org

Prepared by: Maria marco for TETEA

(b) Complete the following table by filling in the properties of sub-atomic particles.**

Sub-atomic particle	Symbol	Location	Charge	Relative mass
Proton	p^+	Nucleus	+1	1
Neutron	n^0	Nucleus	0	1
Electron	e^-	Electron cloud	–1	1/1836

7. (a) Identify the type of bond found in the following compounds:

(i) Magnesium Oxide (MgO)

- Type of Bond: Ionic Bond

- Explanation: Magnesium (Mg) is a metal that loses two electrons to form a Mg^{2+} ion, while oxygen (O) is a non-metal that gains two electrons to form an O^{2-} ion. The electrostatic attraction between these oppositely charged ions forms an ionic bond.

(ii) Table Salt (Sodium Chloride, NaCl)

- Type of Bond: Ionic Bond

- Explanation: Sodium (Na) is a metal that loses one electron to form a Na^+ ion, and chlorine (Cl) is a non-metal that gains one electron to form a Cl^- ion. The electrostatic attraction between these ions results in an ionic bond.

(iii) Drinking Water (H_2O)

- Type of Bond: Covalent Bond

- Explanation: Oxygen (O) and hydrogen (H) are both non-metals. They share electrons to form covalent bonds, resulting in a water molecule.

(iv) Ammonia (NH_3)

- Type of Bond: Covalent Bond

- Explanation: Nitrogen (N) and hydrogen (H) are non-metals that share electrons to form covalent bonds, creating an ammonia molecule.

Find this and other free resources at: http://maktaba.tetea.org

Prepared by: Maria marco for TETEA

(v) Calcium Chloride ($CaCl_2$)

- Type of Bond: Ionic Bond

- Explanation: Calcium (Ca) is a metal that loses two electrons to form a Ca^{2+} ion, and chlorine (Cl) is a non-metal that gains one electron to form a Cl^- ion. Two Cl^- ions pair with one Ca^{2+} ion, resulting in an ionic bond.

b) Consider the following molecule of a certain compound then answer the questions that follow:

i) What is the name of the molecule?

The molecule shown is water.

ii) What is the molecular formula of the compound?

The molecular formula of water is H_2O.

iii) What type of bond holds the molecules?

In water molecules, the bond between hydrogen and oxygen is a covalent bond. Covalent bonds involve the sharing of electrons between atoms.

iv) Give any other two compounds with the same type of bond identified in (b)(iii).

Here are two other examples of compounds with covalent bonds:

- Methane (CH_4): This molecule consists of one carbon atom bonded to four hydrogen atoms through covalent bonds.

- Carbon dioxide (CO_2): This molecule has one carbon atom double-bonded to two oxygen atoms via covalent bonds.

Find this and other free resources at: http://maktaba.tetea.org

Prepared by: Maria marco for TETEA

8. Study the hypothetical elements given in the following table then answer the questions that follow:

Element	Atomic Number
A	2
C	16
D	12
E	18
F	20

(a) (i) Which element qualifies as a noble gas?

- Element E (Atomic Number 18): Noble gases are found in Group 18 of the periodic table. Element E, with an atomic number of 18, corresponds to argon (Ar), a noble gas.

(ii) Which element functions as a halogen?

- Element C (Atomic Number 16): Halogens are located in Group 17 of the periodic table. Element C, with an atomic number of 16, corresponds to sulfur (S), which is not a halogen. Therefore, none of the given elements function as a halogen.

(iii) Which element serves as an alkali metal?

- Element A (Atomic Number 2): Alkali metals are found in Group 1 of the periodic table. Element A, with an atomic number of 2, corresponds to helium (He), which is a noble gas, not an alkali metal. Therefore, none of the given elements serve as an alkali metal.

(b) (i) Which elements are placed in the same group?

- Elements A (He) and E (Ar): Both helium and argon are noble gases, which are in Group 18 of the periodic table.

(ii) Which elements are placed in the same period?

- Elements A (He) and D (Mg): Both helium and magnesium are in Period 2 of the periodic table.

Find this and other free resources at: http://maktaba.tetea.org

Prepared by: Maria marco for TETEA

9. (a) (i)What is the name given to the arrangement of the electrons around the nucleus?

- Electron Configuration: The arrangement of electrons around the nucleus is known as the electron configuration.

(ii) What is the name of the layers in which the electrons are arranged?

- Electron Shells or Energy Levels: The layers in which electrons are arranged are called electron shells or energy levels.

(iii) What does 'n' represent in the formula $2n^2$ for the maximum number of electrons in a shell?

- In the formula $2n^2$, 'n' represents the principal quantum number, which indicates the energy level or shell number of an atom. For example, n = 1 corresponds to the first shell (K shell), n = 2 to the second shell (L shell), and so on.

(iv) Calculate the number of electrons in the K, L, M, and N layers using the formula $2n^2$.

- K shell (n = 1): $2 \times (1)^2 = 2$ electrons

- L shell (n = 2): $2 \times (2)^2 = 8$ electrons

- M shell (n = 3): $2 \times (3)^2 = 18$ electrons

- N shell (n = 4): $2 \times (4)^2 = 32$ electrons

(b) Calculate the relative atomic mass of bromine, given that a sample contains 55% of the isotope with mass number 79 and 45% of the isotope with mass number 81.

ANS:

- Relative Atomic Mass (Ar) Calculation:

- Ar = (Mass of isotope 1 × Abundance of isotope 1) + (Mass of isotope 2 × Abundance of isotope 2)

- Ar = (79 × 0.55) + (81 × 0.45)

- Ar = 43.45 + 36.45

- Ar = 79.9 u

Therefore, the relative atomic mass of bromine is approximately 79.9 u.

Find this and other free resources at: http://maktaba.tetea.org

Prepared by: Maria marco for TETEA

10. (a) Statement of the Problem

The experiment aims to investigate how the solubility of potassium nitrate (KNO_3) in water varies with temperature.

(b) Hypothesis

It is hypothesized that as the temperature of the water increases, the solubility of potassium nitrate will also increase, allowing more salt to dissolve.

(c) Identification of Variables

(i) Dependent Variable: The mass of potassium nitrate that dissolves in water, as it depends on the temperature.

(ii) Independent Variable: The temperature of the water, which is controlled and varied during the experiment.

(iii) Controlled Variables: The mass of water (kept constant at 100 g), the type of solvent (distilled water), and the type of solute (potassium nitrate).

(d) Data Presentation

Temperature C	Mass of potassium g	Mass of water g
0	10	100
20	30	100
30	50	100
40	65	100
50	87	100
60	113	100

(e) Data Interpretation

The data indicates a positive correlation between temperature and the solubility of potassium nitrate. As the temperature increases, the amount of potassium nitrate that dissolves in 100 g of water also increases.

(f) Inference and Conclusion

The experiment demonstrates that the solubility of potassium nitrate in water increases with temperature. This suggests that higher temperatures facilitate the dissolution of potassium nitrate, likely due to increased kinetic energy of water molecules, which enhances the interaction between the solute and solvent.

Find this and other free resources at: http://maktaba.tetea.org

Prepared by: Maria marco for TETEA