

THE UNITED REPUBLIC OF TANZANIA
NATIONAL EXAMINATIONS COUNCIL OF TANZANIA
CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

032/1

CHEMISTRY 1

(For Both School and Private Candidates)

Time: 3 Hours

Year: 2019

Instructions

1. This paper consists of sections A, B and C with total of thirteen questions
2. Answer all questions.

1. For each of the items (i) - (x), choose the correct answer among the given alternatives and write its letter beside the item number in the answer booklet provided.

(i) "Water is referred to as the universal solvent". What does this mean? A.

Water is neither acidic nor basic as compared to other liquids.

B. Water exists in three states of matter than any other liquid.

C. Water dissolves both organic and inorganic solutes.

D. Water is used more domestically than any other liquids.

E. Water dissolves more substances than any other known liquids.

Answer:

Water dissolves more substances than any other liquid due to its polarity and ability to form hydrogen bonds.

The correct answer is E. Water dissolves more substances than any other known liquids.

(ii) When methane undergoes substitutional reaction with excess chlorine, what is the final product? A.

Chloromethane

B. Dichloromethane

C. Trichloromethane

D. Tetrachloromethane

E. Monochloromethane

Answer:

In the presence of excess chlorine, all hydrogen atoms in methane are replaced by chlorine, forming tetrachloromethane (CCl_4).

The correct answer is D. Tetrachloromethane.

(iii) Why is hydrogen gas collected over water and by upward delivery method? A.

It is insoluble in water and less dense than air.

B. It is soluble in water and denser than air.

C. It is insoluble in water and denser than air.

D. It is soluble in water and less dense than air.

E. It is soluble in both water and air.

Answer:

Hydrogen gas is insoluble in water and less dense than air, making it suitable for upward delivery and collection over water.

The correct answer is A. It is insoluble in water and less dense than air.

(iv) Consider the following fuels which are used for different purposes:

1. Coal

2. Firewood

3. Petrol

4. Charcoal

Which fuels originate from fossils?

- A. 1 and 3
- B. 1 and 4
- C. 2 and 3
- D. 2 and 4
- E. 1 and 2

Answer:

Coal and petrol are fossil fuels formed from the remains of ancient plants and animals. The correct answer is A. 1 and 3.

(v) The following are the uses of chromatography except A.

- To analyse blood in crime scenes.
- B. To detect different fibres.
- C. To detect water pollution.
- D. To bleach dye/colour.
- E. To test the purity of organic substances.

Answer:

Chromatography is not used for bleaching dye or color; it is used for separating and identifying mixtures. The correct answer is D. To bleach dye/colour.

(vi) What is the proper set of apparatus that you would use to grind granules of a solid substance into fine powder in the laboratory? A. Pestle and filter funnel

- B. Separating funnel and mortar
- C. Pestle and filter paper
- D. Pestle and mortar
- E. Thistle funnel and mortar

Answer:

A pestle and mortar are specifically designed for grinding substances into fine powders. The correct answer is D. Pestle and mortar.

(vii) Oxygen gas can be produced at a large scale by A.

- Condensation of air.
- B. Condensation of liquefied air.
- C. Liquefaction of steam.
- D. Fractional distillation of liquefied air.
- E. Evaporation of liquefied air.

Answer:

Oxygen gas is produced on a large scale through fractional distillation of liquefied air. The correct answer is D. Fractional distillation of liquefied air.

(viii) Which of the following sets of processes uses a gas that ignites with a “pop” sound when a lighted splint is passed through it?

- A. Balloon filling, welding and diving
- B. Hardening oil, balloon filling and welding
- C. Hardening oil, balloon filling and diving
- D. Fueling rocket, diving and welding
- E. Balloon filling fueling rocket and diving

Answer:

Hydrogen gas ignites with a pop sound, and it is used for balloon filling, rocket fueling, and diving. The correct answer is E. Balloon filling, fueling rocket and diving.

(ix) Which statement is the most correct about a chemistry laboratory? A.

- Is a special room designed for conducting chemical tests.
- B. Is a special room designed for science practicals.
- C. Is a special room designed for keeping apparatuses.
- D. Is a special room where data analysis is carried out.
- E. Is a special room where students learn chemistry.

Answer:

The primary purpose of a chemistry laboratory is to conduct chemical tests and experiments. The correct answer is A. Is a special room designed for conducting chemical tests.

(x) Which role does organic matter play in the soil? A.

- Improving water infiltration of the soil.
- B. Accelerating breakdown of organic matter.
- C. Reserving nutrients thus providing soil fertility.
- D. Converting nitrogen into nitrates.
- E. Providing a room for organic material such as nylons.

Answer:

Organic matter retains nutrients and improves soil fertility.

The correct answer is C. Reserving nutrients thus providing soil fertility.

2. Match the descriptions in List A with the corresponding scientific procedures in List B by writing the letter of the correct response beside the item number in the answer booklet provided.

List A:

- (i) A statement of how the results relate to the hypothesis.
- (ii) A series of investigations.

- (iii) A statement that identifies an even, fact or situation.
- (iv) A tentative explanation.
- (v) A step in which the researcher explains the results.

List B:

- A. Conclusion
- B. Data analysis
- C. Data collection
- D. Experimentation
- E. Hypothesis
- F. Observation
- G. Problem identification

Answer:

- (i) A. Conclusion
- (ii) D. Experimentation
- (iii) C. Data collection
- (iv) E. Hypothesis
- (v) B. Data analysis

3. (a) How many chlorine molecules are in 20 cm³ of chlorine gas at s.t.p.?

Answer:

Step 1: Volume of 1 mole of gas at s.t.p. = 22,400 cm³.

Step 2: Calculate the number of moles in 20 cm³:

Moles = Volume / Molar volume = 20 / 22400 = 0.0008929 mol.

Step 3: Number of molecules = Moles × Avogadro's number:

Number of molecules = 0.0008929 × 6.022 × 10²³ = 5.38 × 10²⁰ molecules.

There are approximately 5.38 × 10²⁰ chlorine molecules in 20 cm³ of chlorine gas.

(b) Calculate the number of ions present in 5 g of copper(II) nitrate.

Answer:

Step 1: Molar mass of Cu(NO₃)₂ = 63.5 + 2(14 + 16 × 3) = 187.5 g/mol.

Step 2: Moles of Cu(NO₃)₂ = Mass / Molar mass = 5 / 187.5 = 0.0267 mol.

Step 3: Number of ions:

Each Cu(NO₃)₂ dissociates into 3 ions (1 Cu²⁺ and 2 NO₃⁻).

Total ions = Moles × Avogadro's number × 3 = 0.0267 × 6.022 × 10²³ × 3 = 4.83 × 10²² ions.

There are approximately 4.83×10^{22} ions in 5 g of copper(II) nitrate.

4. (a) Distinguish normal salts from acidic salts based on how they are formed.

Answer:

Normal salts are formed when all hydrogen ions of an acid are replaced by metal or ammonium ions.

Example: NaCl (formed from HCl and NaOH).

Acidic salts are formed when only part of the hydrogen ions of an acid are replaced by metal or ammonium ions.

Example: NaHSO₄ (formed from H₂SO₄ and NaOH).

(b) Give four uses of salts in daily life.

Answer:

- i. Sodium chloride (NaCl) is used as table salt for cooking.
- ii. Calcium carbonate (CaCO₃) is used in the production of cement.
- iii. Sodium bicarbonate (NaHCO₃) is used as baking soda.
- iv. Potassium nitrate (KNO₃) is used in fertilizers.

5. (a) Distinguish temporary hardness from permanent hardness of water.

Answer:

Temporary hardness is caused by the presence of dissolved bicarbonates of calcium and magnesium, which can be removed by boiling.

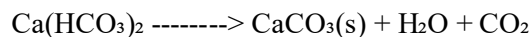
Permanent hardness is caused by sulfates and chlorides of calcium and magnesium, which cannot be removed by boiling.

(b) With the help of chemical equations, explain how you can remove each type of water hardness in 5(a).

Answer:

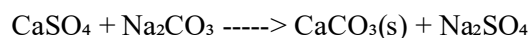
i. Temporary hardness:

Boiling converts bicarbonates to insoluble carbonates:

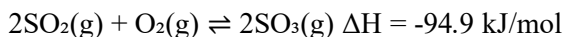


ii. Permanent hardness:

Adding washing soda precipitates insoluble carbonates:



6. In the industrial preparation of sulphur trioxide, equilibrium is established between sulphur dioxide and oxygen gas as follows:



(a) (i) Is the forward reaction an endothermic or exothermic process? Give a reason.

Answer:

The reaction is exothermic because heat is released, as indicated by the negative ΔH value (-94.9 kJ/mol).

(ii) How would you adjust temperature and pressure to maximize the proportion of the product at equilibrium?

Answer:

- Lower temperature to favor the exothermic forward reaction.
- Increase pressure to favor the formation of fewer moles of gas (2 moles of SO_3 vs. 3 moles of reactants).

(b) (i) Why is it unfavorable to work with very high pressure and very low temperature in the Contact process?

Answer:

- High pressure increases equipment costs and safety risks.
- Very low temperature slows down the reaction rate, reducing efficiency.

(ii) What catalyst is used to speed up the rate of formation of sulphur trioxide before attaining equilibrium?

Answer:

Vanadium(V) oxide (V_2O_5).

7. An atom of element X having atomic number 11 combines with an atom of element Y having atomic number 9 to form a compound.

(a) Write the formula of the compound and state the type of bond formed in the compound.

Answer:

The formula of the compound is NaF.

The bond formed is an ionic bond because sodium (Na) donates an electron to fluorine (F), forming Na^+ and F^- ions.

(b) Give four properties of the compound formed in 7(a).

Answer:

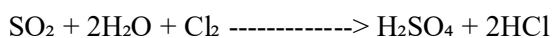
- i. It has a high melting and boiling point due to strong ionic bonds.
- ii. It is soluble in water.
- iii. It conducts electricity in molten or aqueous state due to the presence of free ions.
- iv. It is a crystalline solid at room temperature.

8. Explain each of the following statements and in each give its balanced chemical equation:

- (i) Sulphur dioxide in solution is a powerful reducing agent.

Answer:

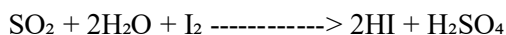
Sulphur dioxide reduces other substances by donating electrons. For example:



- (ii) Sulphur dioxide in solution acts as a bleaching agent.

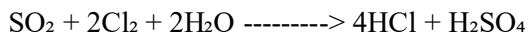
Answer:

Sulphur dioxide removes oxygen from colored substances, bleaching them.



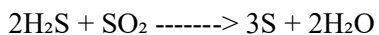
- (iii) Sulphur dioxide can reduce chlorine and itself become oxidized.

Answer: SO_2 reduces Cl_2 to HCl while being oxidized to SO_4^{2-} .



- (iv) When hydrogen sulphide is passed through sulphur dioxide gas, yellow deposits are produced.

Answer: H_2S reacts with SO_2 to form sulfur and water.



9. (a) Write the chemical symbols for beryllium, boron, neon, nitrogen, and phosphorus.

Answer:

Beryllium: Be

Boron: B

Neon: Ne

Nitrogen: N

Phosphorus: P

(b) Why some of the elements in 9(a) are assigned symbols with only one letter while others bear symbols with two letters?

Answer:

Elements with a single letter symbol are the first elements to be discovered and their symbols are derived from their Latin or English names. Elements with two-letter symbols are assigned to avoid duplication when their first letters are already used by other elements.

10. (a) Give three advantages of using chemical equations over word equations.

Answer:

- i. Chemical equations are concise and precise, providing exact information about reactants and products.
- ii. They include stoichiometric ratios, allowing for quantitative analysis of reactions.
- iii. They provide information about the physical states of substances (solid, liquid, gas, or aqueous).

(b) You are provided with a compound of 22.2% zinc, 11.6% sulfur, 22.3% oxygen, and the rest percentage is water of crystallization. Calculate the molecular formula of the compound if its molecular mass is 283.

Answer:

Step 1: Determine moles of each element.

Zinc: $22.2 / 65.4 = 0.34$

Sulfur: $11.6 / 32 = 0.36$

Oxygen: $22.3 / 16 = 1.39$

Water: $43.9 / 18 = 2.44$

Step 2: Simplify mole ratio:

Zn : S : O : H₂O = 1 : 1 : 4 : 7

Step 3: Write the molecular formula.

The formula is ZnSO₄·7H₂O.

11. A Form Three student conducted experiments in the laboratory to synthesize nitrogen, ammonia, and ethane. The experimental results were tabulated as follows:

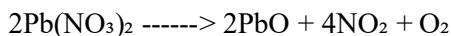
Experiment	Reagents	Conditions	Products
1	Lead nitrate	Heat	Lead oxide, oxygen gas, nitrogen gas
2	Gaseous hydrogen and nitrogen	Catalyst	Ammonia gas
3	Ethene gas and hydrogen gas	Catalyst	Ethane

Write word equations with corresponding chemical equations to summarize the reactions taking place in each of the experiments 1 to 3.

Answer:

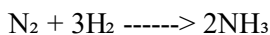
Experiment 1:

Lead nitrate decomposes to form lead oxide, nitrogen gas, and oxygen gas.



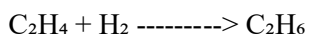
Experiment 2:

Hydrogen gas reacts with nitrogen gas to form ammonia.



Experiment 3:

Ethene gas reacts with hydrogen gas to form ethane.



12. (a) Which ways are the fossil fuels detrimental to the environment? Give four points.

Answer:

i. Fossil fuels release greenhouse gases, contributing to global warming. ii. Burning fossil fuels causes air pollution, releasing harmful substances like sulfur dioxide and nitrogen oxides. iii. Oil spills contaminate water bodies, harming aquatic life. iv. Mining of fossil fuels leads to land degradation and habitat destruction.

(b) Briefly explain how biogas is produced by using domestic waste.

Answer:

Biogas is produced by anaerobic digestion of organic waste in a biogas digester. Microorganisms break down waste materials like food scraps, manure, and sewage in the absence of oxygen, producing methane (CH_4) and carbon dioxide (CO_2) as the main gases.

13. Explain how to handle chemicals having the warning signs of flammable, corrosive, harmful, explosive, and toxic in the laboratory.

Answer:

i. Flammable chemicals:

- Store in flameproof cabinets, away from heat sources.
- Handle in a well-ventilated area, avoiding open flames.
- Use flame-resistant gloves and appropriate tools.

ii. Corrosive chemicals:

- Wear protective clothing, gloves, and goggles to prevent skin and eye contact.

- Use fume hoods when handling corrosive gases.
- Store in containers made of resistant materials like glass or specific plastics.

iii. Harmful chemicals:

- Avoid direct contact by wearing gloves and masks.
- Use in minimal quantities in a ventilated workspace.
- Wash hands thoroughly after handling.

iv. Explosive chemicals:

- Store in cool, dry, and stable conditions, away from incompatible substances.
- Avoid shaking or exposing to impact.
- Handle with extreme care, preferably in small quantities.

v. Toxic chemicals:

- Handle in fume hoods to avoid inhalation of vapors.
- Wear masks and gloves to prevent ingestion or absorption through skin.
- Keep antidotes or emergency equipment ready.

These safety measures ensure minimal risks while working with hazardous chemicals.

14. Explain six measures for minimizing the environmental degradation caused by extraction of metals in Tanzania.

Answer:

i. Reclamation of mined land:

- Restoring disturbed land by planting trees and vegetation reduces soil erosion and enhances biodiversity.

ii. Proper waste management:

- Tailings and waste materials should be treated to neutralize toxic substances before disposal, preventing soil and water contamination.

iii. Use of eco-friendly technologies:

- Employing modern mining technologies reduces energy consumption and environmental harm.

iv. Regulation and monitoring:

- Enforcing strict environmental laws and monitoring mining activities ensures companies adhere to sustainable practices.

v. Recycling of metals:

- Recycling reduces the need for new mining, thus conserving natural resources and reducing waste.

vi. Public awareness and education:

- Educating local communities and miners on sustainable practices helps in reducing environmental harm.