

**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: 2018**

**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 from among the given alternatives and write its letter beside the item number in the answer booklet provided.

- (i) Which of the following is an agricultural chemical product made by the application of chemistry? A. Drugs  
B. Pesticides  
C. Clothes  
D. Yeasts  
E. Cement

Answer:

Pesticides are chemical products used in agriculture to control pests and increase crop yields. The correct answer is B. Pesticides.

(ii) A current of 0.2 A was passed through an electrolyte for 16 minutes and 40 seconds. What is the quantity of electricity produced in coulombs?

- A. 2000 C  
B. 1000 C  
C. 200 C  
D. 0.20 C  
E. 7686 C

Answer:

Step 1: Convert time to seconds.

$$16 \text{ minutes and } 40 \text{ seconds} = (16 \times 60) + 40 = 1000 \text{ seconds.}$$

Step 2: Use  $Q = I \times t$ .

$$Q = 0.2 \times 1000 = 200 \text{ C.}$$

The correct answer is C. 200 C.

(iii) Substance X liberates chlorine gas from acidified potassium chloride. The behavior of X is described as

- A. An oxidising agent  
B. An oxidising and reducing agent  
C. Catalyst  
D. A reducing agent  
E. Bleaching agent

Answer:

An oxidising agent causes the release of chlorine gas by oxidising  $\text{Cl}^-$  ions.

The correct answer is A. An oxidising agent.

(iv) Which carbonate is the most stable to heat?

- A. Calcium carbonate
- B. Copper (II) carbonate
- C. Lead (II) carbonate
- D. Zinc carbonate
- E. Iron (II) carbonate

Answer:

Calcium carbonate is the most stable due to its position in the reactivity series. The correct answer is A. Calcium carbonate.

(v) Aluminium does not react with water and does not corrode much in air because A.

- It is below hydrogen in the reactivity series.
- B. It forms a stable carbonate which prevents reactions.
- C. The metal is covered with a protective coating of an oxide.
- D. Aluminium ions have positive charges.
- E. It is very stable.

Answer:

Aluminium forms a protective oxide layer that prevents further reaction.

The correct answer is C. The metal is covered with a protective coating of an oxide.

(vi) Which of the following compounds does NOT belong to the alkenes homologous series?

- A. C<sub>2</sub>H<sub>4</sub>
- B. C<sub>3</sub>H<sub>6</sub>
- C. C<sub>4</sub>H<sub>8</sub>
- D. C<sub>5</sub>H<sub>12</sub>
- E. C<sub>6</sub>H<sub>10</sub>

Answer:

C<sub>5</sub>H<sub>12</sub> is an alkane, not an alkene. The correct answer is D. C<sub>5</sub>H<sub>12</sub>.

(vii) In the following equilibrium equation,  $2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{SO}_3(\text{g})$ , the forward reaction is exothermic.

Which change would increase the production of sulphur trioxide at equilibrium? A.

- Increasing temperature.
- B. Decreasing temperature.
- C. Decreasing sulphur trioxide concentration.
- D. Decreasing pressure.
- E. Adding a catalyst.

Answer:

Lowering the temperature favors the exothermic forward reaction.  
The correct answer is B. Decreasing temperature.

- (viii) When a burning fuel produces blue color it means there is A.  
Adequate supply of oxygen with production of soot.  
B. Inadequate supply of oxygen without production of soot.  
C. Inadequate supply of oxygen with production of soot.  
D. Adequate supply of oxygen with production of less heat.  
E. Adequate supply of oxygen with production of more heat.

Answer:

Blue flame indicates complete combustion and maximum heat.  
The correct answer is E. Adequate supply of oxygen with production of more heat.

- (ix) Which equation represents the combustion of methane with the products collected at 120°C?  
A.  $\text{CH}_4(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{g})$   
B.  $\text{CH}_4(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{l})$   
C.  $\text{CH}_4(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow \text{CO}(\text{g}) + 2\text{H}_2\text{O}(\text{l})$   
D.  $\text{CH}_4(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow \text{CO}(\text{g}) + 2\text{H}_2\text{O}(\text{g})$   
E.  $\text{CH}_4(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow 2\text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{l})$

Answer:

At 120°C, water remains as vapor.

The correct answer is A.  $\text{CH}_4(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{g})$ .

- (x) Which substance can be reduced when heated with carbon?  
A. Aluminium  
B. Calcium carbonate  
C. Iron (III) oxide  
D. Magnesium oxide  
E. Sodium oxide

Answer:

Iron (III) oxide can be reduced to iron when heated with carbon. The correct answer is C. Iron (III) oxide.

2. Match the items in List A with the responses in List B by writing the letter of the correct response beside the item number in the answer booklet provided.

List A:

- (i) An element which is extracted by Frasch process.
- (ii) A gas with pungent choking smell and forms misty.
- (iii) A substance used for sterilization of drinking water.
- (iv) An alkaline gas.
- (v) A compound used in domestic water-softening.
- (vi) A compound prepared by fermentation of carbohydrates. (vii) The compounds with a general formula of  $C_nH_{2n-1}COOH$ . (viii) The hardest allotrope of carbon.
- (ix) A gas which turns lime-water milky.
- (x) A substance which is amorphous form of carbon.

List B:

- A. Carbon dioxide
- B. Carboxylic acids
- C. Iron (III) oxide
- D. Nitrogen
- E. Diamond
- F. Sodium carbonate
- G. Hydrogen chloride
- H. Sulphur
- I. Graphite
- J. Ethanol

Answer:

- (i) H. Sulphur
- (ii) G. Hydrogen chloride
- (iii) C. Iron (III) oxide
- (iv) D. Nitrogen
- (v) F. Sodium carbonate
- (vi) J. Ethanol
- (vii) B. Carboxylic acids
- (viii) E. Diamond
- (ix) A. Carbon dioxide
- (x) I. Graphite

3. (a) Define the following terms:

- (i) Neutralization: Neutralization is a chemical reaction in which an acid reacts with a base to form water and a salt.

(ii) Unsaturated solution: An unsaturated solution is one in which the solvent can still dissolve more solute at a given temperature.

(iii) Thermal decomposition: Thermal decomposition is a chemical reaction where a compound is broken down into two or more simpler substances when heated.

(b) (i) List two advantages of liming:

- Liming reduces soil acidity, making it more suitable for plant growth.
- Liming improves the availability of essential nutrients like calcium and magnesium in the soil.

(ii) State two roles of climate in soil formation:

- Temperature affects the rate of weathering of rocks, influencing soil texture and composition.
- Precipitation impacts the leaching process, which can wash away certain nutrients and minerals from the soil.

4. (a) Copper obtained from copper pyrites ( $\text{CuFeS}_2$ ) is impure for electrical wiring and has to be purified by electrolysis.

(i) Name the electrolyte and the electrodes used during electrolysis:

- Electrolyte: Copper(II) sulfate solution ( $\text{CuSO}_4$ )
- Electrodes: Copper cathode and anode

(ii) Write the observations that can be made during the electrolysis:

- Copper metal will deposit on the cathode.
- Copper will dissolve from the anode into the electrolyte solution.
- The electrolyte will turn blue as copper ions are added to it.

5. (a) Suggest one method of separating each of the following:

(i) Green solution from leaves: Filtration can be used to separate a green solution (like chlorophyll extract) from solid plant matter.

(ii) Alcohol from water: Distillation can be used to separate alcohol from water due to their different boiling points.

(b) Elements K, L, M, and N have atomic numbers 6, 8, 9, and 20 respectively. Classify each element into its respective period and group:

- K (Atomic number 6): Period 2, Group 14 (Carbon group)
- L (Atomic number 8): Period 2, Group 16 (Oxygen group)
- M (Atomic number 9): Period 2, Group 17 (Halogens)
- N (Atomic number 20): Period 4, Group 2 (Alkaline earth metals)

6. (a) Give one example in each of the following:

- (i) Alkali earth metals: Calcium (Ca)
- (ii) Noble gases: Helium (He)
- (iii) Transition elements: Iron (Fe)

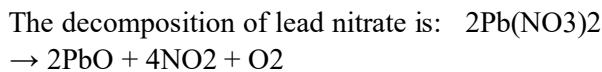
- (b) Write the names of the following processes of changing matter from one state to another:
- (i) Gas to liquid: Condensation
  - (ii) Gas to solid: Deposition
  - (iii) Solid to gas: Sublimation

7. (a) Define the following:

- (i) Mole: A mole is the amount of substance that contains exactly  $6.022 \times 10^{23}$  particles, which is Avogadro's number.
- (ii) Molar mass: The molar mass is the mass of one mole of a substance, typically expressed in grams per mole (g/mol).

(b) 112 dm<sup>3</sup> of oxygen gas was collected at STP. When a sample of lead nitrate was completely decomposed by heat, calculate the volume of nitrogen dioxide gas produced.

Solution:



At STP, 1 mole of oxygen gas occupies 22.4 dm<sup>3</sup>. Given 112 dm<sup>3</sup> of oxygen gas, the moles of oxygen gas can be calculated as:

$$112 \text{ dm}^3 / 22.4 \text{ dm}^3/\text{mol} = 5 \text{ moles of O}_2$$

From the equation, 1 mole of oxygen gas corresponds to 2 moles of nitrogen dioxide gas. Therefore, 5 moles of O<sub>2</sub> would produce 10 moles of NO<sub>2</sub>.

At STP, 1 mole of gas occupies 22.4 dm<sup>3</sup>, so the volume of nitrogen dioxide gas produced is: 10 moles x 22.4 dm<sup>3</sup>/mol = 224 dm<sup>3</sup>.

8. (a) Distinguish manures from fertilizers. Give an example in each case.

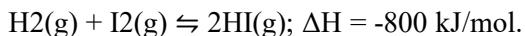
Solution:

- Manures: Natural substances, usually made from plant or animal waste, used to improve soil fertility.

Example: Farmyard manure.

- Fertilizers: Chemical substances that provide essential nutrients to plants. Example: Ammonium nitrate.

(b) The following equation shows the reaction between hydrogen and iodine gas to form hydrogen iodide gas:



(i) What would happen to the position of equilibrium if temperature is lowered?

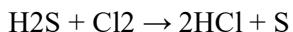
Solution: Lowering the temperature would shift the equilibrium to the right, favoring the formation of more hydrogen iodide because the reaction is exothermic.

(ii) What would happen if hydrogen iodide gas is pumped into the system?

Solution: The position of equilibrium would shift to the left, as the system will try to reduce the concentration of hydrogen iodide by decomposing it into hydrogen and iodine.

9. (a) (i) Name the products formed when hydrogen sulphide reacts with chlorine gas:

Solution: The products are hydrogen chloride (HCl) and sulfur (S). The balanced equation is:



(ii) Mention two uses of hydrochloric acid:

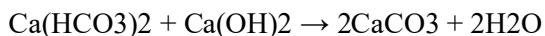
- Hydrochloric acid is used in the cleaning of metals.
- It is used in the production of chlorine gas.

(b) (i) Name the compound which causes temporary hardness of water and the compound which causes permanent hardness of water:

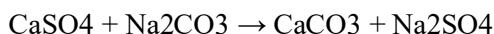
- Temporary hardness is caused by calcium bicarbonate ( $\text{Ca}(\text{HCO}_3)_2$ ).

- Permanent hardness is caused by calcium sulfate ( $\text{CaSO}_4$ ).

(ii) Write one balanced chemical equation in each case to show how to remove temporary and permanent hardness of water: - For temporary hardness:



- For permanent hardness:



10. (a) (i) Define isomerism:

Solution: Isomerism is the phenomenon where two or more compounds have the same molecular formula but different structural arrangements.

(ii) Draw and name two structural formulae of the isomers of  $\text{C}_4\text{H}_8$ :

Solution:

- But-1-ene:  $\text{CH}_2=\text{CH}-\text{CH}_2-\text{CH}_3$

- Cyclobutane:  $(\text{CH}_2)^4$

(b) Carbon dioxide can be prepared by adding an acid to calcium carbonate. (i)

Using a named acid, write a balanced chemical equation for the reaction:

Solution:



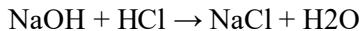
(ii) Name all the products formed in (b) (i):

Solution: The products are calcium chloride ( $\text{CaCl}_2$ ), water ( $\text{H}_2\text{O}$ ), and carbon dioxide ( $\text{CO}_2$ ).

11. (a) With the aid of a chemical equation, describe how you would prepare pure solid sodium chloride by the action of an acid and a base:

Solution:

Sodium chloride can be prepared by reacting sodium hydroxide ( $\text{NaOH}$ ) with hydrochloric acid ( $\text{HCl}$ ). The equation is:



(b) (i) Why are petroleum and coal non-renewable sources of energy?

Solution: Petroleum and coal are non-renewable because they take millions of years to form and are depleted faster than they can be naturally replenished.

(ii) Give three alternatives to non-renewable sources of energy:

- Solar energy
- Wind energy
- Hydroelectric energy

12. Three moles of nitrogen gas combined with five moles of hydrogen gas to form ammonium gas by the Haber process:

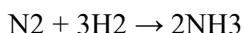
(a) Which reactant is present in smaller amount?

Solution: Nitrogen is present in a smaller amount, as there are 3 moles of nitrogen compared to 5 moles of hydrogen.

(b) Calculate the grams of the reactant left in the container:

Solution:

The balanced equation for the Haber process is:



From the mole ratio, 1 mole of nitrogen reacts with 3 moles of hydrogen. Given that we have 3 moles of nitrogen and 5 moles of hydrogen, all the nitrogen will react with 3 moles of hydrogen, leaving 2 moles of hydrogen.

Mass of hydrogen left = 2 moles  $\times$  2 g/mol = 4 grams

(c) How many moles of NH<sub>3</sub> are produced?

Solution: 3 moles of hydrogen react with 1 mole of nitrogen to form 2 moles of NH<sub>3</sub>. Therefore, 5 moles of hydrogen will produce 10/3 moles of NH<sub>3</sub>, or approximately 3.33 moles of NH<sub>3</sub>.

(d) How many litres of NH<sub>3</sub> are produced at STP?

Solution: 1 mole of any gas at STP occupies 22.4 dm<sup>3</sup>. Therefore, 3.33 moles of NH<sub>3</sub> will occupy: 3.33 moles  $\times$  22.4 dm<sup>3</sup>/mol  $\approx$  74.75 dm<sup>3</sup>.

13. In Tanzania, soil conservation is very important for Industrial Materials production. Explain six methods that are used to manage loss of plant nutrients from the soil:

Solution:

- Crop rotation: This involves changing the type of crops grown on a particular piece of land each season to restore soil nutrients.
- Use of organic fertilizers: Manures and compost provide essential nutrients, improve soil structure, and increase water retention.

- Agroforestry: Planting trees alongside crops helps to prevent soil erosion and improve nutrient cycling.
- Cover cropping: Planting cover crops such as legumes helps to replenish nitrogen in the soil.
- Terracing: Building terraces on sloped land prevents soil erosion and loss of nutrients due to water runoff.
- Water management: Proper irrigation and drainage prevent the leaching of vital nutrients from the soil.