



TANZANIA HEADS OF ISLAMIC SCHOOLS COUNCIL
FORM SIX INTER ISLAMIC MOCK EXAMINATION

CHEMISTRY 1

132/1

(For both School and Private Candidates)

TIME: 3 HOURS

Tuesday, 05th March 2024 p.m.

Instructions

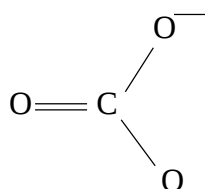
1. This paper consists of sections A and B with a total of ten (10) questions.
2. Answer all questions in section A and two (2) questions from section B.
3. Mathematical tables and non-programmable calculators may be used.
4. Cellular phones and any unauthorized materials are **not** allowed in the examination room.
5. Write your Examination Number on every page of your answer booklet(s).
6. The following information may be used
 - (a) Universal gas constant, $R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1}$ or $0.0821 \text{ L atm mol}^{-1} \text{ K}^{-1}$
 - (b) Ryberg constant, $R_H = 1.09678 \times 10^7 \text{ m}^{-1}$
 - (c) Velocity of Light, $C = 3 \times 10^8 \text{ m/s}$
 - (d) Mass of electron = $9.11 \times 10^{-31} \text{ kg}$
 - (e) Planck's constant, $h = 6.63 \times 10^{-34} \text{ Js}$
 - (f) Atomic masses.

H=1, C=12, O=16, N=14, Na=23, Cl=35.5, K=39, S=32, Cu=63.5, Br=80

SECTION A (70 Marks)

Answer **all** questions

1. (a) (i) Differentiate between an atom and an element as applied in chemistry. **[02 marks]**
- (ii) Calculate the wavelength of hydrogen atom of mass 1.674×10^{-27} kg moving at 700 cm/s. **[03 marks]**
- (b) Describe the Rutherford's observation that
- (i) The nucleus has a relatively small diameter compared with that of an atom.
- (ii) Most of the mass of an atom is concentrated in the nucleus. **[02 marks]**
- (c) Copper has two isotopes, ^{63}Cu and ^{65}Cu . The isotope ^{63}Cu has relative isotopic mass of 62.9 and ^{65}Cu has a relative isotopic mass of 64.9. If the naturally occurring copper has a relative atomic mass of 63.5. Calculate the percentage abundance of each isotope. **[03 marks]**
2. (a) H_2O and H_2S both are group VI hydride. Explain why H_2O is liquid while H_2S is a gas at room temperature. **[02 marks]**
- (b) The bond length of C-O and C=O are 154 nm and 144 nm respectively. The oxonion compound CO_3^{2-} with structure



- has two single bond and one double bond. The x-ray study of the compound CO_3^{2-} show all bonds to have 148 nm length.
- (i) Explain the reason for the bond length observed by x-ray.
- (ii) Draw the hybrid structure of CO_3^{2-} as per x-ray. **[04 marks]**
- (c) What do you understand by the term hybridization. Give one example of compound undergoing the following hybridization.
- (i) dsp^3
- (ii) sp^2
- (iii) sp
- (iv) sp^3 **[03 marks]**

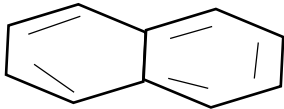
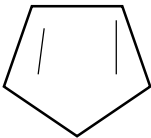
3. (a) (i) Use kinetic molecular theory to explain the origin of gas pressure.
(ii) Can the speed of a given molecule in a gas double at constant temperature?
Explain your answer **[03 marks]**
- (b) A sample of tear gas is released in the last row seats in a lecture hall. At the same time a sample of laughing gas is released in the first row seats. After a time the last 10 rows of students were crying and the first 20 rows of students were laughing. If the laughing gas is N_2O with molar mass of 44. What is the molar mass of the tear gas? **[04 marks]**
- (c) A volatile organic compound weighs 0.2g. On heating in the victor Meyer's tube it displaces 30mls of air at 27°C and 756mmHg atmospheric pressure. Determine the molecular mass of the compound given that the aqueous tension at 27°C is equal to 26mmHg. **[03 marks]**
4. (a) (i) Briefly explain the effect of degree of dissociation of solute on boiling point of solution.
(ii) Derive an expression relating the Vant Hoff factor (i) and degree of dissociation (α) **[03 marks]**
- (b) A 1% solution of sodium chloride freezes at -0.604°C . Calculate the degree of dissociation of the sodium chloride if the molal freezing point depression constant of water is 1.86°Ckg/mol . **[04 marks]**
- (c) Explain how colligative properties are applied in our real life. **[03 marks]**
5. (a) Define the following terms:
(i) Sublimation energy
(ii) Dissociation energy **[02 marks]**
- (b) The enthalpy of formation of carbon dioxide gas and water are -393.0kJ/mol and -286.0kJ/mol respectively. Calculate the enthalpy of formation of acetic acid if its enthalpy of combustion is -867Kj/mol . **[04 marks]**
- (c) When 100cm^3 of 1M KOH and 100cm^3 of 1M HCl were mixed in a calorimeter, temperature rose by 6.25k . Given that the heat capacity of the calorimeter was 95J/k and specific heat capacity of the solution mixture was 4.2J/gK . Calculate the standard enthalpy of neutralization. **[04 marks]**
6. (b) Mention four (4) uses of metal carbonates. **[02 marks]**
- (b) Briefly explain why indirect method of preparing metal hydroxide is also called precipitation method. **[02 marks]**

6. (c) In one laboratory experiment dilute nitric acid was added to a green solid V. A blue solution W and a gas X that forms a white precipitates with lime water were formed. This was followed by evaporating the blue solution to dryness and heating strongly in a crucible. The following products were observed to be formed. A black solid Y, brown fumes of gas Z and a gas that relights a glowing splint.
- Identify solids V and Y.
 - Identify gases X and Z.
 - Write a chemical equation for the reaction between solid V and dilute nitric acid.
 - Write a chemical equation for the formation of solid Y. **[06 marks]**
7. (a) Outline any four (4) control measures which are useful in minimizing the chemical pollution of water bodies. **[04 marks]**
- (b) Mention any three (3) major causes of environmental degradation. **[03 marks]**
- (c) Briefly explain three (3) effects of air pollution to living organisms. **[03 marks]**

SECTION B (30 Marks)

Answer **any two (2)** questions

8. (a) What do you understand by the following:
- Reaction quotient
 - Irreversible reaction
 - Dynamic equilibrium **[03 marks]**
- (b) When solid silver is added to a solution containing Ag^+ , Fe^{2+} and Fe^{3+} with initial concentration 0.4M, 0.2M and 0.6M respectively; the following reversible reaction occurs.
- $$\text{Ag}_{(aq)}^+ + \text{Fe}_{(aq)}^{2+} \rightleftharpoons \text{Fe}_{(aq)}^{3+} + \text{Ag}_{(s)}$$
- If the K_c for this reaction is 5.96 at 25°C. Calculate the equilibrium concentration of each ion in the equilibrium solution. **[04 marks]**
- (c) The following equilibrium is set up in solution by dissolving cobalt (II) chloride crystals in water to form pink species $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$ and then adding concentrated hydrochloride acid until the solution becomes blue.
- $$[\text{Co}(\text{H}_2\text{O})_6]_{(aq)}^{2+} + 4\text{Cl}_{(aq)}^- \rightleftharpoons [\text{CoCl}_4]_{(aq)}^{2-} + 6\text{H}_2\text{O}_{(l)}$$
- Does the reaction cease when the solution become blue? Explain.

- (ii) The forward reaction is endothermic, state and explain colour change observed by cooling the mixture.
- (iii) Mention one way of reversing the change caused by cooling the reaction.
- (d) During industrial Haber process hydrogen was introduced with nitrogen gas under certain unchangeable substance. A form six student witnessed a rapid product with evolution of gas which has pungent smell.
- (i) Suggest the gas produced during the process and its formula. **[01mark]**
- (ii) Suggest and explain the meaning of unchangeable substance during the process. **[01mark]**
- (iii) State two (2) necessary conditions that may hinder the process. **[01 mark]**
9. (a) Determine with reason whether the following molecules are aromatic or not.
- (i) 
- (ii) 
- (iii) 
- (iv)  **[04 marks]**
- (b) Write the structure of the aromatic compounds with the following IUPAC names.
- (i) 2, 3-dibromo-5- chloronitrobenzene
- (ii) 2, 3, 4, 5-tetrachlorophenol **[04 marks]**
- (c) (i) Discuss the effect of substituents on the reactivity of a benzene ring.
- (ii) Two isomeric hydrocarbons P and Q have the molecular formula C_9H_{12} , on oxidation P gives monocarboxylic acid which when heated with excess soda lime yield benzene. Q is oxidized to give a tricarboxylic acid, which then undergo nitration to give mononitroderivative. Deduce the structural formula of P and Q and write all chemical equations for the above information. **[07 marks]**
10. (a) Suggest the proper structure of the following compounds:
- (i) 2 – chloro -3-methylpentane
- (ii) 4-tertbutyl-3-iodoheptane

(iii) 1,4-dibromobut-2-ene

(iv) 1-bromo-4-sec-butyl-2-methylbenzene

[04 marks]

(b) An unknown compound X has molecular formula C_5H_8 . Suggest the possible structure of X from the following data:

(i) One mole of X takes up two moles of chlorine.

(ii) Compound X decolourizes a solution of Br_2 in CCl_4 .

(iii) Compound X form no precipitates with ammoniacal silver nitrate.

Write all the reactions involved.

(c) When 1, 2 – dibromodecane was treated with potassium hydroxide in aqueous ethanol, it yields a mixture of two isomeric compounds of molecular formula $C_{10}H_{19}Br$. Each of this compound was converted to dec-1-yne on reaction with sodium amide. Identify the two isomers and show the chemical reactions taking.

[06 marks]

Wabillah Tawfiq