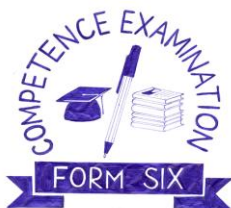


PRESEDENT'S OFFICE
REGIONAL ADMINISTRATION AND LOCAL GOVERNMENT
FORM SIX COMPETENCE EXAMINATIONS (FOSCE) - 2025



132/1

CHEMISTRY 1

Time 3 hours

Wednesday, 19th February 2025 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 in section **B**.
3. Each question carries **ten (10)** marks in section **A** and **fifteen (15)** marks in section **B**.
4. Mathematical tables and non-programmable calculators may be used.
5. Cellular phones are not allowed in the examination room.
6. Write your **Examination number** on every page of your answer sheet(s) provided
7. The following constants may be used:

- (a) Standard temperature is 273 K
- (b) Standard pressure is 760 mmHg or 1atm
- (c) GMV is 22.4dm^3
- (d) $R = 8.314\text{Jmol}^{-1}\text{K}^{-1}$ or $0.0821\text{atmmol}^{-1}\text{K}^{-1}$
- (e) $Rh = 1.09678 \times 10^7\text{m}^{-1}$
- (f) $c = 3 \times 10^8\text{m/s}$
- (g) $h = 6.63 \times 10^{-34}\text{Js}$
- (h) Atomic masses

H = 1, C = 12, O = 16, N = 14, Mg = 24, Na = 23, Cl = 35.5, K = 39, S = 32, Br = 80,

He = 4, Ca = 40

Section A (70 marks)

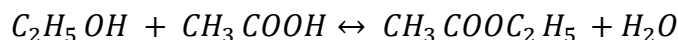
Answer all questions in this section.

1.
 - (a) If a light wave can behave like a stream of particles (photons), then perhaps particles can possess wave properties.
 - (i) State the model for this statement.
 - (ii) Give the mathematical expression that relate the statement in (a) above.
 - (iii) Can the statement in (a) above be applicable to large sized particles? Why?
 - (b) How many photons of light having a wavelength of 4000 nm are necessary to produce 1 kJ/mol of energy?
 - (c) What wavelength of energy is necessary for jumping electron from ground state to infinite energy level?
2.
 - (a) Hydrogen bond have several impacts on physical and chemical properties of a compound. Give three impacts of hydrogen bond
 - (b) Differentiate between sigma bond and pi bond.
 - (c) Use the VSEPR model to predict the geometry of
 - (i) AsH_3
 - (ii) CCl_3F
 - (iv) H_2O
 - (v) SF_6^-
3.
 - (a)
 - (i) Differentiate between density and relative density of a gas.
 - (ii) At 150°C and 755 mmHg pressure, 0.0721g of water vapourize to give 140 cm^3 . Is the relative molecular mass of water vapour prove the formula of steam?
 - (b) Two gases, hydrogen and methane, of the same mass were placed in different containers of the same volume. If hydrogen gas was at 300K temperature and methane was at 600K temperature.
 - (i) Which gas has larger number of molecules? By what factor its number of molecules increased?
 - (ii) Calculate the ratio of their pressure.
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)
 - (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.
 - (c) Explain how colligative properties are applied in our real life.

5. Both ZnSO_4 and ZnCO_3 can be analyzed qualitatively in the laboratory to identify their properties.
- What will be observed when distilled water is added to small amount of each salt?
 - What will be observed when dilute hydrochloric acid is added to a small amount of ZnCO_3 ? Give a chemical equation to support your answer.
 - When sodium hydroxide solution is added dropwise into a solution of ZnSO_4 or ZnCO_3 white gelatinous precipitates observed, but the precipitates dissolves when sodium hydroxide solution is added in excess. Briefly explain with the aid of chemical equation.
 - Give one chemical test that can confirm:
 - the presence of SO_4^{2-} in ZnSO_4 .
 - the presence of CO_3^{2-} in ZnCO_3 .
6.
 - Define the following;
 - Heat of dilution
 - heat of hydration.
 - The standard molar enthalpy of formation of diborane cannot determined directly because the compound cannot be prepared by the reaction of boron and hydrogen. Calculate the standard enthalpy of formation of gaseous diborane (B_2H_6) using the following thermo chemical information.
 - $$4\text{B}_{(s)} + 3\text{O}_{2(g)} \rightarrow 2\text{B}_2\text{O}_{3(s)} \quad \Delta H^\circ = -2509.1\text{KJ/mol}$$
 - $$2\text{H}_{2(g)} + \text{O}_{2(g)} \rightarrow 2\text{H}_2\text{O}_{(l)} \quad \Delta H^\circ = -571.7\text{KJ/mol}$$
 - $$\text{B}_2\text{H}_{6(g)} + 3\text{O}_{2(g)} \rightarrow \text{B}_2\text{O}_{3(s)} + 3\text{H}_2\text{O} \quad \Delta H^\circ = -2147.5\text{KJ/mol}$$
 - Use the information provided below to draw the Born-Haber cycle for sodium fluoride and calculate its heat of formation.

Atomization energy of sodium	+107.5KJ/mol
Ionization Energy of sodium	+496kJ/mol
Dissociation energy of Fluorine	150.6kJ/mol
Electron affinity of fluorine	-328kJ/mol
Lattice Energy of sodium fluoride	-919.8kJ/mol

7. (a) Define the following as used in chemical equilibrium: -
 (i) Equilibrium constant
 (ii) Heterogeneous chemical equilibrium
 (b) In the preparation of ethyl ethanoate as shown in the equation below, concentrated H_2SO_4 is often added to the mixture.



- (i) State two (2) functions of concentrated H_2SO_4 in the production of the compound.
 (ii) What will be the effect of adding $NaOH_{(aq)}$ instead of H_2SO_4 in the production of the compound.
 (c) (i) When 1.0 mol of CH_3COOH were heated with 0.18 moles of CH_3CH_2OH then the reaction attained equilibrium where 0.829 moles of acetic acid was found to be present. Calculate the value of K_c .
 (ii) What mass of ethyl ethanoate should be present in the equilibrium mixture formed under the same experimental conditions as 5c(i) above if 0.3 moles of ethanol were heated with 0.2 moles of ethanoic acid in a $1\ dm^3$ closed vessel

Section B (30 marks)

Answer two (2) questions from this section.

8. (a) Briefly explain the following terms and give an example of family of organic compounds in each case
 (i) Hydrocarbon
 (ii) Saturated hydrocarbon
 (iii) Unsaturated hydrocarbon.
 (b) $10\ cm^3$ of a gaseous hydrocarbon Q require $45\ cm^3$ of oxygen for complete combustion, also Q reacts with 1 mole of bromine gas to form a brominated compound of relative molecular mass 200.02 which contains 79.2% bromine.
 (i) Determine the molecular formula of Q
 (ii) Give the structural formula of Q
 (c) Give structural formula and names of the two products which could be formed when but - 1 - ene react with gaseous hydrogen bromide (HBr).
 (i) Which of the two products above in (b) is most likely to be formed? Why?
 (ii) Explain briefly why Brown alkanol is formed as a major product while bromoalkene is formed as a minor product when alkene molecules are treated with bromine water.

9. (a) Give the meaning and two examples for each of the following terms:
- Deactivating groups.
 - Ortho-para directing groups
- (b) Briefly explain why:
- Addition reaction in benzene ring is only possible under vigorous conditions such as high temperature and pressure?
 - Concentrated sulphuric acid is necessary for nitration of benzene?
 - Nitration of toluene is faster than nitration of benzoic acid?
- (c) With not more than three steps, how will you convert benzene into
- m-nitrobenzoic acid
 - p -nitrotoluene.
10. (a) Justify on the following facts:
- Ion exchange in the soil system is a reversible process
 - Aluminium contributes to soil acidity
 - Compounds of calcium and magnesium can be used as liming materials.
- (b) A soil sample collected from **Heroes Farm Plan** contains the following ions in meq per 100g of oven dry soil.

Ion	Mg ²⁺	Ca ²⁺	Na ⁺	K ⁺	H ⁺	Mn ²⁺	Al ³⁺
meq per 100g of oven dry soil	5.0	10.0	2.5	2.0	11.5	0.5	x

Given the cation exchange capacity of soil is 40 meq per 80g of oven dry soil. Calculate the:

- Concentration 'x' of Al³⁺ in meq per 100g of oven dry soil.
 - Percentage base saturation of the soil sample.
 - Amount of aluminium in grams present in 70g of oven dry soil sample.
- (c) Mr Farmer wants to apply fertilizer that will fulfil the nitrogen requirements in his maize farm. By showing your work clearly, advise him which is the best fertilizer to apply between urea (NH₂)₂CO and ammonium sulphate (NH₄)₂SO₄.