TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF APPLIED AND HEALTH SCIENCES

DEPARTMENT OF PURE & APPLIED SCIENCES

UNIVERSITY EXAMINATION FOR:

BACHELOR OF SCIENCE IN MARINE RESOURCE MANAGEMENT

ACH 4102: FUNDAMENTALS OF CHEMISTRY

END OF SEMESTER EXAMINATION

SERIES: JULY 2025

TIME: 2 HOURS

DATE: Pick DateSelect MonthPick Year

Instructions to Candidates

You should have the following for this examination

Answer Booklet, examination pass and student ID

This paper consists of **FIVE** questions. Attempt question ONE (Compulsory) and any other TWO questions.

Do not write on the question paper.

Some useful information

Speed of light c = 3.0 x 10^{8} ms^{-1}, Plank's Constant h = 6.6262 x 10^{-34} J s, 1nm = 1 x 10^{-9} m, R = -2.18 x 10^{-18}, 1eV = 1.60218 x 10^{-19} J.

Question One (Compulsory)

a) Define or explain each of the following terms:
   i. Photoelectric effect
   ii. Wave number
   iii. Ionisation energy
   iv. Electron affinity
   v. Solubility
   vi. Nuclear decay
   vii. Mole fraction
   viii. Saturated solution
   ix. Molarity of a solution
   x. Crystallization

(10 marks)

b) Distinguish between each of the following

i. Heterogeneous mixture and homogeneous mixture
ii. Solute and solvent
iii. Adsorption and partition chromatography
iv. Molality and molarity

(8 marks)

c) What is the molality of a solution prepared by dissolving 5.0 g of toluene (C_7H_8) in 225 g of benzene (C_6H_6)? (C = 12.0 g/mol, H = 1.0 g/mol) (4 marks)

d) Using the VSEPR model, predict the geometry and draw the structure of each of the following compounds.
i. CCl_4
ii. $CHCl_3$
iii. CO_2
iv. $AlCl_3$

(8 marks)

Question Two

a) Distinguish between each of the following:
i. Covalent and co-ordinate bond
ii. Intramolecular H-bonding and intermolecular H-bonding
iii. Ionic and metallic bonds
iv. Ion-dipole interactions and dipole-dipole forces

(8 marks)

b) Predict and draw the shape of each of the molecules on the basis of VSEPR theory:
i. NH_3
ii. CH_4
iii. PCl_3
iv. BF_3
v. $BeCl_2$
vi. SO_3

(12 marks)

Question Three

a) Define or explain each of the following
i. Aufbau principle
ii. Pauli's exclusion principle
iii. Hund's rule
iv. de Broglie equation

(8 marks)

b) Describe the properties and shapes of p-orbitals. (6 marks)

c) Write the electronic configuration of the following ions
i. F^- (atomic number F = 9)
ii. Ca^{2+} (atomic number Ca = 20)

iii. Cu^{2+} (atomic number of Cu = 29)

(6 marks)

Question Four

a) Distinguish between each of the following terms
   i. Simple and fractional distillation
   ii. Filtration and decantation
   iii. Miscible and immiscible liquids
   iv. Dilute and saturated solution

(8 marks)

b) What is weight of HCl (molar mass = 36.5 g/mol) is present in 155 mL of a 0.540 M solution?

(4 marks)

c) Highlight four major differences between evaporation and distillation. (8 marks)

Question Five

a) State and explain four main properties of ionic compounds

(8 marks)

b) State four differences between nuclear and chemical reactions

(8 marks)

c) The amount of carbon-14 in a piece of wood is found to be one-sixth of its amount in a fresh piece of wood. Calculate the age of old piece of wood. (4 marks)