UNIVERSITY COLLEGE TATI

UNIVERSITY COLLEGE TATI (UCTATI)

FINAL EXAMINATION QUESTION BOOKLET	
COURSE CODE	: FSC 1074
COURSE	: CHEMISTRY 1
SEMESTER/SESSION	: 2 - 2024/2025
DURATION	: 3 HOURS

Instructions:

1. This booklet contains 4 questions. Answer **ALL** questions.
2. All answers should be written in the answer booklet.
3. Write legibly and draw sketches wherever required.
4. If in doubt, raise your hands and ask the invigilator.

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO

THIS BOOKLET CONTAINS 7 PRINTED PAGES INCLUDING THE COVER PAGE

QUESTION 1 — 25 MARKS

a) Identify the number of protons, neutrons and electrons in the following nuclides:

(i) Pb^{2+} (2 marks)

(ii) Si^{3+} (2 marks)

(iii) Ca (2 marks)

b) Calculate the mass of sodium hydroxide, NaOH in a sample containing 2.0×10^{24} molecules of NaOH. (4 marks)

c) Carbohydrates in our diet are our major source of energy. It contains C, H and O. One of its percentage compositions may have 71.3% carbon, 9.7% hydrogen and the remainder is oxygen. Determine:

(i) Empirical formula of the compound. (4 marks)

(ii) Molecular formula of the compound if the molar mass is 252.4 g/mol. (3 marks)

d) Ethyl bromide, C_2H_5Br is prepared by the reaction of ethene gas, C_2H_4 with hydrogen bromide, HBr. In the experiment, 11.2g of ethene reacts with 45.4g of hydrogen bromide.

(i) Give a chemical equation for the reaction. (2 marks)

(ii) Determine the limiting reactant. (4 marks)

(iii) Calculate the mass of ethyl bromide produced. (2 marks)

QUESTION 2

25 MARKS

a) Discuss the electronic configuration, in *spdf* notation, and orbital diagram of

(i) Potassium, K^+ ion (proton number of potassium atom is 19) (5 marks)

(ii) Krypton, Kr (proton number of krypton atom is 36) (5 marks)

b) The electronic configuration for element Y is shown below.

Y: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$

Predict the element and position (group, period and block) of Y in periodic table. (4 marks)

c) From each of the following groups, classify the largest atom.

(i) Na, K, Rb (2 marks)

(ii) C, N, O (2 marks)

d) (i) Describe electron affinity (4 marks)

(ii) *"Chlorine is an element in Group 17 with the proton Number 17. The electronegativity for chlorine is strong, but its electron affinity is weak".*

Interpret the situation above. (3 marks)

QUESTION 3 — 25 MARKS

a) A beaker was filled with 200 mL of H_2SO_4 solution. The solution mass is 65.3g. Compute:

(i) Density (2 marks)

(ii) Number of moles (2 marks)

(iii) Molarity (2 marks)

b) Find the mass of acetic acid, CH_3COOH required to make 250 mL of solution that has a concentration of 0.105 M. (4 marks)

c) If the density of 5.2 ml Al_2Br_6 is 1.05 g/cm^3. Determine

(i) The mass of Al_2Br_6. (3 marks)

(ii) The mass of Al_2Br_6 is needed to prepare 2.0 L solution 4.0 M. (4 marks)

d) A 15.5 g of chromium, heated to 100.0 °C, is dropped into 55.5 g of water at 16.5 °C. The final temperature of the metal and water is 18.9 °C. Calculate the specific heat capacity of chromium. (8 marks)

(c_{water} = 4.184 J g^{-1} C^{-1})

QUESTION 4

25 MARKS

a) Diborane (B_2H_6) is used as a rocket fuel. The equation for the combustion of diborane is shown below:

$$B_2H_6\ (g) + 3O_2\ (g) \rightarrow B_2O3\ (s) + 3H_2O\ (\ell)$$

Calculate the enthalpy of combustion of diborane using the following data. (10 marks)

$2B\ (s) + 3H_2\ (g) \rightarrow B_2H_6\ (g)$ $\quad \Delta H° = 36\ kJ\ mol^{-1}$

$H_2\ (g) + \frac{1}{2}O_2\ (g) \rightarrow H_2O\ (\ell)$ $\quad \Delta H° = 286\ kJ\ mol^{-1}$

$2B\ (s) + 1\frac{1}{2}O_2\ (g) \rightarrow B_2O_3\ (s)$ $\quad \Delta H° = 1274\ kJ\ mol^{-1}$

b) Sketch the molecular structures for each of the following compounds.

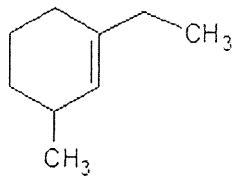
(i) 2,3-dimethyl-4-hexene (3 marks)

(ii) 1,3-dimethyl-3-cycloheptene (3 marks)

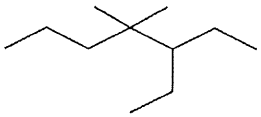
(iii) 5-ethyl-1,1,3-trimethyl-3-cyclohexene (3 marks)

c) Give name for each of the molecular structure below.

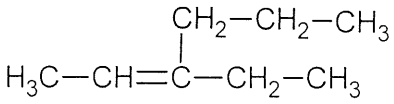
(i) (2 marks)



(ii) (2 marks)



(iii) (2 marks)



----------End of question----------

APPENDIX I

$$Molarity = \frac{mol\ solute}{L\ solution}$$

$$Molality = \frac{mol\ solute}{kg\ solvent}$$

$$mol\ fraction\ (X_A) = \frac{mol\ of\ A}{total\ mol}$$

$$mass\ \%\ (solute\ or\ solvent) = \left(\frac{mass\ of\ solute\ or\ solvent}{mass\ of\ solution}\right) \times 100$$

FORMULA:
m = mass (g)
n = number of moles (mol)
M = Molar Mass (g/mol)

$$n = \frac{m}{M}$$

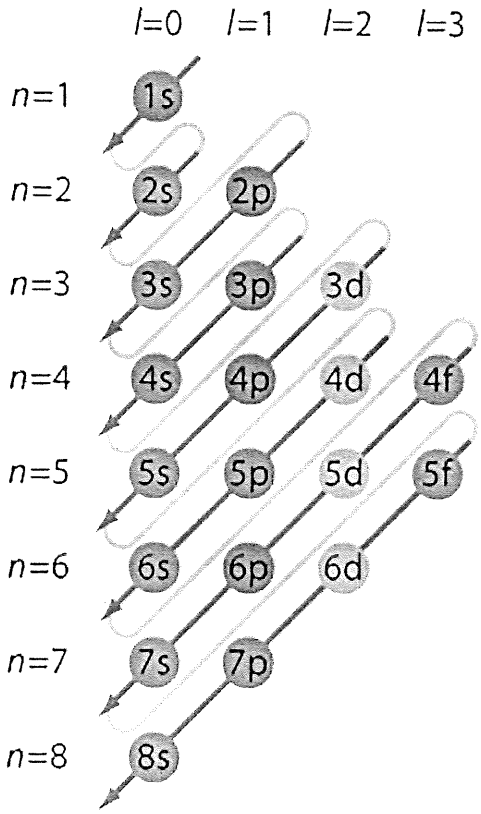
m ⟷ n ⟷ N ⟷ atoms

Avogadro's Constant
6.022×10^{23} molecules = 1 mol

Latin Hydrocarbon Roots

Number of Carbons	Latin Root
1	meth
2	eth
3	prop
4	but
5	pent
6	hex
7	hept
8	oct
9	non
10	dec

Energy Level



APPENDIX II

THE PERIODIC TABLE
SYMBOL
ATOMIC NUMBER
ATOMIC WEIGHT
NAME
( ) = ESTIMATES
ALKALI METALS
ALKALI EARTH METALS
LANTHANIDES
ACTINIDES
HALOGENS
NOBLE GASES
HAYDEN McNEIL SPECIALTY PRODUCTS
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