



## 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)  $\text{Pb}^{2+}$  (2 marks)
  - (ii)  $\text{Si}^{3+}$  (2 marks)
  - (iii) Ca (2 marks)
- b) Calculate the mass of sodium hydroxide, NaOH in a sample containing  $2.0 \times 10^{24}$  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,  $\text{C}_2\text{H}_5\text{Br}$  is prepared by the reaction of ethene gas,  $\text{C}_2\text{H}_4$  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)

## CHEMISTRY I (FSC 1074)

## 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  $\text{H}_2\text{SO}_4$  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,  $\text{CH}_3\text{COOH}$  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  $\text{Al}_2\text{Br}_6$  is  $1.05 \text{ g/cm}^3$ . Determine
- (i) The mass of  $\text{Al}_2\text{Br}_6$ . (3 marks)
  - (ii) The mass of  $\text{Al}_2\text{Br}_6$  is needed to prepare 2.0 L solution 4.0 M. (4 marks)
- d) A 15.5 g of chromium, heated to  $100.0 \text{ }^\circ\text{C}$ , is dropped into 55.5 g of water at  $16.5 \text{ }^\circ\text{C}$ . The final temperature of the metal and water is  $18.9 \text{ }^\circ\text{C}$ . Calculate the specific heat capacity of chromium. (8 marks)
- ( $C_{\text{water}} = 4.184 \text{ J g}^{-1} \text{ }^\circ\text{C}^{-1}$ )

## 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:



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



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

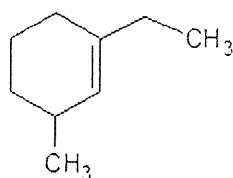
(i) 2,3-dimethyl-4-hexene (3 marks)

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

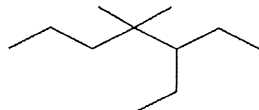
(iii) 5-ethyl-1,1,3-trimethyl-3-cyclohexene (3 marks)

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

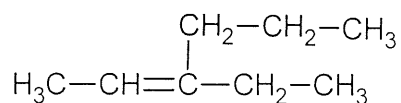
(i) (2 marks)



(ii) (2 marks)



(iii) (2 marks)



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

## CHEMISTRY I (FSC 1074)

## APPENDIX I

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

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

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

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

Avogadro's Constant

$6.022 \times 10^{23}$  molecules = 1 mol

## FORMULA:

$m$  = mass (g)

$n$  = number of moles (mol)

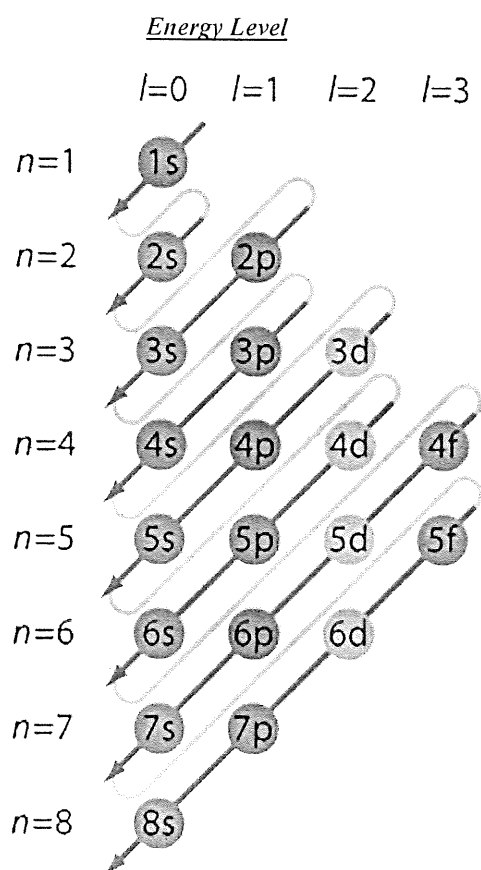
$M$  = Molar Mass (g/mol)

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

$$m \longleftrightarrow n \longleftrightarrow N \longleftrightarrow \text{atoms}$$

## 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



CHEMISTRY I (FSC 1074)

APPENDIX II

THE PERIODIC TABLE

1 <b>H</b> 1.008 Hydrogen	2 <b>He</b> 4.00 Helium																																
3 <b>Li</b> 6.94 Lithium	4 <b>Be</b> 9.01 Beryllium	5 <b>B</b> 10.81 Boron	6 <b>C</b> 12.01 Carbon	7 <b>N</b> 14.01 Nitrogen	8 <b>O</b> 16.00 Oxygen	9 <b>F</b> 19.00 Fluorine	10 <b>Ne</b> 20.18 Neon																										
11 <b>Na</b> 22.99 Sodium	12 <b>Mg</b> 24.31 Magnesium	13 <b>Al</b> 26.98 Aluminum	14 <b>Si</b> 28.09 Silicon	15 <b>P</b> 30.97 Phosphorus	16 <b>S</b> 32.07 Sulfur	17 <b>Cl</b> 35.45 Chlorine	18 <b>Ar</b> 39.95 Argon																										
19 <b>K</b> 39.10 Potassium	20 <b>Ca</b> 40.08 Calcium	21 <b>Sc</b> 44.96 Scandium	22 <b>Ti</b> 47.88 Titanium	23 <b>V</b> 50.94 Vanadium	24 <b>Cr</b> 52.00 Chromium	25 <b>Mn</b> 54.94 Manganese	26 <b>Fe</b> 55.85 Iron	27 <b>Co</b> 58.93 Cobalt	28 <b>Ni</b> 58.69 Nickel	29 <b>Cu</b> 63.55 Copper	30 <b>Zn</b> 65.39 Zinc	31 <b>Ga</b> 69.72 Gallium	32 <b>Ge</b> 72.61 Germanium	33 <b>As</b> 74.92 Arsenic	34 <b>Se</b> 78.96 Selenium	35 <b>Br</b> 79.90 Bromine	36 <b>Kr</b> 83.80 Krypton																
37 <b>Rb</b> 85.47 Rubidium	38 <b>Sr</b> 87.62 Strontium	39 <b>Y</b> 88.91 Yttrium	40 <b>Zr</b> 91.22 Zirconium	41 <b>Nb</b> 92.91 Niobium	42 <b>Mo</b> 95.94 Molybdenum	43 <b>Tc</b> (97.9) Technetium	44 <b>Ru</b> 101.07 Ruthenium	45 <b>Rh</b> 102.91 Rhodium	46 <b>Pd</b> 106.42 Palladium	47 <b>Ag</b> 107.87 Silver	48 <b>Cd</b> 112.41 Cadmium	49 <b>In</b> 114.82 Indium	50 <b>Sn</b> 118.71 Tin	51 <b>Sb</b> 121.76 Antimony	52 <b>Te</b> 127.60 Tellurium	53 <b>I</b> 126.90 Iodine	54 <b>Xe</b> 131.29 Xenon																
55 <b>Cs</b> 132.91 Cesium	56 <b>Ba</b> 137.33 Barium	57 <b>La</b> 138.91 Lanthanum	58 <b>Ce</b> 140.12 Cerium	59 <b>Pr</b> 140.91 Praseodymium	60 <b>Nd</b> 144.24 Neodymium	61 <b>Pm</b> (145) Promethium	62 <b>Sm</b> 150.36 Samarium	63 <b>Eu</b> 152.07 Europium	64 <b>Gd</b> 157.25 Gadolinium	65 <b>Tb</b> 158.93 Terbium	66 <b>Dy</b> 162.50 Dysprosium	67 <b>Ho</b> 164.93 Holmium	68 <b>Er</b> 167.26 Erbium	69 <b>Tm</b> 168.93 Thulium	70 <b>Yb</b> 173.04 Ytterbium	71 <b>Lu</b> 174.97 Lutetium																	
87 <b>Fr</b> 223.02 Francium	88 <b>Ra</b> 226.03 Radium	89 <b>Ac</b> 227.03 Actinium	90 <b>Th</b> 232.04 Thorium	91 <b>Pa</b> 231.04 Protactinium	92 <b>U</b> 238.03 Uranium	93 <b>Np</b> 237.05 Neptunium	94 <b>Pu</b> 244.0 Plutonium	95 <b>Am</b> 243.06 Americium	96 <b>Cm</b> (247) Curium	97 <b>Bk</b> (248) Berkelium	98 <b>Cf</b> (251) Californium	99 <b>Es</b> 252.08 Einsteinium	100 <b>Fm</b> 257.10 Fermium	101 <b>Md</b> (257) Mendelevium	102 <b>No</b> 259.10 Nobelium	103 <b>Lr</b> 262.11 Lawrencium																	
<p>Legend: <b>H</b> = SYMBOL, 1.008 = ATOMIC NUMBER, Hydrogen = ATOMIC WEIGHT, NAME</p>																																	

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LANTHANIDES											
<b>Ce</b> 58 Cerium	<b>Pr</b> 59 Praseodymium	<b>Nd</b> 60 Neodymium	<b>Pm</b> 61 (145) Promethium	<b>Sm</b> 62 Samarium	<b>Eu</b> 63 Europium	<b>Gd</b> 64 Gadolinium	<b>Tb</b> 65 Terbium	<b>Dy</b> 66 Dysprosium	<b>Ho</b> 67 Holmium	<b>Er</b> 68 Erbium	<b>Tm</b> 69 Thulium
ACTINIDES											
<b>Th</b> 90 Thorium	<b>Pa</b> 91 Protactinium	<b>U</b> 92 Uranium	<b>Np</b> 93 Neptunium	<b>Pu</b> 94 Plutonium	<b>Am</b> 95 Americium	<b>Cm</b> 96 (247) Curium	<b>Bk</b> 97 (248) Berkelium	<b>Cf</b> 98 (251) Californium	<b>Es</b> 99 Einsteinium	<b>Fm</b> 100 Fermium	<b>Md</b> (257) Mendelevium

