



## UNIVERSITY COLLEGE TATI (UC TATI)

## FINAL EXAMINATION QUESTION BOOKLET

COURSE CODE	: DIP 1043
COURSE	: BASIC PHYSICAL & ORGANIC CHEMISTRY
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 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 6 PRINTED PAGES INCLUDING COVER PAGE**

**QUESTION 1****(20 MARKS)**

- a) Bromine, Br is a halogen gas. By using the information that bromine atom has 35 protons and 45 neutrons, show the symbol for the bromine atom. (3 marks)
- b) Calculate the molecular weight of the following compounds:
- i)  $\text{Ca}_3(\text{PO}_4)_2$  (4 marks)
  - ii)  $\text{Mg}(\text{NO}_3)_2$  (4 marks)
- c) State the number of protons, neutrons and electrons in a  $^{64}\text{Zn}$  atom (Refer periodic table). (3 marks)
- d) Draw and differentiate three (3) states of matter in term of their particle arrangement. (6 marks)

**QUESTION 2****(30 MARKS)**

- a) Solve the following mole calculations:
- i) The number of moles of  $\text{Ca}(\text{OH})_2$  in 5.62 grams (5 marks)
  - ii) The number of moles of  $\text{Mg}(\text{NO}_3)_2$  in 487.6 grams (5 marks)
- b) Calculate the number of Br atoms in 0.453 moles of  $\text{CBr}_4$  (Given Avogadro constant:  $6.02 \times 10^{23}$ ). (5 marks)
- c) Calculate the mass of sodium, Na in a sample containing  $2.0 \times 10^{24}$  atoms of Na. (Given Avogadro constant:  $6.02 \times 10^{23}$ ) (5 marks)

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- d) Determine the empirical formula for chrysotile asbestos. Chrysotile has the percent composition of 28.03% Mg, 21.60% Si, 1.16% H and 49.21% O. (6 marks)
- e) Determine the molecular formula for naphthalene if its empirical formula is  $C_5H_4$  and the molar mass is 128 g/mol. (4 marks)

**QUESTION 3****(22 MARKS)**

- a) Calculate the following:
- the molality of a NaCl solution containing 9.5g of NaCl in 185 g of water. (5 marks)
  - the molarity of a solution containing 14.8g of NaCl in 750 ml aqueous solution. (5 marks)
- b) Solve the following dilution problems:
- The volume of a 15.0 M stock solution that you need, to prepare 250 ml of a 2.35 M HF solution. (4 marks)
  - 455 ml of 6.0 M  $HNO_3$  is diluted to 2.5 L, calculate the molarity of the diluted solution. (4 marks)
- c) A solution contains 2.65g of anhydrous  $Na_2CO_3$  in 200 ml of solution. Calculate the molarity of the solution. (4 marks)

## QUESTION 4

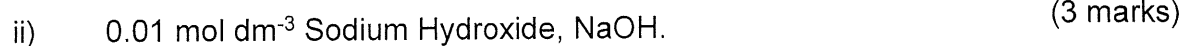
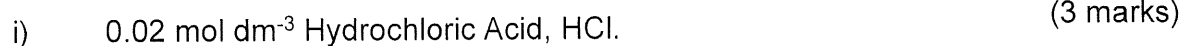
(28 MARKS)

- a) By applying Brønsted-Lowry theory, classify the conjugate acid-base pairs for the following chemical equation:

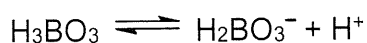


- b) There are three primary theories of acid and bases; Arrhenius, Brønsted-Lowry and Lewis theory. Interpret these three theories based on their definition. (6 marks)

- c) Predict the pH of



- d) Boric acid, H<sub>3</sub>BO<sub>3</sub> is a weak acid. The concentration of solution used for the experiment is 0.2 M and the K<sub>a</sub> value is 7.3 x 10<sup>-10</sup> M.



Solve the following:



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

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APPENDIX I

THE PERIODIC TABLE

		18 VIIIA		17 VIIA		16 VIA		15 VA		14 IVA		13 IIIA							
		He		Ne		Ar		Kr		Xe		Rn							
		2 Helium		10 Neon		18 Argon		36 Krypton		54 Xenon		86 Radon							
		1		2		3		4		5		6		7		8		9	
		IA		IIA		IIIB		IVB		VB		VIB		VIIB		VIII		IX	
		1		2		3		4		5		6		7		8		9	
		H		He		Li		Be		B		C		N		O		F	
		1.008 Hydrogen		4.00 Helium		6.94 Lithium		9.01 Beryllium		10.81 Boron		12.01 Carbon		14.01 Nitrogen		16.00 Oxygen		19.00 Fluorine	
		3		4		5		6		7		8		9		10		11	
		Na		Mg		Al		Si		P		S		Cl		Ar		Kr	
		22.99 Sodium		24.31 Magnesium		26.98 Aluminum		28.09 Silicon		30.97 Phosphorus		32.07 Sulfur		35.45 Chlorine		39.95 Argon		83.80 Krypton	
		11		12		13		14		15		16		17		18		19	
		K		Ca		Sc		Ti		V		Cr		Mn		Fe		Co	
		39.10 Potassium		40.08 Calcium		44.96 Scandium		47.88 Titanium		50.94 Vanadium		52.00 Chromium		54.94 Manganese		55.85 Iron		58.93 Cobalt	
		19		20		21		22		23		24		25		26		27	
		Rb		Sr		Y		Zr		Nb		Mo		Tc		Ru		Rh	
		85.47 Rubidium		87.62 Strontium		88.91 Yttrium		91.22 Zirconium		92.91 Niobium		95.94 Molybdenum		(97.9) Technetium		101.07 Ruthenium		102.91 Rhodium	
		37		38		39		40		41		42		43		44		45	
		Cs		Ba		La		Hf		Ta		W		Re		Os		Ir	
		132.91 Cesium		137.33 Barium		138.91 Lanthanum		178.49 Hafnium		180.95 Tantalum		183.85 Tungsten		186.21 Rhenium		190.2 Osmium		192.22 Iridium	
		55		56		57		72		73		74		75		76		77	
		Fr		Ra		Ac		Rf		Db		Sg		Bh		Hs		Mt	
		223.02 Francium		226.03 Radium		227.03 Actinium		104 (261) Rutherfordium		105 (262) Dubnium		106 (263) Seaborgium		107 (262) Bohrium		108 (265) Hassium		109 (266) Meitnerium	
		87		88		89		104		105		106		107		108		109	
		Unnamed Discovery 118 1999		Unnamed Discovery 116 1999		Unnamed Discovery 114 1999		Unnamed Discovery 112 1999		Unnamed Discovery 111 Nov. 1994		Unnamed Discovery 110 Nov. 1994		Unnamed Discovery 108 Nov. 1994		Unnamed Discovery 106 Nov. 1994		Unnamed Discovery 105 Nov. 1994	
		NOBLE GASES		HALOGENS		ALKALINE EARTH METALS		ALKALI METALS		LANTHANIDES		ACTINIDES		ALUMINUM		TITANIUM		ZINC	
		Lu		Yb		Tm		Er		Ho		Dy		Tb		Gd		Eu	
		71 Lutetium		70 Ytterbium		69 Thulium		68 Erbium		67 Terbium		66 Dysprosium		65 Terbium		64 Gadolinium		63 Europium	
		103		102		101		100		99		98		97		96		95	
		Lr		No		Md		Fm		Es		Cf		Bk		Cm		Am	
		262.11 Lawrencium		259.10 Nobelium		257.10 Mendelevium		257.10 Fermium		252.08 Einsteinium		248 (251) Californium		248 (251) Berkelium		247 (249) Curium		243.06 Americium	

## Appendix II

$$\text{Avogadro constant} = 6.02 \times 10^{23}$$

$$\text{Number of mole} = \frac{\text{No. of particles/atoms}}{\text{Avogadro constant}}$$

$$\text{Number of particle/atoms} = \text{no. of moles} \times \text{Avogadro constant}$$

$$\text{Number of mole} = \frac{\text{Mass (g)}}{\text{Molecular weight (g/mol)}}$$

$$\text{Mass} = \text{no. of moles} \times \text{Molecular weight}$$

$$\text{Molarity} = \frac{\text{number of mole (mol)}}{\text{Volume of solution (L)}}$$

$$\text{Molality} = \frac{\text{number of mole (mol)}}{\text{Mass of solution (KG)}}$$

**Titration**

$$M_1V_1 = M_2V_2$$

$$\text{pH} = -\log[\text{H}^+]$$

$$\text{pOH} = -\log[\text{OH}^-]$$

$$\text{pH} = 14 - \text{pOH}$$

$$K_a = \frac{[\text{A}^-][\text{H}^+]}{[\text{HA}]}$$