UNIVERSITY COLLEGE TATI

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) $Ca_3(PO_4)_2$ (4 marks)

ii) $Mg(NO_3)_2$ (4 marks)

c) State the number of protons, neutrons and electrons in a ^{64}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 $Ca(OH)_2$ in 5.62 grams (5 marks)

ii) The number of moles of $Mg(NO_3)_2$ in 487.6 grams (5 marks)

b) Calculate the number of Br atoms in 0.453 moles of CBr_4 (Given Avogadro constant: 6.02×10^{23}). (5 marks)

c) Calculate the mass of sodium, Na in a sample containing 2.0×10^{24} atoms of Na. (Given Avogadro constant: 6.02×10^{23}) (5 marks)

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:

i) the molality of a NaCl solution containing 9.5g of NaCl in 185 g of water. (5 marks)

ii) the molarity of a solution containing 14.8g of NaCl in 750 ml aqueous solution. (5 marks)

b) Solve the following dilution problems:

i) 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)

ii) 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:

(i) $CN^- + H_3O^+ \rightleftharpoons HCN + H_2O$ (4 marks)

(ii) $H_2Se + H_2O \rightleftharpoons HSe^- + H_3O^+$ (4 marks)

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

i) 0.02 mol dm^{-3} Hydrochloric Acid, HCl. (3 marks)

ii) 0.01 mol dm^{-3} Sodium Hydroxide, NaOH. (3 marks)

d) Boric acid, H_3BO_3 is a weak acid. The concentration of solution used for the experiment is 0.2 M and the K_a value is 7.3×10^{-10} M.

$$H_3BO_3 \rightleftharpoons H_2BO_3^- + H^+$$

Solve the following:

(i) $[H^+]$ (5 marks)

(ii) pH (3 marks)

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

APPENDIX I

THE PERIODIC TABLE

Key: H — SYMBOL; 1 — ATOMIC NUMBER; 1.008 — ATOMIC WEIGHT; Hydrogen — NAME

( ) = ESTIMATES

	1 IA	2 IIA	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8 VIIIB	9 VIIIB	10 VIIIB	11 IB	12 IIB	13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	18 VIIIA
1	**H** 1 1.008 Hydrogen																	**He** 2 4.00 Helium
2	**Li** 3 6.94 Lithium	**Be** 4 9.01 Beryllium											**B** 5 10.81 Boron	**C** 6 12.01 Carbon	**N** 7 14.01 Nitrogen	**O** 8 16.00 Oxygen	**F** 9 19.00 Fluorine	**Ne** 10 20.18 Neon
3	**Na** 11 22.99 Sodium	**Mg** 12 24.31 Magnesium											**Al** 13 26.98 Aluminum	**Si** 14 28.09 Silicon	**P** 15 30.97 Phosphorus	**S** 16 32.07 Sulfur	**Cl** 17 35.45 Chlorine	**Ar** 18 39.95 Argon
4	**K** 19 39.10 Potassium	**Ca** 20 40.08 Calcium	**Sc** 21 44.96 Scandium	**Ti** 22 47.88 Titanium	**V** 23 50.94 Vanadium	**Cr** 24 52.00 Chromium	**Mn** 25 54.94 Manganese	**Fe** 26 55.85 Iron	**Co** 27 58.93 Cobalt	**Ni** 28 58.69 Nickel	**Cu** 29 63.55 Copper	**Zn** 30 65.39 Zinc	**Ga** 31 69.72 Gallium	**Ge** 32 72.61 Germanium	**As** 33 74.92 Arsenic	**Se** 34 78.96 Selenium	**Br** 35 79.90 Bromine	**Kr** 36 83.80 Krypton
5	**Rb** 37 85.47 Rubidium	**Sr** 38 87.62 Strontium	**Y** 39 88.91 Yttrium	**Zr** 40 91.22 Zirconium	**Nb** 41 92.91 Niobium	**Mo** 42 95.94 Molybdenum	**Tc** 43 (97.9) Technetium	**Ru** 44 101.07 Ruthenium	**Rh** 45 102.91 Rhodium	**Pd** 46 106.42 Palladium	**Ag** 47 107.87 Silver	**Cd** 48 112.41 Cadmium	**In** 49 114.82 Indium	**Sn** 50 118.71 Tin	**Sb** 51 121.76 Antimony	**Te** 52 127.60 Tellurium	**I** 53 126.90 Iodine	**Xe** 54 131.29 Xenon
6	**Cs** 55 132.91 Cesium	**Ba** 56 137.33 Barium	**La** 57 138.91 Lanthanum	**Hf** 72 178.49 Hafnium	**Ta** 73 180.95 Tantalum	**W** 74 183.85 Tungsten	**Re** 75 186.21 Rhenium	**Os** 76 190.2 Osmium	**Ir** 77 192.22 Iridium	**Pt** 78 195.08 Platinum	**Au** 79 196.97 Gold	**Hg** 80 200.59 Mercury	**Tl** 81 204.38 Thallium	**Pb** 82 207.2 Lead	**Bi** 83 208.98 Bismuth	**Po** 84 (209) Polonium	**At** 85 (210) Astatine	**Rn** 86 (222) Radon
7	**Fr** 87 223.02 Francium	**Ra** 88 226.03 Radium	**Ac** 89 227.03 Actinium	**Rf** 104 (261) Rutherfordium	**Db** 105 (262) Dubnium	**Sg** 106 (263) Seaborgium	**Bh** 107 (262) Bohrium	**Hs** 108 (265) Hassium	**Mt** 109 (266) Meitnerium	Unnamed Discovery 110 Nov. 1994	Unnamed Discovery 111 Nov. 1994	Unnamed Discovery 112 1996		Unnamed Discovery 114 1999		Unnamed Discovery 116 1999		Unnamed Discovery 118 1999
	ALKALI METALS	ALKALI EARTH METALS															HALOGENS	NOBLE GASES

LANTHANIDES	**Ce** 58 140.12 Cerium	**Pr** 59 140.91 Praseodymium	**Nd** 60 144.24 Neodymium	**Pm** 61 (145) Promethium	**Sm** 62 150.36 Samarium	**Eu** 63 152.97 Europium	**Gd** 64 157.25 Gadolinium	**Tb** 65 158.93 Terbium	**Dy** 66 162.50 Dysprosium	**Ho** 67 164.93 Holmium	**Er** 68 167.26 Erbium	**Tm** 69 168.93 Thulium	**Yb** 70 173.04 Ytterbium	**Lu** 71 174.97 Lutetium
ACTINIDES	**Th** 90 232.04 Thorium	**Pa** 91 231.04 Protactinium	**U** 92 238.03 Uranium	**Np** 93 237.05 Neptunium	**Pu** 94 (240) Plutonium	**Am** 95 243.06 Americium	**Cm** 96 (247) Curium	**Bk** 97 (248) Berkelium	**Cf** 98 (251) Californium	**Es** 99 252.08 Einsteinium	**Fm** 100 257.10 Fermium	**Md** 101 (257) Mendelevium	**No** 102 259.10 Nobelium	**Lr** 103 262.11 Lawrencium

HAYDEN McNEIL SPECIALTY PRODUCTS

www.hmpublishing.com

© Hayden-McNeil Specialty Products

Appendix II

Avogadro constant = 6.02×10^{23}

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

Number of particle/atoms = no. of moles *X* Avogadro constant

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

$\boldsymbol{Mass}$ = no. of moles *X* Molecular weight

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

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

Titration

$M_1V_1 = M_2V_2$

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

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

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

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