



UNIVERSITY COLLEGE TATI (UC TATI)

FINAL EXAMINATION QUESTION BOOKLET

COURSE CODE	: DTC 1033
COURSE	: GENERAL CHEMISTRY
SEMESTER/SESSION	: 1 - 2023/2024
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 7 PRINTED PAGES INCLUDING COVER PAGE

QUESTION 1

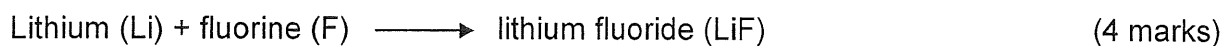
- a) Bromine, Br is a halogen gas. The bromine atom has 35 protons and 45 neutrons. Write the symbol for the bromine atom. (4 marks)
- b) Find the number of atoms in 0.5 mole of ozone gas (O_3).
(Avogadro constant: 6.02×10^{23}) (4 marks)
- c) Calculate the number of moles of sodium, Na in a sample containing 2.0×10^{24} atoms of Na. (Given Avogadro constant: 6.02×10^{23}) (5 marks)
(Relative atomic mass: Na=23)
- d) Write a balance equation for the following chemical reaction. (4 marks)
 $Al + Fe_2O_3 \longrightarrow Al_2O_3 + Fe$
- e) Find
- i) Molecular weight of sulfuric acid, (H_2SO_4). (4 marks)
(Relative atomic mass: H=2, S=32, O=16)
- ii) Molecular mass for magnesium oxide, (MgO). (4 marks)
(Relative atomic mass: Mg=24; O=16)

QUESTION 2

- a) Discuss the electronic configuration, in *spdf* notation, and orbital diagram of
- i) Magnesium, Mg (proton number of magnesium atom is 12) (5 marks)
 - ii) Argon, Ar (proton number of argon atom is 18) (5 marks)
- b) Element Y has 20 proton number. (4 marks)
Predict the position of Y in the periodic table by drawing the electron arrangement.
- c) From each of the following elements, choose the largest atom.
- i) Na, K, Rb (2 marks)
 - ii) C, N, O (2 marks)
- d) Element X has 15 number of proton.
- i) Write the electronic configuration of element X in *spdf* notation. (4 marks)
 - ii) Identify the group and period of element X in periodic table. (3 marks)

QUESTION 3

- a) Sketch the Lewis electron-dot diagram to show the formation of ionic compounds in the following reaction.



- b) Covalent bonds are formed when the atoms are sharing electron so that each atom achieves noble gas configuration. Draw the Lewis electron-dot diagram to show the formation of Br₂ molecules. (4 marks)

- c) Write the equilibrium constant expression K_c for each of the following reactions:



At equilibrium,

$$[HI] = 1.75 \text{ mol dm}^{-3}, [H_2] = 1.125 \text{ mol dm}^{-3}, [I_2] = 0.125 \text{ mol dm}^{-3}$$

Solve the value for K_c .

QUESTION 4

- a) The gases SO_2 , O_2 and SO_3 are allowed to reach equilibrium at a constant temperature. At equilibrium, the partial pressures of the gases are as follows.
Partial pressure of $\text{SO}_2 = 0.050 \text{ atm}$
Partial pressure of $\text{O}_2 = 0.025 \text{ atm}$
Partial pressure of $\text{SO}_3 = 1.00 \text{ atm}$
Solve the value of K_p for the following reaction (5 marks)
- $$2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{SO}_3(\text{g})$$
- b) Based on Brönsted-Lowry concept, compute the definition of acid and base. (4 marks)
- c) Label each species as an acid, base, conjugate acid and conjugate base based on Brönsted-Lowry concept in the following equations.
- i) $\text{HCl}(\text{aq}) + \text{NaOH}(\text{aq}) \rightleftharpoons \text{NaCl}(\text{aq}) + \text{H}_2\text{O}(\text{l})$ (4 marks)
- ii) $\text{HCl}(\text{aq}) + \text{NH}_3(\text{aq}) \rightleftharpoons \text{Cl}^- + \text{NH}_4^+(\text{aq})$ (4 marks)
- d) Predict the pH of
- i) 0.02 mol dm^{-3} hydrochloric acid, HCl (4 marks)
- ii) 0.01 mol dm^{-3} sodium hydroxide, NaOH solution (4 marks)

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

GENERAL CHEMISTRY (DTC 1033)

Appendix 1

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

$$\text{Number of moles} = \frac{\text{No of atoms or molecules}}{\text{Avogadro constant}}$$

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

$$\text{Number of moles} = \frac{\text{Mass (g)}}{\text{Molecular weight (MW)}}$$

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

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

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

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

APPENDIX 2

Periodic Table of the Elements

1 IA 1A	2 IIA 2A	3 IIIB 3B	4 IVB 4B	5 VB 5B	6 VIB 6B	7 VIIB 7B	8 VIII 8	9 VIII 9	10 VIII 10	11 IB 1B	12 IIB 2B	13 IIIA 3A	14 IVA 4A	15 VA 5A	16 VIA 6A	17 VIIA 7A	18 VIIIA 8A
1 Hydrogen 1.008	2 Helium 4.003	3 Lithium 6.941	4 Beryllium 9.012	5 Boron 10.811	6 Carbon 12.011	7 Nitrogen 14.007	8 Oxygen 15.999	9 Fluorine 18.998	10 Neon 20.180	11 Sodium 22.990	12 Magnesium 24.305	13 Aluminum 26.982	14 Silicon 28.086	15 Phosphorus 30.974	16 Sulfur 32.065	17 Chlorine 35.453	18 Argon 39.948
19 Potassium 39.098	20 Calcium 40.078	21 Scandium 44.956	22 Titanium 47.88	23 Vanadium 50.942	24 Chromium 51.996	25 Manganese 54.938	26 Iron 55.845	27 Cobalt 58.933	28 Nickel 58.693	29 Copper 63.546	30 Zinc 65.39	31 Gallium 69.723	32 Germanium 72.64	33 Arsenic 74.922	34 Selenium 78.96	35 Bromine 79.904	36 Krypton 83.80
37 Rubidium 85.468	38 Strontium 87.62	39 Yttrium 88.906	40 Zirconium 91.224	41 Niobium 92.906	42 Molybdenum 95.94	43 Technetium [98.907]	44 Ruthenium 101.07	45 Rhodium 102.906	46 Palladium 106.42	47 Silver 107.868	48 Cadmium 112.411	49 Indium 114.818	50 Tin 118.71	51 Antimony 121.760	52 Tellurium 127.6	53 Iodine 126.905	54 Xenon 131.29
55 Cesium 132.905	56 Barium 137.327	57-71 Lanthanide Series	72 Hafnium 178.49	73 Tantalum 180.948	74 Tungsten 183.85	75 Rhenium 186.207	76 Osmium 192.22	77 Iridium 192.22	78 Platinum 195.08	79 Gold 196.967	80 Mercury 200.59	81 Thallium 204.383	82 Lead 207.2	83 Bismuth 208.980	84 Polonium [209]	85 Astatine [209]	86 Radon 222.016
87 Francium [223]	88 Radium 226.025	89-103 Actinide Series	104 Rutherfordium [261]	105 Dubnium [262]	106 Seaborgium [266]	107 Bohrium [264]	108 Hassium [269]	109 Meitnerium [268]	110 Darmstadtium [269]	111 Roentgenium [272]	112 Copernicium [285]	113 Nh [284]	114 Fl [289]	115 Uup [288]	116 Lv [293]	117 Uus [289]	118 Og [289]
57 Lanthanum 138.905	58 Cerium 140.116	59 Praseodymium 140.908	60 Neodymium 144.24	61 Promethium [145]	62 Samarium 150.36	63 Europium 151.964	64 Gadolinium 157.25	65 Terbium 158.925	66 Dysprosium 162.50	67 Holmium 164.930	68 Erbium 167.255	69 Thulium 168.934	70 Ytterbium 173.054	71 Lutetium 174.967	72 Hafnium 178.49	73 Tantalum 180.948	74 Tungsten 183.85
89 Actinium 227.028	90 Thorium 232.038	91 Protactinium 231.036	92 Uranium 238.029	93 Neptunium 237.048	94 Plutonium 244.064	95 Americium 243.061	96 Curium 247.070	97 Berkelium 247.070	98 Californium 251.080	99 Einsteinium [252]	100 Fermium [257]	101 Mendelevium [258]	102 Nobelium [259]	103 Lawrencium [260]	104 Rutherfordium [261]	105 Dubnium [262]	106 Seaborgium [266]

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