UNIVERSITY COLLEGE TATI

UNIVERSITY COLLEGE TATI (UC TATI)

FINAL EXAMINATION QUESTION BOOKLET

COURSE CODE	: DTC 1033
COURSE	: GENERAL CHEMISTRY
SEMESTER/SESSION	: 1-2024/25 (DNDT)
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 5 PRINTED PAGES INCLUDING COVER PAGE

QUESTION 1

Lewis dot structure follows the octet rule in the bonding of atoms. However, there are a few exceptions implemented.

a) BF_3 has two possible structures. Indicate the stable structure by calculating the formal charge. (7 marks)

b) Structures for CO_2 and NO_2^- have different molecular geometry. Present the molecular geometry for both molecules by drawing the Lewis structures. (10 marks)

c) By giving a suitable example, define the term hydrogen bonding. (3 marks)

QUESTION 2

a) Discuss the acid and base terms based on the below concept. Also, give one (1) example for each. (8 marks)

i. Arrhenius Concept

ii. Bronsted-Lowry Concept

b) In an experiment, students are required to dilute H_2SO_4 to prepare a stock solution.

i. Show how many milliliters of 3.0 M H_2SO_4 are required to prepare 450 mL of 0.10 M of H_2SO_4. (3 marks)

ii. Solve the molar mass of H_2SO_4. (2 marks)

c) If 37.12 mL of 0.543 M LiOH neutralized 40.50 mL of H_2SO_4, show the calculation to solve how much molarity of the acid is needed. (7 marks)

$$2\ LiOH + H_2SO_4 \rightarrow Li_2SO_4 + 2\ H_2O$$

QUESTION 3

Chemical equilibrium is the state reached by a reaction mixture when the rates of forward and reverse reactions have become equal.

a) (4 marks)

$$N_2O_{4(g)} \leftrightarrow 2NO_{2(g)}$$

Based on the Le Chaterlier's Principle, state either the reaction shifts to *right* or *left*.

i. The concentration of $N_2O_4(g)$ is increased.

ii. The concentration of $N_2O_4(g)$ is decreased.

b) For a system: (12 marks)

$$N_2O_{4(g)} \leftrightarrow 2NO_{2(g)}$$

K_c for reaction at 100 °C is 0.36. Determine the concentration of all species at 100 °C if the initial concentration of N_2O_4 is 0.1 M.

c) An equilibrium reaction:

$$CO(g) + H_2O(g) \leftrightarrow CO_2(g) + H_2(g)$$

i. Write the equilibrium constant expression for the above equation. (2 marks)

ii. The initial reaction of the above equation starts with 1.0 mol of CO and 1.0 mole of H_2O in a 50 L vessel and reaches the equilibrium mixture at 1000 °C. The equilibrium constant K_c at this temperature is 0.58. Show the evidence in the calculation how the final mole of each substance in the equilibrium mixture is achieved as listed below: (12 marks)

CO = 0.57 moles; H_2O = 0.57 moles; CO_2 = 0.43 moles; H_2 = 0.43 moles

QUESTION 4

The pH scale is a measure of the hydrogen ion concentration for acid and base.

a) Define these terms and give one example for each. (6 marks)

i. Strong acid

ii. Strong base

b) Predict the molarity of hydronium ion in a solution of pH 8.25. (3 marks)

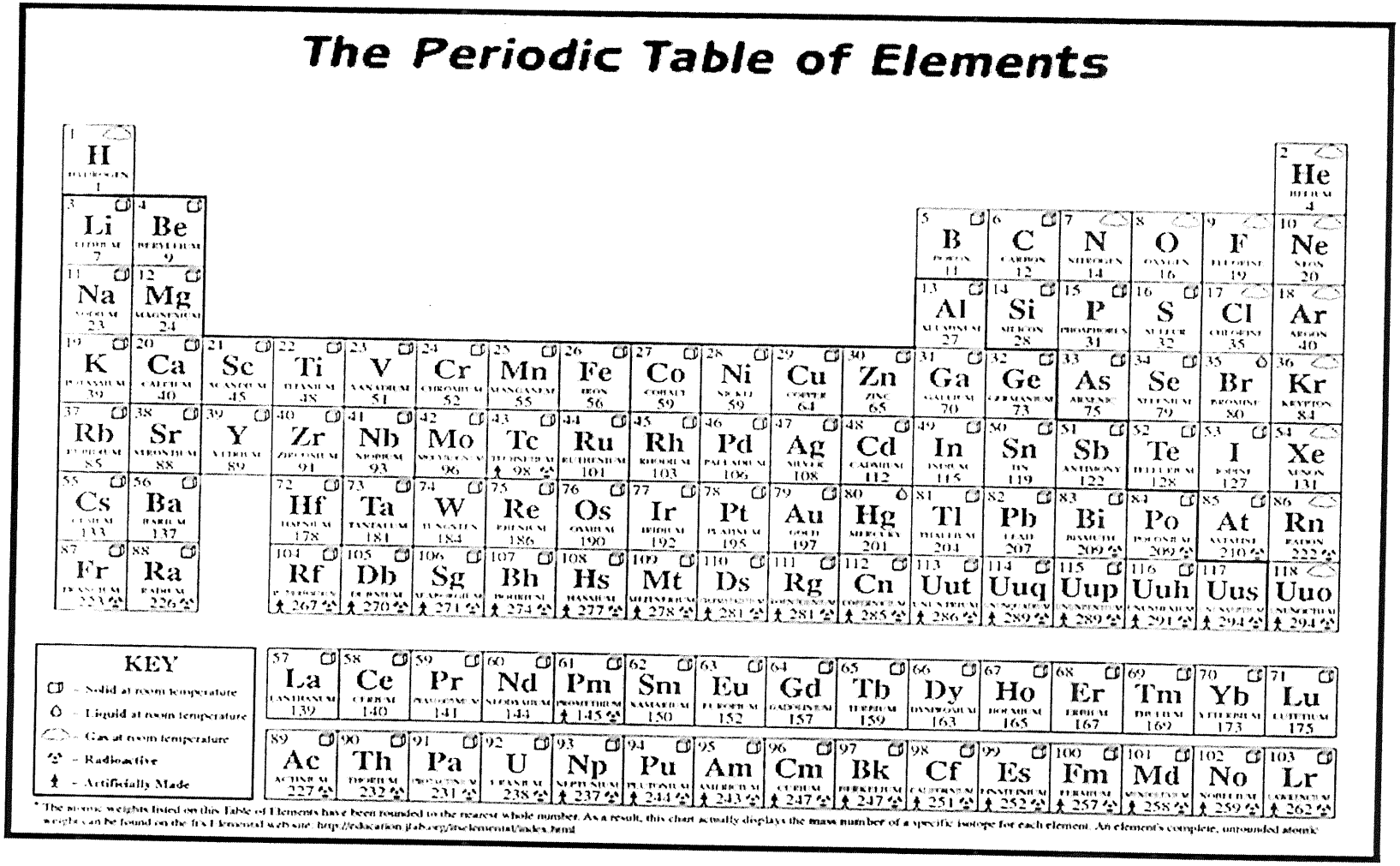
c) 0.25M of HCN solution has a pH of 5. Manipulate the given data to find the value of K_a. (12 marks)

$$HCN\ (aq) \longleftrightarrow H^+(aq) + CN^-(aq)$$

d) At 25 ^oC pH of a base solution is 10.30. Determine pOH. Solve the concentration of H^+ and OH. (9 marks)

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

Appendix 1


The Periodic Table of Elements
KEY
- Solid at room temperature
- Liquid at room temperature
- Gas at room temperature
- Radioactive
- Artificially Made
* The atomic weights listed on this Table of Elements have been rounded to the nearest whole number. As a result, this chart actually displays the mass number of a specific isotope for each element. An element's complete, unrounded atomic weight can be found on the IUPAC Periodical web site. http://education.jlab.org/itselemental/index.html