



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**

## GENERAL CHEMISTRY (DTC 1033)

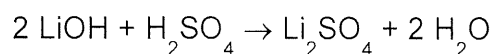
**QUESTION 1**

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

- a)  $\text{BF}_3$  has two possible structures. Indicate the stable structure by calculating the formal charge. (7 marks)
- b) Structures for  $\text{CO}_2$  and  $\text{NO}_2^-$  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  $\text{H}_2\text{SO}_4$  to prepare a stock solution.
  - i. Show how many milliliters of 3.0 M  $\text{H}_2\text{SO}_4$  are required to prepare 450 mL of 0.10 M of  $\text{H}_2\text{SO}_4$ . (3 marks)
  - ii. Solve the molar mass of  $\text{H}_2\text{SO}_4$ . (2 marks)
- c) If 37.12 mL of 0.543 M  $\text{LiOH}$  neutralized 40.50 mL of  $\text{H}_2\text{SO}_4$ , show the calculation to solve how much molarity of the acid is needed. (7 marks)



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**QUESTION 3**

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

- a) 
$$\text{N}_2\text{O}_4(\text{g}) \leftrightarrow 2\text{NO}_2(\text{g})$$
 (4 marks)

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

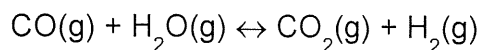
- i. The concentration of  $\text{N}_2\text{O}_4(\text{g})$  is increased.
- ii. The concentration of  $\text{N}_2\text{O}_4(\text{g})$  is decreased.

- b) For a system:



$K_c$  for reaction at 100 °C is 0.36. Determine the concentration of all species at 100 °C if the initial concentration of  $\text{N}_2\text{O}_4$  is 0.1 M.

- c) An equilibrium reaction:



- 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  $\text{H}_2\text{O}$  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)

$\text{CO} = 0.57 \text{ moles}$ ;  $\text{H}_2\text{O} = 0.57 \text{ moles}$ ;  $\text{CO}_2 = 0.43 \text{ moles}$ ;  $\text{H}_2 = 0.43 \text{ moles}$

**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)
- $$\text{HCN (aq)} \rightleftharpoons \text{H}^+(\text{aq}) + \text{CN}^-(\text{aq})$$
- d) At 25 °C pH of a base solution is 10.30. Determine pOH. Solve the concentration of  $\text{H}^+$  and  $\text{OH}^-$ . (9 marks)

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

1	<b>H</b> HYDROGEN 1	2	<b>He</b> HELIUM 4
3	<b>Li</b> LITHIUM 7	4	<b>Be</b> BERYLLIUM 9
11	<b>Na</b> SODIUM 23	12	<b>Mg</b> MAGNESIUM 24
19	<b>K</b> POTASSIUM 39	20	<b>Ca</b> CALCIUM 40
37	<b>Rb</b> RUBIDIUM 85	38	<b>Sr</b> STRONTIUM 88
55	<b>Cs</b> CAESIUM 133	56	<b>Ba</b> BARIUM 137
87	<b>Fr</b> FRANCIUM 223	88	<b>Ra</b> RADIOACTIVELY 226
21	<b>Sc</b> SCANDIUM 45	22	<b>Ti</b> TITANIUM 48
39	<b>Y</b> YTIPIUM 89	40	<b>Zr</b> ZIRCONIUM 91
57	<b>La</b> LANTHANUM 139	58	<b>Ce</b> CELESIUM 140
89	<b>Ac</b> ACTINIUM 227	90	<b>Th</b> THORIUM 232
23	<b>Cr</b> CHROMIUM 52	24	<b>V</b> VANADIUM 51
41	<b>Nb</b> NIOBIUM 93	42	<b>Mo</b> MOLYBDENUM 96
59	<b>Pr</b> PRASEODYMIUM 141	60	<b>Nd</b> NEODYMIUM 144
81	<b>Tm</b> TERBIUM 159	82	<b>Yb</b> YTERBIUM 173
103	<b>Lu</b> LUTETIUM 175	104	<b>La</b> LANTHANUM 139
125	<b>Pr</b> PRASEODYMIUM 141	126	<b>Ce</b> CELESIUM 140
147	<b>Sm</b> SAMARIUM 150	148	<b>Pm</b> PROMETHIUM 145
169	<b>Eu</b> EUROPIUM 152	170	<b>Gd</b> GADOLINIUM 157
191	<b>Tb</b> TERBIUM 159	192	<b>Dy</b> DYSPROSIUM 163
213	<b>Ho</b> HOLMIUM 165	214	<b>Er</b> ERBIUM 167
235	<b>Tm</b> TERBIUM 169	236	<b>Yb</b> YTERBIUM 173
257	<b>Lu</b> LUTETIUM 175	258	<b>La</b> LANTHANUM 139
279	<b>Pr</b> PRASEODYMIUM 141	280	<b>Ce</b> CELESIUM 140
301	<b>Sm</b> SAMARIUM 150	302	<b>Pm</b> PROMETHIUM 145
323	<b>Eu</b> EUROPIUM 152	324	<b>Gd</b> GADOLINIUM 157
345	<b>Tb</b> TERBIUM 159	346	<b>Dy</b> DYSPROSIUM 163
367	<b>Ho</b> HOLMIUM 165	368	<b>Er</b> ERBIUM 167
389	<b>Tm</b> TERBIUM 169	390	<b>Yb</b> YTERBIUM 173
411	<b>Lu</b> LUTETIUM 175	412	<b>La</b> LANTHANUM 139
433	<b>Pr</b> PRASEODYMIUM 141	434	<b>Ce</b> CELESIUM 140
455	<b>Sm</b> SAMARIUM 150	456	<b>Pm</b> PROMETHIUM 145
477	<b>Eu</b> EUROPIUM 152	478	<b>Gd</b> GADOLINIUM 157
499	<b>Tb</b> TERBIUM 159	500	<b>Dy</b> DYSPROSIUM 163
521	<b>Ho</b> HOLMIUM 165	522	<b>Er</b> ERBIUM 167
543	<b>Tm</b> TERBIUM 169	544	<b>Yb</b> YTERBIUM 173
565	<b>Lu</b> LUTETIUM 175	566	<b>La</b> LANTHANUM 139
587	<b>Pr</b> PRASEODYMIUM 141	588	<b>Ce</b> CELESIUM 140
609	<b>Sm</b> SAMARIUM 150	610	<b>Pm</b> PROMETHIUM 145
631	<b>Eu</b> EUROPIUM 152	632	<b>Gd</b> GADOLINIUM 157
653	<b>Tb</b> TERBIUM 159	654	<b>Dy</b> DYSPROSIUM 163
675	<b>Ho</b> HOLMIUM 165	676	<b>Er</b> ERBIUM 167
697	<b>Tm</b> TERBIUM 169	698	<b>Yb</b> YTERBIUM 173
719	<b>Lu</b> LUTETIUM 175	720	<b>La</b> LANTHANUM 139
741	<b>Pr</b> PRASEODYMIUM 141	742	<b>Ce</b> CELESIUM 140
763	<b>Sm</b> SAMARIUM 150	764	<b>Pm</b> PROMETHIUM 145
785	<b>Eu</b> EUROPIUM 152	786	<b>Gd</b> GADOLINIUM 157
807	<b>Tb</b> TERBIUM 159	808	<b>Dy</b> DYSPROSIUM 163
829	<b>Ho</b> HOLMIUM 165	830	<b>Er</b> ERBIUM 167
851	<b>Tm</b> TERBIUM 169	852	<b>Yb</b> YTERBIUM 173
873	<b>Lu</b> LUTETIUM 175	874	<b>La</b> LANTHANUM 139
895	<b>Pr</b> PRASEODYMIUM 141	896	<b>Ce</b> CELESIUM 140
917	<b>Sm</b> SAMARIUM 150	918	<b>Pm</b> PROMETHIUM 145
939	<b>Eu</b> EUROPIUM 152	940	<b>Gd</b> GADOLINIUM 157
961	<b>Tb</b> TERBIUM 159	962	<b>Dy</b> DYSPROSIUM 163
983	<b>Ho</b> HOLMIUM 165	984	<b>Er</b> ERBIUM 167
1005	<b>Tm</b> TERBIUM 169	1006	<b>Yb</b> YTERBIUM 173
1027	<b>Lu</b> LUTETIUM 175	1028	<b>La</b> LANTHANUM 139
1049	<b>Pr</b> PRASEODYMIUM 141	1050	<b>Ce</b> CELESIUM 140
1071	<b>Sm</b> SAMARIUM 150	1072	<b>Pm</b> PROMETHIUM 145
1093	<b>Eu</b> EUROPIUM 152	1094	<b>Gd</b> GADOLINIUM 157
1115	<b>Tb</b> TERBIUM 159	1116	<b>Dy</b> DYSPROSIUM 163
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