Mahira

University of Information Technology & Sciences (UITS)

Faculty of Science and Engineering

Department of Computer Science and Engineering

Program: B.Sc. in CSE

Term Final Examination, Spring 2025

Course Title: Engineering Chemistry

Course Code: CHEM 0531111

Marks: 50 **Time: 3 *(three)* hours**

(Answer all questions)

Q.No.	Questions	Marks
1. (a)	Lewis structures extend the concept of the electron dot diagram by adding lines between atoms to represent shared pairs in a chemical bond. **Identify** the Lewis dot structures of CH_2O, BCl_3, NO_3^-, PCl_3, PCl_5.	[05]
(b)	In Hybridization, the five shapes are linear, trigonal planar, tetrahedral, Trigonal planar, Trigonal by-Pyramidal, and octahedral. However, NH_3 and H_2O both are SP^3 hybridized but H_2O is V shaped where NH_3 is Pyramidal. **Explain** the phenomenon with electronic configuration, hybridization mechanism and appropriate figures.	[05]
2. (a)	The valence-bond theory failed to adequately explain how certain molecules contain two or more equivalent bonds whose bond orders lie between a single bond and pa double bond. However, the molecular orbital theory solves the problem by describing geometry of the molecules. **Describe** the principles of molecular orbital theory.	[04]
(b)	Molecular orbital theory (MOT) can explain the bond order, stability and magnetic behavior of a molecule. **Explain** the bond order and magnetic behavior of N_2, O_2, F_2 and NO using the MOT diagram.	[06]
3. (a)	Karim asks Zaman to prepare buffer solution for an experiment in the chemistry laboratory. Zaman takes CH_3COOH, NH_4OH and some other chemicals to help Karim to prepare buffer solutions. **Explain** how Zaman can prepare acidic and basic buffer solutions and **discuss** the mechanism of acidic and basic buffer solution to maintain constant pH.	[04]
(b)	In the chemical laboratory, sometimes we need to add water to dilute the concentrated solutions. Sometimes, we use simple formula to find out the pH and neutralizing point. Using these formulas, answer the followings:	[06]
	i. You have 0.01M HCl and 0.0125M H_2SO_4 in the laboratory. **Calculate** pH of all of the acids.	
	ii. You have a 18M HCl solution in your lab. But, for a chemical reaction, you need 200mL of 0.5M HCl solution. **Solve** the problem.	
	iii. To neutralize a monoprotic base, 200mL of 1M HCl, 100mL of 0.5M H_2SO_4 and 250mL of 0.25M HNO_3 were required. **Identify** the pH of that base.	

4. (a) In a galvanic cell, Zn and Cu are used as electrode. [06]

i. **Draw** the galvanic cell and **indicate** anode-cathode.

ii. **Write** the oxidation and reduction half-reaction.

(b) Using the Table 4(b), **Calculate** the standard EMF (E°cell) of the electrochemical cell: [04]

i. $Al(s) | Al^{3+} || Zn^{2+} | Zn(s)$

ii. $Ca(s) | Ca^{2+} || Zn^{2+} | Zn(s)$

Table 4 (b): Standard Reduction Potential Series

Half-Reaction	E° (V) vs SHE
$Ca^{2+} + 2e \rightarrow Ca$	−2.87
$Al^{3+} + 3e \rightarrow Al$	−1.66
$Zn^{2+} + 2e \rightarrow Zn$	−0.76

5. (a) Figure 5(a) represents a chemical reaction taking place in a sealed container. [06]

i. **State** and **explain** Le Chatelier's Principle.

ii. **Predict** the effect of decreasing temperature and increasing pressure on the concentration of NH_3.

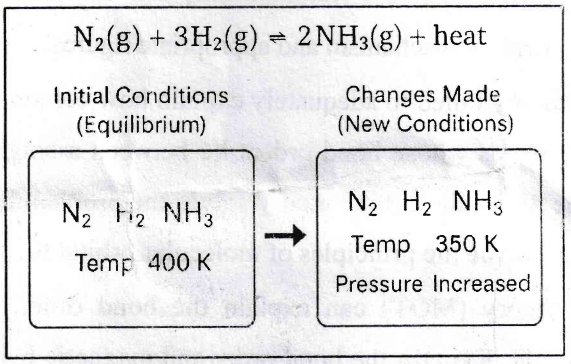

Figure 5(a)

(b) Figure 5(b) represents typical chemical reactions in equilibrium condition. [04]

i. **Identify** which curve (A or B) represents the reactant and product in both Plots.

ii. **Compare** the concentration of reactants and products at equilibrium in the Plot 1 vs. Plot 2.

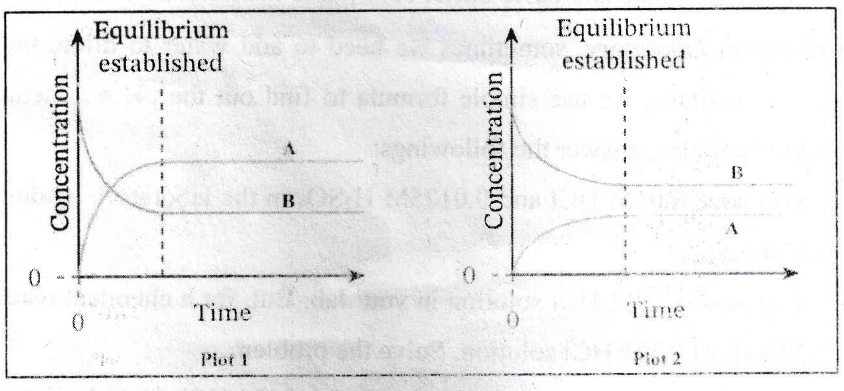

Figure 5(b)