



Registration Number:

Date & Session:

**ST. JOSEPH'S UNIVERSITY, BENGALURU -27**  
**B.Sc. (BIOCHEMISTRY) – I SEMESTER**  
**SEMESTER EXAMINATION: OCTOBER 2023**  
(Examination conducted in November / December 2023)  
**BCH 121 – Inorganic and physical Chemistry**  
**(For current batch students only)**

**Time: 2 Hours**

**Max Marks: 60**

**This paper contains 3 printed pages and 4 parts**

**PART-A**

**Answer any eleven of the following in a word or in a sentence. [1 X 11 = 11M]**

1. Out of 4p and 5s which orbital will be filled first?
2. How does covalent bond form according to VBT?
3. What do you mean by chelation?
4. While diethyl ether has a boiling point of 35 °C, n-butanol has a boiling point of 117 °C. Why?
5. How is Gibbs free energy of dissolution connected to entropy and enthalpy? Express in the form of an equation.
6. Mathematically express  $K_a$  for a weak acid HA which dissociates into  $H^+$  and  $A^-$ .
7. The existence of  $H^+$  and  $OH^-$  in 1 litre of water is  $1 \times 10^{-7}$  M. Based on this, how many water molecules exist in ionic form per mole of water?
8. Why does a salt of strong acid and strong base, eg. NaCl not undergo hydrolysis?
9. A buffer has pKa of 7.21. What is its buffering range?
10. What is equivalent conductance?
11. What would happen if an electrochemical cell would attain equilibrium?
12. If you have three metal electrodes dipped in their salt solutions which are made of Cu ( $E^\circ = +0.337$ ), Zn ( $E^\circ = -0.7628$ ) and Ag ( $E^\circ = +0.799$ ), predict the order of tendency to release electrons from high to low.
13. What is standard Gibbs free energy change?

**PART-B**

**Answer any nine of the following. [2 X 9 = 18M]**

14. Diagrammatically represent covalent bond formation for carbon dioxide molecule.
15. Illustrate the formation of co-ordinate bond in  $H_3O^+$
16. Differentiate between bonding and antibonding molecular orbitals.
17. Write the resonance form of benzene.
18. What causes Donnan equilibrium and how does  $Na^+/K^+$ -ATPase act to counter it?
19. Water possesses dual acid and base character. Show how.
20. Give Faraday's first law of electrolysis.
21. The pKa of acetic acid is 4.76. What should be the ratio of concentrations of acetic acid and acetate ions if the acetate buffer should have a pH of 5.74?

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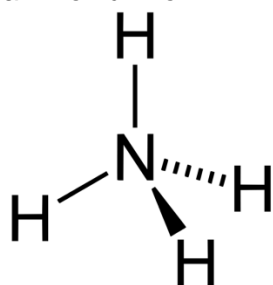
22. How is molar/equivalent conductance influenced by a) increase in temperature and b) strong electrolyte
23. State Kohlrausch's law of independent ion migration.
24. Give the relation between free energy change ( $\Delta G$ ) and emf of a cell ( $E$ )

### PART-C

Answer any seven of the following.

[3 X 7 = 21M]

25. Write the electronic configuration for the following
- (i)  $Z = 29$
- (ii)  $Z = 38$
- (iii)  $Z = 10$
26. With the help of VSEPR theory, discuss the geometry of  $SF_4$  molecule.
27. Calculate the formal charges of ammonium ion



28. Explain  $sp^2$  hybridization with a suitable example.
29. How does the a) radius and b) length of a pipe affect the resistance to flow?
30. Give the reaction of quinhydrone electrode. Why is it used as a reference electrode?
31. What is buffer action? Elucidate how acetate buffer resists the change in pH when HCl and NaOH are added to it.
32. Write Nernst equation and explain the terms.
33. Differentiate the set-up of a voltaic cell and electrolytic cell using simple diagrams. Mark the anode and cathode, and show where reduction & oxidation occurs in both cells.

### PART-D

Answer any two of the following.

[5 X 2 = 10M]

34. (i) Which one among the following species is not likely to have tetrahedral shape?  $SiBr_4$ ,  $NF_4^+$ ,  $SF_4$  and  $SF_4^-$
- (ii) Based on molecular orbital theory, explain which molecule would have the longer bond length:  $F_2$  or  $F_2^+$ ? (3 + 2)
35. a)  $pK_a$  of acetyl salicylic acid (aspirin) is 3.5. Gastric juice has a pH of around 2-3. In the intestine, pH is  $\sim 8.0$ . Based on its  $pK_a$ , assuming that ionized compounds are absorbed better, predict whether aspirin absorption will be higher in the stomach or in the intestine. Substantiate your answer. (2 M)
- b) A glycine solution of 0.01M was prepared by the lab technician.
- $$^+NH_3-CH_2-COOH \longleftrightarrow ^+NH_3-CH_2-COO^- \longleftrightarrow ^-NH-CH_2-COO^-$$
- The pH meter was not functioning well. If  $K_{a1} = 4.5 \times 10^{-3}$  and  $K_{a2} = 1.7 \times 10^{-10}$  at 298K, what would be the pH of this solution?

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36. a) Calculate the emf of the cell  $\text{Ni} \mid \text{Ni}^{2+} (1.0 \text{ M}) \parallel \text{Au}^{3+} (1.0 \text{ M}) \mid \text{Au}$  if  $E^\circ$  for  $\text{Ni}^{2+} \mid \text{Ni} = -0.25 \text{ V}$  and  $E^\circ$  for  $\text{Au}^{3+} \mid \text{Au}$  is  $+1.5 \text{ V}$ . Show the steps in detail. (3 M)
- b) Why do you think that sodium batteries are becoming more popular than the existing Li-ion batteries? Give any 2 advantages of Na-ion over Li-ion batteries (2 M)