JHARKHAND Rai University
RANCHI

PRACTICE SET

End Semester Examination, Spring- 2026

Program: B.Tech.
Semester: II
Course: Chemistry
Course Code: 8BSC103

Course Outcomes	Description
CO1	Learn about the bonding in a molecular structure of simple and complex molecule , magnetism and isomerism in complex molecule
CO2	Learn about limitations of classical mechanics and solution in terms of quantum mechanics for atomic/molecular systems. Gain insight into the basic principles of UV, IR and NMR spectroscopic techniques. Use spectroscopic techniques to determine structure and stereochemistry of known and unknown compounds.
CO3	Learn about aromaticity of organic compound identify and differentiate prochirality and chirality at centres, axis and determine the absolute configuration. Evaluate the stability of various conformers of acyclic and cyclic systems
CO4	Learn about the rate of reaction, order and molecularity of reaction, mechanism of a simple as well as catalytic reaction
CO5	Learn about the phases and the electrochemical behaviour of the molecules, EMF of cell and its application.

UNIT I

Section B (Each carries 10 marks)
(Both HOT/LOT)

1. Elaborate what are the main types of defect that occurs in a solid. [CO1] [Understanding]
2. A coordination compound [Co $(NH_3)_4Cl_2$] Cl exhibits two different isomeric forms. Using Valence Bond Theory, determine the hybridization and geometry of the complex ion. [CO1] [Apply]
3. Based on band theory, explain the different types of metals and their magnetic properties**.** [CO1] [Analyse]
4. What do you mean by radius ratio rule? Give limiting radius for different co-ordinations. [CO1] [Understanding]
5. Why are ionic compounds usually high melting, whilst most simple covalent compounds have low melting points? [CO1] [Understanding]

6. Explain the key principles of Werner's theory related to complex compounds and Describe the postulates of crystal field theory [CO1] [Remember]

Section C (Each carries 20 marks)

(HOT)

7. Have you heard the term CFSE. Explain it. How do you explain crystal field splitting in octahedral and tetrahedral complexes. [CO1][Apply]

8. How would you explain Jahn Teller distortion and its type? [CO1][Apply]

UNIT II

Section B (Each carries 10 marks)
(Both HOT/LOT)

9. What are the applications of NMR and MRI spectroscopy? [CO2][Understand]
10. Discuss what are the principal of spectroscopy? What is IR Spectroscopy used for. [CO2][Understand]
11. Explain the principle behind IR spectroscopy. What are the factors necessary in a molecule to absorb IR radiation? [CO2][Analyse]
12. What are the processes of fluorescence and phosphorescence, and how do you compare them? [CO2][Analyse]
13. Explain the general appearance of IR Spectrum of normal alkane. What are the changes in the above spectrum seen upon the introduction of following structural residues? [CO2][Analyse]

b) a. Benzene
c) b. Alkane
d) c. Alkene
e) d. Alkyne
f) e. Carbonyl

Section C (Each carries 20 marks)
(HOT)

14. A pharmaceutical compound is investigated using fluorescence spectroscopy, infrared (IR) spectroscopy, and Nuclear Magnetic Resonance (NMR) techniques. [CO2][Analyse]

a) The compound shows intense fluorescence in a biological medium but weak fluorescence in isolation. Analyse the possible reasons for this behaviour and discuss how the surrounding environment affects fluorescence efficiency.

b) The IR spectrum of the compound indicates multiple vibrational bands, while rotational fine structure is not clearly observed. Analyse why rotational spectra are often not resolved in IR spectra of molecules under normal conditions.

UNIT III

Section B (Each carries 10 marks)
(Both HOT/LOT)

15. Explain one of the bonding theory in molecule. VBT or Molecular orbital (MO) t h e o r y . [CO3] [Understanding]
16. What is meant by hybridization, and what are the different types of it? [CO3][Remembering]
17. What are conformers in organic chemistry? List and explain the various conformers of butane. [CO3][Understanding]
18. Draw sawhorse formula for a) Ethane b) Butane
Inter convert these two into Newman projection formula. [CO3] [Create]

19. Find out aromatic, anti-aromatic and non-aromatic compound from following. Give reason in behalf of your answer.1) Benzene 2) Benzene anion 3) Cyclopentadien cation 4) Pyrrole 5) Pyridine. [CO3] [Apply]

Section C (Each carries 20 marks)
(HOT)

20. Sketch the MO diagram of O_2 and N_2 molecule. [CO3][Apply]
21. Do Conformational analysis of Cyclohexane. [CO3][Analysis]

UNIT IV

Section B (Each carries 10 marks)
(Both HOT/LOT)

22. If rate of disappearance of H_2 is 12 $molL^{-1}sec^{-1}$

$N_2 + 3\ H_2 \rightarrow 2NH_3$

a) Calculate rate of disappearance of N_2?
b) Calculate rate of formation of NH_3?
c) Calculate rate of reaction?
[CO4][Apply]

23. How would you characterize a catalyst? [CO4][Analyse]
24. A chemical reaction is carried out in a laboratory where the rate of reaction is studied under different conditions. It is observed that:

- The reaction rate doubles when the concentration of reactant A is doubled, but remains unchanged when the concentration of reactant B is increased.

Based on these observations, answer the following:

1. Analyse and determine the order of the reaction with respect to reactants A and B, and hence find the overall order of the reaction.
2. Evaluate whether the molecularity of the reaction can be directly inferred from the given data. Justify your reasoning. [CO4][Create]

Section C (Each carries 20 marks)
(HOT)

25. Give kinetic of first order reaction. The rate constant for a first order reaction is $1.54 * 10^{-3}$ S^{-1}.Calculate half- life time. [CO4][Create]
26. Give kinetic of zero order reaction. A→ B
For a zero order reaction if concentration of A decrease from 0.1M to0.05 in 10 sec. Calculate concentration of A after 15 sec. [CO4] [Create]

UNIT V

Section B (Each carries 10 marks)
(Both HOT/LOT)

27. Explain equilibrium constant and its significance. [CO4][Understanding]
28. What is law of chemical equilibrium? [CO5][Analyse]
29. Derive Nernst equation. [CO5][Apply]
30. A galvanic cell is constructed using two half-cells: one containing a weak electrolyte and the other containing a strong electrolyte. During the experiment, the following observations are made:

- The equilibrium constant of the cell reaction is very high.
- The measured EMF of the cell is positive and decreases slightly over time.
- The ionization of the weak electrolyte increases upon dilution.

Based on these observations, answer the following:

a) Analyse the relationship between the equilibrium constant (K) and EMF of the cell, and explain why a large value of K corresponds to the observed EMF.

b) Compare the behaviour of weak and strong electrolytes in terms of degree of ionization and their effect on cell potential. [CO5][Analyse]

Summary Sheet:

CO Wise

CO	Q. No	Marks
CO1	1,2,3,4,5,6,7,8	80
CO2	9,10,11,12,13,14	70
CO3	15,16,17,18, 19,20,21	80
CO4	22,2324,25,26	70
CO5	27,28,29,30	40
Total		**340**

Unit Wise

Unit	Q. No	Marks
Unit 1	1,2,3,4,5,6,7,8	80
Unit 2	9,10,11,12,13,14	70
Unit 3	15,16,17,18, 19,20,21	80
Unit 4	22,2324,25,26	70
Unit 5	27,28,29,30	40
Total		**340**

Blooms Taxonomy Level (BTL) Wise

BTL	Q. No	Marks
LOT	1,4,7,8,13,14,	60
HOT	2,3,5,6,9,10,11,12,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30	280
Total		**340**

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Disclaimer: - This is a practice set. The Question in End term examination will differ from the practice set. This practice set is meant for practice only.