2026

CHEMISTRY

(Minor)

Paper : CHE4200104MN

(Chemistry—II)

Anandaram Dhekial Phookan College Library * Nagaon : Assam *
Acc. No.
Date

Full Marks : 45

Time : 2 hours

The figures in the margin indicate full marks for the questions.

1. Answer the following as directed : **1×5=5**

(a) Give one example of didentate ligand.

(b) $C_v - C_p = R$. (Write True / False)

(c) Arrange the following in decreasing order of acid strength :

$ClCH_2COOH$, FCH_2COOH, $CNCH_2COOH$, CH_3COOH

(d) The structure of CO_2 is _____. (Fill in the blank)

(e) Which of the following is a state function?

i) Heat ii) Heat capacity iii) Work done iv) Internal energy

(Choose the correct option)

2. Answer *any five* of the following questions : **2×5=10**

(a) State Hess's law and explain it with an example.

(b) How do the presence of electron withdrawing and electron releasing group in the benzene ring affect the strength of benzoic acid?

(c) A reversible heat engine working between 273 K and 373 K absorbs 840 J of heat from the source. Calculate—i) work done and ii) efficiency of the engine.

(d) Write a note on Berry pseudorotation.

(e) What are Lewis acids and bases? Why electrophiles are Lewis acids while nucleophiles are Lewis bases?

(f) State and explain the zeroth law of thermodynamics. What is the significance of the law?

(g) What is ionization isomerism in coordination compounds? Give examples.

(h) What are carbanions? Draw the structure of alkyl carbanion.

(i) What are intermolecular and intramolecular hydrogen bonds? Give one example of each of them.

(j) What is a polar molecule? Explain why H_2O is polar and CO_2 is non-polar molecule.

3. **Answer *any four* of the following questions :** **5×4=20**

(a) Discuss the method of preparation and a few reactions involving benzyne mechanism.

(b) What are nitrenes? What is meant by singlet and triplet nitrene? Give two methods of generation of nitrenes. 1+2+2=5

(c) Mention about different types of hybridization involving *d*-orbitals. On the basis of such hybridization, discuss the formation of PCl_5 and the shape of the molecule. 2+3=5

(d) Name the following according to IUPAC systems : 1×5=5

i) $[Cr(NH_3)_3(H_2O)\ (Cl)\ (NO_2)]Cl$ ii) $[Cu(en)_2]^{2+}$

iii) $Na_3\ [Ag(S_2O_3)_2]$ iv) $Fe_4\ [Fe(CN)_6]_3$

v) $[Co(NH_2\text{-}CH_2\text{-}CH_2\text{-}NH_2)_3]_2(SO_4)_3$

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(e) Give the molecular electronic configuration of C_2 molecule. Draw the MO energy level diagram of the C_2 molecule. Calculate bond order of the molecule and explain its magnetic property. 1+2+2=5

(f) What are the definitions of pK_a and pK_b? Higher the K_a /K_b value of an acid or a base, stronger is the acid/base but more is the pK_a/pK_b value weaker is the acid/base. Explain. 2+3=5

(g) Derive Maxwell's relations. What is the significance of the relations? 4+1=5

(h) Define Joule-Thomson coefficient and derive an expression for the same thermodynamically. Under what conditions cooling and heating effects are observed in case of real gases? 1+2+2=5

4. **Answer *any one* of the following questions :** **10**

(a) (i) With the help of suitable examples, discuss about the stereochemistry of coordination compounds having coordination number '6'. 6

(ii) Draw the structures of the following coordination compounds : 1×4=4

1) Potassium hexabromoplatinate(II)

2) Triamminedibromidochloridoplatinum(IV) ion

3) Tris(ethylenediamine)cobalt(III) chloride

4) Hexaaquairon(III) ion

(b) Discuss with suitable example about the weak chemical forces.

(c) (i) Explain the formation of H_2 molecule on the basis of valence bond theory. 5

(ii) State Fajan's rule. With the help of Fajan's rules, explain the following : 1+(2×2)=5

1) KI is soluble in alcohol whereas KCl is insoluble in alcohol.

2) $AlCl_3$ is covalent but NaCl is ionic.

(d) (i) Explain how Kirchhoff's equation may be used to calculate ΔH value of a reaction from heat capacity data. 5

(ii) What is a Carnot cycle? Derive an expression of the efficiency of a reversible Carnot cycle taking an ideal gas as the working material. Is it possible to have a Carnot cycle of efficiency one? 1+3+1=5

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