6/H–23 (vii) (a) (Syllabus–2015)

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(July)

CHEMISTRY

(Honours)

(Part–A : Inorganic Chemistry)

(Chem–H–601)

Marks : 38

Time : 2 hours

The figures in the margin indicate full marks for the questions

Answer *any* **one** question from each Section

SECTION—I

1. *(a)* What is meant by the -acidity of a ligand? Compare the bonding characteristics of metal carbonyls and metal nitrosyls. 4

(b) Give the mechanism of homogeneous hydrogenation of alkenes with Wilkinson's catalyst. 3

(c) Give the structure of Zeise salt. 1

(d) Give one method of preparation and one use of alkyl-lithium compounds. 2

2. *(a)* Write one method of preparation of $(C_2H_5)_2SnX_2$ and draw its structure. Give two applications of organotin compounds. 3+2=5

(b) Write down the steps involved in the synthesis of acetic acid using rhodium carbonyl iodide catalyst. 2½

(c) Explain the bonding involved in metal-ethylene complexes. 2½

SECTION—II

3. *(a)* What are the criteria for an element to be considered as essential element? 2

(b) List the diseases associated with deficiency and excess of Fe, Ca and I. 3

(c) Discuss the structure of chlorophyll and explain the light and dark reactions in photosynthesis. 5

4. *(a)* In vitamin-B_{12}, what is the oxidation state of Co? Which ligands occupy the 5th and 6th coordination positions of Co in vitamin-B_{12}? Discuss the methylation reaction involving vitamin-B_{12}. 5

(b) Give a probable mechanism for the reversible hydration of CO_2 by carbonic anhydrase. 3

(c) What are the toxic effects associated with the following metal ions? 2

Hg, Pb, Be and Al

SECTION—III

5. *(a)* Discuss the Orgel combined energy level diagram for d^1 and d^9 systems for octahedral and tetrahedral complexes. 3

(b) The IR spectra for *trans*-$[Pd(NH_3)_2Cl_2]$ and *cis*-$[Pd(NH_3)_2Cl_2]$ show the following $_{(Pd-N)}$ and $_{(Pd-Cl)}$ vibrational frequencies in cm^{-1} :

	$_{(Pd-N)}$	$_{(Pd-Cl)}$
trans-$[Pd(NH_3)_2Cl_2]$	496	333
cis-$[Pd(NH_3)_2Cl_2]$	495, 476	327, 306

Comment on the observed characteristic IR bands. 3

6. *(a)* There are no allowed transitions for $[Mn(H_2O)_6]^{2}$ still it is pale pink in colour. Why? 1

(b) IR frequencies ($_{V-F}$) in wave numbers (cm^{-1}) are furnished below for the following complexes. Comment on the differences in the observed IR frequencies : 3

VF_6 (676 cm^{-1}), VF_6^2 (584 cm^{-1}); VF_6^3 (533 cm^{-1})

(c) Determine the term symbols for *(i)* s^1p^1 and *(ii)* d^1s^1. 2

SECTION—IV

7. *(a)* Define *trans*-effect and name two ligands with *trans*-directing effect. 3

(b) What is the general relation between overall stability constant and stepwise stability constant? 3

8. *(a)* Draw the stereochemistry of substitution of the following reactions : $1\frac{1}{2}\times2=3$

(i) $[PtCl_4]^{2}$ ^{NO_2} *A* ^{NH_3} *B*

(ii) $[PtCl_4]^{2}$ ^{NH_3} *C* ^{NO_2} *D*

(b) Show that the inertness of a complex is different from its thermodynamic stability. 3

SECTION—V

9. *(a)* What do you understand by the term 'top-down' and 'bottom-up' methods in the synthesis of nanomaterials? Where are they used in nanotechnology? 3

(b) Give one method of preparation of gold nanoparticles and give its applications. 3

10. *(a)* Name the different types of nano-material and mention their uses. 3

(b) Give one method of preparation of silver nanoparticles and give its applications. 3

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