2018/ODD/08/22/CHM–101/155

PG Odd Semester (CBCS) Exam., December—2018

CHEMISTRY

(1st Semester)

Course No. : CHMCC–101

(Inorganic Chemistry—I)

Full Marks : 70
Pass Marks : 28

Time : 3 hours

The figures in the margin indicate full marks for the questions

Answer **five** questions, taking **one** from each Unit

UNIT—I

1. *(a)* Using suitable figures, work out the symmetry point group of the following species : 2×3=6

(i) O_2

(ii) SO_2Cl_2

(iii) OCS

(b) "A molecule cannot be polar if it has a centre of inversion." Rationalize. Examine if ruthenocene molecule would be polar or not. 3+2=5

(c) Illustrate improper-rotation axis, S_n citing a suitable example. 3

2. *(a)* To which point group does CCl_4 belong? What would be the consequence on symmetry if up to three Cl is replaced one at a time? 4

(b) Furnish examples of real molecules that belong to the following point groups (provide explanations) : 2×3=6

(i) C_s

(ii) C_2

(iii) D_3

(c) Using matrix representations, show that for a C_{2v} molecule

$$_{v} \qquad _{v} \qquad C_2$$ 4

UNIT—II

3. *(a)* Describe the energetics in terms of bond energy and electronegativity differences of polar covalent molecule. Considering H—Cl formation from H_2 and Cl_2, determine the differences in relative electronegativity and percent (%) ionic character. Given,

Molecule	*Bond energy* (kJ/mole)
H_2	430
Cl_2	238
HCl	426

3+1+1=5

(b) Based on VSEPR model, comment on the shapes of the following : 1½×4=6

(i) $ClO_4]$

(ii) $SbCl_5$

(iii) SOF_4

(iv) XeF_6

(c) Illustrate the crystal field splitting of Ni(II) complexes containing H_2O and CN—ligands, respectively. 3

4. *(a)* Explain Walsh diagram in predicting the shape of BeH_2 molecule. 4

(b) Furnish the MO energy level diagram of CO. Comment on mode of bonding with transition metals. 4

(c) Assuming ionic bonding between two atoms in NaF, calculate the crystal energy. Given, r_{Na} 0 95 Å, r_F 1 36 Å repulsive exponents 8 7, Madelung constant 1 747. 3

(d) Write a short note on metallic bond and band theory. 3

UNIT—III

5. *(a)* What are clusters? How does metal cluster differ from coordination complexes? Give examples of *(i)* organo-metallic cluster and *(ii)* suboxide clusters. 3

(b) Draw the topological diagram of B_5H_9 using Styx rule. Calculate the number of skeletal electrons of B_5H_9 and determine the polyhedron to which the cluster belongs. 5

(c) Discuss the preparation, structure and properties of *ortho*-carborane. 3

(d) Complete the following reactions : 3

(i) $B_2H_6 \quad 2N(CH_3)_3$

(ii) $HPO_4^{2} \quad MoO_4^{2} \quad \text{H , 25 C}$

(iii) $(NPCl_2)_3 \quad 6CH_3MgI$

6. *(a)* Discuss the Craig and Paddock models for -bonding in cyclophosphazene $(NPCl_2)_3$. 4

(b) Mention the synthetic procedure of S_4N_4 and draw its structure. What will happen when S_4N_4 reacts with *(i)* Ag_2F in CCl_4 and *(ii)* $SnCl_2$ in MeOH? 4

(c) Write the composition of Beryl and describe its structure and uses. 3

(d) Define non-stoichiometric oxide. Mention three applications. 3

UNIT—IV

7. *(a)* How do greenhouse gases trap the IR-radiation? Describe global warming potential (GWP) of greenhouse gases. Write remedial measures to control emission of greenhouse gases. 2½+2½+2=7

(b) Write a short note on mercury induced toxicity. 4

(c) Give a brief account on bicyclic crown compounds. 3

8. *(a)* What is meant by photochemical smog? What are the causes of smog formation? Discuss the chemistry of photochemical smog formation. 1½+1½+4=7

(b) What are ionophores? Describe the structure and function of naturally occurring Valinomycin ionophores. 1+3=4

(c) Explain the ion transport mechanism by Na -K pump. 3

UNIT—V

9. *(a)* Write a rate law for a dissociative reaction

$$ML_5X \quad Y \rightleftharpoons ML_5Y \quad X$$ 3

(b) What is S_N1CB mechanism? Explain how this mechanism is operative in base hydrolysis reaction of $[Co(NH_3)_5X]^{2}$. 5

(c) Show Ray-Dutt twist pathways racemization of trischelate complex. 3

(d) "The compound $[Ni(CN)_4]^{2}$ and $[Cr(CN)_6]^{3}$ are thermodynamically stable but kinetically $[Ni(CN)_4]^{2}$ is labile and $[Cr(CN)_6]^{3}$ is inert." Explain. 3

10. *(a)* Rate law for a reaction $A \quad B \quad C \quad D$ is $r \quad K_a[A] \quad K_{ab}[A][B] \quad K_{ab}[A][B][H \ ]^{1}$. Write the significance of each term involve in the rate law. 2

(b) What are the different classes of electron transfer reactions? Rate of reduction of $[Co(NH_3)_5(NCS)]^{2}$ by Ti^{3} is 36000 times slower than rate of $[Co(NH_3)_5N_3]^{2}$. Explain. 1+4=5

(c) Predict whether the following complexes would be labile or inert and explain your choices. The magnetic moment is given Bohr magnetons against each complexes— 4

(i) Potassium hexaiodomanganate (IV) —3·82

(ii) Potassium hexacyanoferrate (III) —2·40

(d) The volume of activation $V^{\ddagger}$ for the following reactions are—

(i) $[Co(NH_3)_5(H_2O)]^{3}$ Cl

$[Co(NH_3)_5Cl]^{2}$ H_2O

$V^{\ddagger}$ 1 4 0 8 cm^3 mol ^{1}

(ii) $[Rh(NH_3)_5(H_2O)]^{3}$ Cl

$[Rh(NH_3)_5Cl]^{2}$ H_2O

$V^{\ddagger}$ 3 0 0 7 cm^3 mol ^{1}

(iii) $[Cr(NH_3)_5(H_2O)]^{3}$ NCS

$[Cr(NH_3)_5NCS]^{2}$ H_2O

$V^{\ddagger}$ 4 9 0 6 cm^3 mol ^{1}

What do these value suggest about the mechanism of these reactions? 3

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