PG Odd Semester (CBCS) Exam., December—2017

CHEMISTRY

(1st Semester)

Course No. : CH–101 (C)

(Inorganic Chemistry—I)

Full Marks : 75
Pass Marks : 30

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)* Assign point group symbols for the following species : 2×4=8

(i) CHF_3

(ii) CHBrFCl

(iii) $F_2C{=}O$

(iv) NH_3

(b) Using matrix notations, show that for a C_{2v} point group, the product of two symmetry planes is a rotational axis of symmetry. 4

(c) Work out the point group symmetry of C_2H_2 molecule. How will the symmetry change if one of H atoms is replaced by a Cl atom? 3

2. *(a)* Determine the point group symmetries for the following : 2×4=8

(i) N_3

(ii) H_2O

(iii) $B(OH)_3$-planar

(iv) SF_4

(b) Show how the point group symmetry changes on progressive substitution of *B* by *X* in a square-planar AB_4 molecule : 5

AB_4 AB_3X AB_2X_2

(c) What point group is generated by adding $_h$ to C_3? Explain taking suitable example. 2

UNIT—II

3. *(a)* Based on VSEPR model, sketch the most likely structure of the following species. Comment on the structure : 1½×4=6

(i) $[SbF_4]$

(ii) OIF_5

(iii) PF_3Cl_3

(iv) $[XeF_5]$

(b) What is spectroscopic electronegativity? How does it differ from Mulliken electronegativity? 3

(c) What are intrinsic semiconductors? How does doping influence the energy band? 3

(d) Draw the MO energy-level diagram for the O_2^2 ion. Compare its bond order with O_2. 3

4. *(a)* What is Allred-Rochow electronegativity scale? How is this scale related to Pauling's scale? 4

(b) What is Walsh diagram? Determine the structure of BeH_2 using Walsh diagram. 6

(c) Write short notes on the following : 5

(i) Clathrates

(ii) Hydrogen bonding

UNIT—III

5. *(a)* What are asbestos? Why are they easier to break along the parallel chain? 3

(b) Define non-stoichiometric oxide. Mention three applications. 4

(c) Write a note on polymorphism of phosphorus. 3

(d) Discuss the preparation, structure and isomerism of 1,2-dicarba-*closo*-dodecaborane. 5

6. *(a)* What are cluster compounds? How do they differ from coordination complexes? Classify cluster compounds with examples. 5

(b) Define silicates. What are the general formulas of pyroxenes and amphiboles? Give example for each. 5

(c) Write a short note on zeolites. 3

(d) Using Wade's rule, predict the structures of the following : 2

(i) $Ir_4(CO)_{12}$

(ii) $B_3C_2H_5$

UNIT—IV

7. *(a)* Briefly discuss the ozone layer formation, ozone cycle and possible ozone depletion pathways leading to ozone hole formation. 6

(b) Write short notes on the following : 5

(i) Acid rain

(ii) Phosphate cycle

(c) Write a note on domestic and industrial processes. 4

8. *(a)* "NO_x and hydrocarbons are the key pollutants in the atmosphere for photochemical smog formation." Justify the statement. 5

(b) Write short notes on the following : 6

(i) Active transport

(ii) Crown ether

(c) Write a note on pollution due to lead and mercury. 4

UNIT—V

9. *(a)* What are different classes of electron-transfer reactions? Explain with example, the inner sphere mechanism of electron transfer. 5

(b) What are isomerization and racemization of tris-chelate complex? Show Bailar's twist pathways racemization of tris-chelate complex. 5

(c) Discuss the mechanism of ligand displacement reactions in square-planar complexes. Explain *trans*-effect. 5

10. *(a)* Account for the difference in rate constants for the following reactions : 4

(i) $[Fe(H_2O)_6]^2$ Cl

$[Fe(H_2O)_5Cl]$ H_2O

K 10^6 M^{-1} s^{-1}

(ii) $[Ru(H_2O)_5]^2$ Cl

$[Ru(H_2O)_5Cl]$ H_2O

K 10^{-3} M^{-1} s^{-1}

(b) The reduction of $[Co(NH_3)_5Cl]^2$ is about 10^{10} times faster than $[Co(NH_3)_6]^3$. Rationalize the statement in the light of electron transfer mechanism. 6

(c) Arrange the following in the order of increasing rate of water exchange and explain : 3

$[Na(H_2O)_6]$, $[Mg(H_2O)_6]^2$ and $[Al(H_2O)_6]^3$

(d) Write a short note on anation reaction. 2

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