Birla Institute of Technology and Science, Pilani (Rajasthan)
First Semester 2022-23, December 21, 2022
Comprehensive Examination (Open Book) Part -II
CHEM F214; Inorganic Chemistry I

Time: 2 hours 25 Mins **Max. Marks: 56**

Q.1(a) Δ = (actual bond energy) - (energy for 100% covalent bond). Find out the Pauling electronegativities of C and Cl where the Δ values of C-H and H-Cl are 24.3 and 102.3 kJ/mol respectively [consider $\chi_H = 0$]. If χ_H is shifted to 2, is there any advantage in the scale? **[3]**
(b) Discuss the effect of aniline added to ammonia based on leveling effect. **[2]**
(c) There exists a relationship between energy band gap and electronegativity of the elements present in a compound. What is the relation these hold? Can you provide some reasons for the existing relationship? **[1+2]**
(d) Calculate the equilibrium constant for the disproportionation reaction:
$2Cu^+$ (aq) $\rightleftharpoons$ Cu(s) + Cu^{2+} (aq) at 298 K
[$E^0(Cu^+/Cu)$ = 0.52 V and E^0 (Cu^{2+}/Cu^+) = 0.15V; 2.303RT/F = 0.0591V at 298 K]. **[4]**
(e) Account for the fact that $CH_3CH_2O^-$ is much more basic than CH_3COO^-. **[2]**

Q. 2 (a) How would you synthesize $P(SiMe_3)_3$ from Phosphorus? Draw the structure of $P(SiMe_3)_3$. Write down the expected product of the reaction between CH_3COCl and $P(SiMe_3)_3$. **[1+1+1]**
(b) Account for the fact that in aqueous solution, lithium is as good a reducing agent as Cs despite of having higher ionization energy. **[3]**
(c) With the mention of the products obtained when CCl_4 and $SiCl_4$ individually reacting with H_2O, provide justification to support the observations for these two reactions. **[4]**
(d) What is the role of $(n\text{-}Pr_4N)OH$ in the synthesis of ZSM-5? Which property of ZSM-5 will be tweaked by Si to Al ratio? If you want to introduce Fe^{2+} ions in ZSM-5, how would you proceed? **[2+1+1]**

Q. 3(a) To prepare I_3^+, an oxidizing agent like bis(fluorosulpuryl)peroxide FSO_2OOSO_2F is used to react with I_2. Would you prefer H_2O_2 over FSO_2OOSO_2F for this reaction? Justify your answer. **[3]**
(b) Plenty of fluoride compounds of Xe are known. What could be the possible reason(s) for not having reports of formation of fluorides of Ne? If you imagine a Ne-fluoride compound, what would be the formula and what type of bonding is expected? **[2+2]**
(c) Find out the symmetry point group of boron-phosphorus analogue of borazine $B_3P_3((Ph)_6$ [Consider the -Ph group as an atom] and mention the symmetry elements present. Amongst $B_3P_3((Ph)_6$ and borazine, who is more prone to non-planar structure and why? **[2+2]**
(d) Comment on the aromaticity of S_4N_2 having a closed ring structure. **[3]**

Q.4(a) Justify the participation of specific orbitals in π bonding from P and N atoms in trimeric phosphazene, $P_3N_3Cl_6$. With the typical sets of orbitals once chosen from P and N centers, discuss the 'island model' for the molecule $P_3N_3Cl_6$. **[2+2]**
(b) Draw the molecular orbitals of the 3c-2e bond considering a hypothetical model with the atoms as H-B-H in B_2H_6. Why is the 3c-2e bonds on B-H-B system justified over 3c-2e bond on H-B-H system? **[3+2]**
(c) Explain the bond order of Re-Re bond in $[Re_2Cl_8]^{4-}$. Justify the arrangement of chlorine atoms around each Re atom relatively and the geometry of each Re atom. **[2+3]**

*******END*******