

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

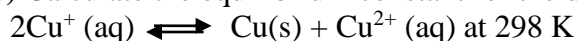
Max. Marks: 56

Q.1(a) $\Delta = (\text{actual bond energy}) - (\text{energy for 100\% covalent bond})$. 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 $\chi_{\text{H}} = 0$]. 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:



$E^0(\text{Cu}^+/\text{Cu}) = 0.52 \text{ V}$ and $E^0(\text{Cu}^{2+}/\text{Cu}^+) = 0.15 \text{ V}$; $2.303RT/F = 0.0591 \text{ V}$ at 298 K]. [4]

(e) Account for the fact that $\text{CH}_3\text{CH}_2\text{O}^-$ is much more basic than CH_3COO^- . [2]

Q. 2 (a) How would you synthesize $\text{P}(\text{SiMe}_3)_3$ from Phosphorus? Draw the structure of $\text{P}(\text{SiMe}_3)_3$. Write down the expected product of the reaction between CH_3COCl and $\text{P}(\text{SiMe}_3)_3$. [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 $(n\text{-Pr}_4\text{N})\text{OH}$ 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(fluorosulphonyl)peroxide $\text{FSO}_2\text{OOSO}_2\text{F}$ is used to react with I_2 . Would you prefer H_2O_2 over $\text{FSO}_2\text{OOSO}_2\text{F}$ 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 $\text{B}_3\text{P}_3(\text{Ph})_6$ [Consider the -Ph group as an atom] and mention the symmetry elements present. Amongst $\text{B}_3\text{P}_3(\text{Ph})_6$ 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, $\text{P}_3\text{N}_3\text{Cl}_6$. With the typical sets of orbitals once chosen from P and N centers, discuss the 'island model' for the molecule $\text{P}_3\text{N}_3\text{Cl}_6$. [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 $[\text{Re}_2\text{Cl}_8]^{4-}$. Justify the arrangement of chlorine atoms around each Re atom relatively and the geometry of each Re atom. [2+3]

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