Birla Institute of Technology and Science, Pilani,

K K Birla Goa Campus

COMPREHENSIVE EXAMINATION (CLOSED BOOK)

1st Semester, 2022-23

Inorganic Chemistry-I **Total Marks: 80**

Course Number: CHEM F214 **Date: 27-12-2022** **Time: 2 PM- 5 PM**

Instructions: Full marks will be awarded for complete answer only. Use only pen for any art-work/ illustration. Use of scientific calculators are allowed.

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1. **(a)** Predict and name the silicate structure of the following minerals:
   (i) Pyrophyllite, $Al_2(Si_4O_{10})(OH)_2$ **(ii)** Grunerite, $Fe_7(Si_4O_{11})_2(OH)_2$ **[4 Marks]**
   (b) Explain why electrical conductivity increases significantly upon intercalation of K in the graphite structure? **[4 Marks]**
   (c) With the help of suitable diagram, explain the origin of partially filled conduction band in $K_2[Pt(CN)_4]\ Br_{0.3}\ .3H_2O$ complex. **[8 Marks]**

2. **(a) (i)** With the help of suitable diagram, explain the structure of $[B_{12}H_{12}]^{2-}$ ion.
   (ii) Explain, Wade's rule for structure prediction in boranes? Predict the structure of B_5H_9 by applying Wade's rule. **[12 Marks]**
   (b) Draw, label and describe the structure of diborane. Explain the formation of 3-center bond in B-H-B bonding in diborane with the help of MO diagram. **[4 Marks]**
   (c) Explain the formation of short Re-Re bond and eclipsed configuration of Cl^- ions in the structure of $[Re_2Cl_8]^{2-}$ anion. **[8 Marks]**

3. **(a)** Draw a suitable diagram and explain the hexagonal close packed (hcp) and cubic close packed (ccp) structures. **[4 Marks]**
   (b) Draw and explain the molecular structure of dichloroiodate ICl_2^- anion. **[6 Marks]**

4. **(a)** Explain why Co(III) forms strong bonds to O- and N- donor ligands, moderately strong bonds to P- donor ligands but only weak bonds to As- donor ligands in its complexes. **[3 Marks]**
   (b) Ion pairing is higher in water than in liquid ammonia. Comment on this statement. **[2 Marks]**

(c) With an authenticated example, explain the criticism faced by solvent system concept of acids and bases. **[3 Marks]**

(d) What is the action of alkali metal in liquid ammonia on gold? **[2 Marks]**

5. **(a)** Draw the molecular structures (clearly showing the position of lone pair(s), if any) for trimethylamine and trisilylamine. Which one is more basic and why? **[4 Marks]**

(b) How is $O_2^+[PtF_6]^-$ formed? Is it possible to form $N_2^+[PtF_6]^-$? Justify your answer using molecular orbital theory approach. **[4 Marks]**

(c) Complete the reactions:

(i) $XeF_2 + Ph_2S \rightarrow ?$ **(ii)** $XeF_4 + SF_4 \rightarrow ?$ **[2 Marks]**

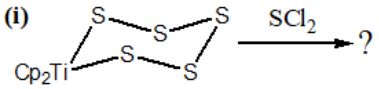
(Where Ph is phenyl)

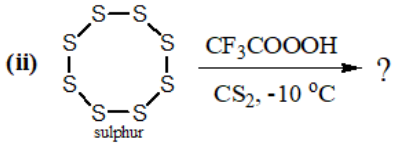
6. **(a)** Draw the molecular structure of $N_3P_3F_6$. What happens to the original structure when two F-atoms attached to single P or N-atom are replaced with two phenyl rings? Explain showing structural changes. **[3 Marks]**

(b) What happens when hexachlorophosphazene is heated up to 120 °C and thereafter, phenylamine is added subsequently. **[2 Marks]**

(c) What do you mean by inert pair effect? Cite an example. **[2 Marks]**

(d) Write down the product(s):

(i) 

(ii) 

(iii) $B_2H_6 \xrightarrow[180\ ^oC]{NH_3}$?

[3 Marks]

(Where Cp is cyclopentadienyl)

End