Birla Institute of Technology and Science, Pilani,

K K Birla Goa Campus

Mid-Semester Examination (Closed Book)

1st Semester, 2022-23

Inorganic Chemistry-I **Date: 03-11-2022** **Total Marks: 60**

Course Number: CHEM F214 **Time: 11.30 AM-1.00 PM**

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

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1. **(a)** Draw the molecular structures and explain, why the axial and equatorial FSF bond angles are 179° and 103° for SF_4 molecule and 170° and 97° for $CH_2{=}SF_4$ molecule, respectively.
   (b) With the help of a suitable diagram, explain the formation of **(i)** Schottky defect and **(ii)** Frenkel defect in crystalline ionic solid.

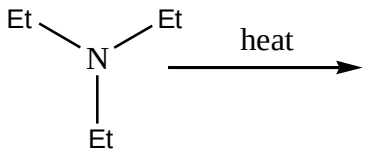
   [6 + 4]

2. **(a)** Draw the molecular structures of the following compounds: **[2 + 3]**

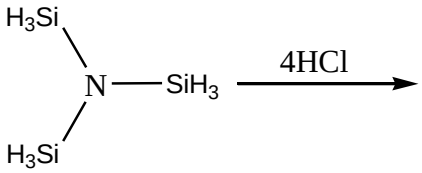
   (i) methyl isocyanate and silyl isocyanate.

   (ii) S_4N_4, $S_4N_4H_4$ and $S_4N_4F_4$

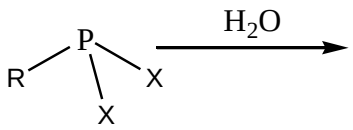
   (b) Complete the following reactions (write down the final products): [**1+1+1]**



(i)



(ii)



Where, × = Cl

(iii)

(c) (i) While phosphine oxides have resonating structures, amine oxides are restricted to only one structure. Why? **[1]**

(ii) Explain why the infrared stretching frequency of the P=O bond in Br_3PO (1261 cm^{-1}) is much lower than that in F_3PO (1404 cm^{-1}). **[1]**

3. (a) Write Arrhenius concept of acids and bases. **[2]**

(b) In which direction the following reaction is expected to take place and why? **[2]**

LiI + CsF = LiF + CsI

(c) How will you explain the nonexistence of Fe(III) carbonate? **[3]**

(d) With authenticated examples, explain the following cases.

(i) Role of size of the ring in deciding the basicity of carbonyl-O in lactams **[3]**

(ii) A case where sterics increases the basicity of the molecule **[3]**

4. (a) What is the main difference between Lewis concept and Usanovich concept of acids and bases?

(b) Explain in detail (with required diagrams) the reason for the anomaly found in the expected trend of basicity of alkyl amines in aqueous solution.

(c) Explain, in detail, the order of basicity of the following species in gas-phase reactions.

OH^-, $R(1°)O^-$, $R(2°)O^-$, $R(3°)O^-$

(d) Write three reasons for naming the bronze coloured solution of alkali metal in liquid NH_3 as "dilute metal".

(e) Write down two advantages of molten salts as solvents over water in carrying out chemical reactions.

[5 ×3]

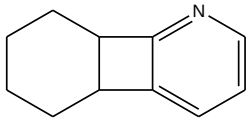
5. (a) How urea behaves (acidic or basic) in the solvents H_2SO_4 and liquid NH_3? Write down the reason for your answer.

(b) What is meant by leveling and differentiating solvents? Explain using suitable examples.

(c) How proton affinity can be used to explain the trend in gas phase acidity? Explain with example.

(d) How will you account for the reduced electron density at N in the given molecule compared to its unconstrained analogue?

[4 ×3]



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