Birla Institute of Technology and Science, Pilani (Rajasthan)

MID-SEM TEST, SEMESTER I (2016-17)

CHEM F214: Inorganic Chemistry I **Closed Book** **Marks: 60**

Time: 90 min **Date: 4th Oct., 2016**

Instructions: There are total five questions in all. Attempt all the questions. Start answering each question on a fresh page and answer all parts in a question together

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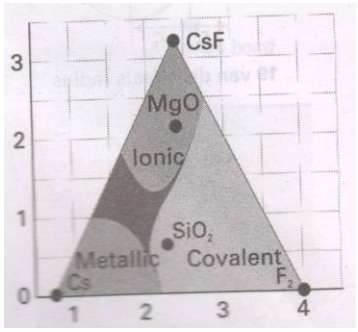
Q1. (i) Consider an element przybylskium (Pz) lies in the middle of the periodic table. The Pz-Pz bond energy is 293 $kJmol^{-1}$, the Pz-F bond energy is 613$kJmol^{-1}$, the F-F bond energy is 155 $kJmol^{-1}$ and I-I bond energy is 149 $kJmol^{-1}$. Using Pauling's electronegativity scale, calculate the expected bond energy of Pz-I (electronegativity of: I: 2.7; F: 4.0).

(ii) (a) What x-axis and y-axis represents in Ketelaar's triangle (given below):



(b) Determine the bond type of BCl_3 using Ketelaar's triangle (electronegativity of B: 2.04; electronegativity of Cl: 3.16).

(iii) Describe the principle underlying to frame Allred-Rochow electronegativity scale (not more than two sentences).

4 + 4 + 2 = 10M

2. (i) Write down the correct reactants / products

(a) $(BrF_2)SbF_6$ + _____ → $AgSbF_6$ + $2BrF_3$

(b) $SbCl_5 + CH_3CN$ → _____.

(c) $H_2S_2O_7 + H_2SO_4$ → _____ + _____

(d) $[Et_3NH]Cl + CuCl$ → _____

(ii) Which shows higher inherent acidity between toluene and methane - explain it in terms of gas phase affinities proton affinity (PA) (PA_{CH3}^-= 1745 kJmol-1; $PA_{C6H3CH2}^-$ = 1593 $kJmol^{-1}$).

(iii) Arrange the following acids based on acid strength along with explanation: $HClO_3$, $HClO_2$, HClO

(iv) Predict the equilibrium constant of the following reaction should be greater or lesser than 1 and explain.

$[CuI_4]^{2-}$ (aq) + $[CuCl_4]^{3-}$ (aq) $\rightleftharpoons$ $[CuCl_4]^{2-}$ (aq) + $[CuI_4]^{3-}$ (aq)

(v) Blue colored species obtained after addition of sodium into liquid ammonia. Propose the structure of the species formed based on experimental support.

5 + 2 + 2 + 2 + 3 = 14M

3. (i) 2,2′-Bipyridine forms complex with Fe(III) and Fe(II). Determine the ratio of stability constants of the bypyridine complex of Fe(III) vs Fe(II) ($K_{Fe3+bipy}/K_{Fe2+bipy}$) ($E^o_{Fe3+/Fe2+}$ = +0.77V; $E^o_{Fe3+/Fe2+}$ = +1.02V).

(ii) Which of the conditions favors the following transformations:

Conditions: acidity / basicity / none of these

(a) $Mn^{2+} \rightarrow MnO_4^-$

(b) $I_2 \rightarrow 2I^-$

Give answer with appropriate reasons.

(iii) Adding NaOH to an aqueous solution containing Ni^{2+} results in precipitation of $Ni(OH)_2$. The standard potential for the Ni^{2+}/Ni couple is +0.26V and the solubility product $K_{sp} = [Ni^{2+}][OH^-]^2 = 1.5 \times 10^{-16}$. Calculate the cell electrode potential at pH = 14 at 25ºC (1faraday = 96500 coulomb; R = 8.314 $Jmol^{-1}K^{-1}$).

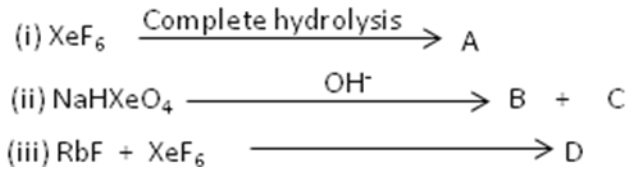
4 + 4 + 6 = 14M

4. (i) (a) Draw the most contributed resonating structures of N_3^- and O_3 (including lone pair and formal charges). (b) What are the appropriate geometries based on VSEPR model? (c) Comment on the observed differences in geometries if applicable.

(ii) State the geometries of the following compounds (with drawing) based on VSEPR model: (i) $SeCl_4$; (ii) XeO_3. (iii) What is the expected trend of bond angle of the following compounds: Cl_2O and H_2O. Explain it with appropriate reason. (iv) Draw the most contributed first two resonating structures of SCN (including lone pair and formal charges in each case). Which one is the most contributed resonating structure and why?

5 + 4 + 2 + 5 = 16M

5. Write down the major products in the following reactions (chemical formula only)



1.5 x 4 = 6M

END