

**B.E. Chemical Engineering 1st Year, 1st semester Supplementary Examination 2018 (OLD)**

SUBJECT: Inorganic Chemistry Time 3 hours Full Marks: 100

**Answer any five questions**

- 1 (a) Write the canonical forms of  $N_3^-$  and  $N_2O_5$  and account their stability. [4]
- (b) Trimethyl amine and trisilyl amine have nearly similar formula but they have different structures. Suggest a reason. [4]
- ii) Sn(II) is a reducing agent, but Pb(IV) is an oxidizing agent, although both Sn and Pb belong to same group of the periodic table. Justify [4]
- (d) Why heavy metals are toxic? Write a note on 'Mercury toxicity'. [4]
- (e) Write the structure and bonding of  $B_3N_3H_6$  [4]
- 2 (a)  $KHF_2$  exists but  $KHCl_2$ ,  $KHBr_2$ , and  $KHI_2$  doesn't exist. Suggest a reason. [4]
- (b)  $CCl_4$  does not undergoes hydrolysis whereas  $SiCl_4$  readily undergoes hydrolysis. Justify. [4]
- (c) Write a short note on pesticides [4]
- (d) Find the oxidation state of the central metal ion and spin only magnetic moment ( $\mu_s$ ) of the following complexes [8]
- i)  $[Fe(CN)_6]^{3-}$  ii)  $Ni(CO)_4$  iii)  $[CoCl_4]^{2-}$  iv)  $[Co(H_2O)_6]^{2+}$  v)  $Ni(DMG)_2$  vi)  $Cu(OAc)_2 \cdot H_2O$
- 3.a) What do you mean by conjugate acid base pair? Give example. [5]
- b) Why second acid dissociation constant of a dibasic acid is always small than first acid dissociation constant? [5]
- c) B-F bond distance in  $BF_3$  is shorter than B-F bond distance in  $H_3N \rightarrow BF_3$  adduct. Is this statement true? Give explanation in support of your answer. [5]
- d) Define hard acids and hard bases. Give examples. [5]

[ Turn over

4. a) How can you calculate pH of a very dilute solution of a strong acid? What is the pH of  $10^{-7}$  (M) HCl solution? [5]
- b) What is the relation between hydrolysis constant and acid dissociation constant? Calculate pH of a solution containing 25 mL of 0.01 (M) acetic acid and 25 mL of 0.01 (M) KOH.  $K_a$  of acetic acid is  $1.75 \times 10^{-5}$ . [5]
- c) Derive the expression of pH when a salt of weak acid and weak base is hydrolyzed. [5]
- d) Arrange the following in their increasing acidity order and explain elaborately:  
HF, HCl, HBr and HI [5]

5. (a) Draw the Walsh Diagram for Linear and bent  $H_3$  system and hence comment on the structure of  $H_3^+$  and  $H_3^-$ . [5]

(b) Draw the MO energy level diagram for  $BeH_2$ . [5]

(c) Draw the MO energy level diagram for CO and hence explain that Metal-Carbon bond is stabilized by  $\sigma$ - $\pi$  synergic effect in transition metal carbonyls. [5]

(d) Comment on the structures and shapes of the following chemical species. Draw their structures. Write the hybridization of the central atoms [5]

$XeF_4$ ,  $SF_4$ ,  $ClF_3$ ,  $NCl_3$ ,  $XeF_2$

6. (a) Draw molecular orbital energy level diagram of HF and hence comment on its polarity. [5]

(b)  $He_2$  does not exist. Comment. [5]

(c) Draw the MO energy level diagram for  $B_2$  and hence explain its magnetism. [5]

(d) Show that Bohr's 2<sup>nd</sup> postulate involving the quantization of the angular momentum can be derived from de Broglie's hypothesis. Draw the shapes of Bohr-Sommerfeld orbits for  $n=3$  and label them. [5]