ST. JOSEPH'S COLLEGE (AUTONOMOUS), BENGALURU-27
M.Sc. CHEMISTRY: I SEMESTER
SEMESTER EXAMINATION: OCTOBER 2018
CH-7118 : INORGANIC CHEMISTRY

Note : (i) The question paper has **THREE printed pages** and **THREE parts**. All parts are compulsory.

(ii)Answer any **SIX** out of eight questions from part – A, Any **FOUR** out of six questions from part – B, and any **two** out of three questions from part – C.

Time : 2 ½ hrs   **Max .Marks : 70**

PART A   **2 x 6 = 12**

1. Write the Lewis structure of SO_4^{2-} . (Use formal charge calculation to predict the best structure possible)
2. Predict the shape of (i) BrF_5 (ii) ClF_2^+ using VSEPR theory.
3. Use molecular orbital diagram to determine the number of unpaired electrons in O_2^+.
4. What are quadruple bonds? Give an example.
5. Give a reaction in supercritical carbon dioxide.
6. Write four applications of carbon nanotubes.
7. With a suitable example explain intercalation compounds of graphite.
8. $LiI + CsF \rightarrow LiF + CsI$. In which direction the reaction proceeds? Right or left? Give reason.

### PART B   **12 x 4 = 48**

9. (a) Draw the molecular orbital energy diagram for CO.
   (b) Draw the molecular orbital energy diagram for NH_3.
   (c) Give reason for the following observation: (i)LiCl is more soluble in organic solvent than NaCl (ii)the melting point of $BeCl_2$ is smaller than that of $CaCl_2$ (iii) AgF is soluble in water whereas AgCl is sparingly soluble.
   (d) (i) Draw the FCC structure and mark the tetrahedral holes.
   (ii) Potassium reacts with C60 (FCC) to give a compound in which all the octahedral and tetrahedral holes are filled by potassium ions. Derive a stoichiometry for this compound.   (3 x 4 =12)

10. (a) (i) Predict the crystal structure of MX using the ionic radii of the cation and the anion given as 159 pm and 181 pm respectively. (ii) Predict whether Zn forms zintl phases with Na or with Cu. give reason.
    (b) Estimate the lattice enthalpy of sodium chloride: Given A = 1.748, $d = r^+ + r^-$ = 283 pm ; N_A = 6.022 x 10^{23} ; e = 1.602 x 10^{-19} C ; d^* in Born-Mayer equation is 34.5 pm. the vacuum permittivity is 8.854 x 10^{-12} $J^{-1}C^2 m^{-1}$.
    (c) Write a note on Schottky defect and Frenkel defect.
    (d) Write a note on substitutional solid solution. Nickel and copper forms continuous solid solution whereas copper and zinc are only partially miscible. Explain this difference.
                                                                                        (3 x 4 =12)

11. (a) (i) Write Bent's rule.
    (ii) Calculate the percentage p character in O-H bond and nonbonding orbitals in water. The H-O-H bond angle is 104 ½°.
    (b) Calculate the electronegativity of C in C-H bond, if the average bond energies , E_{C-H}, E_{H-H}, & E_{C-C} are 413.4, 435.136 & 347.272 kJ/mol respectively.

(c) Write the thermodynamic cycle showing the enthalpy changes involved in the decomposition of a solid carbonate MCO_3. Compare the decomposition temperature of $MgCO_3$ and $CaCO_3$ based on the size of the cation.

(d) Draw the unit cell structure of zinc blende and explain the important features. Give its projection representation. (3 x 4 =12)

12. a) With mechanism explain reactions of diborane with ammonia and triethyl amine .

b) Draw geometrical and Lipscomb's semitopological structures for B_5H_{11} and write its styx number.

c) Calculate α and β for $B_{10}H_{14}$? Draw the structure of CB_5H_9. (4+4+ 4)

13. a)Give the structures of two borazine derivatives.

b) Draw the chair and boat conformations of $(NPCl_2)_4$.

c) Sulphur – nitrogen compounds have unusual structures. Illustrate using S_4N_4 and $S_{11}N_2$.

d) Give the structural difference between linear polyphosphate and metaphosphate. (3+3+3+3)

14. a) What is Hammet acidity function? Give an example for super acid.

b) Give an acid- base reaction in BrF_3.

c)Give the structural difference between white and red phosphorous.

d) Draw the structure of a cyclosulphur and a polycatena sulphur. (3+3+3+3)

PART C

15. From the structural map for the compounds of type MX given, find out the coordination number of Fe in FeO, given the electronegativities of Fe and O are 2.0 and 3.32 respectively. Identify the crystal structure of FeO among the following: (i) Wurtzite (ii)rock salt or (iii)Fluorite structure. Give reason/s for rejecting other two choices given. Draw the unit cell of FeO. If the density of FeO is 5.70 g cm^{-3}, calculate the edge length of the unit cell in cm. The atomic mass of Fe and O are 55.85 g mol^{-1} and 16 g mol^{-1} respectively.
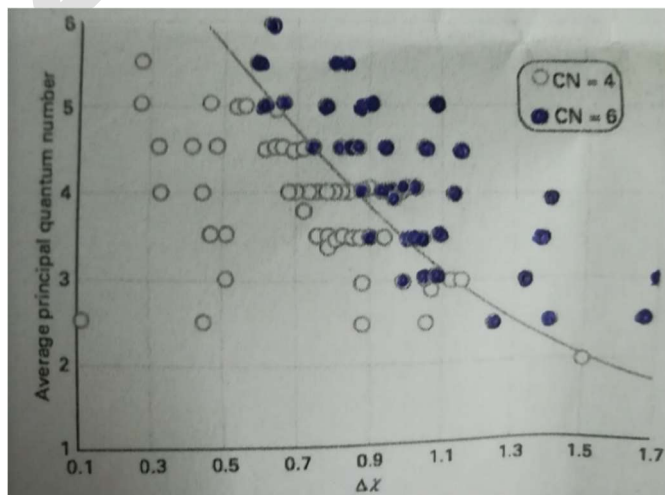
16. Arrange the following in the increasing order of base strength and give reason.

Pyridine , o- methyl pyridine, p- methyl pyridine and o- tert-butyl pyridine. Give reason .

17. a) Calculate the enthalpy of formation of the adduct BF_3-NH_3. Given for BF_3 E_a'=2.00, C_a'=1.69, T_a'=0.91. For ammonia E_b'=0.69, C_b'=2.71and T_b'=11.59. Parameters are given in kJmol^{-1}.

b)An alloy of gold is prepared in which the copper occupies all corners of the cube and gold occupies the centre of all faces. Calculate the percentage of gold in the alloy. The atomic mass of gold and copper are 197 and 64 amu respectively. (3+2)