M.Sc. 1st Semester Examination, 2012

CHEMISTRY

(*Inorganic*)

PAPER – CEM- 103

Full Marks : 40

Time : 2 hours

Answer any **five** questions
taking at least **two** from each Group

The figures in the right hand margin indicate marks

GROUP – A

1. (*a*) 'The distal protein drastically reduces the co-affinity of hemoglobin and myoglobin' – Justify the statement. 2

   (*b*) What do you mean by 'picket-fence' model for hemoglobin or myoglobin ? 1

   (*c*) Discuss the structural features in oxygenated hemocyanin. 2

(*d*) How Vasca's complex can act as 'Synthetic O_2-carrier' ? Write down the structural representation. 2

(*e*) Write down the structure of 4Fe - 4S protein. 1

2. (*a*) What happens when H_2O_2 is added to an acidified solution of $[Cr_2O_4]^{2-}$? How the final product can be isolated ? Write down the structure. 2

(*b*) Write down the structure of $NbCl_4$ and NbF_5. 2

(*c*) Complete the following reactions 2

(*i*) $[RuO_4]^- + [OH^-] \longrightarrow$

(*ii*) $[O_sO_4] \xrightarrow[\text{in cold}]{\text{aqs. KOH}}$

(*d*) Discuss how trans- $[O_sO_2(OH)_4]^{2-}$ is diamagnetic. 2

3. (*a*) In $CuCl_2$, four Cu – Cl bond distances are of 2·30Å and two bond distances are of 2·95 Å. Whereas in K_2CuF_4, four Cu–F bond distances are of 2·08 Å and two bond distances are of 1·95 Å. Explain. 3

(*b*) Which of the compound among $FeAl_2O_4$, $COAl_2O_4$ and $NiAl_2O_4$ is most likely inverse spinel structure. 3

(*c*) $[CuCl_4]^{2-}$ is tetrahedral but other four coordinated Cu(11) complexes are square planer. Explain. 2

4. (*a*) Identify Closo/Nido/Arachno/Hypo boranes

$B_3H_6^+$, B_8H_{16}, B_4H_8, B_5H_{11}. 2

(*b*) Calculate the styx number of B_5H_9 and draw the possible structure of the compound. 4

(*c*) What happens when $[Os_2Cl_6]^{2-}$ is reduced with N_2H_4 ? Write down the structure of the final product. 2

GROUP – B

5. (*a*) For SO_3^{2-} ion, show that symmetry operations belong to three different class. 3

(*b*) Explain why the formation of a crystal with D_{4d} symmetry is impossible. 2

(*c*) What do you mean by "point group" ? Identify the point group for each of the following molecules : 1 + 2

(*i*) SOClF

(*ii*) Ethane (staggered)

(*iii*) B_2H_6

(*iv*) XeF_4.

6. (*a*) Justify that the sum of the squares of the dimensions of the irreducible representations of a group can not be greater than the order of the group. 2

(*b*) Write the "Hermann-Mauguin" notation for the following point groups : 2

C_{4v}, O_h

(*c*) Find the order of the improper axis in the following molecules and identify the other elements of symmetry generated by this axis. 2

(*i*) PCl_5

(*ii*) $Ni(CO)_4$.

(*d*) Find the subgroups of D_{4h} group. 2

7. (*a*) $[Ni(H_2O)_6]^{2+}$ gives absorption at 8500, 15200 and 26000 cm^{-1}. Explain. 2

(*b*) Verify that the scalar product of vectors $\vec{M}$ and $\vec{N}$ in p-dimensional space is equal to the sum of the products of the lengths of projections of the vectors in p-orthogonal axes with no cross terms. 3

(*c*) A borane molecule has its styx number 4020. Predict the formula of the molecule and draw the possible structure. 2

(*d*) Show that if P is conjugate with Q and R, then Q and R are conjugate with each other. (Where P, Q and R are the elements of a group). 1

8. (*a*) Evaluate all the term symbols associated with p^2 electronic configuration. 2

(*b*) Draw the active site structure of oxygenated form of hemerythrin. 2

(*c*) What is the most stable oxidation states of "Ru" and "Rh" ? 1

(*d*) What is rubredoxin ? 1

(*e*) Explain why the electronic spectral bands due to *d-d* transitions in a transition metal complex are broad. 2