CH105(I) Tutorials

Topic 1: Trends in the properties of elements

P.S.: The students are requested to familiarise themselves with the periodic table by considering s, p, d & f blocks and their general inter relations and inter connectivity! There is no need to remember all the elements.

Q01. Explain the van der Waals radius & van der Waals forces!

Q02. Calculate Z* for an electron in 4s orbital of Sc.

Q03. What happens to the size when an atom A is ionized to A^+/ A^- ion & why?

Q04. The difference between the second ionization potential to the first ionization potential is 700 kJ/mol in magnesium while it is ~4000 kJ/mol in case of sodium. Explain.

Q05. Compare atoms Si & Sn using HSAB and comment!

Q06. Compare atom Na with its ion Na^+ & I with its ion I^- using HSAB and comment!

Q07. Identify the oxidation state of the central atom in the following: NH_3, N_2H_4, NH_2OH, NO, HNO_2, NO_2, HNO_3, N_2O_3, N_2O_4 and N_2O_5.

Q08. While the oxidation of Li to Li^+ is more favourable, reduction of Ag^+ to Ag is more favourable. Explain.

Topic 2: – Basic principles of extraction of metals

Q01. Why are the metals Al and Ti are not produced by pyrometallurgical extraction of Al_2O_3 and TiO_2? What will be a better method to produce such metals?

Q02. Using Elligham diagram for oxides, determine whether the Al can be used to reduce MgO? If so at what conditions?

Q03. Ellingham diagram predicts a negative ΔG° value for the reduction of Cr_2O_3 with Al at room temperature. In fact the reduction is carried out at a much higher temperature. Suggest an explanation.

Q04. What is the reducing species in the self reduction of CuS ore?

Q05. Can the carbon be used for the reduction of the metal sulphide ores and why?

Q06. Sodium metal is produced commercially by the electrolysis of a mixture of 40% NaCl and 60% of $CaCl_2$. What is the role of $CaCl_2$ in this process? Will Ca be produced along with Na.

Q07. Why is that Sn^{4+} is more exclusively hydrolyzed in aqueous solution than Pb^{4+}?

Topic 3: Coordination Chemistry

Q01. Crystalline AgO is diamagnetic. Explain.

Q02. Work out the hybridization and geometry for the following complexes using the valence bond approach.

Q03. When high pressure is applied, what type of electronic configuration is favoured for a d^5 transition metal complex?

Q04. Provide reasons for the fact that a number of tetrahedral Co(II) complexes are stable, where as the corresponding Ni(II) complexes are not.

Q05. Using the crystal field stabilization energy as criterion, indicate whether you expect the following spinels to be normal or inverse: Fe_3O_4; Co_3O_4.

Q06. By showing the details, determine the CFSE for the following complexes: (a) $[FeCl_4]^{2-}$; (b) $W(CO)_6$.

Q07. Explain what is meant by the term "synergic bonding"?

Q08. The Cr^{2+} ion in CrF_2 is surrounded by six fluoride ions. Of these, four are at a distance of ~2.00 Å, while the other two are at a distance of 2.43 Å from the metal ion center. Explain this observation.

Topic 4: Magnetism

Q01. What are the permitted values of m_l for f orbitals?

Q02. The following complexes have the indicated effective magnetic moments. Describe the structure and bonding of the complexes on the basis of the μ_{eff} values (in B.M.).

Q03. Identify the transition metal configurations both in the octahedral and tetrahedral environments which are expected to have orbital contribution to the magnetic moment.

Q04. Which one would you expect to have greater magnetic moment: $CoCl_4^{2-}$ or CoI_4^{2-}? Why?

Q05. Calculate μ_{eff} for $Dy_2(SO_4)_3.8H_2O$.

Q06. Calculate μ_{eff} for Gd^{3+}.

Topic 5: –Bioinorganic Chemistry

Q01. What are storage and transport proteins?

Q02. Draw the structure of porphyrin?

Q03. Why is cyanide (CN-) toxic?

Q04. What is the role of globular protein in O_2 transport?

Q05. What is "Cooperative Effect"?

Q06. Why are all oxygen the oxygen carriers that contain iron and porphyrins are inside the cells?

Q07. Why is the size of high spin Fe(II) larger than the low spin Fe(II)?

Q08. What prevents synthetic iron porphyrins from functioning as O_2 carriers?

Q09. While the cis-platin is potent anticancer agent, its trans-isomer is not. Why?

Q10. Are you convinced with the statement that the coordination complexes are capable of acting as drugs for various health disorders? How & Why?