i. Write the most stable electron configuration of copper atom.

ii. What is the oxidation number of most stable copper ion?

iii. Write the electron configuration of most stable copper ion.

iv. Cu^{2+} forms stable octahedral metal complex with water molecules.

a. Write the chemical formula of copper-water complex.

b. Suggest the energy diagram of d orbitals of Cu^{2+} complex using crystal field theory.

c. Show the crystal field splitting energy ($\Delta_{Octahedral}$) in the diagram very clearly.

d. Calculate the total spin number of Cu^{2+} complex.

e. Write the equation for the crystal field stabilizing energy of any octahedral complex and define all the terms in it.

f. Calculate the crystal field stabilizing energy of the Cu^{2+} complex in the term of crystal field splitting energy ($\Delta_{Octahedral}$).

v. Cu^{2+} ions absorb red-orange region of white light with the maximum with 800 nm. Prove that the crystal field splitting energy ($\Delta_{Octahedral}$) of copper-water complex is equal to

-2.48×10^{-17} J. (Plank Constant = 6.623×10^{-34} J and velocity of light 3×10^{8} ms^{-1})

vi. Prove that the crystal field stabilizing energy of the Cu^{2+} complex is equal to -1.5×10^{-17} J under white light illumination.

vii. What is the major assumption that you made to calculate crystal field stabilizing energy of the Cu^{2+} complex under white light illumination.

viii. Write a reason for formation of tetrahedral $[Cu(Cl)_4]^{2-}$ from the reaction of octahedral $[Cu(H_2O)_6]^{2+}$ with Cl ion.

ix. Explain why Cu^{2+} ion is stable than Au^{2+} ion in aqueous media using Jahn-Teller effect.

x. Explain why $[Co(NH_3)_6]^{3+}$ ion undergoes d^2sp^3 and $[Co(F)_6]^{3-}$ ion undergoes sp^3d^2 hybridization.

(200 marks)

3.

i. Derive the following equation starting from total magnetic momentum of coordination compound metal ion, $\mu_{spin} = \sqrt{n(n+2)}$, where n is number of unpaired electrons.

ii. Nickel (II) complexes exhibit both tetrahedral and square planar geometries. Explain tetrahedral $[NiCl_4]^{2-}$ is paramagnetic and square planar $[Ni(CN)_4]^{2-}$ is diamagnetic.

(100 marks)