DEPARTMENT OF CHEMISTRY
NAMBOL L. SANOI COLLEGE, NAMBOL

QUESTION BANK FOR CHEMISTRY (ELECTIVE)
PREVIOUS 3 YEARS (2016-2018)

SEMESTER - VI
PAPER-VIII / CH- 6O8 :

INORGANIC CHEMISTRY

UNIT-1: Bonding in coordination compounds

Very Short Answer Type Carrying 1 mark
(1 MARK QUESTIONS)

(a) Calculate the EAN of Cr(III) in $[Cr(CN)_6]^{3-}$. **(2016)**
(b) Calculate the EAN of $[Mn(CO)(NO)_3]$. **(2017)**
(c) Show the calculation of EAN for $Co_2(CO)_6(RC \equiv CR)$ complex. **(2018)**

SHORT ANSWER TYPE
(2 MARKS QUESTIONS)

(a) Discuss the splitting of d-orbital in case of tetrahedral complexes. **(2016)**
(b) Calculate the CFSE for d^4 high spin and d^6 low spin octahedral complexes. **(2016)**
(c) How do the d-orbitals split when a transition metal ion is placed in square planar crystal field of ligands? **(2017)**
(d) Show that the tetrahedral field splitting is 0.444 times of the octahedral field splitting. **(2017)**
Or
     Using VBT, decide if the complex potassium hexacyanomanganate(III) indicating two unpair electrons by magnetic measurement to be inner or outer orbital complex. **(2017)**
(e) How does valence bond theory account for the following?
     (i) $[Ni(CN)_4]^{2-}$ is diamagnetic and square planar
     (ii) $[NiCl_4]^{2-}$ is paramagnetic and tetrahedral **(2018)**
(f) For the $[Cr(H_2O)_6]^{2+}$ ion, the mean pairing energy, P is found to be 23500 cm^{-1}. The magnitude of Δ_o is 13900 cm^{-1}. Calculate the CFSE for the complex ion corresponding to high- and low-spin states. **(2018)**

SHORT ANSWER TYPE
(3 MARKS QUESTIONS)

(a) Discuss the thermodynamic and kinetic stability of a complex. **(2016)**
(b) Why is the stability constant of a chelate complex much higher than unchelate complex? **(2017)**
(c) Discuss briefly any three properties of central metal ion affecting the stability of the complex.
Or
     Write a short note on Irving-Williams order of stability. **(2018)**

(6 MARKS QUESTIONS)

1. The complex $[Ni(CN)_4]^{2-}$ is diamagnetic but $[NiCl_4]^{2-}$ is paramagnetic with two unpaired electrons. Likewise $[Fe(CN)_6]^{3-}$ has only one unpaired electron whereas $[Fe(H_2O)_6]^{3+}$ has five. Explain on the basis of both valence bond theory and crystal field theory. **(2016)**

2. Explain the following: **(2017)**
   (a) Complexes of Co(III) such as $[Co(NH_3)_6]^{3+}$, $(Co(en)_3]^{3++}$ are diamagnetic while the complexes such as $[CoF_6]^{3-}$, $[Co(H_2O)_3F_3]$ are paramagnetic.
   (b) A nickel salt solution containing $[Ni(H_2O)_6]^{2+}$ is green in colour. On addition of KCN solution the green colour disappears and the complex $[Ni(CN)_4]^{2-}$ is formed.
   (c) The d^6 ion tends to form low-spin complexes even with comparatively weak field ligands.
3. For the splitting of d-orbitals, the CFSE values of $dx^2 - y^2$, dz^2 for tetrahedral complexes are negative while CFSE value of only dz^2 for square planar complexes is negative. Explain. **(2018)**

UNIT-2: Magnetic properties of transition metal complexes

Very Short Answer Type Carrying 1 mark
(1 MARK QUESTIONS)

(a) What is magnetic susceptibility? **(2017)**
(b) What is the magnetic moment of Ni^{2+} in BM? **(2018)**

SHORT ANSWER TYPE
(2 MARKS QUESTIONS)

(a) What are the ferromagnetism and antiferromagnetism in magnetically concentrated substances? **(2016)**
(b) Briefly explain a method for the determination of magnetic susceptibility of a substance. **(2016)**
(c) What is meant by the symbol ^3F? **(2017)**
(d) Give two applications of magnetic moment data in 3-d transition metal complexes. **(2017)**
(e) Show that $\sqrt{4S(S+1)} = \sqrt{n(n+2)}$. **(2018)**
(f) Determine the term symbols **(2018)**
   (i) Ground state of nitrogen and
   (ii) cobalt(II) ion.

SHORT ANSWER TYPE
(3 MARKS QUESTIONS)

(a) The complexes $[Mn(H_2O)_6]^{2+}$, $[Fe(H_2O)_6]^{3+}$, $[MnCl_4]^{2-}$ and $[FeCl_4]^-$ all have magnetic moments of nearly 5.92 BM. What does this tell you about the geometric and electronic structures of these complexes? Why is the spin only formula so precise in this case? **(2016)**
(b) How does the magnetic susceptibility of *para-*, *ferro-* and antiferromagnetic substances vary with temperature? **(2017)**
(c) What are the advantages and limitations of Faraday's method for measuring magnetic moment?
   Or
   Explain briefly Faraday's method for measuring magnetic susceptibility. **(2018)**

UNIT-3: Inorganic polymers

Very Short Answer Type Carrying 1 mark
(1 MARK QUESTIONS)

(a) Mention one important application of zeolites. **(2016)**
(b) What are molecular sieves? **(2016)**
(c) What are molecular sieves? **(2017)**
(d) What are sheet silicates? **(2018)**

SHORT ANSWER TYPE
(3 MARKS QUESTIONS)

(a)   Discuss the structure and bonding in triphosphazine. Also explain why it acts as Lewis base.**(2016)**

(b)   Explain the difference in bonding between chain, double chain and sheet silicates.   **(2016)**

(c)   How are functionalized phosphazine polymers prepared? Why are they considered as a potential polymer candidate in the near future?   **(2017)**

(d)   Draw the structure of $[Si_3O_9]^{6-}$ and $([Si_4O_{11}]^{6-})_n$ enclosing the repeating units in brackets and show that these empirical formulas are correct.   **(2017)**

(e)   How does the f -system in $N_3P_3Cl_6$ differ from f -system in C_6H_6? Also explain why they undergo addition reaction.   **(2018)**

(f)   Explain the role of zeolites in water softening or cation exchange process.   **(2018)**

UNIT-4: Thermoanalytical methods

Very Short Answer Type Carrying 1 mark
(1 MARK QUESTIONS)

(a)   Draw an ideal TGA curve.   **(2016)**

(b)   Give one important factor which affects thermoanalytical technique.   **(2017)**

(c)   Write the basic principle of DSC.   **(2018)**

SHORT ANSWER TYPE
(2 MARKS QUESTIONS)

(a)   What are the types of physical and chemical changes that yield exothermic and endothermic peaks in DTA and DSC?   **(2016)**

(b)   Give a typical TGA curve for magnesium hydroxide or calcium oxalate monohydrate heated up to 1000 °C.   **(2017)**

(c)   Explain a TGA curve for $CuSO_4.5H_2O$.   **(2018)**

(6 MARKS QUESTIONS)

1.   Discuss the basic principles, instrumentation and factor affecting to thermoanalytical techniques of differential scanning calorimeter.   **(2016)**

2.   What is the difference between DTA and DSC? Briefly explain one application each of DSC in organic and inorganic compounds.   **(2017)**

3.   Explain a basic instrumentation outline of DTA. Also state the various physical and chemical phenomenons causing mass change for TGA and heat change for DTA.   **(2018)**

UNIT-5: Organometallic Chemistry

Very Short Answer Type Carrying 1 mark
(1 MARK QUESTIONS)

(a)   Write the molecular formula of tricarbonyl (1- 6 ^{6}) -cyclooctatetraene) chromium.   **(2016)**

(b)   Write the molecular formula of potassium trichloro (^{2}-ethene)-palatinate(II).   **(2017)**

(c)   Write the molecular formula of di- ~ -carbonylbis(tricarbonyl cobalt).   **(2018)**

SHORT ANSWER TYPE
(2 MARKS QUESTIONS)

(a)   Using the 18-electron rule, find out the total number of electrons per Mo atom and also find out the Mo-Mo bond order in $[(\ ^5\text{-cp})Mo(CO_3]_2$.   **(2016)**

(b)   Using the 18-electron rule, determine the unknown quantity (X and Z): **(2017)**

    (i) $[(\eta^5\text{-cp})Mn(CO)_X]_2$

    (ii) $[Ni(CO)_3(NO)]^Z$

(c)   Which of the following obeys 18-electron rule? **(2018)**

    (i) $(\eta^7\text{-}C_7H_7)Co(CO)_3$

    (ii) $(\eta^5\text{-}C_5H_5)Fe(CO)_2Cl$

(6 MARKS QUESTIONS)

(a)   What are organometallic compounds? Explain their classification on the basis of hapticity by giving suitable examples. Briefly explain the metal carbonyl bonds in metal carbonyls. **(2016)**

(b)   By giving suitable examples, briefly explain the metal-nitrogen bonding and their structure in dinitrogen transition metal complex. **(2017)**

(c)   Discuss the nature of bonding in metal carbonyl. Give evidence in support of your answer. **(2018)**

UNIT-6: Bioinorganic Chemistry

Very Short Answer Type Carrying 1 mark
(1 MARK QUESTIONS)

(a)   What are metalloporphyrines? **(2016)**

(b)   What is sodium pump? **(2017)**

(c)   Give one criterion for an element to be essential trace element. **(2018)**

SHORT ANSWER TYPE
(2 MARKS QUESTIONS)

(a)   Discuss the roles of Na, K and Ca in the biological system. **(2016)**

(b)   Mention the importance of two essential trace elements in biological system. **(2017)**

(c)   Explain the biological role of iodine in human system. **(2018)**

SHORT ANSWER TYPE
(3 MARKS QUESTIONS)

(a)   Comment on oxygen uptake and equilibrium in myoglobin and hemoglobin. **(2016)**

(b)   Describe the role of metal complexes in nitrogen fixation. **(2016)**

(c)   Discuss briefly the role of haemoglobin in maintaining the physiological pH and CO_2 transport from tissues to lungs. **(2017)**

(d)   Discuss the structure of metallopor phyrins, giving reason for its electrical neutrality. **(2017)**

(e)   Explain briefly change in iron(II) coordination sphere during oxygenation of haemoglobin and myoglobin. **(2018)**

(f)   Explain briefly the importance of Na^+ -K^+ ion pump. **(2018)**

UNIT-7: Inorganic rings and cages

Very Short Answer Type Carrying 1 mark
(1 MARK QUESTIONS)

(a)   Write the structure of tetrasulphur tetranitride. **(2016)**

(b)   Give a method for the preparation of borazine. **(2016)**

(c)   Give the product of methylation of diborane. **(2017)**

(d)   Write the reaction of reduction of tetrasulphur tetranitride. **(2017)**

(e)   What happens when diborane reacts with $Li[AlH_4]$? **(2018)**

(f)   What happen when S_4N_4 is heated? **(2018)**

SHORT ANSWER TYPE
(3 MARKS QUESTIONS)

(a)   What happens when diborane is allowed to react with ammonia under different experimental conditions?   **(2016)**

(b)   Explain the polyhedral skeletal electron pair theory or Wade's rule of borane.   **(2017)**

(c)   What happens when borazine undergoes –   **(2018)**
   (i) addition reaction with HCl;
   (ii) pyrolysis;
   (iii) hydrolysis?

UNIT-8: Non-stoichiometric compounds

Very Short Answer Type Carrying 1 mark
(1 MARK QUESTIONS)

(a)   What is radius ratio rule?   **(2016)**

(b)   What are ionic crystals?   **(2017)**

(c)   What is number of Schottky defects present per cm³?   **(2018)**

SHORT ANSWER TYPE
(2 MARKS QUESTIONS)

(a)   What types of defect are responsible for the existence of non-stoichiometric compounds of AB type?   **(2016)**

Or

When a mole of crystalline NaCl is prepared from 1 gram atom of sodium and 0.5 mole of chlorine gas, 41 kJ of heat is produced. The heat of sublimation of Na metal is 108.8 kJ. The heat of dissociation of chlorine gas into atoms is 242.7 kJ, the ionization energy of Na is 493.7 kJ and the electron affinity of chlorine is 368.2 kJ. Calculate the lattice energy of NaCl.   **(2016)**

(b)   What are intrinsic and photoexcited semiconductors?   **(2017)**

(c)   Why do CdI_2 structures are known as layer structures?   **(2018)**

SHORT ANSWER TYPE
(3 MARKS QUESTIONS)

(a)   What is lattice energy? Explain the various factors which affect lattice energy with suitable examples.   **(2016)**

(b)   Derive the Born-Lande equation for the lattice energy of an ionic compound.   **(2017)**

(c)   Give the classification of ionic structures with suitable examples in terms of close packing and occupancy of tetrahedral and octahedral holes.   **(2018)**

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