

**FINAL B.SC. EXAMINATION, 2018**

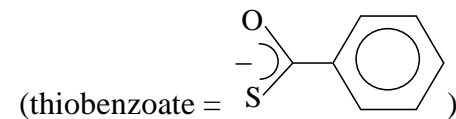
( 1st Semester )

**CHEMISTRY ( HONOURS )****INORGANIC CHEMISTRY****PAPER - XIII**

Time : Two hours

Full Marks : 50

1. a) Answer *any two* questions 2×3
- i) How can you prepare *cis*-and *trans*- $[\text{PtCl}_2(\text{NH}_3)(\text{C}_2\text{H}_4)]$  starting from  $[\text{PtCl}_4]^{2-}$  ?
- ii) Discuss briefly about the extraction of copper from its ore. Write relevant reactions.
- iii) Name one zinc containing enzyme and discuss its mechanism of action.
- b) Give one example of Type 2 copper protein. 1
2. a) Find out the Symmetry point group of the following species with justification : 3
- i)  $[\text{ReH}_9]^{2-}$  **OR**  $[\text{Cu}(\text{OAc})_2]_2$
- ii)  $\text{IOF}_6^-$  **OR**  $\text{B}_7\text{H}_7^{2-}$
- iii)  $[\text{Fe}(\text{bpy})_3]^{2+}$  **OR**  $[\text{Ni}^{11}(\text{thiobenzoate})_3]^-$



[ Turn over

[ 2 ]

b) Which of the following  $dz^2$  AO can mix with the respective valence s AO ? Explain with the help of symmetry criteria used for orbitals.

(i)  $3dz^2$  AO of P in  $PCl_5$ , (ii)  $5dz^2$  AO of P in  $[PtCl_4]^{2-}$

OR

Determine the product  $C_2(z) \otimes \sigma_v(xz) \otimes \sigma_v(yz)$  with the aid of the matrix multiplication for  $C_{2v}$  point group. 2

c) Identify the optically active complexes with reasons. 2

i)  $[CoCl_4(en)]^-$  ii)  $cis-[CoCl_2(en)_2]^+$ ,

iii)  $trans-[CoCl_2(en)_2]^+$ , iv)  $[Co(en)_3]^{3+}$

3. a) i) What happens when Pyrolusite is boiled with HCl (conc.) followed by the addition of solid Potassium iodide to the solution ? Write balanced reaction. Using this reaction, determine % Mn in a Pyrolusite sample.

3

OR

i) Through dry THF solution of  $Co_2(CO)_8$ , a mixture of dry 1-Propene and  $H_2$  gas is passed followed by the flow of pure CO at ambient condition. Write down the reaction involved in this work.

b) i) What are the uses of cobalt in different fields of science and technology ? Briefly explain their scientific reasons.

$1 \frac{1}{2}$

[ 5 ]

d)  $TiCl_4$  reacts with cyclopentadienyl anion in THF solvent and produces a compound of composition,  $Ti(C_5H_5)_4$  which exhibits only a single peak in its  $^1H$ NMR spectrum at room temperature. Suggest the structure of the compound and give a reasonable explanation for the occurrence of a single proton resonance in its  $^1H$ NMR spectrum. 2

7. a) What is Spinel and inverse Spinel structure of oxide ? How it is related with CFSE ? Whether the structure of  $Mn_3O_4$  is Spinel or inverse Spinel ? Discuss with proper justification. 2+2

b) The relative stabilities of complexes formed by high spin divalent first row transition metal ions is as follows :  $Mn(II) < Fe(II) < (Co(II) < Ni(II) < Cu(II) > Zn(II)$ . Justify the reason behind the maximum stability of  $Cu(II)$  and minimum stability of  $Mn(II)$  in the above series.

1+1

c) What do you mean by z-out and z-in distortion in coordinated complexes ? 1

[ 4 ]

5. a) Describe how the antineutrino was discovered to accompany the formation of an electron during nuclear beta decay. 2
- b) With the help of suitable assumptions, derive the condition for fission parameter that allows the fission of a nucleus to occur. 2
- c) With the help of a suitable pyrimidine base explain radiosensitization as an application of gamma rays.  $1\frac{1}{2}$
- d) What is fusion ? Discuss the process in the light of any of the established mechanism.  $1\frac{1}{2}$
6. a) Aqueous solution of Ti(IV) develops an intense orange color with  $\text{H}_2\text{O}_2$  and the colour is discharged by  $\text{F}^-$  ion. Predict the structure of the orange species. 1
- b)  $\text{V}_2\text{O}_5$  dissolves in strong base and forms “vanadates” whose composition is a delicate function of the pH of the solution. Suggest the probable composition along with the structure of the species at (i)  $\text{pH} > 12.0$ , (ii)  $\text{pH} = 6.0$  and (iii)  $\text{pH} = 2.0$ . 2
- c) How pure vanadium can be extracted from its important ore ? Write appropriate reaction involved in each step. 2

[ 3 ]

- ii) Explain the role of P concentration to maintain quality of steel. How do you estimate P from steel ?  $1\frac{1}{2}$

OR

- i) “ $\text{Co}^{2+}$  in acidic medium is stable while ammonical or alkaline solution is prone to oxidation by air.” – Explain.  $1\frac{1}{2}$
- ii) “High valent Mn complexes are oxygen Evolving Complexes (OEC).” – Explain.  $1\frac{1}{2}$
- c) Write a short note on Roussin’s (Red, Black) salt. 2
4. a)  $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$  displays three absorption bands in solution. Assign the bands and hence discuss the  $10\text{Dq}$  value. 3
- b) For the terms,  ${}^2\text{D}(\text{d}^3)$ , determine (a) the values of  $L$ ,  $M_L$ ,  $S$ , and  $M_S$ , (b) possible values of  $J$ . Decide which is the lowest in energy. 1
- c) Calculate the effective magnetic moment of the  $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$  and  $[\text{Ni}(\text{en})_3]^{2+}$  ion ( $\text{en} = 1,2$ -diaminoethane). The lowest energy band in the electronic spectrum is at  $8500$  and  $11500\text{ cm}^{-1}$  respectively and the spin-orbit coupling constant ( $\lambda$ ) is  $-315\text{ cm}^{-1}$ , where  $\alpha = 4$  for both cases. 3

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