TDC (CBCS) Even Semester Exam., 2024

CHEMISTRY

(4th Semester)

Course No. : CHMHCC–401T

(Coordination Chemistry and its Application)

Full Marks : 50
Pass Marks : 20

Time : 3 hours

The figures in the margin indicate full marks for the questions

UNIT—I

1. Answer any *two* questions : 2×2=4

(a) Draw crystal-field splitting diagram of a square-planar complex.

(b) Calculate the CFSE (Dq) for a d^4 high-spin octahedral system.

(c) Write the factors affecting the magnitude of crystal field splitting.

2. Answer any *one* question : 6

(a) *(i)* Compare the CFSE of $Co(H_2O)_6^{]2+}$ and $Co(NH_3)_6^{]3+}$ in terms of Δ_o and *P*. 3

(ii) Explain the consequence of Jahn-Teller effect on the structure of $CuCl_6^{]4-}$. 3

(b) *(i)* Based on CFT, predict the magnetic moment of $[Ni(NH_3)_4]SO_4$. 3

(ii) What is spectrochemical series? Calculate and comment on the CFSE of $Fe(H_2O)_6^{]2+}$. 1+2=3

UNIT—II

3. Answer any *two* questions : 2×2=4

(a) Write the IUPAC names (2005) of the following : 1×2=2

(i) 

(ii) $[Co(NH_3)_6][Cr(C_2O_4)_3]$

(b) Distinguish between ambidentate and flexidentate ligands with suitable examples.

(c) What is chelate complex? Give an example. 1+1=2

4. Answer any *one* question : 6

(a) *(i)* What is meant by terminal ligand? Compare such a ligand with a bridging ligand. Define nuclearity of a complex. 1+1+1=3

(ii) Taking suitable example, describe the possible stereochemistries for a complex of type $[ML_5]$. 3

(b) *(i)* What is meant by flexidentate character of polydentate ligand? Give example. 3

(ii) What type of isomerism is exhibited by $[Co(NH_3)_5X]Cl_2$ ($X = NO_2$)? Give the formula and IUPAC nomenclature of the isomers. 3

UNIT—III

5. Answer any *two* questions : 2×2=4

(a) Compounds of Mn(VII) are intensely coloured while those of Mn(II) are almost colourless. Explain.

(b) Why are 4*d* and 5*d* elements chemically so similar?

(c) $Cu(NH_3)_4^{2+}$ is intense blue in colour. Explain.

6. Answer any *one* question : 6

(a) (i) What is chromyl chloride test? Can this test be performed on aqueous solution containing Cl^-? 2

(ii) Why does chromium exist as $Cr_2O_7^{2-}$ in acidic medium, whereas in alkaline medium as CrO_4^{2-}? 2

(iii) Which one of Cr^{2+} or Cr^{3+} is stable in aqueous solutions? Give reasons. 2

(b) (i) Give reasons why—

(1) in aqueous solution, Cu(I) having d^{10} configuration is less stable than Cu(II) having d^9 configuration;

(2) ZnO is yellow when hot and white when cold;

(3) Zn^{++} compounds are colourless. 1+1+1=3

(ii) Examine feasibility of the reaction

$$Sn + Cu^{2+} \rightarrow Sn^{2+} + Cu$$

given that $E^\circ_{Sn^{2+}/Sn} = -0{\cdot}136$ V and $E^\circ_{Cu^{2+}/Cu} = +0{\cdot}34$ V. 2

(iii) Comment on the colour of scandium(III) ion. 1

UNIT—IV

7. Answer any *two* questions : 2×2=4

(a) Write down the sets of quantum numbers that define the 4*f* atomic orbitals.

(b) What is meant by 'lanthanide contraction'?

(c) Discuss the main differences in the chemistry of lanthanides and actinides.

8. Answer any *one* question : 6

(a) (i) Lanthanum exhibits +3 oxidation state, whereas certain other elements of lanthanum series show +2 and +4 also. Explain. 3

(ii) "Although Ce^{3+} has f-electron, it does not show colour." Explain. 2

(iii) Mention two applications of lanthanide materials. 1

(b) (i) Write general electronic configuration of lanthanides and explain the trends in ionic radii of M^{3+} of this class. 1+2=3

(ii) Why is Ce^{4+} a strong oxidizing agent whereas Sm^{2+} is a reducing agent? 3

UNIT—V

9. Answer any *two* questions : 2×2=4

(a) Define essential elements in biological system. Give two examples of essential trace elements. 1+1=2

(b) Describe the toxic effects of CN^- ion on human health.

(c) Discuss the role of iron in biological function.

10. Answer any *one* question : 6

(a) (i) What are heavy metals? Explain the toxic effects of mercury on human health. 1+2=3

(ii) What are the functions of hemoglobin and myoglobin in biological system? 3

(b) (i) What is chelation therapy? Give one example of its application in detoxification of lead and arsenic. 1+1+1=3

(ii) Can a metal be toxic as well as essential for a living being? Explain with example. 2

(iii) Suggest one antidote for mercury poisoning. 1

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