

2024/TDC (CBCS)/EVEN/SEM/
CHMHCC-401T/302

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.

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(Turn Over)



(2)

2. Answer any one question : 6
- (a) (i) Compare the CFSE of $\text{Co}(\text{H}_2\text{O})_6^{2+}$ and $\text{Co}(\text{NH}_3)_6^{3+}$ 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 $[\text{Ni}(\text{NH}_3)_4]\text{SO}_4$. 3
- (ii) What is spectrochemical series? Calculate and comment on the CFSE of $\text{Fe}(\text{H}_2\text{O})_6^{2+}$. 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) $\left[(\text{en})_2\text{Co} \begin{array}{c} \text{NH}_2 \\ \diagdown \\ \text{OH} \end{array} \text{Co}(\text{en})_2 \right] (\text{SO}_4)_2$
- (ii) $[\text{Co}(\text{NH}_3)_6][\text{Cr}(\text{C}_2\text{O}_4)_3]$
- (b) Distinguish between ambidentate and flexidentate ligands with suitable examples.

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(3)

- (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 $[\text{ML}_5]$. 3
- (b) (i) What is meant by flexidentate character of polydentate ligand? Give example. 3
- (ii) What type of isomerism is exhibited by $[\text{Co}(\text{NH}_3)_5\text{X}]\text{Cl}_2$ ($\text{X} = \text{NO}_2$)? 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.

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(4)

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

(c) $\text{Cu}(\text{NH}_3)_4^{2+}$ 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 $\text{Cr}_2\text{O}_7^{2-}$ 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;

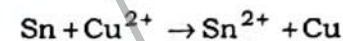
(3) Zn^{++} compounds are colourless. 1+1+1=3

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(5)

(ii) Examine feasibility of the reaction



given that $E_{\text{Sn}^{2+}/\text{Sn}}^\circ = -0.136 \text{ V}$ and

$E_{\text{Cu}^{2+}/\text{Cu}}^\circ = +0.34 \text{ V}$. 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 4f 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

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(6)

- (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

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(7)

- (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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