TDC (CBCS) Even Semester Exam., 2023

CHEMISTRY

(Honours)

(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

SECTION—A

Answer any *ten* of the following questions : 2×10=20

1. What is effective atomic number (EAN) of a complex? Find out the EAN of cobalt in $[Co(NH_3)_6]^{3+}$. 1+1=2

2. What is inner-orbital complex? Show hybridization of inner-orbital complex taking a suitable example. 1+1=2

3. Sketch tetragonal distortion of $NiF_6^{]4-}$ (a d^8 arrangement in weak octahedral field).

4. *(a)* Write the formula of the compound sodium iron (III) hexacyanoferrate (II).

   (b) Write the IUPAC name of the following compound :

   $[Cr(en)_3][Co(CN)_6]$ 1+1=2

5. $[Co(NH_3)_5NO_2]Cl_2$ can be prepared in two isomeric forms. Show the structures and comment on the type of isomerism.

6. What is an ambidentate ligand? How does it differ from polydentate ligand? 1+1=2

7. Cu and Au should be included in transition series, although having d^{10} configuration. Give arguments.

8. Give the reason for the different magnetic behaviours for the first-row transition elements compared to second- and third-row transition elements.

9. "The atomic radii of Zr and Hf are almost same." Explain.

10. Which lanthanide elute first in ion-exchange method? Give reason.

11. Why is Ce^{3+} solution colourless but Ce^{4+} solution yellow in colour?

12. Give the products for the following reactions : 1+1=2

   (i) $EuCl_3 + H_2 \xrightarrow{Zn/Hg} [A]$

   (ii) $Ce(OH)_3 + \frac{1}{2}O_2 \xrightarrow{\Delta} [B]$

13. Is haemocyanin a non-haemeprotein? Write the metal ion, oxidation state and magnetic properties in haemocyanin.

14. Comment on the size and magnetism of Fe^{2+} in oxyhaemoglobin and deoxy-haemoglobin.

15. Write health disorders/diseases (human) originated from deficiency and excess of calcium ions.

SECTION—B

Answer any *five* of the following questions : 6×5=30

16. *(a)* Write the factors that affect the magnitude of Δ_0 values. 2

(b) Calculate the CFSE and expected magnetic moment in BM for $Fe(CN)_6^{]4-}$ and $NiCl_4^{]2-}$ complexes. 2+2=4

17. *(a)* What is spectrochemical series and what is its importance? 2

(b) Sketch and explain the MO diagram for $Co(NH_3)_6^{]3+}$. Comment on the magnetic properties. 3+1=4

18. *(a)* Give the hydrate isomers of $CrCl_3 \cdot 6H_2O$ in solution. How could you detect them experimentally? 2+1=3

(b) Draw all the possible stereoisomers of $Co(en)_2Cl_2^{]+}$. Indicate which isomers are optically active. 3

19. *(a)* Why are chelated complexes more stable than complexes with unidentate ligands? Explain why $Ni(H_2O)_6^{]2+}$ is labile but $V(H_2O)_6^{]2+}$ inert. 1+3=4

(b) What method could be used to distinguish between *cis-* and *trans-* isomers of $[Pt(NH_3)_2Cl_2]$? 2

20. *(a)* What is meant by coordination complex? Give the reason why transition elements form a number of complex compounds. 1+2=3

(b) Write the chemical reactions for the preparation of halide and complex of Mn (II). What is the industrial use of manganese? 2+1=3

21. *(a)* Draw and explain the Frost-Ebsworth diagram of Cr in acid solution. 4

(b) Write two differences in chemical properties between Fe and Ru. 2

22. *(a)* What are lanthanide elements? Give the electronic configuration of Ce and Pr in *(i)* elemental form and *(ii)* ionic (III) form. 1+2=3

(b) Write the reason for the stable (+II, +IV) oxidation states apart from common (+III) oxidation state for lanthanides. Give examples. 3

23. *(a)* Why lanthanides show different magnetic properties than transition (*d*-block) elements? Give the equation for magnetic moment calculation of lanthanides. 2+1=3

(b) Eu^{3+} and Sm^{3+} show anomalous magnetic behaviour than the other lanthanides. Explain. 3

24. *(a)* Describe the biological role of Zn in human body. 3

(b) What is catalase? Write its function. How does it differ from peroxidase? 3

25. *(a)* How lead (Pb) toxicity happens? Write the effect of Pb poisoning on human health. Name the therapy by which Pb poisoning can be prevented. 1+2+1=4

(b) What do you mean by essential and trace elements? Give examples. 2

★★★