

B. SC. CHEMISTRY EXAMINATION, 2023

(5th Semester, CBCS)

CHEMISTRY (CORE)

PAPER: CORE/CHEM/TH/11

Time : Two Hours

Full Marks : 40

(20 marks for each unit)

Use a separate answer script for each unit.

UNIT - 5111 - I

Answer all questions :

1. (a) For its ethylenediamine complexes of divalent first row transition metal ions order of stability 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. 2+1
- (b) Coordination compounds having tetrahedral geometry rarely show low spin complexes. Why? 1
- (c) What do you mean by z-in and z-out distortion in octahedral coordinated complexes? 1
- (d) "The driving force of JT distortion in the octahedral system is the gain of additional CFSE." Justify or criticize the statement. 2

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- (e) In case of $[ML_6]^{n+}$ compound, show the molecular orbital energy diagram considering six ligand group orbital. Also show the relevance of the CFT approach with this MO diagram. 2+1
2. (a) Explain why $[FeF_6]^{3-}$ is almost colourless whereas $[CoF_6]^{3-}$ is coloured and exhibits only a single band in the visible region of the spectrum. 1+3
- (b) Solid copper (II) acetate shows subnormal magnetic moment at room temperature—Explain. 2
- (c) Briefly describe the mode of binding of O_2 to the iron centre in one haem unit of haemoglobin. 2
- (d) Discuss the removal of arsenic from human body using chelation therapy. 2

UNIT - 5112 - I

3. Answer the following questions :
- (a) Calculate the energy difference between ground and first excited state of Tb^{3+} ($\lambda = 202 \text{ cm}^{-1}$) system by considering respective J-levels. 2
- (b) Explain why the magnetic moment of Sm^{3+} is not given from the equation used for the calculation of magnetic moment of Tb^{3+} . 2
- (c) Explain the “antenna effect” for the luminescence properties of rare-earth based metal-organic complex. 2

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- (d) Give two separate examples of Eu^{3+} complexes with square antiprism and tricapped trigonal prism geometries around metal ions. 2
- (e) Write the nuclear reactions for the formation of ^{241}Am and ^{239}Pu from ^{238}U . 2
4. Answer any **four** questions : $2\frac{1}{2} \times 4$
- (a) Discuss the formation of bis(cyclopentadienyl) titanium(III) chloride from suitable starting materials. Highlight an application of this compound. $1\frac{1}{2} + 1$
- (b) Describe the structure of Ti_8C_{12} . How was the spatial environment around each Ti realized from a reaction concerning this molecule? $1\frac{1}{2} + 1$
- (c) With suitable reactions discuss the versatile ability of vanadium compounds to show colour. What is the structure of VO_6^{3-} ? $2 + \frac{1}{2}$
- (d) Write the formula and draw structures of the various isomers of $Cr(H_2O)_6Cl_3$ mentioning the colour of each. What is the isomerism they depict? $2 + \frac{1}{2}$
- (e) Draw the structure of the dichromate ion mentioning bond lengths and bond angles. How and why can the chromate ion be used as an indicator in estimation of halides? $1 + 1\frac{1}{2}$
- (f) In a titration of Fe^{2+} with MnO_4^- in the presence of Cl^- , without an improvisation, a simple titration gives erroneous results. Why? Discuss what is done for such a case. $1 + 1\frac{1}{2}$