

(4)

- (c) With suitable examples, show the versatile ability of vanadium compounds to show distinct colours. (in three different oxidation states) 1½

(OR)

Discuss possible structures for vanadates. How do these compare with phosphates? 1½

- (d) Depict the structures and discuss the structural aspects of $[(Cr^{II})_2(CH_3COO)_4(H_2O)_2]$ 2
- (e) Discuss what happens when manganate ion is subjected to acidic conditions. 1½

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Ex/SC/CHEM/UG/CORE/TH/11/31/2025

BACHELOR OF SCIENCE EXAMINATION, 2025

(5th Semester)

CHEMISTRY (CORE)

PAPER : CORE/CHEM/TH/11

Time : Two Hours

Full Marks : 40

Use a separate Answer Script for each Unit.

UNIT—5111-I

Answer **all** questions :

1. (a) What are spinel and inverse spinel structure of oxide and how it is related with CFSE? Whether the structure of Fe_3O_4 is spinel or inverse spinel? Discuss with proper justification. 2+1
- (b) In crystal field theory, why the octahedral splitting is more predominate than tetrahedral splitting? If an octahedral Fe (II) complex is paramagnetic or diamagnetic in nature, then calculate its CFSE for both cases. 1+2
- (c) What do you mean by z-out and z-in distortion in coordinated complexes? Does a square planar geometry can be considered a terminal case for the z-out distortion in an octahedral system? Justify or criticize the statement. 1+2

(2)

(d) What are the most favorable conditions for the formation of tetrahedral complexes? 1

2. (a) $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$ exhibits three bands at 17000, 24000 and 37500 cm^{-1} respectively. Assign the bands hence calculate the Δ_0 and the Racah parameter B. 3

(b) Show that the μ_{obs} for VCl_4 is slightly lower than μ_{spin} only value. 2
[Given $10 Dq$ of $\text{VCl}_4 = 8000 \text{ cm}^{-1}$, spin orbit coupling constant $\lambda = 250 \text{ cm}^{-1}$ and $\alpha = 2$]

(c) Explain the origin of colour of $[\text{CrO}_4]^{2-}$ and $[\text{Fe}(\text{o-phen})_3]^{2+}$. 2
(o-phen = 1,10-phenanthroline)

(d) Octahedral Ni(II) complexes have magnetic moments in the range $2.9\text{--}3.9 \text{ BM}$ and tetrahedral Ni(II) complexes have magnetic moments up to 4.1 BM , whereas Ni(II) square planar complexes are diamagnetic. Rationalize the observations. 3

(OR)

Draw the structure of oxyhaemoglobin and hence comment on the magnetic behaviour of oxyhaemoglobin. 3

(3)

UNIT—5112-I

1. Answer the following questions :

(a) Write names of three different types of geometries of complexes having coordination number eight around rare-earth metal ions. Cite examples for each of them. 3

(b) Determine the ground state term symbol and calculate magnetic moment of Yb^{3+} system. 2

(c) Aqueous solution of Lu^{3+} is colourless but Yb^{2+} is green in colour although both contain same number of electrons. 1

(d) Discuss with suitable diagram ligand sensitized metal centered emission. Explain why Eu^{3+} and Tb^{3+} ions are appropriate systems to show such properties. 2+1

(e) Write down nuclear reactions for the synthesis of ^{239}Pu and ^{241}Am from ^{238}U . 1

2. (a) With the help of suitable diagrams, explain the structure of TiO_2 . Why is it an useful photocatalyst? $1\frac{1}{2}+1$

(b) How is bis (cyclopentadienyl) titanium (III) chloride prepared? Draw its structure. What makes it an essential template for organic synthesis? Explain. Name this reagent. $\frac{1}{2}+ \frac{1}{2}+1+ \frac{1}{2}$