


Name:			
Enrolment No:			
<b>UNIVERSITY OF PETROLEUM AND ENERGY STUDIES</b> <b>End Semester Examination, May 2022</b>			
<b>Course: Inorganic Chemistry-III</b> <b>Program: B.Sc Chemistry</b> <b>Course Code: CHEM2004</b>		<b>Semester : IVth</b> <b>Time : 03 hrs.</b> <b>Max. Marks: 100</b>	
<b>Instructions: Complete the statements</b>			
<b>SECTION A</b> <b>(5Qx4M=20Marks)</b>			
S. No.		Marks	CO
Q 1	Calculate the CFSE value for the following systems: (i) $d^5$ low spin octahedral (ii) $d^5$ high spin octahedral (iii) $d^6$ high spin octahedral (iv) $d^4$ low spin octahedral.	4	CO1
Q 2	(a) In which of the following species does the transition metal ion have $d^5$ electronic configuration? (i) $[\text{Cr}(\text{NH}_3)_6]^{3+}$ (ii) $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$ (iii) $[\text{CoF}_6]^{3-}$ (iv) $[\text{Fe}(\text{CN})_6]^{3-}$  (b) Which one of the following statements is FALSE? (i) In an octahedral crystal field, the d electrons on a metal ion occupy the $e_g$ set of orbitals before they occupy the $t_{2g}$ set of orbitals. (ii) Diamagnetic metal ions cannot have an odd number of electrons. (iii) Low spin complexes can be paramagnetic. (iv) Low spin complexes contain strong field ligands.	2+2	CO1 CO2
Q 3	Give the general electronic configuration of lanthanides. Explain the anomalous oxidation states of 2+ and 4+ shown by some elements in the series.	4	CO1

Q 4	<p>(a) Which ordering correctly describes the tendency of a ligand to direct ligand substitution in a square planar complex to a position opposite to itself?</p> <p>(i) <math>[\text{CN}]^- &gt; [\text{NO}_2]^- &gt; \text{Br}^- &gt; \text{NH}_3</math>  (ii) <math>[\text{CN}]^- &gt; \text{Br}^- &gt; \text{NH}_3 &gt; [\text{NO}_2]^-</math>  (iii) <math>[\text{NO}_2]^- &gt; [\text{CN}]^- &gt; \text{NH}_3 &gt; \text{Br}^-</math>  (iv) <math>\text{Br}^- &gt; [\text{CN}]^- &gt; \text{NH}_3 &gt; [\text{NO}_2]^-</math></p> <p>(b) Which statement is correct?</p> <p>(i) A dissociative mechanism is a 2-step mechanism with the leaving group departing in the second step  (ii) An associative mechanism is a 2-step mechanism; the intermediate has a lower coordination number than the starting complex  (iii) In a dissociative interchange mechanism, bond breaking dominates over bond formation  (iv) In an associative interchange mechanism, the entering group associates with the substrate after the leaving group has departed.</p>	2+2	CO3
Q 5	The complex ion $[\text{Co}(\text{NH}_3)_6]^{3+}$ is octahedral and diamagnetic, $[\text{CoF}_6]^{3-}$ is also octahedral but paramagnetic in nature. How does valence bond theory (VBT) account for this observation?	4	
<b>SECTION B</b> <b>(4Qx10M= 40 Marks)</b>			
Q 6	Discuss three important factors influencing the magnitude of crystal field stabilization energy (CFSE) in octahedral complexes.	10	CO2
Q 7	<p>(a) Explain Jahn-Teller distortion present in case of <math>d^9</math> and <math>d^8</math> low spin systems.</p> <p>(b) <math>d^8</math> low spin metals never form octahedral complexes. Why it is so?</p>	5+5	CO1
Q 8	What is lanthanide contraction? What are its important consequences?	10	CO1
Q 9	Define Trans Effect. Write down the reactions involved in the preparation of <i>cis</i> - and <i>trans</i> - $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$ by following Trans Effect.	10	CO2

**SECTION-C**  
**(2Qx20M=40 Marks)**

Q 10	What are inert and labile complexes? How will you explain the lability or inertness in case of following complex ions using Valence bond Theory? (i) $[\text{MnCl}_6]^{3-}$ (ii) $[\text{Co}(\text{CN})_6]^{3-}$	<b>20</b>	<b>CO1</b> <b>CO3</b>
Q 11	(i) What are nucleophilic substitution reactions in coordination compounds? (ii) Discuss the dissociative and association mechanism for octahedral complexes.	<b>20</b>	<b>CO3</b>