WEST BENGAL STATE UNIVERSITY

B.Sc. Honours 5th Semester Examination, 2020, held in 2021

CEMACOR11T-CHEMISTRY (CC11)

Time Allotted: 2 Hours | Full Marks: 40

The figures in the margin indicate full marks.
Candidates should answer in their own words and adhere to the word limit as practicable.
All symbols are of usual significance.

UNIT-I

Answer any *two* questions from the following 12×2 = 24

1. (a) Calculate CFSE of $Mn(H_2O)_6^{2+}$, $Fe(H_2O)_6^{2+}$, $Co(H_2O)_6^{2+}$ and $Cu(H_2O)_6^{2+}$. Predict the most Stable ion. 3

   (b) The magnetic moment of the brown ring compound formed in the ring test of nitrate is 3.89 BM. Find out the oxidation state and the type of hybridisation of the central metal ion. 3

   (c) 'Octahedral Cu(II) complexes are distorted' — Explain in the light of CFT using approximate energy diagram . 4

   (d) The aqueous solution of $[Ti(H_2O)_6]^{3+}$ shows a maximum absorption around $20300\ cm^{-1}$ in its electronic spectrum. Express the band position in nm. Will the complex give colour in visible region? 2

2. (a) Although both Co(III) and Ni(IV) are d^6 systems yet $[NiF_6]^{2-}$ is diamagnetic but $[CoF_6]^{3-}$ is paramagnetic. Explain. 3

   (b) Explain why Cr(II) is strong reducing agent but Mn(III) is strong oxidising agent, although both are d^4 ions . 3

   (c) Give expression for CFSE of Fe(II) ion in weak and strong octahedral crystal fields. 2

   (d) Room temperature magnetic moment of Copper(II) sulfate pentahydrate is almost equal to the spin only moment (1.73 BM) of Cu(II), whereas, that of Copper(II) acetate monohydrate is unusually lower (1.4 BM). Explain. 4

3. (a) Find out spin only magnetic moment (μ_s) in 4

   (i) $[Fe(OH_2)_5NO]SO_4$

   (ii) $K_4[Ni(CN)_4]$.

(b) Which of the following pairs of complex has higher 10 Dq value and why? 3

(i) $[Co(NH_3)_6]^{3+}$ and $[Rh(NH_3)_6]^{3+}$

(ii) $[Fe(C_2O_4)_3]^{4-}$ and $[Fe(C_2O_4)_3]^{3-}$

(iii) $[Cr(en)_3]^{3+}$ and $[Cr(C_2O_4)_3]^{3-}$.

(c) Show with calculation, whether $NiFe_2O_4$ will show normal or inverse spinel structure. 3

(d) From electronic spectrum, 10 Dq of $[Mn(H_2O)_6]^{3+}$ is found to be 21000 cm^{-1}. The pairing energy of Mn(III) is 28800 cm^{-1}. Predict whether the complex will be high or low spin. 2

4. (a) Arrange the following pairs on the basis of crystal field splitting parameter (10 Dq): 2

(i) $[V(H_2O)_6]^{2+}$ and $[V(H_2O)_6]^{3+}$

(ii) $[Fe(CN)_6]^{4-}$ and $[Os(CN)_6]^{4-}$.

(b) Though Cr^{2+} and Mn^{3+} are isoelectronic, $[Cr(OH_2)]^{2+}$ is highly reducing but $Mn(OH_2)_6^{3+}$ is highly oxidizing. Explain. 3

(c) OH^- ion is in lower position than H_2O in spectrochemical series — Explain. 3

(d) Among CrF_2 and MnF_2, one is octahedral while the other is distorted octahedral. Explain. 2

(e) "Low spin tetrahedral complexes are rare, though there are many low spin octahedral complexes" — Explain the observation. 2

UNIT-II

Answer any *one* question from the following 16×1 = 16

5. (a) What do you mean by lanthanide contraction? Explain the impact of lanthanide contraction on the chemical behaviour of the lanthanides. 4

(b) 'Oxo-cations are common with the actinides, whereas in case of lanthanides these are not common'. Explain. 2

(c) 'Absorption spectra of lanthanides in acidified solution are line like' — Explain. 2

(d) Explain why La^{3+} and Lu^{3+} are diamagnetic while Sm^{3+} has low magnetic moment. 3

(e) 'Lanthanides normally do not form complexes' – Explain. 2

(f) "Lanthanides exhibit +3 oxidation state in general while actinides can show variable oxidation states." — Explain. 3

6. (a) Discuss the separation of lanthanides by ion-exchange method. 4

   (b) Nobelium(II) is more stable and non-reducing while Ytterbium(II) is a stronger reducing agent. Explain. 2

   (c) What is the correct order of basicity among the following lanthanide(III) hydroxides? $Pr(OH)_3, Sm(OH)_3, Dy(OH)_3, Yb(OH)_3$ — Explain. 2

   (d) Write the names of the lanthanides each of which have a stable oxidation state which is (i) higher than usual (ii) lower than usual. Explain your answer. 2+2

   (e) Qualitatively discuss the magnetic properties of the lanthanides. 4

N.B. : *Students have to complete submission of their Answer Scripts through E-mail / Whatsapp to their own respective colleges on the same day / date of examination within 1 hour after end of exam. University / College authorities will not be held responsible for wrong submission (at in proper address). Students are strongly advised not to submit multiple copies of the same answer script.*

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