

2019

CHEMISTRY

(Major)

Paper : 6.4

(Inorganic Chemistry)

Full Marks : 60

Time : 3 hours

The figures in the margin indicate full marks for the questions

1. Choose the correct answer/Answer the following : 1×7=7

(a) The terms of an octahedral complex are labelled by the symmetry species of the overall orbital state; a superscript prefix shows the

- (i) energy states of the term
- (ii) multiplicity of the term
- (iii) spectroscopic state of the term
- (iv) coupling state of the term

- (b) The correlation between electronic state energies and ligand field strength can be displayed on
- (i) electronic state diagram
 - (ii) Orgel diagram
 - (iii) Tanabe-Sugano diagram
 - (iv) spectral diagram
- (c) Haemoglobin consists of a
- (i) monomer
 - (ii) dimer
 - (iii) trimer
 - (iv) tetramer
- of myoglobin-like subunits.
- (d) $[\text{Ti}(\text{H}_2\text{O})_6]^{+3}$ absorbs the light of wavelength 5000 Å. Which of the following ligands would form Ti (III) complex absorbing the light of higher wavelength than 5000 Å?
- (i) NO_2
 - (ii) CN^-
 - (iii) NH_3
 - (iv) F^-

- (e) What disease is caused by the presence of nitrate more than 50 ppm in water?
- (i) Hemolytic anemia
 - (ii) Sickle-cell anemia
 - (iii) Thalassaemia
 - (iv) Methemoglobinemia
- (f) The ions $[\text{NpO}_6]^{-5}$ and $[\text{PuO}_6]^{-5}$ can be synthesized only in alkaline solution. Because
- (i) their decompositions take place in acidic medium
 - (ii) in acidic solution they form unstable complexes
 - (iii) in alkaline solution they form stable complexes
 - (iv) water molecules coordinated in alkaline medium to form stable complexes
- (g) Of the three isobars $^{114}_{48}\text{Cd}$, $^{114}_{49}\text{In}$ and $^{114}_{50}\text{Sn}$, which is likely to be radioactive?

(4)

2. Answer the following : $2 \times 4 = 8$

- (a) Find out the Russell-Saunders ground-state term for Nb^{+3} ion.
- (b) By applying complexometric titration, 6.5 ml of 0.0091 M EDTA solution was required for titration of a 50 ml sample of water for total hardness. Calculate the total hardness in terms of ppm of CaCO_3 .
- (c) How is artificial radioactivity manifested by K-electron capture?
- (d) Write briefly about in vitro fixation of nitrogen.

3. Answer any three of the following : $5 \times 3 = 15$

- (a) The logarithms of stability constant values of $[\text{Cu}(\text{en})]^{+2}$, $[\text{Cu}(\text{NH}_3)_2]^{+2}$, $[\text{Ag}(\text{en})]^+$ and $[\text{Ag}(\text{NH}_3)_2]^+$ complexes are 10.7, 7.8, 4.7 and 7.2 respectively. Explain why the en-complex of copper is more stable than the ammine complex, whereas the reverse is true for the corresponding silver complexes.

(5)

- (b) Write the $\text{S}_{\text{N}}2$ mechanism of ligand displacement reaction of octahedral complexes.

- (c) Discuss briefly the functions of haemoglobin and myoglobin in biological system.

- (d) Write about the formation of coordination complex by lanthanides.

4. Answer any three of the following : $10 \times 3 = 30$

- (a) (i) Establish a relation between stepwise formation constants and overall formation constant for a complexation reaction between $[\text{Cu}(\text{H}_2\text{O})_6]^{+2}$ and ethylenediamine. 5

- (ii) How will you explain the lability and inertness of the complexes on the basis of CFT? Which one of d^5 and d^6 ions is more inert in low-spin octahedral complex?

$4 + 1 = 5$

(6)

2

- (b) (i) Write the uses of Ag, Pt and Au as medicine. 5
- (ii) Write a note on chelate therapy. 5
- (c) (i) Write about the consequences of lanthanide contraction. 5
- (ii) The higher oxidation states are more common for actinides than for lanthanides—why? 3
- (iii) Why are the observed magnetic moments of actinides lower than the calculated value? 2
- (d) (i) Explain the mechanism of $\text{Na}^+ - \text{K}^+$ pump. 5
- (ii) Why do the tetrahedral complexes show intense colour than the octahedral complexes? 3
- (iii) The reaction
- $$[\text{NiXL}_5]^+ + \text{H}_2\text{O} \rightarrow [\text{NiL}_5(\text{H}_2\text{O})]^{+2} + \text{X}^-$$
- is much faster if L is NH_3 instead of H_2O . Explain. 2

(7)

- (e) (i) State how CO affects biological system and how it can be remedied. 3
- (ii) Discuss the sources and toxicities caused by copper and cadmium. 2
- (iii) A museum wishes to analyze a piece of ruby for chromium content. What should be the preferred method of analysis? Write briefly about the method. 1+4=5
