

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 :

2×4=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 :

5×3=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.

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(Continued)

(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 : 10×3=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

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(Turn Over)

(6)

- (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
