2018

(October)

CHEMISTRY

(Honours)

(Part–A : Inorganic Chemistry—I)

(Chem–H–501)

Marks : 38

Time : 2 hours

The figures in the margin indicate full marks for the questions

1. *(a)* List down all the symmetry operations and symmetry elements present in *cis*-$[Pt(NH_3)_2Cl_2]^{2+}$. 4

(b) For titrating 10 ml of a solution with the help of a micro-burette, the volumes of the titrant used are 9·98 ml, 9·99 ml, 9·95 ml, 10·00 ml and 10·20 ml. Calculate the standard deviation. 3

OR

2. *(a)* Find out the symmetry point group in $XeOF_4$ and XeF_4 by indicating clearly in their structures the symmetry elements present in them. 5

(b) Evaluate the following expressions rounding of the answer to the appropriate number of significant figures : 1×

(i) $42{\cdot}71\ g + 9{\cdot}643\ g + 18{\cdot}0\ g$

(ii) $0{\cdot}16\ m^3 \times 10{\cdot}487\ kg\ m^{-3}$

3. (a) Give the structural and chemical formulae of the cupferron and oxine. Discuss the application of oxine in qualitative and quantitative analyses. 1+1+3

(b) What is coprecipitation? What are the factors responsible for coprecipitation? 1+1

(c) What is meant by digestion of precipitate?

OR

4. (a) Discuss some of the advantages and disadvantages of organic reagents over inorganic reagents.

(b) What are meant by masking and demasking of cations? Give examples.

(c) Why is pH an important factor in selection of an indicator for a complexometric titration?

(Continued

5. (a) Discuss the separation of isotopes by electromagnetic method. 4

(b) Binding energies of $_2He^4$ and $_3Li^7$ are 27·37 MeV and 39·3 MeV respectively. Which of the two nuclei is more stable? Explain. 4

OR

6. (a) Describe the uses of the following in a nuclear reactor : 5

(i) Moderator

(ii) Control rods

(iii) Coolant

(b) What is the binding energy in $_2He^4$? Given,

mass of $_2He^4$ = 4·002604 amu

mass of proton = 1·007825 amu

mass of neutron = 1·008665 amu 3

7. (a) Calculate the crystal field stabilization energy for high-spin d^4-octahedral complex. 2½

(b) Make the plot of lattice energies of M^{2+} ions of the first-row transition metals and explain the important features. 2½

(Turn Over)

(c) Explain in which of the following coordination entities, the magnitude of Δ_o (CFSE in octahedral field) will be maximum (atomic no. of Co = 27) : 2

(i) $[Co(C_2O_4)_3]^{3-}$ and $[Co(H_2O)_6]^{3+}$

(ii) $[Co(NH_3)_6]^{3+}$ and $[Co(CN)_6]^{3-}$

OR

8. (a) Calculate the crystal field stabilization energy for octahedral complexes of Fe^{3+} in a weak field and also in a strong field. 3

(b) Show the splitting of *d*-orbitals in a square planar complex. 2

(c) Predict in the following complexes whether the metal ions exist in high-spin state or low-spin state :

Given

(i) Complex ion $[Cr(H_2O)_6]^{2+}$, $P = 23000\ cm^{-1}$, $\Delta = 13400\ cm^{-1}$

(ii) Complex ion $[Co(NH_3)_6]^{3+}$, $P = 21000\ cm^{-1}$, $\Delta = 23000\ cm^{-1}$

(Where P = pairing energy, Δ = crystal field splitting parameter) 2

(Continued)

9. (a) What is meant by magnetic susceptibility? How is it related to magnetic moment? Calculate the spin only magnetic moments of $K_3[FeF_6]$ and $K_3[Fe(CN)_6]^{3-}$. Explain their magnetic behaviours in terms of CFT. 1+1+3=5

(b) Explain how the magnetic susceptibility of a substance is measured by Gouy's method. 3

OR

10. (a) Show which among the following complexes will exhibit the highest paramagnetic behaviour (Ti = 22, Cr = 24, Co = 27, Zn = 30) : 4

$[Co(NH_3)_6]^{3+}$, $[Zn(NH_3)_6]^{2+}$, $[Ti(NH_3)_6]^{3+}$ and $[Cr(NH_3)_6]^{2+}$

(b) Explain and give one example of an antiferromagnetic and a ferromagnetic compound. 2

(c) Draw a qualitative diagram, indicating the magnetic susceptibility as a function of temperature for simple paramagnetic, ferromagnetic and antiferromagnetic substances. 2

★ ★ ★